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MARBLE HILL NUCLEAR GENERATING STATION
UNITS 1 AND 2
REMOTE SENSING AND GROUND TRUTH PROGRAM
FINAL REPORT

Prepared for
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FOREWORD

Texas Instruments Incorporated (TI) is pleased to submit this final report summarizing the methodology applied and results obtained during the first year of the remote sensing and ground truth program conducted within the prescribed area on and near the proposed Marble Hill Nuclear Generating Station, Units 1 and 2, near Paynesville, Jefferson County, Indiana.



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SECTION I
INTRODUCTION

A. PROGRAM OBJECTIVES

The specific objectives of the Marble Hill remote sensing and ground truth program were to ascertain and document the existing vegetation cover types, vegetation stress and soil chemistry in the vicinity of the Marble Hill Nuclear Generating Station and to provide reference information necessary to monitor the potential effects of cooling tower operation and coincident salt deposition on local vegetation and soil. In addition, the aerial color infrared photography will assist Public Service Indiana in their evaluation of construction impacts on the local environment.

B. PROGRAM SCHEDULE AND STATUS

The scheduled and actual completion dates for each task are listed in Table I-1.

Table I-1
Schedule for the Marble Hill Remote Sensing and
Ground Truth Program by Task and Date

Task	Scheduled Completion Date	Actual Completion Date
Aerial CIR Photography	3 August 1976 15 May 1977	3 August 1976 9 May 1977
Photointerpretation	31 August 1976 27 May 1977	20 August 1976 3 June 1977
Vegetation, Data Collection	15 September 1976 29 October 1976 31 March 1977 31 May 1977	4 September 1976 15 October 1976 30 March 1977 14 June 1977
Soil, Data Collection	15 September 1976 29 October 1976 31 March 1977 31 May 1977	4 September 1976 15 October 1976 30 March 1977 14 June 1977
Reports		
Interim	31 December 1976	31 December 1976
Final	15 August 1977	15 August 1977

Methods of data collection, reduction and analysis are documented in Section II - Methodology; summarized data are presented in Section III - Results and Discussion.



SECTION II METHODOLOGY

The objectives of this study have been addressed through application of appropriate methods of data acquisition, handling, analysis, and interpretation. The five major tasks proposed to fulfill the program objectives included:

- Aerial color infrared photography
- Vegetation cover type mapping
- Vegetation stress delineation
- Vegetation sampling and analysis
- Soil chemical sampling and analysis

Methods applied toward completion of each task are discussed in the text that follows.

A. AERIAL COLOR INFRARED PHOTOGRAPHY

Aerial color infrared (CIR) photographs were obtained in August 1976 and May 1977. Five flight lines were required to obtain the May 1977 coverage of the designated area shown in Figure II-1 and maintain a 30-percent side lap. Color infrared photographs were obtained with a 6-inch focal length camera from an altitude of 5000 feet to assure a working scale of 1:10,000 (1 inch = 833 feet). The forward overlap attained was 60 percent and provided the specified stereoscopic viewing conditions.

Film was processed to positive transparencies; these were encased in plastic sleeves for protection during the mapping and ground truth phases of the study.



Figure II-1. Flight Line Map of Color Infrared Photography Coverage, May 1977



B. MAPPING VEGETATION COVER TYPES

Vegetation cover types were delineated from the transparencies in the following manner. Paired transparencies were placed on the surface of a light table and viewed with a mirror stereoscope. Vegetation cover types were delineated on the odd or even number photographs using a black felt-tip pen to mark boundaries directly on the overlaying plastic sleeve. Initial cover type differentiation was accomplished using image tonal variations, physical characteristics and topography of the area viewed. Each cover type was assigned a numerical code for identification prior to the application of nomenclature.

Cover type nomenclature follows the designation and types of the Society of American Foresters (1954) with some modification to allow adequate description of locally important vegetation units. The type name was determined upon the basis of predominant canopy species as indicated by composition of the dominant and codominant canopy species. Where no single species comprised 50 percent or more of a given stand, the stand was typed on the basis of numerical plurality of canopy species.

Initial ground truth examinations were conducted for type and boundary verification and initial nomenclatural assignment. These data were used to refine vegetation cover type delineations and identify areas requiring further field checking. Additional ground truth data obtained during subsequent sampling periods were used to update and refine the cover type map. Final map revisions were incorporated, nomenclature applied, and the vegetation cover type map drafted at a scale of 1:24,000. A total of fifteen map units were employed to document all important existing features and cover types.

The acreage of each map unit was determined from the 1:24,000 scale map by dot sampling with a modified acreage grid (64 dots per square inch). The dot-count method of estimating horizontal acreage is the principal method used by the U.S. Forest Service.



C. MAPPING VEGETATION STRESS

Areas of apparently stressed vegetation were separately delineated within each cover type. Vegetation under stress from disease, insects or weather was detected on the color infrared photography due to loss of infrared reflectance from affected foliage. The reddish photographic rendition of healthy vegetation grades to magenta, purple, green, and yellow as the loss of infrared progresses due to increased stress. Vegetation stress areas were delineated on the photographs and evaluated by an experienced photointerpreter and independently by an experienced field botanist.

Areas of apparent vegetation stress were noted on photo overlays and each was assigned a reference number. During ground truth reconnaissance, stress areas greater than or equal to 5 acres were field checked for stress verification and documentation of the causal agent(s).

Stressed areas of less than 5 acres were not field checked, but locations were plotted on the photo overlays, assigned a reference number for monitoring purposes, and transferred to the vegetation cover type map.

D. VEGETATION SAMPLING AND ANALYSIS

Vegetation cover and condition were sampled by establishing duplicate permanent 100-square-meter quadrats in one representative unit of each of eight specific cover types delineated from the CIR aerial photographs. Sampling locations for each cover type are shown in Figure II-2. A representative unit was vegetationally characteristic of the cover type. Direction from the cooling towers, proximity to the area of maximum salt deposition and accessibility were considered in locating the permanent vegetation quadrats. Use of permanent quadrats facilitated plot relocation, resampling of the same area and vegetation strata, and monitoring of vegetation stress.

Duplicate circular nested plots were used to estimate vegetation cover by species in each representative unit. Figure II-3 shows the plot



Figure II-2. General Locations of Permanent Vegetation and Soil Sampling Plots

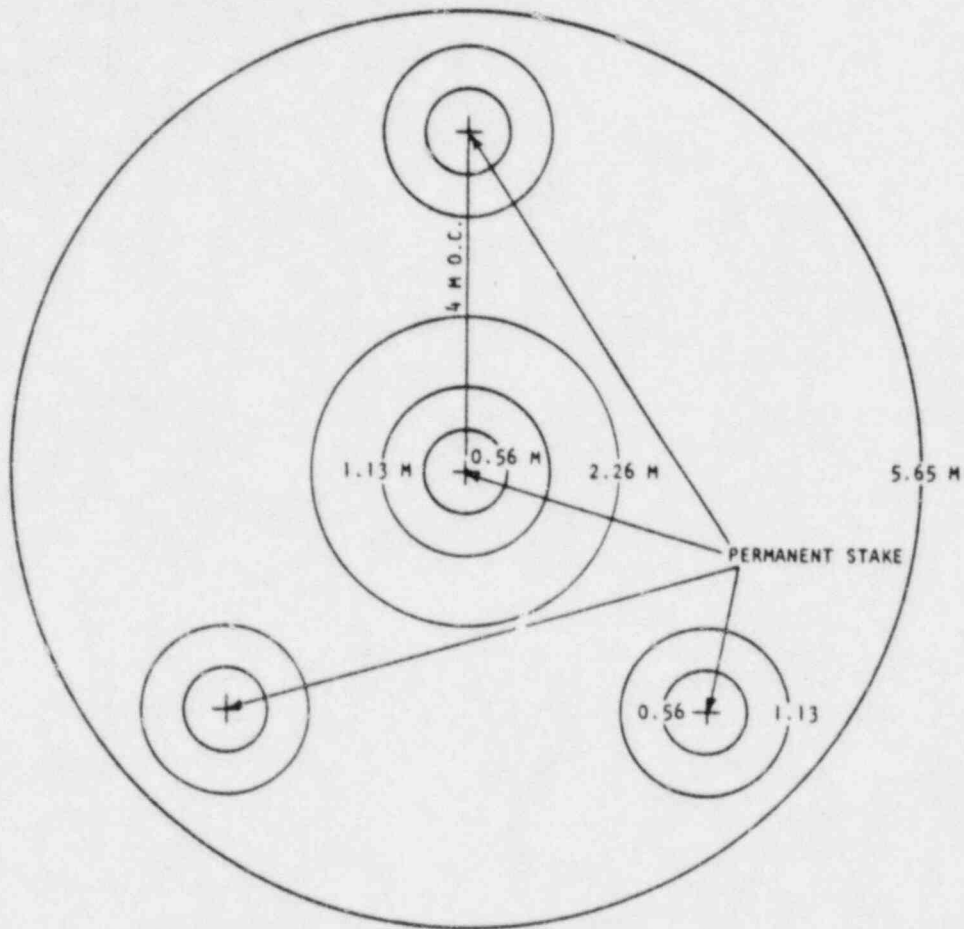


Figure II-3. Nested Circular Plots for Vegetation Sampling
(Numbers represent plot radius)

radii and the nesting arrangement of the four plot types used to sample the various vegetation strata. Vegetation stratum sampled in each plot, the size inclusion criteria, and the plot area are presented in Table II-1.

Nested circular plots were easy to establish and relocate since only a single stake was required to permanently mark a center point from which all radii were measured. Plot sizes and nesting arrangement were modified from those of Cox (1972) and Jhman (1973). The center of each sub-plot within each 100-square-meter plot also was permanently marked.



Table II-1
Vegetation Plot Types

Plot Type (Stratum)	Vegetation Included	Stem dbh* (m)	Stem Height (m)	Plot Radius (m)	Plot Area (m ²)
1	Herbs, grasses, low shrubs, and seedlings	<0.025	<1.0	0.56	1.0
2	Shrubs, vines, and seedlings	<0.025	≥1.0	1.13	4.0
3	Saplings	≥0.025 <0.089	≥1.0	2.26	16.0
4	Trees	≥0.089	≥1.0	5.65	100.0

* Diameter at breast height (1.35 meters above the ground surface)

Herbs, grasses, seedlings, shrubs, and vines (plot types 1 and 2) were sampled during September, October 1976 and March, June 1977 in vegetation cover types, 1, 2, 3, 4, 5, 6, 9, and 11. Data recorded within each of eight subplots per cover type included: taxa present, percent cover (percentage of plot area covered by a given taxon), mode condition (most common state of physical or evident physiological condition of a given taxon), and percentage ground cover (percentage of total plot area covered by vegetation and litter). Condition of orchard trees (cover type 10) was recorded during June 1977.

Diameters of saplings and trees (plot types 3 and 4) were individually measured in each of two plots per cover type during September 1976, March, and June 1977 to determine both species composition and basal area (square meters/hectare). Data recorded for each individual included: taxa, dbh (diameter at breast height) to the nearest 0.1 inch, and condition code (Table II-2). Each individual was numbered with a lumber marking crayon to facilitate recognition and identification of temporal change in apparent health or vigor (condition).



Table II-2
Codes Used to Record Apparent Vegetation Condition

Condition Code	Condition Category
1	Healthy
2	Diseased
3	Insect injury
4	Mechanical injury
5	Browsed
6	Dead
7	Dying
8	Dormant

During October 1976 and March, June 1977 each tree and sapling was inspected for condition and the dbh measured: diameter was not remeasured in October since it was unlikely that this parameter would have changed significantly since the September 1976 measurements.

Plot data were summarized within cover types and the following standard ecological analyses (Cox 1972) were performed for each taxon according to stratum:

$$\text{Cover (\%)} = \frac{\sum \text{percentage areal cover from plots}}{\text{number of plots}}$$

$$\text{Relative cover} = \frac{\text{cover for a species}}{\text{cover for all species}} \times 100$$

$$\text{Basal area (m}^2\text{/ha)} = \frac{\sum_{i=1}^n [(0.5 \text{ dbh in in.})^2 \pi] 0.00064516}{\text{area sampled (ha)}}$$

$$\text{Relative Basal area (\%)} = \frac{\text{basal area for a species}}{\text{basal area for all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of plots in which species occurred}}{\text{number of plots sampled}}$$

$$\text{Relative frequency} = \frac{\text{frequency for a species}}{\text{frequency of all species}} \times 100$$



E. SOIL SAMPLING AND ANALYSIS

Duplicate soil samples (0 to 15 centimeter depth) were collected from each permanent vegetation quadrat during September, October 1976 and March, June 1977. One set of duplicate soil samples was collected from each plot by excavation with a small hand trowel. These samples were placed in appropriately labeled whirlpacs, sealed, and returned to the Dallas laboratory for analysis of pH, conductivity, cation exchange capacity, and percent base saturation.

A second set of duplicate soil samples was collected from each plot for bulk density determinations; sample volume was measured using a sand displacement method (Rice 1968). Percentage moisture in the oven dry soil was measured in association with bulk density determinations by drying samples at 105°C to constant weight. Results were expressed in appropriate units as determined from the following:

$$\text{Bulk density (g/cm}^3\text{)} = \frac{\text{oven dry weight (g) of soil sample}}{\text{sand displacement volume (cm}^3\text{)}}$$

$$\text{Moisture (\%)} = \frac{\text{soil wet weight (g)} - \text{soil dry weight (g)}}{\text{soil wet weight (g)}} \times 100$$

Soil pH in water was determined by mixing equal portions, by weight, of soil and water in an appropriate container. The mixture was stirred periodically and the solids allowed to settle out. The soil-water suspension was then allowed to settle for a short time, after which the pH was measured using an internal reference glass electrode (Black et al 1965). Results were recorded as soil pH measured in water.

Soil conductivity was determined by mixing each soil sample with distilled water and stirring to form a saturated extract. Either soil or water was added to the extract to form the desired soil-water paste. The paste was allowed to stand for one hour, checked for consistency, allowed to



stand for four additional hours, and vacuum-filtered. Conductivity of the filtrate was measured with a cathode-ray conductivity bridge of the Wheatstone type at 85 Hz using a 1.0 constant cell (Black et al 1965). Results were recorded as micromhos/centimeter.

Cation exchange capacity of soils was determined using the ammonium saturation method (Black et al 1965). Samples were air-dried and ground to pass through a 2-millimeter mesh sieve. The sized soil sample was mixed with 1N ammonium acetate, shaken thoroughly, and allowed to stand overnight. The wet sample was filtered, the residue washed with ammonium acetate, and the filtrate set aside for determination of total exchangeable bases (required to calculate percentage base saturation). The residue was then washed several times; once with 99 percent isopropyl alcohol, followed by several washings with 5 percent potassium chloride to a measured volume. Ammonium ion concentration was determined from the washings using an auto analyzer. Results were recorded in milliequivalents per 100 grams of soil.

Percentage base saturation was calculated as follows:

$$\text{Percent base saturation} = \frac{\text{Total exchangeable bases}}{\text{Cation exchange capacity}} \times 100$$

Total exchangeable bases was determined by forced evaporation of the filtrate (set aside during cation exchange processing) to dryness, ignition of the residue in a furnace, and treatment of the cooled residue with 0.1N hydrochloric acid. The acid-treated residue was heated, stirred, and titrated with 0.1N sodium hydroxide to a bromocresol green end-point (Black et al 1965). Results were recorded as milliequivalents per 100 grams of soil based on milliequivalents of standard acid consumed in the titration.

Replicate data from each of the soil chemical analyses were summarized as mean (\bar{x}) and standard error (S.E.) by cover type and date.



