THE VASCULAR FLORA OF THE TABLELANDS: A NATURAL REGION IN THE NORTHEASTERN SECTION OF THE KNOBS OF KENTUCKY

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Accepted by the faculty of the College of Science and Technology, Morehead State University, in partial fulfillment of the requirements for the Master of Science degree.

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ABSTRACT

The Tablelands is a distinct physiographic region comprising approximately 46,580 hectares within the northeastern Knobs in western Rowan, eastern Fleming, and southern Lewis counties, Kentucky. The Tablelands is characterized by broad, flat ridges, steep slopes, and broad valleys. Lower Mississippian sandstone, siltstone, and shale belonging to the Borden Formation underlie the broad ridgetops. Devonian Ohio Shale underlies the steep slopes, while Silurian clay shale belonging to the Crab Orchard Formation underlies the lower slopes. The broad valleys are underlain by Quaternary alluvium. The area is not well known floristically and offers an ecological opportunity to investigate relationships between geology and vegetation. The objectives of this study were to 1) inventory the vascular plants of the Tablelands, 2) identify and locate significant natural communities, and 3) classify the woody plant communities in relationship to geologic layers and slope aspect. For objectives one and two, collections of vascular plants were made over two growing

seasons with a total of 54 four days spent in the field. A total of 780 species and varieties in 402 genera and 122 families was collected. Eight families (Asteraceae, Poaceae, Cyperaceae, Fabaceae, Lamiaceae, Rosaceae, Liliaceae, and Scrophulariaceae) represented 48% of the total flora. The largest families were the Asteraceae (115 species), Poaceae (70 species), and Cyperaceae (68 species). The largest genera, with 10 or more species, were *Carex* (53 species), *Aster* (20 species), *Quercus* (13 species), *Panicum* (11 species), *Viola* (11 species), *Polygonum* (10 species), and *Solidago* (10 species). Nine species documented are state listed species: *Castanea dentata* (Marshall) Borkh. (E), *Carex straminea* Willd. (T), *Prenanthes crepidinea* Michx. (T), *Scutellaria saxatilis* Riddell (T), *Carex seorsa* Howe (S), *Dryopteris carthusiana* (Villars) H. P. Fuchs (S), *Gratiola viscidula* Pennell (S), *Juglans cinerea* L. (S), and *Vernonia noveboracensis* (L.) Michx. (S). Exotic species made up 12.2% of the total flora, with 95 species and varieties (26 monocots, 69 dicots). Ten significant natural areas were located within the Tablelands. Four areas are bottomland swamp forests, four areas harbor prairie species, two areas have steep slopes underlain with Devonian Ohio Shale on which *Scutellaria saxatilis* and *Dryopteris carthusiana* occur, and the tenth area is an oxbow. In order to classify forests in relationship to rock type and slope aspect, a total of forty-five, 0.0942 hectare plots were sampled on five different geologic units: 1) Quaternary alluvium underlying bottomlands, 2) Silurian Crab Orchard Formation underlying lower slopes, 3) Devonian Ohio Shale underlying middle slopes, 4) Mississippian Sunbury Shale underlying upper slopes, and 5) Mississippian Farmers and Nancy Members of

the Borden Formation underlying ridgetops. The identity and diameter at breast height were determined and recorded for all live woody plant species greater than or equal to 5 cm dbh. Importance values (relative basal area + relative frequency + relative density) were calculated for each species present on each geologic unit and slope aspect. Based on species importance values and principal component analysis, four distinct forest types were identified in relationship to rock type. A red maple forest occupied the Quaternary alluvium in bottomlands. A pignut hickory-tulip poplar-red maple forest occupied the Crab Orchard Formation underlying lower slopes, while an oak-hickory forest occupied the Farmers/Nancy unit underlying the ridgetops. The forests growing on Ohio Shale (chestnut oak-red maple forest) and Sunbury Shale (chestnut oak) were similar with the importance of chestnut oak increasing on upper slopes underlain by Sunbury Shale. Slope aspect was not shown to influence forest type. *Quercus prinus* was the most important species in the forests of the Tablelands, accounting for 19.63% of the total importance values of all species present. Forests developed on Silurian strata had the greatest alpha diversity with 35 species, while the forests on Quaternary alluvium had the least alpha diversity with 15 species.

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INTRODUCTION

Understanding and preserving "biodiversity" has become a central issue for scientists and politicians world-wide (Reaka-Kudla et al. 1997). Encompassing the abundance and biological organization of genes, species, and ecosystems (USNRC 1992), biodiversity has drawn widespread attention due to the increasing awareness of the vital role it plays in global processes and the realization that it is fast disappearing (Reaka-Kudla et al. 1997). Biological diversity is fundamental to life on earth, directly and indirectly benefiting all living organisms. As global human populations increase, the task of creating a scientific knowledge base of biodiversity becomes imperative to maintaining a healthy biosphere.

Biological diversity has benefited humanity in countless ways, while potential benefits are yet to be discovered (USNRC 1992). Not only is food, shelter, and clothing provided by living organisms, but in the United States over 40 percent of all medications dispensed by pharmacies is organism-derived. For example, aspirin, the most widely used painkiller, was derived from salicylic acid discovered in meadowsweet (*Filipendula ulmaria*). Two alkaloids from the rosy periwinkle (*Catharanthus roseus*) in Madagascar have proven to cure most cases of Hodgkin's disease and acute lymphocytic leukemia (Wilson 1992).

Unlike more direct benefits, ecological services provided by biodiversity are difficult to determine. Understanding the role biological diversity plays in regulating global processes, or in the structure and function of ecosystems, is a complex task (USNRC 1992). Tilman and Downing (1994) showed a correlation between diversity

and ecosystem stability within grasslands in Minnesota. Tilman (1999) suggested that species diversity increases productivity of European grasslands. Ecosystems are complex, however, and the role each species plays in the overall function of an ecosystem is not understood. Diaz and Cabido (2001) suggested that the diversity of the functional traits of plants (e.g. whether plants are nitrogen fixing legumes, warm season bunchgrasses or rosette forbs) might contribute more to the overall functioning of an ecosystem than the actual numbers of the species living within the ecosystem. Clearly more research is necessary in understanding ecosystems and biodiversity's role in maintaining them.

Beyond the traditional realm of the sciences, the non-economic, intangible, and intrinsic values of biological diversity have played just as important a role in man's existence on earth. Human interaction with nature and the necessity nature plays in human existence has been shown throughout history via the arts, humanities, religion, philosophy, and language (USNRC 1992). Millions of people seek nature in some way or other. Given the means and sufficient leisure, a large portion of the populace likes to backpack, hunt, fish, bird-watch, and garden (Wilson 1992). It is only in the last moment of human history that the delusion has arisen that people can flourish apart from the rest of the living world. It is in these moments that humanity must awake to the call for rational stewardship of the world's heritage of biological resources (USNRC 1992).

Across the United States, the greatest threats to biological diversity can be grouped into the following five broad categories listed in descending importance;

1) loss or degradation of habitat, 2) spread of alien species, 3) pollution, 4) overexploitation, and 5) disease (Stein et al. 2000). The leading cause of habitat destruction, and the greatest threat to biodiversity, is agriculture, followed by land conversion for commercial development, water development, outdoor recreation (including off road vehicles), livestock grazing, infrastructure development (including roads), disruption of fire ecology, logging, mineral and petroleum extraction, and military activities (Stein et al. 2000).

In Kentucky, manipulation and change of habitat by humans has taken place for over 10,000 years, ranging from the burning of the landscape by Native Americans to clearing and conversion of forests and native grasslands for farmland to urban and industrial expansion. These events have greatly affected Kentucky's biodiversity by reducing habitat diversity. Extensive forests once occupied river bottomlands and all topographic positions. Today these forests are mostly confined to steep, unfarmable slopes. Tallgrass prairies and savanna-woodlands have been reduced to less than one percent of their pre-settlement area while more than 80 percent of Kentucky's wetlands have been lost or converted (Taylor 1995).

The task of inventorying the complete biodiversity of the earth, let alone just the United States, is not possible. However, with the rate at which diversity of both species and ecosystems is disappearing, protection of what is left is imperative. We must identify imperiled species and habitats and make them a priority for biological inventories (Stein et al. 2000). To address these issues, various agencies conduct ongoing studies that support natural history themes. Between the early 1970s and the

1980s, The Nature Conservancy, along with state agencies, formed the National Heritage Network. The purpose of this network is to track and provide information on the identity, distribution, and characteristics of species and ecosystems. The first natural heritage program was established in South Carolina in 1974. Since that time, the South Carolina Heritage Network has gathered, organized, and distributed high-quality information on the biodiversity of South Carolina (Stein et al. 2000).

The Kentucky State Nature Preserves Commission, established in 1976, is the agency that oversees the natural heritage program in Kentucky. This agency provides information on Kentucky's rare and sensitive plants and animals, uncommon natural communities, and other significant natural features. Through a statewide nature preserve system; the agency manages natural areas in an effort to protect the most outstanding natural communities in Kentucky.

In 1994, Governor Brereton Jones formed a biodiversity task force to study the biodiversity in Kentucky. After gathering data and public input, the overall status of biodiversity, along with recommended strategies and action plans for conserving biodiversity in Kentucky, was presented in "Kentucky Alive" (Taylor 1995). With less than one-third of the commonwealth inventoried for rare species, it was found that "the state needs a comprehensive inventory of the species that live within its boundaries, as well as inventories of communities and ecosystems" (Taylor 1995). Kentucky lags behind other states in plant biological inventories. As of 1995, 13 herbaria in Kentucky housed 243,000 vascular plant specimens, while 8 herbaria in Tennessee housed 800,000 specimens, 11 herbaria in Indiana housed 700,000

specimens, and 14 herbaria in Ohio housed over 1 million specimens (Jones et al. 1995).

Ecological research conducted within the borders of Kentucky also lags behind that of adjacent states. For example most of the quantitative research conducted in the eastern portion of the state has taken place in Robinson Forest in Breathitt County and Lilly Cornett Woods in Letcher County. Quantitative research conducted in the Knobs Region is limited to only a few relatively small-scale studies and one regional study.

To help address the need for more documentation and better understanding of the biodiversity of Kentucky, a study area, herein referred to as the "Tablelands", was chosen. The Tablelands lies within the northeastern section of the Knobs of Kentucky and is characterized by broad, flat ridges, steep slopes, and broad valleys. The study area is defined by a combination of geology and topography and is a distinct physiographic region. Lower Mississippian strata form the broad ridgetops, Devonian Ohio Shale the steep slopes, Silurian clay-shale the lower slopes, and Quaternary alluvium underlies the broad valleys. The area is not well known floristically and offers an ecological opportunity to investigate relationships between geology and vegetation. The objectives of this study were to:

1) Inventory the vascular plants of the Tablelands,

2) Identify and locate significant natural communities,

3) Classify the woody plant communities in relationship to the underlying rock type and slope aspect.

THE STUDY AREA

Location

The Tablelands is located in western Rowan, eastern Fleming, and south-central Lewis counties, Kentucky (Figure 1), and includes most of the region covered by the Farmers, Plummers Landing, and Burtonville 7.5' topographic maps with minor coverage on the Colfax, Cranston, Flemingsburg, Hillsboro, Stricklett, and Tollesboro maps. The Tablelands lies approximately between 38° 07' 30'' and 38° 31' 30'' N, and between 83° 30' and 83° 39'W. The study region is about 468.5 square kilometers (46,850 ha) in area, and extends approximately 45 km (28 mi.) north to south with an average width of 13 km (8 mi.).

The Tablelands lies completely within the Licking River watershed (Figure 2). Several tributaries of Triplett Creek drain the southern end of the region in the vicinity of Farmers, while the northern tip of the region includes the extreme headwaters of the North Fork Licking River. The majority of the Tablelands lie within the watershed of Fox Creek. Elevations range from 201m (660') in bottomlands of the Licking River at the southern end of the Tablelands to 413m (1356') on the tallest knobs at the eastern edge.

Boundaries

The western boundary of the Tablelands is defined by the bordering Beasley Hills (Campbell 1996), a region of low hills and rounded knobs with lower elevations

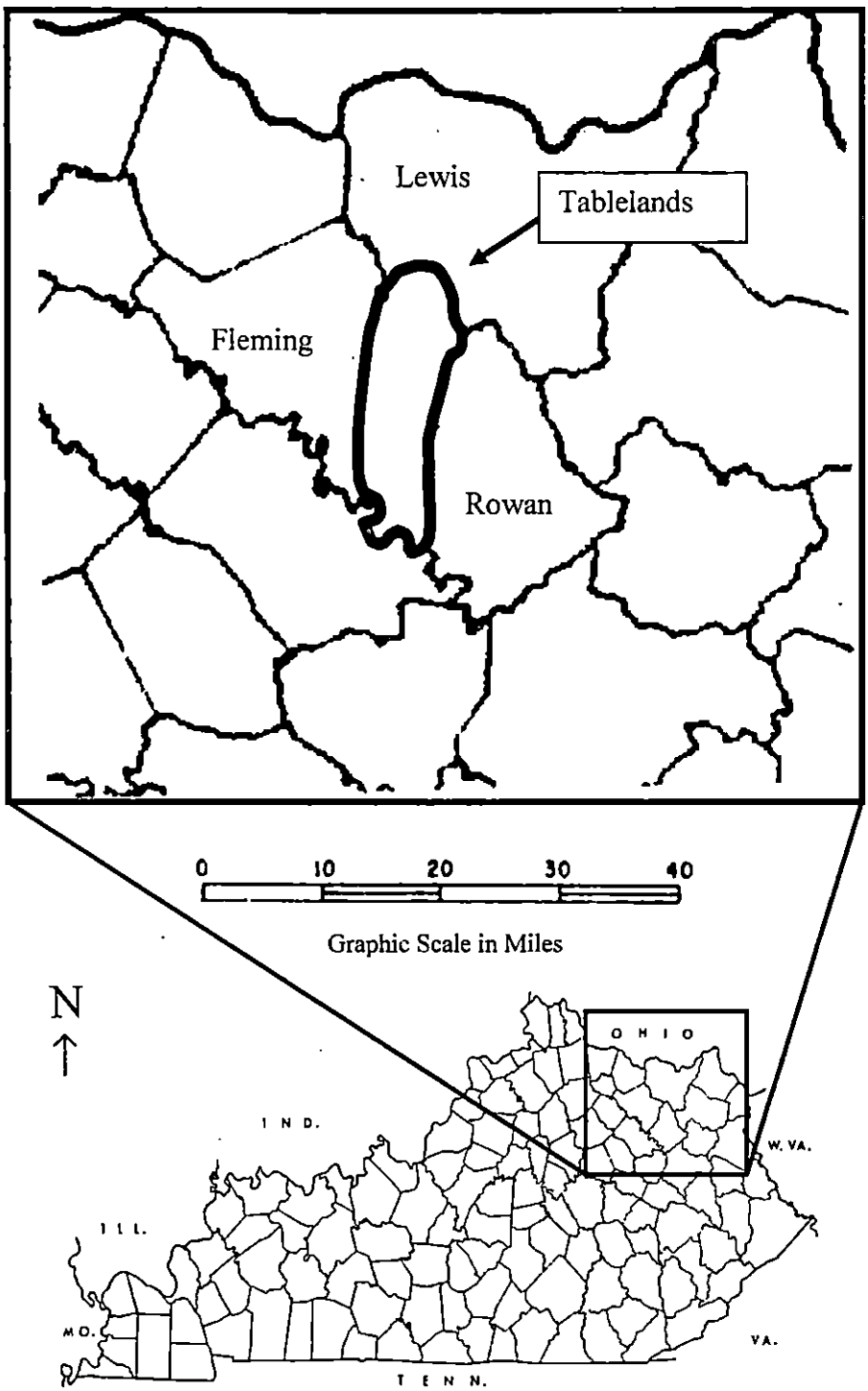


Figure 1. Location of the Tablelands in western Rowan, eastern Fleming and southern Lewis counties of Kentucky.

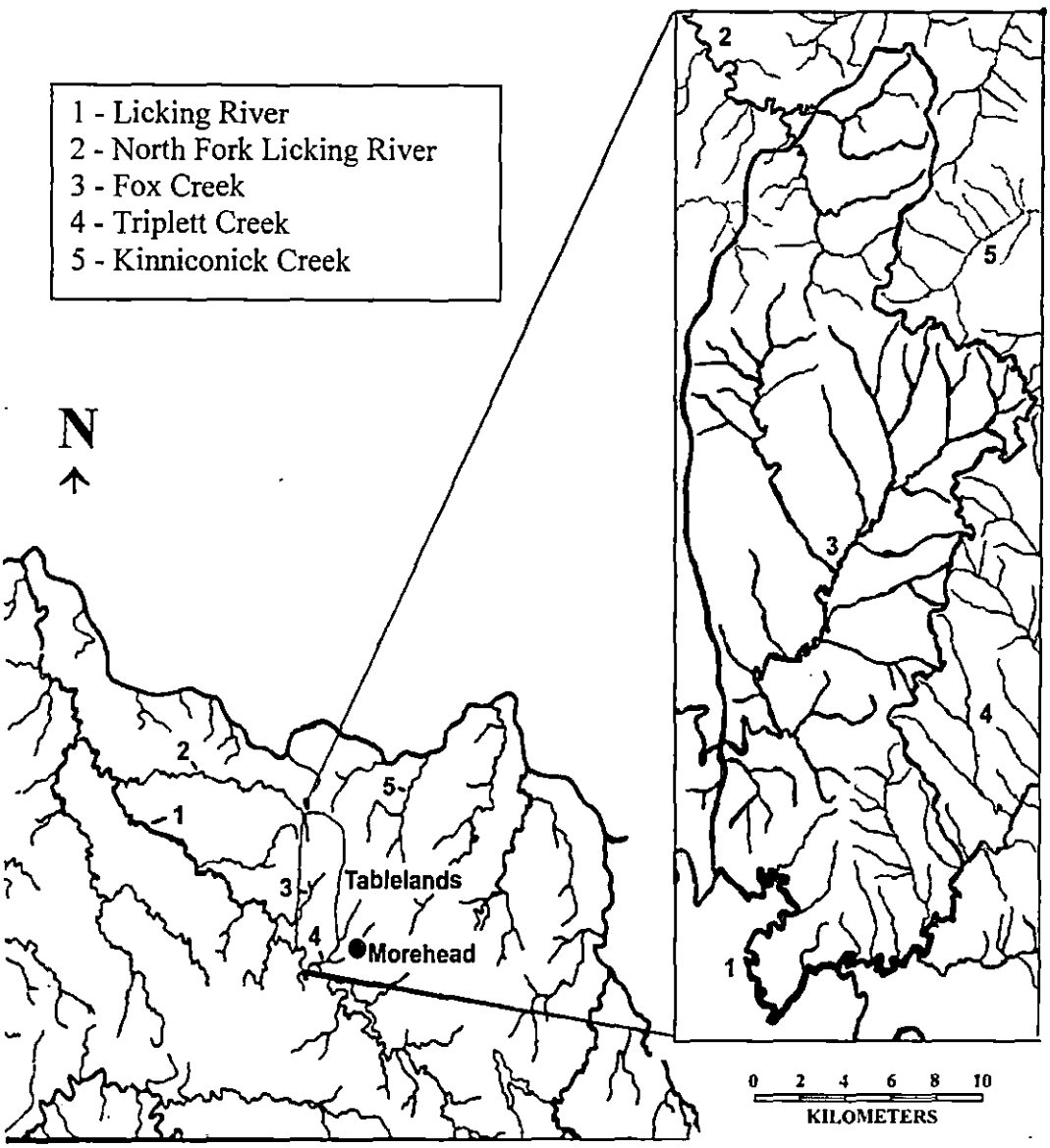


Figure 2. Streams within the boundaries of the Tablelands.

than the Tablelands. The highest elevations of the Beasley Hills range between 244-274m (800'–900'). The western margin of the Tablelands abruptly rises as steep slopes from the Beasley Hills to form the characteristic table-like ridgelines.

The eastern boundary is formed by the Kinniconick Hills. This region is characterized by narrower, knobby ridges that attain elevations of approximately 396m (1300') in contrast with the flat ridges of the Tablelands whose elevations range between 317-348m (1040'-1140').

The northern border is defined by the drainage divide between tributaries of the Licking River (Powderlick Branch and Mud Lick Branch of the North Fork Licking River) and streams that flow directly into the Ohio River (Cabin Creek, Big Branch, and Kinniconick Creek). This watershed divide is accompanied by a change in topography as the ridges north of this drainage separation become narrower and the hills more rounded.

Triplett Creek and the Licking River in the vicinity of Farmers define the southern border. South of these streams, the ridges are narrower, unlike the flat ridges of the Tablelands to the north. Local names within the Tablelands, such as Moore's Flats and Sharkey Flats, confirm the character of the study area.

Physiography and Topography of the Knobs and Tablelands

Weathering and stream erosion have been significant forces in the development of Kentucky's physiography and topography (McGrain 1983). Lying within six sections of three major physiographic regions (Fenneman 1938), the areal

distribution of Kentucky's landforms has resulted from the amount of time exposed to erosion and the paleogeographic distribution of geologic layers (Figure 3).

A major geologic feature influencing the present landscape of Kentucky is a regional upwarp known as the Cincinnati Arch. Centered in central Kentucky, this arch resulted in regional tilting of the rock layers in an eastward and westward direction. Millions of years of erosion removed younger rocks from the crest of the arch, leaving older Ordovician strata exposed in the Bluegrass Region (McGrain 1983). Surface rocks in the rest of the state become progressively younger as one moves in any direction away from the Bluegrass. Some of the youngest strata in Kentucky are exposed in the Appalachian Plateau Province in the east and in the Shawnee Hills region in the west.

The Knobs Region encircles the Bluegrass Region in a horseshoe-shaped belt. A region with highly dissected topography, the Knobs generally can be characterized by flat-topped ridges and hills and isolated conical hills, separated by wide valleys or shale-floored lowlands (Fenneman 1938). The geology of the Knobs Region includes Silurian, Devonian, Mississippian and Pennsylvanian strata, with older Silurian strata inside of the belt and younger Pennsylvanian strata to the outside (Burroughs 1926; McFarlan 1943). The Knobs are erosional remnants, carved from the Pottsville Escarpment in the east and from the uplands behind Muldraugh's Hill on the west and south (McFarlan 1943). They were formed when erosional forces cut through layers of younger Mississippian and Pennsylvanian sandstones and limestones into

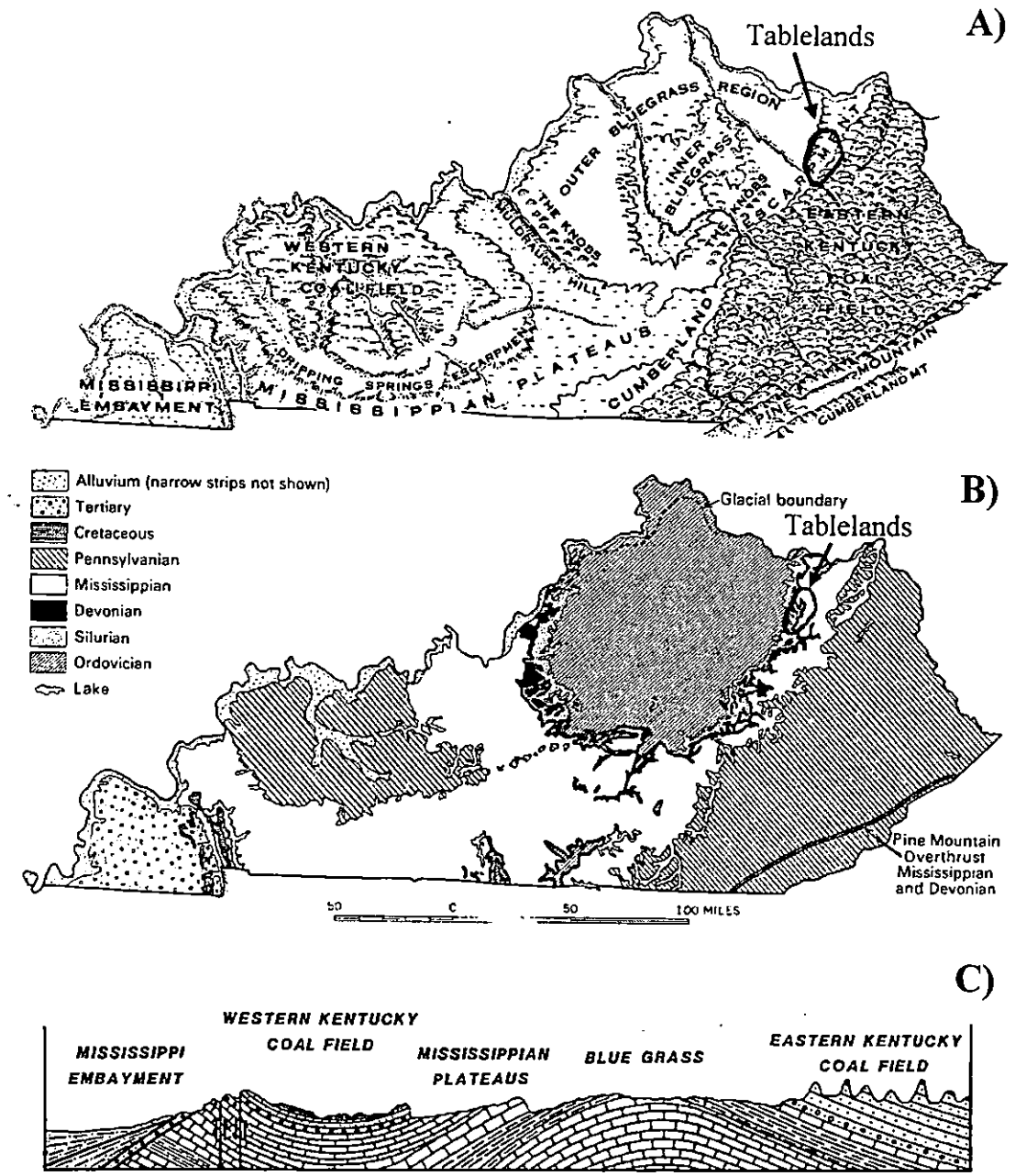


Figure 3. A) Physiographic map of Kentucky showing location of Tablelands; B) Generalized geologic map of Kentucky showing location of Tablelands; C) Cross section of geologic layers in Kentucky. Permission was granted by Kentucky Geologic Survey to use maps from McGrain (1983).

stratigraphically lower, less resistant Devonian and Silurian shales. The variation within the Knobs topography is due to the proximity of underlying structural geology to the crest of the Cincinnati arch and the temporal exposure of the strata to erosional forces (Harker et al. 1981). Knobs located to the inside of the horseshoe belt, having been exposed to erosional forces longer, have had the resistant capstone layers removed leaving behind isolated rounded hills consisting of Devonian strata. Areas further to the outside of the belt and still possessing resistant capstone layers, exist as flat-topped hills or flat ridgelines still connected to the surrounding escarpment (Harker et al. 1981).

Due to its transitional nature, the Knobs region has been placed in different sections of the Interior Low Plateau. Fenneman (1938) placed it in the Highland Rim section while Quarterman and Powell (1978) later designated the area as the Knobstone Escarpment and Knobs Subsection of the Bluegrass Section. Campbell (1996) names the Knobs Region as one of seven natural regions of Kentucky. According to Campbell's map (Figure 4), the Tablelands lies within the Kinniconick Hills and Licking River Knobs subsection of the Northeastern Section of the Knobs.

Geology and Soils of the Tablelands

The broad ridgetops of the Tablelands are capped with Mississippian strata belonging to the Borden Formation (Figure 5). The uppermost layers consist of shale, siltstones, and sandstones of the Nancy Member. Comprised mostly of shale with minor amounts of siltstone and sandstone near the base and top respectively, the Nancy

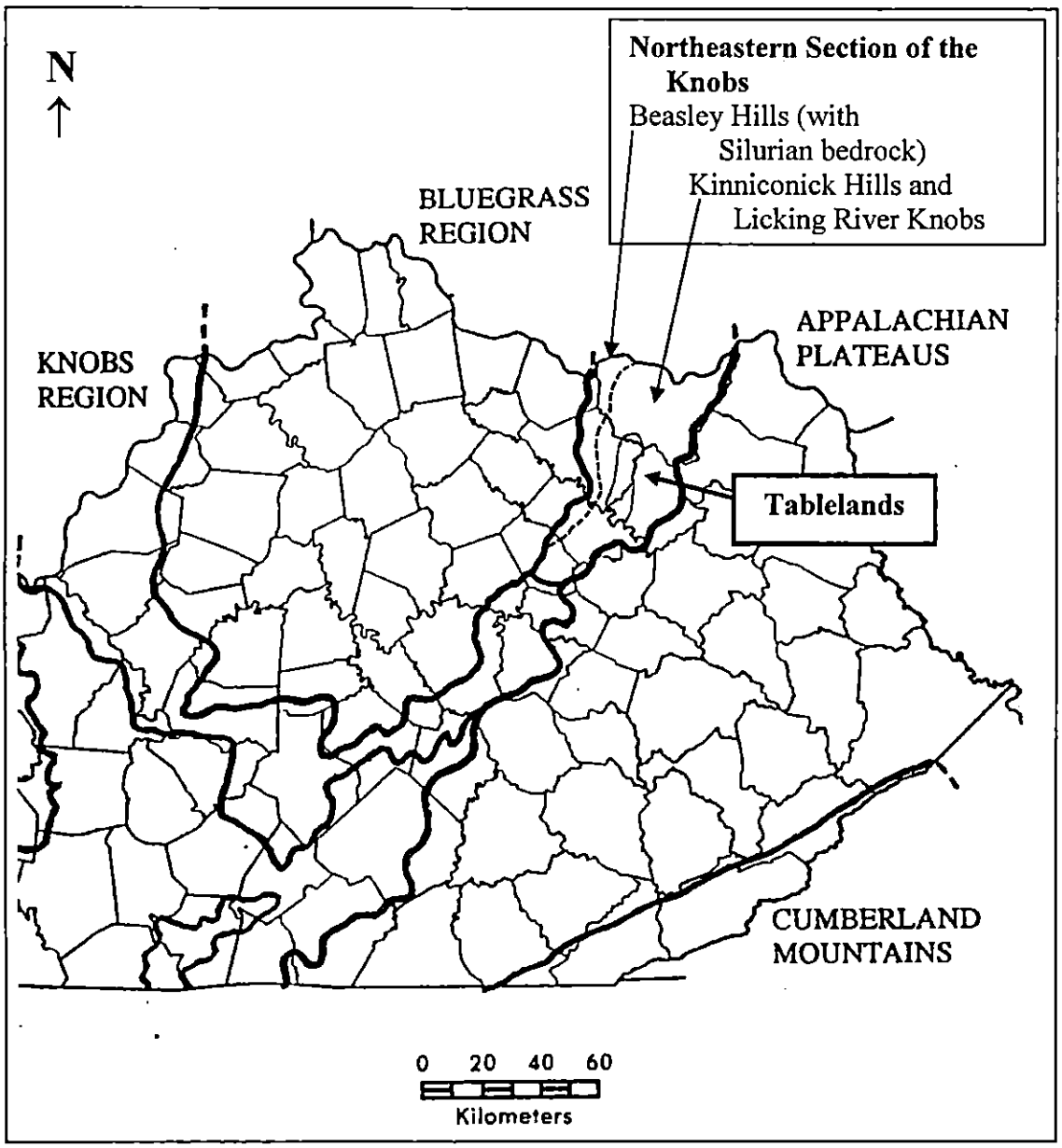


Figure 4. Physiographic map of central and eastern Kentucky showing the location of the Tablelands within the Kinniconick Hills and Licking River Knobs subsection of the Northeastern Section of the Knobs Region according to Campbell (1996).

