Long range management plan: Arboretum ecological communities, 1992. 1992

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LONG RANGE MANAGEMENT PLAN

ARBORETUM ECOLOGICAL COMMUNITIES

1992

Prepared by
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INTRODUCTION

This document is an evaluation of the present status of a unique experiment in community restoration at the University of Wisconsin Arboretum, and a plan for its continuation.

The original objectives for the Arboretum included the development of an example of each of the communities found in Wisconsin before settlement--every type of forest, wetland, prairie and savanna--an audacious challenge, indeed! A map showing the proposed locations for the different community types as envisioned by the first Arboretum Committee was the first master plan. At that time there had been no systematic analysis of Wisconsin vegetation, so even the desired endpoints lacked definition. In the early 1940's, John T. Curtis and his students began comprehensive studies of Wisconsin vegetation as preserved in relatively undisturbed remnants throughout the state. As the study proceeded, the information gained was used to develop the first long range management plan (1958) for the Arboretum ecological areas, a plan that has guided restoration activities in the Arboretum for 34 years. The data were also incorporated into the landmark book "Vegetation of Wisconsin" by John Curtis (1959).

There have been many changes in the communities since Curtis and his students wrote the 1958 plan. Some reflect growth and maturation of the desired communities, including the spread of the prairie species from their planted locations, and the growth of the planted forest trees. A less welcome change has been the spread and growth of exotic species. At least one of these invaders has affected virtually every community, and a substantial annual expenditure of valuable resources is required to keep the invaders under control in even a few selected areas. Land acquisitions have changed Arboretum boundaries, providing space for the expansion of some communities and the introduction of others. These and other changes are reflected in the 1992 plan.

The objective remains the same: to develop and maintain examples of each of the natural communities of Wisconsin, to be used for teaching and research at all stages in their development, and, where appropriate, for the enjoyment of the public.

OVERVIEW

Scope of the plan

This plan deals with the biological communities, or natural areas, which cover roughly 1000 of the Arboretum's 1280 acres. Separate plans have been developed for the horticultural and landscaped areas.

The plan takes advantage of the diversity of topography and soil in the Arboretum to provide locations for at least a small representation of each of 30 of the 34 Wisconsin communities described by Curtis. It includes all the southern and northern forest types, all prairie types and all savanna types. Wetland representation includes fen, sedge meadow, shrub carr and emergent communities. There are small areas of alder thicket, bracken grassland, sand barren, and sunny and shaded cliffs.

Organization of the plan

The natural areas are divided into 40 ecological management units, for example, Gallistel Woods, Marion Dunn Prairie, Juniper Knoll. These units are grouped into four broad vegetation categories: Northern Forests, Southern Forests, Prairies and Savannas, and Open Wetlands, on the basis of the most prevalent type occurring in that unit, but many of the units contain more than one type.

For each management unit there is a summary of the vegetation history and past management, and a general description of the present vegetation. This is followed by a statement of management objectives and recommendations for short- and long-term vegetation management. Remaining sections deal with research, teaching and public use.

General considerations

Efforts to restore or manage a community should be directed toward achieving a quality status that will allow the community to be sustained by routine procedures, such as prescribed burns or occasional brush cutting or mowing.

Wherever possible, gradual ecotones between related communities should be encouraged and/or developed. The plan specifically provides for dynamic ecotones between oak forest, savanna and prairie in the Grady Tract, which may shift in response to climate fluctuations and fire; a gradient in Wingra woods from northern dry-mesic forest to northern mesic forest and then to the

cedar swamp below; and a prairie-forest ecotone at the south edge of Gallistel Woods.

The plan emphasizes grouping related communities together in large blocks, in particular a large block of deciduous forest types north of the Beltline, and a large block of oak forest, oak savanna and prairie in the Grady Tract. Large blocks make management more efficient and are more likely to create conditions suitable for the animals associated with the communities. Southern communities are most suitable for large blocks because they are well adapted to the environment.

Critical management needs

Three categories of management needs appear repeatedly in the plan:

1. Elimination of woody exotics (buckthorn, honeysuckle, Norway maple, black locust and many others).

2. Control of invasive, herbaceous, exotic weeds, such as reed canary grass and leafy spurge.

3. Introduction of appropriate native groundlayer species.

Other, less universal needs include control of aspen and oak in prairies, thinning of the conifer plantings and water level manipulation of the marshes.

STRATEGIES FOR MEETING MANAGEMENT NEEDS

Control of woody exotics

Research in the Arboretum has shown that carefully applied herbicides will control buckthorn and honeysuckle effectively without damage to adjacent vegetation. We continue to test new methods and perfect old ones, but we now have a good idea of what must be done to rid a community of these aggressive aliens, and some idea of the amount of labor involved. Vigorous control measures have been successfully applied in three of the forest units, but because of limited crew time expansion of control to other units is problematic.

Since enough is known about the techniques required to enable an all-out attack on these invaders, the major need is for additional trained labor. Budget constraints make it unlikely that funds will be allocated for additional crew positions. The alternative is use of volunteers. The Arboretum should attract and train a corps of volunteers for this task. It would be particularly helpful to have some volunteers trained to use chain

saws and herbicides. Presently, volunteers cut with clippers and handsaws and pile the brush; the crew follows up with herbicide treatment and also does cutting of trunks too large for a handsaw. It would be very advantageous to have volunteers carry out the entire procedure.

Control of herbaceous exotics

Development of techniques to control these species should have high priority. A few tests have been carried out on leafy spurge and reed canary grass, but much more work is needed.

Improvement of propagation capability

Introduction of native groundlayer species is restrained by the lack of propagation facilities and personnel, and by the need for research to determine the cultural requirements for succesful establishment of individual species.

The Arboretum has a small (approx. 90 sq.ft.), recently renovated greenhouse and a large (60 sq.ft.) coldframe. A nursery for woodland wildflowers was established in Gallistel Woods early in Arboretum history; it has suffered from years of neglect. It should be reorganized and the fence repaired. Nursery space in full sun and partial shade is required, for prairie and savanna species.

Workers trained in propagation techniques, as well as those able to identify species in the wild for seed collection will be essential. These should include specially trained crew members and volunteers willing to take a short training course. Eventually, when budget permits, a propagation specialist should be added to the staff.

The "Focus Area" approach

A few of the Arboretum areas, particularly the prairies, have reached, or nearly reached, a condition that allows them to be maintained with routine management, and have a species composition approaching that desired. Most of the 40 management units, however, are far from that ideal and need considerable very active management to approach it. At a general planning meeting in 1990, the Arboretum staff decided to focus the efforts of staff, grounds crew and volunteers on two, or possibly three, areas at a time for as long as necessary to achieve a low-maintenance state and appropriate composition, rather than assigning to each area a small fraction of the available effort . It was also decided that when large areas requiring a substantial amount of work become a focus, the goal should be to establish a substantial demonstration area,

the remainder of the site to provide a valuable comparison for teaching and research.

Selection of Focus Areas

Two savanna areas, SW Grady Savanna and Ho-Nee-Um Savanna, were selected to be initial Focus Areas. These areas will require both control of woody exotics and propagation of appropriate species for the groundlayer, so they are representative in that respect.

There are several compelling reasons for emphasizing the savanna community in these first selections. The savanna community has high priority because (1) It represents a community that was once the most widespread community in southern Wisconsin and is now among the most rare. (2) The prevailing condition of savannas in the Arboretum, namely good development of savanna trees but groundlayer greatly in need of improvement, is typical of the few remaining remnant savannas elsewhere in southern Wisconsin, so the conservation effort at the Arboretum can provide a model for improvement of others. (3) The growing dominance of nonnative woody invaders is a serious threat. Failure to take prompt action dooms the community. (4) The good match of this community to the soils and climate of southern Wisconsin make it likely that a conservation effort will succeed, and result in a savanna community that can be easily maintained by routine prescribed burning and occasional brush cutting.

The two savanna areas chosen have contrasting soils and slope exposures, as well as differences in the age and size of trees. The SW Grady Savanna is the largest savanna site in the Arboretum, and will also be part of the large block of forest, savanna and prairie. It is buffered from traffic noise, and has a remote wilderness quality. Ho-Nee-Um Savanna is visible from a heavily traveled city street and is one of the most heavily used areas in the Arboretum. This makes it particularly well suited for a major public education effort.

A small "emergency rescue" project already underway was also given Focus Area status. Wingra Fen, a natural example of one of the rarest communities in Wisconsin, was selected because of the rarity of the community itself and the presence in it of an endangered species, the small white ladyslipper. Conservation will involve eradication of woody invaders, especially fen buckthorn, which threaten to permanently damage the fen. With focused effort, the time estimated to rescue this small fen is two years. The fen species are expected to recover and therefore little or no planting will be necessary.

Future considerations

Periodic review of the progress of current Focus Areas, and careful selection of new Focus Areas a few years in advance will be essential. Monitoring of former Focus Areas should be done every year to be sure maintenance procedures are adequate; if more active conservation effort is found to be necessary, this should have high priority.

ACKNOWLEDGEMENTS

A draft of a management plan for the Arboretum written by James H. Zimmerman in 1972 but not officially adopted has been a rich source of ideas and information.

Valuable suggestions were made by members of the Arboretum staff, and by members of the Management Subcommittee of the Arboretum Committee, chaired first by Evelyn Howell and later by Thomas Givnish. Grant Cottam provided important information about early management and research, and read the manuscript. Edward Beals, Brent Haglund, Rich Henderson, Wayne Pauly and many others generously shared their knowledge and experience as the plan developed.

Tom McClintock generated the maps, and he and Pamela Nesbit both provided technical assistance.

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FORESTS OF SOUTHERN WISCONSIN

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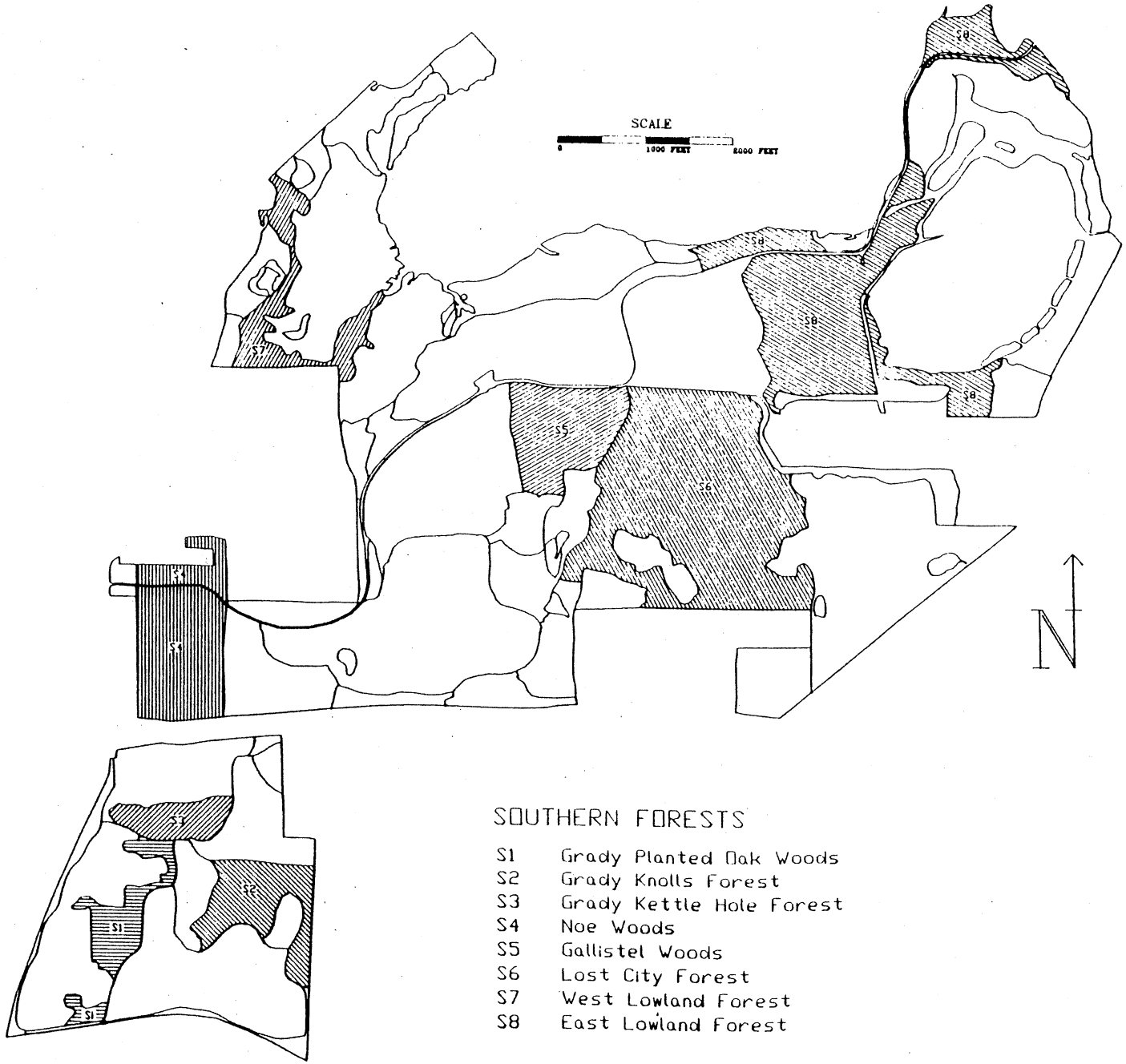
SOUTHERN FORESTS

List of southern forests showing size and community type.

	Acres	SD	SDM	SM	SWM	SW	OV
Grady planted oaks	14	x					
Grady Knolls Forest	23	x					
Grady Kettle Forest	11	x					
Noe Woods	41	x					
Wingra Woods*	52		tx				
Gallistel Woods	28	tx		x			tx
Lost City Forest	108	x	fx	fx	x		
West Lowland Forest	20				x	x	
East Lowland Forest	87				x	x	

*To change to Northern Mesic Forest.

SD=Southern dry SDM=Southern dry-mesic SM=Southern mesic
SWM=Southern wet-mesic SW=Southern wet OV=Ohio Valley
NM=northern mesic t=temporary, to change f=future



SOUTHERN FORESTS

S1 Grady Planted Oak Woods
S2 Grady Knolls Forest
S3 Grady Kettle Hole Forest
S4 Noe Woods
S5 Gallistel Woods
S6 Lost City Forest
S7 West Lowland Forest
S8 East Lowland Forest

SOUTHERN DECIDUOUS FOREST

Southern Wisconsin's soil and climate favor deciduous forest, but this forest type is near its northwest limit here and the forests are less diverse than those farther south and east. At the time of settlement the southern Wisconsin landscape was a dynamic ecotonal mosaic of forest, savanna and prairie, maintained for many centuries by frequent fire. Farther to the west stretched treeless prairie; to the north lay forests and barrens with an important conifer element.

Southern Wisconsin forests can be grouped for convenience into five types, all of which are or will be represented in the Arboretum.

Southern Dry and Southern Dry-mesic Forests. Before settlement these oak-dominated forests and the savannas graded into one another, the boundary changing with variations in climate and fire over time. After settlement, cessation of fire allowed rapid conversion of any unplowed or ungrazed savanna into oak forest as oak grubs long suppressed by fire were released. The familiar oak forests of Dane County, including all the mature oak woods in the Arboretum, are examples. Oak forests are actually more extensive now than they were before settlement, but most have been disturbed by cutting and grazing; the Jackson School Forest southwest of Verona is a rare undisturbed example.

These forests are strongly dominated by even-aged oaks that date from the time of settlement, but black cherry and shagbark hickory are often present as well. The oak species include black, bur, white and red, with black and bur oak more important on very dry sites and red oak more important on the more favorable dry-mesic sites. Enough sunlight penetrates the canopy to support a vigorous shrub layer that typically includes gray dogwood, hazelnut, blackberry and raspberry. Oak saplings are uncommon except on very dry sites. Typical herbaceous species are wild geranium (Geranium maculatum), false solomon's seal (Smilacina racemosa, sweet cicely (Osmorhiza claytoni) and hog peanut (Amphicarpa bracteata). Berries, nuts and sticktights take advantage of plentiful birds and mammals for dispersal. Soils are podsolic and often have a thick litter layer of oak leaves.

In the Arboretum, Noe Woods and Grady Kettle Hole Forest are examples of southern dry forest. Wingra Woods, a dry-mesic stand with a substantial number of very large red oaks, is to be changed to a northern mesic forest. The plan calls for planting of red oak in part of Lost City Forest to provide a dry-mesic forest in the future.

Southern Mesic Forest. Before settlement the mesic forests covered more area in southern Wisconsin than any other type of forest (although not as much as the savannas). Mesic forests occurred in three large blocks and in some smaller areas--usually where conditions were moist and where there was some fire protection. Mesic forests in southern Wisconsin are usually dominated by sugar maple, with basswood, slippery elm, ironwood and (in counties near Lake Michigan) American beech. Red oak may be present in the canopy if there is a history of fire or major disturbance. These forests are very shady and have few shrubs but many maple seedlings and saplings. The herbaceous ground layer includes ephemerals and other early flowering species, many of which are ant-dispersed. Litter does not accumulate, but is incorporated into the soil through the action of earthworms and bacteria, producing a thick A horizon. There are no naturally occurring mesic forests in the Arboretum, but Gallistel Woods and parts of Lost City Forest are to become examples of this type. Abraham's Woods, an outlying property of the Arboretum, is an excellent natural mesic forest.

Southern Wet and Southern Wet-mesic Forests. Occurring on river floodplains, poorly drained outwash and old lake beds, these are the swamp forests of southern Wisconsin. More tree species occur in these forests than in any other Wisconsin type; frequently important are silver maple, American elm, green and black ash, swamp white oak, and river birch. Cottonwood and black willow are pioneer invaders on newly disturbed sites. Vines, especially poison ivy, festoon the trees, and nettles and jewelweed are abundant herbs. Mosquitos flourish, and the many dead and injured trees provide nesting habitat for woodpeckers and other cavity-nesting birds. Good examples include the floodplains along the Wisconsin and Mississippi Rivers at Wyalusing State Park and Avon Bottoms in Green County. At the Arboretum wet forest trees have invaded some poorly drained, disturbed sites, but there is no well-developed swamp forest.

The Arboretum's East and West Lowland Forests will provide examples of these forests.

GRADY PLANTED OAKS

INTRODUCTION

Site description.

Location: 97, 99, 100

Size: 14 acres; 6 hectares.

Slope and aspect: Gentle south slope.

Soil: Sandy loam, silt loam and silty clay loam.

Vegetation history and past management.

The area was cultivated prior to Arboretum acquisition in 1940. Bushels of acorns were planted under the direction of Jake Jacobson, Arboretum Supervisor, in the 1950's. These included red, white, black and bur oaks on the upland sandy and silt loams. In the poorly drained silty clay loam at the south a grove of swamp white oak was planted as well as some silver maple, river birch, and ash. (Some of the oaks were planted in a savanna-like spacing; that part of the planting is included in the savanna section of this plan. See page 135.)

Since the planting of the trees there have been no management activities in this area.

General description of present vegetation.

This is a dense stand of young red, black, white and bur oaks. The trees are much smaller than their cohorts planted at savanna density. The red oaks appear to be the most successful of the four species where all four are interspersed. A small area in which only bur oak was planted now has a stand of very stunted bur oaks. The swamp white oaks at the southeast corner have grown well in spite of very high density, forming a monotypic stand with very little groundlayer vegetation. West of this stand are scattered silver maple, river birch, elm and green ash.

Special features and values.

This is the only young oak woods in the Arboretum; it provides a comparison with the mature stands such as Noe Woods. It is also an uncommon example of an oak woods successfully established by planting acorns in an old field.

MANAGEMENT

Management objectives.

Historical: A map made by Curtis indicates that the entire southwest section of the Grady Tract was to be oak forest.

Present: Maintain this area as an example of a dry oak woods grading into savanna, as part of a fire-maintained mosaic of woods, savanna and prairie similar to the presettlement condition. The lowland trees planted at the lowest (south) end will be part of the mosaic.

Short-term management.

No active management required.

Long-term management.

After savanna has been developed in the more open areas of the southwest section of the Grady Tract, plan and implement a prescribed burn schedule for savanna and woods that will maintain a mix of both. Use additional means to control honeysuckle and buckthorn if the burns do not provide sufficient control. Woods groundlayer species will probably come in naturally, but this would be an excellent location for experimental planting of oak woods species, including those suitable for the swamp white oak stand.

RESEARCH

Research completed or in progress.

None.

Research opportunities.

Studies of the competition between oak species planted on the same site at the same time. Effects of fire on the competition between oak species. Establishment of groundlayer species under oaks, both with and without planting. Animal use of an oak woods managed with prescribed burning.

TEACHING

Value.

Probably of minimal value at present, but will be important as part of the woods/savanna/prairie mosaic in the future.

Accessibility.

A firelane runs along the east side of the woods. Two new east-west trails crossing the southwest section of the Grady Tract also give access.

PUBLIC USE

Sensitivity, suitability.

The area is very suitable for public use providing visitors remain on trails. The new east-west trails were planned to leave a large central block without trails, to help preserve the wilderness quality for wildlife.

Protective measures.

Keep new trails open and well marked to discourage off-trail use. Do not develop additional trails in the area.

GRADY KNOLLS FOREST

INTRODUCTION

Site description.

Location: 96:5-16, 101:1

Size: 23 acres; 10 hectares.

Slope and aspect: Knoll topography, with 2-10% slopes of varied aspect.

Soil: Generally sandy, grading from sandy loam on less steep slopes at north to loamy sand on steeper slopes to south. Smaller areas of loam and silt loam on lower slopes near east boundary.

Vegetation history and past management.

Before settlement the vegetation was probably oak barrens, a savanna with sand prairie understory and scattered open grown oaks, many of them bur oaks. Many grubs were present, especially those of the hybrid black oak-Hill's oak so prevalent in the woods at present. Cessation of fires after settlement allowed the grubs to grow. Taves, a student in Curtis' ecology course in 1950, used tree rings to identify 1847-67 as the interval during which most of the present large trees started. However, grazing kept the area relatively open until it was acquired by the Arboretum in 1940. Elimination of grazing at that time apparently allowed a large number of oak seedlings to start.

A portion of the area was burned in a wildfire in 1946; Fosberg, a student in Curtis' ecology course, reported in 1947 that seedlings were top-killed but all resprouted very vigorously, rivaling the sprouts of top-killed canopy trees. The most recent fire occurred in 1954, when a wildfire sparked by a train burned through the entire area, top-killing seedlings and many of the large trees. The seedlings resprouted and grew well under the thinned canopy, forming thickets of small oaks.

Oak wilt has created openings in the woods, including a large one in the south central area. Blackberries are vigorous in the openings.

Removal of honeysuckle from the part of the woods bordering the east property line began in 1986 and was completed in 1990. This was done in order to facilitate movement of fire crews along the boundary in the event of prescribed burn or wildfire.

Landscape Architecture students under the direction of Professor Evelyn Howell cut trees and shrubs in the strip of woods just east of West Grady Knoll to make the strip more open and savanna-like. A prescribed burn of this strip (an acre or less) was carried out in 1988. It was a very hot burn; the dead lower branches of several large trees ignited, making it necessary for safety reasons to cut those trees. Honeysuckle in the area was top-killed and resprouted only weakly that year.

About half of the remaining woods was burned in the spring of 1990, effectively top-killing the honeysuckle and buckthorn present. Some oak saplings were also top-killed. Groundlayer diversity was substantially increased by the burn. A prescribed burn of the entire woods was attempted in spring, 1991. Most of it burned quite well, but there were unburned patches.

General description of present vegetation.

The canopy is dominated by the black oak-Hill's oak hybrid, with some bur and white oak, the later being particularly important in the northern portion. Mature tree density is low and in the central section there are large gaps caused by oak wilt. Dense saplings and small trees grow between the widely spaced, somewhat open-grown canopy trees. In the oak wilt openings many dead trunks lie on the ground and blackberries are abundant. Honeysuckle forms a nearly continuous shrub layer in much of the unburned part of the woods. Because of the dense honeysuckle, those areas have a poorly developed herb layer.

Special features and values.

This is the most xeric of the natural oak forests in the Arboretum.

It is the Arboretum forest most suitable for management with prescribed burning. The western and southern edges grade into savanna and prairie, providing the best opportunity in the Arboretum to develop the dynamic mosaic of presettlement Dane County vegetation.

It is the only oak woods with substantial oak regeneration.

Hollow trees, living and dead, provide habitat for woodpeckers, crested flycatchers, flying squirrels and other forest dwellers.

MANAGEMENT

Management objectives.

Historical: The original master plan has a map of the Grady Tract showing desired vegetation types, but there is no text or comment. The map shows that the woods was to be part of a block of savanna extending from the (Greene) prairie north to the main E-W firelane (the firelane connecting Posts U3 and Y7). The early establishment of two somewhat parallel firelanes that define a narrow strip of the woods along the north edge of the prairie suggests that an alternative plan was to have a strip of savanna as a transition between prairie and woods.

Present: Maintain this area as an example of a dry oak woods grading into savanna, as part of a fire-maintained mosaic of woods, savanna and prairie similar to the presettlement condition. The focus will be on introducing the process, fire, rather on specific goals of tree density or etc.

Short-term management.

Improve firebreaks, where needed, to allow prescribed burning. Remove hollow trees only where necessary for safety reasons.

Use cutting to open up forest edge where necessary to obtain good woods/savanna/prairie transition.

Continue prescribed burning program, in connection with before-and-after studies of vegetation.

Long-term management.

The major management input will be prescribed burning. Frequency of burning will be based on observations of the effect of the burns on honeysuckle and buckthorn reproduction, on native species, and on the forest/savanna transition. The burn schedule will be planned, so far as possible, to control honeysuckle and buckthorn, and to maintain a mix of woods and savanna. The proportions of woods and savanna will be allowed to fluctuate under the influence of variations in climate, disease, insect infestation and other natural factors.

Woods and savanna species should be allowed to spread naturally. If, after several years, some representative species are still absent they may be introduced and monitored, providing this does not interfere with the before-and-after studies mentioned above.

Research completed or in progress.

Glenn Goff's (1954) MS Thesis (U.W. Botany)

Grant Cottam's permanent plots. Five plots (10mx10m) were staked out in 1941 on a line running from West Grady Knoll east into the present woods. Tree, sapling, seedling and shrub data were recorded. Data in Arboretum files.

Several student papers from the general ecology course taught by Curtis and Cottam deal with this woods, especially the effects of the 1946 and 1954 wildfires.

Steve Glass, graduate student in L.A., studied seed bank, seed rain and herb presence before and after clearing of the oak seedlings and saplings in one portion of the woods.(M.S. 1988)

Virginia Kline and Tom McClintock have recorded data on shrubs and groundlayer species before and after the prescribed burns. (1989-91)

Tree data have been recorded for quadrats located in the southwest corner of each of the ArborLIS grid sections. (Tom McClintock)

Research opportunities.

An interdisciplinary study of the effects of fire on plants, animals, soil, air quality, microclimates, etc., as well as study of the fire itself.

Habitat use by birds and mammals in a dynamic mosaic of prairie, savanna and woods covering over 50 hectares.

Action required for continuing long-term research projects.

If the corner stakes for Grant Cottam's plots can be located, they should be related to the ArborLIS grid and maintained for future reference.

Markers for tree and groundlayer quadrats established prior to the prescribed burns should be maintained.

Degree of manipulation appropriate.

No other major manipulations should take place during the interval of preparation for the burns and evaluation of the effects of the burns. Eventually, introduction of appropriate plant and animal species may be attempted.

TEACHING

Value.

This is the Arboretum's best example of a very dry oak forest on sandy soil. It will be an excellent place to teach the value of fire in maintaining certain forest types (a chance to improve on Smoky's message), and to observe edge effects where the woods grades into savanna.

Accessibility.

The firelanes provide very easy access.

PUBLIC USE

Sensitivity, suitability.

Dry oak woods are quite resilient to human use, and there will probably always be abundant shrubs in this woods, which will protect it from off-trail activity. The firelanes are very suitable for hiking, jogging and cross-country skiing.

Protective measures.

No special measures required.

GRADY KETTLE HOLE FOREST

INTRODUCTION

Site description.

Location: 85:14-16

Size: 11 acres; 4.5 hectares.

Slope and aspect: Gently rolling, with two large, steep-sided kettle holes.

Soil: Sandy loam.

Vegetation history and past management.

The woods developed from presettlement savanna. It was probably lightly grazed, as dense honeysuckle appeared in much of the woods after Arboretum acquisition. A major effort to remove honeysuckle from the kettle holes and adjacent areas took place in 1986.

General description of present vegetation.

The canopy is dominated by white oak and black oak (or perhaps a hybrid of black and Hill's oak). The woods is generally similar to Noe Woods, but on drier soil.

Special features and values.

This is a mature, relatively undisturbed oak woods. It provides an interesting comparison with Noe Woods because of its drier soil.

The kettles are of geologic interest and would be useful for studies of microclimates.

The largest climbing poison ivy plant in the Arboretum grows on the south rim of the west kettle.

There is an interspersion of oaks and planted pines along the north and southwest boundaries that would provide an interesting location to try planting groundlayer species that grow in the acid soils of oak and pine forests.

MANAGEMENT

Management objectives.

Historical: A map made by Curtis shows the area as white oak forest, with "Ozark pine-oak forest" along the east boundary and a small oak opening across the firelane to the southwest. An additional Ozark forest is shown west of the oak opening.

Present: Allow the woods to develop and change naturally as in Noe Woods.

Short-term management.

Complete removal of exotics throughout the woods. Allow oak woods shrubs and herbs to come in naturally. Limit groundlayer planting to the pine-oak edges.

Long-term management.

Continue to monitor for exotic invaders and control by appropriate means.

RESEARCH

Research completed or in progress.

Glenn Goff's MS Thesis (U.W. Botany 1964) "Structure and composition of two oak woods in the U.W. Arboretum" includes Grady Kettle Hole Woods as well as Noe Woods.

Research opportunities.

Comparisons with drier Grady Knolls Forest and slightly more mesic Noe Woods. Long-term changes in composition. Effects of kettles on microclimate, soil, vegetation.

Action required for continuing long-term research projects.

None established.

TEACHING

Value.

Good example of dry oak forest, relatively undisturbed, developing without active intervention except for removal of exotics. Convenient comparison with adjacent conifer forest and nearby savanna. Good examples of kettle holes.

Accessibility.

Easily accessible by firelane or trail from Grady Parking lot.

PUBLIC USE

Sensitivity, suitability.

Very suitable for hiking and birdwatching. The firelane is suitable for running and cross-country skiing.

Protective measures.

No special measures required.

NOE WOODS

INTRODUCTION

Site description.

Location: 83:1-3, 6-8, 9-11, 14-16; 62:1, 2, 13-16.

Size: 41 acres; 16.6 hectares.

Slope and aspect: Gently rolling topography, on end moraine. Generally northeast aspect, 2-12% slope.

Soil: Mainly silt-loam, developed in loess over sandy till.

Vegetation history and past management.

The black oak-white oak woods that developed after preset-tlement fires ended was probably lightly grazed during the agricultural period preceding Arboretum acquisition. The northern third of the woods was heavily cut sometime between 1900 and 1910, but there has been little or no cutting since then. Two large clearings totalling approximately 6 acres were main-tained (perhaps as an orchard) in the east central portion until acquisition.

Oak wilt, spreading gradually through the woods for many years, has greatly reduced the importance of black oak, once the most important dominant in the canopy. More recently, butternut canker has begun to cause heavy mortality in the butternuts. Non-native woody species have spread throughout the woods, becoming most prominent in the more open and disturbed portions.

Since acquisition, management has been limited to attempts to control nonnative woody species, including honeysuckle, buckthorn, Norway maple and black locust. A major systematic effort to control honeysuckle and buckthorn in the entire woods, including the dense thickets of these two species that had developed in the former clearings, began in 1985 and continues.

General description of present vegetation.

