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MANAGEMENT PLAN

SPICER LAKE NATURAL AREA
ST. JOSEPH COUNTY, INDIANA
Sec. 10, T8S, R1W

I. INTRODUCTION

Spicer Lake Nature Preserve is located in the extreme northwest corner of St. Joseph County, Indiana. The approximately square, sixteen hectare preserve is bordered on the north by State Line Road and on the west by County Line Road, which intersects U.S. 20 about 2.5 miles south of the preserve and just west of New Carlisle, Indiana. The site has been studied extensively by Riemenschneider (1978). His report was used in the following sections on natural conditions and plant communities.

II. ORIGINAL AND EXISTING ECOLOGICAL CONDITIONS

Spicer Lake occurs in the Northwestern Prairie and Wetlands Natural Division of Indiana (Figure 1). This region is characterized by rugged glacial topography supporting dry to wet forest or prairie communities. Fire was an important factor in determining the presence of forest or prairie; water bodies or steep topography usually allowed development of forest on the leeward sides of these breaks. Spicer Lake occurs in a glacial kettle hole that apparently allowed the development of a

swamp forest community. However, a more detailed natural character study should be completed to further determine the original vegetation. Spicer Lake is one of three lakes present in the large kettle basin and the only one contained in the nature preserve.

The basin is peat filled but does not form a floating mat as in typical bogs. This suggests a relatively shallow peat substrate and lack of strong groundwater movement. In September, 1982, the woodland around the lake was dry. An impermeable layer of till beneath the peat may be holding water in the basin, allowing seasonal fluctuations. The existing vegetation in the basin is probably floristically similar to presettlement conditions. The dominant community is a red maple swamp forest. Logging alone may have been responsible for significant alteration of the area; however, the adjacent uplands were severely grazed, which suggests that grazing could also have affected the lowland vegetation.

The east border of the lake basin was ditched prior to 1925 in an attempt at drainage. The ditch has been filling in and may be causing a seasonally higher water table than in recent years, as evidenced by the appearance of a floating mat around the open lake and dead trees near the open water. These changes suggest a return to more natural conditions.

III. CHARACTERIZATION OF EXISTING NATURAL CONDITIONS

A. Physical Features

Spicer Lake lies within and near the southwestern boundary of the Valparaiso end moraine formed approximately 12,000 years ago

by the Lake Michigan lobe of the Wisconsinan Ice Sheet. Most of the surrounding area is rolling and rather typical morainic topography; the preserve, however, is within a partially filled, level basin between elevations of 745 and 760 feet. Spicer Lake lies at the northern end of the basin and is drained to the north through Dowling Creek. A drainage ditch constructed along the east preserve boundary prior to 1923 represents an early attempt at drainage. The till of the basin is relatively impermeable and maintains the water level near the soil surface. As a result, the basin is flooded during periods of heavy precipitation.

Approximately 14.5 of the 16 hectares are terrestrial, with Houghton muck occupying about 10 hectares. Approximately 1.5 to 2 hectares of Morley silt loam, a moderately well drained soil, are found on the upland along County Line Road. The remaining area includes Washtenaw silt loam, Milford silty clay loam, and Palms muck, all poorly drained soils.

B. Communities (Figure 3)

The following section is taken from Riemenschneider (1978):

The vegetation within the preserve includes at least 122 species and varies from planted and escaped cultivars in a disturbed community near a former home site on the west through terrestrial successional stages to relatively undisturbed red maple swamp forest and lake succession zones surrounding open water. The major plant communities of the preserve are: yellow pond lily-swamp loosestrife community,

spicebush-winterberry-buttonbush shrub community, and red maple swamp forest. Along the west side of the preserve are a number of minor communities representing various stages of succession due to varying amounts of human disturbance. A partially open marshy meadow in the southwest sector adds to the diversity of habitats and species in the preserve.

The yellow pond lily-swamp loosestrife community encircles and presumably is slowly encroaching on the remaining open water of the lake. The lakeward edge is mostly yellow pond lily (Nuphar advena) and is a floating mat apparently supported by the large (8 cm diameter) Nuphar rhizomes. A floating bladderwort is a common associate on the lakeward edge along with duckweed (Lemna minor) floating throughout the community. It is about 3 meters to the organic bottom on the lakeward side of the mat (about 6M in the center of the lake). Growing back from the lakeward edge, but continuous throughout the zone thereafter, is swamp loosestrife (Decodon verticillatus laevigatus). Dodder (Cuscuta gronovii) is visually prominent in late summer and fall although its contribution to the total biomass is probably small compared to the two dominants. In the shoreward half to two-thirds of the mat, Ceratophyllum demersum, a submerged aquatic, is common. Other species within this community are arrow arum (Peltandra virginica), marsh shield fern (Dryopteris thelypteris pubescens), and Virginia chain fern (Woodwardia virginica).

The spicebush-winterberry-buttonbush shrub community is less distinctive than the yellow pond lily-swamp loosestrife community

in that its width appears to be more variable and the separation from the surrounding swamp forest is poorly defined. The zone is dominated by winterberry (Ilex verticillata) and buttonbush (Cephalanthus occidentalis), with swamp loosestrife a common associate. Other shrubs found along the shoreward edge are winterberry, red-osier dogwood (Cornus stolonifera) and swamp rose (Rosa palustris). Away from the shore, winterberry and spicebush (Lindera benzoin) are the dominant shrubs, with highbush blueberry (Vaccinium corymbosum) and chokeberry (Pyrus sp.) as associates. The herb level is dominated by cinnamon fern (Osmunda cinnamomea), Canada mayflower (Maianthemum canadense), bog hemp (Boehmeria cylindrica) and stalked water horehound (Lycopus rubellus). Marsh fern is relatively common on the shoreward side and other ferns, royal (Osmunda regalis), sensitive (Onoclea sensibilis), Virginia chain, dissected grape, and spinulose wood, are scattered throughout the shrub zone. Other herbs fairly common in this area are goldthread (Coptis groenlandica), dwarf raspberry (Rubus pubescens) and smooth white violet (Viola pallens). These species all add to the northern aspect of this area.