SECTION III
RESULTS AND DISCUSSION

Vegetation of the Ohio River Valley and adjacent slopes and uplands along the eastern Indiana - northwest Kentucky border has generally been classified as part of the mixed mesophytic (Shelford 1963) or western mesophytic forest (Braun 1950). Shelford (1963) cited two species as indicators of this beech-maple (Fagus-Acer) forest association: basswood (Tilia americana) and yellow buckeye (Aesculus octandra); neither is commonly a dominant species in the association. Mumford (1969) indicated that the predominant vegetation in this section of Indiana was of the beech (Fagus) type and Lindsey et al. (1969) place it in a beech-oak-maple-hickory (Fagus-Quercus-Acer-Carya) type, but later (Lindsey and Schmelz 1970) redefined the association in an attempt to include intermediate types.

While most writers are in general agreement as to the vegetation association, the classification of vegetation or cover types within the association is not clearcut. Mumford (1969) cited several major subdivisions and closely followed Gordon's (1936) early vegetation classification. Lindsey et al. (1969) used seventeen categories to map vegetation in natural areas over the state of Indiana; these seventeen categories included eight non-forest types. In a later work (Lindsey and Schmelz 1970), the classification contained only four forest types: oak-hickory, beech-maple, lowland-depressional, and mixed wood; the latter two being extremely variable in composition and dominant species.

Under the Society of American Foresters (1954) classification, the survey area is located in the Central Forest Region where thirty-three distinct forest types have been described.

Since the basis of this study was to identify, document and map existing vegetation types in the survey area, the Society of American Foresters (1954) classification system was used for forested areas with appropriate modification to allow adequate description of locally important



vegetation units and variants of major vegetation types. Land use, other than forest type, was also documented.

Classification of survey area vegetation was complicated by local agronomic practices, extensive selective cutting (past and present), and complex topography and moisture relationships. Elevations in the survey area ranged from about 435 feet above mean sea level (MSL) in the Ohio River bottoms to 820 feet MSL on several ridge tops. Limestone bluffs and steep slopes were characteristic of drainageways and borderlands of the Ohio River. Floodplain alluvial areas were characteristically pastured or cropped. Uplands were generally cropped on areas with good drainage; poorly drained or marginally accessible areas were pastured or left as woodlots. Most woodlots and accessible slope forests have been subjected to selective cutting of commercial timber, fence posts or firewood for many years.

Fifteen map units (Table III-1) were delimited in the survey area; eight of these were sampled using permanent vegetation plots (cover types 1, 2, 3, 4, 5, 6, 9, and 11). The horizontal acreage of the survey area was estimated by dot count at 17,074 acres; the eight sampled cover types comprised 32.2 percent of this total. Cropland was the largest map unit at 5556 acres (32.5 percent); cemetery the smallest at approximately 1 acre.

The distribution of vegetation cover types over the entire survey area is depicted in Figure III-1 (1:24,000 scale map located in the plastic pocket). Most of the Ohio River floodplain area was in cropland (cover type 8), pasture (7) or forest (5); level uplands were generally cropped (8 and 10) with small areas of pasture (7) and forest (2, 4 and 11). Slopes and small drainage ways were forested (1, 2, 3, 6, and 9).

Ten of the fifteen cover types mapped were present on the site proper (Figure III-2). Most of the upland area depicted as cropland (8) in this photo of a portion of the site was actually abandoned cropland; vegetation was primarily teasel (Dipsacus), thistle (Cirsium), and blackberry (Rubus), but was extremely variable in composition as influenced by time



TABLE III-1
Horizontal Acreage for Each Vegetation Cover Type (Map Unit)

Code	Name	Acreage	Percent of Total
1	Maple-Basswood	613	3.6
2	Oak-Maple	2,183	12.8
3	Chestnut oak	528	3.1
4	Red pine	17	0.1
5	Sycamore-Boxelder	596	3.5
6	Oak-Hickory	686	4.0
7	Unimproved pasture (includes scrubland)	2,681	15.7
8	Cropland	5,556	32.5
9	Walnut-Hickory-Buckeye	660	3.9
10	Orchards	24	0.1
11	Virginia pine	205	1.2
12	Residential/farmsteads	360	2.1
13	Industrial	79	0.5
14	Water	2,885	16.9
	Cemetery	1	--
	Total	17,074	100.0

since last cropping and type of crop last grown. The small cemetery present in the lower right center of the photo was not delineated on the overlay since it did not meet the size (>1.0 acre) criteria. Barns and other out-buildings were generally not typed with the residence/farmstead (12) type but were included with the unit surrounding them; usually pasture (7). A total of 130 taxa was observed in sampled cover types during the period September 1976 through June 1977 (Table A-1, Appendix A).



Figure III-2. Example of Color Infrared Aerial Photography (1:10,000 scale) Depicting a Portion of the Marble Hill Site Area with Vegetation Cover Type Overlay, May 1977



A. COVER TYPE ANALYSIS

1. Vegetation

• Maple-Basswood (01)

This type occurred on steep, moist east- and north-facing slopes along the Indiana side of the Ohio River. Canopy dominants were sugar maple (Acer saccharum) and basswood; saplings were sparsely distributed and none occurred in samples (Table III-2). Three white ash (Fraxinus americana) individuals were present in the tree stratum; one was healthy, one mechanically injured, and one dead.

Plots in the shrub stratum contained only pawpaw (Table III-3), but sugar maple and yellow buckeye were present elsewhere in the stand.

Eight species of trees were present in the herbaceous stratum; all were in healthy condition except yellow buckeye (Aesculus octandra) which had been browsed heavily during early spring. More important species in this stratum (based on relative cover values over four sample periods) were late-flowering thoroughwort (Eupatorium serotinum), wild ginger (Asarum canadense), and sugar maple (Table III-4). Important species during March 1977 consisted of spring ephemerals: cut-leaved toothwort (Dentaria laciniata), spring-beauty (Claytonia virginica) and harbinger-of-spring (Erigenia bulbosa). Cover contributed by the spring ephemerals resulted in March vegetation cover values being highest of the year in this cover type (Table III-5). Vegetation cover in June 1977 was just over half that observed in March and none of the ephemerals previously mentioned contributed cover to the June estimates. Twenty-two species were recorded from herbaceous stratum sample plots during the four sample periods.

• Oak-Maple (02)

The oak-maple type occurred on several different exposures, usually on upper slopes or steep slopes of small drainageways and some upland areas. Sugar maple predominated (Table III-6), but chestnut oak

Table III-2

Species Composition, Frequency, Basal Area and Condition of the Tree and Sapling Strata (Plot Type 4 and 3)
Maple-Basswood (01) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live Condition							
<u>Acer saccharum</u>	Sugar maple	5	1.00	33.3	14.0	41.2	Healthy
<u>Tilia americana</u>	Basswood	3	0.50	16.7	13.5	39.7	Healthy
<u>Juglans nigra</u>	Black walnut	1	0.50	16.7	4.0	11.8	Healthy
<u>Fraxinus americana</u>	White ash	2	0.50	16.7	1.9	5.6	Healthy/mechanical injury
Total Live		11	2.50	83.4	33.4	98.3	
Dead Condition							
<u>Fraxinus americana</u>	White ash	1	0.50	16.7	0.6	1.8	
Total Dead		1	0.50	16.7	0.6	1.8	
TOTAL		12	3.00	100.1	34.0	100.0	
Sapling stratum							
No saplings occurred in plots							





Table III-3
Species Composition, Frequency, Areal Cover, and Condition of the Shrub Stratum (Plot Type 2) by Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common	Relative Frequency (%)												Relative Cover (%)												Node Condition
		Sept	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sept	Oct	Mar	Jun	Sep	Oct	Mar	Jun					
Maple-Basswood (01)		0.25	0.25	0.38	0.38	100.0	100.0	100.0	100.0	0.88	1.09	1.35	2.00	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Healthy			
<i>Azimina triloba</i>	Paw Paw	0.25	0.25	0.38	0.38	100.0	100.0	100.0	100.0	0.88	1.09	1.35	2.00	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Healthy			
Oak-Maple (02)		0.50	0.38	0.25	0.38	49.5	45.7	30.1	42.7	1.63	2.25	1.13	1.63	33.5	46.1	37.5	21.0	Healthy	Diseased							
<i>Acer saccharum</i>	Sugar maple	0.50	0.38	0.25	0.38	49.5	45.7	30.1	42.7	1.63	2.25	1.13	1.63	33.5	46.1	37.5	21.0	Healthy	Healthy							
<i>Cornus florida</i>	Flowering dogwood	0.25	0.25	0.13	0.25	20.3	20.3	20.3	20.3	3.50	2.00	1.35	2.00	45.8	45.8	45.8	45.8	Healthy	Healthy							
<i>Q. trityliformis</i>	Ironwood	0.13	0.13	0.13	0.13	14.6	14.6	14.6	14.6	1.00	0.63	0.42	1.00	12.8	12.8	12.8	12.8	Healthy	Healthy							
<i>Prunus serotina</i>	Black cherry	0.13	0.13	0.13	0.13	12.9	12.9	12.9	12.9	0.88	1.09	1.35	0.88	15.7	15.7	15.7	15.7	Healthy	Healthy							
Total		1.01	0.89	0.64	0.89	100.0	100.0	100.0	100.0	6.38	4.89	3.01	7.76	100.0	100.0	100.0	100.0	Healthy	Healthy							
Chestnut Oak (03)		0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Leititis occidentalis</i>	Hackberry	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Panicum virgatum</i>	Leather-flower	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Juniperus virginiana</i>	Periwinkle	0.25	0.25	0.25	0.25	27.8	21.7	12.6	12.6	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Lonicera japonica</i>	Eastern red cedar	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Passiflora lutea</i>	Japanese honeysuckle	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Rubus cuneifolius</i>	Yellow passion-flower	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Ulmus rubra</i>	Black locust	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
<i>Viburnum prunifolium</i>	Slippery elm	0.13	0.13	0.13	0.13	14.4	11.1	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
Total		0.40	0.15	0.13	0.13	27.8	21.7	12.6	10.7	0.13	0.13	0.38	0.88	5.8	4.5	15.1	10.8	Healthy	Healthy							
Red Pine (04)		0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
<i>Acer saccharum</i>	Sugar maple	0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
<i>Cornus florida</i>	Flowering dogwood	0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
<i>Fraxinus americana</i>	White ash	0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
<i>Lonicera japonica</i>	Japanese honeysuckle	0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
<i>Parthenocissus quinquefolia</i>	Virginia creeper	0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
<i>Vitis rotundifolia</i>	Muscadine grape	0.13	0.13	0.13	0.13	16.9	16.9	16.9	16.9	1.88	1.88	1.00	1.75	20.7	23.4	44.2	17.7	Healthy	Healthy							
Total		0.77	0.77	0.64	0.64	128.1	128.1	128.1	128.1	10.0	10.0	5.38	8.71	100.0	100.0	100.0	100.0	Healthy	Healthy							
Sycamore-Boxelder (05)		0.13	0.13	0.13	0.13	100.0	100.0	100.0	100.0	1.88	1.50	1.00	2.50	100.0	100.0	100.0	100.0	Healthy	Healthy							
<i>Ulmus rubra</i>	Slippery elm	0.13	0.13	0.13	0.13	100.0	100.0	100.0	100.0	1.88	1.50	1.00	2.50	100.0	100.0	100.0	100.0	Healthy	Healthy							
Total		0.13	0.13	0.13	0.13	100.0	100.0	100.0	100.0	1.88	1.50	1.00	2.50	100.0	100.0	100.0	100.0	Healthy	Healthy							
Oak-hickory (06)		0.13	0.13	0.13	0.13	26.5	26.5	26.5	26.5	2.50	2.50	0.63	3.13	23.5	33.3	17.9	25.0	Healthy	Healthy							
<i>Cercis canadensis</i>	Eastern Redbud	0.13	0.13	0.13	0.13	26.5	26.5	26.5	26.5	2.50	2.50	0.63	3.13	23.5	33.3	17.9	25.0	Healthy	Healthy							
<i>Gymnocladus dioica</i>	Kentucky coffee-tree	0.13	0.13	0.13	0.13	26.5	26.5	26.5	26.5	2.50	2.50	0.63	3.13	23.5	33.3	17.9	25.0	Healthy	Healthy							
<i>Ulmus rubra</i>	Slippery elm	0.13	0.13	0.13	0.13	26.5	26.5	26.5	26.5	2.50	2.50	0.63	3.13	23.5	33.3	17.9	25.0	Healthy	Healthy							
Total		0.51	0.51	0.51	0.51	100.0	100.0	100.0	100.0	10.63	7.51	3.51	12.31	100.0	100.0	94.9	99.9	Healthy	Healthy							
Walnut-Hickory-Buckeye (09)		0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Acer negundo</i>	Boxelder	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Acer saccharum</i>	Sugar maple	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Asclepias tuberosa</i>	Ohio buckeye	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Asimina triloba</i>	Pawpaw	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Carya ovata</i>	Shagbark hickory	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Cercis canadensis</i>	Eastern redbud	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Fraxinus americana</i>	White ash	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Fraxinus quadrangulata</i>	Blue ash	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Lonicera japonica</i>	Spicebush	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Quercus prinus</i>	Japanese honeysuckle	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Ulmus rubra</i>	Chestnut oak	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
<i>Ulmus rubra</i>	Poison ivy	0.13	0.13	0.13	0.13	4.1	4.1	4.0	4.1	0.63	0.63	2.50	3.2	3.8	1.9	3.2	3.2	Healthy	Healthy							
Total		3.17	3.16	3.29	3.29	130.1	99.3	100.2	99.9	16.54	13.51	6.04	17.77	100.0	100.0	99.9	99.9	Healthy	Healthy							
Virginia Pine (11)		0.11	0.11	0.11	0.11	33.3	33.3	25.5	34.2	0.63	0.63	0.63	0.63	62.5	62.5	50.0	71.6	Healthy	Healthy							
<i>Cornus florida</i>	Flowering dogwood	0.11	0.11	0.11	0.11	33.3	33.3	25.5	34.2	0.63	0.63	0.63	0.63	62.5	62.5	50.0	71.6	Healthy	Healthy							
<i>Lonicera saratica</i>	Tartarian honeysuckle	0.11	0.11	0.11	0.11	33.3	33.3	25.5	34.2	0.63	0.63	0.63	0.63	62.5	62.5	50.0	71.6	Healthy	Healthy							
<i>Prunus serotina</i>	Black cherry	0.11	0.11	0.11	0.11	33.3	33.3	25.5	34.2	0.63	0.63	0.63	0.63	62.5	62.5	50.0	71.6	Healthy	Healthy							
Total		0.39	0.39	0.51	0.38	99.9	99.9	100.0	100.0	1.01	1.01	1.26	0.85	100.0	100.0	100.0	100.0	Healthy	Healthy							

*Data was not observed in plots during indicated (dash) sample period.