White oak and black oak are still the major dominants, but white oak is now more important than black. There is no oak reproduction; the sapling layer is dominated by black cherry, box elder and American elm. Where dense honeysuckle and buckthorn were recently removed, the shrub layer is sparse and herb cover and diversity are low. In other parts of the woods there is a well developed layer of typical oak woods shrubs, gray dogwood being especially prominent, and an herbaceous ground layer that is diverse and quite free of exotics.

Special features and values.

Noe Woods is one of the most intensively studied deciduous forest stands in North America. (See references below.)

It provides a unique opportunity to observe long-term changes in an oak woods in southern Wisconsin. Data collected since 1956 (McCune and Cottam, 1986) have already seriously challenged traditional views of successional processes, and no one really knows what changes will take place in the next thirty years.

It is the site of an ongoing long-term study of soil genesis initiated by Francis Hole.

Noe Woods provides an immediate immersion into a natural community--delightful at any season--for visitors arriving through the west entrance.

Management objectives.

Historical: The Curtis Master Plan specified that Noe Woods, a "typical oak woods", was to be allowed to develop naturally, with use to be limited to non-destructive research. The only management activity recommended was the removal of honeysuckle from two clearings found in the woods, to be followed by planting those clearings with trees similar to those in the surrounding woods.

Present: Allow the woods to develop and change naturally through the interactions of native species with each other and with their environment. Develop oak forest in the former clearings.

MANAGEMENT

Short-term management.

Complete the removal of exotics throughout the woods. Allow oak woods shrubs and herbs to invade naturally, except in the former clearings where there is little canopy.

In the former clearings, develop an oak savanna as a step toward regeneration of oak forest, as suggested by Glenn Goff (1964). Take advantage of the partially open-grown oaks already present along the clearing edges. Burn the area and plant with prairie grass to increase the fuel load for subsequent burns. Allow oak seedlings to come in naturally.

Long-term management.

Continue to monitor and control exotic invaders. Consider the use of prescribed burns as a control measure.

When there are sufficient oak seedlings in the savanna clearings, discontinue burning and allow trees to develop, thus duplicating the sequence that produced the oaks in the surrounding woods.

RESEARCH

Research completed or in progress.

G. Cottam has composition data for each year since 1956 for a permanent grid covering 2 ha in the west central part of the woods. He also has maps showing location, size and species of each tree at five year intervals. The data are computerized. Resulting publication: McCune, Bruce and G. Cottam 1985. The successional status of a southern Wisconsin oak woods. Ecology 66(4), pp. 1270-1278.

Glenn Goff's MS Thesis (U.W.Botany 1964) "Structure and composition of two oak woods in the U.W. Arboretum" divides the woods into four sections based on structure and composition, and includes management recommendations.

As part of the IBP study of Lake Wingra basin, J. H. Huddleston wrote a report "Characteristics and distribution of soils in the Noe Woods, U.W. Arboretum, Lake Wingra basin". It is an I.E.S. report dated September, 1971.

MS Thesis (U.W. Botany 1973) by Jerry Lawson on Noe Woods productivity.

Nielsen, Gerald A. and Francis D. Hole 1963. A study of the natural processes of incorporation of organic matter into soil in the University of Wisconsin Arboretum. Wisconsin Academy of Sciences, Arts and Letters 52:213-227. Arboretum Journal Paper 53. Includes data from permanent soil plots in Noe Woods.

Nadelhoffer, Knute J., John D. Aber, and Jerry M. Melillo 1983. Leaf-litter production and soil organic matter dynamics along a nitrogen-availability gradient in southern Wisconsin (U.S.A.). Can. J. For. Res. 13:12-21. Noe Woods ("OAK2") is one of nine Arboretum sites in this study.

Kline, Cottam and Samingan 1975-79 study of effects of honeysuckle and buckthorn treatment on groundlayer.

Research opportunities.

Management-related studies needed: Response of vegetation following honeysuckle and buckthorn removal from areas with sparse canopy. Colonization of bare patches of soil resulting from burning of brush piles. Regeneration of oak forest by establishing and maintaining an oak savanna as an intermediate stage. Use of prescribed burns to prevent reinvasion of honeysuckle and buckthorn.

General ecological studies: Continuation of Francis Hole's long-term study of soil genesis and the effects of litter manipulation. Continuation of the Grant Cottam long-term study of forest canopy changes. Expansion of the canopy study to include shrub and herb layers. Effects of canopy changes on bird and mammal populations.

Action required for continuing long-term research projects.

The stakes marking the permanent grid should be maintained and they should be related to the Arborlis grid.

The stakes marking the soil plots should be improved, maintained and related to the Arborlis grid. Litter manipulations should be continued if possible. (This is presently being done by a volunteer, Palmer Haynes.)

Degree of manipulation appropriate.

The gridded area and adjacent areas presently having oak canopy should be protected from any activity that might interfere with the course of natural changes over time. The formerly heavily disturbed areas are suitable for major manipulation directed toward establishing oak canopy.

TEACHING

Value.

Good example of white oak-dominated dry oak forest, relatively undisturbed, developing without active intervention except for removal of exotics. Opportunity to compare with Gallistel Woods, a similar oak woods but underplanted with sugar maple and other mesic species. Convenient comparison with adjacent evergreen conifer forest.

Accessibility.

The woods is a short walk from the Curtis Prairie parking lot. A trail provides access to some of the least disturbed interior, including the gridded area.

PUBLIC USE

Sensitivity, suitability.

The trail through the woods is very suitable for use by hikers and bird watchers. Shrubs and poison ivy are quite effective at discouraging off-trail activity.

Protective measures.

Cross-country skiers and joggers should be discouraged from using any part of the woods, including the trail.

GALLISTEL WOODS

INTRODUCTION

Site description.

Location: 57:3-6, 11-14; 58:1, 2, 7-10, 15, 16

Size: 28 acres; 11 hectares

Slope and aspect: Gentle southeast slope

Soil: Fine sandy loam and silt loam at the north grade into imperfectly drained silt loam and poorly drained silt loam and silty clay to the southeast.

Vegetation history and past management.

The even-aged oak canopy found in much of the woods developed from oak savanna after cessation of presettlement fires. Sections along the north and west boundaries were clearcut ca. 1900, after which the resprouts were allowed to grow. The west and east halves of the woods had different ownership histories, and Curtis noted that the west half was apparently more heavily grazed. The creation of openings in the canopy by windthrow and by black oak mortality due to oak wilt has continued for more than 60 years, allowing the invasion of black cherry, shagbark hickory, elm and hackberry.

Between 1941 and 1961, seedlings (mostly 2-6ft) of mesic forest tree species were planted throughout much of the woods, including over 1000 sugar maple and smaller numbers of red maple, beech, basswood, black ash (mistakenly, instead of white ash), white ash, hackberry, walnut and ironwood. In the most southern portion of the woods, trees of the Ohio Valley and of southern Wisconsin floodplains were also planted. Over forty native herbaceous species suitable for mesic to wet-mesic forests were planted during the same interval.

Much of the honeysuckle and buckthorn which invaded this woods was dug and pulled (except along the edges) before 1976. Nearly all remaining buckthorn and honeysuckle, including along the edges, was cut and treated with herbicide (Roundup) between 1983 and 1987. Some Norway maple and burning bush (Euonymus alatus) have also been removed.

General description of present vegetation.

In most of the woods the canopy is dominated by the even--aged bur, black and white oaks which date from the time the savanna fires were ended by settlement. The canopy also includes some black cherry and shagbark hickory, and three large red maples. In the heavily cut areas the trees are younger and there are fewer white oaks; there are also some younger bur oaks on the wetter soils at the southeast.

Of the Ohio Valley tree species planted, five have 13 or more survivors: Aesculus glabra, Liriodendron tulipifera, Nyssa sylvatica, Cercis canadensis and Magnolia tripetala (planted as M. acuminata). Other survivors include 8 Cornus florida, and 3 each of Cladastris lutea and Taxodium distichum.

Naturally occurring saplings account for roughly half of the saplings present; of these, most are shagbark hickory and black cherry, with smaller numbers of slippery elm, American elm, box elder, red maple and mulberry. Of the planted saplings, sugar maple, white ash and black ash are most common, with smaller numbers of basswood, black walnut, beech, ironwood, hackberry, yellowbud hickory and Kentucky coffee tree. The density of saplings, especially of sugar maple, is far below that of a natural mesic forest. In fact, the most obvious structural difference between this woods and a well developed mesic forest is the lack of dense patches of different sizes of sugar maple saplings and seedlings.

The shrub layer is sparse, partly because of the increasing shade of the understory red and sugar maples and partly because of the fairly recent removal of honeysuckle and buckthorn. A few of the herbaceous groundlayer species such as toothwort and trout lily have spread vegetatively, forming large patches close to the trails, where the planting was concentrated. Many species have spread little or not at all (e.g.,trillium, bloodroot, spring beauty) and there has generally been little reproduction by seed.

Special features and values.

There are four Indian mounds in the woods. Three are linear and one is a panther mound.

Some of the Arboretum's largest forest-grown black cherries and shagbark hickories grow in the south section of this woods.

This is the best place in the Arboretum for observation of spring woodland wildflowers and is heavily visited by the public at that time of year. Good fall color for visitors also.

Management objectives.

Historical: The original Curtis plan shows that three forest types, each approximately 10 acres, were to be developed: oak woods at the northwest corner and along the west edge, southern wet-mesic forest with Ohio Valley species at the southeast, and southern mesic (maple-basswood) forest in a NE-SW band between. The actual tree planting did not follow that plan; instead mesic species were planted throughout most of the woods. Both the Curtis (1958) plan and the Zimmerman (1972) proposed plan indicate that the woods should include additional areas to the west of the present west boundary, where young oak woods had begun to develop naturally, but those areas have since been incorporated into the Horticultural Area and a display area for the proposed Wisconsin plant collection.

Present: The primary objective will be to encourage the development of a southern mesic forest that can maintain itself through natural reproduction of both canopy trees and ground layer. The mesic forest will grade into southern wet-mesic forest on the less well drained soils at the southeast, including approximately three acres across the drainageway. No attempt will be made to develop the Ohio Valley forest community, and the species not native to Wisconsin will be phased out as they die. Along the south boundary the woods will grade gradually into the existing natural prairie. The idea of having a section of oak forest will be abandoned.

Short-term management.

Continue to monitor and remove buckthorn, honeysuckle, Norway maple and other exotics.

Using southern Wisconsin seed, start large numbers of sugar maple seedlings each year in the forest nursery. As each year's crop reaches suitable size for transplanting, plant the seedlings densely in selected gaps in the woods. Continue this until each gap throughout the woods has a dense planting of seedling cohorts. This will allow natural selection to take place as it does in mesic forests, create a more authentic reproductive layer and perhaps eventually improve conditions for the mesic forest herbs. It will be important to record the exact location of these plantings so that natural reproduction from the existing sugar maples can be distinguished if any should occur.

Because of the limited success of the hundreds of forest herbs planted in both Gallistel and Wingra Woods, including the total failure of the most recent planting of over 500 individuals, research should be carried out to determine the requirements for establishment and spread of forest herbs before

extensive planting takes place. This is in keeping with the Arboretum's unique role of learning more about the systems we manage by putting the parts together. Factors that should be explored by establishing test plots in different parts of the woods include depth of leaf litter, soil quality, moisture conditions, light, animal predation, and dispersal agents. (A list of herbaceous and woody species appropriate for planting in each of the deciduous forests in the Arboretum was compiled by Zimmerman and is included in the Appendix.)

Begin propagation of woody species needed. Besides sugar maple this includes basswood, ironwood and yellowbud hickory for the mesic forest; basswood, sycamore, hackberry, American hornbeam and river birch for the wet-mesic forest. When large enough, transplant to areas of the woods having sufficient light to support them. Many of the wet-mesic species are shade intolerant; these should be planted at the edge of the woods along both sides of the drainageway and in the planned new extension east of the drainageway.

Remove line of white cedars at the south boundary of the woods, which are what remains of a former nursery planting there, to allow a more natural woods/prairie ecotone.

Remove honeysuckle and buckthorn from approximately three acres of woods east of the drainageway so that wet-mesic plantings can be extended into that area.

Long-term management.

When well established, the mesic forest should be one of the easiest communities to manage, requiring little labor expenditure. Some monitoring and control of buckthorn, honeysuckle and Norway maple may be necessary, particularly along edges and where canopy gaps occur, but the increasing shade of the sugar maples should discourage the growth of such invaders.

Use what is learned about the requirements of the forest herbs to establish a diverse groundlayer throughout the woods by further planting or, preferably, by encouraging natural spread.

Use fire and/or cutting along the south boundary to maintain a gradual woods edge. This will be necessary to prevent the woods from gradually spreading across the adjacent prairie.

RESEARCH

Research completed or in progress.

Nadelhoffer, Knute J., J. D. Aber and J. M. Melillo 1983. Leaf-litter production and soil organic matter dynamics along a nitrogen-availability gradient in southern Wisconsin (U.S.A.). Can. J. For. Res. 13:12-21. Gallistel Woods ("OAK1") is one of nine Arboretum sites in this study.

John Aber's student Jim Fownes did a study of soil/water relations.

Brock Woods' Master's Thesis 198?. A study of ant dispersal of forest herbs.

Robert McCabe's long-term study of the survival of trillium and yellow ladyslipper.

Grant Cottam and students in his Ecological Methods graduate course did a survey of all the trees in a grid covering much of the woods, as a baseline for future surveys.

Tom McClintock has recorded baseline tree data based on the ArborLIS grid.

Becky Brown had buckthorn study plots in a dense patch of buckthorn at the northeast corner of the woods.

Kathy Zuelsdorff's MS study of phosphorous and herbs. 1991.

Research opportunities.

Management-related studies needed: Requirements for the establishment and spread of mesic forest herbs. Response of soil to change in canopy from oak to maple. Environmental conditions favoring sugar maple reproduction. Comparison of environmental conditions in Gallistel Woods and a natural mesic forest such as Abraham's Woods. Growth rates of sugar maple saplings in various locations in the woods.

General ecological studies: Use of a planted mesic forest by mammals and birds. Successional changes in fallen logs. Vegetative versus sexual reproduction in forest herbs. Phenology and pollination studies.

Action required for continuing long-term research projects.

The stakes marking the permanent grid should be maintained and they should be related to the Arborlis grid.

Degree of manipulation appropriate.

Planting of seeds and plants of native forest herbs for research projects is appropriate, as is litter manipulation.

TEACHING

Value.

Excellent for wildflower walks in spring, and a good example of fall color in a deciduous woods. As the tree plantings mature the woods will become a good place to study the characteristics of mesic forests; already it is easy to observe the effects of the maples on the groundlayer, especially the shrubs.

Accessibility.

The woods is easily accessible from either the Wingra Woods or McKay Center parking lot. There is an ample system of wide and narrow trails, although some may be wet after rains.

Mosquitos make the woods inaccessible for school groups for part of the year.

PUBLIC USE

Sensitivity, suitability.

This woods experiences seasonally heavy public use. Because of its easy accessibility and esthetic appeal it is one of the best places to introduce visitors to the Arboretum. Use of the trails for hiking, nature study and bird watching is very appropriate, providing visitors remain on trails. However, lack of shrubs makes mesic forests such as this vulnerable because it is so easy to walk off the trail, causing soil compaction and damage to shallowly rooted herbs.

Protective measures.

The location of trails should be clearly indicated by using chips or other means. Trees or branches falling across the trails should be removed and muddy stretches chipped promptly to prevent development of detours. The shelterhouse seems to invite off-trail exploration; it will be important to restrict activity near it to a single entrance trail and not allow groups to spread out into the woods. This will require monitoring and perhaps

some sort of barrier. In general the small size of Gallistel Woods relative to the heavy use it sustains will require vigilance against encroachments of any kind.

LOST CITY FOREST

INTRODUCTION

Site description.

Location: 56, 57, 66, 67

Size: 108 acres, 44 hectares.

Slope and aspect: Level to nearly level.

Soil: Kegonsa silt loam and Salter sandy loam, wet variant.

Vegetation history and past management.

The oak forest that developed from the presettlement savanna was severely disturbed by an attempt to make it into a real estate development in the 1920's. One of the few roads that were paved in that venture now serves as the main trail through the woods. The disturbance probably made the woods particularly vulnerable to honeysuckle and buckthorn invasion. Eye-witness accounts indicate that as recently as 1950 the view through the forest was as yet unobstructed by shrubs, but a decade later the exotic shrubs obstructed both view and passage through the woods.

Until 1988, management of the woods was largely limited to trail maintenance. Some brush was cut occasionally to favor two or three rather open grown oaks along the main trail in the southern third of the woods. In the northern section three small blocks were cleared in 1975 as part of an experiment on honeysuckle control. After the experiment ended in 1979, approximately 200 sugar maple seedlings less than 1 ft tall were transplanted from the Beltline Maples to two of the blocks cleared. Smaller numbers of nursery-grown seedlings of white ash and basswood were planted in one of the same blocks.

Since 1988, volunteer Aaron Ihde has worked steadily at hand-cutting the nearly impenetrable honeysuckle and buckthorn on the southeast side of the main trail. The crew has followed up with herbicide treatment of the stumps, burning the brush piles and transplanting seedling sugar maples into the area. This has made a remarkable transformation of that part of the woods (as of summer 1991, roughly 3 acres). In spring, 1991, 100 seedling red oaks were planted in the cleared area by volunteers.

In 1988, in an area now surrounded by the Ihde project, Forestry classes taught by Professors Guries and Lorimer began clearing buckthorn and honeysuckle from a small area each year, treating the stumps themselves and planting seedling red oaks.

General description of present vegetation.

The canopy is dominated by black oak, bur oak, shagbark hickory, trembling and bigtooth aspen. Tree density is low, but some of the oaks are large; some have a rather open-grown appearance. Where it has not been cleared, dense honeysuckle and buckthorn form a nearly continuous and almost impenetrable tall shrub layer, with a very depauperate herbaceous layer beneath. In the cleared areas the groundlayer shows signs of recovery, with woodbine, jack-in-the-pulpit, false solomon's seal, ferns and other natives beginning to fill in. The seedling maples are establishing fairly well; the red oaks less so. Deer browsing of the seedlings has been heavy.

Special features and values.

This is the largest block of forest in the Arboretum. Because much of it is inaccessible to people it may play an important role as a refuge for animals such as predatory birds and mammals that are not tolerant of human presence.

There are natural ecotones from forest to open wetlands and fields along the south and east boundaries. There are also moisture gradients within the forest.

Roads and an old foundation are reminders of the attempt to develop the area.

MANAGEMENT

Management objectives.

Historical: There are no management objectives or recommendations in the Curtis Master Plan. At its meeting December 5, 1978, the Management Subcommittee approved in concept a plan to develop the northern part into a sugar maple dominated forest and the southern part into a fire-maintained savanna or open woodland, but no formal action was taken.

Present: Maintain the wilderness quality. Develop dry-mesic to mesic to wet-mesic forest in the northern part of the area, taking advantage of the variation in soil moisture. Where conditions permit, include substantial red oak stands. In the southern portion, encourage the development of a gradient from dry-mesic forest to oak woodland and savanna. The savanna will grade into the wetland at the east and extend south to the property line.

Short-term management.

Select and mark one or two areas in the woods for the long-term study of honeysuckle and buckthorn behavior in the absence of control measures. Continue removal in all other areas.

Monitor the trial plantings of red oak, sugar maple, basswood and white ash in the northern portion and make additional plantings of appropriate trees, using information obtained from the trial plantings.

Begin prescribed burns of the southern portion, including the woods extending west from Pond 3.

Remove row-planted and all non-native woody species in the area south of the forest and east of the Lost City Pines. Begin prescribed burns of this area to keep it open. This will complete the initiation of burning to a large block of the Lost City area.

Long-term management.

Continue to evaluate plantings, start new plantings, and encourage others to experiment with tree plantings.

Continue prescribed burning of all areas indicated above.

Monitor groundlayer development and supplement with plantings if needed to provide a continuum of species appropriate for the continuum of forest and savanna.

RESEARCH

Research completed or in progress.

Barnes, W.J. 1972. The autecology of the Lonicera x bella complex. Dissertation, University of Wisconsin, Madison, Wisconsin. (Also a published paper)

John Emlen's long-term bird surveys.

Kline/Cottam/Samingan 1975-1979 honeysuckle removal experiments.

Becky Brown and students--honeysuckle and buckthorn studies, continuing.

Research opportunities.

Management-related studies needed: Control of honeysuckle and buckthorn by non-chemical means (Goats? Aphids? Shade?). Tree planting techniques for areas infested with honeysuckle. Long-term changes in shrub and herb layers in a woods formerly infested with honeysuckle and buckthorn, with and without tree planting. Long-term changes in vegetation composition and soil in areas where honeysuckle and buckthorn are not controlled.

General ecological studies: Soil development under different tree species. Success of herbaceous species planted beneath trees of different species. Comparisons of soil, microclimate, animal use in edge vs forest interior.

Action required for continuing long-term research projects.

The plots staked out for long-term observation of untreated honeysuckle and buckthorn should be protected from any management activities or unrelated research that might change the natural development.

Degree of manipulation appropriate.

This area is suitable for many types of manipulations, particularly those related to establishment of forest trees and to control of honeysuckle and buckthorn, but others as well. The main constraints should be that the development of a good canopy should not be jeopardized and only native species should be introduced.

TEACHING

Value.

Quiet, remote area. Wide, paved trail good for gathering groups together and for wet weather when other trails may be muddy. Evidence of the "Lost City". Opportunity to see response of vegetation to major disturbance. Comparison of edge and interior plants and animals.

Accessibility.

Not easily accessible from McKay Center, but parking lot is conveniently located. Main trail starts at parking lot and connects to loop trail south of present woods. A shorter loop may be desirable for younger groups; in planning such a loop consideration should be given to using old concrete roads,

avoiding breaking up remote areas of the forest, and coordination with trail needs for public use.

PUBLIC USE

Sensitivity, suitability.

The main trail and the loop south of the present woods are firelanes and are suitable for hiking, running and cross-country skiing. There is a narrow trail that permits cross-country skiers to get into Lost City from the Natural Avenue trail. Shrubs presently effectively restrict visitors to the trails.

Protective measures.

Running and jogging should be prohibited except on firelanes. Heavy use of the area, especially the narrow trails, should not be encouraged. New trails should not be made into the areas presently without trails.

WEST LOWLAND FOREST
EAST LOWLAND FOREST

INTRODUCTION

Site description.

West Lowland Forest: 38, 39, 41, 42; 20 acres (8 hectares)

East Lowland Forest: 13, 26, 34, 35, 45, 46, 55, 56; 87 acres (35 hectares)

Soil: Houghton muck, with small areas of silt loam soil.

Vegetation history and past management.

Between 1950 and 1961, 1050 silver maple (Acer saccharinum), 75 elm (Ulmus americana) and 675 river birch (Betula nigra) were planted in East Lowland Forest, most of them in 26:3,4; 35:25,16; and 45:1,2. There were no large plantings in West Lowland Forest, but a few silver maple, river birch, swamp white oak (Quercus bicolor), hackberry (Celtis occidentalis) and basswood (Tilia americana) were planted on the west side of the Monroe Street pond berm to extend the forest up to the water's edge.

In both forests much of the area has been disturbed in the past because of road construction, dredging to make ponds, and erosion from urban storm water. Before the Monroe Street Pond was constructed in 1983 to capture the storm sewer water entering the Arboretum at that point, the water had cut a deep trench in the woods, depositing the dredged soil in the woods and marsh downstream.

There has been no management to control exotic woody invaders in these two forests.

General description of present vegetation.

These forests show signs of disturbance. Most of the trees are small; there are extensive infestations of exotic shrubs; the ground layer lacks diversity and contains many weedy species.

Besides the planted tree species (some of which occur naturally as well), the canopy includes box elder (Acer negundo), green ash (Fraxinus pennsylvanica), black willow (Salix nigra), cottonwood (Populus deltoides), bigtooth aspen (P. grandidentata) and black walnut (Juglans nigra). Distribution is very patchy. Troublesome exotics include black locust (Robinia pseudoacacia, European alder (Alnus glutinosa) (planted by mistake instead of native alder), honeysuckle and buckthorn. and R. frangula. The

latter three shrubs are abundant in most of the woods, but a few native shrubs, including red osier dogwood (Cornus stolonifera), gray dogwood (C. racemosa), ninebark (Physocarpus opulifolius) and nannyberry (Viburnum lentago) are found where the infestation is not as severe.

Special features and values.

Both of these forests are associated with open wetlands, open water and shrub thickets, and are partially inaccessible to people--a combination that makes excellent habitat for many birds and mammals.

MANAGEMENT

Management objectives.

Historical: Parts of these forests were designated as lowland forest in the Curtis plan, although no specifics were given. The early plantings were made in the area east and southeast of Redwing Marsh, suggesting that that was considered the most promising site. Some of the area now forested has grown up to trees since the Curtis plan was made.

Present: Develop these forests into examples of southern wet/wet-mesic forest, but do not allow the forest to encroach on any good adjacent open wetland, in order to preserve the diversity of habitat.

Short-term management.

Cut and treat with herbicide all exotic woody species. Plant additional trees, including sycamore (Platanus occidentalis) and honey locust (Gleditsia triacanthos), as well as appropriate shrubs in the resulting openings to discourage reinvasion and increase diversity. Make trial plantings of appropriate groundlayer species.

Long-term management.

Monitor edges and cut back as necessary to keep sedgy clearings open. Plant additional groundlayer plants. If standing dead trees are not present naturally to provide habitat for woodpeckers, etc. girdle a few selected trees.

RESEARCH

Research completed or in progress.

Glenda Denniston has made extensive detailed natural history observations in the woods and marsh near Stevens Pond and Pond 6.

Opportunities for research.

Use of varied wet habitats by birds and mammals. Comparison of habitat use in frequented vs inaccessible areas. Comparison of ease of establishment of annual and perennial groundlayer species.

TEACHING

Value.

Good for observation of animal life, comparison with upland deciduous forests.

Accessibility.

Trail from Duck Pond parking lot gives convenient access to a portion of West Lowland Forest; former Natural Avenue traverses a large part of East Lowland Forest and has the advantage of being wide, and high enough to be dry.

PUBLIC USE

Sensitivity, suitability.

The existing trails are very good for bird watching, and the East Lowland Forest trail has the advantage of being remote from the Beltline. Mosquitoes will discourage visitors at some seasons.

Protective measures, if needed.

Trails should not be developed in the inaccessible portions of these forests because of possible adverse effects on wildlife.

FORESTS OF NORTHERN WISCONSIN

Table of Contents

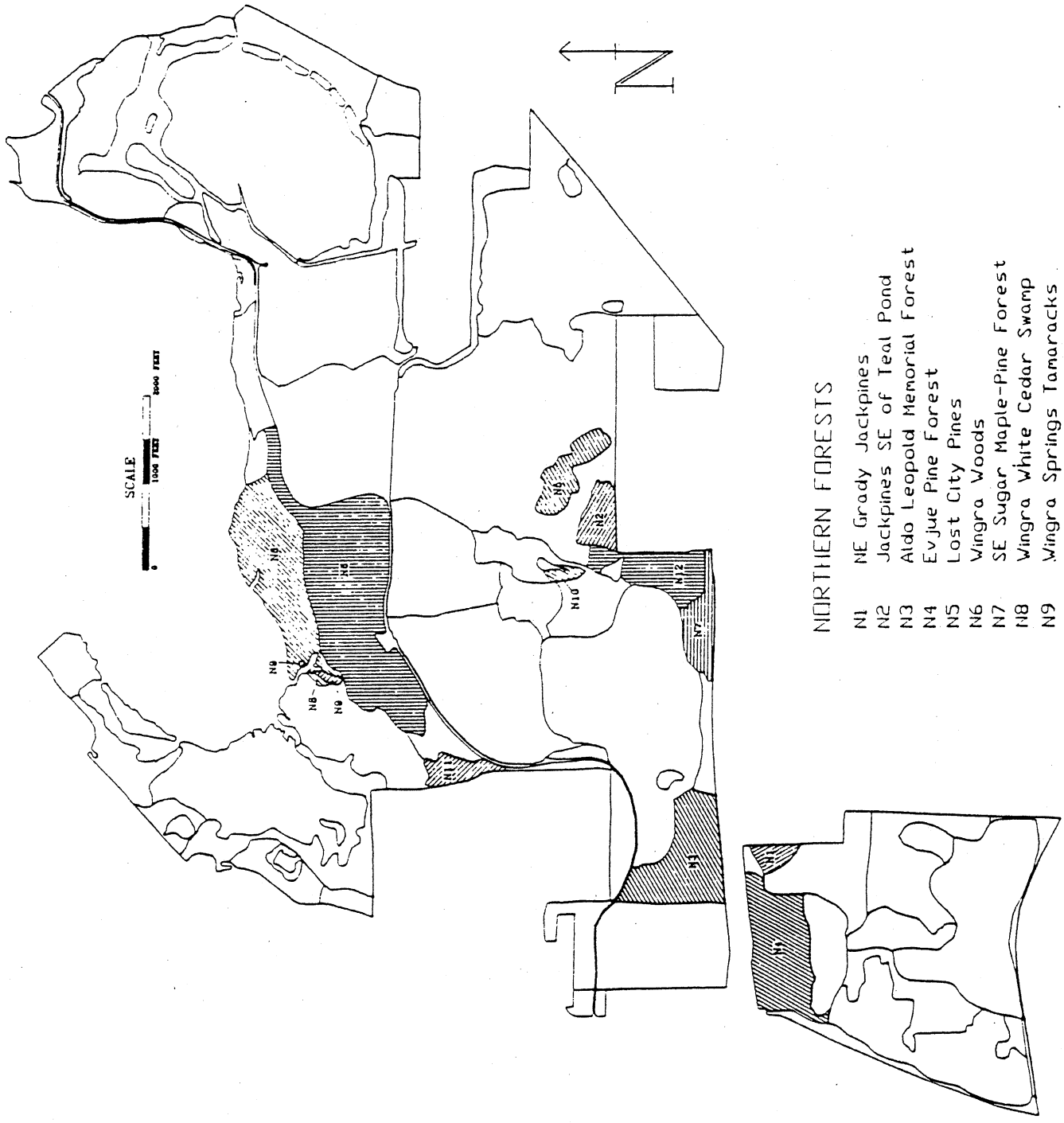
NORTHERN FORESTS

List of northern forests showing area and community types.

	ACRES	ND	NDM	NM	NWM	NW	BF
Northeast Grady Jackpines	3	x					
Jackpines SE of Teal Pond	6	x					
Aldo Leopold Memorial Forest	21		x				
Evjue Pine Forest	22		x				
Lost City Pines	7		x				
Wingra Woods	52		fx	x			
SE Sugar Maple-Pine forest	8			x			
Teal Pond White Cedars	1.5				tx		
Wingra White Cedars	28				fx		
East Marsh Tamaracks	2.5					tx	
Wingra Springs Tamaracks	0.5					x	
Teal Pond Tamaracks	1.5					x	
West Spruce-Fir	4.5						x
Southeast Spruce-Fir	11.5						x

ND=Northern dry NDM=Northern dry-mesic NM=Northern mesic
NWM=Northern wet-mesic NW=Northern wet BF=Boreal forest

t=temporary, to change f=future



NORTHERN FORESTS

N1 NE Grady Jackpines
N2 Jackpines SE of Teal Pond
N3 Aldo Leopold Memorial Forest
N4 Evjue Pine Forest
N5 Lost City Pines
N6 Wingra Woods
N7 SE Sugar Maple-Pine Forest
N8 Wingra White Cedar Swamp
N9 Wingra Springs Tamaracks
N10 Teal Pond Tamaracks
N11 West Spruce-Fir Forest
N12 SE Spruce-Fir Forest

NORTHERN FORESTS

Wisconsin forests north of the Tension Zone are distinguished from those to the south by the presence of conifers, all but one of them evergreen. The conifers are especially well represented on the poorer sites--those that are dry or wet and/or nutrient poor--where they are better able to compete with the broad-leaved deciduous trees. The northern forests of Wisconsin contain elements of the boreal forests of Canada, as well as many species that are found in the deciduous forests to the south. They are related to forests in northern Minnesota and upper Michigan; similar "mixed hardwood" forests stretch eastward to the Appalachian Mountains, becoming richer in species toward the east.