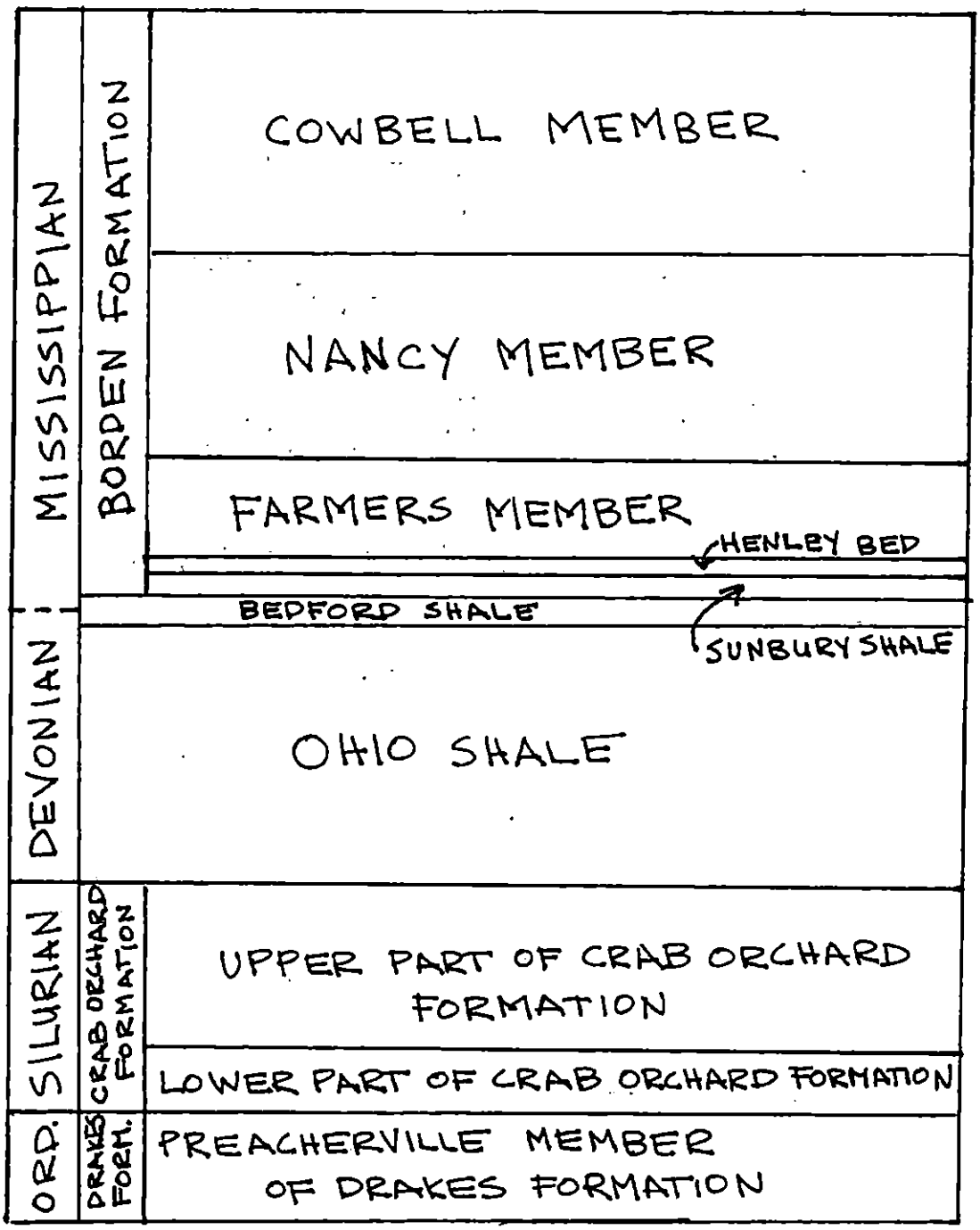


Figure 5. Geologic layers underlying and defining the Tablelands (Modified from McDowell 1975).

Member ranges from 30.5-61m (100-200') thick and erodes to form gentle slopes or extensive flats (McDowell 1975). The shale consists of various amounts of silt and is hard to split. Color of the shale ranges from a bluish- to greenish-gray that weathers to olive gray to grayish orange. The dominant soils that develop on the ridgetops are Tilst silt loam and Blairton silt loam (Jacobs 1993). The Nancy Member is missing from the northernmost ridge-tops of the Tablelands (McDowell 1975; McDowell et al. 1971; Morris 1965).

The Farmers Member of the Borden Formation underlies the Nancy Member. Consisting of sandstones interspersed with minor amounts of shale, the Farmers Member ranges from 6-43m (20-140') thick. This member forms steep, abundant, ledgy outcrops that rim the flat-topped ridges. Beds of the sandstone can be up to four feet thick and are very resistant to erosion. The sandstone consists of very fine-grained particles and is light-brownish gray to yellowish-brown in color.(McDowell 1975; McDowell et al. 1971; Morris 1965). Dominant soils that develop on the Farmers are of the Brownsville-Berks complex of a channery silt loam (Jacobs 1993).

The Henley Bed of the Mississippian Borden Formation is poorly exposed and is generally covered with sandstone derived slabs from the overlying Farmers Member. Commonly occupying a slight topographic bench on the upper slopes, the Henley Bed is 1.5-4.6m (5-15') thick (McDowell 1975; McDowell et al. 1971; Morris 1965) and is composed of greenish-gray, clayey shale (McDowell et al. 1971).

Below the Henley Bed lies the Mississippian Sunbury Shale. Forming steep to moderate slopes, the Sunbury Shale occupies upper slope positions and ranges in

thickness from 4.6-6.1m (15-20'). The shale is carbonaceous and sparsely pyritic, very cleavable and dark-gray to black in color (McDowell et al. 1971). Soils are thin and contain abundant shale chips (McDowell 1975; McDowell et al. 1971; Morris 1965). Dominant soils developing on the Sunbury Shale are Colyer clayey, Trappist and Muse silty loam (Jacobs 1993).

The Devonian/Mississippian Bedford Shale lies below the Henley Bed. Although these strata are generally covered, they may be exposed on prominent benches on topographic noses and hillsides (McDowell et al. 1971). Ranging from 3-18m (10-60') thick, the Bedford Shale is composed of silty clay-shale that is poorly fissile. The shale weathers from a greenish-gray, light-olive-gray color to a reddish, yellowish color (McDowell 1975; McDowell et al. 1971; Morris 1965). Dominant soils developing on the Bedford strata are Colyer clayey, Trappist and Muse silty loam (Jacobs 1993).

The Devonian Ohio Shale underlies the middle slopes of the Tablelands. Ranging from 43-67m (140 to 220') thick, the Ohio Shale forms steep slopes and is locally well exposed. The dark-gray to black shale contains high amounts of organic matter and is sparsely pyritic. The Ohio Shale is evenly bedded and highly fissile, and is occasionally marked by springs or seeps of acidic, sulfurous or iron-rich waters (Morris 1965; McDowell et al. 1971; McDowell 1975). Dominant soils formed on the Ohio Shale are Colyer clayey, Trappist and Muse silty loam (Jacobs 1993).

The lower slopes of the Tablelands consist of calcareous clay-shale included in the upper part of the Silurian Crab Orchard Formation. Ranging from 24-46m (80-

150') thick, clay shale of the upper Crab Orchard Formation forms gentle to moderate slopes that are commonly hummocky, gullied, and poorly exposed. The greenish-gray to gray clay shale is weakly fissile, relatively impermeable, and very plastic when wet. Dolomitic siltstone is rare in the upper portions of this formation (McDowell 1975; McDowell et al. 1971; Morris 1965). Dominant soils are Shrouts silty clay loam and Beasley silty clay loam (Jacobs 1993).

The lower portion of the Silurian Crab Orchard Formation underlies the lowest slopes from the middle of the study area northward. Forming moderate to steep slopes, the lower part of the Crab Orchard Formation consists of calcareous clay-shale ranging in color from greenish-gray to gray. Interbedded in the clay-shale is dolomitic limestone that weathers to rusty brown (McDowell 1975; McDowell et al. 1971; Morris 1965). Dominant soils developing on the strata are Shrouts silty clay loam and Beasley silty clay loam (Jacobs 1993).

The Upper Ordovician Preachersville Member of the Drakes Formation is found only in small pockets in the north portion of study area, between the base of Silurian strata and the edge of alluvium. The unit forms moderate slopes that are commonly gullied. The calcareous clay-shale is poorly bedded and poorly fissile, and becomes plastic when wet. Thin beds of medium-grained dolomite are interbedded in the clay shale (McDowell et al. 1971). Dominant soils are Shrouts silty clay loam and Beasley silty clay loam (Jacobs 1993).

Quaternary alluvium fills the valley floor. Consisting of silt and clayey silt, the dark-brown to yellowish-brown alluvium occurs with variable amounts of organic

material and ranges from 0-8m (0-25') thick (McDowell 1975; McDowell et al.1971; Morris 1965). Dominant soils of these bottomlands are Elk, Newark, Nolin, and Otwell fine-silty soils derived from limestone, siltstone, shale, and loess (Jacobs 1993).

Climate

The climate of the Tablelands is humid continental with an average annual temperature around 12° C (54° F). The average temperature in January is 2.6° C (36.8° F), while the average temperature in July is 24.3° C (75.7° F). The average annual precipitation is between 109-116.6 cm (43-45.9 inches) (Jacobs 1993; Avers et al., 1974) with the greatest rainfall in July, 12.5 cm (4.9 inches), second greatest in March, 11.1 cm (4.35 inches) and the least in October, 5.8 cm (2.3 inches) (USDA FS 1997a). The average growing season is approximately 170 days (Ulack et al. 1998).

Vegetation and Land Use

Braun (1950) classified the vegetation type of the Eastern United States as the Deciduous Forest Formation due to the "prevalence of the deciduous habit of most of its woody constituents". Further dividing the eastern US into nine regions, she placed the Appalachian Plateau physiographic region of eastern Kentucky within the Mixed Mesophytic Forest region and the Interior Low Plateau physiographic region of central Kentucky within the Western Mesophytic Forest region (Braun 1950). Although Braun (1950) included the Knobs of northeastern Kentucky in the

Allegheny Plateau physiographic region, she noted that it is a transition zone between the Mixed Mesophytic Forest region to the east and the Western Mesophytic Forest Region to the west. The forests in this area were also noted to demonstrate the interrelations between vegetation and the underlying rock and physiographic history of the area (Braun 1950).

The term "mixed mesophytic," indicates no generic dominance exists in the climax association of the forest community. The canopy is shared by a number of species including *Acer saccharum*, *Aesculus octandra* (*A. flava*), *Castanea dentata*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Tilia heterophylla*, *Quercus rubra*, *Quercus alba*, and *Tsuga canadensis*. Species occurring less frequently include *Acer rubrum*, *Betula lenta*, *Carya cordiformis*, *C. ovata*, *Fraxinus americana*, *Juglans nigra*, *Magnolia acuminata*, *Nyssa sylvatica*, and *Prunus serotina* (Braun, 1950).

The Western Mesophytic Forest Region is a broad transition region between the Mixed Mesophytic Forests of the east and south, Beech-Maple to the north, and Oak-Hickory to the northwest, west and south, with no single forest climax type characterizing the entire region. The region is a mixture of forest types transitioning from an wide-ranging mosaic of mixed mesophytic communities in the east to an extensive mosaic of oak and oak-hickory communities in the west, all interspersed with areas of prairie (Braun 1950). Forest types tend to be dominated by a few species. Communities of mixed mesophytic species tend to be less diverse than those in the Appalachian Plateau, while the most characteristic trees of the Mixed

Mesophytic Forest Region, *Tilia heterophylla* and *Aesculus octandra* (*A. flava*), drop out (Braun 1950).

Braun's classification of vegetation was an attempt at understanding the original, pre-settlement forest patterns of eastern North America. Most of these same forests, however, have been subjected to various environmental impacts over time. The loss of the American chestnut opened the way to new species assemblages, thus changing the forest composition of Appalachian forests (McCormick and Platt 1980). Logging and agriculture impact forests, and recovery to pre-settlement forest composition may never happen.

A large portion of the Knobs region remained forested until the early 20th century when artificial drainage and fertilizers allowed farming on wet bottomlands and unfertile uplands. Large amounts of timber were used in late 1800s for smelting of iron ore extracted from the thin layers of Devonian rocks (Taylor 1995). Since that time, logging has continued to be a major source of income, leaving slopes forested with second and third growth woods. Within the Tablelands, land use in Lewis and Fleming counties is still mainly agriculture or used for rural housing on the ridgetops and in the valley bottomlands. In Rowan County, industrial and urban housing development is taking place on the ridgetops around the Sharkey Flats area. A regional industrial park has been established in the area and a regional airport has been proposed.

LITERATURE REVIEW

Review of Previous Botanical Works Conducted within the Knobs Region

According to Harker et al. (1981), the Knobs region lies within approximately 22 counties (Figure 6). County floras have been published for only eight of the 22 counties (Table 1). Areas of the inventoried counties range from 48,951 hectares in Oldham County to 162,652 hectares in Hardin County. Oldham County (Matthews 1962) had the greatest number of species per hectare with a total of 846 species in 48,951 ha or 0.0173 species per hectare. The second most diverse flora (number species per hectare) was documented in Estill County (Guetig 1993) with 853 species in 65,786 hectares or 0.0130 species per hectare. Although Hardin County (Cranfill 1991) reported the greatest number of species, 1126, the number of species per hectare was only 0.0070. Casey County (Murphy 1970) had the least number of species per hectare with 252 species collected from 65,786 hectares or 0.0022 species per hectare. It is noted that the survey in Casey County included only collections made in the spring of 1961 and 1962, and specimens in the University of Kentucky Herbarium. The report was considered a preliminary survey of the county. No county floras have been published for the three counties in which the Tablelands is located.

Other botanical and ecological works have been conducted in areas that lie within the Knobs, or in counties in which the Knobs are present (Table 2). Wharton (1945) and Harker et al. (1981) addressed the Knobs as a whole region, while Quarterman and Powell (1978) addressed a broader region, the Interior Low Plateau.

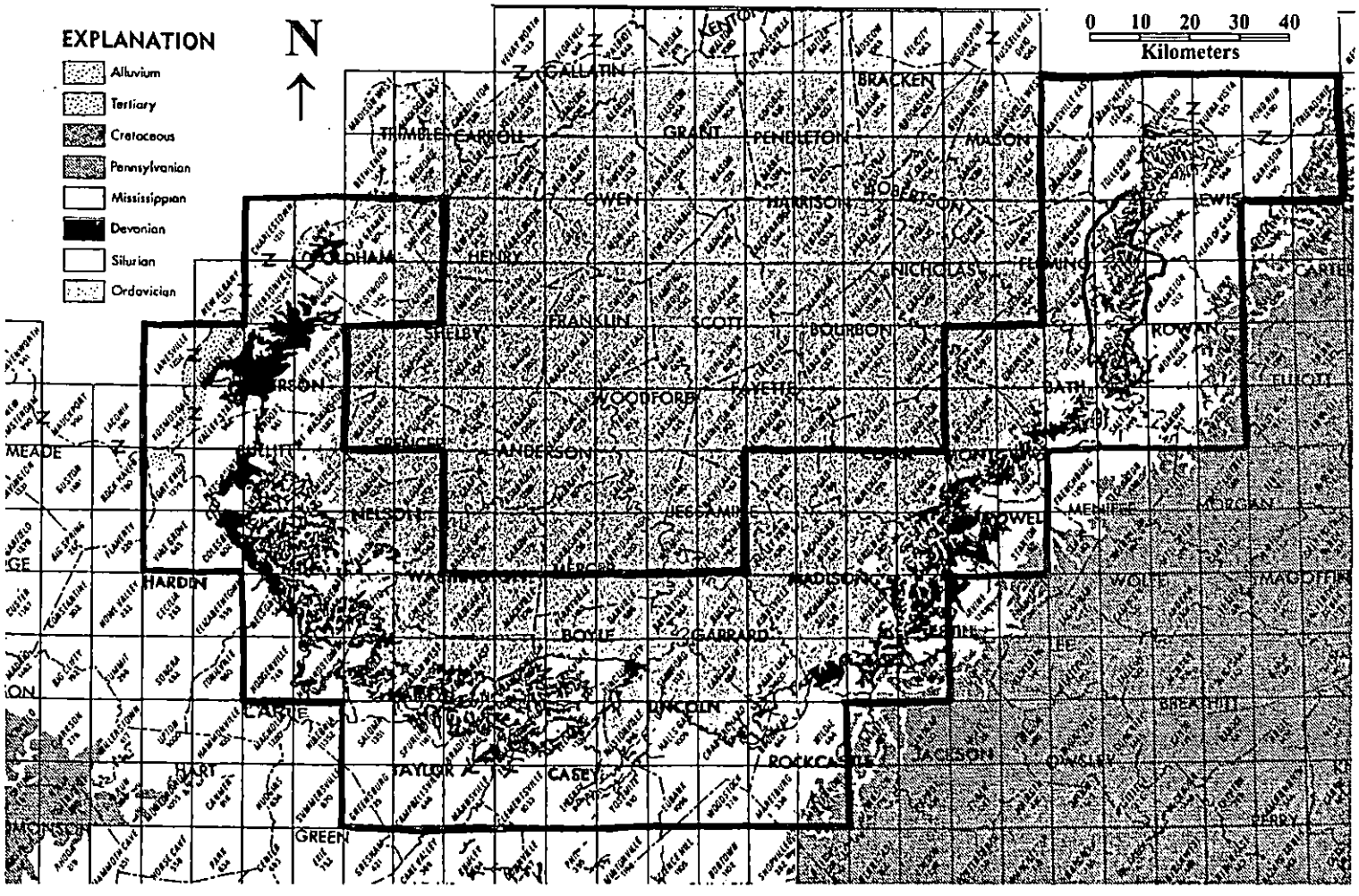


Figure 6. Counties within the Knobs region of Kentucky according to Harker et al. (1981).

Table 1. Counties of the Knobs Region in which county floras have been published, including number of species documented, area of the county, and number of species per hectare.

County (Reference)	Number of Species	Area of County (Hectares)	Number of Species Per Hectare
Bullitt County (Gunn 1968a)	822	77,441 ha	.0106
Casey County (Murphy 1970)	252	115,514 ha	.0022
Clark County (Beckett 1956)	708	65,786 ha	.0108
Estill County (Guetig 1993)	853	65,786 ha	.0130
Hardin County (Cranfill 1991)	1126	162,652 ha	.0070
Jackson County (Abner 1993)	671	89,614 ha	.0075
Nelson County (Greenwell 1935)	863	109,557 ha	.0079
Oldham County (Matthews 1962)	846	48,951 ha	.0173

The other works cited in Table 2 covered more limited areas of the Knobs. Wharton (1945) provided the most extensive documentation of plants growing on soil derived from Devonian-Mississippian black shale within the Knobs region. The purpose of Wharton's work was to investigate plant geography in relationship to geology. In Wharton's words "The nature of a rock influences the soil derived from it, and such features as resistance or non-resistance affect physiography and soil. Soil and physiography, in turn, are important determining factors in vegetation." Wharton (1945) documented 1,014 species, varieties, forms and hybrids of vascular plants from 18 counties in which the black shale occurs. Along with documentation of the

Table 2. Botanical works conducted in counties that lie within or include counties of the Knobs Region of Kentucky (Harker et al. 1981).

BOTANICAL WORK (Reference)	COUNTY
Cedar glade flora of Bullitt County (Baskin and Baskin 1975)	Bullitt County
Cooperative inventory of endangered, threatened, sensitive and rare species: DBNF, Berea Ranger District (Campbell et al. 1991)	Estill, Jackson, Madison, and Rockcastle
Cooperative inventory of endangered, threatened, sensitive and rare species: DBNF, Morehead Ranger District (Campbell et al. 1992)	Bath, Menifee, and Rowan
Cooperative inventory of endangered, threatened, sensitive and rare species: DBNF, Stanton Ranger District (Campbell et al. 1989)	Menifee and Powell
A flora of Bernheim Forest (Gunn 1959)	Bullitt County
The flora of Jefferson and seven adjacent counties (Gunn 1968b)	Bullitt, Hardin, Nelson and Oldham counties
Floristics and vegetation of the Devonian-Mississippian black shale region of Kentucky (Wharton 1945)	All 22 counties
Potential ecological/geological natural landmarks on the Interior Low Plateaus (Quarterman and Powell 1978)	All 22 counties
Preliminary assessment of the ecology of the "Knobs" oil Shale region. (Harker et al. 1981)	All 22 counties
A preliminary survey of the vascular flora of the Red River Gorge of KY (Higgins 1970)	Powell County
Report on the botany of Madison, Lincoln, Garrard, Washington, and Marion Counties, KY (Linney 1882)	Madison, Lincoln, Garrard, and Marion counties
Shrubby and herbaceous flora of the Berea College Forest (Grossman and Pittillo 1962)	Madison County

Table 2. (cont.)

BOTANICAL WORK (Reference)	COUNTY
Swamp forests on high terrace deposits in the Bluegrass and Knobs regions of Kentucky (Meijer et al. 1981)	Bath, Casey, Fleming, Lewis, Montgomery, Powell and Rockcastle
The vascular flora of the Brodhead Swamp Forest (Hannan and Lassetter 1982)	Rockcastle County
The vascular flora of Maywoods Environmental and Educational Laboratory (Godbey 1984)	Garrard and Rockcastle counties
Woody plant of six northern Kentucky counties (Clark and Bauer 2001)	Fleming County

flora, Wharton also characterized the plant communities in detail, distinguishing five upland forest types, seven lowland communities, and three communities that occupied areas of disturbance.. The upland forests on hilltops, ridges, and south-facing hillsides included pine, oak-pine (transitional), and chestnut oak-scarlet oak forests, while forests on less exposed hillsides and in coves included white oak and mixed-mesophytic forests. Two of the lowland communities were willow-birch marginal communities and floodplain woodland communities, both along streams. Lowland communities on broad, flat lowlands were pond communities, sedge marshes, swamp thickets, lowland pinewoods, and sweet gum-pin oak and pin oak-white oak forests. Communities in disturbed areas included those associated with clearings and those

established in areas once cultivated, ruderal communities and shrub communities in old fields.

Prompted by threats of oil shale development as a new energy source, the Kentucky State Nature Preserves Commission (Harker et al. 1981) conducted a preliminary survey to identify potential natural areas within the Knobs. Using maps, aerial photographs and existing biological information, one hundred and sixty-seven areas were identified as potentially having biological significance. Ground-truthing one hundred and three of these areas, fifteen sites were determined as significant ecological areas. None of the fifteen sites were located within the present study area.

The objectives of Quarterman and Powell's (1978) research was to identify and describe significant areas within the Interior Low Plateau that best illustrate geological/ecological occurrences that characterize the region. Only nine significant sites were identified from within the counties of the Knobs, none of which lie within the present study area. Perhaps the reason that no sites were located within the study area is that the area has not been well studied floristically. Of the counties in which the study area is located, only Rowan County has been carefully inventoried with 1,185 species documented (Campbell pers. com.). Lewis County has been inventoried fairly well with 710 documented species while Fleming County has only 403 species documented, indicating a need for a more intensive survey of that flora.

Relatively few studies have focused on quantitative evaluation of the vegetation within the Knobs region (Table 3). Muller and McComb (1986) addressed vegetation patterns across the entire region by sampling 147 plots within eight areas

Table 3. Quantitative botanical works conducted in areas that lie within counties of the Knobs Region of Kentucky (Harker et al. 1981).

Quantitative Botanical Work (Reference)	County
A beech-hemlock stand in the knobstone escarpment (Jones and Thompson 1986)	Madison County
Classification and ordination of forest vegetation in the Knobs Region of Ky (Day 1993)	Bullitt and Nelson counties
Upland forests of the Knobs Region of Kentucky (Muller and McComb 1986)	All counties
The vegetation and its relationships with selected soil and site factors of the Spencer-Morton Preserve (Fedders 1983)	Powell County
The vegetation of the Brodhead Swamp Forest of Rockcastle County, Kentucky (Hannan 1980)	Rockcastle County

of the Knobs. Baseline information on species composition, stand structure, and species-environment relationships was established. Using indirect ordination, four recognizable groupings of plots were identified; a mesophytic hardwood group, and three groups dominated by one of three oak species, *Quercus alba*, *Q. coccinea*, and *Q. prinus*. The mesophytic hardwoods group, comparable to the mixed mesophytic forest of the Appalachian Plateau, was restricted to coves with potentially higher moisture availability, higher pH, and soil fertility. The distribution of the three oak groups did not correlate with local environmental gradients and was thought to be responding to larger geographical gradients instead. Muller and McComb's research supported Braun's concept that the vegetation of the Knobs is transitional between the Mixed Mesophytic Forest Region and the Western Mesophytic Forest Region.

Day (1993) focused on the forest communities in the Bernheim Arboretum and Research Forest in Bullitt and Nelson counties. Three forest types were determined within the study area; white oak (*Quercus alba*), mixed oak-red maple (*Quercus alba*, *Q. prinus*, *Q. velutina*, and *Acer rubrum*), and sugar maple-tulip poplar-beech (*Acer saccharum*, *Liriodendron tulipifera*, and *Fagus grandifolia*). Environmental factors influencing species composition included elevation, slope and aspect, and soil nutrients.

Fedders (1983) identified twelve forest communities in the Spencer-Morton Preserve in Powell County. Oak communities were the most widespread followed by oak-hickory, successional, and hickory communities. Five species had the greatest importance throughout the study area. These species included *Quercus prinus*, *Carya glabra*, *Quercus alba*, *Q. velutina*, and *Carya tomentosa*. Linear correlations between vegetation data, and soil and site properties were frequently significant, however the values were low.

Jones and Thompson (1986) examined a single beech-hemlock stand in Madison County, Kentucky. *Fagus grandifolia* had the greatest importance value, with *Tsuga canadensis* second. These two species comprised 66% of the total basal area of the forest. Associates of the two dominants were *Quercus alba*, *Liriodendron tulipifera*, and *Acer rubrum*. The occurrence of a beech-hemlock community is unusual for the Knobs, since it is more typically found in the forests of the Cumberland Plateau.

Three distinct plant communities were identified in the Brodhead Swamp Forest in Rockcastle County by Hannan (1980). These three communities were a sweetgum-ash-oak community, a sweetgum-oak community, and a sweetgum-sycamore-blackgum community. Seven species had the greatest importance throughout the swamp forest as a whole and included *Acer rubrum*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Platanus occidentalis*, *Quercus bicolor*, and *Q. palustris*. The water regime was the most important abiotic factor affecting the vegetation of the Brodhead Swamp Forest.

PART 1: FLORISTIC INVENTORY

MATERIALS AND METHODS

Documentation of the vascular plants of the Tablelands began in March of 1999 and extended through October of 2000, a span of two growing seasons. Aerial photographs of the area were examined to locate sites of interest such as old growth forests, bottomland forests, and possible prairie openings. Topographic and geologic maps were also examined to identify various areas of interest such as large tracts of forested land, north-facing drains of mesic woods, oxbow ponds, natural springs, or geologic layers in which unusual species had already been documented. Ability to obtain permission from landowners influenced collecting areas, since most of the land is privately owned. Fleming Wildlife Management Area is located in the north part of the study area. Weekly collecting trips were taken with a total of 54 days spent in the field. One thousand two hundred twenty six specimens were collected from a total of 64 areas within the Tablelands, with twenty-three of these areas being revisited at various times throughout the growing season.

Voucher specimens, in duplicate when possible, were collected for all vascular taxa found in the study area. No effort was made to collect all taxa at all sites. However, the dominant species were noted at each collection site and were included on herbarium specimen labels. The primary guides used to identify specimens were Gleason and Cronquist (1991) and Jones (2001). Nomenclature of gymnosperms and angiosperms follows Gleason and Cronquist (1991) while nomenclature of pteridophytes follows *Flora of North America*, Vol. 2 (FNA

Editorial Committee 1993). Dr. Leo Collins annotated specimens of *Scutellaria saxatilis* and Dr. Rob Naczi annotated specimens of selected sedges. Specimens were dried and mounted on 100% rag, heavy weight herbarium sheets along with labels. Label data included scientific name, habitat data, locality data, collector, collection number, and date. The primary set of specimens was deposited in the Morehead State University Herbarium (MDKY) while duplicates were sent to Northern Kentucky University Herbarium (KNK) and/or the Missouri Botanical Garden Herbarium (MO). Elemental of Occurrence Record (EOR) forms for state and federally listed species were submitted to the Kentucky State Nature Preserves Commission.

RESULTS

Floristic Inventory

A total of 780 species and varieties of vascular plants (Appendix A) representing 402 genera and 122 families was verified and documented from the Tablelands (Table 4). These vascular plant taxa included: 28 pteridophytes, 6 gymnosperms, 198 monocots, and 548 dicots. The most diverse family documented from these four groupings included Dryopteridaceae (8 species); Pinaceae (5 species); Poaceae (70 species); and Asteraceae (115 species) respectively. Nine of the 780 taxa are state-listed as endangered (1), threatened (3), or of special concern (5) by Kentucky State Nature Preserves Commission (2000) (Table 5). These comprise 1.2% of the total flora of the Tablelands.

Eight families are represented by twenty or more species each and comprised 48% of the total flora of the Tablelands (Table 6). The Asteraceae is the most diverse family, with 115 species and varieties, comprising 14.7% of the flora. The Poaceae and Cyperaceae families are the next largest families consisting of 70 and 68 species and varieties comprising 9.0% and 8.7% of the total flora, respectively. The largest genus is *Carex*, represented by 53 species. Other genera represented by ten or more species include *Aster* (20), *Quercus* (13), *Panicum* (11), *Viola* (11), *Polygonum* (10), and *Solidago* (10). *Quercus* is the largest woody genus, with thirteen species. A total of 95 species of the flora are introduced species, comprising 12.2% of the total flora (Table 7). Of the 95 introduced species, 26 are monocots and 69 are dicots.

Table 4. Number of taxa of vascular plants documented from the Tablelands.

Taxonomic Group	Families	Genera	Species and Varieties
Fern and fern allies	13	21	28
Gymnosperms	2	3	6
Angiosperms			
Monocotyledons	18	83	198
Dicotyledons	89	295	548
Total	122	402	780

Table 5. State-listed taxa documented from the Tablelands.

Endangered
Castanea dentata (Marshal) Borkh.
Threatened
Carex straminea Willd.
Prenanthes crepidinea Michx.
Scutellaria saxatilis Riddell
Special Concern
Carex seorsa Howe.
Dryopteris carthusiana (Villars) H. P. Fuchs
Gratiola viscidula Pennell
Juglans cinerea L.
Vernonia noveboracensis (L.) Michx.

Table 6. Plant families with the highest number of species documented from the Tablelands.

Family	Number of Species	Percent of Total Taxa
Asteraceae	115	14.7
Poaceae	70	9.0
Cyperaceae	68	8.7
Fabaceae	32	4.1
Lamiaceae	25	3.2
Rosaceae	22	2.8
Liliaceae	21	2.7
Scrophulariaceae	20	2.6
Total	373	47.8

Table 7. Introduced species documented from the Tablelands.

DICOTS

Amaranthus hybridus L.
Arabidopsis thaliana (L.) Heynh.
Arenaria serpyllifolia L.
Barbarea vulgaris R. Br.
Berberis thunbergii DC.
Capsella bursa-pastoris (L.) Medic.
Cardamine hirsuta L.
Carduus nutans L.
Catalpa speciosa Warder
Centarea maculosa Lam.
Cerastium pumilum Curtis
Cerastium semidecandrum L.
Chrysanthemum leucanthemum L.
Cichorium intybus L.
Cirsium vulgare (Savi) Tenore
Conium maculatum L.
Coronilla varia L.
Datura stramonium L.
Daucus carota L.
Dianthus armeria L.
Dipsacus sylvestris Hudson
Draba verna L.
Elaeagnus umbellata Thunb.
Galinsoga parviflora Cav.
Galium pedemontanum All.
Glechoma hederacea L.
Lamium purpurem L.
Lepidium campestre (L.) R. Br.
Lespedeza cuneata (Dumont) G. Don.
Lespedeza striata (Thunb.) Hook & Arnott
Ligustrum vulgare L.
Lonicera japonica Thunb.
Lonicera maackii (Rupr.) Maxim.
Lotus corniculatus L.
Lysimachia nummularia L.
Maclura pomifera (Raf.) C. K. Schneid.
Melilotus alba Medicus
Melitlotus officinalis (L.) Lam.
Mentha piperita L.
Mollugo verticillata L.
Myosotis arvensis (L.) Hill
Pastinaca sativa L.
Plantago lanceolata L.
Polygonum cespitosum Blume
Polygonum convolvulus L.
Polygonum cuspidatum Sieb. & Zucc.

Table 7. (dicots cont.)

Polygonum persicaria L.	*Trifolium campestre* Schreber
Populus alba L.	*Trifolium hybridum* L.
Prunella vulgaris L.	*Trifolium pratense* L.
Rosa multiflora Thunb.	*Trifolium repens* L.
Rumex acetosella L.	*Tussilago farara* L.
Rumex crispus L.	*Verbascum thapsus* L.
Saponaria officinalis L.	*Veronica arvensis* L.
Sida spinosa L.	*Veronica officinalis* L.
Solanum nigrum L.	*Vicia sativa* L.
Sonchus oleraceus L.	*Vicia vilosa* Roth
Stellaria pubera Michx.	*Vinca minor* L.
Taraxacum officinale Weber	

MONOCOTS:

Agrostis gigantea Roth
Allium sativum L.
Allium vineale L.
Anthoxanthum odoratum L.
Belamcanda chinensis (L.) DC.
Bromus commutatus Schrader
Bromus racemosus L.
Commelina communis L.
Digitaria ischaemum (Schreb.) Muhl.
Echinochloa crusgalli (L.) P. Beauv.
Eleusine indica (L.) Gaertn.
Festuca elatior L.
Festuca pratense Hudson
Holcus lantus L.
Hosta sp.
Lolium perenne L.
Microstegium vinineum (Trin.) A. Camus
Ornithogalum umbellatum L.
Phleum pratense L.
Poa annua L.
Poa compressa L.
Poa trivialis L.
Setaria faberii R. Herrm.
Setaria glauca (L.) P. Beauv.
Sorghum halepense (L.) Pers.
Vulpia myuros (L.) C. Gmelin.

State-Listed Rare and Endangered Species

***Castanea dentata* (Marshall) Borkh. (American chestnut) - Endangered**

Castanea dentata was infrequent in the Tablelands (Figure 7). Stump sprouts were observed in upland forests on slopes and ridgelines.