The swamp forest has a well defined canopy, shrub and herb strata with the canopy layer dominated by red maple (Acer rubrum) and the shrub stratum dominated by spicebush. It is difficult to assign dominance in the herb layer due to the spatial variability in the forest. The swamp forest can be subdivided into four areas. An immature area in which the canopy dominance is shared by red maple and elm (Ulmus sp.) and the trees are smaller (perhaps indicating greater disturbance) is located behind the house in the western

sector. Two relatively mature areas--one fairly dry with only small ponded areas and the other much wetter with ponding of 40 percent or more of the surface--are located in the north/northeast and the southeast sectors, respectively. A small section in the northeast corner has had considerable disturbance. This corner has a mixture of sassafras, black cherry and red maple in the canopy with spicebush, elderberry, and blackberry in the shrub layer. Spotted touch-me-not (Impatiens capensis), woodland knotweed (Tovaria virginica), red trillium (Trillium recurvatum), tall nettle (Urtica gracilis) are a few of the herb species that are more common in this area.

The largest portion of the swamp forest is the relatively dry, mature type. The canopy of this type is dominated by red maple (more than 70% of the basal area) with black cherry, sassafras and elm the more common associates. There are a few red oaks, tulip trees (Liriodendron tulipifera), and willows (Salix sp.). Black ash (Fraxinus nigra) and black gum are more common in the southeastern wet area but also occur throughout. The shrub layer is clearly dominated by spicebush but scattered individuals of alternate-leaved dogwood (Cornus alternifolia), choke cherry (Prunus virginiana), red elder (Sambucus pubens), American and common gooseberry (Ribes sp.) are also to be found. Some of the more common herbaceous species are: wild sarsaparilla (Aralia nudicaulis), spinulose wood [shield] fern (Dryopteris spinulosa), dwarf raspberry (Rubus pubescens), sweet scented bedstraw (Galium triflorum), bog hemp (Boehmeria cylindrica),

stalked water horehound (Lycopus rubellus), downy Solomon's seal (Polygonatum pubescens), false Solomon's seal (Smilacina racemosa), Canada mayflower (Maianthemum canadense), and smooth yellow violet (Viola pensylvanica).

In the wetter portion of the swamp forest, both shrub and herb levels are poorly developed, particularly in areas ponded most of the year. Large clumps of cinnamon and royal fern may be found in these areas.

The only other vegetation type of any size is the open marsh in the southwest sector of the preserve. Skunk cabbage (Symplocarpus foetidus) is prominent in the spring before the other herbs begin growing. By late summer and fall, rice cut grass (Leersia oryzoides), spotted touch-me-not (Impatiens capensis), and Spanish needles (Bidens vulgata, B. frondosa, B. connata petiolata) dominate the scene. Pussy willows (Salix discolor) occur in scattered clumps. Other herbaceous species are cardinal flower, turtlehead (Chelone glabra), Joe Pye weed, and water hemlock.

C. Special Features

Four plant species of special concern are reported from the preserve. None were located during field work for this report.

Table 1: Plant species of special concern.

SPECIES	STATUS	DATE
Carex bebbii	rare/restricted	1968
Carex seorsa	endangered	1982
Carex incomperta	endangered	1979
Viburnum cassinoides	endangered	1980?

The aquatic habitat has been studied. Dineen (1979) reported on the plankton and benthos of Spicer Lake, and Dineen (1981?) found the central mud minnow (Umbra limi) and golden shiner (Notemigous crysoluecas) to be inhabitants of the lake. The latter apparently migrated into the lake in spring of 1980 during high water.

IV. EXISTING AND POTENTIAL PROBLEMS

A. Existing Problems

1. Visitor induced (Figure 3)

The existing parking facilities allow visitors to park out of sight of the preserve entrance, encouraging improper use of the preserve. Minor littering occurs in the parking area and along the trail and boardwalk.

2. Human related, requiring management

a. drainage - Sand Mire Ditch was dug along the east boundary prior to 1925. Although it is filling in, the ditch still allows excessive drainage of the lake basin.

b. erosion - Rainwash of cultivated fields adjacent to the northeast preserve boundary is causing erosion and siltation in the preserve. Herbicidal pollution may also be coming from the same source. Erosion is occurring on the steep slopes of the vehicle access road leading to the lower parking area.

c. exotics - Black locust (Robinia pseudo-acacia) and multiflora rose (Rosa multiflora) occur along the east side of the north preserve boundary. Planted Picea sp., Pinus strobus, and Rosa multiflora also occur at the preserve entrance.

3. Naturally induced

Trees in the swamp forest are shallow-rooted due to soil conditions and are prone to windthrow, which should be treated as a natural phenomenon. However, windthrow could damage vehicles or fences along the north preserve boundary and also create openings for exotic species to become established in the preserve.

B. Potential Problems

1. Visitor induced

Greater numbers of visitors could result in increased littering, improper use of the preserve, and damage to the boardwalk.

2. Human related, requiring management

a. drainage - Requests to dredge Dowling Creek in order to improve drainage of homesites downstream from the preserve have been reported. Since Dowling Creek drains the area containing Spicer Lake, changes in the water table may occur which would affect the preserve.

b. exotics - The noxious species glossy buckthorn (Rhamnus frangula) and purple loosestrife (Lythrum salicaria) have not been reported in the preserve or in St. Joseph County. They have, however, been reported as increasing in LaPorte County, Indiana, and Berrien County, Michigan, and could become problems in the preserve. If these species are found in the preserve, they should be eradicated by pulling or with herbicides (Appendix E) in non-aquatic areas.

V. MANAGEMENT RECOMMENDATIONS

A. Maintenance of Existing Conditions

Except for past logging and some apparent grazing, the preserve is essentially in natural condition and its primary management need is protection from disturbance.

B. Restoration of Natural Conditions

1. Exotic species

The black locust and multiflora rose should be removed from the preserve by cutting and treatment with appropriate herbicides (Appendix E). *Picea* and *Pinus strobus* should not be allowed to reproduce.