Northern Wisconsin forests may be grouped for convenience into six categories; each is represented in the Arboretum:

Northern mesic forest. Before settlement, the northern mesic forest covered an area larger than that covered by any other community in the state. It grew on a wide variety of soil types, but gave way to forests more heavily dominated by conifers on very wet or dry soils. Northern mesic forests are dominated by sugar maple, hemlock and yellow birch, with beech becoming a major component in the eastern one-third of the state. Basswood and red oak are also common. In the presettlement forests, a few huge white pines towered over the canopy of maple and hemlock below. The pines dated back to the last fire on the site; some were four hundred or more years old. The northern mesic forest, like its sugar maple-basswood counterpart in the south, has few shrubs because of the intense shade cast by the trees. Where soils are suitable, spring ephemerals and other early flowering herbs may be part of the groundlayer. Ferns and a few evergreen creepers such as partridge berry (Mitchella repens) are frequently present.

Wingra Woods will be the best example of this type in the Arboretum.

Northern dry and dry-mesic forests. Jack pine dominates forests on the very dry sandy soils, along with Hill's oak, trembling aspen and red pine. Fires once were frequent in these areas, and the dry forests graded into more open jack pine barrens. Blueberries (Vaccinium angustifolium) were abundant, especially in the barrens; like the trees, they are fire-adapted. Another characteristic shrub is sweetfern (Comptonia peregrina).

On less severe sandy sites, white pine and red pine are the dominant conifers, and red maple, red oak and white birch are major deciduous elements. There is a well developed shrub layer, which includes common and beaked hazelnut (Corylus americana and C cornuta), northern bush honeysuckle (Diervilla lonicera),

maple-leaf viburnum (Viburnum acerifolium), and witchhazel (Hamamelis virginiana), as well as blueberries.

Typical groundlayer plants in both pine forest types are trailing arbutus (Epigaea repens), pipsissewa (Chimaphila umbellata), wintergreen (Gaultheria procumbens) and other small evergreen creepers, as well as ferns, club mosses, lichens and moss. Soils tend to be acidic and podsolized, with a thick layer of undecomposed pine needles.

Northern dry forest will be represented in the Arboretum by two small jack pine plantings, one east of Teal Pond and one at the northeast corner of the Grady Tract. The latter also provides an opportunity to develop an associated pine barren.

Northern dry-mesic plantings include the Evjue Pines, the Leopold Pines, the Lost City Pines, and the upper part of Wingra Woods by the parking lot and along McCaffrey Drive. Finnerud Forest, an Arboretum property located in Oneida County, is an excellent natural example that can serve as a model.

Northern wet forest. Tamarack and black spruce are characteristic trees of the wettest sites, and the groundlayer is dominated by sphagnum moss. The forest frequently contains or abuts areas of open bog, where the trees are sparse and stunted, and the mat of sphagnum may be floating. Sedges, blueberries and small evergreen shrubs such as bog rosemary (Andromeda glaucophylla), leatherleaf (Chamaedaphne calyculata), bog laurel (Kalmia polifolia) and Laborador tea (Ledum groenlandica) are common in the forest and the open bog. Both may contain insect-consuming pitcher plants and unusual orchid species. The soil consists of peat and is acidic.

It will be problematic to achieve a sphagnum ground layer, but tamaracks will be maintained in the Wingra Spring and Teal Pond areas.

Northern wet-mesic forest. White cedar swamp forest is typical of wet-mesic sites. White cedar is the most dominant species, but balsam fir, red maple, yellow birch and white birch are often well represented. Alder (Alnus rugosa) and winterberry (Ilex verticillata) are important shrubs. The ground surface features many humps of exposed roots and fallen logs, with wet hollows between. The surface is covered with many kinds of mosses, including some sphagnum. Ferns, evergreen creepers, and a variety of northern herbs fill the various topographic microsites. Sedges may be conspicuous in openings. The peaty soil tends to be less acid than that of the tamarack bog.

The best example in the Arboretum is expected to be the area below Wingra Woods. The Teal Pond white cedars will be phased out, and those near Ho-nee-um Pond are part of a buffer.

Boreal forest. The typical "spruce-moose" biome of Canada, dominated by black and white spruce and balsam fir, is represented in Wisconsin in very limited areas near Lake Superior and in Door County. In these areas the most important tree is balsam fir; other dominants are white pine, white cedar, white birch and white spruce. A strong deciduous element includes sugar maple, red maple, mountain maple (Acer spicatum) and mountain ash (Sorbus americana and S decora). Canada mayflower (Maianthemum canadense), bunchberry (Cornus canadensis), starflower (Trientalis borealis), ferns and mosses are groundlayer species making up the "Canadian carpet".

The most promising boreal forest planting is the Southeast Spruce-Fir Forest, located near the flume flowing into Pond 2. There is also a spruce/fir planting that is visible from Wingra Overlook, and one along the north boundary of the Grady Tract that serves as a buffer for the Beltline.

NORTHEAST GRADY JACK PINES

INTRODUCTION

Site description.

Location: 86:3,6,11

Size: 3 acres; 1.2 hectares

Slope and aspect: Gentle south slope.

Soil: Sandy loam.

Vegetation history and past management.

The area was under cultivation until 1949. Over 2000 jack pine and 200 red pine were planted between 1954 and 1961. The stand has never been thinned, but some trees were removed to make an east-west firelane in 1987.

General description of present vegetation.

This is a very dense, nearly monotypic stand of jack pine, with a small area of red pine along the east boundary. Black locust intrudes along the southwest boundary. There are few shrubs, and the herbaceous groundlayer consists mainly of weedy species.

Special features and values.

This is one of two small jackpine stands in the Arboretum.

With the red and white pine plantings to the west, having a jack pine forest here makes it easy to compare the two types of northern pine forests on a short walk.

The pines serve as a screen along the east boundary.

MANAGEMENT

Objectives.

To develop a small demonstration of northern dry forest grading into pine barren.

Short-term management.

Thin the trees.

Remove honeysuckle, buckthorn and black locust.

Plant Hill's oak (quercus ellipsoidalis), hazelnut (Corylus americana, C. cornuta), sweet fern (Comptonia peregrina) and other appropriate northern dry forest trees and shrubs along edges and in clearings.

Long-term management.

Plant groundlayer species, using techniques developed in trial plantings in the Leopold Pines.

Clearcut one-half the area; burn the cut area if possible, to provide a mineral seedbed for a new stand of jack pines. Include part or all of the old field to the west in the burn and encourage more widely spaced jackpines there (as in a jack pine barren), grading into the denser stand.

RESEARCH

There has been no research in this area. Possible research projects include comparisons between the effects of jack pines and those of white and red pines on groundlayer establishment, and on soil development and soil organisms.

TEACHING

It is unlikely that this area will be used extensively for teaching because the natural tendency will be for classes and adult tours using the Grady Tract to choose routes leading to the savanna and prairie areas. It will be of particular interest to those studying northern forest types, and will be more valuable for this if the transition from forest to pine barren is developed.

PUBLIC USE

Use of the area is mainly incidental to use of the firelanes for hiking, skiing and jogging. No special protective measures are needed.

JACK PINES SE OF TEAL POND

INTRODUCTION

Site description.

Location: 66: 11,12,13,14

Size: 6 acres; 2 hectares (This includes the knoll and a small area of jack pines north of the firelane. It does not include the jack pine plantings east of L5, along the Arboretum south boundary.)

Slope and aspect: On a knoll with slopes in all directions.

Soil: Sandy loam.

Vegetation history and past management.

The area was open farmland at the time of acquisition. Between 1951 and 1954, at least 500 jack pine and 250 red pine were planted. Fifty paper birch (5-8ft) were added in 1960. A few groundlayer species, including 22 clumps of wintergreen and 10 of trailing arbutus from northern Wisconsin, were planted between 1956 and 1960, many of them in an exclosure set up on the north slope.

An attempt to carry out a prescribed burn in the pines in (?) was unsuccessful because conditions were too moist (Cottam, pers comm).

The stand sustained heavy losses of jack pine during the ice storm of March,1976.

General description of present vegetation.

The jack pine canopy was opened up by the ice storm, and the remaining trees appear to be growing well. Many of the red pines are dense and stunted, but along the edges of the planting a few are developing well. A few of the paper birch have reached canopy size. Mulberry, box elder, poison ivy, buckthorn and honeysuckle are taking advantage of the openings in the canopy. Some of the groundlayer species have spread substantially.

Special features and values.

This is an interesting small hill in an otherwise rather flat part of the Arboretum.

The ice storm damage is a fine example of the kinds of natural disturbances that historically have influenced forest composition and structure. The patchiness of the canopy and the fallen trunks give a natural aspect to the forest.

Many of the broken jack pine trunks are still suspended well above the ground, but those with ground contact are beginning to support a carpet of moss, an unusual feature in Arboretum pine forests.

This is one of two jack pine forests in the Arboretum.

It appears that at least some species of northern ground-layer plants will grow well here.

MANAGEMENT

Management objectives.

Historical: The Curtis Master Plan indicates that this area was to be developed as a northern dry forest.

Present: Continue the development of the northern dry forest and maintain it for at least one generation of trees. (See last paragraph under Long-Term Management.) Tree species of the northern dry forest include jack, red and white pine; Hill's, white and red oak; trembling and bigtooth aspen; paper birch and red maple.

Short-term management.

Thin the red pines.

Remove mulberry, box elder, hackberry and other inappropriate tree species. Remove honeysuckle, buckthorn and other exotic shrubs.

Burn the cut brush in one or two of the largest openings. Plant jack pines where the burns have removed litter.

In the remaining larger clearings plant aspen, paper birch, red maple and three species of oak: Hill's, white, and red. Also encourage any natural reproduction of white and red pine that occurs. Plant northern shrubs.

Note the locations where groundlayer plants have spread and plant additional species in similar situations.

Use herbicide to control poison ivy, especially along the trail.

Long-term management.

Continue to monitor and remove box elder and exotic woody species.

Allow the forest to mature and change naturally, but if large clearings are created by windfall or disease and no appropriate reproduction appears in the gaps, plant as described above.

Over a long period of time (100 years?) it is likely that the jack pines will be replaced gradually by deciduous trees, perhaps with some white pine. Unless there are compelling reasons for trying to maintain jack pine on the site indefinitely, the forest should be allowed to become more mesic. If it is considered important in the future to continue to maintain jack pines on the site, prescribed burns will be essential, and the area should be enlarged to include adjacent land so that wind and sun can reduce moisture levels more effectively. (The jack pine planting in the northeast corner of the Grady Tract is probably more favorably situated for jack pine forest and savanna.)

RESEARCH

There is no record of research in this area. There are opportunities for studies of the effects of jack pine and red pine on soil development, effects of the ice storm, use of the conifers by winter birds, success of groundlayer under jack pine compared with red pine, succession on fallen logs, etc.

TEACHING

Value.

For groups using the Teal Pond area this site provides an opportunity to see a northern dry forest (eventually probably a northern dry-mesic forest), complementing the nearby tamaracks, boreal forest and northern mesic forest. It appears that it may become a particularly good area for northern groundlayer species. The beneficial effects of the ice storm and the developing moss cover on the logs are good teaching material.

Accessibility.

It is approximately one-half mile from the McKay Center. A firelane curves around the north side of the knoll, and a narrow path leads over the top.

PUBLIC USE

Sensitivity, suitability.

The path is quiet and secluded for walkers. The fallen and suspended trunks, as well as the poison ivy, tend to keep visitors on the trail. The firelane is appropriate for running and skiing and is quite heavily used.

Protective measures.

No special measures required.

ALDO LEOPOLD MEMORIAL FOREST

INTRODUCTION

Site description.

Location: 82: 4-6, 9-16

Size: 18.6 acres; 7.5 hectares (does not include area east of flume)

Slope and aspect: Slopes NE and E from 980' elevation at the SW corner to 900' elevation along E boundary.

Soil: Fine sandy loam on ridges, grading into silt loam at lower elevations.

Vegetation history and past management.

Before settlement the area was covered with oak savanna. Sometime after 1836 cultivation began and this continued until 1926. From then until Arboretum acquisition in 1933 the area was grazed by horses.

The first tree planting took place in 1933, using 340 large specimen pines from an old landscape nursery that was located near the present Olbrich entrance to the Arboretum, and 19,000 small pine seedlings from the Wisconsin Conservation Department. By 1937 all but the NW portion (the "prairie addition") and some designated clearings had been planted to red and white pine at a density of 1700 trees/acre. The prairie addition was planted in 1949-51 at a density of 1240 trees/acre. In general, red pines were planted on the upper, sandier slopes and white pines on the lower slopes, although there are some mixed red and white pine plantings as well.

Deciduous trees, especially red maple, white birch and aspen, were planted in the clearings and along the edges during the pine planting period. Beginning in 1949 large numbers of northern shrubs and herbs were planted (including over 1000 wintergreen plants!). In the late fifties, five exclosures were set up in gaps in the forest to protect plantings of northern deciduous trees, shrubs and herbs.

In 1937 a fire destroyed approximately 900 of the planted pines in a section along the west boundary; replacement plantings were made.

Construction of the Beltline in 1949 required 15 acres of Arboretum land, all of it in the pine forest. Pines in the affected area were moved to a strip along the Beltline east of the forest to serve as a screen.

No thinning of the pines was done until the winter of 1979-80, when a YACC crew thinned approximately 7 acres, including all of the prairie extension and the red pine planting on the upland to the south. The thinning was planned to: (1) favor larger pines, (2) release deciduous trees of appropriate northern species from pine competition, (3) decrease the regularity of pine spacing, (4) create some openings large enough for additional deciduous tree planting, and (5) create a large clearing to be part of a wildlife corridor between Noe Woods and Curtis Prairie Approximately 75 cords of wood were removed.

Between 1980 and 1985 additional plantings of deciduous trees and groundlayer species were made in the thinned prairie extension area, and prairie species were planted in the large clearing.

Beginning in 1983 and continuing to the present, a vigorous effort has been made to eliminate honeysuckle and buckthorn in the thinned area. Much of the work has been accomplished by volunteers.

In 1988, a second thinning of the red pine area along McCaffrey Drive was carried out by students in a Forestry class taught by Professors Ray Guries and Craig Lorimer. Each year since 1989 the class has done some thinning in a selected white pine area south of the prairie extension, as a class exercise that demonstrates how to thin pines to achieve a natural effect.

General description of present vegetation.

Average tree density of the area as a whole is 350 trees per acre, of which 310 are red and white pines (Data from 1986 survey made by Professor George Martin's forestry class). The pines form a nearly continuous canopy. The survey recorded over 250 trees with diameters greater than 14"; all were white pines. There are few red pines over 10"dbh. In general the pines that have done best are those along edges, clearings or firelanes, or those growing next to deciduous trees. A substantial number of red pines on a sandy ridge in the southwest section have died, and there has been some mortality of the pines closest to the Beltline.

The density of saplings, especially of red maple and red oak, is much lower than would be found in a northern dry-mesic forest. There are a few naturally occurring seedlings of red maple and white pine.

A thick litter layer is developing, but there are no tip-up mounds or fallen trunks on which seedlings can start. A few of the planted northern groundlayer species are spreading, mostly vegetatively, including partridge berry (Mitchella repens), Canada mayflower (Maianthemum canadense), starflower (Trientalis borealis), and goldthread (Coptis groenlandica). Others, such as trailing arbutus (Epigaea repens), wintergreen (Gaultheria procumbens) and the club mosses (Lycopodium spp.) have failed to thrive. Moist summers and winters with good snow cover appear to favor the spread of the successful species.

When the pines were younger, the dense low canopy restricted most groundlayer species, including exotic weeds, to edges and clearings. As the canopy has become taller a ground layer of trees, shrubs and herbs, almost all of them bird-dispersed species having berry fruits, has developed in much of the forest. Abundant species include natives black cherry and poison ivy, and nonnatives honeysuckle, buckthorn and bittersweet nightshade (Solanum dulcamara).

Species planted in the exclosures have generally done very well, and the exclosures are relatively free of the bird-dispersed species listed above, perhaps because the exclosures were located in clearings, which provided no perches. The planted groundlayer species have not spread substantially beyond the exclosures, perhaps due to less favorable conditions under the adjacent, more dense pines. Another possible factor is the foot traffic of curious visitors, especially around the perimeter of the two eastern exclosures, which are easily visible from the path. The exclosures are no longer functional because of deterioration of the fencing.

The prairie species planted in the large clearing have done well only in the northern half of the clearing, where more sunlight is available. The southern half is dominated by a woodland herb, sweet-scented bedstraw.

Special features and values.

The area was dedicated to the memory of Aldo Leopold at a ceremony held in one of the openings in the forest on May 23, 1953.

This is the Arboretum's oldest pine forest and has the largest trees. Parts of it appear to have the potential to develop into an old-growth pine forest.

The northwest section (the thinned area), with its protection from Beltline noise, its wide trails and convenient location is particularly well suited for educational use.

MANAGEMENT

Management objectives.

Historical: This area was designated as a white pine-red pine forest (Northern Dry-Mesic Forest) in the original Curtis plan. In March, 1976 the Arboretum Committee, on the recommendation of the Management Subcommittee, approved a management plan for the Leopold Pines proposed by Virginia Kline. The main objectives of the plan were: to increase the diversity of the prairie addition or north limb of the pines as the prime teaching and demonstration area, to protect and enhance the Jackson Oak, to create a wildlife corridor linking Curtis Prairie to the proposed savanna area within Noe Woods, and to develop the best possible noise buffer in the southernmost strip along the Beltline.

Present: (Essentially no change.) Develop a diverse northern dry-mesic forest for teaching and demonstration, including areas demonstrating early successional stages, the latter located to enhance and protect the Jackson Oak and to form a link between Curtis Prairie and Noe Woods. Highest priority will be given to increasing the teaching value of the north limb. The southernmost strip of the forest (approximately 200ft) will be developed as the best possible noise buffer.

Short-term management.

In general, emphasize improvement of the thinned area because of its teaching potential.

Continue thinning of selected areas. Leave some large logs on the forest floor to rot.

Attempt to create some tip-up mounds.

Continue to monitor and protect the planted deciduous trees. Replace as needed.

Plant a few hemlock and yellow birch, as well as red maple and white pine, in the draw south of the large clearing, where the butternuts have died, to take advantage of the more mesic microclimate.

Monitor and protect planted shrubs and add more in clearings and along edges.

Burn the prairie in the large clearing.

Create an indentation in the pines along the McCaffrey Drive

boundary to make a more natural curving edge. Plant the clearing with white birch, red maple and a few white pine seedlings. Diversify the shrub row at the edge by replacing some of the existing shrubs with a variety of northern shrub species including witchhazel (Hamamelis virginiana), beaked hazel (Corylus cornuta), American hazel (C. americana), mapleleaf viburnum (Viburnum acerifolium), and alternate leaved dogwood (Cornus alternifolia). The location would be particularly desirable for use by dendrology classes.

Plant significant quantities of herbs that grow in both northern and southern Wisconsin, such as false solomon's seal (Smilacina racemosa), jack-in-the-pulpit (Arisaema triphyllum), red baneberry (Actaea rubra) and several species of ferns.

Plant more of the successful northern groundlayer species, perhaps taking cuttings from the proven clones on the site. Some of the plantings should be located close to the firelanes traversing the north limb.

Experiment with techniques for growing the northern groundlayer species that have not thrived in the past.

Control rampant poison ivy at the corner near the Jackson Oak and elsewhere along the firelane between the pines and Curtis Prairie.

Make the location of trails in the older section of pines more apparent by marking, chipping or etc.

Monitor and remove honeysuckle, buckthorn and other non-native shrubs, with the north limb as first priority.

Evaluate the buffer strip and replace affected trees with species resistant to highway pollutants. It may be desirable to replace many of the pines with junipers. This strip should be managed in a manner similar to that used for the adjacent buffer strip south of Curtis Prairie.

Long-term management.

Continue to monitor and control exotic species.

Use what is learned about the establishment requirements of the difficult groundlayer species to increase the diversity of the groundlayer.

Create more "edge" within the north limb periodically by recutting the large clearing and/or clearcutting selected areas, such as an area where the pines are doing poorly, or an area adjacent to the present large clearing that would further develop

the wildlife corridor. This will allow the continued presence of shrubs and intolerant tree species such as white birch and aspen for teaching demonstration, animal habitat and esthetic quality.

Break up the straight line of tall pines along the edge between Posts C4 and C7 by cutting one or more indentations and replacing the pines removed with deciduous trees and/or northern shrubs.

Remove undesirable woody species, including box elder, in the former clearing west of the flume. Replace with northern shrubs and pioneer trees.

In general allow natural reproduction of white pine (or of red pine, although that is unlikely) to take place in some clearings and under the red pines, to provide some diversity of age class. White pine reproduction should also be encouraged in the small grove of white birch across the firelane from the northwest section of the pines, and in any major gap resulting from windfall or disease.

The management outlined above should maintain a northern mesic forest with a strong pine component for the foreseeable future. Some parts of the forest appear to be capable of developing into old growth pine stands that could last for another century or more, and natural and contrived clearings will allow for at least some pine reproduction. However, natural regeneration of pine forests in northern Wisconsin historically was dependent upon periodic crown fires to destroy the existing canopy and to bare the mineral soil on which seeds can germinate well, and it is not reasonable to expect that an unburned pine forest can maintain itself through natural reproduction. There will be a tendency for shade tolerant, deciduous tree species to become more important at the expense of the pines. Some time in the future, perhaps after many decades, the status of the forest should be reevaluated and the costs of continuing to maintain pines in the forest should be compared with the benefits of such a forest to the Arboretum's program. The anticipated change to a warmer climate may make it more difficult to sustain pine forests in southern Wisconsin.

RESEARCH

Research completed or in progress.

Anderson, Roger C. 1965. Light and precipitation in relation to pine understory development. M.S. U.W. Botany.

Anderson, Roger C., O. L. Loucks, and A. M. Swain. 1969. Herbaceous response to canopy cover, light intensity, and throughfall precipitation in coniferous forests. Ecology 50: 256-263.

Curtis, J. T. 1955. The development of pine forest communities in the Arboretum. Arboretum News 4:2.

Rees, Colin P. 1967. The effects of three red and white pine stands of differing ages on the pH, litter depth, and nutrient content of the underlying soil. Arboretum News 16:3-4.

Schwehr, David and Roger C. Anderson. 1972. The Leopold Pines. Arb. News 21:1.

Swain, Albert M. 1964. Relationships of understory plants to age and density of conifer forests. MS U.WI Dept. of Botany.

Dwight Forsyth did a study of the seed bank in the Leopold Pines in 1976.

Studies by Peter Dunwiddie (1974) and Art Spingarn (1980) on competition between the trees.

Class data and several student papers from Botany 455, Vegetation of Wisconsin.

Research opportunities.

Soil and tree composition changes over time. Introduction of small mammals. Use of forest by northern birds. Factors influencing the success of plantings of groundlayer species. Response of pines to thinning.

Action required for continuing long-term research.

None. (Unfortunately the stakes marking the plots for the Swain and Schwehr studies appear to be lost.)

TEACHING

Value.

The north limb is already a good place to observe northern pine forest vegetation and make comparisons with adjacent prairie and oak woods, and it should become even better under the management outlined above. It has the advantage of being well protected from Beltline noise. The most impressive pines are in the section west of the pond and south of the prairie, where Beltline noise is more of a problem. Improvement of the buffer strip planting may decrease the noise in the future.

The "natural" thinning of white pines is a good example for teaching.

Accessibility.

The forest is a short walk from the Curtis Prairie parking lot. Two firelanes traverse the area, providing excellent space for groups of students to make observations. Two improvements could be made: (1) Create a trail through or along the edge of the large clearing. (2) Establish more northern groundlayer species along the interior firelanes. Presently the best place to see northern species is at the intersection of two narrow trails, where it is difficult for a group to gather without trampling the objects of study.

PUBLIC USE

Sensitivity, suitability.

The firelanes are suitable for jogging and skiing and all of the trails are suitable for hiking, bird watching and nature study, although noise is a deterrent in the part near the Beltline. The lack of shrubs in many places in the pines makes it easy to leave the trail, and off-trail activity can damage struggling northern groundlayer plants.

Protective measures.

The official location of the trails should be determined and made clear with markers, logs, and/or woodchips.

EVJUE WHITE PINE-RED PINE FOREST

INTRODUCTION

Site description.

Location: 85:1,5-16, 86:4,5,12

Size: 22 acres, 9 hectares

Slope and aspect: Slopes eastward, from 1000ft at the parking lot to 950ft at the east boundary.

Soil: Mostly fine sandy loam, grading into silt loam along the northern boundary.

Vegetation history and past management.

The land was under cultivation until 1949, the year the Beltline was constructed. The western part of the forest (Block 85) was acquired the same year; the eastern part (Block 86) in 1952.

Between 1952 and 1960, approximately 7000 white pine, 5000 red pine and 1600 jack pine were planted. As in the Leopold Pines, white pine was planted in the most favorable situations, and red pine, sometimes mixed with jack pine, in drier situations. Planting density was substantially less than in the Leopold Pines, and two large clearings were left within the forest.

Several hundred red maple and paper birch were planted during the pine planting period; an additional 60 red maple were added in 1974.

There was apparently very little planting of groundlayer species. The planting record shows no partridge berry, bunchberry, gaywings or wintergreen; a total of four sods of Canada mayflower (Maianthemum canadense) and two of starflower (Trientalis borealis) were planted (all in 1980).

The western two-thirds of the forest was thinned during the winters of 1984-85 and 1985-86. Most of the thinning was done in the red pine areas. All trees cut during the second winter were left on the ground where they were cut.

A cluster of red pines died in the early 1980's of unknown causes, creating a substantial clearing close to the main trail and a short distance from the parking lot. The opening was

rapidly invaded by honeysuckle and buckthorn. Volunteer Tim Kessenich has developed this as a demonstration area for groundlayer establishment. He has removed the honeysuckle and buckthorn by digging and pulling, and has planted and successfully established 15-20 groundlayer species appropriate for pine forests.

General description of present vegetation.

Very few of the jack pines have survived, and in general the white pines are larger than the red. There are few deciduous trees, but at the southern edge there is a gradual transition to the adjacent oak forest. Honeysuckle has invaded the edges and clearings but is not abundant in most of the forest, perhaps due to the sandy soil and the relatively low, continuous canopy.

The groundlayer is generally sparse, except in the Kessenich demonstration. A few patches of northern species can be seen along the trail near the pine-oak transition area at the southern boundary. Dense white pine seedlings have come into some of the original clearings.

Special features and values.

The sandy soil will allow more rapid development of the podsolized profile typical of pine forests in northern Wisconsin. This may make the northern groundlayer plants more successful here than in the other Arboretum pine forests.

The site appears to be very favorable for growth of pines. Prevailing wind direction lessens the effect of the Beltline and there has been little dieback even on the edge.

There are fairly gradual transitions from pine to oak on the south and west boundaries that would be interesting sites for experiments in groundlayer establishment and are esthetically more pleasing than sharp boundaries.

With its easy access and wide trails, this forest has good potential for educational use.

MANAGEMENT

Objectives.

Historical: The original Curtis plan indicated that this forest was to be a red pine-white pine forest (Northern Dry-Mesic Forest), but with more jack pine than was present in the Leopold Pines.

Present: Develop a diverse northern dry-mesic forest for teaching and demonstration, including areas demonstrating early successional stages. (In general the management will be the same as for the Leopold Pines.)

Short-term management.

Thin the remaining part of the forest where needed. Create additional openings to allow planting of deciduous trees and shrubs.

Plant red maple, paper birch, red oak, white oak, American hazelnut, beaked hazelnut, witchhazel and other appropriate northern trees and shrubs in openings and along edges, including the edge west of the entrance firelane. Intersperse a few pine seedlings.

Remove honeysuckle, buckthorn and other exotic woody species from the forest, including the clearings. Remove box elder.

Attempt to create some tip-up mounds.

Use the information gained from Tim Kessenich's plantings to expand groundlayer plantings elsewhere.

Make an attempt to improve the screen of pines along the Beltline by adding low foliage such as somewhat shade tolerant shrubs, ironwood or balsam fir. Some trial plantings would help in species selection.

Long-term management.

Continue to monitor and control exotic species.

Carry out a second thinning if needed.

Create more "edge" periodically by recutting clearings and/or creating new clearings, to allow the continued presence of shrubs and intolerant tree species.

Encourage natural pine reproduction.

Continue to add groundlayer species, and encourage their natural reproduction.

The management outlined above should maintain a northern dry-mesic forest with a strong pine component for the foreseeable future. The comments at the end of the Management section for the Leopold Pines apply here as well.

RESEARCH

Research completed or in progress.

John Aber and students have carried out soil studies in this forest.

Research opportunities.

In general the same as for the Leopold Pines. The larger area of sandy soil, the lower planting density and the location south of the Beltline rather than north would allow interesting comparisons between the two stands.

Degree of manipulation appropriate.

Manipulation related to improving the forest or for solving restoration problems should be encouraged. This includes soil manipulation and tree planting or thinning.

Action required for continuing long-term research.

None.

TEACHING

Value.

This forest may have the best potential to develop into a good northern pine forest community, although at present the diversity of both canopy and groundlayer is low.

Accessibility.

The area is immediately accessible from the Grady parking lot, and the trails are wide enough to accommodate class groups easily.

PUBLIC USE

Sensitivity, suitability.

The wide trails will help protect groundlayer species, although the lack of shrubs makes it tempting to leave the trail. The trails are suitable for walking, bird watching and nature study. The firelanes are suitable for skiing and jogging. At present skiers are permitted to use the east-west trail (paralleling the Beltline) between #24 and #23, to allow access from the parking lot to the north-south firelane that bisects the forest. Some skiers ignore signs and use the remaining segment of the trail (to # 18). Use of the trail may create problems when attempts are made to establish groundlayer species and shrubs.

Protective measures.

The effects of skiers' use of the east-west trail should be monitored so that a decision can be made as to whether to continue to allow that section to be used, open the entire trail to skiers, or close the entire trail to skiers.

As a precaution, most of the groundlayer and shrub plantings should be made away from the edges of trails.

LOST CITY PINES

INTRODUCTION

Site description.

Location: 66:9-11,15,16; 67:12,13

Size: 7 acres; 3 hectares

Slope and aspect: Level to gently rolling.

Soil: Silt loam to sandy loam.

Vegetation history and past management.

The land was plowed farmland before acquisition. Planting records are incomplete, but a 1958 aerial photo shows faintly a planting in the area of the red and white pines that appears to be younger than the 1950 planting of the Leopold Pines Prairie Extension. Included in the 10 acres is also the strip of jack pines along the south boundary of the Arboretum, which was planted at the same time (1951-54) as the jack pine forest on the knoll to the west.

General description of the present vegetation.

There are patches of white pine, red pine, jack pine and bigtooth aspen. Some clearings were left when the pines were planted, including one fairly large one; these are being invaded by shrubs and young trees. No groundlayer plantings have been made under the pines.

Special features and values.

Relatively remote and quiet, with less intensive use than the other pine plantings. May be attractive to wildlife.

The jack pine planting provides a screen for the commercial development south of the boundary.

The interspersion of aspen and the unplanted clearings provide welcome diversity.

Many of the pines, particularly the white pines, appear to be doing well on the site, and it is an area where all three native pine species can easily be observed.

MANAGEMENT

Objectives.

Historical: There is no description of this area in the Curtis Master Plan, but apparently a decision was made prior to 1951 to develop a pine forest on the site.

Present: Encourage the development of a northern dry-mesic canopy with a substantial deciduous element.

Short term management.

Thin the red pines where they are stunted, to increase their chance of survival.

Remove undesirable tree species from the clearings and plant red maple, red oak and white birch.

Long term management.

Monitor and protect plantings.

Make new plantings of appropriate tree species if openings develop from disease or windfall.

RESEARCH

There has been no research in this area. Possible studies include comparisons of the effects of different canopy species on soil and groundlayer species, use of the area by winter birds, effects of thinning and of associated deciduous species on the pines, etc.

TEACHING

Value.