***Carex straminea* Willd. (straw sedge) - Threatened**

Carex straminea was documented from the Rowan County Sphagnum Swamp (Figure7). Located in the Licking River floodplain, the Rowan County Sphagnum Swamp is 2.6 km (1.6 mi) northwest of Midland, and is located on the Farmers Quadrangle. This was the only area in the Tablelands in which *C. straminea* was documented. *Carex straminea* was growing in open, wet meadows created by gasline-right-of-ways running through the swamp forest. Populations were vigorous and covered a substantial area. Other species present included *Carex scoparia, Carex vulpinoidea* var. *vulpinoidea, Glyceria septentrionalis, Gratiola viscidula, Proserpinaca palustris, Sisyrinchium angustifolium,* and *Viola primulifolia.*

***Prenanthes crepidinea* Michx. (Midwestern white lettuce) - Threatened**

Prenanthes crepidinea was documented from two sites within the Tablelands (Figure 7). The first site was located in the southernmost headwater drain of Brushy Fork of Fox Creek in Fleming County. Located on the Burtonville Quadrangle, the site is approximately 3.9 km (2.4 mi) east of Wallingford. The habitat was creekside

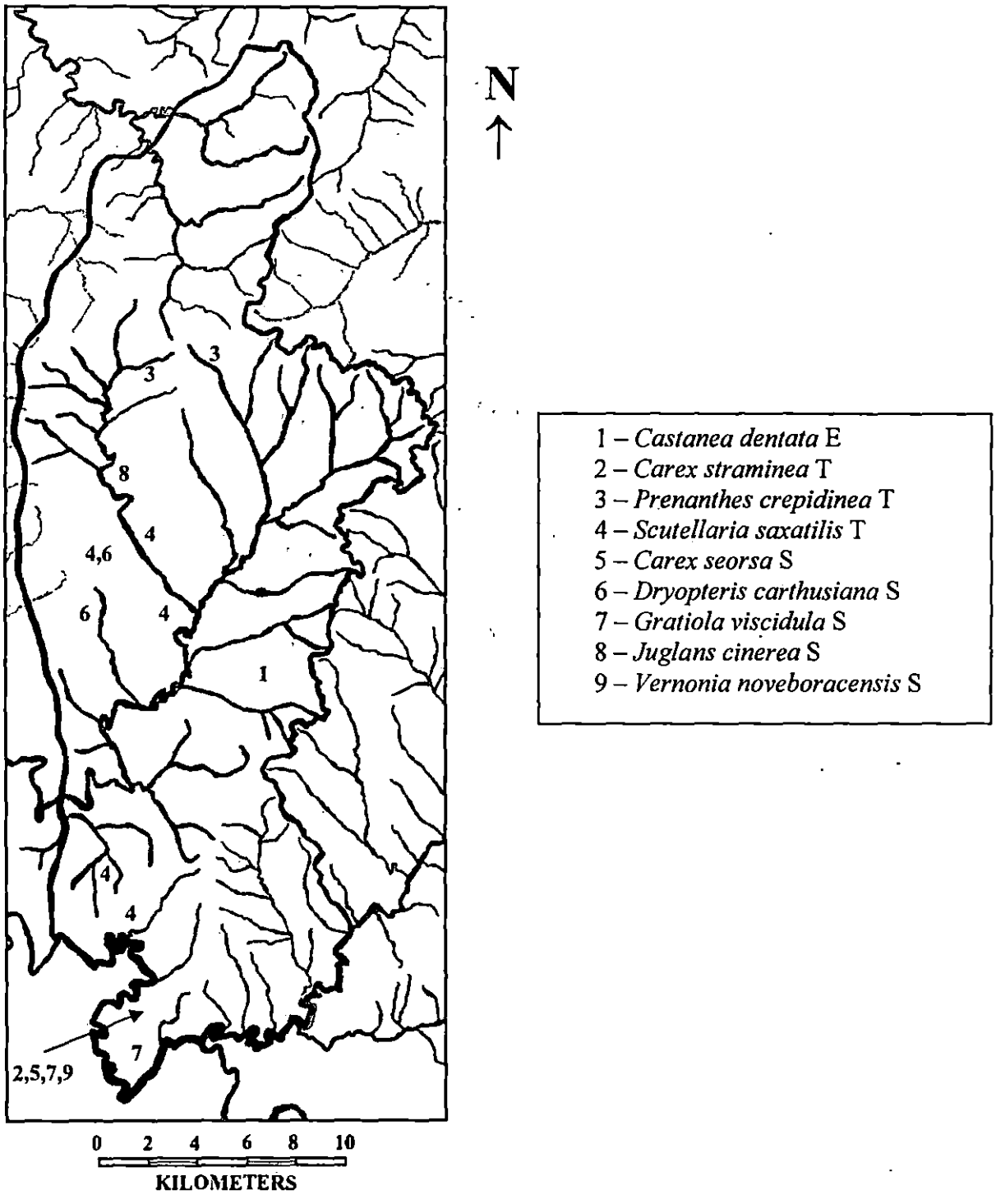


Figure 7. Location of sites for the nine state-listed species found in the Tablelands.

with a thin forest canopy. The site was across the drain from an old house site located on alluvium below an exposure of the Ohio Shale. Only a few individual plants were observed, none in reproductive stages. Other species present at this site included *Ambrosia artemisiifolia*, A. *trifida*, *Aster prenanthoides*, *Cuscuta* sp., *Dioscorea batatas*, *Eupatorium serotinum*, *Hypericum punctatum*, *Impatiens* sp., *Polygonum cespitosum*, *Polygonum sagittatum*, *Sambucus canadensis*, and *Verbesina alternifolia*. The second site for *Prenanthes crepidinea* was along Wooley Creek, a tributary of Sand Lick Creek. Located on the Burtonville Quadrangle, the site is approximately 2.3 km (1.4 mi) south-southeast of Wallingford in Fleming County. The site was located in a forested creek floodplain developed on lower Crab Orchard shales and older Quaternary alluvium. Only a few individuals were observed, none in reproductive stages. Woody species present at the site included *Carpinus caroliniana*, *Carya ovata*, *Cercis canadensis*, *Fraxinus americana*, *Prunus americana*, *Rhamnus lanceolata*, and *Viburnum prunifolium*. The herbaceous layer included *Ambrosia trifida*, *Carex gracilescens*, *Cerastium nutans*, *Osmorhiza longistylis*, and *Verbesina alternifolia*.

***Scutellaria saxatilis* Riddell (rock skullcap) - Threatened**

In the Tablelands, *Scutellaria saxatilis* was documented from five areas (Figure 7). All populations were located on the Ohio Shale or on transitional beds between the Ohio Shale and the upper part of the Crab Orchard Formation. Slope aspect does not appear to influence location of the species as populations were found

growing on all aspects. The species was documented in forested habitats, including woody species such as *Acer rubrum*, *A. saccharum*, *Asimina triloba*, *Carya glabra*, *C. ovata*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Quercus alba*, and *Q. rubra*.

Scutellaria saxatilis was first documented from Three Licks Branch in Rowan County. Located on the Farmers Quadrangle, Three Licks Branch is approximately 2.6 km (1.6 mi) northwest of the junction of KY 211 and KY 1722. Populations at this site were not large, but were flowering. Other species present included *Carex digitalis*, *C. laxiflora*, *Dennstaedtia punctilobula*, *Hedyotis purpurea*, *Osmunda claytoniana*, *Panax quinquefolius*, and *Poa sylvestris*.

Scutellaria saxatilis was also documented from Buckner Branch in Fleming County. Buckner Branch is located 2.4 km (1.5 mi) east-southeast of Colfax on the Farmers Quadrangle. Hundreds of plants were scattered from top to bottom of a steep east-facing slope, which is underlain with Ohio Shale. Other herbaceous species included *Adiantum pedatum*, *Amphicarpaea bracteata*, *Aristolochia serpentaria*, *Aster divaricatus*, *Carex albursina*, *C. rosea*, *Desmodium glutinosum*, *D. nudiflorum*, *Deparia acrostichoides*, and *Polemonium reptans*.

The David Watson farm was the third area in which *Scutellaria saxatilis* was documented. The area is located in Fleming County, approximately 2.3 km (1.4 mi) west of Plummers Landing on the Plummers Landing Quadrangle. Small reproductive populations were observed scattered throughout an east-facing, steeply sloped area. Forests were mature second growth woods, one of the most mature

forests of the Tablelands. The understory layer was dense with *Asimina triloba* while the herbaceous layer included *Podophyllum peltatum* and *Sanguinaria canadensis.*

Bay's Farm, in Fleming County, is the fourth area in which *Scutellaria saxatilis* was documented. Bay's Farm is approximately 2.9 km (1.8 mi) south-southeast of Goddard, west of KY 32, and is located on the Plummers Landing Quadrangle. Small populations were observed on a north-facing, steep slope of Ohio Shale. The understory was dense with *Asimina triloba.* Additional plants occurred on a south-southeast-facing slope on strata transitional between the Ohio Shale and the upper part of the Crab Orchard Formation. Other species present included *Asimina triloba, Carex platyphylla, Cimicifuga racemosa, Deparia acrostichoides, Diplazium pycnocarpon, Dennstaedtia punctilobula, Lindera benzoin, Podophyllum peltatum,* and *Sanicula canadensis.*

Scutellaria saxatilis was also documented from a site between Farris Branch and Hurst Hollow in Fleming County and is located on the Plummers Landing Quadrangle. Located 3.4 km (2.1 mi) southeast of Goddard, the site is on a west-facing slope at the base of the Ohio Shale. A small reproductive population was observed. The herbaceous layer at the site included *Agrimonia rostellata, Desmodium glabellum,* and *Diarrhena americana.*

Carex seorsa Howe (weak stellate sedge) - Special Concern

Carex seorsa was documented in the Tablelands from swamp forest woods at the Rowan County Sphagnum Swamp (Figure 7). Located on the Farmers

Quadrangle, this site is in the Licking River floodplain, 2.6 km (1.6 mi) north-northwest of Midland in Rowan County. Small clumps of the species were found in parts of the wetter areas of the swamp forest. Species present at the collection site included *Decodon verticillatus*, *Glyceria septentrionalis*, *Iris virginica*, *Nyssa sylvatica*, and *Quercus palustris*.

***Dryopteris carthusiana* (Villars) H. P. Fuchs (spinulose wood fern) - Special Concern**

Dryopteris carthusiana is known from two sites (Figure7). The first site was Bay's Farm. *Dryopteris carthusiana* was growing at the base of the Ohio Shale on an east-facing slope. One clump of *D. carthusiana* was observed. The habitat was forested with *Acer rubrum*, *A. saccharum*, *Carpinus caroliniana*, *Cercis canadensis*, *Fraxinus americana*, *Juglans nigra*, *Liriodendron tulipifera*, and *Ulmus rubra*.

The second site for *Dryopteris carthusiana* is near Campbell Mountain Girl Scout Camp. The site is located approximately 4.7 km (2.9 mi) west of Plummers Mill in Fleming County, and is located on the Plummers Landing Quadrangle. Several individuals were observed growing at the base of the Ohio Shale on an east-facing slope.

***Gratiola viscidula* Pennell (Short's hedge-hyssop) - Special Concern**

Gratiola viscidula was previously known from one site, the Rowan County Sphagnum Swamp (Figure 7). Located in the Licking River floodplain, the

Rowan County Sphagnum Swamp is 2.6 km (1.6 mi) northwest of Midland, and is located on the Farmers Quadrangle. *Gratiola viscidula* was found in open gasline right-of-ways. Other species present were *Carex vulpinoidea*, *C. scoparia*, *Glyceria septentrionalis*, *G. striata*, *Juncus acuminatus*, *J. effusus*, *Proserpinaca palustris*, *Sisyrinchium angustifolium*, and *Viola primulifolia.*

Gratiola viscidula was also documented from a new site, Marie's Woods (Figure7). Also located in the Licking River floodplain in Rowan County, Marie's Woods is approximately 1.6 km (1.0 mi) from Midland, located on the Farmers Quadrangle. The population of *Gratiola viscidula* was extensive throughout a gasline-right-of-way.

***Juglans cinerea* L. (white walnut) - Special Concern**

Juglans cinerea was rare, only observed and documented from one site (Figure 7). The individual was growing along a gravel road at the mouth of a drain, 0.6 km (0.4 mi) southeast of Goddard. The site lies near the contact between Ordovician and Silurian strata. Woody species around the site included *Acer negundo*, *Carya ovata*, *Cercis canadensis*, *Euonymus atropurpureus*, *Fraxinus americana*, *Platanus occidentalis*, *Staphylea trifolia*, and *Ulmus rubra.* Herbaceous species included *Aristolochia serpentaria*, *Delphinium tricorne*, *Trillium sessile*, and *Senecio obovatus.*

***Vernonia noveboracensis* (L.) Michx. New York ironweed - Special Concern**

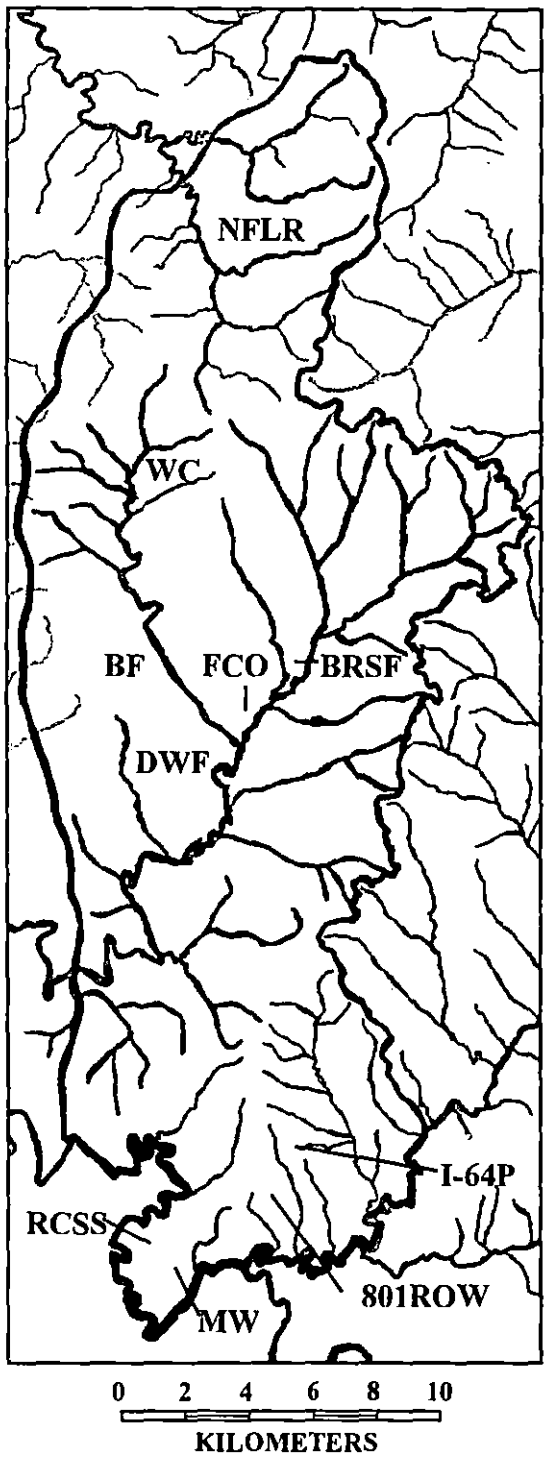
Vernonia noveboracensis was documented from one site (Figure 7). The site is located just outside the Rowan County Sphagnum Swamp, approximately 2.4 km (1.5 mi) northwest of Midland. Located on the Farmers Quadrangle, the wet meadow site is located in the Licking River floodplain. Other species included *Scirpus cyperinus* and *Solidago gigantea.*

Significant Natural Areas

Ten natural areas within the Tablelands are considered significant (Table 8). Four of these areas are bottomland swamp forests. Three are areas in which prairie species dominate the plant community. Two rare species, *Dryopteris carthusiana* and *Scutellaria saxatilis*, are associated with poor soils developed on the Ohio Shale. Two areas of significance are on slopes that harbor one or both of these species, although *S. saxatilis* was documented in other areas. The tenth area of significance is an oxbow. The ten areas will be discussed below in more detail, beginning with the areas in the northern portion of the study area, working southward (Figure 8).

Table 8. Significant natural areas in the Tablelands.

1.	North Fork Licking River Bottomland Forest	6.	Fox Creek Oxbow
2.	Wooley Creek	7.	I-64 Prairie
3.	Bays Farm	8.	801 Right-of-Way Tallgrass Prairie
4.	David Watson Farm	9.	Marie's Woods
5.	Big Run Swamp Forest	10.	Rowan County Sphagnum Swamp



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NFLR – North Fork Licking River
WC – Wooley Creek
BF – Bays Farm
DWF – David Watson Farm
BRSF – Big Run Swamp Forest
FCO – Fox Creek Oxbow
I-64P – I-64 Prairie
801ROW – 801 Right-of-Way Tallgrass Prairie
MW – Marie's Woods
RCSS – Rowan County Sphagnum Swamp

Figure 8. Locations for the ten designated significant natural areas in the Tablelands.

1. North Fork Licking River Bottomland Forest

The North Fork Licking River Bottomland Forest is located in the north section of the Tablelands along the North Fork Licking River in Lewis County. Located on the Burtonville Quadrangle, the 51 ha (125 A) bottomland forest is approximately 1.6 km (1.0 mi) southeast of Foxport (junction of KY 344 and KY 902) (Figure 9). The area inventoried had been selectively logged within the last ten years, leaving the canopy thin in areas. Cattle have grazed parts of the area compacting the soil. Uncommon species in the forest bottomland include *Glyceria septentrionalis* and *Quercus bicolor*. *Glyceria septentrionalis* is an obligate wetland species often found in shade. This species was observed in several wetland habitats in the Tablelands. *Quercus bicolor* is associated with swamp forests and wet woods. Known from the Interior Low Plateau and Mississippian Embayment, *Q. bicolor* was observed in three bottomland forests of the Tablelands.

Species present in the canopy layer of the North Fork Licking River bottomland forest included *Acer negundo*, *A. rubrum*, *A. saccharum*, *Aesculus flava*, *Carya laciniosa*, *Fraxinus americana*, *F. pennsylvanica*, *Liriodendron tulipifera*, *Quercus bicolor*, and *Q. palustris*. Understory species included *Asimina triloba*, *Carpinus caroliniana*, *Cephalanthus occidentalis*, *Sambucus canadensis*, and *Viburnum prunifolium*. Species in the herbaceous layer included *Agalinus purpurea* var. *purpurea*, *Callitriche palustris*, *Carex crinita*, *C. granularis*, *C. lurida*, *C. typhina*, *Glyceria striata*, *Gratiola neglecta*, *G. virginiana*, *Lobelia cardinalis*, *Mimulus alatus*, *Ophioglossum vulgatum* var. *pycnostichum*, *Phlox paniculata*,

Rudbeckia laciniata, *Scutellaria lateriflora*, *Senecio glabellus*, and *Teucrium canadense* var. *virginicum*.

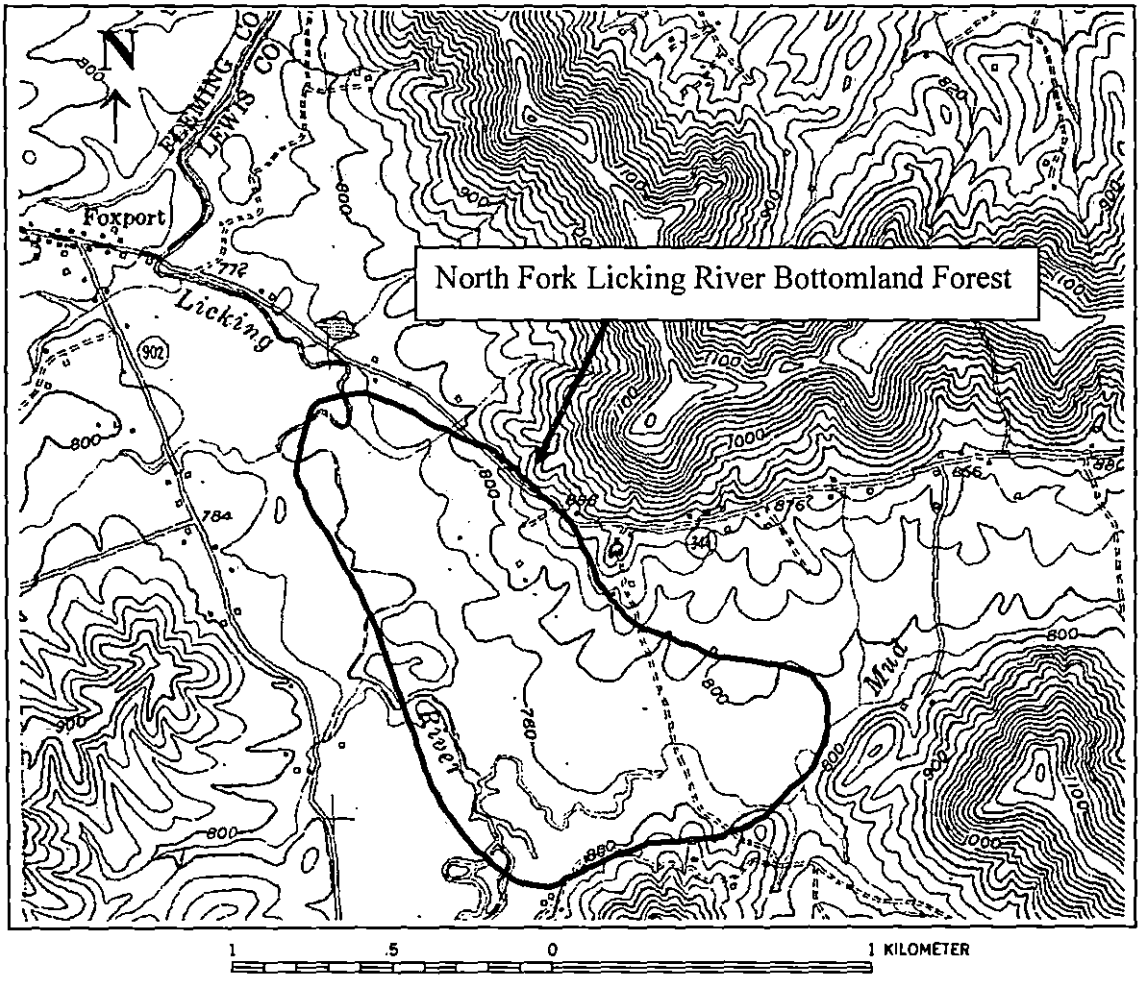

Figure 9. North Fork Licking River Bottomland Forest in Lewis County, Burtonville Quadrangle.

2. Wooley Creek

Wooley Creek is located approximately 1.9 km (1.2 mi) south-southeast of Wallingford (Figure 10). The area is in Fleming County and is located on the Burtonville Quadrangle. *Silphium terebinthinaceum*, along with other prairie species, was found growing in old fields. The state listed species, *Prenanthes crepidinea*, was documented along Wooley Creek.

Silphium terebinthinaceum was abundant in old fields at Wooley Creek. This was the only site documented for the species in the study area. Located on lower slopes, the fields are underlain by the upper part of the Crab Orchard Formation. Soils are shallow and the underlying rock is exposed throughout the area. Young woody plants were beginning to succeed in the field. Species included *Diospyros virginiana*, *Juniperus virginica*, *Quercus stellata*, and *Q. imbricaria*. Other species present included *Allium cernuum*, *Eupatorium altissimum*, *Kuhnia eupatorioides* var. *eupatorioides*, *Liatris spicata*, *Linum medium*, *Orbexilum pedunculatum*, *Pycnanthemum tenuifolium*, and *Solidago juncea*.

State listed as threatened, *Prenanthes crepidinea* was documented in the creek floodplain of Wooley Creek. Quaternary alluvium and the lower part of the Crab Orchard Formation underlie the area while deep soils are found along the creek. Only a few individuals of *Prenanthes crepidinea* were observed, none in reproductive stages. The plant community included *Ambrosia trifida*, *Carex gracilescens*, *Carpinus caroliniana*, *Carya ovata*, *Cerastium nutans*, *Cercis canadensis*, *Fraxinus*

americana, Osmorhiza longistylis, Prunus americana, Rhamnus lanceolata,

Verbesina alternifolia, and *Viburnum prunifolium.*

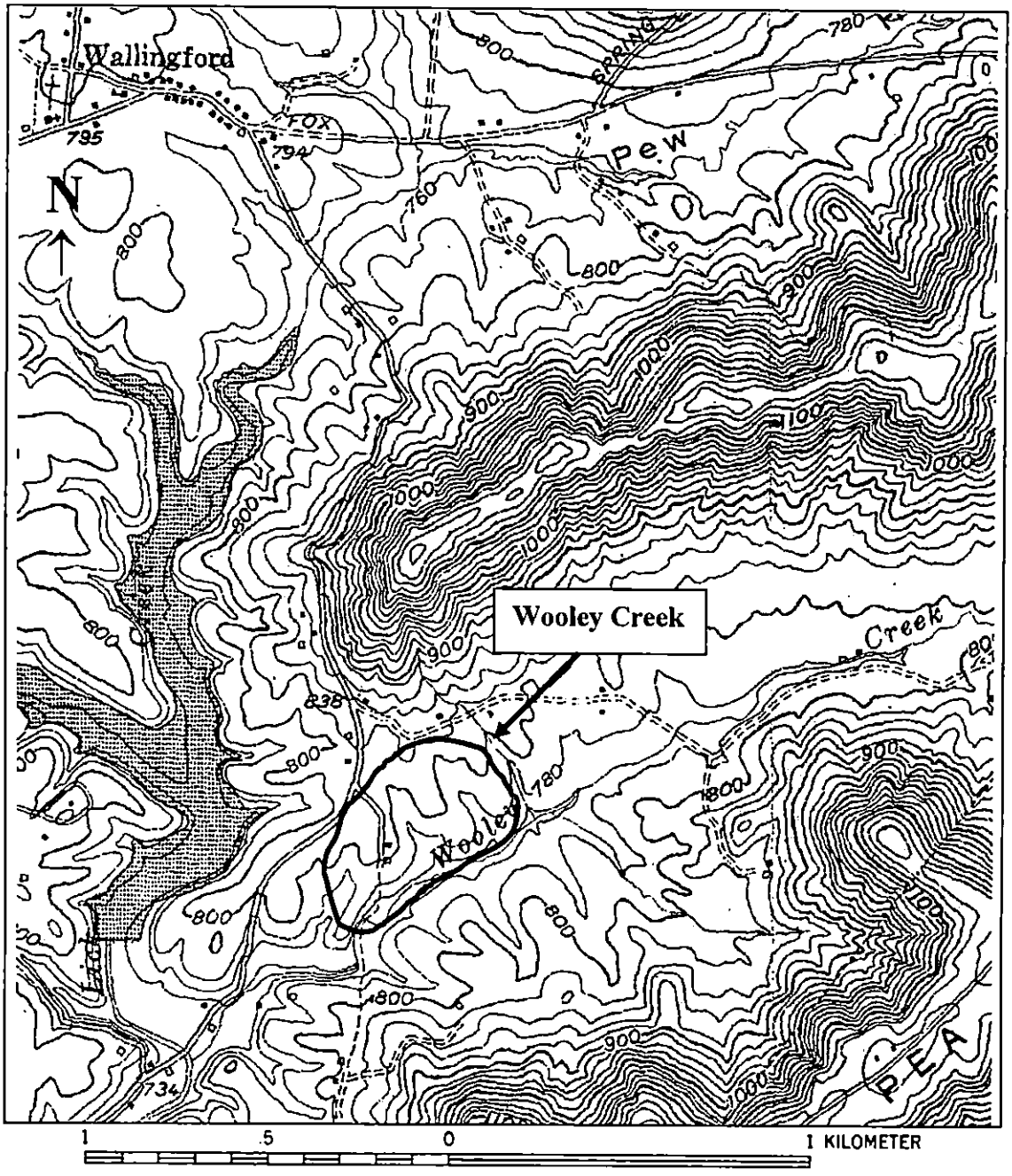

Figure 10. Wooley Creek in Fleming County, Burtonville Quadrangle.

3. Bays Farm

Bays Farm is located to the west of KY 32, approximately 2.9 km (1.8 mi) south-southeast of Goddard (Figure 11). Located in Fleming County, the site is located on the Plummers Landing Quadrangle. Most of the lower slopes were cleared for pasture and are underlain by rocks of the upper Crab Orchard Formation. The hillsides are forested with some of the best-developed second-growth woods still present in the study area. A spring was located along the lower slope on Crab Orchard shales. Small populations of *Scutellaria saxatilis* were found growing on a north-facing slope of Ohio Shale. More populations were growing on southeast-facing lower slopes on strata transitional between the Ohio Shale and the upper part of the Crab Orchard Formation. One clump of *Dryopteris carthusiana* was documented from the base of the Devonian Ohio Shale layer. Canopy species of the area included *Acer rubrum, A. saccharum, Carya glabra, C. ovata, Fagus grandifolia, Fraxinus americana, Juglans nigra, Liriodendron tulipifera, Quercus alba, Q. rubra* and *Ulmus rubra.* The understory was often dense with *Asimina triloba* , but also included *Carpinus caroliniana, Cercis canadensis, Cornus florida,* and *Lindera benzoin.* Herbaceous species included *Carex platyphylla, Cimicifuga racemosa, Deparia acrostichoides, Diplazium pycnocarpon, Dennstaedtia punctilobula, Podophyllum peltatum,* and *Sanicula canadensis.*

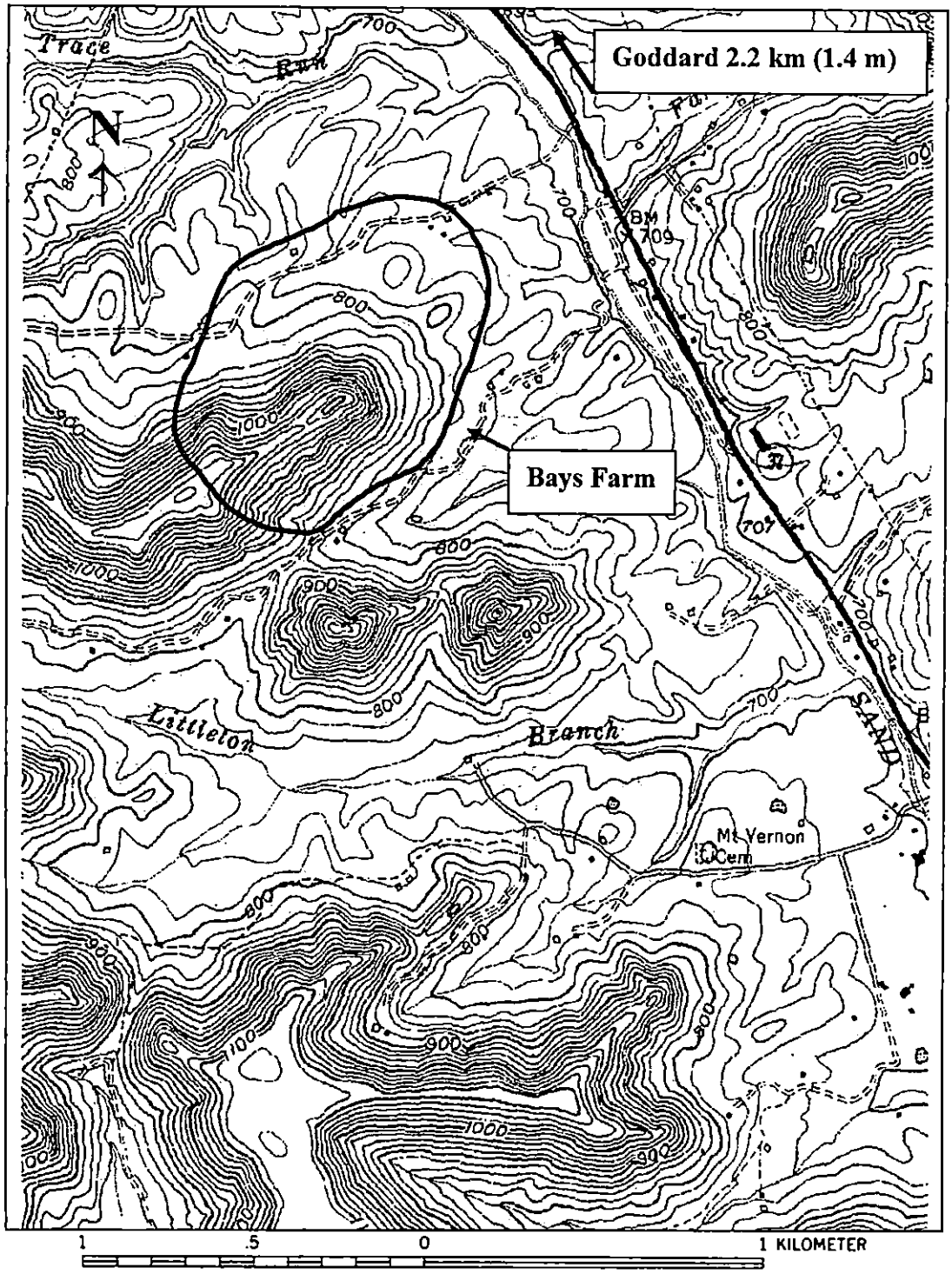

Figure 11. Bays Farm in Fleming County, Plummers Landing Quadrangle.