2. Water table

The ditch on the northeast preserve boundary should be allowed to continue filling in. The water level should be monitored to determine whether it is rising and vegetation changes are taking place.

C. Protection from Adverse Human Use

All preserve boundaries should be posted. The access road leading to the lower preserve parking area should be permanently closed to prevent improper preserve use. Erosion and herbicide pollution from the adjacent farm field should be monitored. A grass barrier could be established on the lower slopes of the field to prevent severe runoff and siltation.

D. Facilities

Once the lower preserve parking area is closed, the existing facilities will be adequate for visitor use. The existing trail and

boardwalk could be extended if additional land is added to the preserve. Picnic or playground equipment should not be installed.

E. Patrolling and Surveillance Needs

The preserve access area should be patrolled on weekends and other periods of heavy visitor use. The preserve boundaries and interior should be surveyed twice yearly to monitor posting needs, exotic species, and potential disturbances.

F. Research Needs and Recommendations

1. Vegetation sampling

Several permanent sampling transects or plots should be established in each natural community to collect baseline data that will serve to document any changes in the vegetation due to management of the area. All endangered or threatened plant species should be included in at least one sampling plot. Sampling methods are provided in Appendix B.

2. Fauna

Vertebrate species should be monitored to determine locations and numbers of breeding animals. Bird populations should be monitored by a strip census method with permanent sampling points (Appendix C).

3. Photographic stations

Permanent photographic stations should be established at selected sampling points and locations of special features. Photographs should be recorded on black and white and color transparency film. Exposures should be made with a 35 mm camera and "normal" or wide angle lens in each of the cardinal

directions from the selected sites. Data to be recorded is provided in Appendix D.

4. Special features

Representative populations of all special plant species should be located and permanently sampled so that number of stems, cover, associates, and other features can be monitored over time. Data to be recorded is provided in Appendix D.

5. Water quality

Water quality may be critical in maintaining the wetland communities and rare aquatic plants present in the preserve and should be monitored. Appendix F provides recommendations for monitoring general preserve water quality.

G. Nature Preserve Additions

The entire basin containing Spicer Lake and Lancaster Lake should be acquired. Adequate buffer to protect the basin from siltation, pollution, and drainage should also be acquired. The basin should be inventoried to determine areas that qualify for addition to the nature preserve.

VI. MANAGEMENT SUMMARY

A. Management Objectives

The primary objective is protection of the natual area from physical disturbance and pollution from adjacent land use.

Secondary objectives are better control of visitor use, protection of the entire lake basin, and control of exotic species.

B. Review of Management Programs

1. Protection and visitor use

a. Post boundaries (p. 10).

b. Close access road to lower parking area (pp. 8, 10).

c. Monitor erosion and herbicide pollution from adjacent farm field; establish grass barrier to prevent severe runoff and siltation (pp. 8, 10).

d. Extend existing trail and boardwalk if additional land is added to preserve (pp. 10, 11).

e. Patrol access area on weekends and other periods of high visitor use (p. 11).

f. Survey preserve boundaries and interior twice yearly (p. 11).

g. Acquire lake basin containing Spicer and Lancaster lakes and adequate buffer to protect basin (p. 12).

h. Inventory lake basin; determine areas that qualify for addition to nature preserve (p. 12).

i. Complete detailed presettlement natural character study (p. 2).

2. Restoration and maintenance

a. Monitor threat of glossy buckthorn and purple loosestrife invasion; eradicate if necessary by pulling or with herbicides in non-aquatic areas (p. 9).

b. Remove black locust and multifora rose by cutting and treatment with appropriate herbicides. Prevent reproduction of Picea and Pinus strobus (pp. 8, 10).

c. Allow ditch on northeast boundary to continue filling in; monitor changes in water level and vegetation (pp. 2, 8, 10).

d. Establish permanent vegetation sampling transects or plots to monitor effects of management on vegetation; include all endangered or threatened plant species in at least one plot (p. 11).

e. Monitor breeding populations of vertebrate species; establish permanent sampling points for monitoring bird populations (p. 11).

f. Establish permanent photographic stations (pp. 11, 12).

g. Monitor special plant species over time (p. 12).

h. Monitor water quality (p. 12).

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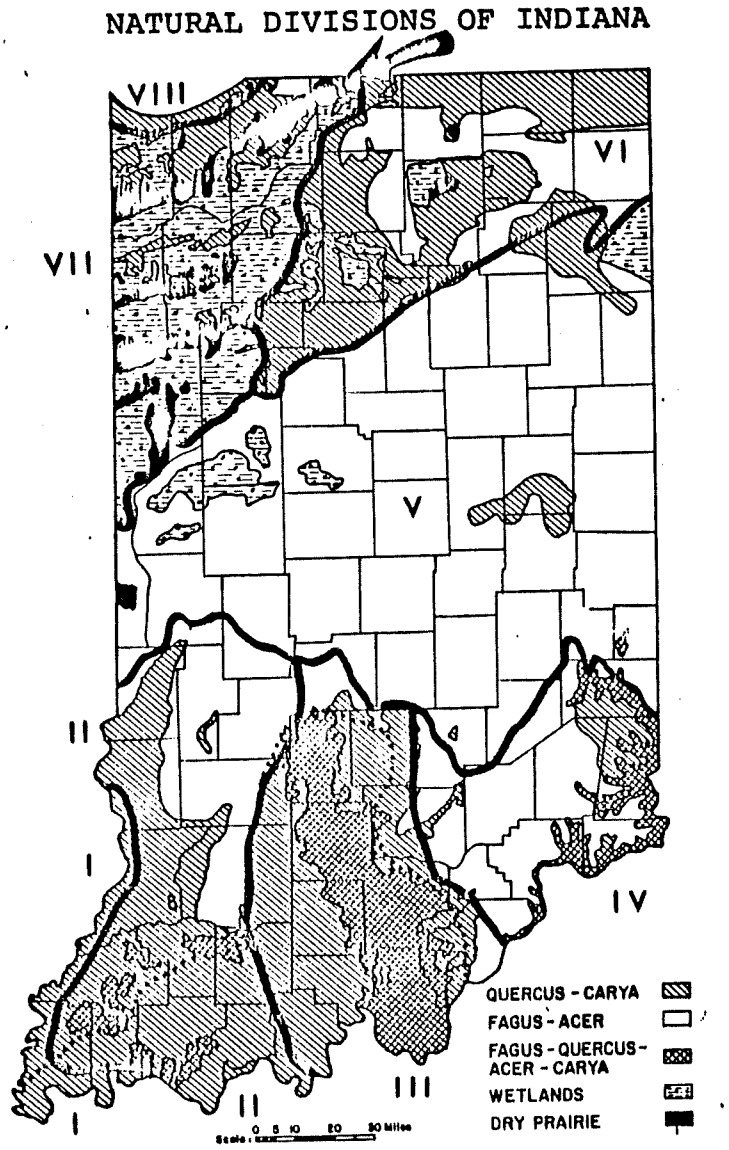