Groups entering from the Martin Street entrance might use this area to observe differences between deciduous and conifer forests. For those studying northern forests, it provides an example of dry-mesic pine forest canopy to complement the boreal forest and tamarack plantings to the east and southeast, and the dry jack pine forest to the west. Each of the three native Wisconsin pines can be seen.

Accessibility.

This planting is less accessible from a parking lot than the Leopold Pines and the Grady Pines and for that reason will probably be used less than those areas. The firelanes and single narrow trail are well located for making observations.

PUBLIC USE

Sensitivity, suitability.

The firelanes are fairly popular with skiers and runners, but the traffic is less than in the other pine plantings. An increase in this type of activity could lower the wilderness quality here and in the adjacent Lost City Forest, adversely affecting both wildlife and people whose recreational needs include a remote and quiet place to walk.

Protective measures.

Do not promote the firelanes in this area for recreational. running and skiing; in particular discourage use by running teams and organized groups.

WINGRA WOODS

INTRODUCTION

Site description.

Location: 43, 44, 57-59

Size: 52 acres, 21 hectares

Slope and aspect: Fairly level hilltop grades gently east and west, more steeply north toward Lake Wingra. An escarpment of Cambrian sandstone runs east-west through the center of the woods.

Soil: Mostly well-drained silt-loam, with poorly drained silt-loam along the east boundary, and a small area of sandy loam near the southeast corner.

Vegetation history and past management.

The canopy oaks are the first generation of trees to grow since the presettlement savanna fires ceased. There is no evidence of cutting, but the woods were grazed. Early Arboretum pictures show a closely cropped groundlayer with no visible shrubs. The elimination of grazing allowed development, temporarily, of a shrub layer typical of oak forests.

Over 3000 2-8ft sugar maple, red maple, white ash, yellow birch, beech, hemlock and other species characteristic of Wisconsin's northern mesic forests were planted between 1943 and 1964. Most of the hemlock and beech are in the east section of the woods. Striped maple and black birch, species that do not occur in Wisconsin but occur in similar forests farther east, were also planted in the eastern section. The shrub layer has been greatly reduced as a result of the increased shade of the planted trees.

Several hundred northern mesic forest herbs were planted during the same interval, and an additional 500 plants were planted in 1985.

A clearing in the woods west and northwest of the parking lot was planted with Scotch and Austrian pines.

Honeysuckle and buckthorn control measures were carried out

intermittently for many years. Since 1980 a concerted effort has been made to rid the woods of these two species, using cutting followed by application of Roundup immediately or after resprouts have appeared.

A stone shelter built in the upper part of the woods by the CCC in the forties was used by the public for picnics and other gatherings until it was removed in 19 . The damaged area has recovered well and is now difficult to distinguish.

General description of present vegetation.

At the top of the hill and on the upper slopes the canopy is dominated by bur, white and black oak. A few of the original savanna trees survive, although their lower branches have succumbed to the shade. The north slope is dominated by very large red oaks, an indication that this is a very favorable location.

The planted trees form a fairly continuous understory; some are approaching canopy size. The density of seedlings and saplings, especially of sugar maple, is far lower than would be found in a natural forest of this type.

A few of the early plantings of forest herbs have survived; a few have spread, mostly vegetatively. There are no apparent survivors of the 1985 planting. There are some spontaneously occurring forest herbs, but the ground layer generally is very sparse.

Special features and values.

There are ten Indian mounds, including an eagle mound and a panther mound.

A small old quarry exposes the underlying Cambrian sandstone.

The red oak stand is the only one in the Arboretum and is the Arboretum's most impressive "big tree" woods.

Spring and fall aspects are esthetically very appealing, making this one of the most frequently visited areas in the Arboretum.

This will be the largest and most authentic creation of northern mesic forest in the Arboretum, and the selection of the cool, north facing slope near the lake for its establishment greatly enhances the chances of success. The woods has the potential to be a showcase for the Arboretum.

MANAGEMENT

Management objectives.

Historical: Wingra Woods was designated as a northern mesic forest in the original Curtis Plan except for the driest area at the top, which was to be oak forest. At its meeting Dec. 5, 1978, the Arboretum Committee approved a modification to make the dry area at the top into a northern dry-mesic forest, and the wet area below the woods into a northern wet-mesic forest. This would provide a continuum particularly useful for teaching.

Present: (Essentially the same.) Develop a northern mesic forest grading into northern dry-mesic forest at the top and into wet-mesic forest in the nearly level, poorly drained area below. (See "Wingra White Cedar Swamp", p.82) The mesic forest should be able to maintain itself by natural reproduction of both the trees and the groundlayer species.

Short-term management.

Plant sugar maple seedlings as described in the short-term management section for Gallistel Woods, page 30.

Plant additional hemlocks: (1) densely, in a selected area in the west portion of the woods, and (2) as scattered individuals in both mesic and dry-mesic areas.

As gaps form, add yellow birch; also leatherwood (*Dirca palustris*), Canada yew (*Taxus canadensis*) and fly honeysuckle (*Lonicera canadensis*).

Plant experimental plots of herb species as described for Gallistel Woods (page 30). Include some trial plantings in the old quarry.

Remove nonnative pines west and northwest of the parking lot and replace with northern dry-mesic tree and shrub species. (Note: This project was begun in 1991 with the help of Rotary Club members.)

Monitor and protect as needed the northern dry-mesic plantings east and west of the parking lot, and supplement with additional plantings wherever canopy gaps provide light. In particular the area needs more white birch, aspen, white pine, red pine and red maple.

Continue to monitor and remove honeysuckle, buckthorn and other exotics.

Long-term management.

The northern mesic forest type that will be developed in most of the woods should require little management effort once established. Some monitoring and control of exotics may be necessary, particularly along the edges, and in the more open dry-mesic portion at the top near McCaffery Drive.

It is possible that the northern dry-mesic portion of the woods may eventually begin to be invaded by sugar maple. If that should occur, the costs of resisting the change should be weighed against the benefits of having a northern dry-mesic forest example at that location, and the decision made as to whether to allow the gradual change to a more mesic forest to take place.

As in Gallistel Woods, what is learned about the requirements of the forest herbs should be used to establish a diverse groundlayer throughout the woods by further planting or, preferably, by encouraging natural spread.

RESEARCH

Research completed or in progress.

Nadelhoffer, Knute J., J. D. Aber and J. M. Melillo 1983. Leaf-litter production and soil organic matter dynamics along a nitrogen-availability gradient in southern Wisconsin (U.S.A.). Can. J. For. Res. 13:12-21. Wingra Woods ("OAK3") is one of nine Arboretum sites in this study.

Becky Brown's buckthorn shading experiment.

In the 1950's Grant Cottam set up four permanent 1m X 1m quadrats to follow development of the herb layer. The quadrats are quite empty of plants and no data has been taken for years.

Grant Cottam's Ecological Methods class sampled the north slope of the woods each year from the 1950's to 1985.

Francis Hole's permanent soil plots.

Research opportunities.

See suggestions for Gallistel Woods, page 32.

Action required for continuing long-term research projects.

Francis Hole's soil plots should be maintained and the marking of the plots should be improved.

The marking of Grant Cottam's permanent herb plots should be improved and the locations entered into the Arborlis system.

Tree data recorded and summarized by Grant Cottam's Ecological Methods classes should be obtained and preserved, along with directions for repeating the sampling.

Degree of manipulation appropriate.

Planting of seeds and plants of native forest herbs for research projects is appropriate, as is litter manipulation.

TEACHING

Value.

This will be the best area for classes to observe the northern Wisconsin forest continuum from dry-mesic to mesic to wet-mesic. It is an excellent place to observe differences in microclimate. The impressive red oaks illustrate how the growth of trees is favored by good site conditions. Spring wildflowers and fall color are timely for school field trip seasons.

The Indian Mounds are a valuable feature for educational tours.

Accessibility.

A new short trail allows groups to enter the woods from near the center of the north boundary of the lot, continue north to a good vantage point for viewing the linear mound, then turn east to join the main trail. This relieves congestion at the parking lot when large busloads of students arrive for tours. In general the system of wide and narrow trails through the woods provides a useful selection of tour loops.

PUBLIC USE

Sensitivity, suitability.

Like Gallistel Woods this woods has easy access and esthetic appeal, and is heavily used. It is vulnerable to off-trail activity because of the absence of shrubs, although along some of the trails poison ivy forms a protective barrier. The trails are suitable for hiking, nature study and bird watching. Skiers trying to negotiate the trail leading downhill to the spring cause damage to plantings near the trail.

Protective measures.

Trails should be kept open and well marked to encourage visitors to remain on trails. Traffic should be directed around the Indian mounds. The path from the parking lot to the spring should remain closed to skiers.

SOUTHEAST SUGAR MAPLE-PINE FOREST

Site description.

Location: 80:10-16

Size: 8.5 acres; 3.5 hectares

Slope and aspect: Nearly level

Soil: Silt loam grading to silty clay loam at the east.

Vegetation.

The southern portion of this unit is a stand of sugar maple that was planted with a nurse crop of silver maple in what was then an old field. The trees were planted over the period 1938 to 1958, and the earliest planting cards refer to the area as the "hard maple association". More recently it has been known as the "Beltline maples".

The northern portion is also dominated by planted sugar maple, but in addition has a substantial red pine component, and a few river birch and spruce--all survivors of a woody plant nursery that occupied the site during early Arboretum development.

There is no record of ground layer planting, but there are large patches of toothwort. Sugar maple seedlings, some as tall as five feet, occur in substantial numbers.

Special features and values.

The planting provides a good screen for the Beltline.

Fall color of the sugar maples mixed with pine is striking when viewed across Curtis Prairie.

This planting affords an excellent opportunity to compare a maple forest developing on formerly open land with one developing beneath an established oak canopy as in Wingra and Gallistel Woods.

The abundant sugar maple reproduction is unique in the Arboretum.

MANAGEMENT

Management objectives.

The main objective will be to maintain a stand of large trees dense enough to screen the Beltline effectively. Tree composition will be appropriate for a northern mesic forest unless it becomes necessary to use only species known to tolerate highway effects..

Short-term management.

Effects of the Beltline on the trees should be monitored. If adverse effects become severe, it may be necessary to plant a buffer strip of salt-resistant trees such as junipers to protect the maples.

A modest increase in diversity might be achieved by adding a small amount of hemlock, yellow birch and white pine in gaps in the northern portion, or as replacements for the inappropriate river birch, but the noise of the Beltline makes it unlikely that this will be a prime area for teaching.

The nearly pure sugar maple stand in the south section has been especially valuable for the study of the effects of sugar maple on soil. For this reason, and because northern mesic forests frequently contain relatively pure patches of sugar maple, no additional tree species should be planted in this area as long as the stand remains healthy.

Long-term management.

Continue to monitor the trees for damage from the Beltline.

Evaluate sugar maple reproduction as the stand matures, and supplement with additional plantings if needed to maintain the stand.

RESEARCH

Research completed or in progress.

Nadelhoffer, Knute J., J. D. Aber and J. M. Melillo 1983. Leaf-litter production and soil organic matter dynamics along a nitrogen-availability gradient in southern Wisconsin (U.S.A.). Can. J. For. Res. 13:12-21. The sugar maple stand was one of nine Arboretum sites used this study.

A study of sugar maple decline was carried out by a student of Jim Kuntz.

Research opportunity.

Comparisons between sugar maple stands planted in the open and under an existing oak canopy, including: tree growth and reproduction, susceptibility to maple decline, soil development, water relationships, ease of ground layer establishment. Effects of highway pollutants on sugar maple.

Action required for continuing long-term research projects.

None.

Degree of manipulation appropriate.

Manipulations that do not adversely affect trees, saplings or seedlings are appropriate.

TEACHING

Value.

Beltline noise makes the area undesirable for teaching.

Accessibility.

The area is accessible from the firelane that separates it from Curtis Prairie. There is also an E-W trail that goes through the woods.

PUBLIC USE

Sensitivity, suitability.

Use of the firelane by joggers, skiers and hikers has little or no adverse effect on the forest. The trail is not heavily used, although skiers enter the Arboretum illegally through the fence at the southeast corner.

Protective measures.

None appear to be necessary from the standpoint of the vegetation, although it may be desirable to discourage skier access at the southeast corner for other reasons.

TEAL POND WHITE CEDARS

INTRODUCTION

Site description.

Location: 65:1,8

Size: 1.5 acres; 0.6 hectare.

Slope and aspect: Level.

Soil: Silt loam, somewhat poorly drained.

Vegetation.

In 1935, 400 white cedar seedlings from a Sturgeon Bay nursery were planted; in 1960, 300 from the Wisconsin Conservation Department. The trees were planted in a dense patch on the north side of Teal Pond, extending north into a strip of remnant native prairie and east to the edge of a small open wetland. The trees have grown well and have formed a very dense canopy in which a small number of large bur oaks and black cherries persist. North of the remnant prairie strip, at the south edge of Gallistel Woods, there is a narrow strip of similar sized white cedar trees that have grown up from an old nursery planting. All of the white cedars show a conspicuous deer browse line. There is very little ground layer.

European alder (Alnus glutinosa) was planted inadvertently instead of the intended native alder (Alnus rugosa) at the northeast and east edges of the white cedars. The alders spread rapidly and attempts to control them by cutting resulted only in massive resprouting. Most of these have now been eliminated by means of herbicides, although follow-up will be important.

Special features and values.

The intense shade keeps the area under the canopy relatively free of buckthorn and honeysuckle.

MANAGEMENT

This white cedar planting will be eliminated. The soil is not wet enough for a cedar swamp, and the cedars interfere with a potential large continuum of southern communities from deciduous forest to prairie to wetland and pond. A white cedar swamp will

be developed below Wingra Woods, where the soil is more suitable and it will be part of a northern forest continuum.

The cleared area should be observed to determine what species naturally invade before planting is done. The space will provide a transition between prairie, oak woods, open wetland (with emergents introduced into Teal Pond), shrub thicket and tamaracks--a more natural combination for which there is a model in Summerton Bog, a State Natural Area in southern Wisconsin. Elimination of the white cedars will also facilitate management of the prairie, wetland and woodland in that general area by making it feasible to use prescribed burning from the south edge of Gallistel Woods to the prairie on the berm of Pond 2.

WINGRA WHITE CEDAR SWAMP

INTRODUCTION

Site description.

Location: 36:13,14; 37:16; 43;9,10,14,15,16; 44:3,4,5

Size: 28 acres; 11 hectares

Slope and aspect: Level

Soil: Muck soil, very poorly drained

Vegetation.

The area was disturbed open wetland (mostly sedge meadow) with scattered trees and shrubs when acquired by the Arboretum. Since then the area has been heavily invaded by buckthorn (two species) and honeysuckle. Parts of it have a continuous canopy of buckthorn 3 meters or more tall. There are patches of open sedge meadow, however, and some areas where native red osier dogwood is dominant. Mosses are an important component of the groundlayer. A few very large cottonwoods occur in two patches near the lake.

Approximately 200 seedling white cedars from DNR were planted 1983-85. Some were planted under the buckthorn; others in clearings that had recently been made in the buckthorn for Becky Brown's experimental plots. Fewer than 10 have survived, and most of those are not vigorous. Many of the seedlings suffered from deer browse and/or frost heave.

The experimental plots which were cleared now have a good cover of herbs and grasses, in striking contrast to the bare soil beneath the thick buckthorn in the uncleared plots.

Special features and values.

Potentially the best site for the cedar swamp type of wet-mesic forest if white cedars can be established. Moss cover and protruding buckthorn roots already suggest that type of forest. Location at foot of north slope should provide appropriate microclimate.

Includes patches of reasonably good sedge meadow.

Good wilderness feeling; away from roads and noise.

Wildlife habitat with little human impact.

MANAGEMENT

Management objectives.

To develop and manage a white cedar swamp forest with patches of open sedge meadow and shrub carr.

Short-term management.

Eradicate buckthorn and honeysuckle.

Check area carefully for purple loosestrife and dig out any found.

Develop a strategy to establish white cedar successfully. Experiment with rotting logs or piles of wood chips for substrate, mulch to prevent frost heave, deer protection, etc.

Identify the best sedge meadow and shrub carr areas. Plant white cedar, balsam fir, red maple, a few tamarack, winterberry (*Ilex verticillata*), mountain-holly (*Nemopanthus mucronata*) and other appropriate trees and shrubs in the areas that are less choice, using the techniques developed.

Make trial plantings of groundlayer plants, including several species of ferns.

Long-term management.

Continue to monitor and remove exotics.

If the trial plantings are successful, expand the plantings of groundlayer species.

RESEARCH

Don Waller and his students used this area for studies of the life history and demography of jewelweed (*Impatiens capensis*).

Becky Brown and her students have done research on buckthorn reproduction and the effects of buckthorn on the community.

Clearing the buckthorn will provide an opportunity for a study of natural invasion of exposed wetland soils.

TEACHING

Value.

The cedar swamp here will be part of a northern forest continuum that will include the small dry-mesic pine forest at the top of the hill, the northern mesic forest on the north and east slopes, the cedar swamp at the foot of the hill and the northern wet forest of tamaracks in the Wingra Spring area.

This will be an active restoration project that will provide an easily observed and understood on-going demonstration.

Accessibility.

The area is within very easy walking distance of the Wingra-Gallistel parking lot.

There are no trails through the proposed swamp forest, although the south edge is visible from the trail along the foot of the slope. A boardwalk should be considered as a future possibility.

PUBLIC USE

Sensitivity, suitability.

The wet soil makes this area extremely vulnerable to trampling and unsuitable for public use without a boardwalk.

The location along the lakeshore results in unauthorized foot traffic by persons coming by boat or wishing to park in the parking lot and get to the lake.

Protective measures.

The area should be viewed from the upland trail only unless a decision is made to build a boardwalk.

Unauthorized foot traffic by persons coming by boat or skis across the lake or by persons wishing to get to the lake from the parking lot for fishing, swimming or etc. should be discouraged. If the decision to build a boardwalk is made, the walk should not go to the lake or be readily visible from the lake. It should also leave a major part of the forest and sedge meadow without trail access in order to maintain some of the present wilderness quality.

EAST MARSH TAMARACKS

INTRODUCTION

Site description

Location: 48:2,3,5,6,12

Size: 2.5 acres; 1 hectare

Slope and aspect: level

Soil: alkaline fen peat

Vegetation history and past management

The presettlement vegetation was probably sedge meadow and the site at that time was much wetter. Arboretum plantings included an unknown number of the 2000 4-9ft tamaracks transplanted to the Arboretum from the Lake Mills area in 1933, and 15,000 seedlings from the State Nursery at Wisconsin Rapids planted in 1933-34.

General description of the present vegetation

The vegetation consists of an impenetrable thicket of shrubs, mostly buckthorn, with a few surviving tamaracks emerging above the thicket. Oxidation of the dry peat has exposed as much as a foot of the tree roots.

MANAGEMENT

The tamaracks will be phased out as they die and the area will be managed as part of Gardner Marsh.

TEAL POND TAMARACKS

INTRODUCTION

Site description

Location: 65:8,9

Size: 1.5 acres; 0.6 hectare

Slope and aspect: level

Soil: Sedge peat

Vegetation history and past management

Before settlement this area probably supported wet prairie and sedge meadow. In 1933, 2000 4-9ft tamarack were dug in the Lake Mills area and transplanted to three Arboretum sites, including the Teal Pond area. From 1950-61, 1800 tamarack and 2000 black spruce seedlings were planted on the site, and several large cottonwoods were girdled to favor the conifers. Twenty each of speckled alder (Alnus rugosa) and winterberry (Ilex verticillata) were also planted.

Large numbers of European alder (A. glutinosa), established in both the tamarack and white cedar plantings near Teal Pond, were recognized as a serious problem by the mid-sixties. It is generally believed that these were mistakenly planted as A. rugosa. The date of the planting is unknown since there is no record in the planting file of a large planting of any species of alder. In 1986-87 a major effort was made to eradicate the alder, using herbicide on cut stumps.

Most of the black spruce were planted south of the major tamarack planting, toward the boreal forest, where many of the few that survived until 1980 were destroyed that year by the construction of Pond 2.

There has been high mortality in the mature tamaracks close to the pond, beginning in the early 70's. Experts consulted agree that there appears to be no disease or insect pest involved, and that water level change is likely to be a factor.

General description of the present vegetation

Close to the pond most of the dead tamaracks are still standing, and shrubs, both native and nonnative, are dense.

Where the European alder was removed there are few shrubs; the ground is covered with pioneer wetland herbs. The surviving tamaracks are mostly south and southwest of the pond; their density is low and their height varied, which gives the stand a rather natural appearance. The few native alders have grown well and are readily visible along the firelane.

Special features and values

Many northern birds, such as crossbills and pine siskins, are attracted to the area in winter.

The tamaracks are esthetically very pleasing. There is a view from the firelane looking south through the tamaracks and across the sedge meadow to the boreal forest that captures a northwoods atmosphere very well.

MANAGEMENT

Management objectives

Maintain a small stand of tamaracks and some associated species as an example of Northern Wet Forest, for teaching and demonstration. Development of the typical bog groundlayer of sphagnum and Ericaceous shrubs will not be attempted because of the high pH of the soils and groundwater in the area. The relic tamarack stands at Hub City Bog and Summerton Bog are probably better models than the bogs in northern Wisconsin.

Short-term management

Remove buckthorn, honeysuckle, any remaining European alder and other undesirable woody species.

Plant additional native alder and winterberry. Other appropriate species to try include mountain-holly (Nemopanthus mucronatus), cinnamon fern (Osmunda cinnamomea) and royal fern (O. regalis).

Experiment with controlled burns. It would simplify management to add this area to the large burn unit that will include the Teal Pond Wetlands and the Juniper Knoll Uplands, but it will be important to know whether the tamaracks can be maintained if the area is burned.

Long-term management

Continue to monitor and remove undesirable woody species.

RESEARCH

There has been no research in this area. A study of the effects of fire on tamarack is needed. The effect of the tamaracks on the groundlayer, the relationship of ground water level to tamarack mortality, and the use of the area by birds are other possible research topics.

TEACHING

Value

The tamaracks are of special interest because of their deciduous habit, which is unusual in conifers. As an example of a northern wet forest type it is a useful complement to the nearby pine and boreal forests.

Accessibility

The area is within easy walking distance of the McKay Center. It is the only location in the Arboretum where tamaracks are near a trail and the branches can be observed at close range.

PUBLIC USE

Suitability, sensitivity

The area is easily seen without leaving the firelane, which provides very pleasant access for visitors and keeps their feet dry. There has been no problem of off-trail use.

Protective measures needed

None at this time.

WINGRA SPRINGS TAMARACKS

INTRODUCTION

Site description

Location: 43:5,12

Size: 0.5 acre; 0.2 hectare

Slope and aspect: level

Soil: alkaline fen peat

Vegetation history and past management

Before settlement the level of the lake was 0.3m higher than at present, making this area wetter. The vegetation was open wetland, probably dominated by sedges. Lowering of the lake level, elimination of fire, and possibly disturbance associated with dredging of the lake, encouraged shrub growth. Native red-osier dogwood, willows and bog birch were among the first invaders, joined later by two species of Eurasian buckthorn (*Rhamnus cathartica* and *R. frangula*).

The tamaracks were probably planted in 1933, when 2000 tamaracks were dug in the Lake Mills area and transplanted to Arboretum locations. No associates were planted at that time.

Substantial brush clearing took place in the 1980's, and an unsuccessful attempt was made to establish black spruce in the cleared area west of the spring, using seedlings dug in northern Wisconsin.

General description of the present vegetation

There is a grove of tamaracks surrounding the shallow pond west of the stream flowing from Big Spring. That area is relatively open as a result of the recent buckthorn removal. Toward the lake from the tamaracks shrubs are dense and mostly native. There is an additional group of tamaracks east of the stream; this is a brushy area still in need of buckthorn removal. The tamaracks have had little recent mortality, in contrast to those at Teal Pond, and appear to be growing quite well.

Special features and values

One of the tamaracks was uprooted by wind, making the Arboretum's first tip-up. The roots had grown in a very shallow mat which is now vertically displayed.

Pollen studies have shown that tamaracks once grew naturally near the lakeshore, so this planting has some historical significance.

The area has a great deal of esthetic appeal, whether viewed from the Courtenay Overlook or from across the lake. The fall color, reaching its peak after most trees have shed their leaves, is particularly striking.

This is an important component of the northern forest gradient from dry to wet to be developed from the top of the hill to the lake.

MANAGEMENT

Management objectives

The tree composition is to resemble that of a Northern Wet Forest. The groundlayer will have as many of the appropriate species as can be established on the soil that is present. The high pH will probably prevent establishment of sphagnum moss and the small Ericaceous shrubs that are typical of wet forests in the north.

Short-term management

Complete removal of woody exotics.

Plant black spruce, balsam fir and a few jack pines. (Jack pines occur in some wet forests in northern Wisconsin. A few here would provide an interesting example of a bimodal species.)

Make test plantings of shrub and groundlayer species, selecting species from the Curtis list of prevalents for Northern Wet Forest, but avoiding species known to grow only on acid soils. These test species might include speckled alder (Alnus rugosa), mountain holly (Nemopanthus mucronatus), Canada mayflower (Maianthemum canadense), bunchberry (Cornus canadensis), wild sarsaparilla (Aralia nudicaulis), bluebead lily (Clintonia borealis), cinnamon fern (Osmunda cinnamomea) and crested shield fern (Dryopteris cristata).

Long-term management

Plant additional groundlayer species, using information acquired through the trial plantings.

Check for woody exotics on a regular basis and eliminate any that appear.

If the tamaracks do not reproduce, replace those that die by planting seedlings.

RESEARCH

There has been no research in this area. Research to develop techniques for establishment of black spruce and other desired species will be important. Other possible studies include use of the area by birds, growth and reproduction of tamarack in an alkaline fen peat, and comparisons of this planting with the Teal Pond Tamaracks.

TEACHING

Value

This is an important component of the planned moisture gradient of northern forests.

Accessibility

The area is close to the Wingra Woods parking lot. The tamaracks can be seen from the overlook at Big Spring, and a loop trail with a boardwalk allows entry into part of the planted area.

PUBLIC USE

Suitability, sensitivity

The wet soil makes the vegetation vulnerable to foot traffic.

Protective measures needed

Off-trail activity should be discouraged. The overlook with railing helps. The new loop trail with boardwalk should be clearly defined and chipped so that visitors know where to walk.

WEST SPRUCE-FIR FOREST

INTRODUCTION

Site description.

Location: 59:5,11-14; 64:4

Size: 4.5 acres; 2 hectares.

Slope and aspect: Gentle north slope.

Soil: Silt loam, grading into organic loam to north.

Vegetation.

This is a planting of white spruce and balsam fir, with a few Norway spruce and Douglas fir; also one Colorado blue spruce. The trees are grouped in two linear clusters west and northwest of the Sinaiko Overlook and a small cluster (including the Colorado blue spruce) on the east side of Wingra Overlook Prairie. Planting records are very incomplete; the only record is for balsam fir plantings made in 1950-53. It is likely that all the large conifers were planted at that time. There are smaller spruce and fir along the east edge that were apparently planted at a later date.

Special features and values.

Esthetically pleasing skyline of conifer silhouettes visible from McCaffery Drive.

Provides screen for golf course.

Conifers frequently used for feeding by winter finches.

This is the only boreal forest planting away from Beltline noise and pollution.

MANAGEMENT

Management objectives.

To maintain a small boreal forest planting that will enhance the view from the overlook and screen the golf course.

Short-term management.

Remove small group of isolated conifers next to Wingra Woods and allow that area to be a natural transition between woods and prairie.

Remove honeysuckle, buckthorn and other undesirable woody species.

Plant additional red maple and white birch, as well as mountain ash, mountain maple and other appropriate woody species. These plantings can be made in the gap between the two linear clusters and along the edges.

Encourage conifer reproduction by placing logs in gaps or under the planted birches. A few seedlings of balsam fir have been observed along the trail, which suggests that moisture conditions may be good for reproduction. Consider augmenting these with plantings of white spruce and balsam fir seedlings.

At the south end, where the planting narrows to a single row of spruces that have lost their lower branches (and thus their effectiveness as a screen), remove several large spruces and replace with younger ones.

Plant a few boreal forest groundlayer species, especially those which have grown best in other conifer plantings, such as Canada mayflower and partridge berry.

Long-term management.

Continue to monitor and remove honeysuckle, buckthorn and other undesirable woody species.

Phase out the nonnative conifers and replace with native spruce and fir.

Continue to manage for a mixed age structure of white spruce and balsam fir.

RESEARCH

There have been no research projects in this area. The reproduction of balsam fir, unique for the Arboretum, suggests that a study of the conditions that have been favorable for reproduction here might be useful in management of the younger Southeast Spruce-Fir Planting.

TEACHING

This area is not often used for teaching because the trail leads only to McCaffery Drive; it is not part of a loop going through prime teaching areas. It does provide an interesting contrast with the adjacent prairie.

PUBLIC USE

Sensitivity, suitability.

The trail is inviting to hikers along McCaffery Drive, particularly on hot days; it plunges them immediately into the cool forest microclimate. If they follow it past the prairie and through Wingra Woods they experience interesting contrasts in vegetation, and the entire route is relatively quiet. On-trail hiking is not a problem to the vegetation.

Protective measures.

To enhance the quiet and prevent excessive compaction, runners should be discouraged from using the trail. The unfortunate use of the area by a few runners as a secluded "pit stop" sometimes makes the trail very unpleasant for others. Use of the entire trail from here through Wingra Woods by skiers should be evaluated.

SOUTHEAST SPRUCE-FIR FOREST

INTRODUCTION

Site description.

Location: 80: 1,7-10

Size: 11 acres; 4 hectares

Slope and aspect: Nearly level.

Soil: Silty clay loam.

Vegetation history and past management.

The area was open farmland at the time of acquisition. The first plantings were made in 1950 along the east boundary. This was followed by plantings first in the southern half, then in the northern half. By 1964, according to the planting record, approximately 5000 balsam fir (most of them from a New Hampshire nursery) and 9000 white spruce (from the Wisconsin Conservation Department) had been planted. Some of the spruce were actually Norway spruce, although that was not known at the time of planting.

In 1954, 850 trembling aspen were dug in the low east end of the Curtis Prairie and planted along the west edge of the spruce-fir planting and in the Leopold Pines. Three hundred red maple were planted, and a few hemlock along the west edge. Ground layer plantings have not been attempted.

The spruce and fir plantings have never been thinned. A few were killed by flooding south of the E-W firelane, and about twenty spruces died of a fungus disease in 1970.

General description of present vegetation.

This is a very dense stand of spruce and fir, with substantial numbers of aspen, especially in the western portion and along the edge. The aspen grew faster than the conifers, so at first the appearance was as if the conifers had come in under the aspen, a sequence thought to be common in natural boreal forests. Actually the situation in the boreal forests of the north may often be similar to what really happened here, namely, that the aspen and conifers started at about the same time but grew at different rates. The spruces and firs are now overtaking the aspen. Red maples have survived in the area where flooding killed the spruces.

Special features and values.

This is the largest of the boreal forest plantings and the most promising for further development. Its location near other northern forest types and next to Pond 2 enhances its teaching value.

It provides important screening for the Beltline.

With the adjacent Southeast Sugar Maple-Pine Forest it provides an esthetic view across Curtis Prairie.

MANAGEMENT

Management objectives.

Develop and maintain a small boreal forest planting suitable for demonstration and teaching. Continue to provide a screen for the Beltline.

Short-term management.

Remove Norway spruce. Leave trunks on the ground.

Remove honeysuckle, buckthorn and other undesirable woody species.

Plant mountain maple (Acer spicatum), red maple, mountain ash (Sorbus americana and S. decora), and other boreal tree species presently poorly represented. Use the openings created by the removals, and create additional openings if necessary. Plant hemlock where sugar maples adjoin at the south (a more appropriate location than the west edge).

Make plantings of boreal species, including white cedar and paper birch as well as those listed above, on the south and east berms of Pond 2 to bring the forest to the pond edge.

Plant boreal forest shrubs including beaked hazel, northern bush honeysuckle (Diervilla lonicera) and thimbleberry.