4. David Watson Farm

The David Watson Farm is located west of KY 32, approximately 1.8 km (1.1 mi) northwest of Plummers Mill (Figure 12). The area is located on the Plummers Landing Quadrangle in Fleming County. A large portion of the lower slopes and all bottomlands of the farm were previously cleared for pasture or agriculture crops. Some forest remains on the lower slopes upper Crab Orchard shales and limestones. The forests in the area are probably the best-developed second-growth woods still present in the Tablelands. A red oak measured 100 cm dbh while a recently fallen black oak measured close to 100 cm dbh. Numerous other large trees were present as well. Several large populations of *Scutellaria saxatilis* were observed on the middle slopes underlain by Ohio Shale. Large numbers of *Hydrastis canadensis* were found growing in the area, as well as *Panax quinquefolius*. Woody plant species on slopes included *Acer rubrum, A. saccharum, Asimina triloba, Carya glabra, C. ovata, Cornus florida, Fagus grandifolia, Lindera benzoin, Liriodendron tulipifera, Quercus alba, Q. prinus, Q. rubra, Q. velutina* and *Viburnum acerfolium*. Herbaceous species on the slopes included *Aureolaria laevigata, Caulophyllum thalictroides, Cimicifuga racemosa, Circaea lutetiana, Corallorhiza odontorhiza, Dioscorea villosa, Diplazium pycnocarpon, Epifagus virginiana, Galium concinnum, Laportea canadensis, Diphasiastrum digitatum,* and *Solidago rugosa*. Species on the ridgetops included *Gaylussacia baccata, Hamamelis virginiana, Porteranthus stipulatus, Quercus coccinea, Q. prinus, Q. velutina*, and *Vaccinium pallidum*.

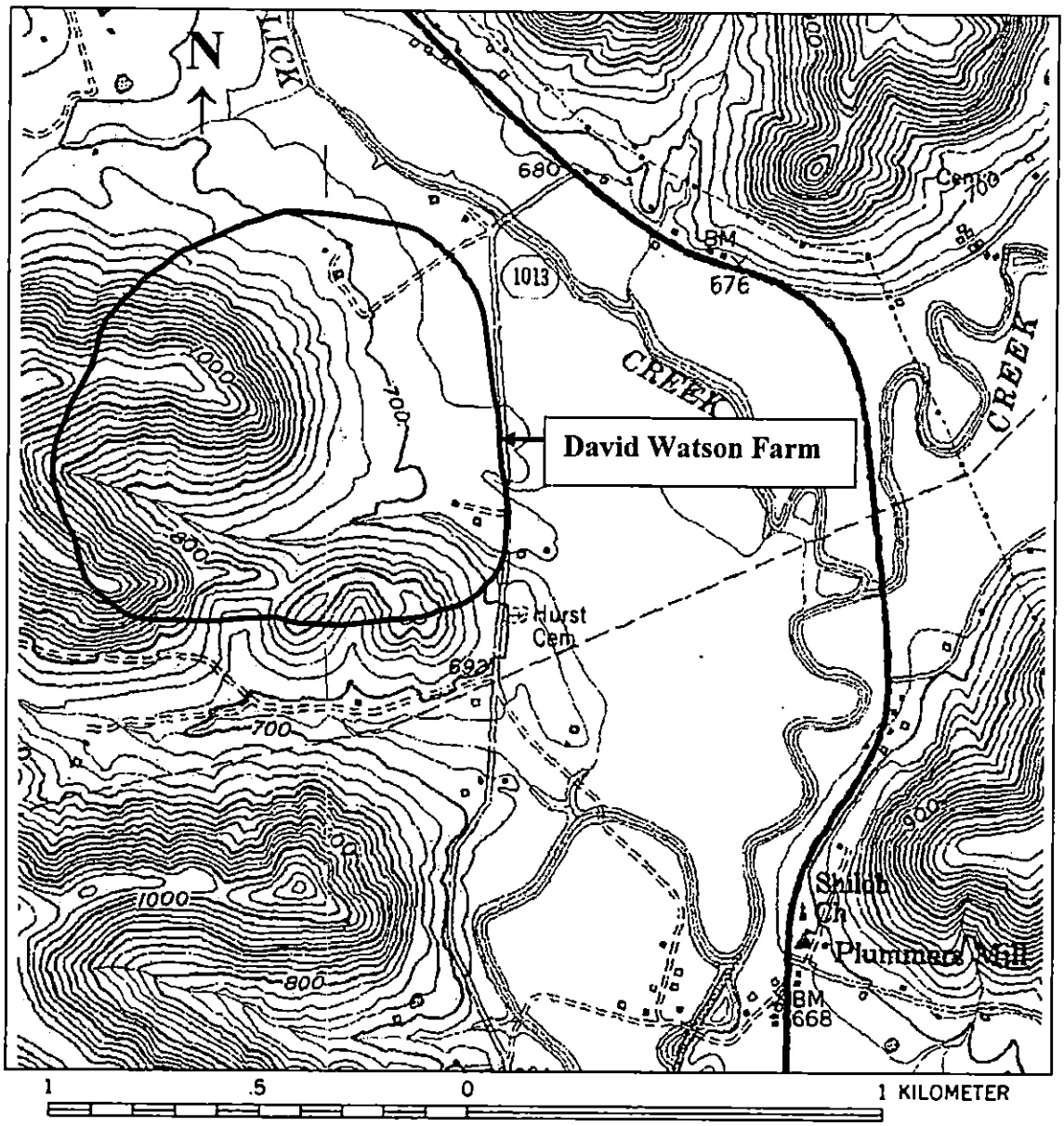

Figure 12. David Watson Farm in Fleming County, Plummers Landing Quadrangle.

5. Big Run Swamp Forest

Big Run Swamp Forest is located on Quaternary alluvium, in bottomland between Big Run and Fox Creek in Fleming County. The site is approximately 2.3 km (1.4 mi) northeast of Plummers Landing, and is located on the Plummers Landing Quadrangle (Figure 13). The forest is approximately 12 hectares (30 A) in size. Several uncommon, facultative wetland species that occur in or around the forest are *Habenaria lacera*, *Quercus bicolor*, and *Thelypteris palustris*. *Habenaria lacera* occurs infrequently across Kentucky in wet woods or meadows. *Quercus bicolor* occurs infrequently in wet woods or swamp forests in the Interior Low Plateau and in the Mississippian Embayment. *Thelypteris palustris* is rare in Kentucky, occurring in wet woods and meadows across the state.

The woody plant species of the forest included *Acer rubrum*, *Carpinus caroliniana*, *Carya glabra*, *Fagus grandifolia*, *Ilex verticillata*, *Liriodendron tulipifera*, *Quercus alba*, *Q. bicolor*, *Q. palustris* and *Ulmus* sp. Herbaceous species of the forest included *Boehmeria cylindrica*, *Carex squarrosa*, *Carex typhina*, *Cicuta maculata*, *Habenaria lacera*, *Lygodium palmatum*, *Polygala sanquinea*, *Onoclea sensibilis*, *Osmunda cinnamomea*, *O. regalis*, and *Podopyllum peltatum*.

Thelypteris palustris was growing in a wet meadow at the edge of the swamp forest. Other species in the meadow included *Bidens polylepis*, *Cephalanthus occidentalis*, *Cicuta maculata*, *Euthamia graminifolia*, *Fimbristylis autumnalis*, *Impatiens capensis*, *Onoclea sensibilis*, *Panic anceps*, *P. rigidulum*, *Phyllanthus caroliniensis*, *Scutellaria incana* var. *incana*, and *Spiraea tomentosa*.

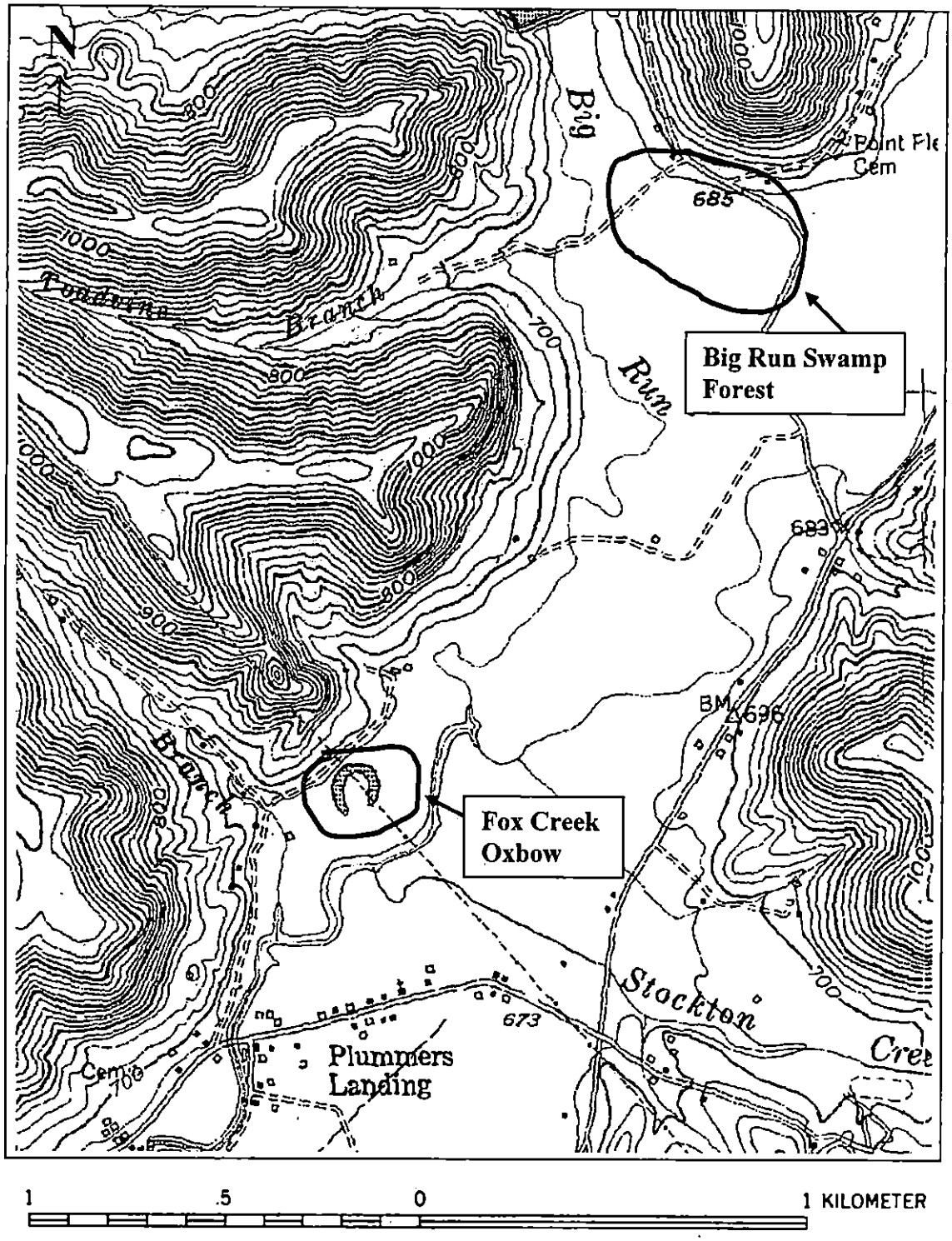

Figure 13. Big Run Swamp Forest and Fox Creek Oxbow in Fleming County, Plummers Landing Quadrangle.

6. Fox Creek Oxbow

The Fox Creek Oxbow is an old meander of Fox Creek located on Quaternary alluvium. The oxbow is approximately 0.8 km (0.5 mi) northeast of Plummers Landing in Fleming County and is located on the Plummers Landing Quadrangle (Figure 13). A spring is situated on the Crab Orchard Formation above the oxbow, keeping the area wet most of the year. The oxbow is forested, while the surrounding bottomland is an open wet meadow. The meadow is periodically mowed. Two uncommon species, *Aster puniceus* and *Lythrum alatum*, occur in and around the oxbow. *Aster puniceus* is an obligate wetland species, requiring mesic to wet open woods and meadows. The species was documented from within the oxbow. *Lythrum alatum* is a facultative wetland species growing in wet meadows and on stream banks. *Lythrum alatum* was growing in a wet ditch along the edge of the oxbow.

The woody species growing in the oxbow included *Acer rubrum*, *Cephalanthus occidentalis*, *Cornus amomum*, *Diospyros virginiana*, *Fraxinus pennsylvanica*, *Rosa palustris*, *Salix nigra*, and *Sambucus canadensis*. The herbaceous layer included *Aster puniceus*, *Carex stipata var. maxima*, *C. louisianica*, *Chelone glabra*, *Cinna arundinacea*, *Glyceria septentrionalis*, *Lysimachia ciliata*, *Scutellaria lateriflora*, and *Triadenum tubulosum*.

Species growing in the meadow included *Agrimonia parviflora*, *Agrostis elliottiana*, *A. hyemalis* var. *hyemalis*, *Apios americana*, *Ambrosia artemisiifolia*, *Bidens polylepis*, *Cassia fasciculata*, *Eupatorium fistulosum*, *Conyza canadensis*,

Diodia teres, *D. virginiana*, *Eragrotis capillaries*, *Juncus tenuis*, *Polygonum hydropiperoides*, *Trifolium repens*, *T. hybridum* and *Tridens flava*.

7. I-64 Prairie

The I-64 Prairie is located in a gasline right-of-way on the north side of I-64. The site is approximately 1.4 km (0.9 mi) east of the Sharkey exit in Rowan County and is located on the Farmers Quadrangle (Figure 14). The prairie area is a small corridor running through the forest, approximately 1.6 hectares (4 A) in size. The site is maintained by mowing although small saplings are encroaching on the edges. Nancy shales underlie the area. Two uncommon species, *Aletris farinosa* and *Liatris spicata*, were found at the site. *Aletris farinosa* is known from the Interior Low Plateau and Appalachian Plateau regions, growing in open sandy woodlands. *Liatris spicata* is distributed from the western edge of the Appalachian Plateau region westward throughout the rest of Kentucky. *Liatris spicata* is known from barrens and open woods. Populations of both species were vigorous. A large population of *Sorghastrum nutans* was present at the site.

Other species growing in the gasline right-of-way included *Agalinus fasciculata*, *Aster dumosus*, *A. undulatus*, *Ceanothus americanus*, *Chrysopsis mariana*, *Coreopsis auriculata*, *Danthonia spicata*, *Lysimachia quadrifolia*, *Orbexilum pedunculatum*, *Phlox maculata*, *Rhexia mariana*, and *Solidago erecta*.

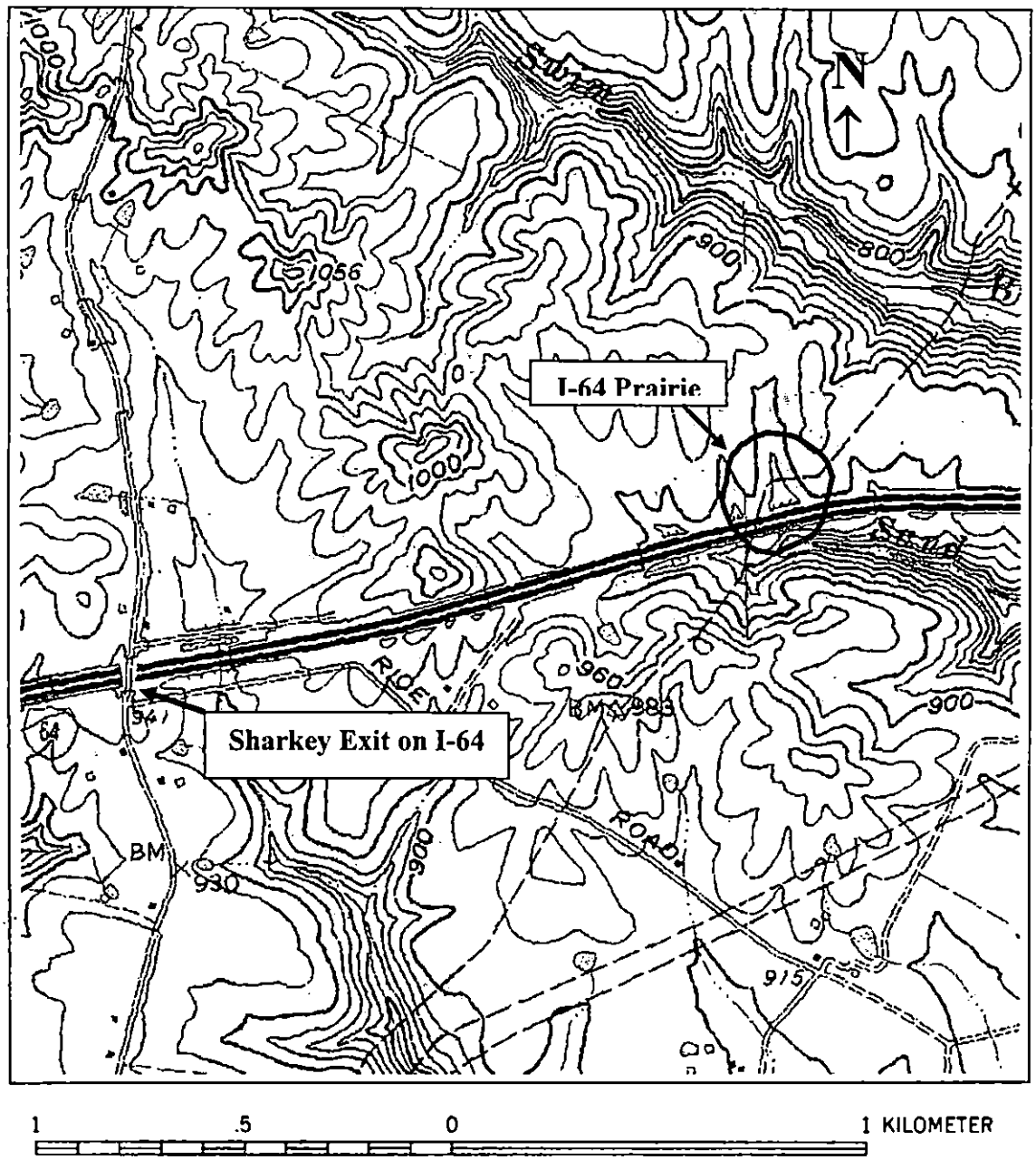

Figure 14. I-64 Prairie in Rowan County, Farmers Quadrangle.

9. 801 Right-of-Way Tallgrass Prairie

801 Right-of-Way Tallgrass Prairie is located approximately 2.3 km (1.4 mi) south of the Sharkey Flats exit on I-64 (Figure 15). The area is located on the west side of KY 801 in Rowan County, and is located on the Farmers Quadrangle. The area occupies powerline right-of-ways and gasline right-of-ways on ridgetops underlain by shales of the Nancy Member of the Borden Formation. Large areas of *Sorghastrum nutans* are found along with other prairie species. The right-of-ways are maintained by periodic mowing.

Young woody species scattered throughout the right-of-ways included *Acer rubrum, Liriodendron tulipifera; Liquidambar styraciflua,* and *Pinus virginiana.* Herbaceous species included *Andropogon gerardii, Aster infirmus, A. solidagineus, A. surculosus, A. umbellatus, Eupatorium album* var. *album, E. rotundifolium, Euthamia graminifolia, Lespedeza hirta, L. intermedia, Liatris spicata, Lobelia puberula, Panicum anceps, P. verrucosum, Pycnanthemum loomisii, Rhexia mariana, Schizachyrium scoparium* var. *scoparium,* and *Spiraea tomentosa.*

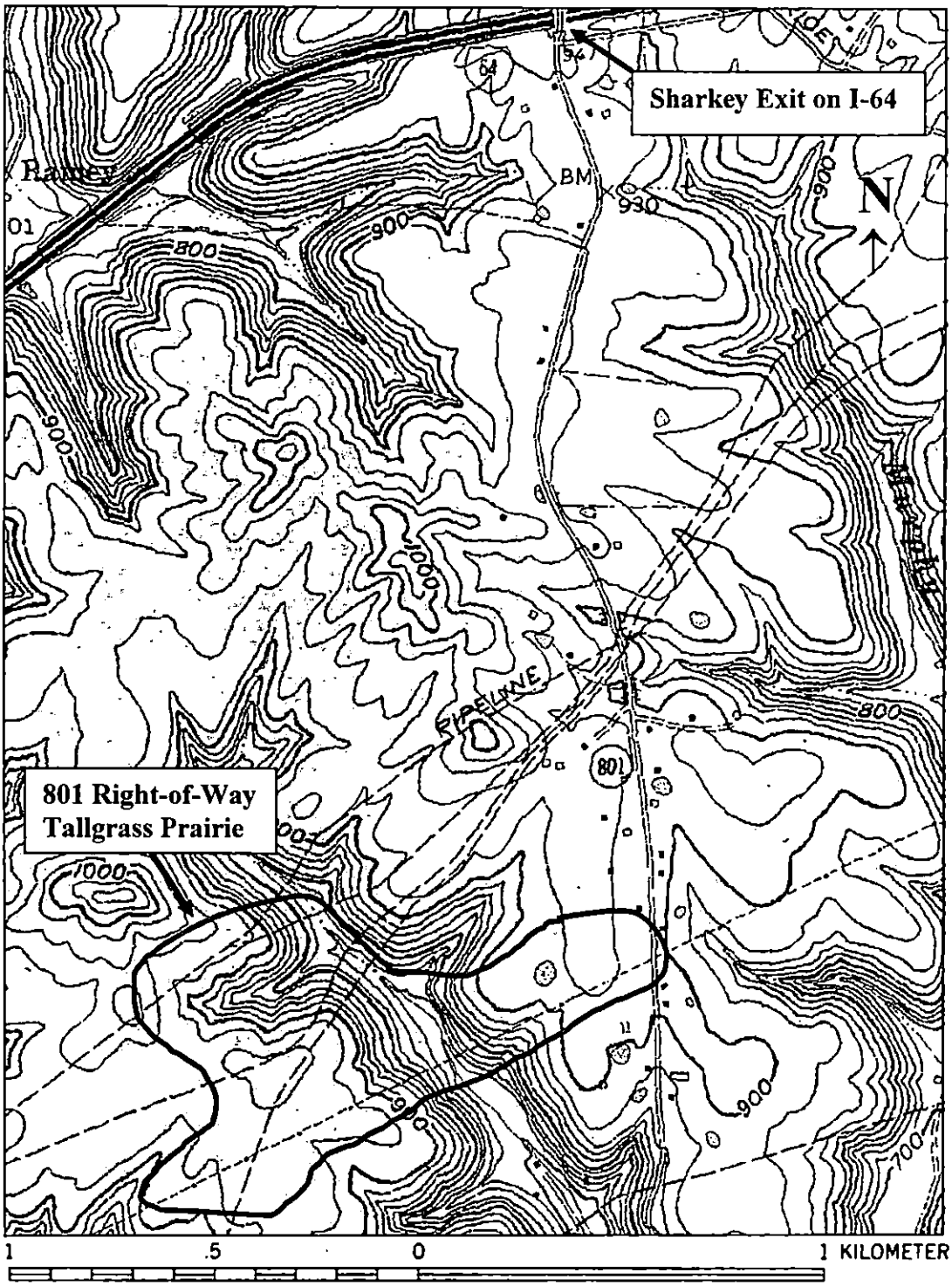

Figure 15. 801 Right-of-Way Tallgrass Prairie in Rowan County, Farmers Quadrangle.

10. Marie's Woods

Marie's Woods lies in the bottomlands of the Licking River on Quaternary alluvium. The area is located approximately 1.4 km (0.9 mi) west-northwest of Midland in Rowan County on the Farmers Quadrangle (Figure 16). Marie's Woods is approximately 9 hectares (22 A) in size and has been logged and grazed by cattle. The bottomland woods are some of the last remaining hardwood bottomland forests in the county. A new location for the state-listed species, *Gratiola viscidula,* was found in a gasline right-of-way maintained as pasture that runs through part of the woods. The population was large and reproducing.

Woody plant species of the surrounding forest included *Acer rubrum, A. negundo, Betula nigra, Cephalanthus occidentalis, Cornus amomum* var. *amomum, Fagus grandifolia, Ilex verticillata, Liquidambar styraciflua, Nyssa sylvatica, Sambucus canadensis*, and *Quercus palustris.* Herbaceous species included *Carex debilis, C. festucacea, C. grayii, C. intumescens, C. typhina, C. squarrosa, Chasmanthium latifolium, Diodia virginiana, Eleocharis tenuis, Glyceria septentrionalis, Lysimachia lanceolata, Onoclea sensibilis, Rhexia mariana, Sagittaria latifolia, Saururus cernuus*, and *Spiraea tomentosa.*

Species present in the gasline right-of-way included *Apocynum cannabinum, Asclepias incarnata, Chamaecrista fasciculata, Hypericum punctatum, Lycopus americanus, Euthamia graminifolia, Lactuca canadensis, Panicum anceps, P. rigidulum, Solidago gigantea, Spiraea tomentosa*, and *Verbena hastata.*

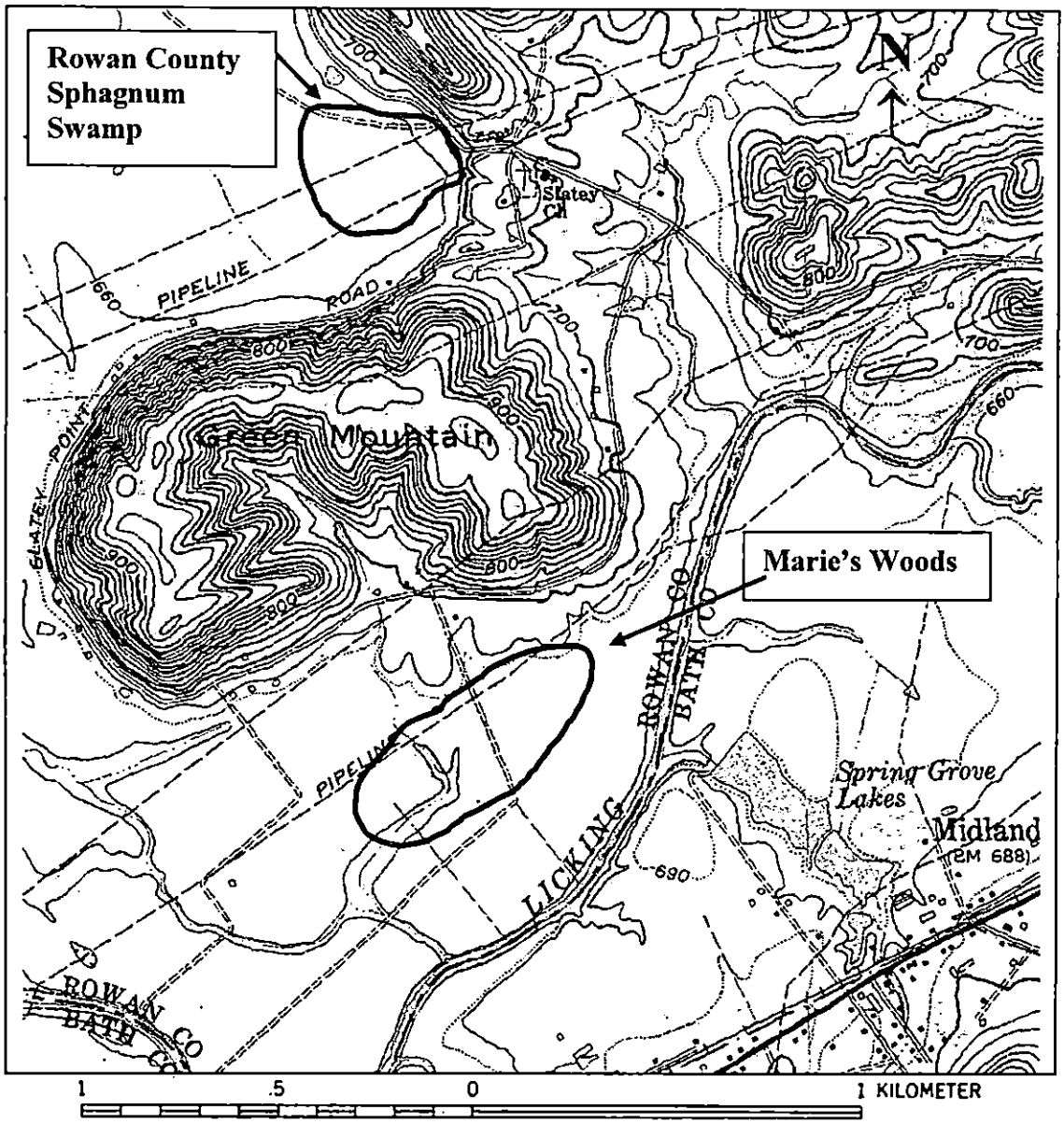

Figure 16. Marie's Woods and Rowan County Sphagnum Swamp in Rowan County, Farmers Quadrangle.

11. Rowan County Sphagnum Swamp

Rowan County Sphagnum Swamp is located in Rowan County on the Farmers Quadrangle. Owned by Morehead State University, the area is located approximately 2.6 km (1.6 mi) northwest of Midland on Quaternary alluvium in the Licking River floodplain (Figure 16). Both swamp forest and wet meadow communities occupy the area that is approximately 8 hectares (20 A) in size. The Rowan County Sphagnum Swamp is probably the most significant natural area within the Tablelands. Three state listed species (*Carex straminea*, *Gratiola viscidula* and *Vernonia noveboracensis*) occur within the swamp meadows and one state listed species (*Carex seorsa*) occurs within the swamp forest. Four uncommon species also occur within the area. These species are *Decodon verticillatus*, *Gentiana saponaria*, *Polygonum arifolium*, and *Woodwardia areolata.*

Decodon verticillatus is an obligate wetland species whose habitat is cypress swamps and marshes. The species is rare in Kentucky and is known chiefly from the Mississippian Embayment region of Kentucky. *Decodon verticillatus* is documented from six counties, Fulton, Henderson, Livingston, Logan, Metcalf and Rowan. The population found in Rowan County is a disjunct population. *Decodon verticillatus* was only documented from this area within the Tablelands. A large population of *Decodon verticillatus* was found growing just to the south of the Rowan County Sphagnum Swamp on private property.

Gentiana saponaria grows in wet meadows and open woods across Kentucky, but is infrequent. A few individuals were observed at the Rowan County Sphagnum

Swamp growing in the gasline right-of-way. The species was observed at only two locations in the Tablelands.

Polygonum arifolium is known from wetlands across Kentucky, but is infrequent. It was documented just outside the Rowan County Sphagnum Swamp in bottomland woods. This was the only site in the Tablelands in which *P. arifolium* was observed.

Woodwardia areolata grows in swamps and wet woods in the Appalachian Plateau, through the southern Interior Low Plateau, into the Mississippian Embayment. The species is infrequent throughout Kentucky, while in the Tablelands it is rare, only observed in and around the Rowan County Sphagnum Swamp.

Woody plant species occurring in the swamp forest included *Acer rubrum*, *Betula nigra*, *Ilex opaca*, *Nyssa sylvatica*, *Liquidambar styraciflua*, and *Quercus palustris*. Herbaceous species included *Carex albolutescens*, *C. crinita*, *C. louisianica*, *Galium obtusum*, *Glyceria septentrionalis* and *Iris virginica*.

Plant species found growing in the gasline right-of-ways included *Carex vulpinoidea*, *C. scoparia*, *Glyceria septentrionalis*, *G. striata*, *Gratiola viscidula*, *Juncus acuminatus*, *J. effusus*, *Proserpinaca palustris*, *Sisyrinchium angustifolium*, and *Viola primulifolia*.

DISCUSSION

Floristic Inventory

A total of 780 species was documented within the 468.5 km^2 of the Tablelands. The number of species per hectare is 0.0167. In comparison to the eight counties in the Knobs in which county floristic inventories have been conducted, the Tablelands is slightly below that of Oldham County, whose ratio was the highest with 0.0173 species per hectare.

The number of taxa collected in the Tablelands is lower than predicted by the species-area curve derived by Wade and Thompson (1991). Calculations from the regression formula, $S=272A^{0.113}$, predicts the Tablelands to have a diversity of 917 species. The actual number collected, 780, falls short of this prediction by 15 %. The lower number of species may be the result of the homogeneous geology and topography defining the Tablelands. With the same geologic layers defining the area throughout, habitat diversity may be more limited relative to that found within an entire county, therefore limiting plant diversity.

The topographic position that would perhaps offer the most variety of habitats has been altered the most. Land use practices have eliminated many wetland habitats throughout the bottomlands. Many of the uncommon species in the Tablelands require wetland habitats. For example, four of the nine state-listed species occurring in the Tablelands are wetland indicator species (*Carex straminea* and *Gratiola viscidula* - obligate species; *Carex seorsa* and *Vernonia noveboracensis* - facultative

wet species). Wetland habitats are imperiled across the state, as well as in the Tablelands.

The size of the study area may also contribute to the less than predicted number of species documented from within the Tablelands. Complete field coverage over all seasons is impossible. Wharton and Barbour (1991) state, "No floristic account of a region is ever complete because every square meter of ground cannot be covered at all seasons."

State-Listed Rare and Endangered Species

***Castanea dentata* (Marshall) Borkh. (American chestnut) - Endangered**

Due to the introduction of the chestnut blight in the beginning of the 20th century, the American chestnut was essentially wiped-out by the 1930s, removing a dominant species of the Appalachian forests (McCormick and Platt 1980). To date, the chestnut survives as stump root sprouts in upland forests on acid soils, and rarely reaches reproductive ability (Gleason and Cronquist 1991). In Kentucky, *Castanea dentata* is known to occur in the Interior Low Plateau and Appalachian regions (Jones 2001).

Castanea dentata has been found throughout most of the Knobs region (Abner 1993; Beckett 1956; Braun 1950; Clark and Bauer 2001; Cranfill 1991; Godbey 1984; Greenwell 1935; Gunn 1968a; Higgins 1970; Linney 1882; Murphy 1970; Muller and McComb 1986; Wharton 1945). It was not documented recently from Oldham

County (Matthews 1962) or Estill County (Guetig 1993), but had been previously listed for Oldham County by Braun (1943) and for Estill County by Wharton (1945). Abundance varied from frequent in Jackson (Abner 1993) and Jefferson (Gunn 1968b) counties to rare in Clark County (Beckett 1956).