Table III-4



Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot Type 1) Maple-Basswood (01) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	Frequency				Relative Frequency (%)				Areal Cover (%)				Relative Cover (%)				Node Condition			
		SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN
<i>Acer saccharum</i>	Sugar maple	0.36	0.38	0.38	0.63	10.0	10.3	6.4	16.7	2.13	2.86	0.38	2.00	10.4	16.2	1.2	11.6	Healthy	Healthy	Dormant	Healthy
<i>Aesculus octandra</i>	Yellow buckeye	0.13	0.13	0.13	0.75	3.4	3.5	2.9	6.6	0.01	0.01	1.13	0.08	0.1	0.1	3.6	5.1	Healthy	Healthy	Healthy	Browsed
<i>Anemone thalictroides</i>	Roe anemone	-	-	0.13	-	-	-	2.9	-	-	-	1.06	-	-	-	3.7	-	-	-	Healthy	-
<i>Arisaema atrorubens</i>	Jack-in-the-pulpit	-	-	0.13	0.25	-	-	2.9	6.6	-	-	0.13	0.50	-	-	0.4	2.9	-	-	Healthy	Healthy
<i>Asarum canadense</i>	Wild ginger	0.50	0.50	0.25	0.50	13.2	13.6	5.5	13.3	5.01	5.75	1.13	5.75	24.6	32.4	3.6	33.3	Healthy	Healthy	Healthy	Healthy
<i>Asimina triloba</i>	Pawpaw	0.13	0.13	-	-	3.4	3.5	-	-	0.01	0.01	-	-	0.1	0.1	-	-	-	-	-	-
<i>Carya cordiformis</i>	Yellowbud hickory	-	-	-	0.13	-	-	-	3.4	-	-	-	0.13	-	-	0.8	-	-	-	-	Insect Injury
<i>Claytonia virginica</i>	Spring-beauty	-	-	0.80	-	-	-	19.4	-	-	-	2.25	-	-	-	8.7	-	-	-	Healthy	-
<i>Dentaria laciniata</i>	Cut-leaved toothwort	-	-	1.00	-	-	-	22.0	-	-	-	22.13	-	-	-	69.9	-	-	-	Healthy	-
<i>Frigaria bulbosa</i>	Sarabinger-of-spring	-	-	1.00	-	-	-	22.0	-	-	-	2.13	-	-	-	6.7	-	-	-	Healthy	-
<i>Eupatorium serotinum</i>	Late-flowering thoroughwort	0.50	0.50	-	0.50	13.2	13.0	-	13.3	6.00	7.00	-	5.00	29.4	39.5	-	29.0	Healthy	Healthy	-	Healthy
<i>Fraxinus americana</i>	White ash	0.38	0.38	0.13	0.38	10.0	10.3	2.9	10.1	1.25	1.00	0.13	1.36	6.1	5.7	0.4	8.0	Healthy	Healthy	Dormant	Healthy
<i>Gallium boreale</i>	Northern bedstraw	-	-	0.13	-	-	-	2.9	-	-	-	0.13	-	-	-	0.4	-	-	-	Healthy	-
<i>Parthenocissus quinquefolia</i>	Virginia creeper	0.13	0.13	-	0.13	3.4	3.5	-	3.4	0.25	0.01	-	0.50	1.2	0.1	-	2.9	Insect Injury	Dormant	-	Healthy
<i>Phryma leptostachya</i>	Lopseed	-	-	-	-	6.6	6.6	-	-	4.63	0.25	-	-	12.7	1.4	-	-	Healthy	Dormant	-	-
<i>Pinus strobus</i>	White pine	0.13	0.13	-	-	3.4	3.5	-	-	0.01	0.01	-	-	0.1	0.1	-	-	Healthy	Healthy	-	-
<i>Rhus radicans</i>	Poison ivy	0.25	0.25	-	0.25	6.6	6.8	-	6.6	0.39	0.14	-	0.25	1.9	0.9	-	1.4	Healthy	Healthy	-	Healthy
<i>Sanicula trifoliata</i>	Snakeroot	0.13	0.13	-	-	3.4	3.5	-	-	0.25	0.25	-	-	1.2	1.4	-	-	Healthy	Healthy	-	-
<i>Tilia americana</i>	Basswood	-	-	0.13	-	-	-	3.5	-	-	0.01	-	-	-	0.1	-	-	Healthy	Healthy	-	-
<i>Ulmus rubra</i>	Slippery elm	0.25	0.38	0.13	0.75	19.8	10.3	2.9	19.9	0.44	0.26	0.25	0.68	2.2	1.6	0.6	5.1	Healthy	Healthy	Healthy	Healthy
<i>Viola sp.</i>	Violet	-	-	0.25	-	-	-	5.5	-	-	-	0.38	-	-	-	1.2	-	-	Healthy	Healthy	-
<i>Vitis aestivalis</i>	Summer grape	0.13	0.25	-	-	3.4	6.8	-	-	0.01	0.14	-	-	0.7	0.8	-	-	Healthy	Healthy	-	-
TOTAL		3.79	3.67	4.54	3.77	99.8	95.5	100.2	99.9	10.39	17.74	11.67	12.77	100.1	100.3	100.1	100.1				

*Taxa was not observed in plots during indicated (dash) sample period

Table III-5

Percentage of Ground Surface Covered by Vegetation and Litter in the Herbaceous Stratum of Each Vegetation Cover Type during September, October 1976 and March, June 1977

Code	Cover Type	Areal Cover (%)*											
		Vegetation				Litter				Total			
		Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun
01	Maple-Basswood	20.6	17.5	31.6	17.8	53.8	58.8	65.3	72.0	74.4	76.3	96.9	89.8
02	Oak-Maple	25.1	19.4	6.5	30.6	67.4	76.9	89.1	65.3	92.5	96.3	95.6	95.9
03	Chestnut oak	15.9	12.9	6.3	33.1	71.6	77.1	81.2	58.8	87.5	90.0	87.5	91.9
04	Red pine	29.8	25.8	7.0	41.6	70.2	74.2	93.0	58.4	100.0	100.0	100.0	100.0
05	Sycamore-Boxelder	70.0	57.5	15.5	51.3	21.9	38.8	81.4	45.0	91.9	96.3	96.9	96.3
06	Oak-Hickory	12.1	8.1	38.6	15.6	52.9	60.6	48.3	60.7	65.0	68.7	86.9	76.3
09	Walnut-Hickory-Buckeye	29.1	16.5	8.0	46.3	61.9	81.4	86.4	48.1	91.0	97.9	94.4	94.4
11	Virginia pine	13.8	12.9	9.5	23.0	73.7	74.6	89.4	76.1	87.5	87.5	98.9	99.1

* Based on mean of 8 plots per cover type per sample date.



Table III-6

Species Composition, Frequency, Basal Area and Condition of the Tree and Sapling Strata (Plot Type 4 and 3)
Oak-Maple (02) Cover Type, September, October 1976 and March, June 1977



Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live Condition							
<u>Acer saccharum</u>	Sugar maple	6	1.00	20.0	9.6	30.0	Healthy
<u>Quercus prinus</u>	Chestnut oak	1	0.50	10.0	6.2	19.4	Mechanical injury
<u>Quercus velutina</u>	Black oak	1	0.50	10.0	5.6	17.5	Healthy
<u>Fraxinus americana</u>	White ash	3	0.50	10.0	5.6	17.5	Healthy
<u>Prunus serotina</u>	Black cherry	2	1.00	20.0	2.7	8.4	Healthy/dying
<u>Cornus florida</u>	Flowering dogwood	2	0.50	10.0	0.8	2.5	Healthy/diseased
<u>Juniperus virginiana</u>	Eastern red cedar	1	0.50	10.0	0.4	1.3	Diseased
Total Live		16	4.50	90.0	30.9	96.6	
Dead Condition							
<u>Acer saccharum</u>	Sugar maple	1	0.50	10.0	1.1	3.4	
Total Dead		1	0.50	10.0	1.1	3.4	
TOTAL		17	5.00	100.0	32.0	100.0	
Sapling stratum							
Live Condition							
<u>Acer saccharum</u>	Sugar maple	5	1.00	100.0	1.8	100.0	Healthy
Total Live		5	1.00	100.0	1.8	100.0	
Dead Condition							
None							
Total Dead		0	0	0	0	0	
TOTAL		5	1.00	100.0	1.8	100.0	

III-10

services group



(Quercus prinus), black oak (Quercus velutina) and white ash had significant basal area in the sampled stand. Sugar maple was the only sapling represented in plots; however, other sections of the stand contained ironwood (Ostrya virginiana), blue beech (Carpinus caroliniana), and eastern red cedar (Juniperus virginiana) as sapling size individuals.

The oak-maple type included many upland areas that were extremely variable in composition and specific species dominants. Major tree species encountered in these upland areas were yellow poplar (Liriodendron tulipifera), black oak, scarlet oak (Quercus coccinea), southern red oak (Quercus falcata), sassafras (Sassafras albidum), and white ash. Beech (Fagus grandifolia) and Hercules-club (Aralia spinosa) were common in a few isolated areas.

The sampled shrub stratum was composed entirely of tree seedlings (Table III-3); other areas in the type had spicebush (Lindera benzoin) present.

Most important species in the herbaceous stratum (based on relative cover values over four sample dates) were sugar maple, flowering dogwood (Cornus florida), and slippery elm (Ulmus rubra). During March 1977 the ephemerals gained prominence (Table III-7): wild garlic (Allium canadense), cut-leaved toothwort and wood anemone (Anemone quinquefolia). Sugar maple was also one of the most important species in March.

Thirty-four taxa were recorded from herbaceous stratum sample plots; ten of these were tree species.

- Chestnut Oak (03)

Most stands of chestnut oak occurred on dry rocky slopes or on south-facing slopes. Stand basal area was low (21.7 m²/ha) compared to other types (except the Virginia pine type which was comparable) and the sapling stratum was not well defined. Chestnut oak was the clear dominant



Table III-7

Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot Type 1), Oak-Maple (02) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	Relative Frequency (%)												Relative Cover (%)												MOE	MGE	JUN
		SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN							
Acer saccharum	Sugar maple	0.38	0.40	0.38	0.50	4.9	6.6	6.7	6.9	4.39	3.50	1.00	2.75	17.7	17.9	15.6	10.0	Healthy	Healthy	Healthy	Healthy							
Allium canadense	wild garlic	0.50	0.50	0.50	0.50	6.6	6.6	6.6	6.6	6.6	0.50	0.50	6.6	6.6	6.6	6.6	6.6	6.6	Healthy	Healthy	Healthy	Healthy						
Anemone pulsatilla	wind anemone	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Anemone thalictrifolia	blue anemone	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Aster sp.	Aster	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Aster altissimus	Azure aster	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Botrychium virginianum	Virginia grape-fern	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Carya cordiformis	Willow oak	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Cercis canadensis	Eastern redbud	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Cornus florida	Flowering dogwood	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Demissa laciniata	Cut-leaved toothwort	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Dicentra cucullaria	Buttercup	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Elymus virginicus	Virginia wild rye	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Fragaria virginiana	Wild strawberry	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Fraxinus americana	White ash	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Fraxinus quadrangulata	Green ash	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Galium boreale	Northern bedstraw	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Galium aparine	Witch-ham	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Geum canadense	Canada anemone	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Hydrophyllum appendiculatum	Spotted waterleaf	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Jeffersonia diphylla	Wild geranium	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Linaria genzoni	Spicebush	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Ostrya virginiana	Ironwood	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Parthenocissus quinquefolia	Virginia creeper	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Prunus serotina	Black cherry	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Quercus grisea	Chestnut oak	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Rhus glabra	Toxic sumac	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Rubus odoratus	Blackberry	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Solidago canadensis	Goldenrod	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Solidago nemoralis	Canada goldenrod	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Symphoricarpos orbiculatus	Groundcover	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Thalictrum flavum	Yellow poppy	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Viburnum prunifolium	Black haw	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
Viola erucifolia	Viola	0.13	0.13	0.13	0.13	1.7	1.7	1.7	1.7	1.7	0.13	0.13	1.7	1.7	1.7	1.7	1.7	1.7	Healthy	Healthy	Healthy	Healthy						
TOTAL		7.82	7.57	5.68	7.22	100.6	99.7	100.1	99.9	24.84	19.55	6.47	30.97	100.1	99.9	99.9	99.9	100.0										

*Data was not observed in plots during indicated (dash) sample period



(Table III-8) with 52.7 percent of the basal area in the stand. Most blue ash observed was not healthy as evidenced by results in Table III-8.

The shrub stratum consisted of tree seedlings and vines (Table III-3). Forty-five taxa were recorded in the herbaceous stratum sampling plots (Table III-9); 29 percent were tree seedlings. Eastern red cedar (Juniperus virginiana) was present in all sampled strata and seedling Virginia pine (Pinus virginiana) occurred in the herbaceous stratum. Reproduction of dominant tree species was evident. The ephemeral flora was not important in this cover type.

- Red Pine (04)

Cover type 4 was a 3.6 acre representative of an abandoned pine plantation. The predominant species was red pine (Pinus resinosa); white pine (Pinus strobus) was subdominant (Table III-10). These two species are common associates in their northern natural range; neither is native to southeast Indiana. White pine seedlings were present, but evidence of red pine reproduction was not observed.

Thirteen percent of the trees in plots were dead in September 1976, 27 percent were dead in March and June 1977 (Table III-11). All dead individuals were red pine. Twenty-three percent of the trees were diseased or dying in September, 27 percent in March and June 1977 (Table III-11). A majority of trees that incurred a decline in condition between September 1976 and March 1977 were dominant individuals with crowns into and above the stand canopy. Major source of stress on red pine was cold injury resulting from severe icing and low temperatures during winter.

The shrub stratum contained three tree species and three vines (Table III-3); muscadine grape was the predominate species. Thirty-one taxa were recorded from plots in the herbaceous stratum (Table III-12); eleven of these were tree seedlings. Flowering dogwood and Japanese honeysuckle were the two most important herbaceous stratum species. A small uncommon orchid



Table III-8

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3),
Chestnut Oak (03) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live condition							
<u>Quercus prinus</u>	Chestnut oak	11	1.00	16.7	10.7	49.5	Healthy
<u>Fraxinus americana</u>	White ash	7	1.00	16.7	4.9	22.7	Healthy
<u>Juniperus virginiana</u>	Eastern red cedar	5	1.00	16.7	2.9	13.4	Healthy
<u>Quercus rubra</u>	Red oak	1	0.50	8.3	0.6	2.8	Healthy
<u>Acer saccharum</u>	Sugar maple	1	0.50	8.3	0.4	1.9	Healthy
<u>Ulmus rubra</u>	Slippery elm	1	0.50	8.3	0.4	1.9	Diseased
<u>Fraxinus quadrangulata</u>	Blue ash	1	0.50	8.3	0.3	1.4	Dying
Total Live		27	5.00	83.3	20.2	93.5	
Dead condition							
<u>Quercus prinus</u>	Chestnut oak	2	0.50	8.3	0.7	3.2	
<u>Fraxinus quadrangulata</u>	Blue ash	1	0.50	8.3	0.7	3.2	
Total Dead		3	1.00	16.7	1.4	6.4	
TOTAL		30	6.00	100.0	21.6	99.9	
Sapling stratum							
Live condition							
<u>Juniperus virginiana</u>	Eastern red cedar	1	0.50	100.0	0.8	100.0	Healthy
Total Live		1	0.50	100.0	0.8	100.0	
Dead condition							
None							
Total Dead		0	0	0	0	0	
TOTAL		1	0.50	100.0	0.8	100.0	

III-14

services group

Table III-10

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3)
Red Pine (04) Cover Type, September, October 1976 and March, June 1977



Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live condition							
<u>Pinus resinosa</u>	Red pine	6	1.00	16.7	3.7	9.4	Healthy
		5	1.00	16.7	9.5	24.1	Diseased
		3	1.00	16.7	4.4	11.2	Dying
<u>Pinus strobus</u>	White pine	5	1.00	16.7	7.5	19.0	Healthy
<u>Liriodendron tulipifera</u>	Yellow poplar	1	0.50	8.3	3.6	9.1	Healthy
<u>Fraxinus americana</u>	White ash	2	0.50	8.3	2.4	6.1	Healthy
Total Live		22	5.00	83.4	31.1	78.9	
Dead condition							
<u>Pinus resinosa</u>	Red pine	8	1.00	16.7	8.3	21.1	
Total Dead		8	1.00	16.7	8.3	21.1	
TOTAL		30	6.00	100.1	39.4	100.0	
Sapling stratum							
No saplings occurred in plots							



Table III-11

Change in Condition of Trees in the Red Pine (04) Cover Type between September 1976 and June 1977 (*italicized entries indicate a substantive change for that individual*)

Scientific Name	Common Name	Tree No. ¹	Canopy Position ²	DBH ³ (inches)	Condition ⁴		
					September	March	June
<i>Pinus resinosa</i>	Red pine	41-1	3	4.8	2	1	1
		41-2	3	6.3	6	6	6
		41-3	3	4.7	6	6	6
		41-4	1	6.1	7	6	6
		41-5	3	5.7	6	6	6
		41-6	1	6.3	1	2	2
		41-7	4	3.6	7	6	6
		41-10	1	8.3	7	7	7
		41-12	1	8.0	1	2	2
		41-13	1	8.0	1	2	2
		41-14	1	9.6	1	7	7
		42-1	3	3.8	7	7	7
		42-3	1	9.0	1	6	6
		42-4	1	6.1	6	6	6
		42-8	1	8.3	1	2	2
		42-9	1	5.6	4	1	1
		42-10	2	5.0	1	1	1
		42-11	2	5.0	1	1	1
		42-12	2	5.2	1	1	1
		42-13	1	8.5	4	6	6
42-14	1	9.5	1	2	2		
42-15	3	4.3	4	1	1		
<i>Pinus strobus</i>	White pine	41-8	2	6.4	1	1	1
		41-11	3	5.6	2	1	1
		42-2	3	12.3	4	4	4
		42-5	1	6.6	4	1	1
<i>Fraxinus americana</i>	White ash	42-6	1	4.9	1	1	1
		42-7	1	6.3	2	8	1
<i>Liriodendron tulipifera</i>	Yellow poplar	42-16	1	7.4	1	8	1
		41-9	1	11.9	1	1	1

¹Permanent identification number assigned to each individual tree.