Figure 1. Eight major natural divisions of Indiana, distinguished on a map of presettlement vegetation types, as follows:

I LOWER WABASH DIVISION
II SOUTHWESTERN LOWLAND DIVISION
III SOUTH-CENTRAL OAK AND MIXWOODS DIVISION
IV SOUTHEASTERN TILL PLAIN DIVISION
V TIPTON TILL PLAIN BEECH-MAPLE DIVISION
VI NORTHEASTERN MORAINE AND KETTLE DIVISION
VII NORTHWESTERN PRAIRIE AND WETLANDS DIVISION
VIII CALUMET LAKE PLAIN DIVISION

Spicer Lake natural area lies in the NORTHWESTERN PRAIRIE AND WETLANDS NATURAL DIVISION OF INDIANA. It is represented on the map by a solid circle. (Lindsey, et al. 1969).

Spicer Lake Nature Preserve

TOPOGRAPHIC MAP

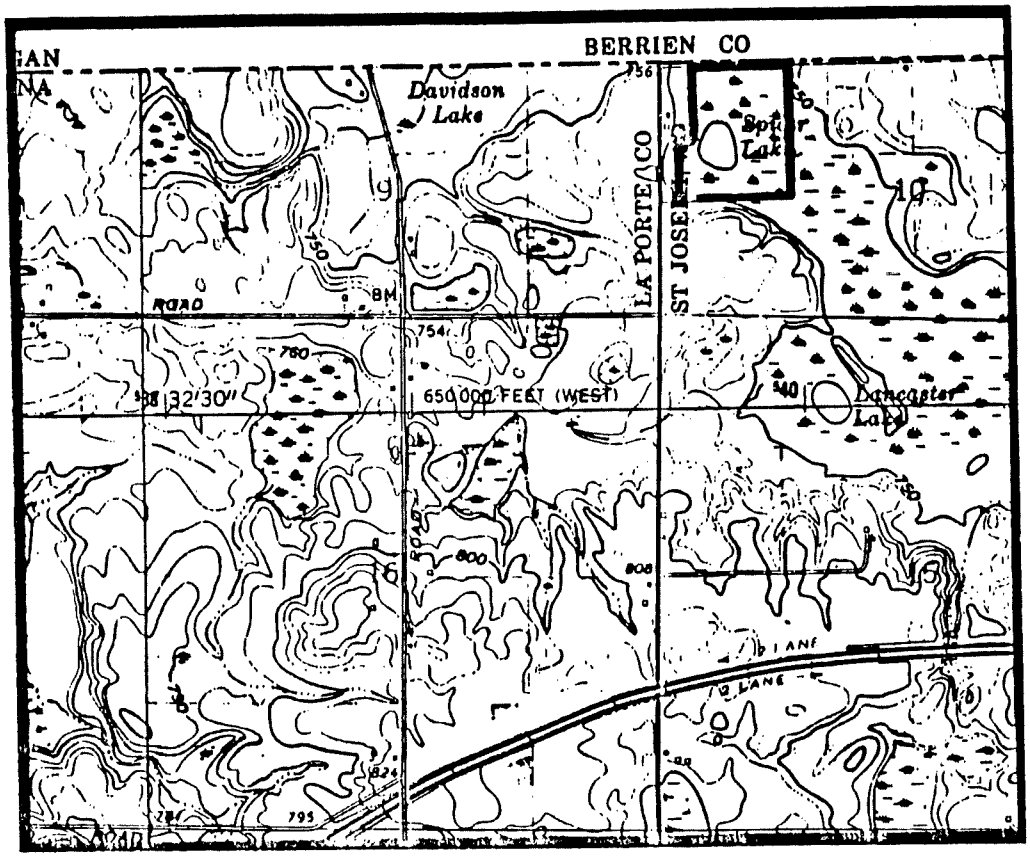

Figure 2. Spicer Lake Nature Preserve is outlined on the New Carlisle, Indiana, USGS topographic map 7.5 minute series (scale: 1:24,000).