Made a trial planting of groundlayer species.

Long-term management.

Evaluate reproduction of spruce and fir and take appropriate steps if needed to maintain these species on the site, such as

making clearings, providing more logs as seedbeds, and planting seedlings.

Expand groundlayer planting if trial planting is successful.

Continue to monitor and remove honeysuckle and other unwanted woody species.

RESEARCH

There have been no research projects in this area. Possible projects include studies of the effects on soil of spruce and fir compared with other canopy types in the Arboretum, and comparisons with spruce and fir forests in the north. Comparisons might also be made of the success of groundlayer establishment here and in the pine plantings.

TEACHING

Value.

This is the Arboretum's best example of a boreal forest. Students can see it at a distance across the prairie or from the north across the marsh and pond, and also walk through it for a closer view.

Accessibility.

It is less than one-half mile from the McKay Center. The Curtis Prairie firelane marks the west boundary of the forest. An E-W firelane traverses the forest to the flume for Pond 2. From that point a group can take the loop trail on the berm around the pond (which will eventually afford an opportunity to see the new pond-edge plantings), or a meandering trail going south through the spruce and fir to the sugar maple forest.

PUBLIC USE

Sensitivity, suitability.

The two trails should be limited to hiking, but the firelanes are appropriate for running and skiing.

Protective measures.

No special measures required.

PRAIRIES AND SAVANNAS

Table of Contents

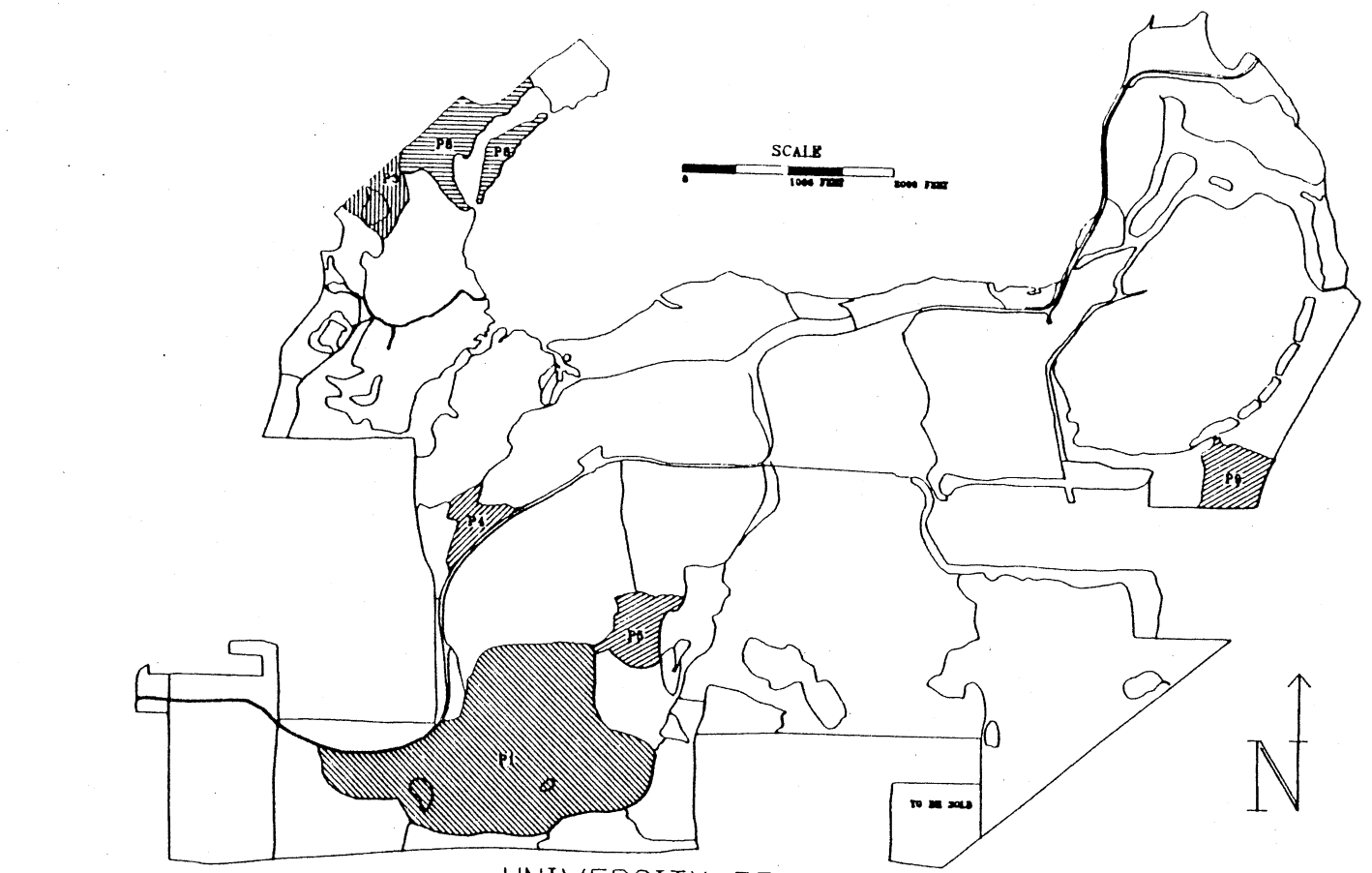
PRAIRIES AND SAVANNAS

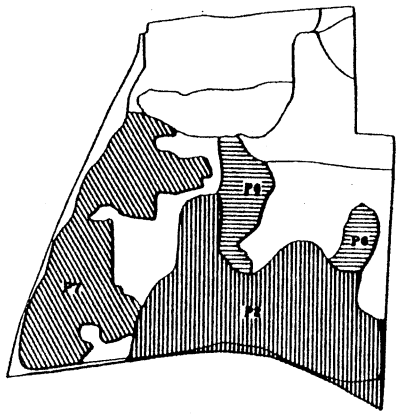
List of prairies and savannas showing size and community type.

	Acres	PW	PWM	PM	PDM	PD	OO	OB	CG
Curtis Prairie	73	x	x	x	x	x*	x		
Greene Prairie	50	x	x	x	x	x		x	
Marion Dunn Pr.	4	x	x	x	x		x		
Wingra Overlook	5			x	x				
Juniper Knoll	8			x	x				x
Grady Knolls	14				x	x		x	
SW Grady Savanna	36				x	x	x	x	
Wingra Oak Savanna	15			x			x		
Carver St. Area	8			x			x		

*Lime Prairie

PW=wet prairie PWM=wet-mesic prairie PM=mesic prairie PDM=dry-mesic prairie PD=dry prairie OO=oak opening OB=oak barren CG=cedar (juniper) glade





UNIVERSITY OF WISCONSIN - MADISON
ARBORETUM MANAGEMENT UNITS - 1991

PRAIRIES AND SAVANNAS

P1	Curtis Prairie
P2	Henry Greene Prairie
P3	Marion Dunn Prairie
P4	Wingra Overlook Prairie
P5	Juniper Knoll Uplands
P6	Grady Knolls
P7	SW Grady Savanna
P8	Wingra Savanna
P9	Carver Street Savanna

PRAIRIES AND SAVANNAS OF WISCONSIN

North American grasslands formed a triangular wedge in mid-continent, with the base extending from Texas to Canada and the apex extending east to southern Ohio. From west to east, moisture gradually increased, as did the height of the grasses, the frequency of trees and the dependency on fire to maintain the grassland community. Southern Wisconsin lies in the eastern portion of the wedge, an area known as the "Prairie Peninsula", where the grassland known as the tallgrass prairie began to give way to the deciduous forests of the east. The prairie/forest transition was a shifting mosaic of prairie, savanna and oak forest, the boundaries of each determined by recent fire history and climate fluctuations, with frequent fires and dry periods favoring prairie and savanna over forest.

In his study of Wisconsin vegetation, John Curtis defined prairie as an open community dominated by grasses, and having no more than one tree per acre. A grass-dominated community with more than one tree per acre, but having a tree canopy cover of less than 50%, was a savanna; a community with greater tree cover was a forest. Curtis recognized that the boundaries between these community types were not discrete, rather there was a continuum of tree cover from prairie to forest.

PRAIRIES

The prairies were rich in species, with grasses, composites and legumes especially well represented. The particular species present depended on geographic location and on local topography and soil. Prairies on high rocky ridges, sand terraces, deep silt loam soils and poorly drained lowlands differed from one another in composition. Disturbance and fire history influenced composition as well, with some species requiring soil disturbance, such as bison wallows or animal burrows, to get started, and some species doing best when fires were frequent or occurred at a particular season.

Prairie plants grow close together, sharing available resources in time and space. Each species is adapted to the extreme temperatures, drought, wind, high light intensity, fire and grazing that are part of the prairie environment. Adaptations easily observed on the prairie include finely divided or narrow vertical leaves to prevent overheating by the sun and offer less resistance to the wind, hairy surfaces to deflect sunlight and wind, leathery or waxy leaves to reduce water loss, and abundant leaf surfaces to take advantage of the high light intensity are adaptations easily observed on the prairie. Unseen are the extensive root systems that make up two-thirds of the total plant biomass--an adaptation that helps maintain a

favorable water balance and allows rapid regrowth after fire or grazing. Organic matter, deeply incorporated into the soil from decaying roots, plus the mixing action of mound building prairie ants, combined to form the deep, rich prairie soils that eventually led to the nearly total conversion of prairie to agricultural crops.

For convenience, Curtis divided Wisconsin prairies into five types based on moisture conditions. Dry and dry-mesic prairies were those growing on shallow soil on dolomite ridges ("high lime prairies" or "goat prairies"), or those on very sandy soil. Dominant grasses included big bluestem (Andropogon gerardi), little bluestem (A. scoparius), prairie dropseed (Sporobolus heterolepis), side oats grama (Bouteloua curtipendula) and needle grass (Stipa spartea). Important forbs included purple prairie clover (Petalostemum purpureum), flowering spurge (Euphorbia corollata), old field goldenrod (Solidago nemoralis), leadplant (Amorpha canescens), pasque flower (Anemone patens) and silky aster (Aster sericeus).

Mesic prairie occurred on the better soils, including the extensive areas of silt loam derived from loess. Once the most widespread prairie type, these prairies were dominated by very tall (6-10ft) big bluestem, with lesser amounts of Indian grass (Sorghastrum nutans), little bluestem, prairie dropseed and needle grass. Characteristic forbs included many composites, such as smooth aster (Aster laevis), showy sunflower (Helianthus laetiflorus), blazing star (Liatris aspera), yellow coneflower (Ratibida pinnata) and compass plant (Silphium laciniatum). Legumes were well represented, including leadplant, purple prairie clover, bush clover (Lespedeza capitata), creamy wild indigo (Baptisia leucophaea) and tick trefoil (Desmodium canadense and D. illinoense).

Wet and wet-mesic prairies were found in floodplains and in areas poorly drained as a result of glaciation. Here bluejoint grass (Calamagrostis canadensis), cord grass (Spartina pectinata) and big bluestem were the most important dominants. Characteristic forbs included tall meadowrue (Thalictrum dasycarpum), mountain mint (Pycnanthemum virginianum), bigtooth sunflower (Helianthus grosseseratus), turk's cap lily (Lilium michiganense), New England aster (Aster novae-angliae) and bottle gentian (Gentiana andrewsii).

As can be seen in the table on page 100, each of the prairie types is represented in the Arboretum. In addition, the outlying properties of the Arboretum include three high dry prairies (Oliver, Bolz and Pasque Flower Hill), and Faville Prairie, which has large wet prairie areas interspersed with some low ridges of dry sand prairie.

SAVANNAS

After settlement, savanna rapidly changed from the most common community of southern Wisconsin to the most rare, as it succumbed to grazing, plowing and fire suppression. Examples of savanna having both the open grown trees and the ground layer intact were difficult to find when Curtis and his student Roger Bray did their savanna study. However, they were able to describe four types: Oak openings, the most widespread type, with bur and/or swamp white oaks and an understory of mesic or wet-mesic prairie; oak barrens, occurring on sandy soils of the central sand plain and on river terraces, with black oak (Quercus velutina, Hill's oak (Q. ellipsoidalis) and an understory of dry-mesic prairie or sand barren grassland; pine barrens, similar, but more northern, with jack pine (Pinus banksiana) as well as Hill's oak; and cedar glade, on steep slopes and rocky ledges, with red cedar (Juniperus virginiana) and an understory of dry prairie. The oak openings and the oak and pine barrens owed their existence to fire, while the cedar glade required the fire protection afforded by its rocky location, since red cedar is fire susceptible.

Bray's studies included determination of the species composition in shade and partial shade beneath the canopy of the open-grown trees and in the unshaded area beyond the canopy. Not too surprisingly, most of the prevalent species found in the shade were common oak woods species, while those in the unshaded areas were prairie species. Those in semi-shade were also prairie species, but there Bray found no prairie grasses. Work by Steve Packard in Illinois suggests that besides prairie and oak woods species there were species particularly associated with savannas as well, and that with the destruction of the savannas these species have become rare or uncommon.

The Arboretum has some representation of oak barrens on the Grady Knolls, with native but somewhat depauperate understory. Curtis Prairie includes two oak openings; both are very small and the one near Curtis Prairie Pond has an understory consisting mainly of reed canary grass (Phalaris arundinacea). The proposed savannas for Southwest Grady, along Monroe Street (Wingra Oak Savanna) and on Carver Street will add much needed and larger examples of oak openings. The Southwest Grady Savanna will add oak barrens as well.

A small planting on Juniper Knoll includes some elements of a cedar glade. There is no pine barren at present; the possibility of developing one is discussed in the northern forests section.

CURTIS PRAIRIE

INTRODUCTION

Site description.

Location: 64:8-10, 15, 16; 65:11-14; 80:2-7, 13-15; 81:1-12, 14-16; 82:6-10

Size: 73 acres; 30 hectares

Slope and aspect: Nearly level to very gentle N and E slopes

Soil: Silt loam, grading from well drained at the west and south to poorly drained in the central and east sections.

Vegetation history and past management.

The presettlement vegetation of the site was oak opening--groves of open-grown oaks, most of them bur oaks, interspersed with tallgrass prairie clearings.

Settlement took place in the late 1830's. The western two-thirds (area west of the N-S firélane) of Curtis Prairie was under cultivation until 1920. Most of the east section was used as a mowing meadow, but the most northerly part of the east section was undisturbed. From 1926 until Arboretum acquisition in 1932, a herd of 35-40 horses was pastured on the entire field.

The first plantings were in small experimental plots set up in 1935 by Norman Fassett and his student John Thomson. The first major plantings (42 species) were made between 1936 and 1940, by a crew of Civilian Conservation Corps men directed by Theodore Sperry. Additional extensive plantings (156 species) were made by Dave Archbald in 1950-57. Sods dug in natural prairies as well as seeds were used in these plantings.

In 1959, large chunks of dolomite rock and truckloads of crushed dolomite were used to create a raised level area in the south central section of Curtis Prairie to serve as the setting for plants of the dry hill prairies of southern Wisconsin, since a suitable "lime prairie" site did not exist in the Arboretum.

In 1950, after experiments carried out by John Curtis and Max Partch showed that burning favors prairie species and discourages pasture grasses, the first large prescribed burn was carried out. Burning was repeated every second or third year until a schedule of more frequent and variable burns was adopted

in 1980. Mowing and brush cutting have been used repeatedly to supplement fires in brushy parts of the prairie.

Substantial quantities of silt were deposited along the main drainageway through the prairie by storm water entering from the south through the conifer plantings. Erosion gullies formed in the conifers, and the material removed was deposited in the prairie. In 1970, a two-acre pond was constructed in the prairie to catch runoff from the construction of additional lanes on the Beltline. A concrete flume was constructed through the conifer planting from the storm sewer outlet to the pond. The pond had to be dredged following the highway construction; the material dredged was made into a berm along the firelane east of the flume.

Since 1980 considerable effort has been expended on control of sweet clover, a nonnative biennial that had been favored by the burn schedule followed prior to that time. Techniques have included burns in two consecutive years (the second one in mid-May) and mowing or hand cutting in summer to prevent seeding.

A hedgerow between McCaffery Drive and the prairie was removed and a strip of prairie planted in its place in 1985. In 1986, prairie was planted where the old nursery had been located. These two additions expanded the prairie by approximately 5 acres.

General description of the present vegetation.

The prairie grades from dry-mesic through mesic to wet-mesic and wet. Big bluestem is the most important grass; in a good year it reaches ten feet in height. Besides the moisture-related variability, there is a patchiness apparently related to planting history, with some areas strongly dominated by grass, while other areas have more forbs. Some species have spread widely throughout most of the prairie; others are more limited in distribution. Spring flowering species in general are poorly represented. Altogether there are 170 prairie species present. Two small groves of bur oak are located at the edge of the prairie.

Nonnative weedy species include white and yellow sweet clover, wild parsnip, knapweed (on the lime prairie), several nonnative pasture grasses, reed canary grass, and leafy spurge, the last two being the most serious problems. Leafy spurge is spreading through a large part of the central section and is especially competitive in the lime prairie. There is no known control technique. In less well-drained and/or disturbed areas the most serious problem is reed canary grass, which forms a monotypic stand around the pond, on the berm of dredge spoils, and along drainageways through the prairie.

Parts of the prairie are very brushy. There are large patches of trembling aspen in the east section, shrubby willows in the wet areas, gray dogwood near the oak opening at the north, and a mixture of woody species along the south boundary where the adjacent pines have a strong influence.

Special features and values.

Curtis Prairie is the oldest restored prairie in the world. It is the largest Arboretum prairie and one of the Arboretum's most successful restorations.

Because of the good silt loam soil, the grass grows taller here than in the other Arboretum prairies and provides a demonstration of the kind of tallgrass prairie that once grew where corn now stretches to the horizon. It is one of the few places where people can have the experience of walking through a prairie with tall grasses over their heads.

It is the site of the classic burn experiments of Curtis and Partch that showed the importance of fire in managing prairie.

It is the location of long term studies of vegetation and soil that were initiated in the 1950's.

The Jackson Oak is located at the west end of the prairie.

MANAGEMENT

Management objectives.

Historical: To develop a good example of tallgrass prairie, with appropriate species throughout the moisture continuum.

Present: Essentially the same.

General management of prairies and savannas.

Basic management is prescribed burning, supplemented with brushing. Frequency of burning depends on the type of prairie and what species need to be encouraged or discouraged. Burns should be frequent enough to make extensive brushing unnecessary, and the schedule irregular enough to avoid a repeating pattern that might favor sweet clover or other troublesome species. Most burns will take place during the dormant season, but summer burns may be used to discourage or encourage particular species. Generally at least one-fourth of a prairie will be left unburned to serve as a refuge for invertebrates that might be vulnerable to fire. A burn schedule appears in the Appendix.

Where sweet clover is a problem, standard procedure will be to follow an early spring burn one year with a May burn the next year to kill second year plants. In addition, all prairie and savanna areas should be checked for second year plants in flower each summer and any found should be pulled up or cut at ground level before seeds are formed.

Herbicides are seldom required in prairie and savanna management, but will be used when needed to control selected pest species, such as leafy spurge, reed canary grass, black locust and, in some situations, small oaks.

Attempts should be made to introduce additional appropriate plant species into the less diverse prairie and savanna areas, and to introduce prairie animals.

Site-specific management.

Frequent burning will be required to keep brush under control. Two consecutive years without burning should be avoided.

Besides sweet clover, pest species in need of eradication include leafy spurge, bracken fern, knapweed (in the lime prairie), reed canary grass (especially along drainageways and the edge of the pond), and poison ivy (because of the hazard to the burn crew).

More spring-flowering prairie species should be introduced.

Appropriate savanna species should be introduced into the two savanna areas and under single large oaks, including the Jackson Oak.

RESEARCH

Research completed or in progress.

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McCabe's study of willow flycatchers.

Lee Hackeling's study of Silphium laciniatum and Baptisia leucophaea in connection with the Kline/Howell project

Cottam permanent plots. 10 plots 1m x 1m

Research opportunities.

Management-related studies needed: Continuation of prairie survey, perhaps on a ten year basis. Seedling establishment. Techniques for increasing diversity. Insect survey. Control of Euphorbia esula and reed canary grass. Effect of trails. Establishment of savanna understory. Introduction of Franklin's ground squirrel, prairie butterflies, etc.

General ecological studies: Pollination of prairie plants. Response of individual species to drought years. Causes of species population explosions. Pattern and its causes.

Action required for continuing long-term research projects.

Maintain the Hole soil plots by manipulating the litter and vegetation according to his plan. Do not burn the manipulated plots.

Maintain stakes for Cottam permanent plots and relate location to Arborlis grid.

Degree of manipulation appropriate.

Burning, clipping, and mowing are allowed. In some cases, soil disturbance will be permitted.

TEACHING

Value.

Gives students a rare chance to experience and study a tallgrass prairie. Provides a good example of restoration of a community to its former location.

Accessibility.

This is the most accessible of the Arboretum prairies, with easy access from either the McKay Center parking lot or from the Curtis Prairie parking lot. Firelanes around and through the prairie facilitate teaching of large groups, and there is an extensive trail system. It is sometimes difficult to use the narrow trails when the grasses are tall, but the experience of walking through the tall grasses makes it worth the effort for most groups.

PUBLIC USE

Sensitivity, suitability.

This is one of the most heavily used areas in the Arboretum, attracting large numbers of hikers, runners and skiers. The firelanes can accommodate runners and skiers, providing they are considerate of class groups and other walkers. Trails are suitable only for walking. The prairie is sensitive to off-trail activity, and the quality of the prairie is always poorer along the trail edges, which tend to have more weeds, woody species and pasture grasses.

Protective measures.

Restrict activity to the trails and firelanes, and do not expand the trail system. Skiers and joggers should use firelanes only, and should not detour into trailside vegetation when encountering a tour group. Use of the firelanes for team running practice should be discouraged.

To encourage photographers to stay on the trail, it would be helpful to make sure that there are examples of showy prairie species near the trail.

GREENE PRAIRIE

INTRODUCTION

Site description.

Location: 95:13,14; 97:10,15; 100:1-3,5-12; 101:2-12

Size: 50 acres; 20 hectares

Slope and aspect: Very gentle south slope

Soil: Varies from loamy sand and sandy loam at the north to clay loam in the south and southwest. The southern edge and much of the west section are poorly drained.

Vegetation history and past management.

At the time of the original survey the area was a brushy oak opening with an understory of prairie grasses and forbs. After settlement the land was cultivated, and when acquired by the Arboretum in 1941 it was an abandoned corn field. (The furrows are still visible today.) Prairie plants persisted along the railroad tracks to the south, on the prairie knolls to the north and around small ponds (at least three) in the former cornfield. Restoration planting was done almost single-handedly by Henry Greene, most of it from 1945 to 1952. Using seed, sod transplants, and seedlings raised in the greenhouse, he planted 133 prairie species, including 12,000 seedlings and mature plants that he planted by hand.

Because of the prior experience in Curtis Prairie, burning was part of the management from the beginning. Oaks invading along the NE edge and a small black locust clone in the east central section were cut and treated with herbicide in the 1980's. When Baptisia australis, a southeastern species planted by Greene, began to hybridize freely with the native B. leucophaea, a concerted effort to eliminate all individuals of the imported species and its hybrid offspring was initiated and continues. Mowing has been used repeatedly on aspen invading vigorously in the northeast part of the prairie.

Development south and east of the prairie has caused flooding and silt deposition along the south boundary. Reed canary grass has invaded this area, which appears to be expanding.

General description of the present vegetation.

This is a diverse, colorful prairie--in many ways the most successful of the Arboretum prairies. The prairie grades from dry sand prairie to wet prairie. There are tremendous shows of Indian paintbrush, prairie dock, gayfeather, blazing star, prairie dropseed and gentians, to name a few. Weeds are much less troublesome than in Curtis Prairie. The success is due partly to the poor soils, which are less favorable to pasture weeds, but largely to the expertise and devoted effort of Henry Greene.

There is a natural transition along the north boundary to oak savanna and dry oak woods. Aspen have invaded the prairie heavily along part of this boundary. The flooded and silted area at the south supports a monotypic stand of reed canary grass. The southeast corner has a variety of dense shrubs, and is much used by species of birds that inhabit shrub carrs.

Special features and values.

Excellent quality prairie with few weeds.

Species known to be difficult to start in prairie plantings are found here in fairly large populations.

Good transition to savanna and oak woods along the long north boundary is esthetically pleasing and ecologically sound.

The large area included in the prairie-savanna-oak woods mosaic should be large enough to support a variety of animal populations.

The area is buffered from the noise of the Beltline, so is especially pleasant for teaching and public use.

It is the site of long term prairie composition studies beginning in the 1950's.

Several rare and uncommon species are present, among them small white ladyslipper (Cypripedium candidum), small yellow ladyslipper (C. parviflorum), prairie white fringed orchid (Habenaria leucophaea), and prairie parsley (Polytaenia nuttallii).

MANAGEMENT

Management objectives.

Historical: To develop a good example of prairie, with appropriate species throughout the moisture continuum.

Present: No change.

General management of prairies.

See Curtis plan, page 107.

Site-specific management.

Solicit help from the city and town in correcting the flooding and siltation at the south boundary. Eradicate reed canary grass and replant that part of the prairie.

Monitor the spread of trembling aspen into the prairie and develop techniques to control it.

Eradicate all leafy spurge with herbicide even though some prairie plants are killed in the effort. There is very little present; this is the time to get rid of it.

Continue work to eliminate the nonnative purple baptisia and its hybrid offspring, using herbicide.

Check for recurrence of black locust and eliminate immediately if any is found.

Try to prevent intensive development of the privately owned hillside south of the railroad tracks to preserve the long view that is a critical part of the unique esthetic appeal of the prairie.

Monitor erosion and sand deposition caused by storm sewer runoff from Arbor Hills at the NE corner of the prairie, and take action if effects on the prairie are undesirable.

RESEARCH

Research completed or in progress.

Blewett, T.J. 1981. An ordination study of plant species ecology in the Arboretum prairies. Univ. of Wis.-Madison Ph.D. thesis.

Anderson, M.R. and G. Cottam. 1970. Vegetational change on the Greene Prairie in relation to soil characteristics. In: Proceedings of a symposium on prairie and prairie restoration. Knox College Field Station Pub.3. pp. 42-47.

Allsup, Mark. 1978. Henry Greene's Prairie. Arboretum News 27(4): 1-4. Also MS thesis.

Greene, H. C. 1943-1951. Annual reports: Report on the Grady Tract Prairie for (year). Univ. of Wisconsin Arboretum files.

_____. 1955. Record of plantings and seedings in the Grady Prairie. Univ. of Wisconsin Arboretum file report.

Hartman, J.M. 1981. A comparison of sampling methods for tallgrass prairie communities in terms of land management problems. M.S. thesis. Landscape Architecture, Univ. of Wis.-Madison.

White, R.P. 1982. Comparison of bird species on two plots in the Univ. of Wis.-Madison Arboretum Grady Tract. Report in Arb. files.

Research opportunities.

Management-related studies needed: Continuation of prairie survey, perhaps on a ten year basis. Insect and bird surveys. Animal introductions. Monitoring of populations of rare species. Aspen control. Causes of willow invasion. Siltation and reed canary grass.

General ecological studies: Pollination of prairie plants. Effects of microtopography. Bird use of savanna vs prairie.

Action required for continuing long-term research projects.

Preserve directions for doing prairie survey.

Degree of manipulation appropriate.

Burning, clipping and mowing are allowed. In some cases, soil disturbance will be permitted.

TEACHING

Value.

Beautiful setting for first exposure to prairie. Excellent example of very successful restoration. Quiet, remote.

Accessibility.

It requires a half mile hike to get there from the Grady Tract parking lot, so is not suitable for short tours. A loop trail with a short cutoff provides access through the prairie. The trail includes a boardwalk through the wetter areas. It is difficult to talk to a group on the narrow trail, but the firelane along the north edge provides opportunity for group instruction and sharing.

PUBLIC USE

Sensitivity, suitability.

The trails are suitable only for walking. The wet parts of the prairie are particularly vulnerable to off-trail activity.

The beauty and quiet of the prairie provide a remarkable experience for city dwellers.

Protective measures.

Prohibit use of trails by joggers and skiers. As soil on the trails becomes more compacted, drainage is impeded and additional boardwalk may be needed to keep people on the trail. Keep boardwalks in good repair.

MARION DUNN PRAIRIE

INTRODUCTION

Site description.

Location: 39:7-10

Size: 4 acres; 1.7 hectares

Slope and aspect: On the berm of a constructed pond; varied slopes.

Soil: Consists of material dredged when pond was dug.

Vegetation history and past management.

The area was an open wetland (probably sedge meadow) at the time of settlement. Development of the land in the watershed above resulted in disturbance, including damage from road construction as well as erosion and siltation due to runoff. The site became drier and a woods of box elder, green ash, elm and other weedy wetland trees developed. The woods was cut and a settling pond was constructed in 1982 at the outlet of the storm sewer serving the developed area. This decreased the amount of erosion and siltation. The pond berm was planted with a cover crop of perennial rye that fall.

The berm on the east and south sides of the pond and the adjacent graded areas were planted with prairie in 1983 and 1984 by volunteers, using seeds of 89 species collected mainly from Arboretum prairies. Some plants from the DNR Wilson Nursery were also used. Additional plants from Prairie Nursery were added to the area near the Marion Dunn rock in 1989. Emergents were planted in the pond.

To help the prairie get started, volunteers to weed the new planting were recruited, trained and supervised by super-volunteer Marion Dunn, for whom the prairie is named. Some weeding continues, although the number of weeds has been greatly reduced. The crew has used herbicide to treat the stems of cottonwood seedlings and other woody species that were not controlled by hand weeding. The prairie was burned in 1987, 1988 and 1991.

In the fall of 1986 and the spring of 1987, an additional area was planted north of the pond, incorporating test plots intended to compare fall vs spring planting and site preparation with and without herbicide. This planting did not succeed, presumably because of the drought of 1987. It was replanted in 1990.

General description of the present vegetation.

The area planted in 1983 and 1984, which includes the island and the berm from the storm sewer inlet east around the pond to the southwest outlet, is a model of a successful new prairie restoration. Sixty-five prairie species have been observed and the prairie forbs are very showy.

Dandelions and other low stature weeds that have not been the target of the weeding effort are still very evident, especially along the edge of the trail, and cottonwood invasion has been a problem. The triangular area between the two diverging trails at the Marion Dunn rock marker is particularly weedy.

Classes studying the hydrology of the pond disturb the prairie near the established well-points, making those areas weedy also.

The prairie grades down into a monotypic stand of reed canary grass; some reed canary has appeared in the prairie itself. There is a dense thicket of shrub willows and Eurasian alder south of the prairie between the two pond outlets.

Few of the planted emergents survived.

Special features and values.

This is a very successful new prairie restoration in a location that makes it very conspicuous to the public.

The pond and its surrounding area including the prairie provide an excellent example of the restoration of abused land in an urban setting.

The prairie enhances and helps maintain an excellent view of Lake Wingra from Monroe Street.

It is a very good example of the value of volunteer input.

MANAGEMENT

Management objectives.

Develop a good example of prairie grading from dry-mesic prairie on the berm crest to wet prairie where the new plantings merge with the sedge meadow below. Develop an emergent community in the pond. Enhance and keep open the view of Lake Wingra.

General management of prairies.

See Curtis Prairie plan, page 107.

Site-specific management.

Continue efforts to improve the area around the Marion Dunn rock by planting and weeding. Reduce the size of some of the large clones of common goldenrod along the trail by summer cutting.

Continue to encourage the hydrology classes to cooperate in protecting the prairie as much as possible.

Improve the transition between prairie and sedge meadow below by controlling willow and Eurasian alder invasion and replacing reed canary grass with wet prairie species.

Try to determine the cause of failure of the emergents planted and try again.

RESEARCH

The area has provided opportunity for observations related to establishing prairie, and would be a good location for studies related to the replacement of reed canary by more desirable species. It is an area too small and too heavily used to be attractive for many types of research.

TEACHING

Value.