²Position of each individual tree crown relative to other individuals in the vicinity:
1-dominant, 2-codominant, 3-intermediate, 4-suppressed.

³Diameter at breast height (4.5 ft above the ground surface).

⁴Condition code: 1-healthy, 2-diseased, 3-insect injury, 4-mechanical injury, 5-browsed, 6-dead, 7-dying, 8-dormant.



Table III-12
Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot Type 1), Red Pine (04) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	Frequency						Relative Frequency (%)						Areal Cover (%)						Relative Cover (%)						Male Condition					
		SEP	OCT	MAR	JUN	SEP	OCT	SEP	OCT	MAR	JUN	SEP	OCT	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN		
<i>Cercis canadensis</i>	Eastern redbud	0.75	0.75	0.38	0.63	10.2	12.1	9.1	7.7	4.63	1.65	1.76	1.65	2.25	5.5	4.9	5.4	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy		
<i>Cornus florida</i>	Flowering dogwood	0.75	0.63	0.38	0.63	10.2	10.2	6.0	6.0	4.13	0.38	5.75	5.75	15.5	16.0	9.3	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Bontaria laciniata</i>	Cut-leaved toothwort	0.13	0.13	0.25	0.13	1.8	2.1	1.6	1.6	0.25	0.63	0.75	0.75	2.5	2.4	1.8	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Eupatorium serotinum</i>	Late-flowering thoroughwort	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.25	0.25	0.13	0.75	0.8	1.0	0.6	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Fagus grandifolia</i>	Beech	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.25	0.25	0.13	0.75	1.3	1.0	1.5	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Fragaria virginiana</i>	Wild strawberry	0.25	0.25	0.13	0.38	3.4	4.0	3.1	4.6	2.25	1.25	0.13	2.50	7.5	4.8	1.9	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Fraxinus americana</i>	White ash	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.25	0.25	0.13	0.75	1.3	1.5	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Gallium aparitum</i>	Northern bedstraw	0.50	0.38	0.13	0.38	6.8	6.1	4.6	4.6	0.51	0.26	0.63	1.7	1.0	1.0	1.5	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Gallium circeoides</i>	White wild licorice	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.13	0.13	0	0.38	0.4	0.5	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Gallium triflorum</i>	Fragrant bedstraw	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.13	0.13	0	0.38	0.4	0.5	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Geum canadense</i>	Canadian avens	0.50	0.50	0.38	0.38	6.8	8.1	11.9	4.6	9.88	12.25	3.88	6.75	33.0	47.5	57.2	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Lonicera japonica</i>	Japanese honeysuckle	0.38	0.13	0.13	0.13	5.2	2.1	3.1	6.1	1.00	0	0	3.38	3.4	3.4	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Muhlenbergia subulifera</i>	Muhly grass	0.38	0.13	0.13	0.50	5.2	2.1	3.1	6.1	1.00	0	0	3.38	3.4	3.4	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Parthenocissus quinquefolia</i>	Virginia creeper	0.13	0.13	0.13	0.25	1.8	2.1	3.1	3.0	1.00	0.13	0	1.50	3.4	0.5	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Phytolacca</i>	Looseleaf	0.38	0.50	0.38	0.75	5.2	8.1	9.1	9.1	0.04	0.51	0.50	0.75	0.1	1.9	7.4	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Pinus strobus</i>	White pine	0.25	0.50	0.88	0.88	3.4	8.1	21.0	10.7	0.25	0.50	0.50	1.75	0.8	1.9	7.4	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Prunella serotina</i>	Black cherry	0.13	0.13	0.13	0.13	1.8	2.1	3.1	3.0	1.13	1.01	1.50	1.75	3.4	2.4	4.2	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Quercus prinus</i>	Chestnut oak	0.25	0.38	0.25	0.25	3.4	6.1	3.0	3.0	1.13	1.01	1.50	1.75	3.8	3.9	3.6	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Quercus velutina</i>	Black oak	0.75	0.13	0.50	0.50	10.2	2.1	6.1	6.1	0.80	0	0	1.13	2.7	3.9	3.6	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Rhus radicans</i>	Poison ivy	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.50	0.01	0	0.25	1.7	0.1	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Rosa sp.</i>	Rose	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.50	0.01	0	0.25	1.7	0.1	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Rubus sp.</i>	Rubus	0.88	0.75	0.63	0.88	12.0	12.1	15.0	10.7	2.13	1.63	0.50	4.13	7.1	6.3	7.4	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Sanicula trifoliata</i>	Snakefoot	0.13	0.25	0.25	0.25	1.8	4.0	3.0	3.0	0.38	0.38	0	0.50	1.3	1.5	1.2	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Sassafras</i>	Sassafras	0.13	0.25	0.25	0.25	1.8	4.0	3.0	3.0	0.38	0.38	0	0.50	1.3	1.5	1.2	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Syntherisma albidum</i>	Gorallberry	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.25	0.25	0	0.50	0.4	0.4	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Syntherisma orbiculatus</i>	Slippery elm	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.38	0.13	0	0.13	1.3	0.5	0.3	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Vitis rotundifolia</i>	Violet	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.13	0.13	0	0.13	0	0	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Vitis rotundifolia</i>	Muscadine grape	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.13	0.13	0	0.13	0	0	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Vitis rotundifolia</i>	Vine A	0.13	0.13	0.13	0.13	1.8	2.1	3.1	1.6	0.13	0.13	0	0.13	0	0	0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy			
<i>Dicotyledonae</i>	TOTAL	7.33	6.19	4.19	8.21	100.2	99.9	100.0	101.5	30.06	25.84	6.78	41.67	100.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0			

*Data was not observed in plots during indicated (dash) sample period



genus, rattlesnake plantain (Goodvera sp.), was observed in several areas of the red pine type. Since members of this genus usually flower during July or August, positive species identification should be obtained during August 1977.

- Sycamore-Boxelder (05)

This type was found on stream edges, floodplain areas (including first bottoms), and seep areas of slopes. The type was extremely variable, but either sycamore (Platanus occidentalis) or boxelder (Acer negundo) was always present. On terraces, basswood, flowering dogwood, and black walnut (Juglans nigra) were often important. Honey locust (Gleditsia triacanthos), black locust, slippery elm, silver maple (Acer saccharinum) and hackberry (Celtis occidentalis) were common associates in various stands in the study area. In the sample area sycamore predominated, but did not appear healthy (Table III-13). Boxelder, hackberry and slippery elm were the only members of the sapling stratum (Table III-13).

Slippery elm was the only species in the shrub stratum and its cover in June 1977 was the highest of the four sample dates (Table III-3). Twenty-four taxa were recorded from the herbaceous stratum with small enchanter's nightshade (Circaea alpina) and sedge attaining highest relative cover values over the sampling year (Table III-14). Boxelder and flowering dogwood were the only tree seedlings present in the herbaceous stratum.

- Oak-Hickory (06)

This cover type occurred in the Kentucky portion of the survey area on west-facing slopes. Few sapling size trees were present in the type; none were found in plots (Table III-15). Canopy dominants were blue ash and black oak based on plot data (Table III-15). Significant numbers of shagbark hickory (Carya ovata), chestnut oak, and black locust (Robinia pseudoacacia) were present throughout the type. Ohio buckeye (Aesculus glabra) was present both in plots and throughout the type as numerous small diameter individuals. Fifteen percent of the trees in the samples were dead (Table III-15); all were blue ash.



Table III-13

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3), Sycamore-Boxelder (05) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live condition							
<i>Platanus occidentalis</i>	Sycamore	4	0.50	14.3	31.9	74.0	Diseased
<i>Juglans nigra</i>	Black walnut	2	0.50	14.3	4.3	10.0	Healthy
<i>Ulmus rubra</i>	Slippery elm	1	0.50	14.3	4.2	9.7	Healthy
<i>Cornus florida</i>	Flowering dogwood	2	0.50	14.3	1.1	2.6	Healthy
<i>Tilia americana</i>	Basswood	1	0.50	14.3	0.8	1.9	Healthy
<i>Acer negundo</i>	Boxelder	1	0.50	14.3	0.5	1.2	Healthy
<i>Prunus serotina</i>	Black cherry	1	0.50	14.3	0.3	0.7	Mechanical injury
Total Live		12	3.50	100.1	43.1	100.1	
Dead condition							
None							
Total Dead		0	0	0	0	0	
TOTAL		12	3.50	100.1	43.1	100.1	
Sapling stratum							
Live condition							
<i>Acer negundo</i>	Boxelder	2	0.50	33.3	1.3	65.0	Healthy/diseased
<i>Celtis occidentalis</i>	Hackberry	1	0.50	33.3	0.4	20.0	Healthy
Total Live		3	1.00	66.6	1.7	85.0	
Dead condition							
<i>Ulmus rubra</i>	Slippery elm	1	0.50	33.3	0.3	15.0	
Total Dead		1	0.50	33.3	0.3	15.0	
TOTAL		4	1.50	99.9	2.0	100.0	

III-20

services group



Table III-14

Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot Type 1) Sycamore-Boxelder (05) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	Frequency (%)				Relative Frequency (%)				Areal Cover (%)				Relative Cover (%)				Node Condition			
		SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN	SEP	OCT	MAR	JUN
<i>Acer negundo</i>	Boxelder	0.33	0	0	0.25	2.4	0	0	0.25	0.13	0	0	0.25	0.2	0	0	0.2	Healthy	Healthy	Healthy	Healthy
<i>Actinomeris altemifolia</i>	Wingspot	0.38	0.13	0.38	0.38	7.1	6.7	8.2	2.63	1.88	0.13	0.13	4.75	3.8	3.3	3.3	9.3	Healthy	Healthy	Healthy	Healthy
<i>Amaranthus</i> sp.	Pigeon	0.13	0	0	0	2.4	0	0	0	0.13	0	0	0	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Cirsium alpinum</i>	Small encanter's nightshade	1.00	1.00	0.50	0.50	10.8	17.6	10.7	42.63	30.63	16.13	16.13	60.9	53.6	31.5	31.5	31.5	Healthy	Healthy	Healthy	Healthy
<i>Claytonia virginiana</i>	Spring beauty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Healthy	Healthy	Healthy	Healthy
<i>Compositae</i> sp.	Dayflower	0.13	0.13	0.13	0.13	2.4	2.3	2.8	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Cornus</i> sp.	Flowering dogwood	0.13	0.13	0.13	0.13	2.4	2.4	2.6	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Cypripedium Canadense</i>	Hoarwort	0.13	0.13	0.13	0.13	2.4	2.4	2.6	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Dentaria bicincta</i>	Sedge	0.50	0.50	0.50	0.50	9.4	8.3	9.9	10.7	12.34	10.50	3.50	4.75	17.7	18.4	22.4	8.3	Healthy	Healthy	Healthy	Healthy
<i>Elymus virginicus</i>	Cut-leaved toothwort	0	0	0	0	0	0	7.5	0	0	0	2.36	0	0	0	15.3	0	Healthy	Healthy	Healthy	Healthy
<i>Eupatorium serotinum</i>	Virginia wild yew	0.13	0.13	0.13	0.13	2.4	2.3	2.8	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Gallium circaeazans</i>	Late-flowering thoroughwort	0.25	0.50	0.25	0.25	4.1	8.0	10.1	1.50	2.75	7.00	2.25	7.00	4.8	4.8	4.8	11.7	Healthy	Healthy	Healthy	Healthy
<i>Gallium triflorum</i>	White wild licorice	0.13	0.13	0.13	0.13	2.4	2.3	2.6	0.13	0.13	0.13	0.13	0.13	0.4	0.2	0.4	0.4	Healthy	Healthy	Healthy	Healthy
<i>Geum Canadense</i>	Fragrant bedstraw	0.53	0.75	0.38	0.25	11.8	13.2	12.5	5.4	2.75	1.89	0.75	0.63	3.9	3.3	4.8	1.2	Healthy	Healthy	Healthy	Healthy
<i>Jeffersonia diphylla</i>	Canadian avens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Healthy	Healthy	Healthy	Healthy
<i>Parthenocissus quinquefolia</i>	Twinleaf	0.13	0.13	0.13	0.13	2.4	2.3	2.6	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Prinla paniculata</i>	Virginia creeper	0.13	0.13	0.13	0.13	2.4	2.3	2.6	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Polypogon scopitoxus</i>	Cleardew	0.38	0.50	0.38	0.38	7.1	3.8	10.7	0.63	0.88	0.88	0.88	0.88	0.9	1.5	22.7	22.7	Healthy	Healthy	Healthy	Healthy
<i>Rhus radicans</i>	Long-bristled smartweed	0.13	0.13	0.13	0.13	2.4	2.3	2.6	0.13	0.01	0.01	0.01	0.50	0.2	0.0	0.0	1.0	Healthy	Healthy	Healthy	Healthy
<i>Sentella trifoliata</i>	Poison ivy	0.13	0.13	0.13	0.13	2.4	2.3	2.6	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Solidago</i> sp.	Snakeroot	0.13	0.13	0.13	0.13	2.4	2.3	2.6	0.13	0.13	0.13	0.13	0.13	0.2	0.2	0.2	0.2	Healthy	Healthy	Healthy	Healthy
<i>Viola eriocarpa</i>	Carrion-flower	0.38	0.25	0.25	0.25	7.1	4.4	5.0	1.25	2.25	2.25	2.25	0.75	2.0	3.9	4.1	1.5	Healthy	Healthy	Healthy	Healthy
TOTAL	Violet	5.32	5.67	5.04	4.66	49.4	49.9	49.6	100.2	70.2	57.19	15.52	53.28	100.3	99.9	99.9	100.3	Healthy	Healthy	Healthy	Healthy

*Taxa was not observed in plots during indicated (dash) sample period

Table III-15

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3) Oak-Hickory (06) Cover Type, September, October 1976 and March, June 1977



Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live condition							
<u>Fraxinus quadrangulata</u>	Blue ash	7	1.00	20.0	15.3	41.5	Healthy
<u>Quercus velutina</u>	Black oak	2	0.50	10.0	11.7	31.7	Healthy
<u>Catalpa speciosa</u>	Northern catalpa	1	0.50	10.0	3.7	10.0	Insect injury
<u>Aesculus glabra</u>	Ohio buckeye	5	1.00	20.0	3.0	8.1	Healthy
<u>Fraxinus americana</u>	White ash	1	0.50	10.0	1.0	2.7	Diseased
<u>Ulmus rubra</u>	Slippery elm	1	0.50	10.0	0.9	2.4	Insect injury
Total Live		17	4.00	80.0	35.6	96.4	
Dead condition							
<u>Fraxinus quadrangulata</u>	Blue ash	3	1.00	20.0	1.3	2.4	
Total Dead		3	1.50	20.0	1.3	3.5	
TOTAL		20	5.50	100.1	36.9	99.9	
Sapling stratum							
No saplings occurred in plots							



The shrub stratum consisted of older tree seedlings (Table III-3) mainly slippery elm and eastern redbud (Cercis canadensis); Kentucky coffee-tree (Gymnocladus dioica) was also present. Black locust and blue ash were observed in all four vegetation strata.