Spicer Lake Nature Preserve

MANAGEMENT FEATURES

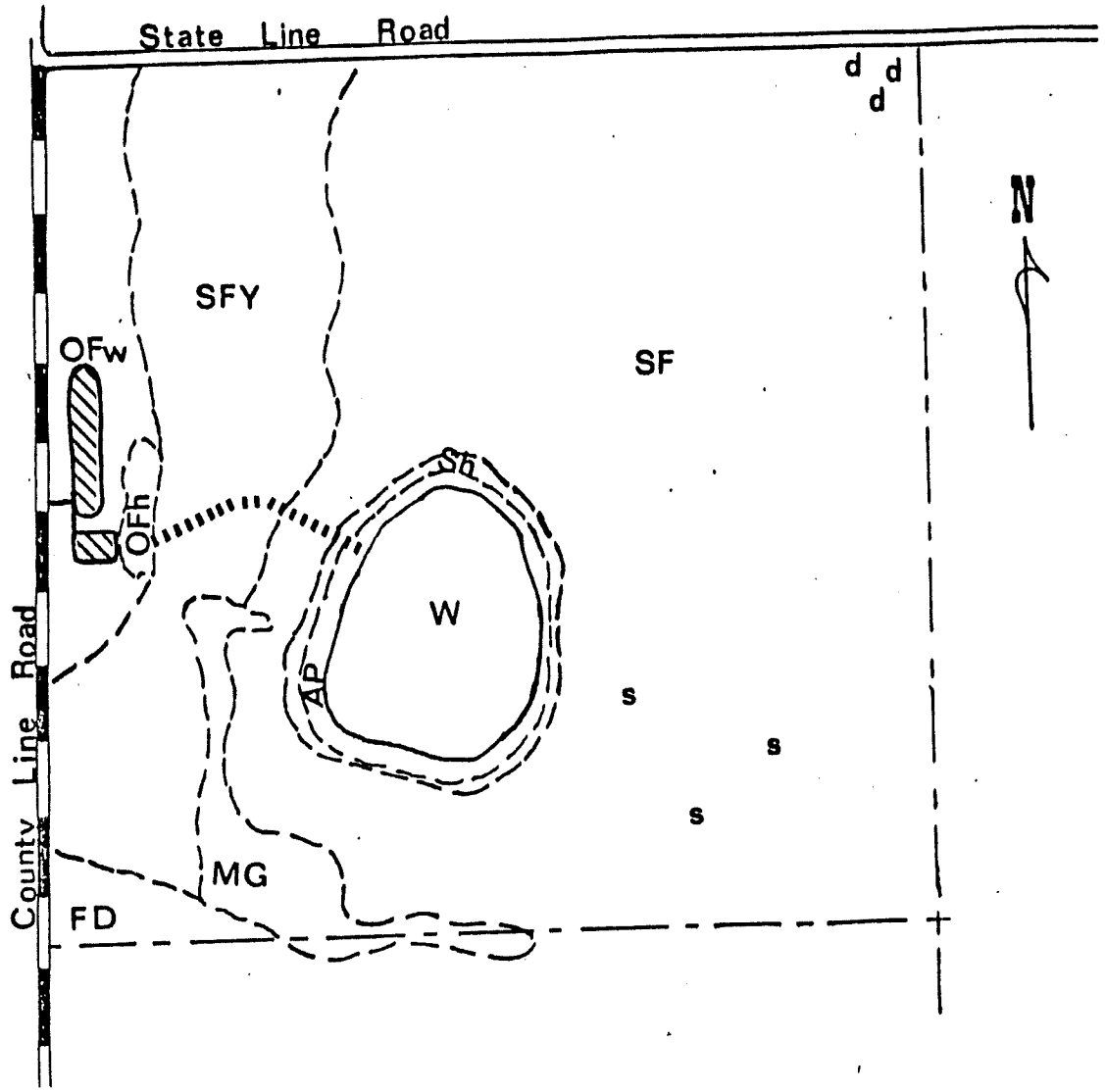

Figure 3. Major plant communities of Spicer Lake Nature Preserve: AP, Yellow Pond Lily-Swamp Loosestrife; FD, Disturbed upland forest; MG, Marsh; OFh, Herbaceous old field; OFw, Woody old field (area includes planted woody and herbaceous cultivars); SF, Red Maple Swamp Forest (d, highly disturbed and better drained portion; s, area with surface ponding during most seasons of the year); SFY, Red Maple-Elm Swamp Forest(immature); Sh, Shrub zone; W, open water.
Source: Riemenschneider, 1978.

Parking areas

Trail

APPENDIX A

Spicer Lake Nature Preserve
PLANT LIST

Acer rubrum	RED MAPLE
Alisma triviale	LARGE-FLOWERED WATER PLANTAIN
Ambrosia trifida	GIANT RAGWEED
Amelanchier laevis	ALLEGHENY SHADBLOW
Aralia nudicaulis	WILD SARSAPARILLA
Arisaema atrorubens	JACK-IN-THE-PULPIT
Asclepias incarnata	SWAMP MILKWEED
Asimina triloba	PAWPAW
Aster lateriflorus	SIDE-FLOWERING ASTER
Aster lowrieanus	LOWERY'S ASTER
Aster novae-angliae	NEW ENGLAND ASTER
Aster simplex interior	MARSH ASTER
Barbarea vulgaris	YELLOW ROCKET
Bidens connata petiolata	PURPLE-STEMMED TICKSEED
Bidens frondosa	COMMON BEGGAR'S TICKS
Bidens vulgata	TALL BEGGAR'S TICKS
Boehmeria cylindrica	BOG HEMP
Botrychium dissectum	CUT-LEAVED GRAPE FERN
Carex bebbii	
Carex crinita	FRINGED SEDGE
Carex incomperta	
Carex lupuliformis	
Carex lurida	
Carex seorsa	
Carex tribuloides	
Carpinus caroliniana	BLUE BEECH
Carya cordiformis	BITTERNUT HICKORY
Carya ovalis	SMALL-FRUITED HICKORY
Cephalanthus occidentalis	BUTTONBUSH
Ceratophyllum demersum	HORNWORT
Chelone glabra	TURTLEHEAD
Cicuta maculata	WATER HEMLOCK
Cinna arundinacea	COMMON WOOD REED
Circaea quadrisulcata	ENCHANTER'S NIGHTSHADE
Claytonia virginica	SPRING BEAUTY
Coptis groenlandica	GOLDTHREAD
Cornus alternifolia	ALTERNATE-LEAVED DOGWOOD
Cornus racemosa	GRAY DOGWOOD
Cornus stolonifera	RED-OSIER DOGWOOD
Cryptotaenia canadensis	HONEWORT
Cuscuta gronovii	COMMON DODDER
Cystopteris fragilis	FRAGILE FERN
Decodon verticillatus laevigatus	SWAMP LOOSESTRIFE
Dryopteris spinulosa	SPINULOSE SHIELD FERN
Dryopteris thelypteris var. pubescens	MARSH SHIELD FERN
Epilobium coloratum	CINNAMON WILLOW HERB