***Carex straminea* Willd. (straw sedge) - Threatened**

Carex straminea requires wet areas and is listed as an obligate wetland species (Reed 1986). In Kentucky, distribution of the species is the Interior Low Plateau (Jones 2001) with herbarium specimen documentation from only three counties, Hart, Meade, and Rowan (Campbell pers. com). Regional distribution is the northeastern United States (Gleason and Cronquist 1991).

Greenwell (1935) reported this species from Nelson County in moist woods and Gunn (1968b) reported it from wet places in his study of Jefferson and seven adjacent counties.

***Prenanthes crepidinea* Michx. (midwestern white lettuce) - Threatened**

Prenanthes crepidinea requires mesic to wet open woods and is known from the Interior Low Plateau and Appalachian Plateau regions of Kentucky (Jones 2001). Regional distribution is throughout the mid-western portion of the eastern United States (Gleason and Cronquist 1991).

A small patch of *Prenanthes crepidinea* was found on the Berea Ranger District of the Daniel Boone National Forest (Campbell et al. 1991). The site was

forested along a dirt road next to Horse Lick Creek. The species also has been found in Clay and Leslie counties (Campbell et al. 1993), growing at forest edges in bottomland clearings. In the Tablelands, the habitat from which the species was documented included a forested creek floodplain and a creekside area with thin woods, near an old house site. None of the plants documented in the Tablelands were flowering. Campbell et al. (1993) noted that only those plants at the forest edge were flowering suggesting the need for sufficient sunlight to reproduce.

***Scutellaria saxatilis* Riddell (rock skullcap) - Threatened**

Scutellaria saxatilis grows in rocky, mesic woods and is chiefly known from the Appalachian Plateau in Kentucky (Jones 2001). *Scutellaria saxatilis* is regionally distributed from Delaware to Ohio and southern Indiana, south to South Carolina and Tennessee, growing chiefly in the mountains (Gleason and Cronquist 1991).

Although Wharton (1945) examined the Knob's flora in 17 counties, she only documented *Scutellaria saxatilis* from Lewis County on a moist north slope in mixed-mesophytic woods. She noted the abundance of the species as rare throughout the black shale region. The vigorous populations of *Scutellaria saxatilis* observed in the Tablelands, however, suggest the species has a strong affinity for the Ohio Shale. Further investigation into areas underlain by this shale in other parts of the Knobs may lead to documentation of more populations and a better knowledge of the actual abundance of the species in Kentucky.

***Carex seorsa* Howe (weak stellate sedge) - Special Concern**

Carex seorsa is listed as a facultative wetland species (Reed 1986). It grows in alluvial and wet woods. Distribution in Kentucky includes the Mississippian Embayment and the Appalachian Plateau (Jones 2001). Regional distribution is along the Coastal Plain of the eastern United States with irregular occurrence inland from southern Ontario south to Tennessee (Gleason and Cronquist 1991).

Carex seorsa has been reported from Graves County in western Kentucky (McKinney et al. 2000) and from Bath County in eastern Kentucky (Risk and Ousley 1998). The species was also previously documented from Rowan County in eastern Kentucky at the Rowan County Sphagnum Swamp. The species was documented again at the Rowan County Sphagnum Swamp in the present study. Habitat for the species in Rowan County is wooded swamp forests, which are similar to the habitat in Graves County. In Bath County, the species is found in wooded swamps in streamheads topography instead of bottomlands.

***Dryopteris carthusiana* (Villars) H. P. Fuchs (spinulose wood fern) - Special Concern**

Dryopteris carthusiana grows in mesic to wet woods in the Interior Low Plateau and Appalachian Plateau regions of Kentucky (Jones 2001). *Dryopteris carthusiana* is circumboreal, ranging as far south in the United States as South Carolina, Arkansas and Washington (Gleason and Cronquist 1991).

Dryopteris carthusiana has been reported from several areas in the Knobs region. Wharton (1945) documented the species (=*Dryopteris spinulosa* var. *intermedia*) from a single site on the black shale of the Knobs. The site was located in Powell County on a moist wooded slope. The species was listed also as occurring at the Brodhead Swamp Forest (Hannan 1980) in Rockcastle County. The species had been previously listed for Jackson County, occurring with white pines in the Turkey Foot area (Abner 1993). Gunn (1968b) lists the species in low woods in Jefferson and the seven adjacent counties. The species was listed for the Morehead Ranger District (Campbell et al. 1992) in woods along Martin's Branch.

The only report of *Dryopteris carthusiana* as being "common" was at the Brodhead Swamp Forest in the 1970s (Campbell et al. 1991). The area has since been logged, so abundance at the swamp forest is presently questionable. The species is listed as rare at other sites (Campbell et al. 1992; Gunn 1968b; Wharton 1945) as is the case for the species in the Tablelands.

Wharton (1945) documented *Dryopteris carthusiana* as occurring on the black shale of the Knobs. In the Tablelands, *D. carthusiana* was documented from the base of the steep slopes of Ohio Shale where it transitions to the Crab Orchard Formation. These accounts suggest a possible affinity to the black shale.

***Gratiola viscidula* Pennell (Short's hedge-hyssop) - Special Concern**

Growing in open wetlands, *Gratiola viscidula* is listed as a wetland obligate species (Reed 1986). In Kentucky, distribution of *G. viscidula* is the Interior Low

Plateau and Appalachian Plateau regions (Jones 2001). Regional distribution is from Delaware to South Carolina, with irregular distribution from southern Ohio, West Virginia, Kentucky, Missouri and east Tennessee (Gleason and Cronquist 1991).

Gratiola viscidula was previously reported from the Knobs in Rowan and Bath counties by Campbell et al. (1992) and in Estill County by Guetig (1993). The species was growing in wet brushy fields at the Rowan County Sphagnum Swamp, and among shrubs at the edge of an open *Nuphar* zone at the Bath County Bayou. In Estill County, *G. viscidula* was growing in open bottomlands. In the present study, *Gratiola viscidula* was documented from a new location approximately 1.6 km (1 mi) south of the Rowan County Sphagnum Swamp. The new site for *G. viscidula* was located in open wet bottomlands in a gasline right-of-way, similar to the habitat in which the species was reported from in Estill County.

***Juglans cinerea* L. (white walnut) - Special Concern**

Juglans cinerea grows in bottomlands, ravines, and on lower slopes with rich, moist soil (Jones 2001). Distribution is across Kentucky and throughout central to northeastern United States (Gleason and Cronquist 1991; Jones in progress).

Juglans cinerea is present in the Knobs Region in rich woods and on creek banks (Beckett 1956; Braun 1950; Clark and Bauer 2001; Cranfill 1991; Greenwell 1935; Gunn 1968a, 1968b; Higgins 1970; Linney 1882; Matthews 1962; Muller and McComb 1986). The species had been previously documented from Clark (Matthews 1962) and Hardin (Cranfill 1991) counties in calcareous areas. Abundance varied

from rare to frequent in Jefferson and the seven adjacent counties (Gunn 1968b). In the Tablelands, *Juglans cinerea* was found near the contact between Ordovician and Silurian strata. Only one individual was observed in the Tablelands.

***Vernonia noveboracensis* (L.) Michx. (New York ironweed) - Special Concern**

Vernonia noveboracensis is listed as a facultative wetland species (Reed 1986) and grows in wet woods and marshes (Jones 2001). Distribution in Kentucky is the Interior Low Plateau and Appalachian Plateau regions (Jones 2001). Regionally, the species is distributed mainly along the coast in the eastern United States, but ranges inland from western Pennsylvania southward through eastern Kentucky to eastern Tennessee (Gleason and Cronquist 1991).

Vernonia noveboracensis was previously found at the Rowan County Sphagnum Swamp in Rowan County. Linney (1882) reported the species from Washington and Marion counties. In this survey, the species was collected just outside the Rowan County Sphagnum Swamp in an open wet meadow on private property.

Significant Natural Areas

Four of the ten designated significant areas in the Tablelands are bottomland forests. Historically, bottomland forests were extensive throughout Kentucky, but have been reduced to small, disconnected areas. This reduction makes most remaining bottomland forests ecologically significant areas for Kentucky. Out of the

fifteen significant areas identified by Harker et al. (1981) in the Knobs, two were bottomland forests. One of these two areas was in Hardin County and contained two relatively undisturbed second growth floodplain forests in which the canopy was dominated by *Acer negundo*, *A. saccharinum*, and *Platanus occidentalis*. The second area was a mosaic of forest types, which occupied the floodplain of the Rolling Fork Salt River in Nelson County. Oaks such as *Quercus bicolor*, *Q. michauxii*, and *Q. palustris* dominated one area while another area was dominated by *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, and *Platanus occidentalis*. *Acer rubrum* was a subdominant in the latter area. Most of the canopy trees had died in a third area due to poor drainage. Species along the edge of the area included *Acer rubrum*, *Fraxinus pennsylvanica*, and *Liquidambar styraciflua*.

Meijer et al. (1981) mapped *Quercus bicolor* in 11 swamp forests in the Bluegrass and Knobs. Species present at 10 of the 11 sites included *Acer rubrum*, *Fraxinus pennsylvanica*, *Nyssa sylvatica*, and *Quercus palustris*.

Similar species as those found in the previous accounts were found in the four significant bottomland forests in the Tablelands. Although all four areas have been previously logged, rare and uncommon species are found within all four forests. The Rowan County Sphagnum Swamp harbors four of the nine state-listed species documented in the Tablelands along with several uncommon species. It is probably the most significant ecological area in the Tablelands. Although the site is presently owned by Morehead State University, acquisition of some of the surrounding bottomland area would add sites of *Vernonia noveboracensis* and *Decodon*

verticillatus to the protected area. Protection from further loss of the other three existing bottomland forests is greatly needed in order to conserve a vanishing habitat.

At the time of European settlement in the late 1700s, large areas of central Kentucky were dominated by grasses and forbs that were common to the prairies to the west and of open habitats (Baskin et al. 1994). The existence of these "Barrens" is thought to have originated and been maintained by fire set by Native Americans and grazing by large herbivores (Chester et al. 1997). Although the historical extent of barren or prairie areas is unknown in the Knobs, Braun (1950) noted scattered areas of prairie species along belts of limestone in the northeastern section of Knobs. In Estill County, Guetig (1993) found communities of prairies species along the Grassy Knob Ridge System, an area of limestone knobs and cliffs. In Hardin County, Cranfill (1991) described two types of remnant grassland patches, cedar barrens and sandy barrens. The cedar barrens occupied slopes of limestone and shale, while the sandy barrens were located on broad, undissected flats underlain by sandstone (Cranfill 1991).

Two of the three significant prairie areas in the Tablelands are located in utility right-of-ways on broad ridgetops capped by shale of the Nancy Member. *Sorghastrum nutans* was the most prominent grass of the prairie community in these two areas. A few taxa found at one or both of these areas were also found in wet sandy barrens in Hardin County (Cranfill 1991). These included *Sorghastrum nutans*, *Schizachyrium scoparium*, *Spiraea tomentosa*, *Aletris farinosa* and *Lobelia pubera.*

Rhexia virginica was found in Hardin County, while *Rhexia mariana* was found in the Tablelands.

The Eftspan Prairie was identified as an ecologically significant area in Marion County (Harker at al. 1981). The area consists of two small hill prairies on upper slopes. Although the Nancy shale underlies some of the area, only a few species present in the Eftspan Prairie were found in right-of-way prairies in the Tablelands. These species included *Sorghastrum nutans* and *Schizachryum scoparium*.

The third significant prairie area was located above Wooley Creek in an old field. The site is located on Silurian dolomite outcrops, the same geologic condition in Adams County, Ohio, where prairies are well developed (Braun 1950). Prairie grasses were not established at the Wooley Creek area; instead prairie forbs dominated the community. Several species present are found in prairies of the Midwest and in the Big Barrens of Kentucky, but are not restricted to prairies (Baskin et al. 1994). They included *Eupatorium altissimum*, *Kuhnia eupatorioides*, and *Pycnanthemum tenuifolium*.

Silphium terebinthenacum was present in large numbers at Wooley Creek. A variety of the species, *Silphium terebinthenacum* var. *luciae-brauniae*, was found in a few areas of Estill County (Campbell et al. 1989). The habitat and geology of the Estill county sites are in contrast to that of the Tablelands. The sites in Estill County were located in grassy thickets or dry open woods just below limestone cliffs on shaley parts of the Borden Formation (Campbell et al. 1989).

With the loss of large herbivores and the suppression of fire, the conservation of barren and prairie areas now relies on human activities. As seen in the Tablelands, utility right-of-ways have become important land use practices for maintaining communities of prairie species. As fields succeed to woods, deliberate clearing or prescribed burns will be the necessary action to preserve these unique plant assemblages. Awareness of these uncommon plant communities and their dependence on human activities sets the stage for future opportunities to maintain diversity.

Three oxbows were shown to exist on topographic maps of the Tablelands. Field observation determined that the oxbow near Plummers Landing had been filled for agriculture uses. The second oxbow, located next to a cultivated field, was occupied by more common species. The Fox Creek Oxbow was the only oxbow lake determined to be ecologically significant.

A few oxbows have been reported from the Knobs region. Maud Swamp is located in Washington County and is an old meander of Beech Fork of the Rolling Fork-Salt River drainage system (Harker et al. 1981). The area was deemed ecologically significant due to the occurrence of two rare terrestrial vertebrate species. No detailed vegetation survey was presented, however, general observations indicated grasslands occurred along the periphery of the area, which included *Cyperus* spp., *Juncus* spp., *Polygonum* spp., and *Scirpus* spp. A dense forest canopy with *Impatiens* sp. and *Leersia* spp. occurred inside the grasslands while *Cephalanthus occidentalis*, *Sagittaria* spp., *Salix* spp., and *Typha latifolia* were

observed in hydric soils. Open water occurred in the central portion of the swamp. The second oxbow site is the Bath County Bayou, an old meander of the Licking River located in Bath County. The site contains a more or less permanent pool of water with a surrounding strip of forest, all surrounded by bottomland fields. The state-listed species, *Gratiola viscidula*, was found growing among *Alnus* and *Cephalanthus* (Campbell et al. 1992). Uncommon species also present at the bayou included *Decodon verticillatus, Dulichium arundinaceum, Glyceria septentrionalis, Lemna valdiviana, Lycopus rubellus, Polygonum arifolium, Sium suave*, and *Utricularia gibba.* Other associates included *Acer negundo*, A. *rubrum, Aster ontarionis, Carex* spp., *Betula nigra, Boehmeria cylindrica, Hibiscus moscheutos, Iris virginica, Liriodendron tulipifera, Platanthera flava, Platanus occidentalis, Rosa palustris, Quercus palustris*, and *Saururus cernuus.*

The Fox Creek Oxbow has many similar species to the Bath County Bayou, although most of the uncommon species are lacking as well as the state listed species, *Gratiola viscidula.* The proximity to the Rowan County Sphagnum Swamp, where most of the uncommon species and *G. viscidula* also are located may indicate that the Licking River floodplain was once a rich, diverse area of wetlands. The lack of oxbows within the Knobs and the tenuous state of the few remaining wetlands in Kentucky reinforces, however, the need to further study and protect the few areas known to still exist.

PART 2: CLASSIFICATION OF FOREST COMMUNITIES

MATERIALS AND METHODS

Site Locations and Sampling Technique

During the spring and summer of 2001, the woody vegetation of the Tablelands was sampled in order to examine the influence of rock type and slope aspect on woody plant communities. Temporary plots were sampled at a total of 45 sites (Appendix B) across five different geologic settings; 1) Quaternary alluvium underlying bottomlands, 2) Crab Orchard clay-shale underlying lower slopes, 3) Ohio Shale underlying middle slopes, 4) Sunbury Shale underlying upper slopes, and 5) Farmers sandstone/Nancy shale underlying ridgetops. Three different sites were sampled on the Quaternary alluvium unit and also on the Farmers/Nancy unit since aspect is negligible at these topographic positions. Since aspect may influence environmental conditions in which woody plant communities develop, three different sites were sampled at each slope aspect on each of the three geologic units underlying slopes. For example, on the Crab Orchard clay-shale unit, three sites were located on north-facing slopes, three sites on south-facing slopes, three sites on east-facing slopes, and three sites on west-facing slopes. The same method was repeated on the Ohio Shale unit and the Sunbury Shale unit. Typically, plots at a particular site were first sampled on a lower slope underlain by the Crab Orchard unit on a slope facing north, south, east or west. Continuing upslope, plots were sampled on the Ohio Shale unit on a similar facing slope, and then on the Sunbury Shale unit. Plots were sampled on the ridgetop on the Farmers/Nancy unit then down the slope facing the

opposing cardinal point, sampling all three geologic units. Note, due to the method of sampling up and over ridgetops, the Farmers sandstone/Nancy shale unit was sampled at six sites, three times above north-south slopes and three times above east-west slopes. Sampling on Quaternary alluvium was incongruous to the other layers due to the limited location of existing bottomland forests. The primary criteria for site choice were landowner permission, the presence of a closed canopy, and a full-stature forest.

Sampling at each site consisted of three 10-meter radius circular plots (0.0314 ha each), for a total area of 0.0942 ha per site (Figure 17). Plots were spaced 10 m apart from edge to edge. Species identity and diameter at breast height were determined and recorded for all living stems greater than or equal to 5 cm dbh. Four pH readings were made at each plot using a Kelway soil tester instrument. The soil tester was placed approximately in the center of each quarter section of the plot.

Data Analysis

Alpha diversity was calculated for each geologic unit. Sampling data were summarized for each tree species at each site. Calculations included; basal area (BA), relative basal area (BA), frequency (F), relative frequency (RF), density (D), relative density (RD), and importance value (RBA + RF +RD). Importance values of tree species were averaged for all sites on each geologic layer and for all sites on each slope aspect. Averaged importance values were used to identify the forest type in

relationship to geology and or aspect. Soil pH readings were averaged per site, per geologic unit and by aspect.

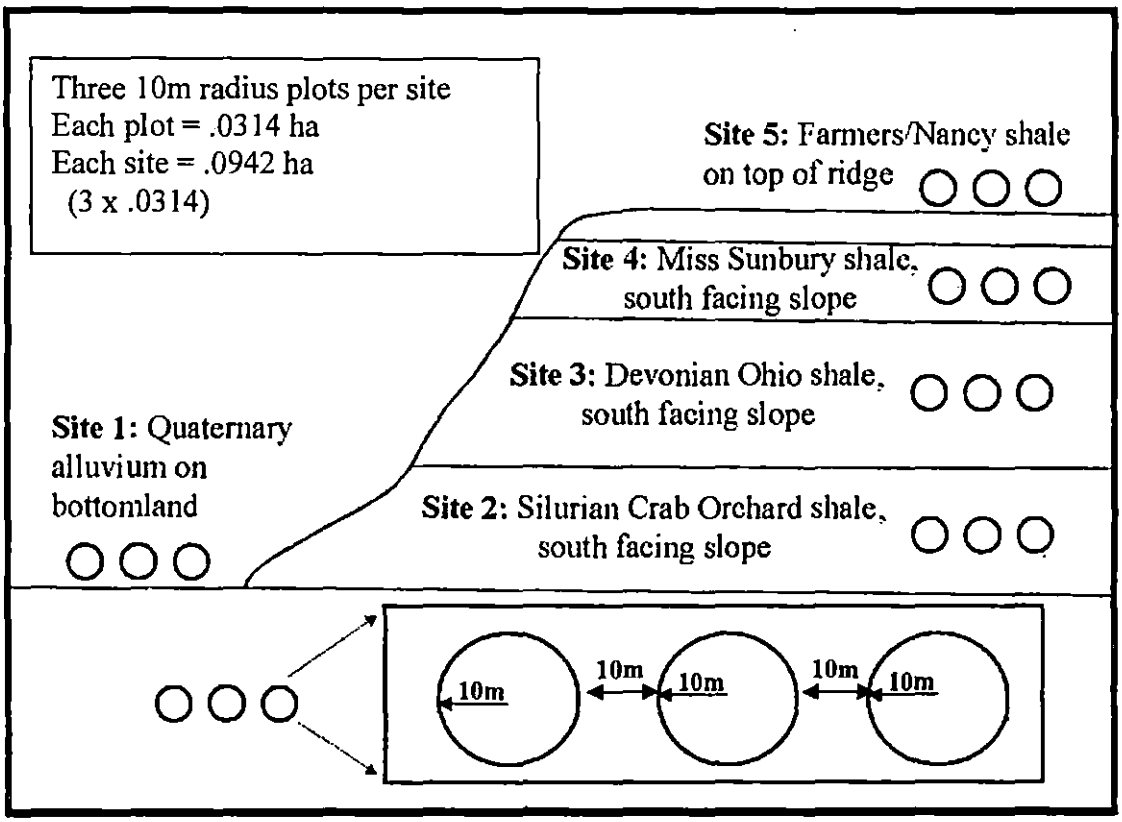

Figure 17. Three 10 m sampling plots on each of the five geologic units.

Statistical Analysis

Principal Component Analysis (PCA) was used to examine similarity patterns of woody plant communities across sites and to assess the importance of each species in the forests in relationship to geology and slope aspect. Thus two separate PCA's

were conducted, the first with the sites labeled by geologic position and the second with the sites labeled by slope aspect. Only sites sampled on the three middle geologic units (Crab Orchard Formation, Ohio Shale, and Sunbury Shale) were used in the latter analysis. PCA was performed on a covariance matrix that was generated from importance values of the 46 tree species at the 45 sampling sites.

The Shannon Diversity Index ($H' = -\sum p_i \log p_i$) (Brower et al. 1990) was used to quantify the diversity of the woody plant community occupying each geologic unit and each slope aspect. Each importance value used to calculate diversity on each geologic unit was an average of importance values of that species from 12 sites on that geologic unit. Each importance value used to calculated diversity of slope aspect was an average of importance values of that species from nine sites, three sites on the Crab Orchard clay-shale unit, three on the Ohio Shale unit, and three on the Sunbury Shale unit, all on the same slope aspect.

Sorenson's Coefficient ($2c/(s_1 + s_2)$) (Brower et al. 1990) was calculated to compare similarity between the woody plant communities of each geologic unit.

RESULTS

Woody Plant Diversity in Relationship to Rock Type

A total of 46 species was tallied in the 45 sampling sites (Table 9). *Acer rubrum* was the only species that occurred in forests at all sites on all geologic units. Seven species occurred in forests on all geologic units except bottomland Quaternary alluvium. These were *Acer saccharum*, *Carya glabra*, *Cercis canadensis*, *Cornus florida*, *Fraxinus americana*, *Quercus alba*, *Q. rubra*, and *Q. velutina.*

The woody plant community on the Crab Orchard Formation was the most diverse with 34 species (Table 9). Seven species were sampled from forests only growing on the Crab Orchard Formation. These were *Carya cordiformis*, *Gleditsia triacanthos*, *Platanus occidentalis*, *Quercus falcata*, *Q. imbricaria*, *Q. muhlenbergii*, and *Q. shumardii.*

The woody plant community on the Sunbury Shale was second in diversity with 22 species, closely followed by the communities on the Ohio Shale and the Farmer/Nancy unit, each with a diversity of 20 species (Table 9). Three species, *Amelanchier arborea*, *Quercus coccinea*, and *Q. prinus*, were sampled on only these three geologic units.

Four species observed only in forests growing on the Farmers/Nancy units were *Fraxinus quadrangulata*, *Juglans nigra*, *Quercus stellata*, and *Robinia pseudoacacia* (Table 9). The Quaternary alluvium was the least diverse with 15 species (Table 9). Five species observed only from bottomlands were *Acer negundo*, *Betula nigra*, *Carya laciniosa*, *Fraxinus pennsylvanica*, and *Quercus bicolor.*

Table 9. Woody species present on each geologic unit.

SPECIES	Quaternary Alluvium	Crab Orchard Formation	Ohio Shale	Sunbury Shale	Farmers/ Nancy
Acer rubrum	X	X	X	X	X
Acer negundo	X				
Acer saccharum		X	X	X	X
Amelanchier arborea			X	X	X
Asimina triloba		X		X	
Betula nigra	X				
Carpinus caroliniana	X	X			
Carya cordiformis		X			
Carya glabra		X	X	X	X
Carya laciniosa	X				
Carya ovata		X		X	X
Carya tomentosa		X	X	X	
Cercis canadensis		X	X		X
Cornus florida		X	X	X	X
Fagus grandifolia	X	X	X	X	
Fraxinus americana		X	X	X	X
Fraxinus pennsylvanica	X				
Fraxinus quadrangulata					X
Gleditsia triacanthos		X			
Juglans nigra					X
Juniperus virginiana		X			X
Liquidambar styraciflua	X	X			
Liriodendron tulipifera	X	X	X	X	
Morus rubra		X	X		
Nyssa sylvatica	X	X	X	X	
Ostrya virginiana		X		X	
Oxydendrum arboreum	X	X	X	X	
Pinus echinata		X		X	
Pinus virginiana		X		X	X
Platanus occidentalis		X			
Prunus serotina	X	X	X		
Quercus alba		X	X	X	X
Quercus bicolor	X				
Quercus coccinea			X	X	X
Quercus falcata		X			
Quercus imbricaria		X			

Table 9. (cont.)

Species	Quaternary Alluvium	Crab Orchard Formation	Ohio Shale	Sunbury Shale	Farmers/ Nancy
Quercus muhlenbergii	X	X			
Quercus palustris		X	X	X	X
Quercus prinus			X	X	X
Quercus rubra		X			
Quercus shumardii		X			
Quercus stellata					X
Quercus velutina		X	X	X	X
Robinia pseudoacacia					X
Sassafras albidum		X	X	X	
Ulmus rubra	X	X			X
Total number of species	15	34	20	22	20

Shannon Diversity Index

The Sunbury Shale was the least diverse unit with an index value of 0.90. The most diverse geologic unit was the Crab Orchard Formation with an index value of 1.26 (Fig. 18). The range of diversity was lower for communities on each slope aspect. The least diverse slope aspect was the west-facing aspect (1.04) and the most diverse aspect was the south-facing aspect (1.14) (Fig. 19).

The average basal area across all sites was 28.13 m^2/ha. Average soil pH did not show significant variation between geologic units (Table 10).

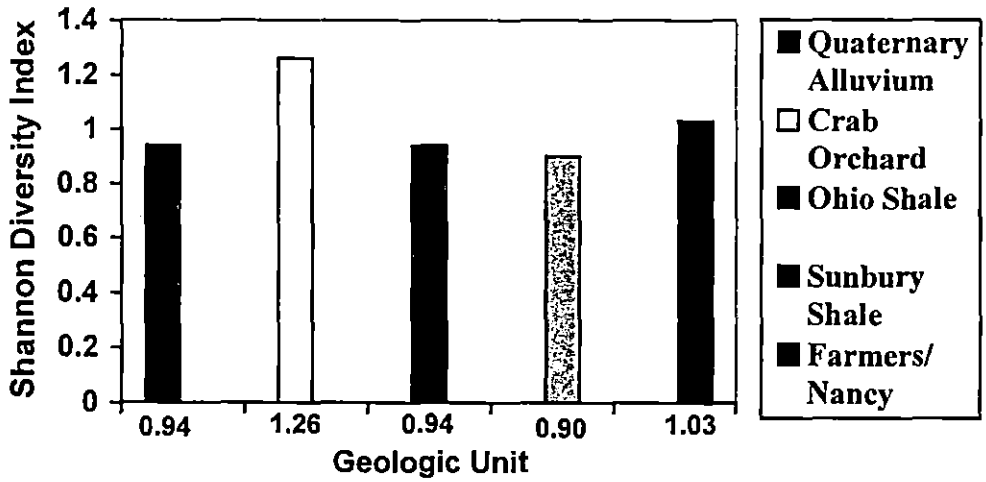

Figure 18. Comparison of Shannon Diversity Index values between forest communities on Quaternary alluvium, Crab Orchard Formation, Ohio Shale, Sunbury Shale, and Farmers/Nancy units.

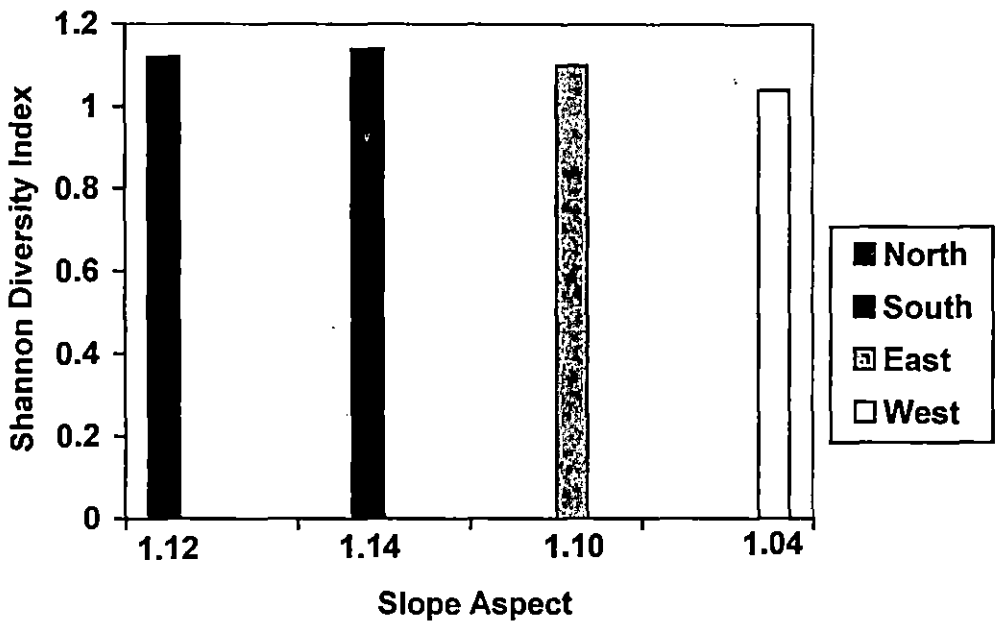

Figure 19. Comparison of Shannon Diversity Index values between forest communities on north, south, east, and west slope aspects.

Table 10. Average pH value for all 45 sites sampled, average pH values for each aspect on three geologic units, and average pH value for each geologic unit.

Quaternary Alluvium		Site 1	Site 2	Site 3		Average/ Geologic Unit
		5.4	6.0	5.8		5.7
Crab Orchard Formation	Aspect	Site 1	Site 2	Site 3	Average/ Aspect	Average/ Geologic Unit
	North	6.5	5.9	6.7	6.4	
	South	5.9	6.0	6.7	6.2	
	East	6.2	6.1	6.0	6.1	
	West	6.3	6.1	6.4	6.2	
						6.2
Ohio Shale	Aspect	Site 1	Site 2	Site 3	Average/ Aspect	Average/ Geologic Unit
	North	6.2	6.1	6.7	6.3	
	South	6.3	5.5	6.6	6.1	
	East	6.3	6.0	6.0	6.1	
	West	6.5	5.7	6.3	6.2	
						6.2
Sunbury Shale	Aspect	Site 1	Site 2	Site 3	Average/ Aspect	Average/ Geologic Unit
	North	6.1	6.1	6.7	6.3	
	South	6.2	5.8	6.8	6.3	
	East	6.7	6.1	6.2	6.3	
	West	6.5	6.1	6.3	6.3	
						6.3
Farmers/Nancy		Site 1	Site 2	Site 3		Average/ Geologic Unit
		6.0	5.8	6.9		
		Site 4	Site 5	Site 6		
		6.8	5.9	6.5		
						6.3

Classification of Forest Types on the Five Geologic Units

Analysis of importance values from all sites indicates that *Quercus prinus* was the most important species in the Tablelands, accounting for 19.63 % of the total importance values of all species present (Table 11). Second in importance was *Acer rubrum* followed by *Carya glabra, Nyssa sylvatica,* and *Quercus alba.* These five species accounted for 56.48% of the total.

Analysis of tree species importance values indicated that distinct forest types occupy each geologic unit. Bottomland forests on Quaternary alluvium are classified as red maple forests with *Acer rubrum* having an importance value of 96.35, almost three-fold higher than the next important species, *Quercus palustris* (34.83) (Table 12). Other species present in bottomland forests included *Liquidambar styraciflua, Nyssa sylvatica, Carpinus caroliniana, Betula nigra,* and *Carya laciniosa.*

The forest type occupying the Crab Orchard Formation is classified as a pignut hickory-tulip poplar-red maple forest with *Carya glabra, Liriodendron tulipifera,* and *Acer rubrum* having importance values of 41.06, 38.05 and 33.33 respectively (Table 13). These three species accounted for 37.5% of the total importance values of all species present on the Crab Orchard Formation.

The forest type occupying the Ohio Shale is classified as a chestnut oak-red maple forest with *Quercus prinus* and *Acer rubrum* having importance values of 106.41 and 57.43 respectively (Table 14). These two species accounted for 54.6% of the total importance values of all 20 species present on the Ohio Shale.

Table 11. Percent of total importance value for each species, based on an average importance value for each species at all sites.