This is a good place for a short introduction to prairie as part of a tour of the other small examples of communities in the Monroe St. area. The pond area including the prairie is an outstanding example of an ecologically sound and esthetically pleasing restoration of abused land in an urban setting.

Accessibility.

It is easily accessible even for those dependent upon public transportation.

PUBLIC USE

Suitability, sensitivity.

The area is very suitable for fairly heavy public use and public exposure is very desirable. The prairie is sensitive to off-trail trampling, however.

Protective measures.

Discourage off-trail activity. Discourage dog walking and bicycling on the trail.

WINGRA OVERLOOK PRAIRIE

INTRODUCTION

Site description.

Location: 59:10,11,14

Size: 5 acres; 2 hectares

Slope and aspect: 2-6% northwest-facing

Soil: Sandy loam.

Vegetation history and past management.

Oak savanna covered the site before settlement. From about 1840 until 1935 it was grazed and may have been plowed. After acquisition by the Arboretum it was kept as an open old field until 1969 when the first prairie plantings were made in experimental plots by graduate student Jerry Schwarzmeier, who was testing the use of companion crops in prairie plantings. Additional experimental plantings were made in 1974-76 by Jim Zimmerman, who has continued to monitor the plots.

The first burn was carried out in 1972, and since then the site has been burned 3-4 times. A hedgerow of sumac and black cherry along the road was cut and treated with herbicide in the mid 1980's to facilitate management of the prairie.

General description of the present vegetation.

The prairie is a dry-mesic prairie with relatively few weeds. It is dominated by Indian grass, and is quite patchy due to its origin as experimental plots.

Special features and values.

This is the Arboretum's only prairie planting on a moderately steep slope. From the trail that goes along the lower edge the prairie sweeps up to the sky with no distracting buildings and few trees.

The presence of prairie here keeps an important view of Lake Wingra open.

Good observation point for woodcock courtship display.

MANAGEMENT

Management objectives.

To develop a good example of dry mesic prairie for teaching and research; to serve as part of a continuum from prairie to fen below; to keep the lake view open.

General management for prairies.

See Curtis Prairie plan, page 107.

Site-specific management.

Extend dry-mesic prairie downslope as far as mineral soil extends (100 feet?). Experiment to find out what kind of prairie (or other low-growing community) can be started on the fairly dry peaty soil below that to form a connecting link with Wingra Fen. After that has been determined, plant the appropriate species.

RESEARCH

Research completed or in progress.

Schwarzmeier, J.A. 1972. Competitional aspects of prairie restoration in the early stages. In: Proceedings of the second Midwest prairie conference. pp. 122-139.

Zimmerman, J.H. and J.A. Schwarzmeier. 1978. Experimental prairie restoration at Wingra Overlook. In: Proceedings of the Fifth Midwest Prairie Conference. pp. 125-130

Zimmerman continues to monitor the plots. Schwarzmeier did a re-survey in 1991.

Research opportunities.

Studies limited to those compatible with the long-term monitoring by Schwarzmeier and Zimmerman.

Action required for continuing long-term research projects.

Consult with Zimmerman or Schwarzmeier prior to burning or mowing so that Arboretum activity does not interfere with his data collection.

Degree of manipulation appropriate.

Mowing and cutting experiments are appropriate, but should be coordinated with long-term research by Schwartzmeier and Zimmerman.

TEACHING

Value.

This small prairie can be used to increase the diversity of tours through Wingra Woods; it provides a good contrast to the woods.

Accessibility.

The prairie can be seen from the trail that goes west from Wingra Woods and follows the lower boundary of the prairie.

PUBLIC USE

Sensitivity, suitability.

The small size of the prairie makes it especially vulnerable to off-trail activity, and the moderately steep slope has the potential for erosion. Visitors can enjoy a glimpse of the prairie from the road above and a better view from the trail below without harm to the prairie.

Protective measures.

Do not build additional trails through the prairie. Bicycles should not be allowed on the trail. Monitor edge along road for development of unofficial trails and block these promptly.

JUNIPER KNOLL UPLANDS

INTRODUCTION

Site description

Location: 65:1,2,6-8

Size: 8 acres; 3 hectares (including level prairie area east of the firelane and small woods to the south)

Slope and aspect: A knoll with slopes in all directions. Area east of firelane is level.

Soil: Sandy loam

Vegetation history and past management.

Before settlement, uplands such as this were covered with oak savanna. Post-settlement farming eliminated the savanna on the knoll, although some prairie species persisted in the lower area to the east. After Arboretum acquisition, red cedar (Juniperus virginiana) was planted in a dense grove on the north slope of the hill and widely spaced on the other slopes. Small numbers of common juniper (J. communis var depressa) and horizontal juniper (J. horizontalis) were also planted. The first plantings are not in the planting record, but were made while Curtis was in charge. Curtis also supervised the installation of slabs of dolomite to provide habitat for J. horizontalis at the top of the hill. Additional plantings of J. virginiana were made in 1959 and 1960.

In an aerial photo taken in 1958, a path forms the boundary between the open knoll and the oak woods to the south. Since then the woods has spread to the north well beyond the path, creating a broad transition zone of young oak and black cherry.

A concerted effort to remove honeysuckle and buckthorn, which had severely infested the knoll and the prairie area across the firelane to the east, was begun in 1983 and continues. Much of the labor has been provided by volunteers, who cut and stacked the honeysuckle and buckthorn. The Arboretum crew burned the brush piles and applied herbicide to the resprouting stumps. Native shrubs present were cut but not treated. During the same period the crew cut and treated the large black locust clones in the SE corner and in the west section near the stone fence. Selected large junipers were cut and removed from the savanna area. Prairie plants and seeds were added to improve the quality of the groundlayer in the cleared areas.

The knoll and the prairie to the east were burned 5 times in the 1980's and again in 1991. The 1991 burn extended south to the path and included the woods transition zone.

General description of the present vegetation.

The area includes:

1. A dense grove of mature red cedar on the north slope. There is virtually no groundlayer except along the edges, where there are many buckthorn seedlings.

2. A planting of paper birch adjacent to the dense red cedars, on the northeast slope. This area has recently been cleared of honeysuckle and there has not been sufficient time for an understory to become established.

3. Widely spaced red cedars on the upper south, east and west slopes of the hill. This is an area where volunteers have cut large amounts of dense honeysuckle and where most of the recent planting of prairie species has occurred. The groundlayer consists of weedy prairie between the trees, with more shade-tolerant species under the trees. Wild parsnip is abundant. A few Juniperus communis var depressa and a single J. horizontalis survive from the original planting. There are a few seedling junipers.

4. Open prairie with occasional bur or black oaks, stretching from the lower west slope to Curtis Prairie and from the lower east slope across the firelane to the small wetland north of Teal Pond. These areas are brushy with invading native shrubs and trees including sumac, aspen and gray dogwood, but most of the honeysuckle has been removed. Part, perhaps all, of the prairie east of the firelane is native prairie, which was more extensive before a portion was destroyed by the white cedar planting north of Teal Pond.

5. The woods transition zone at the foot of the south slope. Dense honeysuckle has been removed, but little groundlayer development has taken place. The trees are young oaks, black cherry and aspen.

6. A small oak woods extending south from the transition zone to the Teal Pond lowlands. This woods is infested with honeysuckle and buckthorn. It appears to be younger than Gallistel Woods.

Special features and values.

The interesting topography, long views and varied vegetation make this one of the most esthetically pleasing areas in the Arboretum.

The area of native prairie east of the firelane is one of the few in the Arboretum.

This is the only demonstration planting of a "cedar glade", the name used by Curtis for this type of savanna.

The area is heavily used by birds, and was once the site of a fox den.

MANAGEMENT

Management objectives.

Historical: Develop a cedar glade.

Present: Develop a cedar glade that grades into prairie, and includes an example of an exposed cliff community. Keep long views open. Develop gradual transitions from prairie to adjacent oak woods and wetland. Screen dump.

Short term management.

Manage the open areas (3 and 4, above) according to the "General management of prairies and savannas" section of Curtis Prairie plan, p.107.

Complete the eradication of honeysuckle, buckthorn and black locust throughout the site. (In the small oak woods this might be accomplished by prescribed burning.)

Protect and encourage the small red cedars planted to screen the dump.

Keep the dense area of red cedars intact except for natural mortality. Plant appropriate cedar glade species such as Aquilegia canadensis and Campanula rotundifolia along the edges where there is more light, but do not try to plant the interior until natural mortality breaks up the dense canopy.

The birches are intended to be part of the community. Soften the boundary between red cedars and birches by allowing a few seedling red cedars to come in. Soften the boundary between

birches and prairie by planting prairie and savanna species as far into the trees as light will allow.

Remove one of the large junipers in the savanna occasionally and allow it to be replaced by a seedling, to vary the size and age structure. Protect desired juniper seedlings from prescribed burns.

Replace two or three of the J. communis that have been adversely affected by the dense honeysuckle.

Burn the encroaching woods along the south edge whenever the rest of the site is burned. Monitor the encroachment. If fire is not adequate to control it, use other methods, but try to keep a gradual edge.

Burn the small oak woods frequently enough to prevent reinvasion of honeysuckle and buckthorn.

Selectively thin the small bur oaks at the bottom of the west slope to maintain a savanna-like spacing.

Remove white cedars remaining from old nursery planting near edge of Gallistel Woods so that the oak woods grades naturally into the prairie east of the firelane. (See also Gallistel plan.)

Long-term management.

Install additional dolomite ledges and a "cliff" to provide habitat for more J. horizontalis and for a sunny cliff community. The rocks already installed are in the right location for good light exposure and the new rock habitat should be planned for the same general area. Removal of some of the junipers north of the trail would make space while limiting damage to the prairie groundlayer. The ground would be graded to accommodate a low, curving rock "formation" facing southwest, below the remaining junipers. Alternately, if proposed improvements to the dumpsite result in construction of a berm between the dump and the savanna, the rock formation might be incorporated into the berm. Small pockets and ledges should be part of the design. After the rock is in place, plant appropriate cliff species, including rock cress (Arabis lyrata), bellflower (Campanula rotundifolia), columbine (Aquilegia canadensis), and ferns such as Woodsia obtusa, W. ilvensis and Polypodium vulgare.

Remove the white cedars along the north edge of Teal Pond and expand the prairie into that area. This will make a better transition to the marsh below and facilitate fire management of the area.

RESEARCH

An experimental plot is set up in the prairie east of the knoll to test a two-stage treatment of large clones of small aspen.

There is no record of any other research in the area. It would be a good place to compare the effects on soil of junipers vs prairie, and to study the effects that junipers have on prairie composition. Changes in animal use as the vegetation changes.

TEACHING

Value.

The knoll and adjacent areas provide great diversity and esthetic appeal for an excellent short introductory tour of the Arboretum.

Accessibility.

Very easy access from the McKay Center. Trail is narrow but firelanes east and west of the knoll allow gathering of groups.

PUBLIC USE

Sensitivity, suitability.

Trail is very suitable for public use and area is visually appealing. It is a good place for family walks and for birding. Off-trail activity would make weed control efforts less effective and damage young prairie plants.

Protective measures.

Trail should be kept open enough so that its location is obvious even when the grass is tall. There is a tendency for additional trails to start on the east slope. Joggers should be discouraged from using the trail.

WEST GRADY KNOLL
EAST GRADY KNOLL

INTRODUCTION

Site description.

Location: 96:5,9,10,12,13,15,16; 97:8,9,16

Size: West Knoll, 9.4 acres; 4 hectares
East Knoll, 4.1 acres; 2 hectares

Slope and aspect: West Knoll, moderate slopes, S, SW
East Knoll, moderate (S, SW) to fairly steep (N, E) slopes

Soil: Sandy loam

Vegetation history and past management.

Like the Grady Knolls Forest, this area was probably oak barren, a savanna with dry prairie groundlayer and scattered, open-grown bur oaks and black oak-Hill's oak hybrids. Post-settlement grazing kept the oaks from developing into woods on these high, mostly southerly slopes. Prairie species persisted, apparently due to the combination of sandy soil (reducing weed competition) and light grazing (enough to keep it open but not enough to eliminate all the prairie species).

After Arboretum acquisition in 1940, sprouting oak grubs began to dominate these open areas in spite of sporadic efforts to control them by burning and cutting. Many of the old, open-grown black oaks succumbed to oak wilt, but the younger invaders did not. In 1977, an experimental project was initiated to demonstrate the use of oak wilt as a biological control. During the next five years over 10,000 sprouting oak grubs and seedlings on West Knoll were inoculated with the oak wilt fungus, and most of these became infected and died. On East Knoll oak grubs were repeatedly cut without further treatment. Since then both knolls have had frequent prescribed burns.

In the mid-1980s, shrubs and small oaks were cut and treated with herbicide in the grove of oaks between Greene Prairie and East Knoll (south of the firelane). This extended the East Knoll savanna to the prairie.

A large clone of smooth sumac, Rhus glabra, on the West Knoll was brought under control by repeated summer cutting in 1979-82. Poison ivy in an area near the firelane on the west has been treated with herbicide.

A few prairie species, such as Anemone patens and Delphinium virescens, have been planted, but most of those present represent natural recovery of the community as a result of management.

General description of present vegetation.

Both knolls have moderately diverse sand prairie with scattered bur oak and a black oak-Hill's oak hybrid. Quality is patchy, with some patches that contain few or no prairie species and others that have many. The most spectacular prairie recovery is on the east half of West Knoll. There is a higher density of large trees on the East Knoll, as well as many times as many sprouting grubs and seedling oaks. On the north and east slopes woody species, including the oaks and honeysuckle, are particularly dense.

Dominant grasses are little bluestem (Andropogon scoparius), prairie dropseed (Sporobolus hetereolepis, needle grass (Stipa spartea), several small panic grasses (Panicum spp.) and, on East Knoll, sideoats grama grass (Bouteloua curtipendula). Prominent among the forbs are lupine (Lupinus perennis), spiderwort (Tradescantia ohiensis), wormwood (Artemisia caudata and A. ludoviciana), showy goldenrod Solidago speciosa) and flax leaved aster (Aster linariifolius). One area near the firelane at the west boundary of West Knoll is particularly sandy and dry; it supports spotted bergamot (Monarda punctata) and a few other sand barren species.

Leafy spurge infests large areas of the central and west sections of West Knoll. It appears to be spreading rapidly.

There are very large patches of poison ivy on the west side of West Knoll.

Special features and values.

The knolls provide excellent examples of savanna recovering well from past disturbance. Natural savannas are among the most rare of Southern Wisconsin's community types now, although they were once the most common.

The knolls are the Arboretum's only example of the type of savanna that Curtis called "oak barrens".

West Knoll is one of the few places in the country where oak wilt has been used as a biological control in a natural area.

The view across West Knoll toward the south from the top of the hill is one of the most esthetically pleasing views in the Arboretum.

Several of the species present are not found elsewhere in the Arboretum.

The very dry sandy area at the west boundary of West Knoll is one of three places in the Arboretum suitable for developing a small example of sand barren vegetation. (The others are in the Southwest Grady Savanna and the old field in the northeast section of the Grady Tract.)

MANAGEMENT

Management objectives.

Historical: The map made by Curtis indicates the knolls were to be part of a larger savanna area. No further detail was provided.

Present: Develop a good representation of oak barrens in a mosaic of prairie, savanna and oak woodland, similar to that found on sandy soils in the Dane County landscape before major settlement took place. Improve and enlarge the small example of sand barrens vegetation.

Short-term management.

Take whatever steps are necessary to protect the view to the south, preferably by incorporating the hillside property south of the railroad track into the Dane County Greenway.

Continue to burn frequently. Where burning does not adequately discourage woody invaders, supplement the fires with cutting and herbicide. Use herbicide to reduce the cover of poison ivy to levels that pose little risk to burn crews.

Make a major effort to develop a method to control leafy spurge on West Knoll--or at least to keep it from spreading. It may be possible to discourage further spread somewhat by increasing grass competition through seeding and frequent burning.

Gather seeds from prairie species present in the best areas on the knolls and broadcast these in the less diverse areas. Additional appropriate species can be gathered from other sandy areas in southern Wisconsin. The list of prevalent species for oak barrens in Vegetation of Wisconsin should guide species selection.

Double the size of the small sand barrens patch (near X3) by rototilling some of the adjacent prairie vegetation and removing roots. Plant characteristic species such as Aristida tuberculosa, Draba reptans and Krigia virginica. If planting is successful, continue to expand the patch and consider developing an additional patch 400 ft uphill to the north where a small excavation has exposed deep sand. Management of these small barrens may require repeated cultivation to keep the prairie from invading. Disturbed areas should be closely monitored for leafy spurge, however, and any found should be treated aggressively with herbicide.

Long-term management.

Continue to use fire as the main management tool. Develop burn units that include both the knolls and adjacent woods so that the boundaries between savanna and woods can become more gradual.

RESEARCH

Research completed or in progress.

Cottam permanent plots included 2 on West Knoll. Two of the stakes from one of these remain.

Glass, Steve. 1988. An investigation of the mechanisms responsible for the revegetation of a degraded oak barrens after removal of the canopy. M.S. Thesis. Dept. of Landscape Architecture, University of Wisconsin-Madison

Kline, V.M. 1982. Use of oak wilt to control oak invasion of prairie. In: Proceedings of the Eighth Annual North American Prairie Conference, R. Brewer, Ed. Kalamazoo, Michigan.

Kline, V.M. 1982. Control of sumac in a sand prairie by repeated cutting. Restoration and Manaagement Notes 1:2 p21.

Kline, V.M. Use of herbicide to control oak grubs, and the effect on prairie vegetation. Unpublished data.

Reich, P. Studies on moisture stress included a site on West Knoll. Publication status unknown.

White, R.P. 1982. Composition of bird species on two plots in the University of Wisconsin-Madison Grady Tract. Report in Arboretum files.

Research opportunities.

Management-related studies needed: Control of leafy spurge. Effect of leafy spurge on prairie. Changes in groundlayer composition when light is increased by canopy reduction. Introduction of appropriate animal species, such as green snakes.

General ecological studies: Animal use (mammals, birds, insects) of a prairie-savanna-forest ecotone. Soil development under trees and in open areas. Enrichment of degraded prairie.

Action required for continuing long-term research projects.

Stakes for one of the two Cottam plots remain and should not be removed.

Degree of manipulation appropriate.

The area is suitable for canopy manipulation, soil studies involving manipulation, and for introduction of appropriate plants and animals. Burning, clipping and mowing are allowed for research purposes.

TEACHING

Value.

This is an excellent place for students to enter a landscape resembling that preceding major settlement, and to observe vegetation adapted to sandy soil. As the ecotones become more naturally gradual they will be an asset that is unusual in the Arboretum. It should become an area having much animal activity, where classes can easily observe birds, mammal sign, etc.

Accessibility.

The fairly long walk from the parking lot on Seminole Highway to West Knoll makes it unsuitable for short tours. The firelanes and the West Knoll trail provide good access for groups having longer tours (1 1/2 hours minimum), and the new trail through the northern unit of the SW Grady savanna makes possible an interesting loop. East Knoll is too far from the parking lot and has no trail through it, making it much less suitable for teaching.

PUBLIC USE

Sensitivity, suitability.

West Knoll is one of the most popular areas for visitors, but most stay on the trail so the impact has not been serious. The sandy soil discourages weed growth along the trail on West Knoll; instead there is a population of Bouteloua hirsuta.

Protective measures needed.

Off-trail public activity should continue to be discouraged, as should skiing down the steep firelane on the east side of West Knoll, since most skiers cannot negotiate the sharp turn required to remain on the firelane.

SOUTHWEST GRADY SAVANNA

INTRODUCTION

Site description.

Location: 97:2-7,11,12,14; 98:8,9,15,16; 99:1,2,7-11; 100:3-5,12

Size: 36 acres; 14.5 hectares

Slope and aspect: Gentle S to SE slope. A drainageway carrying street storm water crosses the area from NW to SE.

Soils: Grade from loamy sand at the north to silt loam at the southwest. Wet variants of these soils are associated with the drainageway.

Vegetation history and past management.

As in much of southern Wisconsin, the vegetation of the site at the time of settlement was fire-maintained oak savanna. When the Arboretum acquired the Grady Tract in 1940, the SW section had been under cultivation for many years. Lilacs and an old foundation in the north part of the site are clues to the location of a farmstead, near a single very large bur oak. In the 1950's, bushels of acorns were planted throughout most of the SW Grady Tract under the direction of Jake Jacobson, Arboretum Supervisor. The acorns were not distributed evenly. Roughly one-third of the area was planted densely, as if for a forest; this portion is treated in the Southern Forests section of this plan. (See "Grady Planted Oaks", p.S-6) In the remainder of the area, patches of widely spaced acorns were planted, as if for an oak opening, or savanna. At the north end, a narrow, 500ft long strip of white and red pine was planted as part of an experiment, and the trees were allowed to grow after the experiment ended.

No further management took place until the mid 1980's; meanwhile honeysuckle and buckthorn became rampant, making it difficult to walk through much of the area. Large clones of black locust apparently began at the edge of the planted oak woods and extended into the more open adjacent areas, while box elder, cottonwood, American elm and other pioneers of disturbed wet places grew thickly along the drainageway. Two small areas, one in the south half and one in the north, remained relatively open.

In the mid 1980's, control measures began in the relatively open area to the south. Honeysuckle, buckthorn and other undesirable woody species were cut and the stumps herbicided.

The effort was extended along the periphery of the opening, especially toward the east, with the aid of a heavy duty brush cutter obtained from DNR. By 1990 the area cleared of unwanted woody species was approximately 10 acres. In 1989 some seeding of prairie species was done in experimental plots set up in the cleared area. (The experiment was designed to test site preparation methods.)

Control of buckthorn and honeysuckle in the north unit of the savanna began in late fall 1990.

General description of the present vegetation.

Of the 35 acres that have the open grown oaks, over half are severely overgrown with various combinations of buckthorn, honeysuckle, and trees not appropriate for oak savanna. Where honeysuckle and buckthorn are dense, the ground layer is sparse.

The ground layer of the more open areas is similar to that of other abandoned farm fields, with weedy grasses such as brome grass and Kentucky and Canada bluegrass, and weedy forbs, including wild parsnip, common goldenrod and horseweed. On the higher, sandier soils, several species of dry prairies are found; like the plants of nearby West Grady Knoll, these are likely to be remnants of presettlement vegetation. An occasional prairie plant is found on the less sandy soils; these are mainly pioneer species and probably have started from seeds blown in from nearby Greene Prairie.

The planted oaks vary in size; those that have grown well are 20-30ft tall and have well-developed round crowns, but there are many smaller individuals as well. The spacing varies also, with single trees and groves of trees interspersed with areas having no trees. White, bur, black and red oaks are represented.

The red and white pines planted in a row at the north are large and uniformly spaced; ground layer beneath the trees is sparse.

A grove of large silver maples is growing along a shallow draw south and west of the pines. These appear to have been planted, but there is no record in the files of such a planting in that area.

Special features and values.

This area has the potential to be the largest restored savanna in the Arboretum; it will resemble the presettlement landscape of the area.

Young (30-40years old), vigorous, widely spaced, open grown oaks present a unique opportunity for savanna restoration.

There are opportunities along the east boundary for gradual transitions to prairie and woodland, as well as a link to the savanna on West Grady Knoll.

Remnant prairie/savanna species occur in the area.

The very dry sandy area at the northwest is one of three places in the Arboretum suitable for developing small examples of sand barren vegetation.

The area is buffered by land contour and forest from the noise of the Beltline, and has a remote wilderness quality.

MANAGEMENT

Management objectives.

Historical: A map made by Curtis indicates that the entire southwest section of the Grady Tract was to be oak forest.

Present: The area is to be savanna (oak opening grading into oak barren), and will be part of a mosaic of prairie, savanna and oak woodland that will cover all of the Grady Tract south and east of the Kettle Hole Forest.

Short-term management.

White and red pine strip: Remove all trees.

Silver maples adjacent to pines: Remove; treat stumps.

Black locust: Eradicate, using best known method.

Leafy spurge: Check for leafy spurge every year. Eradicate any found. It is very important to prevent leafy spurge from obtaining a foothold as it has in the adjacent Grady West Knoll.

Control of honeysuckle and buckthorn: Experiment with cutting, fire and herbicide treatment, alone or in combinations, to determine the best site preparation for planting prairie and savanna species. (Since future maintenance by fire is anticipated it should not be necessary to completely eliminate all individuals of the exotic shrubs prior to planting.) Use the technique(s) selected to expand the north and south clearings.

Planting: Open areas should be planted with a mix of prairie seeds matched to moisture level. A special mix of

savanna species should be used under the trees. Many of the savanna species are uncommon; it will be necessary to grow them in a nursery established in the Arboretum in order to obtain enough seeds. The seeds used to start the nursery should be gathered from prairies and woods in Dane County, or as close to the county as possible.

Prescribed burns: Divide area into burn units. Burn according to planned schedule. Allow fire to burn through any remaining trees and shrubs to the firelanes and across the drainageway at will.

Long-term management.

Continue to monitor and eradicate leafy spurge.

Prescribed burning will be the main management procedure. This area will be part of the fire-managed mosaic of prairie, savanna and oak woodland that will cover much of the Grady Tract. Boundaries between savanna and woods will be gradual and subject to natural fluctuations.

If fire is not effective in opening up the trees along the drainageway and along the firelanes, cut and remove non-oaks. Plant widely spaced swamp white and bur oaks along the drainageway, and appropriate wet-mesic prairie species if needed.

RESEARCH

Research completed or in progress.

Glass, Kline. Comparison of burning, mowing and cultivating for site preparation for prairie planting. In progress.

McClintock, Taylor, Kline. 1989. Baseline data for Southwest Grady. Trees, shrubs. In Arboretum computer files.

Kline, Glass. Comparison of cutting, burning and herbiciding to prepare site infested with honeysuckle and buckthorn for savanna planting. In progress.

Leach, Mark, and T. Givnish. Study of savanna restoration. In progress.

Research opportunities.

Management-related studies needed: Life histories and propagation techniques for savanna species. Periodic monitoring as follow-up to baseline study. Animal populations in SW Grady

Savanna before and after restoration. Comparison between oak species of the effects of fire on growth. Success of oak seedlings as related to ground cover.

General ecological studies: Comparisons of the growth and physiology of open grown and forest grown oaks of four species. Use of savanna and young oak woodland by birds and mammals. The occurrence of prairie, savanna and oak woods species along a light gradient.

Action required for continuing long-term research projects.

Maintain stakes marking quadrat at each grid point.

Degree of manipulation appropriate.

The area is suitable for soil studies involving manipulation, for introduction of appropriate plants and animals, and for mowing, burning, clipping and competition studies.

TEACHING

Value.

This should be a prime teaching area. Classes will be able to experience being within a savanna similar to those existing in the area before settlement. The quiet wilderness atmosphere will allow listening for bird songs and other natural sounds.

Accessibility.

The area is within easy walking distance from the parking lot on Seminole Highway. Two new E-W trails cross the savanna, one at the south and one at the north; each goes through open savanna and oak woods.

PUBLIC USE

Sensitivity, suitability.

The trails are very suitable for hiking, birdwatching and nature study and the quiet setting will have special appeal for such activities. The firelanes along the boundaries are suitable for skiing and running.

Protective measures.

It will be important to discourage skiing and running on the new E-W trails, which would make them less suitable for teaching and quieter, more leisurely use by others.

WINGRA OAK SAVANNA

INTRODUCTION

Site description.

Location: 21:13,14

Size: 15 acres; 6 hectares

Slope and aspect: Level (in part), moderately steep SE slope (in part)

Soil: Silt loam

Vegetation history and past management.

The presettlement vegetation was a fire-maintained oak opening with widely spaced, open-grown bur oaks and a ground layer of prairie grasses and forbs in unshaded areas, and savanna or woods edge herbs and shrubs beneath the trees. The oak opening extended down the slope to a large sedge meadow bordering Lake Wingra. After settlement, some factor other than fire kept the forest from developing, so that the open-grown bur oaks were not shaded by forest trees. Presumably that factor was grazing, but grazing light enough to prevent severe root damage to the oaks.

After the area became part of the Arboretum, Ho-nee-um Pond was dug, the Wheeler Council Ring was built into the east end of the slope, where a half-circle of bur oaks provided an esthetic background, and the level area near Monroe Street was put into lawn and parking lot. Shrubs were planted along the edges of the lawn, and a screen of planted and volunteer woody species developed between the lawn and Monroe Street. With neither fire nor mowing to keep woody invaders under control, the bur oaks on the slope soon were competing with a variety of weedy pioneer trees, particularly box elder, as well as assorted shrubs and vigorous herbaceous weeds. The sedge meadow to the south, impacted by the dredging of the pond and by run-off from construction of roads and homes, was invaded by cottonwood, box elder, honeysuckle and buckthorn.

In 198? the City installed a bicycle trail roughly parallel to Monroe Street, running across the lawn and continuing east to Arbor Drive. The trail was considered necessary because there was at the time no sidewalk along the street.

For many years sporadic efforts were made to cut box elders and other trees under the bur oaks on the slope, including those

in the Council Ring area. In the mid-1980's a major effort succeeded in eliminating most of the competing trees, as well as many of the shrubs. Trees and shrubs between the lawn and Monroe Street and around the parking lot were removed.

In 1992, volunteers from the Monroe Street neighborhood began to participate in restoration of the Wingra Oak Savanna through the Arboretum's Earthcare program by removing brush and preparing areas for planting.

Wingra Oak Savanna includes the area between Monroe Street/Arbor Drive and the lake, stretching from the white cedar planting at the northeast to Marion Dunn Prairie at the southwest. Within this strip, the area near the Council Ring and parking lot is managed as an Historic Arboretum Landscape Area; a separate, more detailed plan for that area is available.

General description of present vegetation.

The higher, level area is in lawn; some of the open grown oaks are within the mowed area. Most of the oaks are on the southeast-facing slope leading down to the level area along the pond. They are impressively large trees with the characteristic branching of old bur oaks. Some have lost branches and a few have died. The understory on the slope is a mixture of shrubs, weeds, and forest herbs.

The level area between the slope and the pond, where there was sedge meadow before the pond was dug, is now a weedy woods of box elder, cottonwood, willow and black locust, with a shrub layer of buckthorn and honeysuckle. Southeast of the Council Ring a lawn covers the end of the slope and extends across the level area to the pond.

A small woods dominated by black cherry and box elder has grown up in the area adjacent to Marion Dunn Prairie.

Special features and values.

The grove of magnificent open grown bur oaks is an outstanding feature. There is also an unusually large open-grown hackberry.

Ho-nee-um Pond provides the opportunity to have the savanna grade into an emergent marsh community.

A spring below the Council Ring flows throughout the year, creating a small stream that empties into the pond.

Ho-nee-um Pond is the largest settling pond in the Arboretum. It was built by the CCC crew in the 1930's. It

provides an opportunity to have the savanna grade into an emergent marsh community.

There is the potential for an excellent view of the pond and lake.

The area is considered one of the best birding locations in the Madison area.

The area is highly visible from a heavily used city street.

MANAGEMENT

Management objectives.