Erythronium americanum	YELLOW TROUT LILY
Eupatorium maculatum	SPOTTED JOE PYE WEED
Eupatorium perfoliatum	COMMON BONESET
Eupatorium regosum	WHITE SNAKE ROOT
Floerkea proserpinacoides	FALSE MERMAID
Fraxinus americana	WHITE ASH
Fraxinus nigra	BLACK ASH
Galium aparine	CLEAVERS
Galium triflorum	SWEET-SCENTED BEDSTRAW
Geum canadense	WHITE AVENS
Glechoma hederacea	GROUND IVY
Glyceria striata	FOWL MEADOW GRASS
Ilex verticillata	WINTERBERRY
Impatiens capensis	SPOTTED TOUCH-ME-NOT
Juglans nigra	BLACK WALNUT
Juncus tenuis	ROADSIDE RUSH
Lactuca biennis	TALL BLUE LETTUCE
Lamium purpureum	PURPLE DEAD NETTLE
Laportea canadensis	WOOD NETTLE
Leersia oryzoides	RICE CUT GRASS
Lemna minor	SMALL DUCKWEED
Lindera benzoin	SPICEBUSH
Liriodendron tulipifera	TULIP TREE
Lobelia cardinalis	CARDINAL FLOWER
Lycopus rubellus	STALKED WATER HOREHOUND
Maianthemum canadense	CANADA MAYFLOWER
Medeola virginiana	INDIAN CUCUMBER ROOT
Menispermum canadense	MOONSEED
Muhlenbergia frondosa	COMMON SATIN GRASS
Nuphar advena	YELLOW POND LILY
Nyssa sylvatica	BLACK GUM
Onoclea sensibilis	SENSITIVE FERN
Osmorhiza claytonii	HAIRY SWEET CICELY
Osmorhiza longistylis	SMOOTH SWEET CICELY
Osmunda cinnamomea	CINNAMON FERN
Osmunda regalis	ROYAL FERN
Parthenocissus quinquefolia	VIRGINIA CREEPER
Peltandra virginica	ARROW ARUM
Phleum pratense	TIMOTHY
Picea sp.	
Pilea pumila	CLEARWEED
Pinus strobus	WHITE PINE
Podophyllum peltatum	MAY APPLE
Polygonatum pubescens	DOWNY SOLOMON'S SEAL
Polygonum sagittatum	ARROW-LEAVED TEARTHUMB
Polygonum scandens	CLIMBING FALSE BUCKWHEAT
Populus grandidentata	LARGE-TOOTH ASPEN
Prunus serotina	WILD BLACK CHERRY
Prunus virginiana	CHOKE CHERRY
Pyrus arbutifolia	PURPLE CHOKEBERRY
Pyrus melanocarpa	BLACK CHOKEBERRY

Quercus rubra	RED OAK
Ranunculus abortivus	SMALL-FLOWERED BUTTERCUP
Ranunculus recurvatus	HOOKED BUTTERCUP
Rhus radicans	POISON IVY
Rhus vernix	POISON SUMAC
Ribes americanum	WILD BLACK CURRANT
Ribes cynosbati	PRICKLY WILD GOOSEBERRY
Robinia pseudo-acacia	BLACK LOCUST
Rosa multiflora	MULTIFLORA ROSE
Rosa palustris	SWAMP ROSE
Rubus allegheniensis	COMMON BLACKBERRY
Rubus pubescens	DWARF RASPBERRY
Rumex obtusifolius	BITTER DOCK
Salix amygdaloides	PEACH-LEAVED WILLOW
Salix discolor	PUSSY WILLOW
Sambucus canadensis	ELDERBERRY
Sambucus pubens	RED-BERRIED ELDER
Sanicula gregaria	CLUSTERED BLACK SNAKEROOT
Sanicula trifoliata	LARGE-FRUITED BLACK SNAKEROOT
Sassafras albidum	SASSAFRAS
Scutellaria lateriflora	MAD-DOG SKULLCAP
Smilacina racemosa	FEATHERY FALSE SOLOMON'S SEAL
Smilax lasioneura	COMMON CARRION FLOWER
Solanum dulcamara	BITTERSWEET NIGHTSHADE
Solidago altissima	TALL GOLDENROD
Solidago graminifolia	GRASS-LEAVED GOLDENROD
Solidago rugosa	ROUGH GOLDENROD
Solidago ulmifolia	ELM-LEAVED GOLDENROD
Spiraea tomentosa	HARDHACK
Stellaria media	COMMON CHICKWEED
Symplocarpus foetidus	SKUNK CABBAGE
Taraxacum officinale	COMMON DANDELION
Tovaria virginiana	WOODLAND KNOTWEED
Trillium grandiflorum	LARGE-FLOWERED TRILLIUM
Trillium recurvatum	RED TRILLIUM
Ulmus americana	AMERICAN ELM
Ulmus rubra	SLIPPERY ELM
Urtica dioica	STINGING NETTLE
Urtica gracilis	TALL NETTLE
Vaccinium corymbosum	HIGHBUSH BLUEBERRY
Verbena urticifolia	WHITE VERVAIN
Viburnum cassinoides	WITHE ROD
Viburnum lentago	NANNYBERRY
Viola canadensis	CANADA VIOLET
Viola pallens	SMOOTH WHITE VIOLET
Viola papilionaceae	COMMON BLUE VIOLET
Viola pensylvanica	SMOOTH YELLOW VIOLET
Viola sororia	HAIRY WOOD VIOLET
Vitis riparia	RIVERBANK GRAPE
Woodwardia virginica	CHAIN FERN
Xanthoxylum americanum	PRICKLY ASH

APPENDIX B

VEGETATION SAMPLING PROCEDURE*

Woody Vegetation - Savannas

Establish permanent 1/10 ha circular plots (radius 17.841 meters) marked with center stakes and stakes at perimeter of plots at each cardinal direction.

Record woody stem density by species in each quarter of the plot by six size classes:

<2 cm, >2<4 cm, >4<6 cm, >6<8 cm, >8<10 cm, >10 cm

Herbaceous Vegetation - Savannas

Establish nine permanent $1/4m^2$ circular nested plots (radius .2821 meters) within each woody vegetation plot. Plots are located at the center, midway, and end points of lines radiating in each cardinal direction. Record frequency by species. Additional nested plots should be established within the 1/10 ha plots if significant species are not encountered.