The herbaceous stratum sampling plots contained 34 taxa with eastern redbud and virginia creeper (Parthenocissus quinquefolia) exhibiting highest areal cover values over the year (Table III-16). Ephemeral taxa in this type had highest cover values of any type in the survey area resulting in a March 1977 vegetation cover value of 38.6 percent (Table III-5). Ephemerals constituted nearly 45 percent of the total cover during March; bluebells (Mertensia virginica) contributed 41 percent of the relative cover. Six tree species were present in the herbaceous stratum, but only blue ash was also an important canopy tree.

- Walnut-Hickory-Buckeye (09)

This type generally occurred on east-facing slopes and was often adjacent to and interdigitant with stands of the Maple-Basswood (01) type. Composition was variable over the study area. Several areas had been subjected to tornadic winds a few years ago, had suffered considerable disturbance and were characterized by dense regrowth of sapling size walnut (Juglans nigra), blackberry (Rubus sp.), and japanese honeysuckle (Lonicera japonica).

Predominant tree species (Table III-17) were shagbark hickory (Carya ovata), black walnut, and Ohio buckeye (Aesculus glabra). White ash was the only sapling that occurred in plots, but Ohio buckeye was scattered throughout the stand in the sapling stratum.

The shrub stratum contained twelve species of tree seedlings, vines and shrubs; those with the highest cover values being sugar maple, pawpaw (Asimina triloba), blue ash, and japanese honeysuckle (Table III-3). Vines, shrubs, and tree seedlings made up a large proportion of the herb stratum cover (Table III-18). Japanese honeysuckle had the highest cover



Table III-16

Species Composition, Frequency, Areal Coverage, and Condition of the Herbaceous Stratum (Plot Type 1), Oak-Hickory (06) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	Frequency						Relative Frequency(%)						Areal Cover(%)						Relative Cover(%)						Moist Condition					
		Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct				
Allium canadense	Wild garlic	0.11	-	0.38	-	-	-	5.4	-	-	-	0.25	-	-	-	0.6	-	-	-	Healthy	-	-	-	Healthy	-	-	-				
Anemone sp.	Piweed	-	-	1.00	-	-	-	14.2	-	-	-	4.13	-	-	-	10.7	-	-	-	Healthy	-	-	-	Healthy	-	-	-				
Anemone canadensis	Canada anemone	-	-	0.13	-	-	-	1.8	-	-	-	0.13	-	-	-	0.3	-	-	-	Healthy	-	-	-	Healthy	-	-	-				
Anemone thalictroides	Rue anemone	0.13	0.13	-	0.13	2.3	2.8	2.8	2.8	0.13	0.13	0.25	1.0	1.6	1.6	1.6	1.6	1.6	1.6	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Aster asters	Aster	-	-	0.38	0.13	-	-	5.4	2.8	-	-	0.50	0	-	-	1.3	0	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Ceanothus douglasii	Purple ceanoth	-	-	0.13	-	-	-	2.8	-	-	-	0.13	-	-	-	1.6	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Carya cordifolia	Pellucid hickory	0.50	0.50	0.13	0.50	9.0	10.5	1.8	10.9	1.86	1.13	0.13	2.75	15.6	14.2	0.3	14.3	Insect	Injury	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant				
Cercis canadensis	Redbud	-	-	0.13	-	-	-	2.8	-	-	-	0.13	-	-	-	1.6	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Circaea alpina	Small encounter's nightshade	0.13	-	-	-	2.3	-	2.8	-	-	-	0.13	-	-	-	1.6	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Composita sp.	Bayflower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Cornus prinos	Miss Price's cornel	0.88	0.63	0.13	0.38	15.8	13.8	1.8	8.3	0.68	0.88	0.13	0.50	5.6	11.0	0.3	3.2	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Cyperaceae	Sedge	-	-	0.88	-	-	-	12.5	-	-	-	4.63	-	-	-	12.0	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Geranium macranthum	Ger-leaved toothwort	0.50	0.25	-	0.25	9.0	5.5	5.5	1.14	1.00	-	1.25	9.5	12.6	8.0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Lythrum alatum	White trout-lily	-	-	0.50	-	-	-	7.1	-	-	-	6.38	-	-	-	16.5	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Opuntia virginiana	Late-flowering thornwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Fraxinus americana	White ash	0.13	0.13	-	-	2.3	2.8	2.8	0.01	0.01	-	0.01	0.01	0.1	0.2	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Fraxinus quadrangulata	Blue ash	0.25	0.25	-	0.13	4.4	5.5	2.8	0.25	0.25	-	0.38	2.1	3.2	2.4	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Geum canadense	Canadian avens	0.25	0.13	0.25	0.13	4.4	5.5	2.8	0.14	0.25	0.25	0.13	1.3	3.2	0.6	0.8	0.8	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Hydrophyllum appendiculatum	Appendaged waterleaf	0.13	0.38	-	-	2.3	2.8	2.8	0.01	0.26	-	0.01	0.26	0.1	0.3	3.3	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Hystris patula	Hotlebrush	0.25	0.13	0.13	0.25	4.5	2.8	1.8	5.5	2.39	2.13	0.25	0.63	24.0	25.8	0.6	4.0	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Lonchocarpus japonica	Japanese honeysuckle	0.13	0.13	-	0.13	2.3	2.8	2.8	0.13	0.13	0.13	0.13	1.0	1.6	1.6	0.8	0.8	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Malva virginica	Blotch	0.13	0.25	1.00	-	-	-	14.2	-	-	-	15.88	-	-	-	41.1	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Mertensia virginica	Moody grass	0.13	0.25	0.13	0.13	2.3	2.8	2.8	0.25	0.25	0.25	0.13	2.1	3.2	0.6	0.8	0.8	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Parthenocissus vitacea	Virginia creeper	0.88	0.13	0.25	0.88	15.8	10.9	3.5	19.3	2.38	0.39	0	5.13	19.8	4.9	0	32.7	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant				
Polypodium bifurcum	Solomon's-seal	0.13	0.13	0.38	-	-	-	2.3	2.8	5.4	-	0.13	0.01	0.75	1.0	0.2	1.9	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Rhus glabra	Poison ivy	0.13	-	-	-	2.3	-	-	-	-	-	-	-	-	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Rhus typhina	Black locust	0.13	0.13	0.13	0.13	2.3	2.8	1.8	2.8	0.25	0.25	0	1.00	2.1	3.2	0	6.3	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Robinia pseudoacacia	Bloodroot	-	-	0.13	-	-	-	1.8	2.8	-	-	0.63	0.88	-	-	1.6	5.6	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Sambucus racemosa	Sagebrush	0.13	-	-	-	2.3	-	-	-	-	-	-	-	-	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Sambucus racemosa	False Solomon's-seal	0.13	-	-	-	2.3	-	-	-	-	-	-	-	-	-	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Sambucus racemosa	Goatberry	0.13	0.13	0.13	0.13	2.3	2.8	1.8	2.8	0.13	0.13	0.38	0.25	1.0	1.6	1.0	1.6	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant	Dormant				
Sambucus racemosa	Toadshade	-	-	0.63	-	-	-	8.9	-	-	-	3.88	-	-	-	10.0	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Sambucus racemosa	Slippery elm	0.88	0.38	0.25	0.50	6.8	8.3	3.5	10.9	1.00	0.38	0.13	0.88	6.3	4.7	0.3	5.6	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Sambucus racemosa	Summer grape	0.13	0.13	-	0.13	2.3	2.8	2.8	2.8	0.13	0.13	0.13	0.38	1.0	1.6	-	-	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy				
Total		5.58	4.57	7.06	4.57	99.8	99.5	99.7	99.5	12.05	7.97	38.68	15.68	99.8	100.3	99.7	99.7														

*Taxa was not observed in plots during indicated (dash) sample period

Table III-17

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3)
Walnut-Hickory-Buckeye (09) Cover Type, September, October 1976 and March, June 1977



Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live condition							
<i>Carya ovata</i>	Shagbark hickory	2	0.50	12.5	8.5	28.1	Healthy
<i>Juglans nigra</i>	Black walnut	1	0.50	12.5	8.3	27.4	Mechanical injury
<i>Aesculus glabra</i>	Ohio buckeye	8	0.50	12.5	7.4	24.4	Healthy
<i>Fraxinus americana</i>	White ash	2	0.50	12.5	3.5	11.6	Healthy
<i>Ulmus rubra</i>	Slippery elm	2	0.50	12.5	0.8	2.6	Diseased
<i>Cercis canadensis</i>	Eastern redbud	2	0.50	12.5	0.8	2.6	Healthy/diseased
<i>Fraxinus quadrangulata</i>	Blue ash	1	0.50	12.5	0.3	1.0	Healthy
Total Live		18	3.50	87.5	29.6	97.7	
Dead condition							
<i>Ulmus rubra</i>	Slippery elm	1	0.50	12.5	0.7	2.3	
Total Dead		1	0.50	12.5	0.7	2.3	
TOTAL		19	4.00	100.0	30.3	100.0	
Sapling stratum							
Live condition							
<i>Fraxinus americana</i>	White ash	1	0.50	100.0	0.6	100.0	Healthy
Total Live		1	0.50	100.0	0.6	100.0	
Dead condition							
None							
Total Dead		0	0	0	0	0	
TOTAL		1	0.50	100.0	0.6	100.0	

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Table III-18

Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot Type 1), Walnut-Hickory-Buckeye (09) Cover Type, September, October 1976 and March, June 1977

Scientific name	Common name	Frequency (%)			Relative frequency (%)			Areal cover (%)			Relative cover (%)			Moist Condition				
		Sep	Oct	Mar	Sep	Oct	Mar	Sep	Oct	Mar	Sep	Oct	Mar	Sep	Oct	Mar	Jun	
<i>Acer negundo</i>	Boxelder	0.13	0.13	1.3	-	-	-	0	0.38	-	-	-	-	-	-	-	Healthy	
<i>Actinomeris alternifolia</i>	Witchhazel	-	-	0.13	-	-	-	-	0.75	-	-	-	-	-	-	-	Healthy	
<i>Allium canadense</i>	Wild garlic	0.13	0.13	-	1.5	-	-	0.13	-	-	-	-	-	-	-	-	Healthy	
<i>Rubus laevigata</i>	Smoother	0.13	0.13	0.25	4.4	4.1	2.9	0.25	1.50	4.4	1.4	1.6	2.6	2.6	2.6	2.6	Healthy	
<i>Asimina triloba</i>	Pawpaw	0.38	0.25	0.13	2.9	4.1	3.3	1.25	0.13	0.13	1.8	2.1	0.6	0.6	0.6	0.6	Healthy	
<i>Gardenia douglasii</i>	Purple cress	0.25	0.25	0.13	2.9	4.1	3.3	0.50	0.38	1.8	2.1	0.6	0.6	0.6	0.6	0.6	Healthy	
<i>Carya coralliformis</i>	Yellowbud hickory	0.13	0.13	0.25	2.9	4.1	3.3	0.50	0.38	1.8	2.1	0.6	0.6	0.6	0.6	0.6	Healthy	
<i>Carya ovata</i>	Shagbark hickory	0.13	0.13	0.25	2.9	4.1	3.3	0.50	0.38	1.8	2.1	0.6	0.6	0.6	0.6	0.6	Healthy	
<i>Cercis canadensis</i>	Eastern redbud	0.62	0.38	0.13	7.1	6.3	1.7	0.53	0.26	1.8	1.5	-	0.2	Insect Injury	-	-	Healthy	
<i>Circaea alpina</i>	Song sparrow	0.13	0.13	0.13	1.5	-	-	-	0.13	-	-	-	-	-	-	-	Healthy	
<i>Cornus sp.</i>	Spicebush	0.25	0.25	0.13	2.9	4.1	1.7	0.39	0.14	1.4	0.8	-	0.2	Healthy	-	-	Healthy	
<i>Cyperaceae</i>	Cut-leaved toothwort	-	-	1.00	-	-	22.0	-	2.88	-	-	35.8	-	-	-	-	Healthy	
<i>Desmodium illinoense</i>	Harbinger-of-spring	0.63	0.63	0.50	10.1	10.4	6.5	2.88	3.86	10.1	16.9	7.8	3.4	Healthy	-	-	Healthy	
<i>Eucalyptus serotinum</i>	Late-flowering thoroughwort	0.88	0.63	0.25	4.4	6.3	5.5	5.0	1.13	1.00	0.13	1.6	2.8	Healthy	-	-	Healthy	
<i>Fraxinus americana</i>	White ash	0.25	0.13	0.38	2.9	2.2	8.4	3.3	0.38	3.5	1.4	3.1	0.6	Healthy	-	-	Healthy	
<i>Fraxinus quadrangula</i>	Blue ash	0.38	0.38	0.25	4.4	4.1	2.9	0.13	0.14	0.4	0.8	0	0.6	Healthy	-	-	Healthy	
<i>Geum canadense</i>	Yellow-rose hips	0.13	0.25	0.13	1.5	4.1	2.9	0.13	0.14	0.4	0.8	0	0.6	Healthy	-	-	Healthy	
<i>Glechoma hederacea</i>	Ground-ivy	0.13	0.25	0.13	1.5	4.1	2.9	0.13	0.14	0.4	0.8	0	0.6	Healthy	-	-	Healthy	
<i>Helianthus sp.</i>	Sunflower	0.13	0.25	0.13	1.5	4.1	2.9	0.13	0.14	0.4	0.8	0	0.6	Healthy	-	-	Healthy	
<i>Hydrophyllum appendiculatum</i>	Appendaged water-leaf	0.38	0.38	0.25	4.4	4.1	3.3	0.50	1.00	1.8	5.6	-	1.1	Healthy	-	-	Healthy	
<i>Lindera benzoin</i>	Spicebush	0.25	0.38	0.25	2.9	6.3	22.0	13.0	9.00	7.88	2.50	17.63	31.1	30.0	Healthy	-	-	Healthy
<i>Lonicera japonica</i>	Japanese honeysuckle	1.00	1.00	1.00	11.5	16.5	22.0	13.0	9.00	7.88	2.50	17.63	31.1	30.0	Healthy	-	-	Healthy
<i>Parthenocissus quinquefolia</i>	Virginia creeper	0.88	0.13	1.00	10.1	2.2	13.0	2.50	0.01	19.13	8.6	0.1	32.6	32.6	Healthy	-	-	Healthy
<i>Rhus radicans</i>	Poison ivy	0.88	0.63	0.75	10.1	10.4	9.8	4.63	0.89	16.2	5.0	-	13.6	13.6	Healthy	-	-	Healthy
<i>Rubus sp.</i>	Blackberry	0.13	0.13	0.13	1.5	2.2	2.9	1.7	0.38	1.3	2.1	1.6	1.1	Healthy	-	-	Healthy	
<i>Sambucus trifoliata</i>	Smoother	0.25	0.50	0.13	2.9	8.3	2.9	9.8	0.14	0.28	0.13	1.6	2.8	Healthy	-	-	Healthy	
<i>Synonymon orbiculatus</i>	Lordsberry	0.50	0.38	0.38	5.8	6.3	8.4	9.8	1.63	0.39	1.00	2.86	12.4	4.9	Healthy	-	-	Healthy
<i>Thalictrum sessile</i>	Toadshade	0.13	0.13	0.13	1.5	2.2	2.9	0.13	0.13	1.8	1.5	-	1.6	1.6	Healthy	-	-	Healthy
<i>Ulmus rubra</i>	Slippery elm	0.38	0.13	0.25	4.4	2.2	3.3	0.50	0.13	1.8	0.7	-	0.4	Healthy	-	-	Healthy	
<i>Vitis aestivalis</i>	Summer grape	0.13	0.13	0.25	1.5	2.2	3.3	0.50	0.13	1.8	0.7	-	0.4	Healthy	-	-	Healthy	
1074		8.69	6.06	4.55	7.67	100.2	100.4	100.4	107.3	29.63	17.89	8.04	58.70	100.3	100.3	99.8	99.8	

*Taxa was not observed in plots during indicated (dash) sample period



value of any species in the herbaceous stratum. A total of thirty-one taxa was encountered in the sampling plots.