Species	Percent	Species	Percent
Quercus prinus	19.63	*Pinus virginiana*	0.94
Acer rubrum	14.78	*Sassafras albidum*	0.92
Carya glabra	9.60	*Fraxinus pennsylvanica*	0.64
Nyssa sylvatica	6.52	*Cercis canadensis*	0.58
Quercus alba	5.95	*Amelanchier arborea*	0.51
Acer saccharum	3.67	*Prunus serotina*	0.47
Quercus rubra	3.50	*Fraxinus quadrangulata*	0.42
Liriodendron tulipifera	3.38	*Quercus stellata*	0.33
Liquidambar styraciflua	2.88	*Carya cordiformis*	0.26
Quercus palustris	2.54	*Asimina triloba*	0.25
Fagus grandifolia	2.19	*Juglans nigra*	0.24
Fraxinus americana	2.05	*Pinus echinata*	0.24
Oxydendrum arboreum	1.96	*Acer negundo*	0.16
Quercus velutina	1.85	*Platanus occidentalis*	0.15
Carya ovata	1.78	*Quercus bicolor*	0.13
Betula nigra	1.63	*Robinia pseudoacacia*	0.12
Carpinus caroliniana	1.57	*Quercus falcata*	0.11
Cornus florida	1.55	*Morus rubra*	0.09
Carya tomentosa	1.47	*Ostrya virginiana*	0.07
Carya laciniosa	1.35	*Quercus imbricaria*	0.07
Quercus coccinea	1.26	*Quercus muhlenbergii*	0.06
Ulmus rubra	1.05	*Quercus shumardii*	0.04
Juniperus virginiana	1.02	*Gleditsia triacanthos*	0.03

Table 12. Species and importance values of the woody plant community growing on bottomlands on Quaternary alluvium. Species are arranged from greatest to least importance.

Species	Importance Value	Species	Importance Value
Acer rubrum	96.35	*Liriodendron tulipifera*	8.81
Quercus palustris	34.83	*Fagus grandifolia*	6.62
Liquidambar styraciflua	32.78	*Ulmus rubra*	4.34
Nyssa sylvatica	32.61	*Acer negundo*	2.41
Betula nigra	24.51	*Oxydendrum arboreum*	2.15
Carpinus caroliniana	20.81	*Quercus bicolor*	1.92
Carya laciniosa	20.30	*Prunus serotina*	1.91
Fraxinus pennsylvanica	9.64		0.33

Table 13. Species and importance values of the woody plant community growing on lower slopes on Silurian Crab Orchard Formation. Species are arranged from greatest to least importance.

Species	Importance Value	Species	Importance Value
Carya glabra	41.06	*Quercus palustris*	3.20
Liriodendron tulipifera	38.05	*Oxydendrum arboreum*	3.15
Acer rubrum	33.33	*Carpinus caroliniana*	2.77
Nyssa sylvatica	22.78	*Ulmus rubra*	2.34
Quercus alba	21.83	*Juniperus virginiana*	2.29
Carya tomentosa	19.58	*Platanus occidentalis*	2.26
Cornus florida	15.34	*Asimina triloba*	1.98
Fagus grandifolia	15.06	*Pinus echinata*	1.88
Quercus velutina	10.80	*Sassafras albidum*	1.82
Acer saccharum	10.47	*Quercus falcata*	1.63
Liquidambar styraciflua	10.36	*Quercus imbricaria*	0.98
Quercus rubra	7.32	*Pinus virginiana*	0.95
Carya ovata	7.08	*Quercus muhlenbergii*	0.83
Fraxinus americana	5.67	*Quercus shumardii*	0.63
Cercis canadensis	4.79	*Ostrya virginiana*	0.55
Prunus serotina	4.38	*Morus rubra*	0.49
Carya cordiformis	3.87	*Gleditsia triacanthos*	0.48

Table 14. Species and importance values of the woody plant community growing on middle slopes on Devonian Ohio Shale. Species are arranged from greatest to least importance.

Species	Importance Value	Species	Importance Value
Quercus prinus	106.41	*Fagus grandifolia*	5.19
Acer rubrum	57.43	*Quercus coccinea*	3.95
Nyssa sylvatica	19.06	*Cornus florida*	3.04
Acer saccharum	18.79	*Fraxinus americana*	2.41
Carya glabra	17.36	*Amelanchier arborea*	2.12
Quercus rubra	17.11	*Liriodendron tulipifera*	1.97
Oxydendrum arboreum	16.11	*Carya tomentosa*	0.84
Quercus alba	12.51	*Cercis canadensis*	0.80
Sassafras albidum	7.00	*Morus rubra*	0.80
Quercus velutina	6.42	*Prunus serotina*	0.70

The forest type occupying the Sunbury Shale is classified as a chestnut oak forest with *Quercus prinus* having an importance value of 141.91 (Table 15), accounting for 47% of the total importance values of all 22 species on this unit. The next important species on the Sunbury Shale is *Acer rubrum* with an importance value of 33.87, approximately one-fourth the importance value of chestnut oak.

The forest type growing in Farmers/Nancy lithologies is classified as a pignut hickory-oak forest with *Carya glabra*, *Quercus alba*, and *Quercus prinus* having importance values of 74.38, 49.94, and 46.19 respectively (Table 16). These three species accounted for 58.8 % of the total importance values of all 20 species present on the Farmers/Nancy unit.

Table 15. Species and importance values of the woody plant community growing on upper slopes on Mississippian Sunbury Shale. Species are arranged from greatest to least importance.

Species	Importance Value	Species	Importance Value
Quercus prinus	141.91	*Sassafras albidum*	4.91
Acer rubrum	33.87	*Quercus rubra*	4.83
Nyssa sylvatica	23.35	*Amelanchier arborea*	3.45
Acer saccharum	17.29	*Fraxinus americana*	3.38
Quercus coccinea	11.51	*Carya ovata*	2.89
Carya glabra	11.22	*Cornus florida*	2.73
Oxydendrum arboreum	7.93	*Liriodendron tulipifera*	1.93
Pinus virginiana	6.78	*Asimina triloba*	1.80
Fagus grandifolia	5.97	*Pinus echinata*	1.76
Quercus velutina	5.38	*Carya tomentosa*	1.58
Quercus alba	4.97	*Ostrya virginiana*	0.56

Table 16. Species and importance values of the woody plant community growing on ridgetops on Mississippian Farmers and Nancy Members of the Borden Formation. Species are arranged from greatest to least importance.

Species	Importance Value	Species	Importance Value
Carya glabra	74.38	*Pinus virginiana*	6.30
Quercus alba	49.94	*Quercus velutina*	5.22
Quercus prinus	46.19	*Quercus stellata*	4.89
Quercus rubra	23.23	*Juglans nigra*	3.66
Fraxinus americana	19.25	*Quercus coccinea*	3.50
Carya ovata	16.68	*Cercis canadensis*	3.05
Juniperus virginiana	12.98	*Cornus florida*	2.13
Ulmus rubra	9.11	*Amelanchier arborea*	2.06
Acer saccharum	8.56	*Robinia pseudoacacia*	1.74
Fraxinus quadrangulata	6.36	*Acer rubrum*	0.78

Woody Plant Diversity on North, South, East, and West Slope Aspects

The south-facing slope had the greatest alpha diversity with 29 species. The north, east and west-facing slopes had an alpha diversity of 26 species each (Table 17). No distinct forest type could be classified for any of the forests on each slope aspect (Tables 18, 19, 20, 21). *Quercus prinus* had the greatest importance on all aspects with the greatest importance on a west-facing slope. The second most important species on all slope aspects was *Acer rubrum*. Although no forest type could be classified for each slope aspect, some species showed greater importance on different slopes (Table 17). On north and east slopes, the importance of *Acer saccharum* and *Quercus rubra* increased. *Cornus florida*, *Liriodendron tulipifera* and *Sassafras albidum* had greater importance on north slopes. *Carya glabra* had greater importance on north, south, and east slopes, while *Quercus alba* and *Q. velutina* had greater importance on south, east, and west slopes. *Nyssa sylvatica* had increased importance on south and west slopes.

Table 17. Average importance values for each woody plant species sampled on each slope aspect. Values for each species are an average of 9 sites, 3 sites on Crab Orchard Formation, 3 on Ohio Shale, and 3 on Sunbury Shale with the same slope aspect.

Species	North	South	East	West
Acer rubrum	43.12	44.46	41.01	37.59
Acer saccharum	17.23	4.41	32.85	7.57
Amelanchier arborea	0.77	1.82		4.83
Asimina triloba	1.72		3.32	

Table 17. (cont.)

Species	North	South	East	West
Carpinus caroliniana	0.72	1.20	1.77	
Carya cordiformis	1.82			3.34
Carya glabra	34.32	22.48	26.53	9.52
Carya ovata	7.65		1.85	3.79
Carya tomentosa	10.88	7.11	3.63	7.70
Cercis canadensis	1.20	1.32	4.22	0.72
Cornus florida	16.67	4.60	3.46	3.42
Fagus grandifolia	7.62	11.15	10.06	6.14
Fraxinus americana	4.15		8.47	2.67
Gleditsia triacanthos		0.64		
Juniperus virginiana		3.05		
Liquidambar styraciflua		5.53	3.71	4.57
Liriodendron tulipifera	20.67	10.27	13.57	11.42
Morus rubra		0.65	1.07	
Nyssa sylvatica	14.85	29.67	15.03	27.27
Ostrya virginiana	0.74			0.74
Oxydendrum arboreum	9.79	17.97	0.59	7.90
Pinus echinata		3.96		1.09
Pinus virginiana	1.27	2.19		6.84
Platanus occidentalis		2.14		0.87
Prunus serotina	2.14	3.54	1.09	
Quercus alba	3.01	15.35	14.13	19.93
Quercus coccinea	1.57	10.75	1.35	6.95
Quercus falcata			2.17	
Quercus imbricaria		1.31		
Quercus muhlenbergii			1.10	
Quercus palustris		2.53		1.74
Quercus prinus	70.13	73.98	76.98	109.92
Quercus rubra	14.16	2.71	18.81	2.40
Quercus shumardii		0.85		
Quercus velutina	0.48	12.63	9.19	7.84
Sassafras albidum	11.80	1.75	1.50	3.24
Ulmus rubra	0.60		2.52	

Table 18. Species and importance values on north-facing slopes.

Species	Importance Value	Species	Importance Value
Quercus prinus	70.13	*Fraxinus americana*	4.15
Acer rubrum	43.12	*Quercus alba*	3.01
Carya glabra	34.32	*Prunus serotina*	2.14
Liriodendron tulipifera	20.67	*Carya cordiformis*	1.82
Acer saccharum	17.23	*Asimina triloba*	1.72
Cornus florida	16.67	*Quercus coccinea*	1.57
Nyssa sylvatica	14.85	*Pinus virginiana*	1.27
Quercus rubra	14.16	*Cercis canadensis*	1.20
Sassafras albidum	11.80	*Amelanchier arborea*	0.77
Carya tomentosa	10.88	*Ostrya virginiana*	0.74
Oxydendrum arboreum	9.79	*Carpinus caroliniana*	0.72
Carya ovata	7.65	*Ulmus rubra*	0.60
Fagus grandifolia	7.62	*Quercus velutina*	0.48

Table 19. Species and importance values on south-facing slopes.

Species	Importance Value	Species	Importance Value
Quercus prinus	73.98	*Prunus serotina*	3.54
Acer rubrum	44.46	*Juniperus virginiana*	3.05
Nyssa sylvatica	29.67	*Quercus rubra*	2.71
Carya glabra	22.48	*Quercus palustris*	2.53
Oxydendrum arboreum	17.97	*Pinus virginiana*	2.19
Quercus alba	15.35	*Platanus occidentalis*	2.14
Quercus velutina	12.63	*Amelanchier arborea*	1.82
Fagus grandifolia	11.15	*Sassafras albidum*	1.75
Quercus coccinea	10.75	*Cercis canadensis*	1.32
Liriodendron tulipifera	10.27	*Quercus imbricaria*	1.31
Carya tomentosa	7.11	*Carpinus caroliniana*	1.20
Liquidambar styraciflua	5.53	*Quercus shumardii*	0.85
Cornus florida	4.60	*Morus rubra*	0.65
Acer saccharum	4.41	*Gleditsia triacanthos*	0.64
Pinus echinata	3.96		

Table 20. Species and importance values on east-facing slopes.

Species	Importance Value	Species	Importance Value
Quercus prinus	76.98	*Carya tomentosa*	3.63
Acer rubrum	41.01	*Cornus florida*	3.46
Acer saccharum	32.85	*Asimina triloba*	3.32
Carya glabra	26.53	*Ulmus rubra*	2.52
Quercus rubra	18.81	*Quercus falcata*	2.17
Nyssa sylvatica	15.03	*Carya ovata*	1.85
Quercus alba	14.13	*Carpinus caroliniana*	1.77
Liriodendron tulipifera	13.57	*Sassafras albidum*	1.50
Fagus grandifolia	10.06	*Quercus coccinea*	1.35
Quercus velutina	9.19	*Quercus muhlenbergii*	1.10
Fraxinus americana	8.47	*Prunus serotina*	1.09
Cercis canadensis	4.22	*Morus rubra*	1.07
Liquidambar styraciflua	3.71	*Oxydendrum arboreum*	0.59

Table 21. Species and importance values on west-facing slopes.

Species	Importance Value		Importance Value
Quercus prinus	109.92	*Amelanchier arborea*	4.83
Acer rubrum	37.59	*Liquidambar styraciflua*	4.57
Nyssa sylvatica	27.27	*Carya ovata*	3.79
Quercus alba	19.93	*Cornus florida*	3.42
Liriodendron tulipifera	11.42	*Carya cordiformis*	3.34
Carya glabra	9.52	*Sassafras albidum*	3.24
Oxydendrum arboreum	7.90	*Fraxinus americana*	2.67
Quercus velutina	7.84	*Quercus rubra*	2.40
Carya tomentosa	7.70	*Quercus palustris*	1.74
Acer saccharum	7.57	*Pinus echinata*	1.09
Quercus coccinea	6.95	*Platanus occidentalis*	0.87
Pinus virginiana	6.84	*Ostrya virginiana*	0.74
Fagus grandifolia	6.14	*Cercis canadensis*	0.72

Principal Component Analysis

In the principal component analysis of sites labeled with geologic position, principal component 1 (PC 1) accounted for 46 % of the variation in the data and principal component 2 (PC 2) accounted for 15% of the variation in the data (Table 22).

The species with the highest loadings on PC 1 were *Quercus prinus*, with a coefficient value of -0.940350, and *Carya glabra* and *Quercus alba* with coefficient values of 0.192853 and 0.162717, respectively (Table 22). Principal component 1 thus separated sites in which chestnut oak is an important species (Ohio Shale and Sunbury Shale) from those sites in which pignut hickory and white oak are important species (Crab Orchard Formation and Farmers/Nancy lithologies).

The species with the highest loadings on PC 2 were *Acer rubrum* with a coefficient value of 0.615503 and *Carya glabra* and *Quercus alba* with coefficient values of -0.474392 and -0.457944, respectively (Table 22). Principal component 2 thus separated sites in which red maple is an important species (Quaternary alluvium) from those sites in which pignut hickory and white oak are important species (Farmers/Nancy lithologies).

The plot of PC 1 on PC 2 (Figure 20) clusters the bottomland sites together (Q = Quaternary alluvium), the ridgetop sites together (F = Farmers/Nancy lithologies) and most of the Crab Orchard sites together (S = Crab Orchard Formation). The remaining two layers (D = Ohio Shale and M = Sunbury Shale) are intermixed with one another.

In the PCA analysis of the 36 sites labeled by aspect, PC 1 accounted for 56% of the variation in the data and PC 2 accounted for 10 % of the variation in the data (Table 23).

The species with the highest loadings on PC 1 were *Quercus prinus*, with a coefficient value of -0.939866, and *Carya glabra, Liriodendron tulipifera, Quercus alba*, and *Carya tomentosa* with coefficient values of 0.169899, 0.157333, 0.129844, and 0.127206, respectively (Table 23). The species with the highest loadings on PC 2 were *Oxydendrum arboreum, Quercus alba, Nyssa sylvatica*, and *Acer rubrum*, with coefficient values of 0.197152, 0.190265, 0.170758, and 0.157213, respectively, and *Acer saccharum, Carya glabra*, and *Fraxinus americana* with coefficient values of - 0.892715, -0.145115, and -0.127284, respectively (Table 23).

The plot of principal component 1 on principal component 2 shows no clustering of sites into aspect groups (Figure 21).

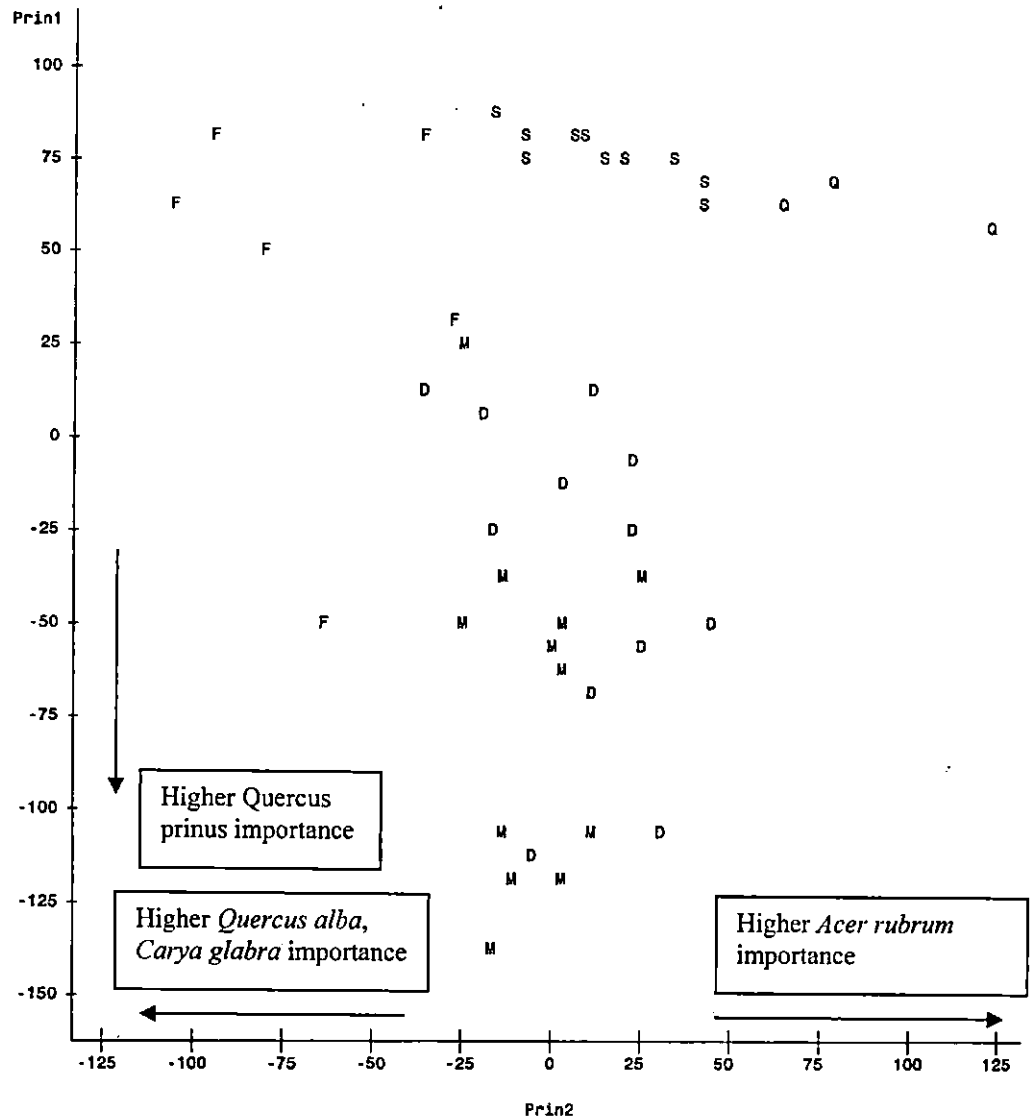

Figure 20. Plot of scores of 45 sites sampled on five geologic units in the Tablelands on PC 1 and PC 2. Q=Quaternary alluvium, S=Crab Orchard Formation, D= Ohio Shale, M=Sunbury Shale, F=Farmers/Nancy lithologies. One score is hidden.

Table 22. Eigenvectors and eigenvalues of principal component 1 and 2 from a PCA of 45 sampling sites on all geologic units. Only eigenvector values with an absolute value greater than 0.1 are listed.

Species	Prin 1	Prin 2
Acer rubrum		0.615503
Acer saccharum		-0.108478
Betula nigra		0.123065
Carya glabra	0.192853	-0.474392
Liquidambar styraciflua		0.165699
Liriodendron tulipifera	0.116768	
Nyssa sylvatica		0.170268
Quercus alba	0.162717	-0.457944
Quercus palustris		0.115207
Quercus prinus	-0.940350	-0.179792
Eigenvalue	5149.19169	1684.32964
Proportion	0.4577	0.1497
Cumulative	0.4577	0.6074

Table 23. Eigenvectors and eigenvalues of principal component 1 and 2 from a PCA of 36 sampling sites on four different slope aspects on the Crab Orchard Formation, Ohio Shale, and Sunbury Shale geologic units. Only eigenvector values with an absolute value greater than 0.1 are listed.

Species	Prin 1	Prin 2
Acer rubrum		0.157213
Acer saccharum		-0.892715
Carya glabra	0.169899	-0.145115
Carya tomentosa	0.127206	
Fraxinus americana		-0.127284
Liriodendron tulipifera	0.157333	
Nyssa sylvatica		0.170758
Oxydendrum arboreum		0.197152
Quercus alba	0.129844	0.190265
Quercus prinus	-0.939866	
Eigenvalue	5398.44423	919.38760
Proportion	0.5641	0.0961
Cumulative	0.5641	0.6601

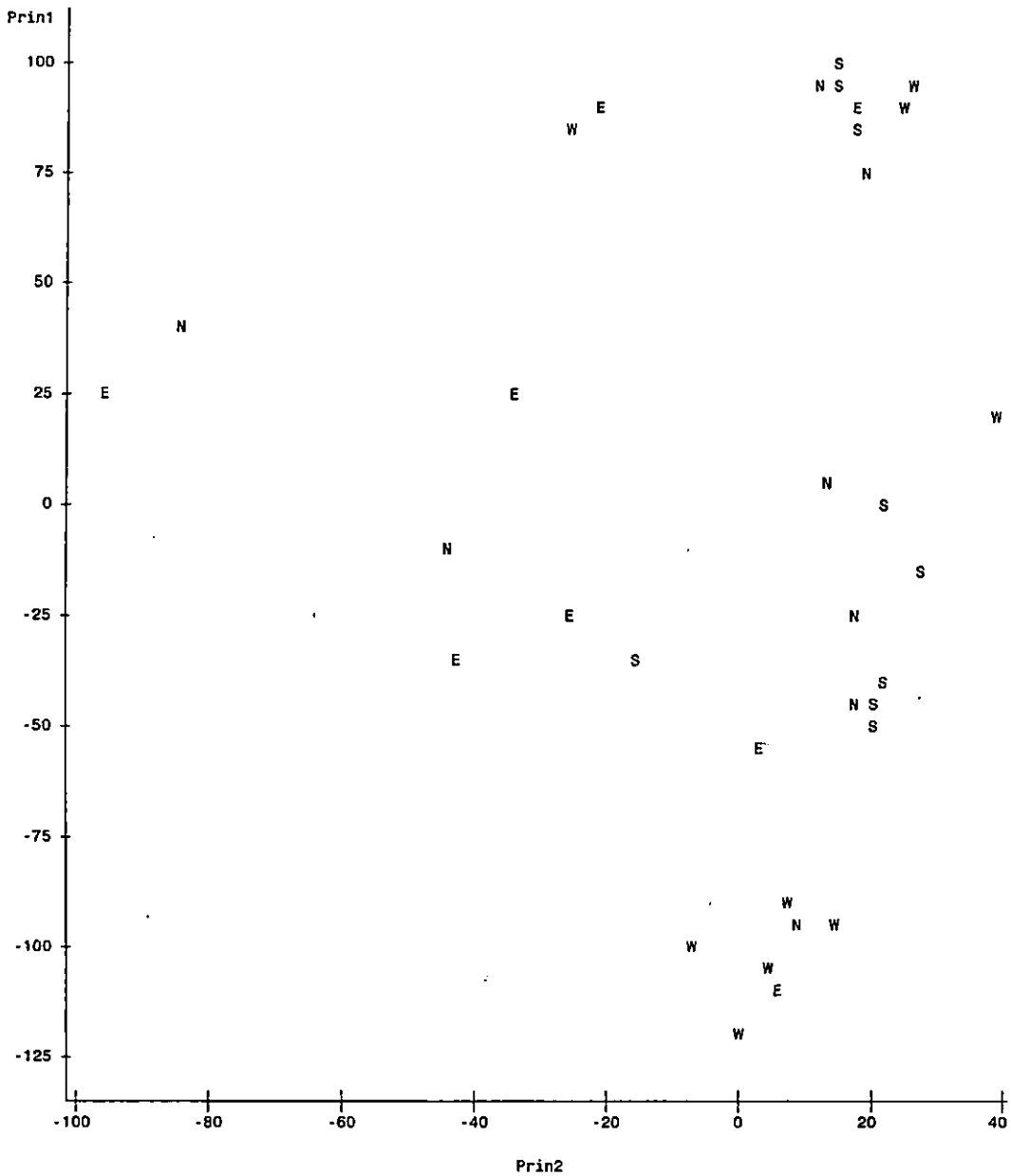

Figure 21. Plot of scores of 36 sites sampled on four slope aspects in the Tablelands on PC 1 and PC 2. N=north, S=south, E=east, and W=west.

Sorenson Coefficient of Community Similarity

Analysis of the similarity of forest communities between geologic units indicated that the forests on Ohio Shale and those on Sunbury Shale were the most similar at 81% (Table 24). The Crab Orchard Formation was similar to the Ohio Shale and Sunbury Shale with coefficient values of over 60%. The forests on Ohio Shale, Sunbury Shale, and Farmers/Nancy lithologies were similar with coefficient values of 60 percent and higher. The forest community on Quaternary alluvium was less than 50 percent similar to any other forests on any other strata and was most dissimilar to the forests on Farmers/Nancy sandstone/shales with an 11 percent similarity.

Table 24. Percent similarity (Sorenson coefficient) between forest communities on geologic units.

Geologic Unit	Crab Orchard Formation	Ohio Shale	Sunbury Shale	Farmers/Nancy lithologies
Quaternary alluvium	41%	34%	27%	11%
Crab Orchard Formation		63%	67%	48%
Ohio Shale			81%	60%
Sunbury Shale				62%

DISCUSSION

Classification of Forest Communities

All species present in sampling plots are typical of the Knobs region and include most of the woody dominant species found in the Mixed Mesophytic Forest Region of the Appalachian Plateau. Several of the more characteristic mixed mesophytic species, *Aesculus flava, Tilia americana* [including *T. heterophylla* (Gleason and Cronquist 1991)] and *Tsuga canadensis*, were not sampled in the 45 sites. These species, however, were documented from the area. Both *Tsuga canadensis* and *Tilia americana* were confined to more mesic areas such as north- and east-facing drainages that were not sampled quantitatively, while *Aesculus flava* was documented along the North Fork Licking River in Lewis County. The confinement of these mixed mesophytic species to more mesic habitats in the study area suggests the transitional nature of the Tablelands between the Mixed Mesophytic Forest Region and the Western Mesophytic Forest Region.

The forest canopy of the Tablelands was not shared by many species, but was instead dominated by a few species, especially oaks. On the slopes and ridges, five oaks (*Quercus alba, Q. coccinea, Q. prinus, Q. rubra*, and *Q. velutina*) accounted for 32.19 % of the total importance of all species. Four hickories (*Carya cordiformis, C. glabra, C. ovata*, and *C. tomentosa*) accounted for an additional 13.11 % for a combined total of 45.3%. These nine oak and hickory species accounted for almost half of the importance values of all 46 species present in the Tablelands. A similar oak-hickory species composition was described by Braun (1950) as originally

occurring in forests of the Knobs Region on the drier upper slopes and ridges. Braun (1950) also noted that the original forests occupying the lower slopes of the Knobs were mixed mesophytic forests. She did indicate, however, that these forests were often replaced after logging by second growth forests dominated by more xeric taxa such as *Quercus* and *Carya* spp. The high abundance of oaks and hickories on slopes and ridgetops, coupled with the historical prevalence of logging throughout the area, supports Braun's observations. The transitional nature of the vegetation of the Tablelands is qualified by the high importance of oaks and hickories.

Underlying these vegetation patterns in the Knobs is the strong influence of geologic substrates. Ranging from Ordovician limestone to Pennsylvanian sandstones, these substrates, which are variously exposed throughout the Knobs region, demonstrate the interrelations between vegetation, underlying rock, and physiographic history (Braun 1950). The classification of the forests of the Tablelands demonstrates further the interrelationship between forest types and geologic strata of the region.

The forests occupying bottomland Quaternary alluvium were the least diverse of all geologic units, having an alpha diversity of 15 species. All 15 species were previously documented from bottomland forests of the Knobs region (Wharton 1945; Harker et al. 1981; Meijer et al. 1981). The low diversity of these forests may result from limiting environmental factors such as hydrology and hydric soils, which allows only species tolerant of wet conditions. Five of the species occupying the Quaternary layer occurred only within bottomland forests of the Tablelands. Wetland indicator

status of four of these species, *Betula nigra*, *Carya laciniosa*, *Fraxinus pennsylvanica*, and *Quercus bicolor*, is facultative wet, while wetland status of *Acer negundo* is facultative (Reed 1986).

The forests growing on Quaternary alluvium were classified as a red maple type with *Acer rubrum* having an importance value almost three-fold higher than the next important species, *Quercus palustris*. Red maple can be consistently found in bottomland forests of the Knobs. However, abundance varies with site location and stand history (Harker et al. 1981). Braun (1950) described the swamp forests of the Knobs occurring on either alluvium or black shale as being principally made up of pin oak, sweet gum and red maple, indicating a shared dominance between the three species. Wharton (1945) classified the swamp forests occurring only on the black shale in Montgomery County as sweet gum-pin oak and pin oak-white oak forests. Red maple contributed a small percent to the total composition. *Liquidambar styraciflua* was the most important species in all three-forest types identified in the Brodhead Swamp Forest in Rockcastle County (Hannan 1980). The area was last extensively logged in 1919, suggesting Hannan studied a relatively mature swamp forest. *Acer rubrum* was one of seven important species present in the Brodhead Swamp Forest, but not a dominant in the canopy.

The dominance of *Acer rubrum* in the bottomland forests of the Tablelands may be indicative of land use patterns within the forests. Field observations suggest that logging has taken place within the last 30 years within all forests sampled. With time, red maple may be replaced or at least only share dominance of the canopy. The

forest found in the more hydric conditions of the Brodhead Swamp Forest was a sweet gum-pin oak forest. The lack of dominance of these two species in the forests of the Tablelands may also point to a change in the hydrology of the bottomlands. The hydrology of both the Big Run Swamp Forest and Marie's Woods have been changed with the construction of a flood control reservoir upstream from the Big Run Swamp Forest, and the construction of Cave Run Lake upstream from Marie's Woods.

The forests developed on the Crab Orchard Formation had the greatest diversity and were most similar in structure to those of a mixed mesophytic forest. Thirty-four woody species were documented in the forests, which is a 55% increase in diversity over other layers. Although three species (*Carya glabra*, *Liriodendron tulipifera*, and *Acer rubrum*) dominate the forest, the canopy is shared by many species. The top eleven species accounted for 80% of the total importance values, many of which are characteristic of mixed mesophytic forests. These include *Acer rubrum*, *Acer saccharum*, *Cornus florida*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Nyssa sylvatica*, and *Quercus alba*.

A mixed mesophytic forest was identified by Muller and McComb (1986) in rich coves throughout the Knobs region. The dominant species varied within these coves between *Fagus grandifolia*, *Acer saccharum*, and *Liriodendron tulipifera*. *Carya glabra* and *Acer rubrum* were of low importance within rich coves. The contrast between the high importance of these latter two species in lower slope forests in the Tablelands and the low importance of these species in rich coves throughout

the Knobs suggests a moisture difference with greater moisture availability in rich coves (Muller and McComb 1986). The parent material was not qualified in the cove areas, thus the influence of geology cannot be compared.

Day (1993) identified two forest types on the lower slopes underlain with Silurian limestone in Bernheim Forest. An Ultra Mesophytic forest type (*Platanus occidentalis*, *Ulmus americana*, *Acer saccharum* and others) occupied northeast-facing slopes and an Essential Mesophytic forest type (*Acer saccharum*, *Fagus grandifolia*, *Liriodendron tulipifera* and others) occupied southwest-facing slopes. The presence of mesophytic forests on the Silurian lower slopes in Bernheim Forest is comparable to the pattern shown in the Tablelands, although the dominant species do vary on the Silurian rocks between the two areas.

Present in minor abundance, and adding to the overall species richness of forest over the Crab Orchard shales and limestones, were several species more characteristic of the vegetation of the Bluegrass. These species included *Gleditsia triacanthos*, *Morus rubra*, *Quercus muhlenbergii*, and *Q. shumardii* (Quarterman and Powell 1981). The presence of most of these species is indicative of calcareous soils (Braun 1950; Martin et al. 1993) and suggests, along with the presence of mesophytic species, the transitional nature of the forests over the Crab Orchard Formation between the Mixed Mesophytic Forest Region and the Western Mesophytic Forest Region.

The diversity of the forests decreases as one moves upslope from the more mesic lower Crab Orchard onto the steep middle slope of Ohio Shale. Twenty

species were sampled in the forest on the Ohio Shale, a decrease in species richness of 41 percent as compared to the Crab Orchard Formation. The dominant species were chestnut oak primarily and red maple secondarily. The importance of *Quercus prinus* on the Ohio Shale suggests a gradation to less mesic conditions than those found on the lower Crab Orchard Formation, since *Q. prinus* is indicative of drier slopes and ridgelines in the Mixed Mesophytic Forest Region (Braun 1950). Very little soil accumulates on the steep slopes of the Ohio Shale, additionally allowing only species tolerant of dry, shallow soils to persist.