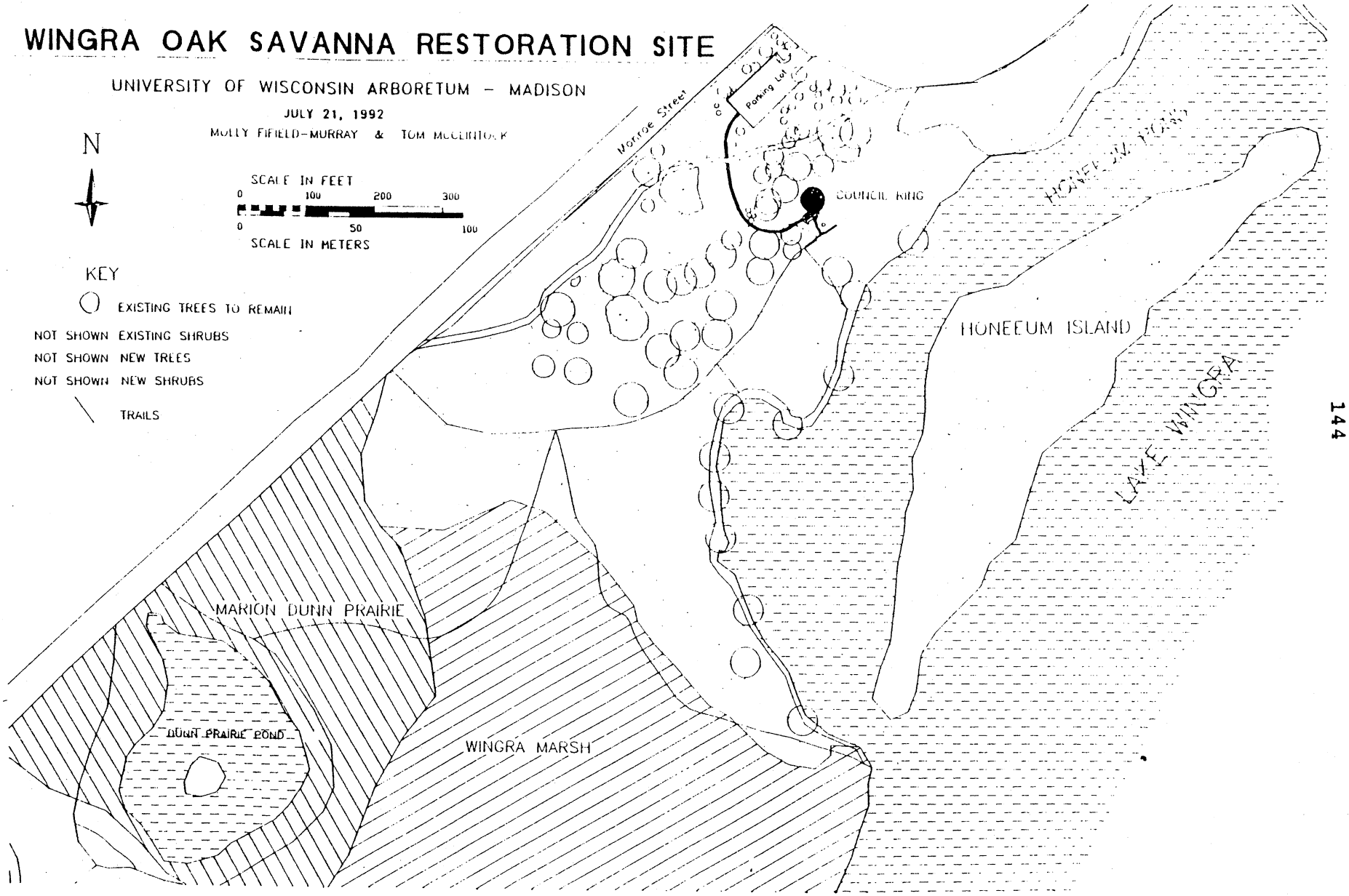
Historical: The first landscape plan for Arboretum land along Monroe Street shows the lawn and shrub groupings in the upper, level area. The oaks on the slope are shown, but the groundlayer is not specified.

Present: The area is to be bur oak savanna (oak opening), with savanna groundlayer under the trees grading into open prairie in the present lawn areas. The savanna/prairie mosaic will extend southwest to Marion Dunn Prairie and northeast to the white cedar planting. Toward the pond the bur oak savanna will grade into a wetter savanna with swamp white oaks, interspersed with open wetland (wet prairie or sedge meadow, depending on soil conditions after the weedy trees are removed). Emergent vegetation will be encouraged in the pond to add to the gradient of wet communities. Views of the lake will be an important feature.

Short-term management.

Cut and treat with herbicide all woody shrubs and small trees on the slope beneath the bur oaks. (A few individuals of gray dogwood, hazelnut and other native shrubs that once grew in the savannas might be left, but a thick growth of shrubs in the early stages is likely to make it difficult to establish herbaceous species.) Eradicate trees and shrubs in the level area between the slope and the pond. The trees closest to the slope are especially important because they shade the slope too much. Plant appropriate savanna, wet prairie and sedgemeadow species, depending on how wet the area is after shrubs and trees are removed. These communities will grade into shrub carr south of the pond.

Clear-cut the woods between the lawn area and Marion Dunn Prairie. Treat stumps. Plant tallgrass prairie seeds. Plant approximately five bur oaks, well spaced.


WINGRA OAK SAVANNA RESTORATION SITE
UNIVERSITY OF WISCONSIN ARBORETUM – MADISON
JULY 21, 1992
MOLLY FIFIELD-MURRAY & TOM MCCLINTOCK
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SCALE IN FEET
0 100 200 300
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SCALE IN METERS
KEY
EXISTING TREES TO REMAIN
NOT SHOWN EXISTING SHRUBS
NOT SHOWN NEW TREES
NOT SHOWN NEW SHRUBS
TRAILS
Monroe Street
Parking Lot
COUNCIL RING
HONEEUM ISLAND
LAKE WINGRA
MARION DUNN PRAIRIE
DUNN PRAIRIE POND
WINGRA MARSH

Allow the grass in the lawn areas to grow without mowing, in order to increase the fuel load. Burn both sites. Plant with a mix of mesic prairie species in the open area, and with appropriate savanna species under the trees.

Determine what factors have discouraged emergents in the pond and what is needed to provide suitable habitat. Develop an emergent community of bullrushes, arrowleaf, wild rice etc. This may require creating more gradual edges and controlling carp.

Begin prescribed burning. Monitor the plantings for troublesome species, especially leafy spurge, and undertake control measures if any are found.

Long-term management.

When the planted oaks grow large enough to begin to shade out the prairie plants, introduce savanna species under the trees.

Prescribed burning will be the main management procedure. Some parts of the area may need further cutting and/or spot treatment with herbicide in addition to burning.

Additional species may be added to increase the diversity of the plantings.

Continue to monitor for troublesome species, especially leafy spurge, and eradicate before the population expands.

RESEARCH

Research completed or in progress. None

Research opportunities.

Management-related studies needed: Baseline and follow-up monitoring studies of the savanna planting. Expanded studies of the life history and cultural requirements of species that fare poorly, or well, in the planting. Comparison of bird use of the area before and after restoration. Effect on bur oaks of re-establishment of savanna understory. Effects of re-establishment of savanna ground layer on soil moisture and nutrients, and on the quantity and quality of surface run-off. Response of a degraded sedge meadow to removal of invading trees and shrubs. Factors limiting emergents in Ho-nee-um Pond and how to change them.

Action required for continuing long-term research projects.

None

Degree of manipulation appropriate.

Generally no manipulation unless related to improving management of the area. The area is small and difficult to supervise.

TEACHING

Value.

This small example of the community once so widespread in the landscape provides a glimpse of the early history of the area--This is what was here when native Americans used the nearby spring for water and the marsh below for fishing and hunting; this is the kind of scene that greeted the first settlers. The restored oak opening will be an asset for school groups exploring the history of the area and the changes made by people since settlement, as well as for making comparisons of the ecology of oak savanna with that of prairie, wetland and woods, as represented by small examples within easy walking distance.

Accessibility.

The area is immediately adjacent to a parking lot. It is also on a city bus route.

PUBLIC USE

Sensitivity, suitability.

The area is subject to heavy use, and particularly inappropriate use such as dog walking. However, the weedy state of the vegetation found on the site now is due more to past management and neglect than to present usage. As the vegetation is improved, inappropriate use is likely to have more impact. Its small size and easy accessibility could make the site quite vulnerable.

The steep slopes with silt loam soil are prone to erosion.

The area is very suitable for hiking, birdwatching and nature study, and is likely to continue to attract large numbers of people. Hikers who use the bicycle trail are at risk when fast-moving bikers go through.

Protective measures.

Unauthorized trails should be blocked soon after they appear, especially on the slopes. Official trails should be wide, comfortable and appealing.

Since there is a sidewalk along the street now, changing the bicycle trail to a pedestrian walk should be considered. Alternately, bikes could be slowed by installation of grooved pavement strips.

Dog walking and off-trail activities should be discouraged. Signs alone are unlikely to change such long-established use patterns. More intensive patrolling of the area would be desirable, but the key is likely to be education of local users.

CARVER STREET SAVANNA

INTRODUCTION

Site description.

Location: 54:1,2,7,8

Size: 8 acres; 3 hectares

Slope and aspect: Nearly level to gentle NW slope

Soil: Silt loam

Vegetation history and past management.

As in much of the Arboretum, the presettlement vegetation was a fire-maintained oak opening with widely spaced, open-grown bur oaks and a ground layer of prairie grasses and forbs, savanna or woods edge species, and woodland herbs and shrubs. After settlement it was probably kept open by grazing. After the area was acquired by the Arboretum, it was designated as a display area for native Wisconsin trees and shrubs, and some were planted, along with Ohio buckeye (for reasons not explained). Caretaking was insufficient to prevent invasion by buckthorn, honeysuckle and pioneer trees, although the Arboretum crew periodically cut trees and shrubs that threatened to shade the bur oaks.

General description of present vegetation.

Most of the 7-10 large bur oaks are clustered in the northeast section of the area. The remainder of the site has islands of planted and invading trees and shrubs with open, grassy old field patches between.

Special features and values.

The old oaks are striking; only the Ho-Nee-Um oaks are comparable in the Arboretum.

The area is easily seen from heavily used Fish Hatchery Road.

This is relatively high ground overlooking East Marsh, although at present any potential view is blocked by buckthorn and other woody invaders. Twenty years ago it was one of the best places in the Arboretum for watching woodcocks perform their mating dance.

MANAGEMENT

Management objectives.

Historical: An early planning map shows the area designated as "Woody Taxonomic Garden", and the general understanding seems to have been that it would include Wisconsin species only. No detailed plans exist.

Present: The area is to be bur oak savanna (oak opening), with savanna species under the trees grading into prairie species in the open areas. Special consideration will be given to its potential value for public education because of its location on a busy road.

Short-term management.

The bur oaks should be protected from shading pending the restoration of the site.

To prepare the site for planting, eliminate all trees other than the bur oaks, and all shrubs other than a few individuals of species known to occur in oak savannas.

Plant savanna species under the trees and prairie species in the open areas, using the expertise gained in restoring Ho-Nee-Um Savanna.

Begin prescribed burning. Monitor the plantings for troublesome species, especially leafy spurge, and undertake control measures if any are found.

Long-term management.

Prescribed burning will be the key management procedure, supplemented by cutting and/or herbicide treatment as needed.

Continue to monitor for troublesome species, especially leafy spurge, and take appropriate action promptly if any are found.

RESEARCH

Research completed or in progress.

None.

Research opportunities.

Management-related studies needed: Baseline and follow-up monitoring studies of the savanna planting. Comparisons of success of restoration, animal use of the area, etc. between this area and Ho-Nee-Um Savanna.

General ecological studies: Soil development under savanna trees and adjacent open prairie, effects of road on vegetation.

Action required for continuing long-term research projects.

None.

Degree of manipulation appropriate.

Soil studies, plant harvest for biomass measurements, competition studies involving plant manipulation.

TEACHING

Value.

This area will have little appeal for classes because of the lack of parking and other facilities, the noise of Fish Hatchery Road, and the small area to be explored.

Accessibility.

Lacks bus parking and is far from the McKay Center.

PUBLIC USE

Sensitivity, suitability.

The area is suitable for nature study and bird watching, although there is no official trail at present. It is expected that most use will be by neighbors.

Protective measures.

A loop trail may be necessary if use becomes too heavy, or, temporarily, during the active restoration phase.

OPEN WETLANDS

Table of Contents

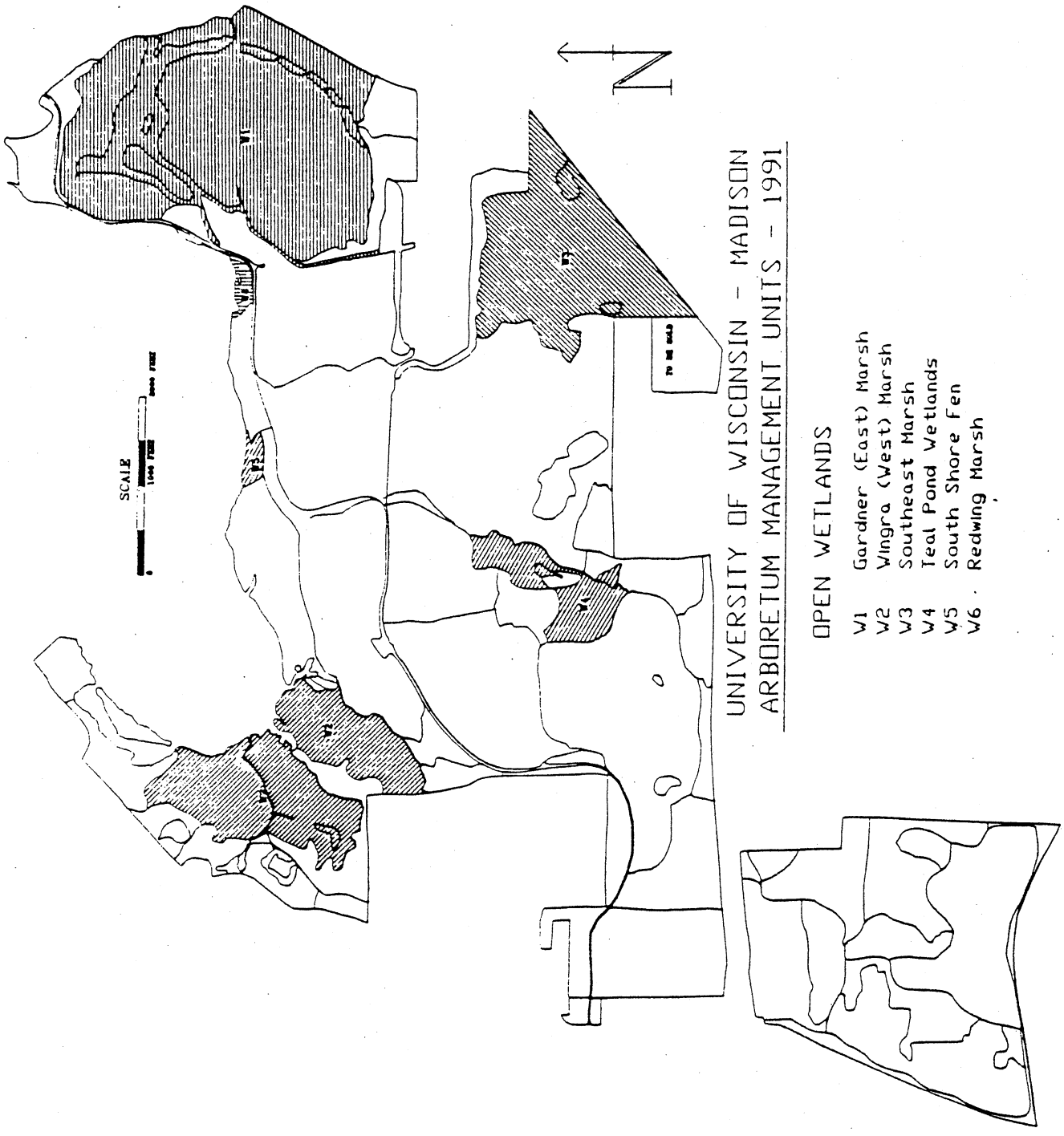
OPEN WETLANDS

List of Open Wetlands showing size and community type

	Acres	SC	SS	FN	AQE
Gardner Marsh	174*	x	x		x
Wingra Marsh and Fen	72*	x	x	x	x
Southeast Marsh	72*	x	x		
Teal Pond Wetlands	21	x	x		x
South Shore Fen	2.7	x		x	
Redwing Marsh	2.6				x

*Includes some upland

SC=shrub carr SS=southern sedge meadow
FN=fen AQE=emergent aquatic


N
SCALE
UNIVERSITY OF WISCONSIN - MADISON
ARBORETUM MANAGEMENT UNITS - 1991
OPEN WETLANDS
W1 Gardner (East) Marsh
W2 Wingra (West) Marsh
W3 Southeast Marsh
W4 Teal Pond Wetlands
W5 South Shore Fen
W6 Redwing Marsh

OPEN WETLANDS:
DEEP WATER MARSH, SEDGE MEADOW, FEN, SHRUB CARR BOG

Before settlement, open (treeless) wetlands were widespread in the glaciated areas of Wisconsin, where poorly drained depressions provided diverse hydrologic conditions supporting a variety of wetland vegetation types. Open wetlands were also found along rivers with broad valleys in both glaciated and nonglaciated areas. More than two-thirds of the original wetlands have been destroyed by draining or filling; many of those remaining, including those in the Arboretum, have been drastically altered and degraded by human activity.

Open wetlands are among the most productive communities in the world. The vegetation provides habitat for an abundance of animals, including mammals, birds, fish, amphibians and reptiles. Upland predators often use open wetlands for feeding, and flocks of waterfowl find protection and food there on long migratory flights.

The type of vegetation found in a particular wetland depends in large part on water depth, which can fluctuate over time due to long-term fluctuations in climate, or to fire (which can destroy peat and thereby effectively raise water level) or to disturbances such as beaver dams or agricultural practices. Fire may also influence wetland vegetation directly by preventing woody invasion. Textbooks often treat wetland vegetation types as successional seres leading to a predictable forested endpoint. There is little evidence of this in nature; the time scale involved appears to exceed that of climate changes or natural disturbance frequencies.

The deep water marsh, or emergent community, is found in standing water up to 3-4ft deep. The plants are rooted in the soft bottom mud and have leaves above the water surface. Some deep water marshes are dominated by monotypic stands of cattail (Typha latifolia, T. angustifolia, and their hybrid); while others are more diverse. Besides cattail, typical plants include several species of bulrush (Scirpus acutus, S. validus and others), arrowhead (Sagittaria latifolia), pickerelweed (Pontederia cordata), and burreed (Sparganium eurycarpum). The Arboretum has no good example of a diverse emergent community remaining today, although there are rather small areas of cattails in Wingra and Gardner Marshes, and in Redwing Marsh.

Sedge meadows are found where water is at or near the ground surface much of the year, but fluctuates seasonally and may be quite dry in summer. The most common dominants are sedges (Carex stricta, C. lacustris, and others), bluejoint grass (Calamagrostis canadensis) and cordgrass (Spartina pectinata). Tall, late-blooming composites may be an important element,

particularly on disturbed sites. The community can often be recognized by the striking microrelief of sedge tussocks, a growth form that is advantageous where water levels fluctuate. Peat accumulates since the rate of production greatly exceeds that of decomposition in these frequently waterlogged soils. Sedge meadows grade into wet prairie on less wet sites, a transition characterized by a decrease in the cover of sedges and an increase in that of grasses.

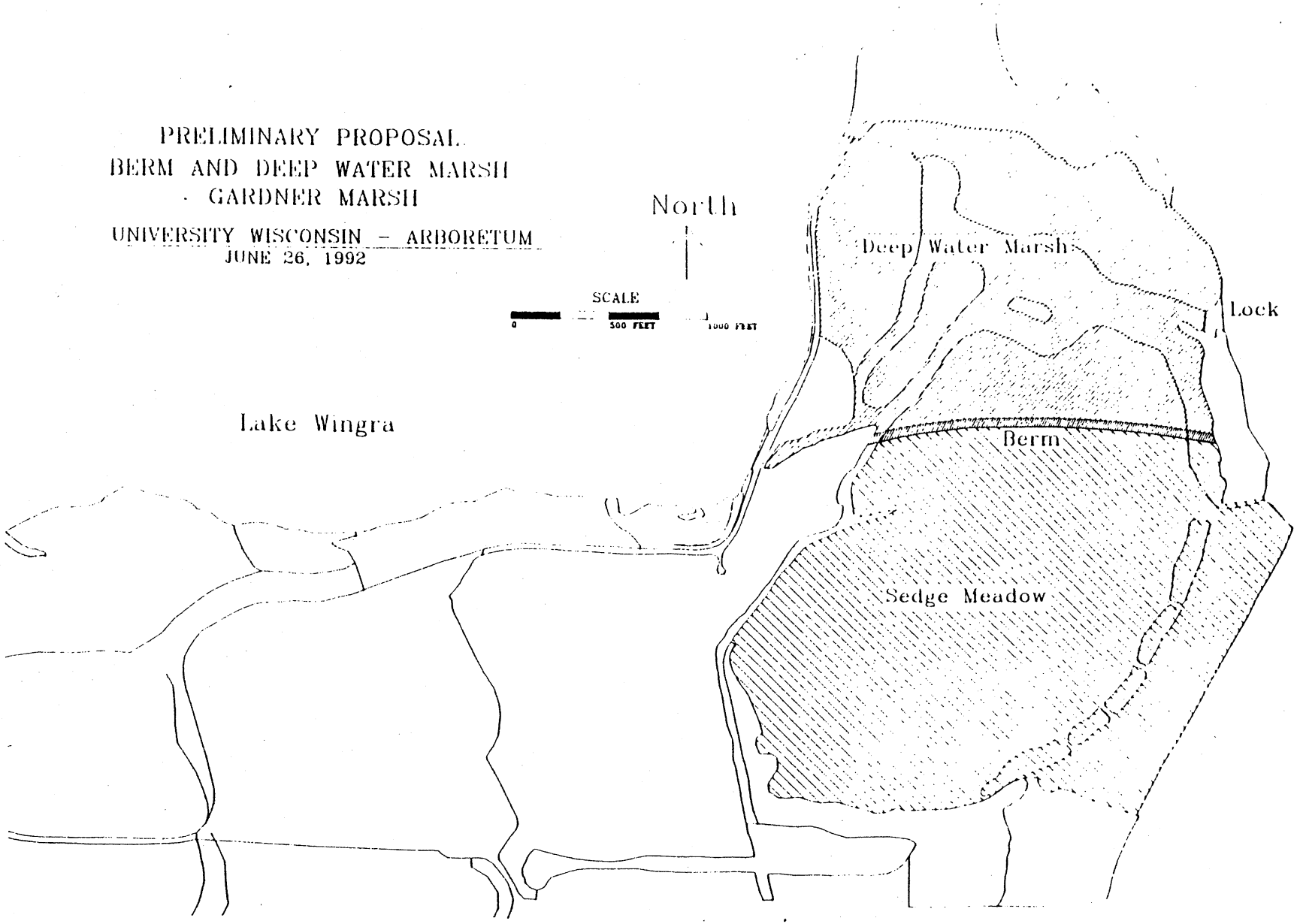
Small areas of fairly good quality sedge meadow can be found in Wingra and Gardner Marshes, in the shrub thicket below Wingra Woods, in the Teal Pond lowland area, and in the wettest parts of Curtis Prairie. Most of the Arboretum's sedge meadows have been invaded by nonnative shrubs and reed canary grass. In Gardner Marsh, lowered water levels have resulted in loss of peat through oxidation.

Because they are usually dominated by grasses, fens may be considered a unique type of wet prairie. Several rare plant species grow only in fens, and botanists usually identify a fen by the presence of these species. Fens develop on sites with special hydrological and chemical characteristics, usually a site when there is upwelling ground water that is rich in calcium and has a high pH. They may also be found along the shores of marly lakes. Never very widespread because of their dependence on somewhat unusual conditions, fens have become quite rare in Wisconsin since settlement. In the Arboretum there are two small natural fens, both severely degraded and invaded by nonnative buckthorn. In addition, there is a wet area in Greene Prairie where fen species, both remnant and planted, are growing well.

Sedge meadows, wet prairies and fens may be invaded by shrubs, particularly if there has been sedimentation or other disturbance. Wet communities where the shrubs are dominant are known as shrub carrs. Shrub carrs have become more common since settlement because of lack of fire, increased soil disturbance, and lowered water levels. Originally the common shrubs were red osier dogwood (Cornus stolonifera) and willows (Salix discolor, S. petiolaris, S. bebbiana and others), but these areas have been very vulnerable to invasion by two introduced buckthorns, Rhamnus cathartica and R. frangula. These newcomers develop into stands that are probably much more dense than was found in presettlement shrub carrs, and the ground layer may be completely lacking. Overgrown shrub carrs are common in the Arboretum wetlands.

Bogs are wetlands dominated by sphagnum mosses. The water in a bog is acidic and low in nutrients and oxygen. Bogs generally occur in cool climates and are much more common in northern than in southern Wisconsin. The sphagnum puts on new growth each year, and because decay is very slow in the cool, low oxygen water, the dead sphagnum accumulates, forming sphagnum peat that may be many feet deep. Specialized plants that can

resist being engulfed by the peat and can tolerate the water conditions and the cold temperatures grow in the peat, among them Ericaceous shrubs, sedges, pitcher plants, sundews and several orchid species. A few stunted black spruce and tamarack trees may be found in the bog. The sphagnum, intertwined with the roots of the shrubs, may form a floating mat extending from the shore of a lake--a kettle hole bog-- or it may simply fill a shallow glacial lake bed. The Arboretum has no site with natural conditions suitable to support a bog. It might be possible to create a bog garden where suitable conditions can be maintained on a small scale.


PRELIMINARY PROPOSAL
BERM AND DEEP WATER MARSH
GARDNER MARSH
UNIVERSITY WISCONSIN – ARBORETUM
JUNE 26, 1992
North
SCALE
0
500 FEET
1000 FEET
Deep Water Marsh
Lock
Lake Wingra
Berm
Sedge Meadow

GARDNER MARSH (EAST MARSH)

INTRODUCTION

Site description.

Location: 26,27,32,33,46-48

Size: 174 acres; 70 hectares

Slope and aspect: Level

Soils: Muck, peat, marl

Vegetation history and past management.

Before 1900, Lake Wingra was approximately 0.3m higher than at present and the marsh was an extension of the lake, with no barrier between. The vegetation included a diversity of wetland communities, including deepwater marsh with cattails and bulrushes, and wet meadows dominated by sedges and grasses. Wild rice was abundant. In 1905 and 1906 the first major impact on the site occurred when a channel was dredged from the Fish Hatchery bridge to a point near Randall Avenue-along the route of what is now considered upper Wingra Creek. Spoils from the dredging were deposited along the edge of the adjacent marsh. A dam was built near the Fish Hatchery Road bridge to maintain the lake at the original level.

Between 1914 and 1920, the Lake Forest Land Company attempted to develop the lowlands at the east end of the lake, including the areas now called Lost City Forest and Gardner Marsh. The marsh was isolated from the lake by construction of a dike (where Arboretum Drive now borders the lake) and then was drained to a level lower than the lake. Lagoons were dredged, a strip of developed lots (the Martin Street/Carver Street area) cut Gardner Marsh off from the marshland to the south, and an attempt was made to build a road running northeast through the marsh in the direction of the Capitol. The company failed in 1920, but the extreme degradation of the marsh wrought by their efforts lingers.

In 1917 a breach in the dike lowered the lake level by one meter. Two years later a new dam was built closer to the lake outlet, and the lake was brought up to its present level, 0.3m lower than the original level. Separated from the lake by the dike, water in the marsh is 0.3 to 0.6m below the lake level.

Honeysuckle and buckthorn first appeared on the dredge spoils, then moved out to engulf large areas of the marsh where it was no longer wet enough to exclude shrubs. Exposed soil along the road on the dike allowed invasion by cottonwoods. A monotypic patch of nettles developed in the southern section and persisted for many years; it was thought to have been the result of a peat fire. A once thriving population of white ladyslippers (Cypripedium candidum) disappeared. (Some of these had been previously transplanted to Greene Prairie, where they continue to do well.)

After Arboretum acquisition, channels in the marsh were redredged and small ponds for limnological research were dredged in the southeast part of the marsh. Spoils from these activities also were rapidly invaded by buckthorn.

In recent years, Arboretum management of the marsh has been largely limited to occasional prescribed burns of selected areas, the most recent ones in 1972, 1976 and 1983. The areas selected were those with enough fine fuel to burn well, and included a large area in the south-central part and a smaller area at the northeast.

General description of the present vegetation.

Widening bands of dense, tall, almost impenetrable buckthorn outline much of the perimeter of the marsh and extend along the channels, often in nearly pure stands, but sometimes growing with honeysuckle, red osier dogwood or willow. Various combinations of shrubs also form patches in the interior. A line of tall cottonwoods separates the road from the northwest section of the marsh, a section distinguished by a monotypic stand of cattail. Most parts are drier, and the better areas are dominated by sedges, bluejoint grass, or a mixture of goldenrods, asters and other tall composites. Other, presumably more disturbed areas are dominated by reed canary grass and/or nettles. Where dredged marl was spread out (in parts of the northeast section) the marsh vegetation includes some species often associated with fens or with the shores of marl lakes. An example is a species introduced by planting, shrubby cinquefoil (Potentilla fruticosa), which has spread to fill a substantial area.

Special features and values.

The area is large, relatively remote and attractive to wildlife. If it contained a more diverse open wetland vegetation it would attract more diverse birds, mammals and other animal life.

Of the wetlands in the Arboretum, this marsh appears to have the greatest potential for water level manipulation, and for creation of an emergent community, a type presently poorly represented.

MANAGEMENT

Management objectives.

The area is to be an open wetland, with varied natural vegetation, including a diverse emergent community. It will be important to establish a water level control system and to restore a connection with the lake if possible.

Short-term management.

Monitor for purple loosestrife and dig out any found.

Use prescribed burns, supplemented by cutting and herbicide, to maintain and enlarge sedge meadow openings and to eradicate trees and exotic shrubs on the spoil berms, concentrating on the berms along the channels and the experimental ponds.

Leave a strip of shrubs and trees along the east and south boundaries to serve as a screen, but eradicate heavily fruiting female buckthorns.

Long-term management.

Monitor annually for purple loosestrife and dig out any found.

Continue prescribed burns to control woody invasion.

Develop a water level control system and create a 30 to 40-acre deep water marsh in the north half of Gardner Marsh. This must be accomplished without flooding the Martin Street/Carver Street area; consultation with hydrology and engineering experts will be essential. One possible approach would be to separate water flow across the northern half of the marsh from water flow across the southern half, and allow the north half to be connected to the lake via controlled inlets, creating conditions for a deep water marsh.

Improve the quality of the sedge meadow in the southern half of the marsh by keeping the water level as high in summer as it presently is in spring. This could be accomplished by using the Beld Street weir or by means of a dam at the outlet. That level is not troublesome to the residents on Carver/Martin Street, and would be helpful to the sedge meadow. (See Friedman report.) The two wetland areas would be separated by a berm and have separate outlets to Wingra Creek. The berm might be designed to support a trail and viewing platforms. Preliminary discussions with hydrologists/engineers indicate that such a project may be feasible.

RESEARCH

Research completed or in progress.

Kogler, Barbara. M.S. study of red osier dogwood invasion.

Friedman, Jonathan. M.S. study of a former fen area in East Marsh, with recommendations for management.

Irwin, Harriet. M.S. study of vegetation of East Marsh.

Baumann, Paul C., James F. Kitchell, John J. Magnuson and Terrence B. Kayes. 1974. Lake Wingra, 1837-1973: a case history of human impact. Wisconsin Academy of Sciences, Arts and Letters 62:57-94.

Goodroad, L.L. and D. R. Keeney. 1983. Nitrous oxide emissions from forest, marsh and prairie ecosystems. One of the sites was at SE corner of East Marsh. Copy of manuscript on file at the Arboretum.

Studies of small mammals and/or birds by Robert McCabe.

Research opportunities.

Management-related studies needed: Hydrology of the marsh and how it would be affected by the proposed changes. Baseline data for before-and-after comparisons of plants and animals.

General ecological studies: Use of an urban wetland by birds and mammals. Effect of the marsh on quality of run-off. Changes in depth of peat over time. Map of peat, muck, marl soils or depth of peat.

The small ponds are available for limnological studies.

Action required for continuing long-term research projects.

None.

Degree of manipulation appropriate.

Good location for manipulative studies. Introduction of nonnative species should be prohibited.

TEACHING

Value.

If the marsh is improved as proposed this will be an extremely valuable site for learning about wetlands. It will include the only large emergent community in the Arboretum.

Accessibility.

It is presently very inaccessible, with a barrier of buckthorn and the entrance located on very busy Fish Hatchery Road.

PUBLIC USE

Sensitivity, suitability.