Cut-leaved toothwort and japanese honeysuckle contributed 66.9 percent relative cover in March; however, vegetation cover (total live vegetation) in March was only 8 percent (Table III-5) while litter cover was 86.4 percent.

- Virginia Pine (11)

Most Virginia pine stands were upland or in a cove position. Two occurred on the Marble Hill site. Virginia pine was predominant comprizing 54.5 percent of the tree basal area and 25.9 percent of the sapling basal area (Table III-19).

Flowering dogwood had the highest percent cover in the shrub stratum (Table III-3) and was the only species present in all four vegetation strata. Nearly 50 percent of the species present in the herbaceous stratum were either tree seedlings or vines and, with the exception of flowering dogwood, species frequencies were generally low (Table III-20). Twenty-six taxa were recorded in the herbaceous stratum plots.

Ephemeral taxa did not occur in plots, but were present as scattered individuals throughout the area.

- Orchard (10)

The largest orchard within the survey area, Reed Orchard Company, is located adjacent to the northwest corner of the Marble Hill site. Soil sampling and a condition survey were conducted during June 1977. Individual sets (plantings) of trees are shown in the CIR photo-overlay (Figure III-3) and the type, condition and age are listed in Table III-21. All bearing age peach trees suffered cold injury to flower buds and in some sets also incurred leaf bud injury. Figures III-4 and III-5 depict two degrees of cold injury on peaches. No cold injury was evident in the seven apple sets and



Table III-19

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3) Virginia Pine (11) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	No. Individuals in Sample	Frequency	Relative Frequency (%)	Basal Area (m ² /ha)	Relative Basal Area (%)	Mode Condition
Tree stratum							
Live condition							
<i>Pinus virginiana</i>	Virginia pine	12	1.00	18.2	11.6	54.5	Healthy
<i>Liriodendron tulipifera</i>	Yellow poplar	1	0.50	9.1	3.5	16.4	Healthy
<i>Juniperus virginiana</i>	Eastern red cedar	2	1.00	18.2	1.9	8.9	Dying/Healthy
<i>Cornus florida</i>	Flowering dogwood	3	1.00	18.2	1.8	8.5	Healthy
<i>Cercis canadensis</i>	Eastern redbud	2	1.00	18.2	1.1	5.2	Healthy
<i>Diospyros virginiana</i>	Persimmon	1	0.50	9.1	0.6	2.8	Healthy
Total Live		21	5.00	91.0	20.5	96.3	
Dead condition							
<i>Juniperus virginiana</i>	Eastern red cedar	1	0.50	9.1	0.8	3.8	
Total Dead		<u>1</u>	<u>0.50</u>	<u>9.1</u>	<u>0.8</u>	<u>3.8</u>	
TOTAL		22	5.50	100.1	21.3	100.1	
Sapling stratum							
Live condition							
<i>Pinus virginiana</i>	Virginia pine	1	0.50	16.7	1.5	25.9	Healthy
<i>Cercis canadensis</i>	Eastern redbud	1	0.50	16.7	1.3	22.4	Diseased
<i>Juniperus virginiana</i>	Eastern red cedar	1	0.50	16.7	1.3	22.4	Diseased
<i>Cornus florida</i>	Flowering dogwood	2	1.00	33.3	1.3	22.4	Healthy
Total Live		5	2.50	83.4	5.4	93.1	
Dead condition							
<i>Cercis canadensis</i>	Eastern redbud	1	0.50	16.7	0.4	6.9	
Total Dead		<u>1</u>	<u>0.50</u>	<u>16.7</u>	<u>0.4</u>	<u>6.9</u>	
TOTAL		6	3.00	100.1	5.8	100.0	

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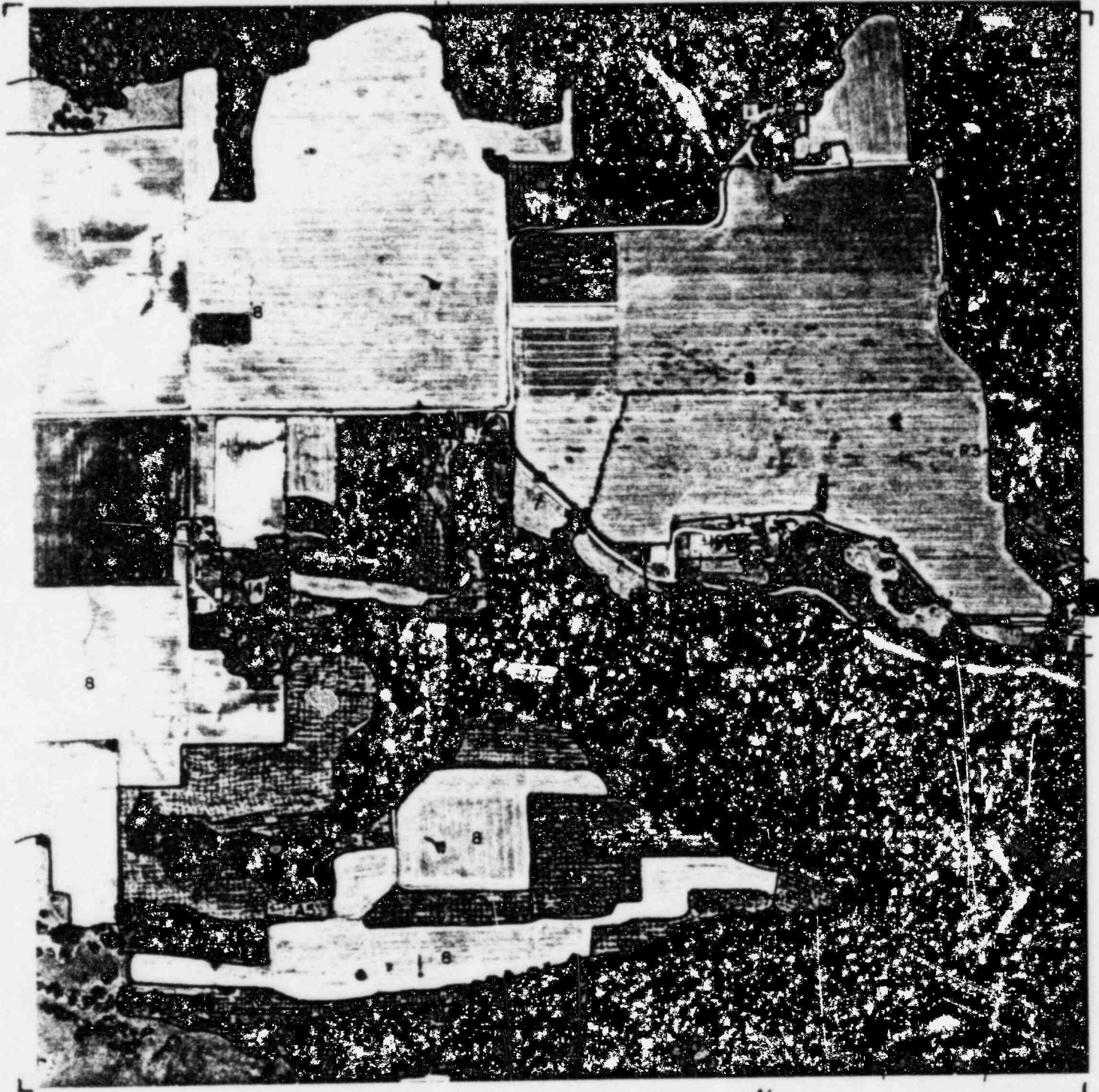
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Table III-20

Species Composition, Frequency, Areal Cover, and Condition for the Herbaceous Stratum (Plot Type 1),
Virginia Pine (11) Cover Type, September, October 1976 and March, June 1977

Scientific Name	Common Name	Frequency				Relative Frequency (%)				Areal Cover (%)				Relative Cover (%)				Moisture Condition				
		Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	Sep	Oct	Mar	Jun	
<i>Allium canadense</i>	Wild garlic	-*	0.25	0.63	-	-	4.8	16.2	-	-	0.25	1.13	-	-	1.8	11.8	-	-	Healthy	Healthy	-	
<i>Asplenium platyneuron</i>	Ebony spleenwort	0.25	0.25	0.25	0.25	4.1	4.8	6.4	4.2	0.50	0.63	0.25	0.38	3.8	4.5	2.6	1.7	Healthy	Healthy	Healthy	Healthy	
<i>Botrychium virginianum</i>	Virginia grape-fern	0.13	-	-	0.13	2.1	-	-	2.2	0.13	-	-	0.25	1.0	-	-	1.1	Healthy	-	-	Healthy	
Bryophyta	Mosses	-	-	0.25	0.25	-	-	6.4	4.2	-	-	1.75	1.00	-	-	18.3	4.5	-	-	Healthy	-	Healthy
<i>Campsis radicans</i>	Trumpet vine	0.25	0.13	-	0.25	4.1	2.5	-	4.2	1.00	0.13	-	1.00	7.6	0.9	-	4.5	Healthy	Dormant	-	Healthy	
<i>Carex leersii</i>	Little prickly sedge	0.50	0.38	0.25	0.38	8.2	7.3	6.4	6.4	0.39	0.75	0.38	0.63	3.0	5.4	4.0	2.8	Healthy	Healthy	Healthy	Healthy	
<i>Carya cordiformis</i>	Yellowbud hickory	0.25	0.13	-	0.25	4.1	2.5	-	4.2	0.25	0.13	-	0.38	1.9	0.9	-	1.7	Healthy	Healthy	-	Healthy	
<i>Cornus florida</i>	Flowering dogwood	1.00	1.00	0.75	1.00	16.5	19.2	19.2	16.9	2.74	3.00	0.88	6.50	21.0	21.6	9.2	29.1	Healthy	Healthy	Dormant	Healthy	
<i>Desmodium paniculatum</i>	Panicled tick-trefoil	0.25	0.13	-	0.25	4.1	2.5	-	4.2	0.63	0.13	-	0.50	4.8	0.9	-	2.2	Healthy	Healthy	-	Healthy	
<i>Eupatorium serotinum</i>	Late-flowering thoroughwort	0.13	0.13	-	0.13	2.1	2.5	-	2.2	0.63	0.63	-	0.50	4.8	4.5	-	2.2	Healthy	Healthy	-	Healthy	
<i>Fragaria virginiana</i>	Wild strawberry	0.38	0.13	0.38	0.13	6.8	2.5	9.7	2.2	0.26	0.13	0.25	0.13	2.0	0.9	2.6	0.6	Healthy	Healthy	Healthy	Healthy	
<i>Fraxinus americana</i>	White ash	0.13	0.13	-	-	2.1	2.5	-	-	0.38	0.13	-	-	2.2	0.9	-	-	Healthy	Dormant	-	-	
<i>Fraxinus quadrangulata</i>	Blue ash	0.25	0.25	-	0.38	4.1	4.8	-	6.4	0.25	0.14	-	0.50	1.9	1.0	-	2.2	Healthy	Healthy	-	Healthy	
<i>Galium circaeazans</i>	White wild licorice	0.13	0.13	0.25	0.25	2.1	2.5	6.4	4.2	0.13	0.13	0.13	0.38	1.0	0.9	1.4	1.7	Healthy	Healthy	Healthy	Healthy	
<i>Geum canadense</i>	Canadian avens	0.38	0.38	-	0.38	6.3	7.3	-	6.4	0.25	0.75	-	1.25	1.9	5.4	-	5.6	Healthy	Healthy	-	Healthy	
<i>Lonicera japonica</i>	Japanese honeysuckle	0.13	0.25	0.25	0.13	2.1	4.8	6.4	2.2	1.25	3.88	4.13	2.88	9.5	27.9	43.3	12.9	Healthy	Healthy	Healthy	Healthy	
<i>Parthenocissus quinquefolia</i>	Virginia creeper	0.25	0.13	0.13	0.13	4.1	2.5	3.3	2.2	1.14	0.13	0.13	2.00	8.7	0.9	1.4	9.0	Healthy	Dormant	Healthy	Healthy	
<i>Prunus serotina</i>	Black cherry	0.13	0.13	0.13	0.50	2.1	2.5	3.3	8.4	0.13	0.13	0.13	0.50	1.0	0.9	1.4	2.2	Healthy	Healthy	Healthy	Healthy	
<i>Quercus rubra</i>	Red oak	0.13	0.13	0.13	-	2.1	2.5	3.3	-	0.25	0.25	0	-	1.9	1.8	0	-	Healthy	Healthy	Healthy	-	
<i>Rhus radicans</i>	Poison ivy	0.38	-	-	0.25	6.3	-	-	4.2	0.65	-	-	2.13	5.0	-	-	9.6	Healthy	-	-	Healthy	
<i>Rubus</i> sp.	Blackberry	0.13	0.13	-	0.13	2.1	2.5	-	2.2	1.25	1.25	-	0.13	9.5	9.0	-	0.6	Healthy	Healthy	-	Healthy	
<i>Sanicula trifoliata</i>	Snakeroot	0.25	0.50	0.50	0.50	4.1	9.6	12.8	8.4	0.14	0.50	0.38	0.75	1.1	3.6	4.0	3.4	Healthy	Healthy	Healthy	Healthy	
<i>Smilax</i> sp.	Greenbrier	0.25	0.25	-	-	4.1	4.8	-	-	0.64	0.75	-	-	4.9	5.4	-	-	Healthy	Healthy	-	-	
<i>Smilax herbacea</i>	Carrión-flower	0.13	0.13	-	0.13	2.1	2.5	-	2.2	0.13	0.13	-	0.38	1.0	0.9	-	1.7	Healthy	Dormant	-	Healthy	
<i>Solidago</i> sp.	Goldenrod	0.13	0.13	-	0.13	2.1	2.5	-	2.2	0.01	0.01	-	0.13	0.1	0.1	-	0.6	Healthy	Healthy	-	Healthy	
<i>Ulmus rubra</i>	Slippery elm	0.13	-	-	-	2.1	-	-	-	0.01	-	-	-	0.1	-	-	-	Healthy	-	-	-	
TOTAL		6.07	5.20	3.90	5.93	100.0	99.9	99.8	99.9	13.15	13.96	9.54	22.3	100.4	100.1	100.0	99.9					