Wharton (1945) described a similar forest type, chestnut oak- scarlet oak, on hilltops, ridges, and steep south slopes on black shale. The replacement of scarlet oak by red maple in the forests on black shale may reflect past land use or the lack of fire in the Tablelands.

The forest occupying the black shale in the Bernheim Forest was described by Day (1993) as Essential Mesophytic to Moderate Mesophytic. *Acer saccharum*, *Liriodendron tulipifera*, and *Fagus grandifolia* were the more important species, followed by a mixed oak group (*Quercus alba*, *Q. prinus*, and *Q. velutina*). This species-group is significantly different in species importance from that presented here. Slope position of the Devonian shale layer at the Bernheim Forest is lower than in the Tablelands (Day 1993), perhaps leading to more mesic conditions resulting in different forest types. *Acer saccharum* had a higher importance on north- and east-facing slopes in the Tablelands where moisture would be greater. This occurrence supports the idea that greater moisture availability may be one reason for the different

forest types on the black shale in the Bernheim Forest and the black shale in the Tablelands.

While species composition of the forest on the upper slope on the Sunbury Shale was similar to that of the forest on the Ohio Shale, alpha diversity was slightly higher in forests on the upper slope. With the increase in topographic position and decrease in moisture availability, two species of pine, *Pinus echinata* and *P. virginiana* were added to the community. The importance of *Quercus prinus* increased 33 percent, making it a clear dominant of the canopy. The dominance of chestnut oak and the presence of pines suggest a slight transition to a drier, more exposed habitat. Similar communities occupy dry, shallow soil ridgelines of the Cumberland Mountains to the east (Braun 1950). Braun (1950) noted the presence of a chestnut oak zone on the upper slopes of the Knobs Border Area, hence the same position as the Sunbury Shale in the Tablelands. Although Wharton (1945) described an oak-pine forest on the ridges in the Knobs, the importance value of pine on the Sunbury Shale was only 8.6, or 2.9 percent of the total.

In the Tablelands, the forests occupying the top of the ridges on Farmers sandstones and Nancy shales were similar in species richness to those on the Ohio Shale, but very different in species composition. Four species were present only on the top geologic unit (*Fraxinus quadrangulata, Juglans nigra, Quercus stellata* and *Robinia pseudoacacia*). Three of these species, *Fraxinus quadrangulata, Juglans nigra*, and *Robinia pseudoacacia*, are generally restricted to calcareous soils (McInteer 1941). *Juniperus virginiana*, a species indicative of calcareous soil, was

also present on the top layer. The presence of these four species suggests that the soil on the Farmers and Nancy sandstones/shales tends to be calcareous. These species were noted by Harker et al. (1981) as occurring on limestone outcrops in the Knobs.

The forest on the Farmers Nancy shales was classified as an oak-hickory forest. *Carya glabra* was the dominant species followed by *Quercus alba, Q. prinus,* and *Q. rubra.* These four species accounted for 65 percent of the total importance value of all 20 species. Harker et al. (1981) suggested that *Carya glabra* was typically the dominant species in oak-hickory forests throughout the Knobs, accompanied by *Quercus prinus, Quercus coccinea,* or *Quercus velutina.* In contrast, the oaks of more importance in the ridgetop forests of the Tablelands were white oak, chestnut oak and red oak, suggesting more mesic conditions.

The Farmers and Nancy shales underlie the middle slopes of the Spencer Morton Preserve in Powell County (Fedders 1983). Fedders described five forest types that occupy various positions on Farmers/Nancy sandstone and shale. A pignut hickory and post oak-pignut hickory forest occupied a small area of the upper portion of the Farmers/Nancy strata on southwest-facing slopes. This forest type increased in coverage up the slope and on narrow ridge crests underlain by siltstones and shales of the Cowbell Member of the Borden Formation. A chestnut oak-black oak forest occupied upper portions of the Farmers/Nancy lithologies on open southwest- to south-facing slopes, while a chestnut oak forest occupied upper portions on open west- to east- to north-facing slopes. White oak and chestnut oak-white oak forests occupied lower portions of the Farmers/Nancy strata on all open slopes. A mixed

oak-hickory forest and a northern red oak-shagbark hickory forest occupied protected east-northeast-facing slopes. This latter forest type is most similar to that identified on the Farmers/Nancy sandstone and shales in the Tablelands and further suggests the more mesic conditions found on the ridgetops.

In the Bernheim Forest, Mississippian shale and sandstone underlie the middle to upper slopes (Day 1993). The forests on the upper northeast-facing slopes were classified as Moderate Mesic, which include *Acer rubrum, Acer saccharum, Liriodendron tulipifera, Fagus grandifolia, Quercus alba, Quercus prinus*, and *Quercus velutina*. On southwest-facing slopes the mesic species drop out and only the oaks and red maple occupy the upper slope.

The forest patterns seen throughout the Knobs suggest that forest composition and structure are primarily related to underlying parent materials and secondarily to the topographic position of these parent materials. Aspect, therefore, may influence forest structure depending on the topographic position of the parent material. In the Tablelands, aspect was not shown to significantly influence the canopy dominants, or forest types. The black shale underlying the steep middle and upper slopes of the Tablelands is already limiting to only those species capable of establishing and growing in shallow, dry conditions. Aspect, therefore, only influenced abundance of these species not forest type. In comparison, aspect was shown to influence forest types at both the Spencer Morton Preserve (Fedders 1983) and in the Bernheim Forest (Day 1993). The black shale is only exposed on the lower, moderately steep, slopes in the Bernheim Forest. This topographic position would offer more moisture

availability and less limiting soil conditions therefore aspect could influence forest structure. The black shale is not exposed in the Spencer Morton Preserve. The middle slope of both the Bernheim Forest and Spencer Morton Preserve are underlain with Mississippian shale and sandstone. Since aspect was shown to influence forest type at both areas, this suggests that the Mississippian shale and sandstone parent material is less limiting and aspect becomes a factor in forest structure. In the Bernheim Forest "moderate mesic" forests occurred farther upslope on northeast-facing slopes where moisture would be more available. In the Spencer Morton Preserve, a mixed oak-hickory and northern red oak-shagbark hickory forest were classified on the east to northeast slopes, which were most mesic.

It is of interest that the Mississippian shale and sandstone (Farmers and Nancy Members of the Borden Formation) is the parent material that underlies the ridgelines in the Tablelands. Although aspect is not a factor, the topographic position of ridgetop often reduces moisture availability and forest structure is more limited. In the Tablelands, the forest transitions from a more limited forest type on the black shale (the chestnut oak forest), to a mixed oak-hickory forest type on the ridgeline. This further suggests that the Mississippian shale and sandstone offer more favorable environmental conditions.

Muller and McComb (1986) suggest that the variation of upland forest types seen throughout the Knobs could also be the result of geographic distribution pattern. In one hundred and forty-seven plots *Quercus prinus* was more important in forests located to the eastern side of the Knobs, while *Quercus alba* was more important in

areas located in the western portion of the Knobs. *Quercus coccinea* was most important in one area toward the western portion of the Knobs. No environmental factor was found to influence the distribution of these forest types, therefore, Muller and McComb (1986) suggested, that since *Quercus prinus* is an Appalachian species, it would have greater importance in areas closer to the Cumberland Plateau and *Quercus alba*, having a wider geographic distribution, would have greater importance further from the Cumberland Plateau.

The types of forest classified from the Tablelands, Spencer Morton Preserve, and the Bernheim Forest follow Muller and McCombs' idea of geographic distribution. The Tablelands is located just outside the Cumberland Plateau and *Quercus prinus* is by far the most importance species of oak. The Bernheim Forest is located far from the Cumberland Plateau and Day (1993) found *Quercus alba* to be the most important oak species. Located between the two previous areas, Fedders (1983) found areas of forest at the Spencer Morton Preserve where either white oak or chestnut oak was the dominant species and other areas where the canopy was shared by both chestnut oak and white oak. Although this pattern may be the result of geographic distribution of the dominant oaks across the Knobs, more research is needed. Since results from the present study suggest that parent material and topographic position of the parent material influence forest composition and structure and parent materials and topographic position vary throughout the Knobs, more detailed research of soils and parent materials throughout the Knobs may shed light on which factors are influencing forest types and distribution patterns.

Chester et al. (1998) characterized the woody strata in xeric-site chestnut oak forest communities in Land Between the Lakes. Although Land Between the Lakes is west of the Knobs, the study suggests that chestnut oak dominated forests may occur in environmentally limited areas, supporting the idea of parent material and topographic placement being the primary influence of forest composition.

Principal component analysis supported classification of three different forest types on the Quaternary alluvium, Crab Orchard Formation and Farmers/Nancy unit. Sites for the Ohio Shale and Sunbury Shale were intermixed with one another on the PCA plot, suggesting a high degree of similarity between the forests of these two geologic units, thus a fourth forest type. The high negative weight of *Quercus prinus* on PC 1 supports the great importance the species has on the Ohio Shale and Sunbury Shale, separating sites on these two geologic units from the Quaternary alluvium, Crab Orchard Formation and Farmers/Nancy unit. The high positive weight of *Carya glabra* and *Quercus alba* supports the importance these two species have on the Crab Orchard Formation and Farmers/Nancy unit. Principal component 2 separates sites on the bottomland from sites on the ridgetop. The high positive weight of *Acer rubrum* on PC 2 supports the importance the species has in the bottomland forest on Quaternary alluvium. The high negative weight of *Carya glabra* and *Quercus alba* reflects the importance of the two species in the forest occupying the ridgetop Farmers/Nancy unit.

SUMMARY AND CONCLUSIONS

The Tablelands is a distinct physiographic region in the northeastern section of the Knobs of Kentucky. Located in western Rowan, eastern Fleming, and southern Lewis counties, the Tablelands is characterized by broad flat ridgetops, steep slopes, and broad wide valleys. The Tablelands encompasses an area of approximately 468.5 km^2 and lies mostly in the Fox Creek watershed of the Licking River.

The objectives of this study were to 1) inventory the vascular plants of the Tablelands 2) identify natural areas of ecological significance in the Tablelands, and 3) classify the woody plant communities in relationship to geology and slope aspect.

This study documented 780 species and varieties of vascular plants in 402 genera and 122 families. The largest family documented was the Asteraceae with 115 species. The largest genus was *Carex* with 53 species.

Nine taxa documented from the Tablelands are listed for the state of Kentucky as rare. One species is designated as endangered, three as threatened, and five as of special concern. Two state-listed species, *Scutellaria saxatilis* and *Dryopteris carthusiana*, showed an affinity to the Devonian Ohio Shale while four other state-listed species require some form of wetland habitat. These nine species represent 1.2% of the total flora documented in the Tablelands. Introduced species make up 12.2% of the total flora.

Ten natural areas in the Tablelands were determined to be of ecological significance. Four of these are bottomland swamp forests, three are areas with prairie plant communities, and one is an oxbow pond. The two additional areas contain

some of the best-developed forests of the Tablelands. Both of these latter two areas have large populations of *Scutellaria saxatilis* (state-listed as threatened). *Dryopteris carthusiana* (state-listed as of special concern) is found at one of these areas.

The Tablelands had 0.0167 species per hectare (780/46,850 hectares). In comparison to eight counties in the Knobs Region in which county floras have been previously conducted, the number of species per hectare in the Tablelands is close to Oldham County, whose diversity was the highest, 0.0173 species per hectare.

The number of species documented in the Tablelands during the present inventory was lower than predicted by a species-area curve presented by Wade and Thompson (1991). The reasons for the lower than predicted numbers may be the result of 1) the homogenous geology defining the study area, which may limit environmental conditions for species diversity, and 2) the loss of wetland habitats due to past land use practices.

A total of forty-five sites was sampled on five different geologic units in order to classify the woody plant communities on each geologic unit and with respect to slope aspect where applicable. Three sites were located on Quaternary alluvium in bottomland. Three sites were located on each north-, south-, east-, and west-facing lower slopes underlain by Silurian Crab Orchard Formation for a total of twelve sites. Twelve sites were also located on middle slopes underlain by Devonian Ohio Shale, and on upper slopes underlain by Mississippian Sunbury Shale (three sites on each north-, south-, east-, and west-facing slopes). Six sites were located on ridgetops underlain by Mississippian Farmers and Nancy Members of the Borden Formation.

Species composition of the canopy of forests of the Tablelands was comparable to that documented by Wharton (1945), Braun (1950), Hannan (1980), Harker et al. (1981), Fedders (1983), Muller and McComb (1986), and Day (1993).

In the Tablelands, forests growing on the Crab Orchard Formation had the greatest alpha diversity with 34 species, followed by forests growing on Sunbury Shale with 22 species. Forests growing on Ohio Shale and Farmers/Nancy lithologies had alpha diversities of 20 species each, while forests on Quaternary alluvium were least diverse with 15 species.

Quercus prinus was the most importance species of the Tablelands, accounting for 19.63% of the total importance values of all species present. Second in importance was *Acer rubrum* followed by *Carya glabra*, *Nyssa sylvatica*, and *Quercus alba*. All five species accounted for 56.48% of the total.

The forests on Quaternary alluvium were classified as red maple. Although red maple was the dominant species in bottomland forests in the Tablelands, it is not typically the dominant species in bottomland forests throughout the Knobs Region (Wharton 1945; Braun 1950; Hannan 1980). Typically the canopy is shared by several species including *Acer rubrum*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Platanus occidentalis*, *Quercus alba*, *Q. bicolor*, and *Q. palustris*. The importance of red maple in the bottomlands forests of the Tablelands may be due to past selective logging of the forests.

The forests on the Crab Orchard Formation were classified as pignut hickory-tulip poplar-red maple forests. However, the canopy of these forests was shared by

many species with eleven species accounting for 80% of the total importance value of all species on this unit. The species present on the Crab Orchard Formation included species typical of the mixed mesophytic forests of the Allegheny Plateau to the east and the Bluegrass Region to the west.

The forests on the Ohio Shale were classified as chestnut oak-red maple forests. The importance of *Quercus prinus* suggests a gradation from more mesic conditions on the Crab Orchard to more xeric conditions on the Ohio Shale. *Quercus prinus* becomes the sole dominant on the Sunbury Shale suggesting a continued decrease in moisture since the species is indicative of drier slopes and ridgelines in the Mixed Mesophytic Forest Region (Braun 1950). Braun (1950) noted the presence of a chestnut oak forest on upper slopes in the Tablelands (= Knobs Border Area).

The forests on the Farmers/Nancy shales and sandstones were classified as oak-hickory with *Carya glabra*, *Quercus alba*, *Q. prinus*, and *Q. rubra* sharing dominance of the canopy. The importance of oaks and hickories suggests a transition to the Western Mesophytic Forest Region. Oak-hickory forests were also found on slopes underlain with the Farmers/Nancy strata in other areas of the Knobs (Fedders 1983; Day 1993).

Principal component analysis supported four groupings that relate to rock type. Sites were ordered along axes that primarily corresponded to importance value of four species; *Quercus prinus*, *Acer rubrum*, *Carya glabra*, and *Quercus alba*. Principal component analysis indicated that slope aspect does not influence forest

type as strongly as rock type and topographic position of geologic units. The similarity of the Ohio and Sunbury Shales was 81%.

The present study suggests that rock type is important in plant distribution patterns and should be considered when conducting botanical research. Plant inventories, although never complete, are necessary for understanding the diversity and distribution of plants. Inventories allow significant ecological areas to be identified. Since habitat destruction is the leading cause of the loss of biodiversity, identification of these areas opens the possibilities of protection and sustained biological diversity. In the Tablelands, four of the nine state listed species require some form of wetland habitat. The conservation of wetland habitats and bottomland forests is imperative in Kentucky and specifically in the Tablelands if biological diversity is to be maintained.

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APPENDIX A

AN ANNOTATED SPECIES LIST OF THE VASCULAR FLORA OF THE TABLELANDS IN ROWAN, FLEMING AND LEWIS COUNTIES

The annotated checklist contains 780 species of vascular plants collected. The checklist is arranged into five phyla: 1) Lycopodiophyta, clubmoss and spike mosses; 2) Equisetophyta, horsetails; 3) Polypodiophyta, ferns; 4) Pinophyta, gymnosperms; 5) Magnoliophyta, flowering plants. Magnoliophyta is further divided into two classes: Magnoliopsida, dicotyledons; and Liliopsida, monocotyledons. Nomenclature of all species, except those in the Phylum Polypodiophyta, follows Gleason and Cronquist (1991). Nomenclature of species of the Polypodiophyta follows *Flora of North America*, Vol. 2, Pteridophytes and Gymnosperms (FNA Editorial Committee 1993). Family, genus, and species arrangement is alphabetical within the five major phyla and two classes. Each entry includes the scientific name and author; brief description of habitat in which collected; geologic unit on which species was growing; county; and collection number of collected specimen of taxon. In the case of a species being collected more than once during the study, the habitat of each collection is listed in order of ascending collection number, followed by the geologic unit for each collection in the same ascending order, followed by county and collection number in ascending order. A number in parenthesis follows an entry if two or more collections occurred in the same habitat or on the same geologic unit. A semicolon separates each collection. Introduced species are designated by a * in front

of taxon scientific name. Kentucky rarity status is designated by a small circle (°) in front of taxon name and is based on Kentucky State Nature Preserve Commission listings (2000). Designations of Endangered (E), Threatened (T), or Special Concern (S) will be presented in parentheses after the species name.

LYCOPODIOPHYTA

LYCOPODIACEAE

***Diphasiastrum digitatum* Dillenius ex A. Braun**
Forested lower S slope; forested lower E slope. Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale. Fleming Co., *572*; *1182*.

SELAGINELLACEAE

***Selaginella apoda* (L.) Spring**
Seep area below pond. Mississippian Nancy shale. Rowan Co., *1079*.

EQUISETOPHYTA

EQUISETACEAE

***Equisetum hyemale* L.**
Powerline right-of-way, seep area, lower W slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1297*.

POLYPODIOPHYTA

ASPLENIACEAE

***Asplenium platyneuron* (L.) Britton, Sterns & Poggen.**
Mowed field, lower slopes of drain; forested ridgetop. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; near contact between Mississippian Sunbury Shale and Mississippian Farmers sandstone. Rowan Co., *482*; Fleming Co., *1244*.

***Asplenium rhizophyllum* L.**
Forested E-W drain, lower drain. Near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Rowan Co., *1471.*

BLECHNACEAE

***Woodwardia areolata* (L.) Moore**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *986.*

DENNSTAEDTEACEAE

***Dennstaedtia punctilobula* (Michx.) T. Moore**
Forested lower to middle NNE slope; forested steep slope just above creek in head of hollow; forested bottomland. Devonian Ohio Shale (2); Quaternary alluvium. Rowan Co., *466*; Fleming Co., *930*; Rowan Co., *1496.*

***Pteridium aquilinum* (L.) Kuhn**
Powerline right-of-way, NW slope. Mississippian Nancy shale. Fleming Co., *599.*

DRYOPTERIDACEAE

***Athyrium filix-femina* (L.) Roth ex Mertens**
Forested lower to middle NNE slope; powerline right-of-way, head of drain on ridgetop; forested steep slope just above creek in head of hollow; gasline right-of-way, E slope. Devonian Ohio Shale; Mississippian Nancy shale; Devonian Ohio Shale; near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Fleming Co., *471*; *605*; *929*; Rowan Co., *1379.*

***Cystopteris protrusa* (Weatherby) Blasdell**
Forested lower SE slope; forested lower NNE slope; exposed rock outcrops in middle of forested SW slope; lower slope of forested SW-NE drain. Devonian Ohio Shale (2); Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale. Rowan Co., *978*; *1145*; Fleming Co., *1235*; *1527.*

***Deparia acrostichoides* (Swartz) M. Kato**
Forested lower SE slope; forested lower N slope. Silurian upper Crab Orchard clay-shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Fleming Co., *1125*; *1520.*

***Diplazium pycnocarpon* (Spreng.) A. Braun**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *557.*

°***Dryopteris carthusiana*** **(Villars) H.P. Fuchs (S)**
Forested lower E slope. Base of Devonian Ohio Shale. Fleming Co., *1126.*

Dryopteris goldiana **(Hooker ex Goldie) A. Gray**
Forested lower NNE slope. Devonian Ohio Shale. Rowan Co., *1153.*

Dyropteris marginalis **(L.) A. Gray**
Forested E-W drain, lower drain. Near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Rowan Co., *1468.*

Onoclea sensibilis **L.**
Forested bottomland; bottomland swamp forest. Quaternary alluvium (2). Rowan Co., *508*; Fleming Co., *543.*

OPHIOGLOSSACEAE

Botrychium dissectum **Spreng.**
Forested bottomland. Quaternary alluvium. Rowan Co., *668.*

Botrychium virginianum **(L.) Swartz**
Forested middle NE slope; forested lower NNE slope. Devonian Ohio Shale (2). Fleming Co., *934*; Rowan Co., *1149.*

Ophioglossum vulgatum **L.**
Bottomland forest, recently selectively logged; wet area on forested ridgetop. Quaternary alluvium; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Lewis Co., *430*; Rowan Co., *450.*

OSMUNDACEAE

Osmunda cinnamomea **L.**
Bottomland swamp forest. Quaternary alluvium. Fleming Co., *542.*

Osmunda claytoniana **L.**
Forested lower to middle NNE slope. Devonian Ohio Shale. Rowan Co., *465.*

Osmunda regalis **L.**
Bottomland swamp forest. Quaternary alluvium. Fleming Co., *547.*

POLYPODIACEAE

***Polystichum acrostichoides* (Michx.) Schott**
Open, dry forested ridgetop. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *447*.

PTERIDACEAE

***Adiantum pedatum* L.**
Forested middle NW slope. Devonian Ohio Shale. Rowan Co., *393*.

SCHIZAEACEAE

***Lygodium palmatum* (Bernh.) Schwartz**
Bottomland swamp forest. Quaternary alluvium. Fleming Co., *546*.

THELYPTERIDACEAE

***Phegopteris hexagonoptera* (Michx.) Weatherby**
Forested middle NW slope; forested steep slope just above creek in head of hollow. Devonian Ohio Shale (2). Rowan Co., *394*; Fleming Co., *928*.

***Thelypteris noveboracensis* (L.) Nieuw.**
Forested lower to middle NNE slope. Devonian Ohio Shale. Rowan Co., *469*.

***Thelypteris palustris* Schott**
Open meadow on edge of bottomland swamp forest. Quaternary alluvium. Fleming Co., *1319*.

PINOPHYTA

CUPRESSACEAE

***Juniperus virginiana* L.**
Old field, regrown with young woods, lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *835*.

PINACEAE

***Pinus echinata* Miller**
Roadside, ridgetop. Mississippian Nancy shale. Fleming Co., *1455*.

***Pinus rigida* Mill.**
Forested ridgetop. Mississippian Nancy shale. Rowan Co., *657.*

***Pinus strobus* L.**
Edge of field and forested creekside in bottomland. Quaternary alluvium. Fleming Co., *1028.*

***Pinus virginiana* Miller**
Forested dry ridgetop. Mississippian Farmers sandstone. Rowan Co., *314.*

***Tsuga canadensis* (L.) Carr.**
Forested upper SW slope. Mississippian Nancy shale. Rowan Co., *656.*

MAGNOLIOPHYTA: DICOTYLEDONS

ACANTHACEAE

***Ruellia caroliniensis* (Walter) Steudel**
Forested lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., 1071.

***Ruellia humilis* Nutt.**
Pastureland, lower E slope; cedar glade area. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *712*; *1110.*

ACERACEAE

***Acer negundo* L.**
Bottomland woods. Quaternary alluvium. Rowan Co., *669*; *1008.*

***Acer nigrum* Michx.**
Forested creekside and lower SSW slope above creek. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *940.*

***Acer rubrum* L.**
Wooded, dry ridgetop. Mississippian Farmers sandstone. Rowan Co., *313.*

***Acer saccharinum* L.**
Bottomland riparian woods. Quaternary alluvium. Fleming Co., *791.*

***Acer saccharum* Marsh.**
Wooded riparian zone; forested, lower E slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Rowan Co., *403*; Fleming Co., *791*.

AMARANTHACEAE

****Amaranthus hybridus* L.**
Cultivated field. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1267*.

ANACARDIACEAE

***Rhus copallina* L.**
Successional old field, lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *829*.

***Rhus glabra* L.**
Wooded streamside. Silurian lower Crab Orchard clay-shale. Fleming Co., *721*.

ANNONACEAE

***Asimina triloba* (L.) Dunal.**
Forested, lower to middle SW slopes. Devonian Ohio Shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *342*; Rowan Co., *863*.

APIACEAE

***Chaerophyllum procumbens* (L.) Crantz.**
Bottomland, forested drainage ditch and creekside. Quaternary alluvium. Lewis Co., *407*; *856*.

***Cicuta maculatum* L.**
Open meadow on edge of bottomland swamp forest. Quaternary alluvium. Fleming Co., *1324*.

****Conium maculatum* L.**
Bottomland, edge of field and forested creekside. Quaternary alluvium. Fleming Co., *1027*.

***Cryptotaenia canadensis* (L.) DC.**
Forested bottomland. Quaternary alluvium. Rowan Co., *1010*.

***Daucus carota* L.**
Roadside, powerline right-of-way. Quaternary alluvium. Fleming Co., *531*.

***Osmorhiza claytonii* (Michx.) Clarke**
Wooded middle NW slope. Devonian Ohio Shale. Rowan Co., *391*.

***Osmorhiza longistylis* (Torr.) DC.**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *954*.

***Oxypolis rigidior* (L.) Raf.**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1483*.

***Pastinaca sativa* L.**
Roadside ditch. Quaternary alluvium. Fleming Co., *1204*.

***Sanicula canadensis* L.**
Forested lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1127*.

***Sanicula gregaria* E. Bickn.**
Bottomland, forested creekside. Quaternary alluvium. Fleming Co., *1016*.

***Sanicula smallii* E. Bickn.**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1200*.

***Sanicula trifoliata* E. Bickn.**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1199*.

***Thalictrum clavatum* DC.**
Wooded lower NW slope. Silurian upper Crab Orchard clay-shale. Lewis Co., *636*.

***Thaspium barbinode* (Michx.) Nutt.**
Forested roadside, lower S slope; forested creekside. Silurian upper Crab Orchard clay-shale; near contact between Quaternary alluvium and Ordovician clay-shale. Rowan Co., *1137*; Fleming Co., *1251*.

***Thaspium trifoliatum* (L.) A. Gray**
Rock outcropping, open canopy; gasline right-of-way; middle of forested E-W drain. Mississippian Farmers sandstone; Mississippian Nancy shale; Mississippian Farmers sandstone. Fleming Co., *538*; Rowan Co., *1086*; *1466*.

***Thlaspi perfoliatum* L.**
Roadside cedar forest, lower SE slope. Near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Fleming Co., *895.*

***Zizia aptera* (A. Gray) Fern.**
Roadside, forested lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1060.*

APOCYNACEAE

***Apocynum cannabinum* L.**
Bottomland, gasline right-of-way. Quaternary alluvium. Rowan Co., *501*; *692.*

***Vinca minor* L.**
Forested lower N slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1519.*

AQUIFOLIACEAE

***Ilex opaca* Aiton**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *983.*

***Ilex verticillata* (L.) A. Gray**
Forested bottomland; forested broad ridgetop, E slope, along shallow drain. Quaternary alluvium; Mississippian Nancy shale. Rowan Co., *505*; *1069.*

ARALIACEAE

***Aralia racemosa* L.**
Forested upper E slope. Devonian Ohio Shale. Fleming Co., *1217.*

***Aralia spinosa* L.**
Powerline right-of-way, middle S slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *734.*

***Panax quinquefolium* L.**
Wooded lower to middle NNE slope. Mississippian Sunbury Shale. Rowan Co., *461.*

ARISTOLOCHIACEAE

***Aristolochia serpentaria* L.**
Wooded lower NE slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *489.*

***Asarum canadense* L.**
Forested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *903*.

ASCLEPIADACEAE

***Asclepias incarnata* L.**
Bottomland, gasline right-of-way. Quaternary alluvium. Rowan Co., *689*.

***Asclepias purpurascens* L.**
Forested roadside, lower S slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1141*.

***Asclepias syriaca* L.**
Roadside field. Silurian upper Crab Orchard clay-shale. Fleming Co., *533*.

***Asclepias tuberosa* L.**
Roadside field. Silurian upper Crab Orchard clay. Fleming Co., *532*.

***Asclepias variegata* L.**
Powerline right-of-way, ridgetop. Mississippian Nancy shale. Rowan Co., *1099*.

***Asclepias viridis* Walter**
Old fields with scattered wooded areas; mowed field. Near contact between Silurian lower Crab Orchard clay-shale and upper Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *575*; *1066*.

***Cynanchum laeve* (Michx.) Pers.**
Successional old field, lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *831*.

***Matelea obliqua* (Jacq.) Woodson**
Forested creekside and lower SSW slope above creek. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1230*.

ASTERACEAE

***Achillea millefolium* L.**
Roadside, powerline right-of-way. Quaternary alluvium. Fleming Co., *528*.

***Ambrosia artemisiifolia* L.**
Bottomland, along roadway through wet meadow. Quaternary alluvium. Rowan Co., *709*.

***Ambrosia trifida* L.**
Wooded creekside; creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *848*; *1408*.

***Antennaria plantaginifolia* (L.) Richardson**
Wooded ridgetop (2); forested lower S slope (2). Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *335*; Rowan Co., *362*; Fleming Co., *946*; *947*.

***Aster cordifolius* L.**
Forested SW-NE drain, lower slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1524*.

***Aster divaricatus* L.**
Wooded NW slope along old roadbed; forested bottomland; powerline right-of-way, ridgetop, edge of woods in shallow drain. Devonian Ohio Shale; Quaternary alluvium; Mississippian Nancy shale. Fleming Co., *619*; Lewis Co., *651*; Rowan Co., *1370*.

***Aster dumosus* L.**
Powerline right-of-way, ridgetop; gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale (2). Rowan Co., *1359*; *1388*.

***Aster infirmus* Michx.**
Forested middle S slope; powerline right-of-way, ridgetop. Mississippian Nancy shale. Fleming Co., *1331*; Rowan Co., *1365*.

***Aster laevis* L.**
Forested lower SW slope, cedar glade. Silurian upper Crab Orchard clay-shale. Fleming Co., *1449*.

***Aster lateriflorus* (L.) Britton**
Successional old field, lower NW slope; field, lower SW slope, bottom of drain; thin forest, lower NE slope. Silurian lower Crab Orchard clay-shale (2); Silurian upper Crab Orchard clay-shale. Fleming Co., *834*; *1454*; *1512*.

***Aster lowrieanus* T. C. Porter**
Forested lower SW slope, cedar glade. Silurian upper Crab Orchard clay-shale. Fleming Co., *1448*.

***Aster macrophyllus* L.**
Forested middle to lower NNE slope; forested lower E slope. Devonian Ohio Shale; Mississippian Farmers sandstone. Fleming Co., *1195*; *1344*.

***Aster novae-angliae* L.**
Powerline right-of-way through pasture land. Silurian lower Crab Orchard clay-shale. Fleming Co., *809*.

***Aster ontarionis* Wiegand**
Bottomland woods around edge of oxbow; forested bottomland; bottomland field with wet areas. Quaternary alluvium (3). Fleming Co., *768*; Rowan Co., *873*; Lewis Co., *1478*.

***Aster patens* Aiton**
Forested upper W slope. Mississippian Nancy shale. Rowan Co., *1463*.

***Aster paternus* Cron.**
Gasline right-of-way, ridgetop; forested ridgetop. Mississippian Nancy shale; Mississippian Farmers sandstone. Rowan Co., *1162*; Fleming Co., *1213*.

***Aster pilosus* Willd.**
Successional old field, lower SE slope; pond, lower SE slope. Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale. Fleming Co., *1404*; *814*.

***Aster prenanthoides* Muhl.**
Field, along drain of lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *790*.

***Aster puniceus* L.**
Wooded oxbow and seep (2). Quaternary alluvium (2). Fleming Co., *1041*; *1502*.

***Aster shortii* Lindley**
Forested lower SE slope above creek; forested SW-NE drain, creek floodplain. Silurian lower Crab Orchard clay-shale; Ordovician clay-shale. Fleming Co., *1415*; *1528*.

***Aster solidagineus* Michx.**
Powerline right-of-way, ridgetop; gasline right-of-way, ridgetop. Mississippian Nancy shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *1098*; *1375*.

***Aster surculosus* Michx.**
Around old pond in field, ridgetop; powerline right-of-way, ridgetop (2). Mississippian Nancy shale (3). Rowan Co., *802*; *1362*; *1438*.

***Aster umbellatus* Miller**
Powerline right-of-way, ridgetop (2). Mississippian Nancy shale (2). Rowan *1358*; *1364*.

***Aster undulatus* L.**
Gasline right-of-way, drainhead on ridgetop (2). Mississippian Nancy shale (2). Rowan Co, *1384*; *1391*.

***Bidens bipinnata* L.**
Forested, lower to middle S slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Fleming Co., *1330*.

***Bidens connata* Muhl.**
Bottomland oxbow; forested seep area, lower NE slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Fleming Co., *751*; *1511*.

***Bidens frondosa* L.**
Bottomland, wooded creekside; creek floodplain. Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *780*; *1412*.