The present infrequent use by individuals or very small groups moving through the marsh without trails seems to do little damage, and provides a wild experience for those willing to penetrate the buckthorn barrier. Heavier use would damage vegetation and encourage the spread of exotic weeds.

Protective measures needed.

At present the buckthorn discourages entry. If the marsh improvement plan is carried out, walking off the trail should be discouraged by other means.

WINGRA MARSH AND FEN (WEST MARSH)

INTRODUCTION

Site description.

Location: 38,39,41,42,59

Size: 72 acres; 29 hectares (includes some upland)

Slope and aspect: Mostly level; very gradual NW facing slope at the south end.

Soil: Peat and muck.

Vegetation history and past management:

Before 1900 the vegetation was sedge meadow, grading into a zone of emergents along the shore of the lake, which was 0.3m higher than its present level. Upwelling, calcium-rich water supported a fen part way up the gradual slope; the fen contained unusual species such as the small white ladyslipper (Cypripedium candidum). It is likely that the sedge meadow and the fen were mowed for hay after European settlement of the area.

Urbanization of the uplands draining into the marsh caused heavy sedimentation, especially where storm sewer outlets fed directly into the marsh. The storm water cut channels, one as deep as ten feet, and the material displaced was subsequently deposited farther out in the marsh, along with soil, sand and debris from city streets. Reed canary grass, as well as trees and shrubs, colonized the sediments and spread into large areas of the marsh. At first the invading woody species were native, but before long two exotic buckthorns, common buckthorn (Rhamnus cathartica) and fen buckthorn (R. frangula) dominated large areas, and European alder (Alnus glutinosa), a species planted in the Duckpond area upstream, began to appear along the drainageways.

Prescribed burns have been used in attempts to control woody invaders. The entire marsh and fen were burned in 1972 and in 1976; earlier burns are known to have occurred, but were not recorded.

Several observers noted a dramatic increase in shrub cover in 1983, possibly due to summer drought.

In 1983, holding ponds (Ponds 5 and 6) were built at two storm sewer outlets to protect Wingra Marsh (and the lake) from further sedimentation and other damaging effects of the runoff.

The fen has been particularly vulnerable to woody invasion, perhaps because of reduced water flow resulting from pumping by municipal wells. Attempts to control the invasion began with a study initiated in 1937 by John Curtis, in which he showed excellent growth and flowering response of white ladyslippers after the fen was mowed five years in a row. Curtis recommended mowing as a management tool. He noted that bog birch was a major invader, but did not mention buckthorn.

No record was made of subsequent mowing, and apparently mowing was discontinued at least by the early 1970's because of concern over ruts made by heavy machinery when the peaty soil was soft.

Jim Zimmerman led groups of students and other volunteers on brush-cutting forays in the fen intermittently in the 1970's and 80's; by then fen buckthorn was the most dominant species. The fen was burned in 1980, 1984, 1987, and 1988. In 1989, a major effort to control woody invasion in the fen by cutting and judicious use of herbicide was initiated. It is expected that this will continue through the winter of 1991-92.

General description of the present vegetation.

Trees and shrubs, especially buckthorn, form a dense wide border around the marsh and along the drainageways; they also appear in scattered patches elsewhere. These in turn are bordered by stands of reed canary grass and/or nettles. Cattail, bulrush (Scirpus validus), giant reed (Phragmites communis) and several species of sedges (including tussock formers such as Carex stricta) are found in various combinations in the wettest areas. Areas with somewhat shallower water support tussock sedges, bluejoint grass (Calamagrostis canadensis), marsh marigold (Caltha palustris), marsh violet (Viola cucullata) and wild iris (Iris virginica var shrevei). More disturbed and/or drier areas have sedges such as C. hystricina and C. vulpinoidea, which are tolerant of some disturbance, and many large composites.

In the fen, some of the area recently cleared of shrubs has developed a ground layer of tall meadowrue (Thalictrum dasycarpum), willow herb (Epilobium sp), marsh milkweed (Asclepias incarnata) and several composites, but there are patches containing mostly buckthorn seedlings. Approximately 60 white ladyslipper plants were observed in 1990 following the massive shrub removal and stump treatment; none flowered that year, but in 1991 most of those had flowers. At the north end of

the fen, where the shrub invasion had been more recent, several plants with multiple flowering shoots were observed.

Special features and values.

There will be a sweeping view of the wetland and the lake after removal of woody invaders.

It is an excellent place to observe changes in vegetation along a moisture gradient extending from the prairie at the south to the lake at the north.

The area is large and diverse enough to provide habitat for a variety of wetland animals; many have been observed there.

Fens are among the rarest of communities in southern Wisconsin today, and Wingra Fen before buckthorn invasion was described by Curtis as the best in Dane County.

The population of small white ladyslipper is one of the few remaining in the state.

MANAGEMENT

Management objectives.

Historical: Objectives for specific wetlands were not part of the original plan, but it is clear that some of the early policy makers had an interest in managing for wildlife. Curtis stressed the importance of maintaining the populations of white ladyslipper and other unusual plants in the fen.

Present: Maintain and/or develop high quality open wetland communities suitable for the gradient of moisture conditions present on the site. Maintain and improve the quality of the fen.

Short-term management.

Search annually for purple loosestrife; eradicate any plants found.

Use a combination of mowing, cutting, herbicide application and burning to control or eliminate woody invaders in the fen. Eliminate all female individuals of buckthorn in a buffer strip around the cleared area as an aid in preventing reinvasion. Caution: Reed canary grass presently dominates the strip between

Wingra Woods and the fen. It is possible that the dense buckthorn in the fen has prevented the reed canary from spreading into the fen; this edge should be monitored carefully after the strip of buckthorn next to the reed canary is removed, and appropriate action taken. Appropriate action might include use of herbicides, installation of a strip of plastic or even temporary use of male buckthorns to shade out the advancing reed canary.

Locate and eradicate any individuals of European alder invading the wetland.

Use fire to set back woody invaders in the remainder of the marsh; allow these fires to burn through the woods along the drainage way running from the golf course, and through the brushy area between the marsh and Wingra Overlook Prairie. Identify patches of woody vegetation that resist burning; use girdling to kill unwanted species known to be controlled by that procedure. Selectively treat other undesirable woody species with herbicide.

Monitor pond outflow effect on vegetation and develop protective measures if needed.

Long-term management.

Use a combination of mowing, cutting, herbicide application and burning to control woody invasion throughout the marsh. All exotic species should be eliminated; the native woody species (red osier dogwood, willows, etc.) should be allowed to grow in areas selected to be shrub carr, but their density and height should be controlled by burning and cutting.

Experiment with measures to control reed canary grass; apply successful measures and eliminate reed canary.

Identify areas that need species enrichment and add appropriate species.

Identify areas that are too dry for wetland vegetation. Conduct experiments to determine how to convert these areas to prairie.

RESEARCH

Research completed or in progress.

Glenda Denniston, naturalist and local resident, has made extensive observations of wildlife in the northwest part of the marsh.

Linda Short, student of Ed Beals, did a transect study of the marsh vegetation as part of her master's degree study. She did not complete the degree.

Research opportunities.

Management-related studies needed: Control of reed canary grass. Establishment of prairie on dry peaty soils presently supporting marsh nettle. Effect of urban wells on water level.

General ecological studies: Vegetation along a moisture gradient. Use of an urban marsh by wildlife. Effect of run-off on a marsh and the effect of the marsh on the quality of the run-off.

Degree of manipulation appropriate.

Good location for manipulative studies of soil, vegetation, etc.

TEACHING

Value.

An excellent place to observe vegetation on a moisture gradient and the effects of people on marshes.

Accessibility.

There is no easy access for class groups.

PUBLIC USE

Sensitivity, suitability.

The fen is small and very vulnerable to trampling. The remaining marsh appears to suffer little damage from the infrequent visitors using the area. Heavier use would be likely to damage vegetation and discourage some of the diverse wildlife. (G. Denniston noted that her most interesting observations were made after she left the areas of pedestrian use and entered more secluded parts of the marsh.)

Protective measures needed.

None, as long as access is difficult and public use is infrequent. Traffic through the fen should noted and redirected by blocking any developing trails.

SOUTHEAST MARSH

INTRODUCTION

Site description.

Location: 67:8,9,16; 68:1-15

Size: 72 acres; 29 hectares (includes some upland)

Slope and aspect: Nearly level (very slight northerly slope), except for constructed berms.

Soil: Silty clay loam and muck.

Vegetation history and past management.

This area was part of the extensive marsh system that once surrounded the lake. It was impacted by construction of the railroad at the present south boundary, and by the Martin Street/Culver Street development, which separated it from Gardner Marsh to the north. Aerial photographs indicate that much of the marsh, with the exception of the northwest quarter, was under cultivation as late as 1958. Invasion of reed canary grass and shrubs followed cessation of farming activity. No effort has been made to control this invasion, and there have been no prescribed burns. Most of the area was acquired by the Arboretum in 1969; a small triangular addition at the south along the railroad track was added in 1983.

The marsh receives run-off from a 641-acre watershed via several storm sewer outlets at the south. Water leaves the marsh through culverts traversing Martin and Carver Streets to the north, then enters the lagoon system of Gardner Marsh. (This is the only connection between the two parts of the once continuous marsh.) Development of the watershed has increased run-off and caused overland flooding of the Martin/Carver area. In 1981, in response to concerns of the residents of that area about the flooding, an L-shaped berm 2,400 feet long was built that parallels Martin Street for most of its length, turning south at the east end. This berm creates a detention basin in which storm water is held temporarily when there is more than the culverts under the streets can carry.

In return for allowing the Town of Madison and the City of Madison to construct the berm on Arboretum land, the Arboretum asked to have the project include, in addition, construction of two settling ponds (Ponds 3 and 4) near the south boundary to remove some sediment from the stormwater before it enters the marsh. The pond berms and the long berm were allowed to

revegetate naturally for the most part, although the presence of a few prairie plants on the Pond 3 berm may be the result of some limited seeding.

General description of the present vegetation.

There is some fairly good quality sedge meadow, especially in the west half of the site. This grades into prairie in limited areas along the west boundary. Reed canary grass is abundant elsewhere. Brush invasion is most advanced along the west and south boundaries, and includes buckthorn and honeysuckle as well as natives such as red osier dogwood and willow.

Special features and values.

The area is critical for storm water control.

There is the potential to develop a vegetation gradient from sedge meadow to prairie to the savanna and woods in the adjacent Lost City Forest area.

A large erratic boulder just south of the long berm near its west end is considered a sacred rock by Native Americans.

It is a secluded, relatively unused area that may be important to wildlife.

MANAGEMENT

Management objectives.

Historical: The site was acquired because of its importance for surface water control. No vegetation plan was developed.

Present: Continue to use the site for surface water control. Encourage the development of a sedge meadow community with islands of shrub carr, grading into wet and wet-mesic prairie where soil moisture is appropriate.

Short term management.

Check annually for purple loosestrife and eradicate any found.

Initiate a schedule of prescribed burns.

Eradicate all nonnative shrubs and trees. Select one or a few areas with native shrubs to be maintained as shrub carr, but

discourage native shrubs as well as exotics in areas having the best quality sedge meadow and prairie.

Long-term management.

Continue annual loosestrife check and prescribed burns.

Convert reed canary areas to sedge meadow and prairie.

Consider reshaping the holding ponds to make them larger, more shallow, and more naturally contoured, to allow establishment of emergent aquatics.

RESEARCH

Research completed or in progress.

None

Research opportunity.

Management-related research needed: Development of techniques to replace reed canary grass with native sedge meadow and prairie species. Effect of temporary water storage on the flooded vegetation. Vegetation changes in areas receiving pond outflow water. Rate of invasion of reed canary grass into disturbed sedge meadow or vice versa.

General ecological studies: Wildlife use of areas dominated by reed canary grass compared with more diverse sedge meadow.

Degree of manipulation appropriate.

Because of the amount of past disturbance this is a good place to encourage manipulative studies.

TEACHING

Value.

Demonstration of human impact on wetlands, and attempts to ameliorate that impact.

Demonstration of vegetation types on a moisture gradient.

Accessibility.

Class groups can get a view of the marsh from the berm along Martin Street. There is no trail through the marsh.

PUBLIC USE

Suitability, sensitivity.

The trail on the long berm is a good place to view the marsh. Small numbers of individuals walking through the marsh itself, as at present, do not appear to cause damage.

Protective measures, if needed.

None at present time. Recreational use of the ponds by children has occurred and should be discouraged.

TEAL POND WETLANDS

INTRODUCTION

Site description.

Location: 65:8-11,14-16; 66:3-5

Size: 21 acres; 8.5 hectares

Slope and aspect: Nearly level. Drainage is NE.

Soil: Organic, poorly drained.

Vegetation history and past management.

The area was probably sedge meadow grading into wet and wet-mesic prairie before settlement. Teal Pond can be seen on aerial photographs taken in 1937 and there is no indication of any soil disturbance at that time, which suggests that the pond was in existence before settlement. An early observer reports that there was some dredging of the pond soon after Arboretum acquisition. Since there is no apparent deposition area, material dredged may have been removed from the site. The pond has become dry during recent drought years; it is likely that this was true before settlement also.

Early Arboretum plantings included a dense grove of eastern white cedar north of the pond (treated in this plan as part of the Juniper Knoll Uplands, p.124), and tamaracks in varying densities south of the pond. (See the section on Teal Pond Tamaracks, p.86 of this plan.) The plantings also included large numbers of alder that were intended to be the native shrub Alnus rugosa, but unfortunately were actually the invasive European tree Alnus glutinosa. Attempts to establish sphagnum bog plants in the pond were unsuccessful.

Development of the commercial area between the Arboretum and the Beltline prompted the construction of Pond 2 in 1980, to handle the anticipated increased run-off. The pond was constructed in the southern part of the marsh, destroying half of the good quality sedge meadow south of Teal Pond. Two outlets from the pond were provided, including one into the remaining sedge meadow which, it was hoped, would help prevent drying of the wetland. Planting of the pond berm followed a plan developed as a Landscape Architecture class exercise, and included prairie species along those sections of the berm adjacent to the sedge meadow. Trees were planted on the east and south, to bring the boreal forest planting down to the water's edge.

In the marsh south of Teal Pond, there has been extensive woody invasion, including native shrubs, box elder and aspen, as well as the exotic buckthorns and honeysuckle. During the 1980's, selected areas were cut once; a large aspen clone was treated with herbicide; and a major effort was made using herbicide to eradicate the European alder, which was spreading rapidly through the entire area.

In the marsh area north and east of Teal Pond there has been little or no active management other than European alder eradication. Posts have been put in to mark the route of a proposed boardwalk.

General description of the present vegetation.

The southern unit of the marsh (south and west of the firelane) includes an area of sedge meadow with fairly diverse representation of native species, well developed sedge tussocks and few exotics. This is adjacent to Pond 2 at the south. Shrubs are dense (mainly red osier dogwood and willow), but relatively short. Farther west, near the boundary with Curtis Prairie, there is a row of cottonwoods and dense tall shrubs, many not native. Reed canary grass is abundant there as well as where the marsh grades into the oak woods that separates it from Juniper Knoll. South of Teal Pond and east of the firelane is the area having most of the surviving tamaracks. It is very brushy.

There is a wide, weedy, brushy strip around most of Teal Pond edge, where stumps of the once abundant European alder are still visible.

The northern unit has patches dominated by bluejoint grass, a few small areas of sedges and bulrushes, and some typical sedge meadow forbs. Surprisingly, there are a few individuals of white ladyslipper (Cypripedium candidum), an uncommon orchid often associated with fens. There are large areas of reed canary grass, and woody invasion is extensive.

Special features and values.

A population of white ladyslipper is unusual-- especially for a site that is so disturbed and is not a fen..

It is the only wetland within easy walking distance of the McKay Center, which may make it especially important for public education.

Teal Pond is the only large shallow pond with gradual edges in the Arboretum, and has the potential to look like a natural "prairie pothole" in the restored prairie-wetland landscape.

MANAGEMENT

Management objectives.

Historic: There is no mention of the marsh in the Curtis Plan. Presumably, the parts not planted with trees were to remain open marsh. The tamarack, white cedar and alder plantings, as well as the attempt to grow bog plants, suggest that the pond and its immediate surroundings were to be northern in character.

Present: Develop a complex of open water, marsh, shrub carr and wet prairie that will grade into the open stand of tamaracks south and southeast of Teal Pond, and also into Curtis Prairie on the west and the woods on the north. This will be a microcosm of a southern Wisconsin presettlement landscape of prairie, woods and wetland, with the wetland featuring a relic tamarack stand such as occurred in Hub City Bog, Summerton Bog and other special locations south of the Tension Zone.

Short-term management.

Check annually for purple loosestrife and eradicate any found.

Use herbicide to eradicate all nonnative woody species and all box elder, black cherry and elm in both north and south units, including the dense thickets along the firelane adjacent to Curtis Prairie. Use girdling to kill aspen and perhaps selected large cottonwoods.

Begin a prescribed burn program in both units to control native shrubs and reinvasion by the eradicated species. Supplement with cutting and herbicide treatment if necessary during the early stages. In general try to keep shrub density very low in the best parts of the sedge meadows, allowing shrub carr to develop elsewhere in selected areas.

Encourage/plant sedge meadow and wet prairie species along the east shore of Teal Pond; discourage development of a woody strip between the marsh and the pond. (When the white cedars are removed, as described on p.80 of this plan, the prairie replacing it will also come to the water's edge.)

Monitor the white ladyslipper population and take appropriate precautions to protect the plants from trampling, herbicides, etc. when management procedures are implemented.

Long-term management.

Continue to monitor for purple loosestrife and eradicate any found.

Continue to monitor and protect the white ladyslipper population.

Continue prescribed burns. Continue other woody plant control measures if needed.

Introduce additional sedge meadow species.

After techniques have been developed, replace reed canary grass with native species.

RESEARCH

Research completed or in progress.

Melody Moore's Master's thesis study (I.E.S.)

Research opportunities.

Management-related research needed: Development of techniques for replacing reed canary grass with native species. Effect on bird use of the area related to the changes that take place. Comparison of sedge meadow community composition and structure with and without a tamarack overstory.

General ecological studies: Changes in the vegetation and insect populations of a shallow pond as a function of periodic drought. Comparison of the productivity (or response to fire, or etc.) of native and nonnative (or woody and nonwoody) sedge meadow vegetation.

Degree of manipulation appropriate.

The better parts of the sedge meadow should be protected from any major disturbance. Manipulation of reed canary areas for management-related research only.

TEACHING

Value.

This is a diverse and very attractive area for learning about wetlands and their restoration. It has a surprisingly wild and remote atmosphere.

Accessibility.

The area is within easy walking distance of the McKay Center, but before class groups can use the area a trail with a boardwalk will be essential. Moore's thesis study included plans for such a trail.

PUBLIC USE

Suitability, sensitivity.

With a trail and boardwalk the area would be very suitable for public use. At present there is no good access.

Protective measures needed.

Use should be discouraged until a trail is in place, and then people should be required to stay on the trail. It should be a place where leisurely strollers will not have to cope with runners.

SOUTH SHORE FEN

INTRODUCTION

Site description.

Location: 34:1,2.

Size: 2.7 acres; 1 hectare.

Slope and aspect: Nearly level. There are two low berms paralleling the lakeshore; one right at the lake edge and one approximately 12 meters farther inland.

Soil: Peat.

Vegetation history and past management.

The Lake Wingra basin was formed by glacial action about 12,000 B.P. The lake level was much higher than it is now, and 77sand layers in the fen soil profile indicate a shoreline extending at least 35 meters farther inland. The presence of marl layers in soil throughout the fen suggests that it was once entirely under water.

When the first settlers arrived, the complex of lake and extensive wetlands was more than twice--perhaps three times--its size today. An early description of the fen area (Cahn 1915) mentions water depths of 6-12 inches in spring, and hazardous holes in the peat. The vegetation was dominated by "Spartina" with some Indian grass (Sorghastrum nutans), but there were shrubby islands of red osier dogwood and willow.

Urbanization of the watershed was accompanied by increased pumping of well water, which probably reduced water flow from underground aquifers into the fen. Activities associated with the attempted development of Gardner Marsh resulted in a drop in lake level of 1 meter when the dike supporting McCaffery Drive broke in 1917. Two years later a dam was constructed that raised the lake to its present level, 0.3 meter below the presettlement level. These changes made the fen drier and brush invasion increased--at first native shrubs and trees including red osier dogwood, willow, bog birch, aspen and box elder. Later invaders were honeysuckle and, especially, buckthorn (Rhamnus cathartica and R. frangula). Periods of drought may have been an important factor. Gourley (1985) reports that the oldest Arboretum buckthorn she found dated from 1938; she suggests that the drought of the 1930's may have facilitated buckthorn invasion.

Since Arboretum acquisition there has been sporadic brush cutting, but no sustained effort.

General description of present vegetation.

The site is overgrown with woody species, with buckthorn and red osier dogwood of greatest importance. In some areas the growth is almost impenetrable. A recent study shows 19 of the 40 species listed for fens by Curtis still present, but where buckthorn is dense the ground is essentially bare except for buckthorn seedlings.

Virginia Nickerson, in her 1990 Senior Thesis, identifies 3 zones paralleling the lakeshore: Closest to the shore, between the lakeshore berm and the inner berm, is an area always under water, the Cattail Zone. This is the area with greatest species diversity. The inner berm supports the Buckthorn Zone, a zone with tall, dense buckthorn, considerable red osier dogwood and honeysuckle, and an average of 75% bare ground beneath. Between the inner berm and the oak woods on the upland is the Sedge-Cornus Zone, where Cornus dominates the shrub layer and Carex sedges, marsh fern (Thelypteris palustris) and marsh violet (Viola cucullata) the ground layer.

Special features and values.

This fen is an example of one of the most threatened communities in Wisconsin.

This is one of the six fens studied by Curtis to obtain the data for his section on fens. (Wingra Fen was also one of the six.)

The Nickerson study would make an excellent pre-restoration baseline study.

MANAGEMENT

Management objectives.

Historical: It was always assumed that the fen should be protected, but the Curtis plan does not deal with wetlands in detail.

Present: Restore the fen to the best possible condition.

Short-term management.

Check annually for purple loosestrife and eradicate any found.

Eradicate all shrubs in half the area studied by Nickerson and observe the effects for two or three years. Repeat hydrological and vegetative sampling of both halves; then eradicate all shrubs in the uncleared area.

Limit access in order to provide protection for the fen during this period.

Long-term management.

After shrubs are removed, evaluate the recovery of fen vegetation and the reinvasion of shrubs. If the recovery is determined to be satisfactory, establish a schedule of mowing and burning that is variable in seasonal timing and provides adequate control of reinvading shrubs.

If recovery is unsatisfactory, consider ways to increase water flow into the fen. One technique that has been suggested is installment of a well and pump to operate during dry periods. It might also be possible to remove the soil forming the inner berm to make that zone wetter and less hospitable to buckthorn.

Continue to monitor for purple loosestrife and eradicate any found.

Add appropriate species to increase diversity.

RESEARCH

Research completed or in progress.

Nickerson, Virginia, 1990. A preliminary history of South Shore Fen. Senior Thesis, University of Wisconsin-Madison.

Cahn, A. R. 1915. An ecological survey of the Wingra Springs region, near Madison, Wisconsin with special reference to its ornithology. Bull. Wis. Nat. Hist. Soc. 13:124-177.

Pennequin, D. F. and M. P. Anderson. 1983. The groundwater budget of Lake Wingra, Madison, Wisconsin. Tech. Report. Wis. WRC 83-01, U.W. Water Resources Center.

Research opportunities.

Management-related studies needed: Comparison of the hydrology of SS Fen with fens having less woody invasion. Determination of the impact of well pumping on ground water in the fen. Determination of the impact of shrub growth on the water level.

General ecological studies: Pollination of fen plants. Changes in fen composition over time. Comparisons of South Shore Fen and Wingra Fen: Hydrology, water chemistry, composition, phenology, etc.

Degree of manipulation appropriate.

Because of its small size and sensitivity, major manipulations should be restricted to those considered necessary for restoration of the site.

TEACHING

Value.

Fens are a unique community with a clear dependence on specific environmental conditions, and the gradation of community composition from upland to shoreline is of interest. However, it would be difficult to handle a class group in this small area.

Accessibility.

There is no official trail into the fen. It is too far for a class to walk from the nearest parking lot, although there is some parking on streets in the developed area across McCaffery Road to the north.

PUBLIC USE

Sensitivity, suitability.

The fen is not suitable for public use because of its small size and its vulnerability to trampling.

Protective measures needed.

Access should be restricted and casual use discouraged.

REDWING MARSH

INTRODUCTION

Site description.

Location: 34:13,-15

Size: 3 acres; 1.2 hectares

Slope and aspect: Level.

Soil: Sand.

Vegetation history and past management.

Little is known. Presumably the cattails have been there for as long as the water has been the right depth for them, but at some time in the past there must have been exposed wet soil there or in a nearby area that provided the necessary conditions for seed establishment. Sometime after settlement a wood jetty was constructed offshore, which protected the area from wave action until too much wood was lost to decay.

General description of the present vegetation.

It is a nearly monotypic stand of narrow-leaved cattail (Typha angustifolia).

Special features and values.

It is an example of a type of vegetation poorly represented in the Arboretum.

The cattails are growing in hard sand, which is somewhat unusual.

There is a long history of studies of redwing blackbird behavior in the marsh.

MANAGEMENT

Management objectives.

Maintain the cattail marsh.

Short-term management.

Check each year for purple loosestrife and eradicate any found. No other action needed.

Long-term management.

Same.

RESEARCH

Research completed or in progress.

Many studies of redwing blackbird behavior have been carried out over the years by Wildlife Ecology students.

Research opportunities.

Use of the marsh by aquatic invertebrates. Effect of wave action on the community. Effect of carp.

Action required for continuing long-term research.

None.

Degree of manipulation appropriate.

Limited plant harvesting and soil investigation. Cattails are resilient after disturbance but the area is small enough to be vulnerable.

TEACHING

Value.

This is one of the few cattail marsh areas in the Arboretum of reasonably good quality. Birds are easily observed, and it would be a good place to look for aquatic invertebrates.

Accessibility.

Easily accessible from the road, but there is no provision for parking. There is no boardwalk through the marsh.

PUBLIC USE

Suitability, sensitivity.

Public use might jeopardize bird studies in progress, and people wading through would damage the vegetation.

Protective measures needed.

Discourage fishing in and near the marsh, as well as foot traffic.

BOG GARDEN

Early attempts to create a bog in Teal Pond were unsuccessful, probably because the surface water entering the pond is neither acid nor low in nutrients. In addition, the crushed dolomite on the road that crosses the inlet stream may increase the alkalinity.

If the Arboretum is to have a bog, it will have to be supplied with water other than surface or ground water; rain water is a possibility. A demonstration bog "garden" in a pool is probably the best possibility. A site should be selected, using the following criteria:

1. It should be located near the McKay Center or other building where rainwater can be collected and where it will be easy to supervise and maintain.

2. It should be exposed to full sun, or nearly full sun.

3. It should be in a topographic position to benefit from cold air drainage.

4. It should not be in contact with ground water.

5. It should not be exposed to dust from gravel roads or firelanes.

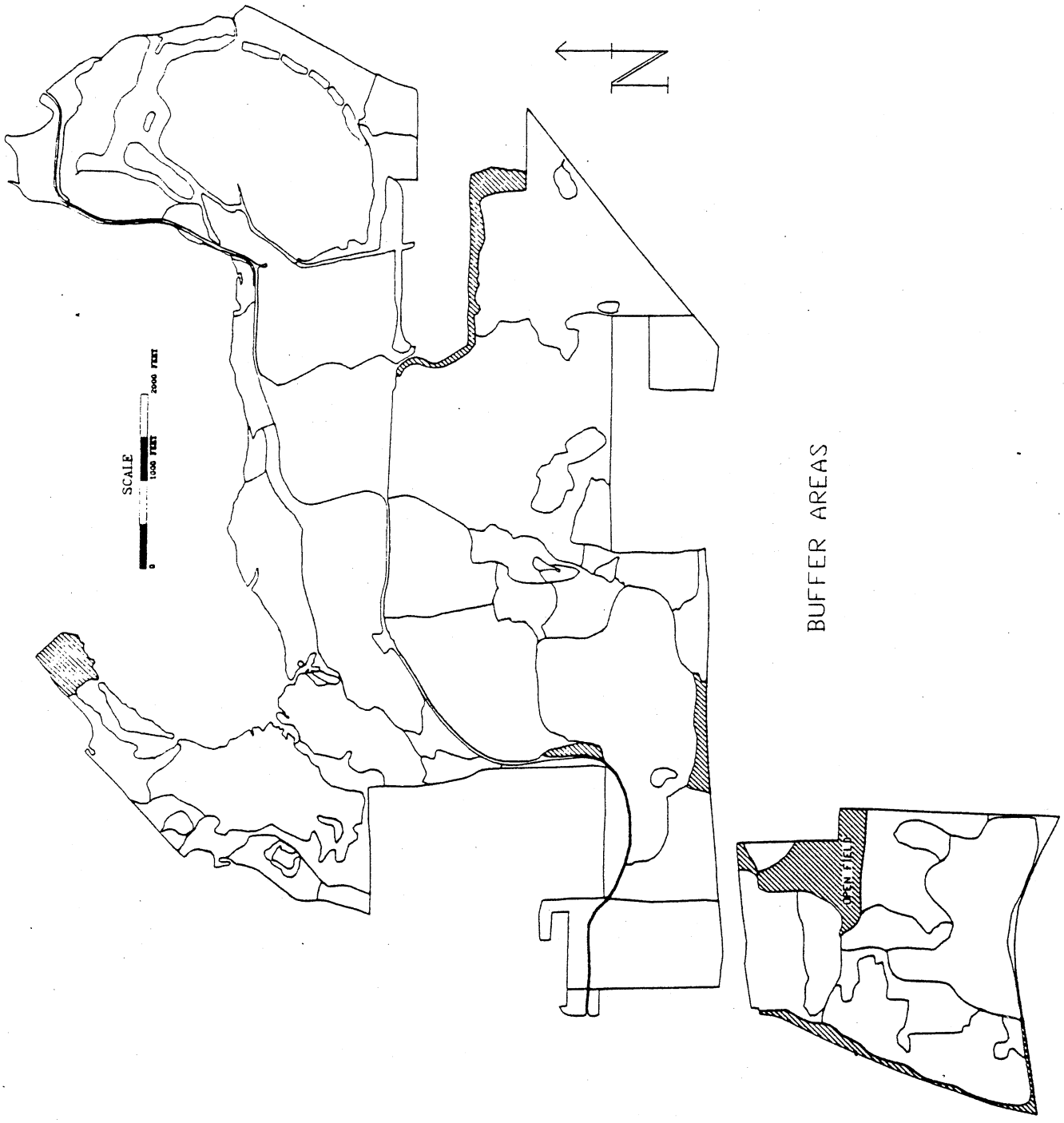
A trial should be carried out to determine whether sphagnum can be grown in a small pool supplied with rainwater on the selected site before attempts are made to introduce other species, since the sphagnum is critical for the bog habitat. Later some of the smallest Ericaceous shrubs and appropriate sedges can be added, and finally other species, including pitcher plant.

BUFFERS AND OLD FIELD

Along some sections of the Arboretum boundary a strip of vegetation unlike the natural community adjacent to it will be maintained as a buffer. Trees and shrubs in such buffers will not represent a natural community, and no effort will be made to establish ground layer plants. Management will consist of maintaining trees and shrubs that will provide the kind of screening or buffering desired. Using species that grow naturally together is desirable, but is considered of lesser importance than maintaining the buffering function.

The white cedar planting east of Ho-nee-um Pond is also considered to be buffer. Although the white cedars are growing well, they have no relationship to the savanna/prairie complex planned for the Ho-nee-um area.

A fifteen acre field in the Grady Tract will be kept open by mowing and/or burning so that it will be available in the future for research or propagation requiring an open area. The field is presently heavily invaded with elm, black locust, box elder, sumac, honeysuckle and buckthorn. A few conifers from an old nursery are also present.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