*Taxa was not observed in plots during indicated (dash) sample period



SCALE
0 500 1000 FT
Figure III-3. Color Infrared Aerial Photograph (1:10,000 scale photo enlarged to 1:6,600) of the Reed Orchard Company Property with Overlay Depicting Vegetation Cover Types and Location of Orchard Sets, May 1977

Table III-21

Fruit Tree Type, Condition and Age of Sets for the Orchard Type (10), Reed Orchard Company Property, June 1977



Code ¹	Set Type	Age of Set (yrs.) ²	Condition		Remarks
			Vegetative	Fruit	
P1	Peach	5	Healthy	None	Cold injury - flower buds
P2	Peach	12	Mechanical injury	None	Cold injury - leaf and flower buds
P3	Peach	3	Healthy	None	Immature trees
P4	Peach	10	Mechanical injury	None	Cold injury - leaf and flower buds
P5	Peach	10	Mechanical injury	None	Cold injury - leaf and flower buds
P6	Peach	15	Mechanical injury	None	Cold injury - leaf and flower buds
			Diseased	None	Wood rot fungus
P7	Peach	13	Mechanical injury	None	Cold injury - leaf and flower buds
P8	Peach	5	Mechanical injury	None	Cold injury - leaf and flower buds
P9	Peach	18	Mechanical injury	None	Severe cold injury - leaf and flower buds
P10	Peach	31	Mechanical injury	None	Cold injury - leaf and flower buds
			Decline	None	General decline - age
P11	Peach	31	Mechanical injury	None	Cold injury - leaf and flower buds
			Decline	None	General decline - age
P12	Peach	13	Mechanical injury	None	Cold injury - leaf and flower buds
P13	Peach	3	Healthy	None	Immature trees
P14	Peach	5	Mechanical injury	None	Slight cold injury - leaf and flower buds
A1	Apple	5	Healthy	Healthy	
A2	Apple	5	Healthy	Healthy	
A3	Apple	11	Healthy	Healthy	
A4	Apple	11	Healthy	Healthy	
A5	Apple	11	Healthy	Healthy	
A6	Apple	11	Healthy	Healthy	
A7	Apple	5	Healthy	Healthy	

¹ Code identifies location of individual sets on photo overlay (Figure III-3)

² Personal Communication - Mr. Reed, Reed Orchard Company, R.R. 1, Hanover, Indiana 47243

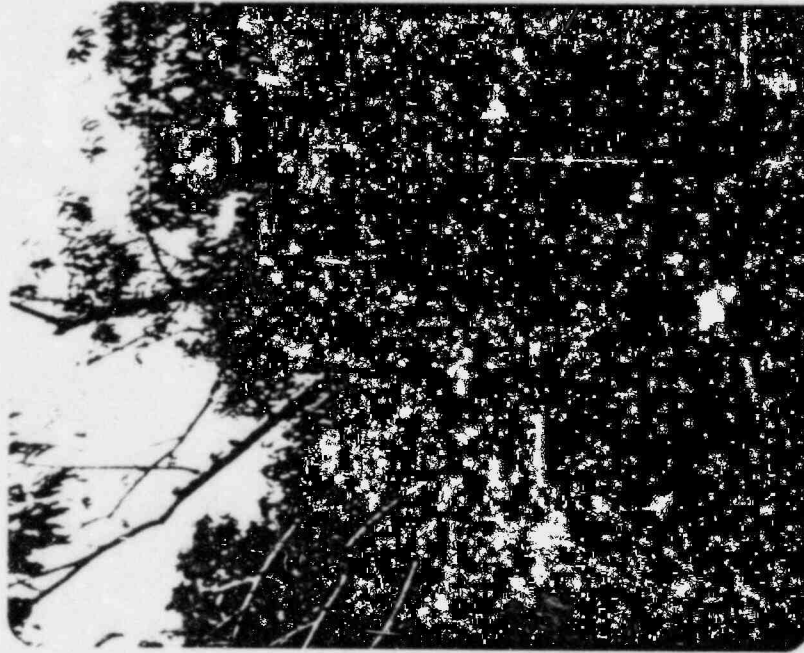


Figure III-5. Color Photograph of Peach Set P-2
Depicting Leaf and Flower Bud Cold
Injury, June 1977

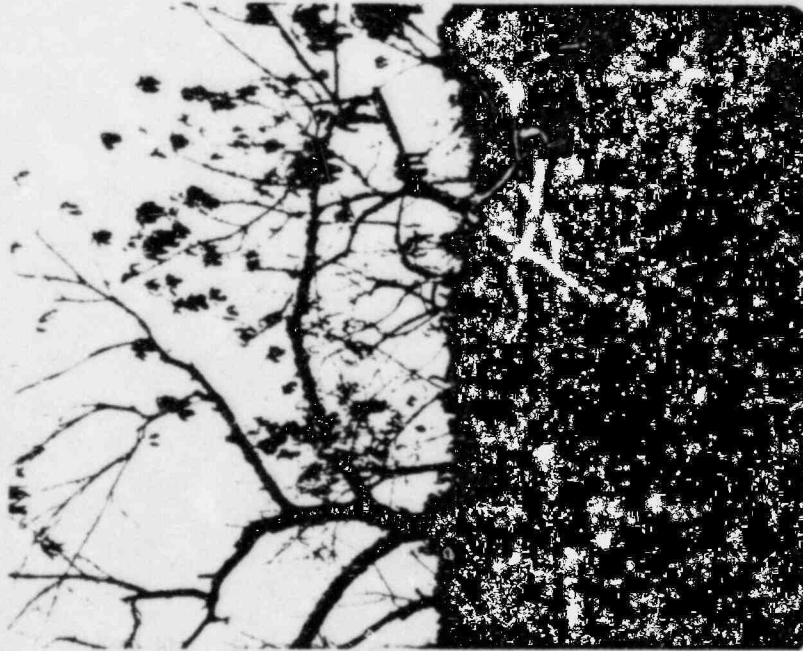


Figure III-4. Color Photograph of Peach Set P-9
Depicting Severity of Leaf and
Flower Bud Cold Injury, June 1977



abundant fruit was present. . Since no fruit had set on peach trees due to flower bud injury, the incidence of peach brown rot could not be estimated.

Orchard maintenance normally consists of pruning individual trees, removal of diseased trees, between-row cultivation, weed control using paraquat (Figure III-6) within rows, pesticide applications at about 10-day intervals between flowering and harvest, and fungicides and trace metal applications as needed to control disease or nutrient deficiencies. A general view of several sets (includes three ages of trees) is depicted in Figure III-7.

- Other Significant Types

Five other cover types were mapped in addition to the nine sampled. These were unimproved pasture (07), cropland (08), residential/farmstead (12), industrial (13), and water (14).

The unimproved pasture (07) was compositionally the most variable type encountered. Some areas were severely overgrazed and consisted mainly of weedy adventives such as ragweed (Ambrosia sp.), bluegrass (Poa sp.), and broomsedge (Andropogon virginicus). Other areas supported good stands of palatable grasses, and had scattered trees and a few pioneer shrubs or trees. Common tree species were shagbark hickory and pin oak (Quercus palustris). Pioneer trees were persimmon (Diospyros virginiana), sassafras, and black locust. Shining sumac (Rhus glabra) was common in scrub areas.

Cropland (08) was the largest single map unit at 5556 acres. Included in this type were actively cropped areas, fallow fields, and old fields. This type was found on well-drained uplands and in the Ohio River floodplain.

The residence/farmsteads type (12) covered towns, suburbs, farmsteads (excluding out-buildings), and mobile home parks. Cover type 13, industrial, included working manufacturing plants, gravel operations, power



Figure III-6. Color Photograph from Peach Set P-2 Showing Early Spring Herbicide Treated (Paraquat) Strip Beneath Trees, June 1977



Figure III-7. Color Photograph from Apple Set A-5 (Mixed Apple and Peach) Toward Peach Sets P-9 and P-10 in Background, June 1977



production facilities, ash ponds, and other similar type operations. Only 79 acres of type 13 were mapped. The industrial acreage will change in the future when construction progress on the Marble Hill site is photographically documented and mapped.

Water (14) areas mapped were the Ohio River, stock ponds and impoundments, and open water areas of nonproducing gravel pits and the ash pond near Clifty Creek. Streams were not mapped.

2. Soils

- Moisture

Percent moisture (Table III-22) in March and June 1977 soil samples was 2 to 3 times higher than in the September and October 1976 samples. In 1976, the maple-basswood type exhibited the highest soil moisture values while during the 1977 period, when overall soil moisture was high in all types, the maple-basswood type contained the lowest values. The highest value (80.9 percent) was obtained from June 1977 orchard (10) samples, reflecting the success of the water conservation program practiced by this orchard owner. The orchard type can be compared to the Virginia pine type (11) since topographic position, soil and native vegetation are similar.

Based on high spring moisture values, vegetation should have an excellent growth year in 1977.

- Bulk Density

Bulk density, as a measure of soil compaction, was determined from each cover type, and included a June 1977 sample from the orchard type. The red pine (04) and sycamore-boxelder (05) types exhibited higher bulk densities than other types; the maple-basswood (01) type had the lowest bulk density values (Table III-23) throughout the year. In June, the orchard type exhibited the highest bulk density value, probably due to machinery compaction.



Table III-22

Mean (\bar{x}) and Standard Error (S.E.) Values * for Soil Moisture (%) from Each Vegetation Cover Type for September, October 1976 and March, June 1977

Code	Cover Type	SEP		OCT		MAR		JUN	
		\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
01	Maple-Basswood	31.9	1.4	31.9	1.4	63.3	0.9	62.3	1.5
02	Oak-Maple	23.0	1.9	26.3	1.3	68.5	1.9	71.3	2.1
03	Chestnut oak	20.0	1.6	27.3	1.4	68.3	1.5	76.3	1.2
04	Red pine	16.7	1.9	21.7	0.4	74.8	0.9	74.5	0.6
05	Sycamore-Boxelder	19.4	1.3	25.5	1.5	74.2	0.7	75.8	2.1
06	Oak-Hickory	17.1	0.8	19.7	1.3	77.9	1.5	75.3	1.4
09	Walnut-Hickory-Buckeye	25.3	1.1	31.0	0.9	67.0	1.1	67.8	1.5
10	Orchard	-**	-	-	-	-	-	80.9	0.5
11	Virginia pine	17.2	2.6	18.4	0.6	74.4	0.7	73.8	0.7

* Based on 4 replicates per cover type per date sampled

** Dash indicates that cover type was not sampled on that date



Table III-23
 Mean (\bar{x}) and Standard Error (S.E.) Values* for Soil Bulk Density (g/cm^3) from Each Vegetation Type for September, October 1976 and March, June 1977

Code	Cover Type	SEP		OCT		MAR		JUN	
		\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
01	Maple-Basswood	0.865	0.078	0.674	0.112	0.732	0.089	0.700	0.083
02	Oak-Maple	0.931	0.042	0.926	0.062	0.816	0.457	0.823	0.044
03	Chestnut oak	0.908	0.074	0.949	0.027	0.799	0.559	0.869**	0.030
04	Red pine	1.206	0.051	1.132	0.086	1.014	0.019	0.985	0.066
05	Sycamore-Boxelder	1.125	0.036	0.983	0.039	1.190	0.081	0.905	0.112
06	Oak-Hickory	0.929	0.097	1.040	0.030	0.862	0.428	0.711	0.035
09	Walnut-Hickory-Buckeye	0.894	0.022	0.893	0.031	0.844	0.049	0.768	0.069
10	Orchard	-***	-	-	-	-	-	1.080	0.074
11	Virginia pine	0.858	0.048	0.907	0.014	0.931	0.043	0.809	0.056

* Based on 4 replicates per cover type per date sampled

** Based on 3 replicates this sample date

*** Dash indicates that cover type was not sampled on that date

III-37

services group



- pH

Soil pH values for September 1976 through June 1977 were slightly alkaline (Table III-24) except for the Virginia pine type that was consistently acid, ranging between 6.1 and 6.5, and the red pine type that was acidic in March and June 1977. Sycamore-boxelder type pH ranged from a low of 6.0 in March 1977 to a high of 8.1 in October 1976. Lindsey and Schmelz (1970) suggest that pH 7.0 is most favorable for sycamore growth, while an alkaline pH (>7.0) seems most favorable for sugar maple, basswood and buckeye development. Results of this study generally substantiate these literature results.

- Conductivity

Soil conductivity results (Table III-25) indicate that the two pine types (04 and 11) had generally lower values throughout the year than other types. The oak-hickory cover type had the highest annual average conductivity (346); red pine had the lowest (150). Conductivity is an expression of the concentration of total soluble salts in the soil matrix.

- Cation exchange capacity and base saturation percentage

The ability of the organic matter and clay minerals in the soil to absorb exchangeable cations such as calcium, magnesium, sodium, and potassium is expressed as cation exchange capacity (Thompson 1957). It is these exchangeable cations that are available to plants for maintenance and growth. The ratio of the concentration of total exchangeable bases to the cation exchange capacity gives the percentage base saturation.