Herbaceous Vegetation - Graminoid Communities

Establish 20 or more permanent $1/4m^2$ circular plots (radius 28.2 meters) located randomly along permanent transects through each community. Record species frequency.

Plot Location

All community sampling plots should be located by a stratified random technique with random selection along predetermined lines within community types.

Herbaceous Vegetation - Critical Species

Permanent meter square sampling plots should be located to include colonies of specified plants. Plot corners should be marked with permanent stakes or other means for relocation (examples of forms attached).

*Note: These procedures have been developed for fire-adapted communities where ecological changes are expected with manipulation by prescribed burning. Standard sampling designs for other forest communities can be determined from a quantitative ecology text.

APPENDIX C

BREEDING BIRD SAMPLING INSTRUCTIONS

PURPOSE: To obtain, through standardized, systematic sampling, an estimate of abundance and distribution of breeding birds. The information obtained will be used to monitor populations of species and to provide appropriate management recommendations.

SAMPLING TECHNIQUE: Even though the actual plan for each area will have to be individually prepared, the standard technique will be Spot Censusing along accompanying Transect Routes. Each natural area will be divided into Transects one quarter mile apart with each stop one quarter mile apart and equivalent to one stop for every 160 acres. At each Census Stop all birds heard and seen will be recorded for ten minutes; in addition, all birds will be recorded during the one quarter mile walk between each Stop. Each Transect Set should be repeated four times during the Survey Period. The natural communities should be recorded for each Census Stop. Daily field investigations should begin at the starting point of a particular Transect Set by at least sunrise and be completed by 10 a.m. Additional searches should be made if it is felt that species or communities were missed.

SURVEY PERIOD: Field investigations should be conducted during May and June.

STRICT ADHERENCE TO THE FOLLOWING RULES IS ESSENTIAL FOR CONDUCTING INVESTIGATIONS

REQUIREMENTS: Observers must be familiar with the songs, calls, and visual identification of all species likely to be encountered; this is especially important for the discovery and documentation of rare, threatened, and endangered species. Since identification by songs and calls is required, acute hearing is extremely important and necessary.

ADVANCE PREPARATIONS AND SCOUTING: Much valuable time can be lost if Transect Routes are not followable and Census Stops cannot be relocated; therefore, scouting of all Transect Sets should be completed in advance of the first census of the Set and each Census Stop should be permanently marked in the field and on maps.

EQUIPMENT: Clipboard, pencils, field sheets, report forms, maps, binoculars, watch with a second hand (or other time piece for recording precise ten [10] minute intervals).

WEATHER: Transect Routes and Census Stops must be completed under satisfactory weather conditions: good visibility, little or no precipitation, light wind. Occasional light drizzle or a very brief shower may not affect bird activity, but fog, steady drizzle, or prolonged rain should be avoided. Wind speeds should not exceed 10 m.p.h.

WHICH BIRDS TO COUNT: Count all individual birds (of all species) seen and/or heard during the transects and the 10-minute census periods, regardless of distance. Make a special note (including numbers) when migrants are recorded and when dependent young or downy chicks of water or shorebirds are observed.

Address: _____

INVESTIGATIONS

TABULATION SHEET

Year: _____

Page ___ of ___ (for this year)

Species (in A.O.U.* order)	Total Number of Different** TRANSECT LEGS Species	Total Number of Different** CENSUS STOPS Recorded	Species Present in Additional Habitats@	Estimated# Population	Habitat Preferences

* A.O.U. = American Ornithologists' Union

** Indicate the total number of different Transect Legs and Census Stops the species was recorded; five Transect Sets would have about 50 Census Stops and 55 Transect Legs.

@ If the species occurred in 6 of the "Additional" Census Stops established by the observer for qualitative sampling, enter the number 6 in this column.

Use one of the following categories for this column: 1-5 prs; 6-15 prs; 16-50 prs; or

APPENDIX E

USE OF HERBICIDES

General Information

The use of herbicides is recommended for eradication of undesirable vegetation in areas where management techniques such as prescribed burning and water level control are not possible. Trees or shrubs that sprout after burning or develop fire resistance through large size or thickened bark or are protected by lack of understory fuel can often quickly and efficiently be eliminated by properly-used herbicides. Weedy herbaceous plants which are fire resistant due to their growth form or other adaptations can also be eradicated by proper use of herbicides.

All herbicides can be harmful to native plants or the environment if used incorrectly.* Some, however, can be used more safely than others. Five herbicides are suggested here for control of unwanted plants and are reviewed below. Others may be experimented with and found useful in certain situations.

1. GROWTH REGULATORS (2,4-D dichlorophenoxyacetic acid; 2,4,5-T picolinic acid and related compounds): Two are treated below, others may also be useful.

a. 2,4-D tends to be selective and may not affect all plants. It may be foliar sprayed or applied to cut or filled stumps. It affects some trees and herbaceous plants.

b. Picloram (Tordon™=picolonic acid; Tordon™ RTU=picolinic acid and 2,4-D) is highly effective against resistant woody plants such as Robinia pseudo-acacia or Rosa multiflora; however, it must be used carefully because it is nonselective, has a long period of persistence, and may leach from the roots of treated plants and affect adjacent vegetation. Both are available as liquids; Tordon™ is also available as a soil sterilant pellet and is the more effective herbicide. This herbicide is highly toxic to plants and animals and must be used with care.

2. AMINO ACID SYNTHESIS INHIBITORS:

Glyphosate (Roundup™) was developed as a preemergent herbicide for crop use. It is highly effective as a direct spray on all herbaceous plants and is effective when injected into cut tree surfaces. It has low mammalian toxicity and quickly becomes inactive in the soil. This herbicide may be useful against Lythrum salicaria athough it is nonselective.