The two pine types (04 and 11) and the floodplain type (05) had the lowest cation exchange capacities (Table III-26); however, red pine and floodplain types had base saturation percentages approximating levels in other types, while the Virginia pine type had low base saturation percentages (Table III-27). A low base saturation percentage indicates that few cations are available to plants for maintenance or growth. In a crop

Table III-24

Mean (\bar{x}) and Standard Error (S.E.) Values* for Soil pH (measured in water) from Each Vegetation Cover Type for September, October 1976 and March, June 1977

Code	Cover Type	SEP		OCT		MAR		JUN	
		\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
01	Maple-Basswood	7.8	0.1	8.6	0.0	7.5	0.0	7.5	0.1
02	Oak-Maple	7.2	0.4	8.5	0.3	7.1	0.3	7.0	0.4
03	Chestnut oak	7.6	0.1	8.6	0.0	7.5	0.2	7.4	0.1
04	Red pine	7.0	0.5	7.5	0.1	5.3	0.2	6.0	0.2
05	Sycamore-Boxelder	7.2	0.4	8.1	0.2	6.0	0.9	7.0	0.4
06	Oak-Hickory	7.7	0.1	8.6	0.0	7.6	0.1	7.7	0.0
09	Walnut-Hickory-Buckeye	7.6	0.2	8.3	0.1	7.4	0.0	7.4	0.1
10	Orchard	-**	-	-	-	-	-	6.9	0.2
11	Virginia pine	6.2	0.2	6.5	0.2	6.1	0.6	6.4	0.1

* Based on 4 replicates per cover type per date sampled

** Dash indicates that cover type was not sampled on that date





Table III-25

Mean (\bar{x}) and Standard Error (S.E.) Values* for Soil Conductivity ($\mu\text{mho/cm}$) from Each Vegetation Cover Type for September, October 1976 and March, June 1977

Code	Cover Type	SEP		OCT		MAR		JUN	
		\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
01	Maple-Basswood	300	32	301	42	200	31	183	16
02	Oak-Maple	209	16	221	36	176	24	187	26
03	Chestnut oak	280	34	194	20	194	14	198	11
04	Red pine	153	17	160	23	137	9	150	6
05	Sycamore-Boxelder	282	15	245	26	259	12	199	24
06	Oak-Hickory	635	127	216	13	310	28	222	23
09	Walnut-Hickory-Buckeye	207	27	263	28	210	28	168	13
10	Orchard	-**	-	-	-	-	-	170	6
11	Virginia pine	166	24	221	17	184	32	121	11

*Based on 4 replicates per cover type per date sampled

**Dash indicates that cover type was not sampled on that date



Table III-26

Mean (\bar{x}) and Standard Error (S.E.) Values* for Soil Cation Exchange Capacity (meq/100g) from Each Vegetation Cover Type for September, October 1976 and March, June 1977

Code	Cover Type	SEP		OCT		MAR		JUN	
		\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
01	Maple-Basswood	48.3	2.1	50.9	2.3	49.7	5.0	24.1	5.0
02	Oak-Maple	39.8	6.5	37.4	0.7	35.1	7.5	24.9	3.5
03	Chestnut oak	50.1	4.1	43.4	3.8	56.4	3.3	20.4	4.8
04	Red pine	18.8	3.0	21.3	1.1	24.6	3.8	18.3	2.6
05	Sycamore-Boxelder	17.4	1.4	23.6	2.3	29.2	2.8	17.5	1.1
06	Oak-Hickory	36.9	2.2	35.7	3.5	44.1	3.5	22.5	1.2
09	Walnut-Hickory-Buckeye	50.6	1.8	52.1	1.4	43.8	3.38	22.4	3.1
10	Orchard	-**	-	-	-	-	-	16.9	1.2
11	Virginia pine	18.0	1.0	19.1	0.9	22.1	1.76	18.2	0.9

* Based on 4 replicates per cover type per date sampled

** Dash indicates that cover type was not sampled on that date



Table III-27

Mean (\bar{x}) and Standard Error (S.E.) Values* for Soil Base Saturation (%) from Each Vegetation Cover Type for September, October 1976 and March, June 1977

Code	Cover Type	SEP		OCT		MAR		JUN	
		\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
01	Maple-Basswood	59.6	7.9	69.6	2.3	25.4	3.8	62.2	11.6
02	Oak-Maple	68.0	7.6	61.5	5.4	61.5	28.7	60.8	7.3
03	Chestnut oak	75.6	4.1	72.8	7.7	21.1	4.8	93.0	17.5
04	Red pine	64.7	6.3	40.8	2.4	23.0	2.6	62.1	7.0
05	Sycamore-Boxelder	104.2	20.3	70.7	7.7	46.9	12.2	76.9	13.9
06	Oak-Hickory	91.5	3.2	77.1	1.5	40.6	10.6	95.7	8.9
09	Walnut-Hickory-Buckeye	76.6	7.2	64.6	1.2	53.1	5.3	86.5	21.7
10	Orchard	-**	-	-	-	-	-	50.7	4.2
11	Virginia pine	48.9	4.6	40.4	2.9	35.2	10.0	39.0	3.7

* Based on 4 replicates per cover type per date sampled

** Dash indicates that cover type was not sampled on that date



production system, lime is required when base saturation percentages may fall below 80 percent during the production season. With the exception of a few values in the September and June samples, all base saturation percentages fell below 80 percent.

B. VEGETATION STRESS

Forty discrete areas of apparent vegetation stress were delineated within the survey area (Figure III-1); 31 were less than 5-acres and are listed by cover type and location in Table III-28. Several of these small areas consisted of only one to five trees exhibiting various stress reactions resulting from various causes. Causal agents included cold weather, bagworms, sulfur dioxide, various blights, fungal invasion, age, mechanical injury, and general decline.

Nine areas are listed in Table III-29 by cover type, location and causal agent (if known). The oaks and buckeye present in area 6-2C exhibit evidence of sulfur dioxide injury. The plume from Clifty Creek Power Plant was observed on the ground in this area and in the vicinity of 5-4C, 2-4C and 9-4C on June 10 and June 12 about 11:00 am both days. Only old injury was observed on upper exposed portions of tree crowns and this cannot be conclusively attributed to sulfur dioxide since cold injury has a similar appearance and was widespread in the survey area. In area 5-4C, sycamore, eastern red cedar and boxelder were in general decline. A moderate bagworm infestation of eastern red cedar was also observed.

Area 10-9A, Reed Orchard Company, exhibited varied effects of cold weather on peaches (refer to figures III-3, -4, -5, Table III-21 and associated text).

Area 4-10B resulted from effects of cold weather on canopy status red pine. Discussion of the effects on this stand of pine was presented on page III-13 and in Table III-11. The entire map unit on the Marble Hill site was affected, but other units in grid areas 6A and 7A did not exhibit cold injury symptoms.



Table III-28

Cover Type and Location of Vegetation Stress Areas Covering <5 Acres
Within the Marble Hill Survey Area, May 1977

Cover Type	Location*	Number of Stress Areas
9	1B	1
9	1C	1
9	2B	2
5	2C	2
6	2C	2
6	2D	1
9	3A	3
3	3A	1
1	3A	1
9	3B	2
2	3C	1
9	4A	3
9	4B	1
6	4B	1
2	5A	1
9	5C	1
5	5C	1
1	7B	1
9	8B	1
10	9A	7
2	9B	1
2	11C	1
5	12B	1

*Keyed to location grid on vegetation cover type map (Figure III-1) and within a grid unit from north to south

Table III-29

Cover Type, Location and Causal Agent of Vegetation Stress for Areas
>5 Acres within the Marble Hill Survey Area, May 1977

Cover Type	Location*	Number of Stress Areas	Causal Agent
6	2C	1	Sulfur dioxide
5	4C	1	General decline, bagworms
2	4C	1	General decline, Sulfur dioxide
5	4C	1	General decline, Sulfur dioxide
9	4C	2	General decline, Sulfur dioxide
1	6B	1	Unknown
10	9A	1	Cold weather
4	10B**	1	Cold weather

*Keyed to location grid on vegetation cover type map (Figure III-1) and within a grid unit from north to south

**Entire map unit affected, 3.6 acres



SECTION IV
LITERATURE CITED

- | Reference Number | Citation |
|------------------|---|
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APPENDIX A

TAXA PRESENT IN SAMPLED COVER TYPES, SEPTEMBER 1976 THROUGH JUNE 1977



Table A-1

List of Taxa Present in Sampled Cover Types, September 1976 through June 1977

Scientific Name	Common Name	Cover Type									
		01	02	03	04	05	06	09	11		
<i>Acer negundo</i>	Boxelder					X			X		
<i>Acer saccharum</i>	Sugar maple	X	X	X	X				X		
<i>Actinomeris alternifolia</i>	Wingstem					X			X		
<i>Aesculus glabra</i>	Ohio buckeye							X	X		
<i>Aesculus octandra</i>	Yellow buckeye	X									
<i>Allium canadense</i>	Wild garlic		X	X				X	X	X	
<i>Amaranthus</i> sp.	Pigweed					X		X			
<i>Anemone canadensis</i>	Canada anemone							X			
<i>Anemone quinquefolia</i>	Wood anemone		X	X							
<i>Anemone virginica</i>	Thimbleweed			X							
<i>Anemone thalictroides</i>	Rue anemone	X	X	X				X			
<i>Arabis laevigata</i>	Smooth rock-cress								X		
<i>Aralia spinosa</i>	Hercules-club		X								
<i>Arisaema atrorubens</i>	Jack-in-the-pulpit	X									
<i>Asarum canadense</i>	Wild ginger	X									
<i>Asimina triloba</i>	Pawpaw	X							X		
<i>Asplenium platyneuron</i>	Ebony spleenwort									X	
<i>Aster</i> sp.	Aster		X			X					
<i>Aster azureus</i>	Azure aster		X	X				X			
<i>Botrychium virginianum</i>	Virginia grape-fern		X							X	
Bryophyta	Mosses	X								X	
<i>Bumelia lanuginosa</i>	Chittamwood							X			
<i>Camosis radicans</i>	Trumpet vine									X	
<i>Cardamine douglassii</i>	Purple cress							X	X		
<i>Carex leersii</i>	Little prickly sedge									X	
<i>Carpinus caroliniana</i>	Blue beech	X	X								
<i>Carya</i> sp.	Hickory									X	
<i>Carya cordiformis</i>	Yellowbud hickory	X	X					X	X	X	
<i>Carya ovata</i>	Shagbark hickory									X	
<i>Celtis occidentalis</i>	Hackberry			X		X			X		
<i>Cercis canadensis</i>	Eastern redbud		X	X	X		X	X	X	X	
<i>Circaea alpina</i>	Small enchanter's nightshade					X	X	X			
<i>Claytonia virginica</i>	Spring-beauty	X	X			X					
<i>Clematis viorna</i>	Leather flower			X							
<i>Commelina</i> sp.	Dayflower					X	X				
<i>Convolvulus</i> sp.	Bindweed								X		
<i>Cornus florida</i>	Flowering dogwood		X		X	X				X	
<i>Cornus priceae</i>	Miss Price's cornel						X				
<i>Cryptotaenia canadensis</i>	Honewort					X					
Cyperaceae	Sedges					X	X	X			
<i>Dentaria laciniata</i>	Cut-leaved toothwort	X	X	X	X	X	X	X			
<i>Desmodium glutinosum</i>	Pointed-leaved tick-trefoil		X								
<i>Desmodium paniculatum</i>	Panicled tick-trefoil									X	
<i>Dicentra</i> sp.	Bleeding heart									X	
<i>Dicentra cucullaria</i>	Dutchman's breeches		X								
<i>Dioscorea villosa</i>	Wild yam			X							
<i>Diospyros virginiana</i>	Persimmon			X						X	
<i>Elymus virginicus</i>	Virginia wild rye										
<i>Eriogonum bulbosum</i>	Harbinger-of-spring	X	X						X		
<i>Erythronium albidum</i>	White trout-lily							X			
<i>Erythronium americanum</i>	Adder's-tongue		X								
<i>Euonymus americanus</i>	American strawberry-bush							X			
<i>Eupatorium maculatum</i>	Spotted joe-pye-weed			X							
<i>Eupatorium serotinum</i>	Late flowering thoroughwort	X			X	X	X	X	X	X	
<i>Fagus grandifolia</i>	Deech	X	X		X						
<i>Fragaria virginiana</i>	Wild strawberry				X					X	
<i>Fraxinus americana</i>	White ash	X	X	X	X		X	X	X	X	
<i>Fraxinus quadrangulata</i>	Blue ash		X	X	X		X	X	X	X	
<i>Galium asprellum</i>	Rough bedstraw				X						
<i>Galium boreale</i>	Northern bedstraw	X	X								
<i>Galium circaeazans</i>	White wild licorice		X	X	X	X				X	
<i>Galium triflorum</i>	Fragrant bedstraw	X			X	X					
<i>Geum canadense</i>	Canadian avens		X	X	X	X	X	X	X	X	
<i>Glechoma hederacea</i>	Gill-over-the-ground								X		
<i>Gleditsia triacanthos</i>	Honey locust					X	X				
<i>Goodyera</i> sp.	Rattlesnake plantain				X						
<i>Gymnocladus dioica</i>	Kentucky coffee-tree							X			



Table A-1 (continued)

Scientific Name	Common Name	Cover Type									
		01	02	03	04	05	06	09	11		
<u>Helianthus sp.</u>	Sunflower			X					X		
<u>Hemerocallis fulva</u>	Daylily	X									
<u>Hydrophyllum appendiculatum</u>	Appendaged water leaf		X				X	X			
<u>Hystrix patula</u>	Bottlebrush			X			X				
<u>Jeffersonia diphylla</u>	Twinleaf		X	X		X					
<u>Juglans nigra</u>	Black walnut	X				X		X			
<u>Juniperus virginiana</u>	Eastern red cedar	X	X	X	X		X	X	X		
<u>Lindera benzoin</u>	Spicebush	X	X	X				X			
<u>Liriodendron tulipifera</u>	Yellow poplar		X		X				X		
<u>Lonicera japonica</u>	Japanese honeysuckle			X	X		X	X	X		
<u>Lonicera tatarica</u>	Tartarian honeysuckle									X	
<u>Mertensia virginica</u>	Bluebells						X				
<u>Maianthemum canadense</u>	Canada mayflower			X							
<u>Muhlenbergia sobolifera</u>	Muhly grass			X	X		X				
<u>Oenothera sp.</u>	Evening primrose			X							
<u>Ostrya virginiana</u>	Ironwood		X	X							
<u>Panicum boscii</u>	Bosc's panicum			X							
<u>Panicum clandestinum</u>	Corn grass									X	
<u>Parthenocissus quinquefolia</u>	Virginia creeper	X	X	X	X	X	X	X	X	X	
<u>Passiflora lutea</u>	Yellow passion-flower			X							
<u>Phryma leptostachya</u>	Looseseed	X			X						
<u>Pilea pumila</u>	Clearweed					X					
<u>Pinus resinosa</u>	Red pine				X						
<u>Pinus strobus</u>	White pine	X			X						
<u>Pinus virginiana</u>	Virginia pine			X						X	
<u>Platanus occidentalis</u>	Sycamore		X			X		X			
<u>Poaceae</u>	Grasses				X						
<u>Polygonatum biflorum</u>	Soloman's-seal			X			X				
<u>Polygonum despitatum</u>	Long-bristled smartweed					X					
<u>Prunus serotina</u>	Black cherry		X	X	X	X				X	
<u>Quercus coccinea</u>	Scarlet oak		X				X				
<u>Quercus falcata</u>	Southern red oak		X								
<u>Quercus palustris</u>	Pin oak		X								
<u>Quercus prinus</u>	Chestnut oak		X	X	X			X			
<u>Quercus rubra</u>	Red oak		X							X	
<u>Quercus velutina</u>	Black oak		X	X	X		X				
<u>Rhus aromatica</u>	Skunkbrush			X							
<u>Rhus radicans</u>	Poison ivy	X	X	X	X	X	X	X	X	X	
<u>Robinia pseudoacacia</u>	Black locust			X			X	X			
<u>Rosa sp.</u>	Rose			X	X						
<u>Rubus sp.</u>	Blackberry				X				X	X	
<u>Ruellia carolinensis</u>	Hairy ruellia			X							
<u>Sanguinaria canadensis</u>	Bloodroot		X	X			X				
<u>Sanicula trifoliata</u>	Snakeroot	X	X	X	X	X	X	X	X	X	
<u>Sassafras albidum</u>	Sassafras		X		X						
<u>Smilacina racemosa</u>	False Soloman's-seal						X				
<u>Smilax sp.</u>	Greenbrier									X	
<u>Smilax herbacea</u>	Carrion-flower		X			X				X	
<u>Solidago sp.</u>	Goldenrod									X	
<u>Solidago ulmifolia</u>	Goldenrod			X							
<u>Symphoricarpos orbiculatus</u>	Coral berry		X	X	X		X	X			
<u>Taraxacum officianale</u>	Common dandelion			X							
<u>Thalictrum dipicum</u>	Early meadow-rue			X							
<u>Tilia americana</u>	Basswood	X				X					
<u>Tradescantia virginiana</u>	Spiderwort						X				
<u>Trillium sessile</u>	Toadshade	X	X				X	X			
<u>Ulmus rubra</u>	Slippery elm	X	X	X	X	X	X	X	X	X	
<u>Ulmus thomasi</u>	Rock elm									X	
<u>Viburnum prunifolium</u>	Blackhaw		X	X							
<u>Viola sp.</u>	Violet	X	X		X						
<u>Viola eriocarpa</u>	Violet		X			X					
<u>Vitis aestivalis</u>	Summer grape	X		X			X	X			
<u>Vitis rotundifolia</u>	Muscadine grape				X						

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