3. MISCELLANEOUS

a. Ammonium sulfamate (Ammate™) is a relatively safe herbicide with low toxicity with general use in treating cut surfaces of woody plants. It may not be effective on all trees and shrubs and should be experimented with on different plants in different seasons.

b. Ammonium ethyl carbamoyl phosphonate (Krenite™) is highly effective as a foliar spray on shrubs such as sumac (Rhus sp.) and dogwood (Cornus sp.). It is reported as selective but may kill grasses and forbs and should usually be used only where it will not affect other than the

target plants. This herbicide is applied in late summer just before leaf fall; it is taken into the plant and prevents bud initiation the following spring. Hard water should not be used as a mixing agent due to inactivation from chemical bonding.

*Note: Herbicides should be applied by trained or supervised personnel only. Some states offer training in herbicide use and provide testing and licensing services.

For more information consult:

Hamel, D. R. 1981. Forest management chemicals: A guide to use when considering pesticides for forest management. U.S. Forest Serv. Agr. Handbook No. 585. 512pp.

Holt, H. A., and B. C. Fisher, eds. 1981. Proc. Weed Control in Forest Management. Purdue University. 305pp.

Mullison, W. R., et al. 1979. Herbicide handbook. 4th ed. Weed Society of America, Champaign, Illinois. 479pp.

Brown, A. W. A. 1978. Ecology of pesticides. John Wiley & Sons, Inc. 525pp. (see pp. 11-14)

General Terms

Selective herbicides kill certain plants without harming others, usually all broad-leaved plants or all grassy plants.

Nonselective herbicides are toxic to all plants.

Toxicity is the inherent capacity of an herbicide to produce injury or death.

General use herbicides will not harm the applicator or the environment to an unreasonable degree when used as directed.

Restricted herbicides could harm the applicator and the environment even when used as directed.

LD_{50} is a term used to express the toxicity of herbicides. It is expressed in milligrams per kilogram of body weight. If an herbicide has an oral LD_{50} of 100, 100 milligrams of the herbicide will kill about five out of ten test animals each weighing a kilogram.

Basal sprays are herbicides which are applied to the trunks or bases of the plants.

Foliar sprays are applied to the leaves of the plants.

Herbicides for cut surface treatments are injected or applied to cuts on the tree trunk.

Soil applied herbicides are incorporated into the soil.

Herbicides Treatment Chart

Target Plant	2,4-D	Tordon	Roundup	Ammate	Krenite	Treatment (or alternatives)
Dogwood (Cornus)				x		apply to cut stumps
					x	foliar spray
Barberry (Berberis)						pull out by hand
Purple loosestrife (Lythrum salicaria)			x		x	foliar spray; pull if possible
Honeysuckle (Lonicera)			x			apply to cut stumps
					x	foliar spray
Sweetclover (Melilotus)			x			pull out by hand; spot spray rosettes or foliar spray
Pines (Pinus)						cut below all live branches
Poplars (Populus)		x				apply to cut stumps if resistant
				x		apply to cut stumps
Multiflora rose (Rosa multiflora)		x				apply pellets as soil sterilant
					x	foliar spray
Buckthorn (Rhamnus)			x	x		apply to cut stumps
					x	foliar spray
Sumac (Rhus)					x	foliar spray
Locust (Robinia)		x				apply to cut stumps
					x	foliar spray

x = Recommended herbicide application based on literature and field use by Natural Land Institute, 1982. Always follow manufacturers' instructions and safety recommendations.

APPENDIX F

WATER QUALITY

Water quality should be monitored for pollution or changes in chemistry that might alter natural conditions or affect critical species. In general, undisturbed aquatic communities should be free from unnatural color or turbidity, plant or algal growth, odors, sediments or floating debris. If these conditions are identified, their sources should be identified and controlled.

The following parameters serve as key chemical indicators or criterion for measuring water quality and the health of an aquatic ecosystem: pH, dissolved oxygen (DO), total phosphorous (P), ammonia nitrogen (NH_3-N), fecal coliform bacteria, nitrate/nitrite (NO_3-N/NO_2-N), biological oxygen demand (BOD_5), and presence of pesticides.

pH. Changes in pH may critically affect survival or reproduction of plant species and aquatic animal life adapted to a narrow range of pH levels.

Dissolved oxygen (DO). The DO content of a stream is an indicator of the stream's ability to support fish and aquatic life and of the amount of pollution being received by a stream. Untreated or insufficiently treated sanitary sewage or industrial waste contains organics which consume oxygen, forcing aquatic life to compete with waste for dissolved oxygen.

Total phosphorous and nitrogen. Various forms of these elements can accumulate in excessive quantities from fertilizer runoff and become pollution when their concentration is high enough to produce algae in quantities greater than the amount of DO available to allow decomposition of the algae. All streams contain a certain amount of nitrogen and phosphorous naturally. Nutrients in excess of standards designed to protect fish and aquatic life can be contained in municipal and industrial waste discharges, improperly functioning septic systems, and nonpoint runoff from agricultural fields, highly erodable construction sites, and runoff from urban areas.

Ammonia nitrogen. Ammonia nitrogen is contained in municipal sewage treatment plant and livestock waste. It can be toxic to fish in high concentrations and is readily converted to nitrate, using dissolved oxygen in the process.

Fecal coliform bacteria. Fecal coliform bacteria come from the digestive systems of warm-blooded animals and are not in themselves harmful to human health but indicate the presence of other disease-producing microorganisms. Highest coliform bacteria counts are usually downstream from sewage treatment plants; however, farm animals using streams and spring runoff from fields containing winter-applied manure are also contributors.

Biological oxygen demand (BOD_5). BOD_5 is a measure of the amount of oxygen being consumed by organic waste in the process of its decomposition; it describes "pollution strength" of wastewater. Organics are a natural part of stream water that become pollution when they deplete the DO concentration enough to reduce the quality of aquatic life in the stream.

Pesticides (organophosphates, cloroganics, and chlorinated hydrocarbons). The presence of these chemicals indicates pollution from insecticides or herbicides.

Tests of pH, dissolved oxygen, nitrates and ammonia can be made with kits available from Hach Chemical Company, Loveland, Colorado (800/525-5940), or by local laboratories. Pesticides are more difficult to test for and require a professional laboratory.