***Bidens polylepis* S. F. Blake**
Powerline right-of-way, ridgetop; bottomland field near oxbow; bottomland field with wet areas. Mississippian Nancy shale; Quaternary alluvium (2). Fleming Co., *852*; *1275*; Lewis Co. *1476*.

***Cacalia atriplicifolia* L.**
Logged forest, lower NNW slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1144*.

****Carduus nutans* L.**
Bottomland, edge of field and forested creekside. Quaternary alluvium. Fleming Co., *1029*.

****Centarea maculosa* Lam.**
Bottomland, disturbed area. Quaternary alluvium. Lewis Co., *1256*.

****Cichorum intybus* L.**
Low ground of mowed field in bottomland. Quaternary alluvium. Rowan Co., *866*.

***Chrysanthemum leucanthemem* L.**
Roadside, powerline right-of-way. Quaternary alluvium. Fleming Co., *527.*

***Chrysopsis mariana* (L.) Elliott**
Around field pond, ridgetop; gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale (2). Rowan Co., *804*; *1392.*

***Cirsium altissimum* (L.) Spreng.**
Forested lower E facing drain. Mississippian Nancy shale. Fleming Co., *1335.*

***Cirsium vulgare* (Savi) Tenore**
Powerline right-of-way, ridgetop. Mississippian Nancy shale. Fleming Co., *735.*

***Conyza canadensis* (L.) Cron.**
Bottomland, along roadway through wet meadow. Quaternary alluvium. Rowan Co., *708.*

***Coreopsis auriculata* L.**
Gasline right-of-way, ridgetop; forested E-W drain. Mississippian Nancy shale; Mississippian Farmers sandstone. Rowan Co., *1088*; *1467.*

***Coreopsis major* Walter**
Rock outcropping, open canopy. Mississippian Farmers sandstone. Fleming Co., *535.*

***Echinacea purpurea* (L.) Moench**
Bottomland, open, escaped cultivation. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1176.*

***Eclipta prostrata* (L.) L.**
Bottomland, wooded creekside; powerline right-of-way, low area in drainhead on ridgetop. Quaternary alluvium; Mississippian Nancy shale. Fleming Co., *778*; Rowan Co., *1431.*

***Elephantopus carolinianus* Willd.**
Edge of field and wooded creekside in bottomland. Quaternary alluvium. Lewis Co., *653.*

***Erechtites hieracifolia* (L.) Raf.**
Bottomland, gasline right-of-way. Quaternary alluvium. Rowan Co., *693.*

***Erigeron annuus* (L.) Pers.**
Forested lower E slope. Mississippian Farmers sandstone. Fleming Co., *1342.*

***Erigeron philadelphicus* L.**
Bottomland, riverside woods; forested bottomland. Quaternary alluvium (2). Rowan Co., *345*; *1011*.

***Erigeron strigosus* Muhl.**
Roadside, powerline right-of-way. Quaternary alluvium. Fleming Co., *529*.

***Eupatorium album* L.**
Ridgetop, powerline right-of-way (2). Mississippian Nancy shale (2). Rowan Co., *1356*; *1439*.

***Eupatorium altissimum* L.**
Wooded, lower NW slope. Silurian lower Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale. Fleming Co., *825*; *1262*.

***Eupatorium aromaticum* L.**
Gasline right-of-way, E slope; ridgetop powerline right-of-way, fence line along forest edge. Near contact between Mississippian Sunbury shale and Mississippian Farmers sandstone; Mississippian Nancy shale. Rowan Co., *1377*; *1428*.

***Eupatorium coelestinum* L.**
Bottomland wet meadow. Quaternary alluvium. Rowan Co., *701*.

***Eupatorium fistulosum* Barratt**
Wooded creekside. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *839*.

***Eupatorium purpureum* L.**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1194*.

***Eupatorium rotundifolium* L.**
Wooded, NW slope along old roadbed; old pond in ridgetop field; ridgetop, powerline right-of-way. Near contact between Devonian Ohio Shale and Mississippian Sunbury shale; Mississippian Nancy shale (2). Fleming Co., *618*; Rowan Co., *805*; *1367*.

***Eupatorium rugosum* Houttuyn**
Wooded, lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *824*.

***Eupatorium serotinum* Michx.**
Ridgetop, powerline right-of-way; wooded creekside. Mississippian Nancy shale; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *740*; *842*.

***Eupatorium sessilifolium* L.**
Forested ridgetop. Mississippian Cowbell sandstone. Fleming Co., *1332.*

***Euthamia graminifolia* (L.) Nutt.**
Bottomland gasline right-of-way. Quaternary alluvium. Rowan Co., *685.*

****Galinsoga parviflora* Cav.**
Disturbed area in bottomland. Quaternary alluvium. Lewis Co., *1474.*

***Gnaphalium obtusifolium* L.**
Ridgetop, powerline right-of-way. Mississippian Nancy shale. Fleming Co., *736.*

***Gnaphalium purpureum* L.**
Bottomland, gasline right-of-way. Quaternary alluvium. Rowan Co., *497.*

***Helenium autumnale* Raf.**
Wooded creekside. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *837.*

***Helenium flexuosum* Raf.**
Wooded head of drain; bottomland wet meadow. Mississippian Nancy shale; Quaternary alluvium. Fleming Co., *614*; Rowan Co., *702.*

***Helianthus divaricatus* L.**
Ridgetop, powerline right-of-way; wooded ridgetop, head of drain. Mississippian Nancy shale (2). Fleming Co., *609*; *613.*

***Helianthus hirsutus* Raf.**
Powerline right-of-way, middle S slope (2). Silurian upper Crab Orchard clay-shale (2). Fleming Co., *722*; *723.*

***Helianthus microcephalus* T. & G.**
Forested, lower to middle W slope; forested ridgetop. Silurian upper Crab Orchard clay-shale; Mississippian Cowbell sandstone. Fleming Co., *1307*; *1333.*

***Helianthus strumosus* L.**
Gasline right-of-way, drainhead on ridgetop; forested ridgetop, edge of woods (2); creekside. Mississippian Nancy shale (3); Silurian lower Crab Orchard clay-shale. Rowan Co., *1386*; *1399*; *1400*; Fleming Co., *1416.*

***Helianthus tuberosus* L.**
Roadside ditch along fence line. Silurian lower Crab Orchard clay-shale. Fleming Co., *1281.*

***Heliopsis helianthoides* (L.) Sweet**
Powerline right-of-way, pasture; successional old field, lower SE slope; successional old field, lower NW slope; bottomland field; forested creekside. Silurian lower Crab Orchard clay-shale (3); near contact between Quaternary alluvium and Ordovician clay-shale; Devonian Ohio Shale. Fleming Co., *808*; *812*; *832*; *1253*; *1309*.

***Hieracium gronovii* L.**
Powerline right-of-way, middle S slope; field, along drain of lower E slope; gasline right-of-way, drainhead on ridgetop. Silurian upper Crab Orchard clay-shale (2); Mississippian Nancy shale. Fleming Co., *726*; *787*; Rowan Co., *1394*.

***Hieracium scabrum* Michx.**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1489*.

***Hieracium venosum* L.**
Wooded outer slope of ridgetop; gasline right-of-way, ridgetop. Mississippian Farmer sandstone; Mississippian Nancy shale. Rowan Co., *452*; *1081*.

***Iva annua* L.**
Bottomland, wet open field; forest, thin, lower NE slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Lewis Co., *1479*; Fleming Co., *1514*.

***Krigia biflora* (Walter) Blake**
Forested broad ridgetop, E slope. Mississippian Nancy shale. Rowan Co., *1072*.

***Kuhnia eupatorioides* L.**
Successional old field, lower SE slope; forested roadside, lower SE slope; forested old field, lower E slope. Fleming Co., *816*; *1418*; *1426*.

***Lactuca biennis* (Moench) Fern.**
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1292*.

***Lactuca canadensis* L.**
Powerline right-of-way, ridgetop; bottomland gasline right-of-way. Mississippian Nancy shale; Quaternary alluvium. Fleming Co., *611*; Rowan Co., *684*.

***Lactuca floridana* (L.) Gaertn.**
Wooded lower NW slope; powerline right-of-way, lower W slope; creek floodplain; forested roadside. Silurian upper Crab Orchard clay-shale (2); near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; Devonian Ohio Shale. Lewis Co., *635*; Fleming Co., *1284*; *1407*; Rowan Co., *1473*.

***Lactuca saligna* L.**
Forested ridgetop, edge of woods. Mississippian Nancy shale. Rowan Co., *1401.*

***Liatris spicata* (L.) Willd.**
Wooded, lower NW slope; old field with young cedar, lower SE slope. Silurian lower Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *821*; *1258.*

***Polymnia uvedalia* L.**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1196.*

***Prenanthes altissima* L.**
Forested E-W drain, middle drain; forested E-W drain, lower drain; forested creek floodplain. Mississippian Farmers sandstone; near contact between Devonian Ohio Shale and Mississippian Sunbury shale; near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Rowan Co., *1465*; *1469*; Fleming Co., *1488.*

°*Prenanthes crepidinea* Michx. (T)
Forested creek floodplain; creekside, old house site. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; Devonian Ohio Shale. Fleming Co., *955*; *1187.*

***Prenanthes serpentaria* Pursh**
Forested roadside, lower S slope; powerline right-of-way, lower W slope; gasline right-of-way, drainhead on ridgetop; powerline right-of-way, ridgetop, fence line at forest edge. Silurian upper Crab Orchard clay-shale (2); Mississippian Nancy shale (2). Rowan Co., *1139*; Fleming Co., *1288*; Rowan Co., *1395*; *1430.*

***Pyrrhopappus carolinianus* (Walter) DC.**
Field, creek bottomland; bottomland, field near oxbow. Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *1219*; *1273.*

***Ratibida pinnata* (Vent.) Barnhart**
Old field with scattered wooded areas. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay. Fleming Co., *578.*

***Rudbeckia fulgida* Aiton**
Creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *1409.*

***Rudbeckia fulgida* Aiton**
Forested lower E slope. Mississippian Farmers sandstone. Fleming Co., *1339*.

***Rudbeckia hirta* L.**
Roadside powerline right-of-way. Quaternary alluvium. Fleming Co., *526*.

***Rudbeckia laciniata* L.**
Forested bottomland. Quaternary alluvium. Lewis Co., *650*.

***Rudbeckia triloba* L.**
Old field, regrown with young woods, lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *833*.

***Senecio anonymus* A. Wood**
Powerline right-of-way. Silurian lower Crab Orchard clay-shale. Fleming Co., *589*.

***Senecio aureus* L.**
Forested bottomland; wooded old roadbed, lower NE slope. Quaternary alluvium; Devonian Ohio Shale. Rowan Co., *370*; *374*.

***Senecio glabellus* Poiret**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *426*.

***Senecio obovatus* Muhl.**
Wooded lower E slope; roadside cedar forest, lower SE slope. Devonian Ohio Shale; near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Rowan Co., *380*; Fleming Co., *897*.

***Silphium perfoliatum* L.**
Creekside and edge of grass field. Ordovician clay-shale. Fleming Co., *711*.

***Silphium terebinthinaceum* Jacq.**
Roadside powerline right-of-way. Silurian upper Crab Orchard clay-shale. Fleming Co., *627*.

***Silphium trifoliatum* L.**
Wooded roadside; wooded lower NW slope; cedar glade area; powerline right-of-way, middle S slope; old field, regrown with young woods, lower SE slope. Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale (3); Silurian lower Crab Orchard clay-shale. Fleming Co., *551*; Lewis Co., *637*; Fleming Co., *715*; *724*; *815*.

***Solidago caesia* L.**
Forested lower S slope; forested upper W slope. Devonian Ohio Shale; Mississippian Nancy shale. Fleming Co., *1444*; Rowan Co., *1464*.

***Solidago canadensis* L.**
Powerline right-of-way, pastureland. Silurian lower Crab Orchard clay-shale. Fleming Co., *807*.

***Solidago erecta* Pursh**
Gasline right-of-way, drainhead on ridgetop (2). Mississippian Nancy shale (2). Rowan Co., *1387*; *1393*.

***Solidago flexicaulis* L.**
Forested drain, middle S slope; forested SW-NE drain, lower slope. Mississippian Farmers sandstone; Silurian lower Crab Orchard clay-shale. Rowan Co., *1457*; Fleming Co., *1525*.

***Solidago gigantea* Aiton**
Forested bottomland; bottomland, gasline right-of-way. Quaternary alluvium (2). Rowan Co., *664*; *691*.

***Solidago hispida* Muhl.**
Around old pond in field on ridgetop; forested lower SW slope, cedar glade; open roadside, lower SSW slope. Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *803*; Fleming Co., *1447*; *1498*.

***Solidago juncea* Aiton**
Powerline right-of-way; old field with young cedar, lower SE slope. Silurian lower Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *591*; *1264*.

***Solidago nemoralis* Aiton**
Powerline right-of-way, middle S slope; old field, regrown with young woods, lower SE slope; old field, regrown with young woods, lower NW slope; forested lower SW slope, cedar glade. Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale (2); Silurian upper Crab Orchard clay-shale. Fleming Co., *727*; *818*; *828*; *1446*.

***Solidago rugosa* Miller**
Wooded, lower E slope; bottomland field near oxbow. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Quaternary alluvium. Fleming Co., *799*; *1274*.

***Solidago ulmifolia* Muhl.**
Powerline right-of-way, ridgetop. Mississippian Nancy shale. Rowan Co., *1355.*

****Sonchus oleraceus* L.**
Forested roadside, lower S slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1140.*

****Taraxacum officinale* Weber**
Wooded lower S slope, roadside. Devonian Ohio Shale. Rowan Co., *330.*

****Tussilago farfara* L.**
Bottomland roadside. Quaternary alluvium. Rowan Co., *328.*

***Verbesina alternifolia* (L.) Britton**
Bottomland, woods around edge of oxbow; creek floodplain. Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *767*; *1410.*

***Verbesina occidentalis* (L.) Walt.**
Creek floodplain; roadside, open, lower SSW slope. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Fleming Co., *1411*; *1497.*

***Vernonia gigantea* (Walter) Trel.**
Bottomland meadow. Quaternary alluvium. Rowan Co., *704.*

***°Vernonia noveboracensis* (L.) Michx. (S)**
Bottomland wet meadow. Quaternary alluvium. Rowan Co., *878.*

***Xanthium strumarium* L.**
Bottomland oxbow. Quaternary alluvium. Fleming Co., *750.*

BALSAMINACEAE

***Impatiens capensis* Meerb.**
Open meadow on edge of bottomland swamp forest. Quaternary alluvium. Fleming Co., *1318.*

***Impatiens pallida* Nutt.**
Forested bottomland. Quaternary alluvium. Lewis Co., *647.*

BERBERIDACEAE

***Berberis thunbergii* DC.**
Forested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1423*.

***Caulophyllum thalictroides* (L.) Michx.**
Wooded middle E slope; forested hollow, N facing, creek floodplain. Devonian Ohio Shale (2). Fleming Co., *556*; *887*.

***Jeffersonia diphylla* (L.) Pers.**
Forested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *905*.

***Podophyllum peltatum* L.**
Wooded lower SSE slope. Devonian Ohio Shale. Rowan Co., *355*.

BETULACEAE

***Alnus serrulata* (Aiton) Willd.**
Low ditch in bottomland field. Quaternary alluvium. Rowan Co., *306*.

***Betula lenta* L.**
Forested E-W drain, lower part of drain. Near contact between Devonian Ohio Shale and Mississippian Sunbury shale. Rowan Co., *1470*.

***Betula nigra* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *514*.

***Carpinus caroliniana* Walter**
Forested bottomland, along small drainage ditch. Quaternary alluvium. Lewis Co., *409*.

***Corylus americana* Walter**
Creek floodplain. Silurian upper Crab Orchard clay-shale. Fleming Co., *925*.

***Ostrya virginiana* (Miller) K. Koch**
Forested ridgetop; forested lower to middle W slope. Mississippian Farmers sandstone; Silurian upper Crab Orchard clay-shale. Fleming Co., *1240*; *1298*.

BIGNONIACEAE

***Bignonia capreolata* L.**
Bottomland, roadside. Quaternary alluvium. Rowan Co., *1007.*

***Campsis radicans* (L.) Seemann**
Fence line in bottomland. Quaternary alluvium. Rowan Co., *494.*

****Catalpa speciosa* Warder**
Field, lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *782.*

BORAGINACEAE

***Cynoglossum virginianum* L.**
Wooded, lower E slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *436.*

****Myosotis arvensis* (L.) Hill**
Forested dry ridgetop, thin canopy. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *448.*

***Myosotis scorpioides* L.**
Roadside bottomland. Quaternary alluvium. Rowan Co., *327.*

***Myosotis verna* Nutt.**
Forested creek floodplain; powerline right-of-way through field in bottomland. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *958*; *1054.*

BRASSICACEAE

****Arabidopsis thaliana* (L.) Heynh.**
Roadway through bottomland field; bottomland field. Quaternary alluvium. Rowan Co., *309*; *324.*

***Arabis laevigata* (Muhl.) Poir.**
Forested outer slope of ridgetop. Mississippian Farmers sandstone. Rowan Co., *451.*

****Barbarea vulgaris* R. Br.**
Forested bottomland. Quaternary alluvium. Rowan Co., *372.*

****Capsella bursa-pastoris* (L.) Medicus**
Gravel parking lot. Devonian Ohio Shale. Fleming Co., *333.*

***Cardamine angustata* O. E. Shulz**
Forested hollow, N facing, lower NW slope. Devonian Ohio Shale. Fleming Co., *892*.

***Cardamine arenicola* Britton**
Wooded upper SSW slope. Mississippian Farmers sandstone. Rowan Co., *315*.

***Cardamine concatenata* (Michx.) O. S.**
Bottomland, forested riparian area. Quaternary alluvium. Rowan Co., *320*.

***Cardamine douglassii* (Torrey) Brit.**
Bottomland, forested riparian area. Quaternary alluvium. Rowan Co., *307*.

***Cardamine heterophylla* Nutt.**
Forested middle to lower SW slope. Devonian Ohio Shale. Fleming Co., *339*.

***Cardamine hirsuta* L.**
Bottomland, roadway through field; roadside cedar forest, lower SE slope. Quaternary alluvium; near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Rowan Co., *308*; Fleming Co., *898*.

***Cardamine pensylvanica* Muhl.**
Forested creek bottom. Quaternary alluvium. Rowan Co., *1015*.

***Cardamine rhomboidea* (Pers.) DC.**
Bottomland forest, recently selectively logged; bottomland forest. Quaternary alluvium (2). Lewis Co., *433*; *854*.

***Draba verna* L.**
Gravel parking lot. Devonian Ohio Shale. Fleming Co., *332*.

***Lepidium campestre* (L.) R. Br.**
Roadside, lower slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1002*.

***Lepidium densiflorum* Schrad.**
Pasture, lower E slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1112*.

***Rorippa palustris* (L.) Besser**
Oxbow, open mowed area. Quaternary alluvium. Fleming Co., *1030*.

***Sibara virginica* (L.) Rollins**
Cultivated field in bottomland. Quaternary alluvium. Rowan Co., *853*.

CAESALPINIACEAE

***Cercis canadensis* L.**
Forested middle to lower SW slope. Devonian Ohio Shale. Fleming Co., *341.*

***Chamaecrista fasciculata* (Michx.) Greene**
Bottomland, gasline right-of-way. Quaternary alluvium. Rowan Co., *683.*

***Chamaecrista nictitans* (L.) Moench**
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1282.*

***Gymnocladus dioca* (L.) K. Koch**
Forested ridgetop. Near contact between Devonian Ohio Shale and Mississippian Farmers sandstone. Fleming Co., *1243.*

CALLITRICHACEAE

***Callitriche palustris* L.**
Forested bottomland, growing on mud in small drainage ditch. Quaternary alluvium. Lewis Co., *411.*

CAMPANULACEAE

***Campanula americana* L.**
Roadside powerline right-of-way; forested lower NW slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Fleming Co., *525*; Lewis Co., *634.*

***Lobelia cardinalis* L.**
Forested bottomland, natural drainage ditch. Quaternary alluvium. Lewis Co., *644.*

***Lobelia inflata* L.**
Bottomland, cleared with scattered trees. Quaternary alluvium. Lewis Co., *641.*

***Lobelia puberula* Michx.**
Powerline right-of-way, ridgetop; forested lower E slope; powerline right-of-way, ridgetop; gasline right-of-way, E slope. Mississippian Nancy shale; Mississippian Farmers sandstone; Mississippian Nancy shale; near contact between Devonian Ohio Shale and Mississippian Sunbury shale. Fleming Co., *741*; *1341*; Rowan Co., *1369*; *1378.*

***Lobelia siphilitica* L.**
Forested bottomland along creek. Quaternary alluvium. Fleming Co., *775.*

***Lobelia spicata* Lam.**
Rock outcropping, open canopy; gasline right-of-way. Mississippian Farmers sandstone; Mississippian Nancy shale. Fleming Co., *537*; Rowan Co., *1089*.

***Triodanis perfoliata* (L.) Nieuwl.**
Mowed field, lower slopes of drain. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *481*.

CANNABACEAE

***Humulus lupulus* L.**
Reforested old field, lower W slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *912*.

CAPRIFOLIACEAE

****Lonicera japonica* Thunb.**
Roadside, lower slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1003*.

****Lonicera maackii* (Rupr.) Maxim.**
Roadside, lower SW slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Lewis Co., *857*.

***Sambucus canadensis* L.**
Bottomland, edge of woods and field. Quaternary alluvium. Rowan Co., *495*.

***Symphoricarpos orbiculatus* Moench.**
Forested roadside. Silurian upper Crab Orchard clay-shale. Fleming Co., *631*.

***Triosteum angustifolium* L.**
Forested old field, lower W slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *909*.

***Viburnum acerifolium* L.**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *554*.

***Viburnum dentatum* L.**
Forested upper S slopes. Near contact between Farmers sandstone and Mississippian Nancy shale. Rowan Co., *383*.

***Viburnum prunifolium* L.**
Open woods, bottomland; powerline right-of-way; bottomland, oxbow. Quaternary alluvium; Silurian lower Crab Orchard clay-shale; Quaternary alluvium. Lewis Co., *412*; Fleming Co., *593*; *759*.

CARYOPHYLLACEAE

****Arenaria serpyllifolia* L.**
Field, rock outcrop, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *952*.

***Cerastium nutans* Raf.**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *959*.

****Cerastium pumilum* Curtis**
Mowed field along drain. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *477*.

****Cerastium semidecandrum* L.**
Forested seep area, lower NE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1121*.

***Cerastium vulgatum* L.**
Seep area in field, lower SE slope; bottomland pasture. Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *949*; Rowan Co., *999*.

****Dianthus armeria* L.**
Pasture, lower E slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1111*.

***Paronychia canadensis* (L.) A. Wood**
Forested upper E slope. Devonian Ohio Shale. Fleming Co., *1214*.

****Saponaria officinalis* L.**
Gravel road bank. Ordovician clay-shale. Fleming Co., *710*.

***Silene caroliniana* Walter**
Forested lower SSW slopes. Devonian Ohio Shale. Rowan Co., *389*.

***Silene stellata* (L.) Aiton f.**
Forested seep area, lower E slope; forested upper E slope. Devonian Ohio Shale (2). Fleming Co., *1192*; *1218*.

***Silene virginica* L.**
Forested upper E slope. Mississippian Farmers sandstone. Rowan Co., *382*.

***Stellaria media* (L.) Cyrillo**
Forested lower S slope, roadside. Devonian Ohio Shale. Rowan Co., *329*.

****Stellaria pubera* Michx.**
Forested middle to lower SW slope; forested lower E slope, partially cleared; forested lower SE slope. Devonian Ohio Shale (3). Fleming Co., *338*; Rowan Co., *962*; *979*.

CELASTRACEAE

***Celastrus scandens* L.**
Forested roadside; forested bottomland. Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *628*; Rowan Co., *876*.

***Euonymus americanus* L.**
Forested upper SSE slope. Mississippian Sunbury Shale. Rowan Co., *1529*.

***Euonymus atropurpureus* Jacq.**
Pastureland, with scattered woods, lower S slope; seep area in field, lower SE slope; forested bottomland, creekside. Silurian lower Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *849*; *950*; *1018*.

CHENOPODIACEAE

***Chenopodium album* L.**
Cultivated field in bottomland. Quaternary alluvium. Fleming Co., *763*.

CLUSIACEAE

***Hypericum mutilum* L.**
Forested bottomland, creekside. Quaternary alluvium. Fleming Co., *772*.

***Hypericum prolificum* L.**
Forested lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1225*.

***Hypericum punctatum* Lam.**
Gasline right-of-way through bottomland; forested creekside; old field with young trees; powerline right-of-way, lower W slope. Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *500*; Fleming Co., *843*; *1248*; *1283*.

***Hypericum stragulum* P. Adams & Robson**
Powerline right-of-way, middle S slope; gasline right-of-way, ridgetop. Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Fleming Co., *731*; Rowan Co., *1163*.

***Triadenum tubulosum* (Walter) Gleason**
Forested oxbow and seep. Quaternary alluvium. Fleming Co., *1507*.

CONVOLVULACEAE

***Calystegia sepium* (L.) R. Br.**
Bottomland, edge of oxbow and field. Quaternary alluvium. Fleming Co., *1268*.

***Calystegia spithamaea* (L.) Pursh**
Forested roadside, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1057*.

***Ipomoea hederacea* Jacq.**
Cultivated field in bottomland. Quaternary alluvium. Rowan Co., *681*.

***Ipomoea lacunosa* L.**
Cultivated field in bottomland. Quaternary alluvium. Rowan Co., *680*.

***Ipomoea pandurata* (L.) G. Meyer**
Old field with young trees; gasline right-of-way, E slope; forested creek floodplain. Silurian lower Crab Orchard clay-shale; near contact between Devonian Ohio Shale and Mississippian Sunbury Shale; near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1247*; Rowan Co., *1381*; Fleming Co., *1490*.

CORNACEAE

***Cornus amomum* Mill.**
Forested bottomland (2); forested oxbow and seep; forested lower E slope; forested oxbow and seep. Quaternary alluvium (3); Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Rowan Co., *665*; *679*; Fleming Co., *1043*; *1226*; *1277*.

***Cornus florida* L.**
Bottomland riverside woods. Quaternary alluvium. Rowan Co., *347*.

CRASSULACEAE

***Sedum ternatum* Michx.**
Riparian zone of forested bottomland; forested lower E slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Lewis Co., *405*; Fleming Co., *793*.

CUSCUTACEAE

***Cuscuta gronovii* Willd.**
Forested creekside-roadside. Devonian Ohio Shale. Fleming Co., *1316*.

DIPSACACEAE

****Dipsacus sylvestris* Hudson**
Roadside drain. Ordovician clay-shale. Fleming Co., *1250*.

EBENACEAE

***Diospyros virginiana* L.**
Powerline right-of-way, middle S slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *730*.

ELAEAGNACEAE

****Elaeagnus umbellata* Thunb.**
Wet meadow in bottomland. Quaternary alluvium. Rowan Co., *706*.

ERICACEAE

***Gaultheria procumbens* L.**
Forested lower to middle SW slope. Devonian Ohio Shale. Rowan Co., *1456*.

***Gaylussacia baccata* (Wangenh.) K. Koch**
Forested, dry ridgetop; forested middle W slope. Mississippian Farmers sandstone; Devonian Ohio Shale. Fleming Co., *564*; Rowan Co., *884*.

***Kalmia latifolia* L.**
Forested middle W slope. Devonian Ohio Shale. Rowan Co., *885*.

***Oxydendrum arboreum* (L.) DC.**
Forested E-W ridgeline. Mississippian Nancy shale. Fleming Co., *623*.

Vaccinium corymbosum **L.**
Forested middle W slope. Devonian Ohio Shale. Rowan Co., *886.*

Vaccinium pallidum **Aiton**
Forested, dry ridgetop; forested upper SW slope. Mississippian Farmers sandstone; Mississippian Nancy shale. Fleming Co., *565*; Rowan Co., *883.*

Vaccinium stamineum **L.**
Forested lower W slope; forested lower to middle W slope. Silurian upper Crab Orchard clay-shale (2). Fleming Co., *953*; *1300.*

EUPHORIACEAE

Acalypha rhomboidea **Raf.**
Bottomland oxbow; forested bottomland, creekside; forested creekside. Quaternary alluvium (2); near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *752*; *779*; *838.*

Acalypha virginica **L.**
Forested upper E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1216; 1453.*

Euphorbia commutata **Engelm.**
Forested creekside and lower SSW slope; forested drain, lower SW slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale. Fleming Co., *939*; *1453.*

Euphorbia corollata **L.**
Old field with scattered wooded areas; forested lower E drain. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Fleming Co., *583*; *1334.*

Euphorbia nutans **Lagasca**
Cultivated field in bottomland. Quaternary alluvium. Fleming Co., *766.*

Phyllanthus caroliniensis **Walter**
Open meadow on edge of bottomland swamp forest. Quaternary alluvium. Fleming Co., *1317.*

FABACEAE

Amphicarpaea bracteata **(L.) Fern.**
Forested bottomland. Quaternary alluvium. Rowan Co., *670.*

***Apios americana* Medicus**
Bottomland oxbow; forested creekside. Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *754*; *847*.

****Coronilla varia* L.**
Roadside, lower slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1001*.

***Desmodium canescens* (L.) DC.**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *1406*.

***Desmodium glabellum* (Michx.) DC.**
Forested middle W slope (2); powerline right-of-way on ridgetop (2). Base of Devonian Ohio Shale; Quaternary alluvium; Mississippian Nancy shale (2). Fleming Co., *1303*; *1322*; Rowan Co., *1354*; *1366*.

***Desmodium glutinosum* (Muhl.) A. Wood**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *1210*.

***Desmodium nudiflorum* (L.) DC.**
Forested lower to middle W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1301*.

***Desmodium paniculatum* (L.) DC.**
Gasline right-of-way through bottomland; forested lower to middle W slope; open meadow on edge of bottomland swamp forest; gasline right-of-way, drainhead on ridgetop. Quaternary alluvium; Silurian upper Crab Orchard clay-shale; Quaternary alluvium; Mississippian Nancy shale. Rowan Co., *688*; Fleming Co., *1302*; *1320*; Rowan Co., *1385*.

***Desmodium rigidum* (Elliott) DC.**
Gasline right-of-way, drainhead on ridgetop (2). Mississippian Nancy shale (2). Rowan Co., *1389*; *1390*.

***Desmodium rotundifolium* DC.**
Forested upper E slope. Devonian Ohio Shale. Fleming Co., *1215*.

***Desmodium viridiflorum* (L.) DC.**
Gasline right-of-way, ridgetop; powerline right-of-way on ridgetop, forest edge-fence line. Mississippian Nancy shale (2). Rowan Co., *1165*; *1429*.

***Gleditsia triacanthos* L.**
Forested roadside. Silurian upper Crab Orchard clay-shale. Fleming Co., *633*.

****Lespedeza cuneata* (Dumont) G. Don**
Wet meadow in bottomland. Quaternary alluvium. Rowan Co., *700*.

***Lespedeza hirta* (L.) Hornem.**
Ridgetop field. Mississippian Nancy shale. Rowan Co., *1349*.

***Lespedeza intermedia* (S. Watson) Britton**
Powerline right-of-way, middle S slope; forested upper SW slope; powerline right-of-way, lower W slope; ridgetop field. Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Fleming Co., *729*; Rowan Co., *881*; Fleming Co., *1290*; Rowan Co., *1350*.

***Lespedeza procumbens* Michx.**
Powerline right-of-way, middle S slope; old field, regrown with young woods, lower SE slope; reforested old field, lower E slope. Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale (2). Fleming Co., *732*; *819*; *1425*.

***Lespedeza repens* (L.) Barton**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1357*.

****Lespedeza striata* (Thunb.) Hook & Arnott**
Edge of cultivated field in bottomland; open meadow on edge of bottomland swamp forest. Quaternary alluvium (2). Rowan Co., *682*; Fleming Co.,*1321*.

****Lotus corniculatus* L.**
Field, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1224*.

****Melilotus alba* Medicus**
Powerline right-of-way along roadside. Quaternary alluvium. Fleming Co., *530*.

****Melilotus officinalis* (L.) Lam.**
Roadside, lower slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1068*.

***Orbexilum pedunculatum* (Mill.) Rydb.**
Gasline right-of-way; old field with young cedar, lower SE slope. Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *1082*; Fleming Co., *1263*.

***Robinia pseudo-acacia* L.**
Forested roadside, lower SW slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *862.*

***Senna marilandica* (L.) Link**
Above creek on forested lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1417.*

***Strophostyles leiosperma* (T. & G.) Piper**
Ridgetop field. Mississippian Nancy shale. Rowan Co., *1352.*

****Trifolium campestre* Schreber**
Bottomland, wet open field; roadside bottomland; roadside, lower slope; bottomland field (2). Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale; Quaternary alluvium; Silurian upper Crab Orchard clay-shale (3). Lewis Co., *396*; Rowan Co., *1006*; *1067*; Fleming Co., *1220*; *1221.*

****Trifolium hybridum* L.**
Powerline right-of-way through bottomland field. Quaternary alluvium. Fleming Co., *1053.*

****Trifolium pratense* L.**
Roadside bottomland. Quaternary alluvium. Rowan Co., *1005.*

****Trifolium repens* L.**
Powerline right-of-way through bottomland field. Quaternary alluvium. Fleming Co., *1052.*

***Vicia caroliniana* Walter**
Forested roadside, dry lower SW slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Lewis Co., *858.*

****Vicia sativa* L.**
Edge of bottomland field. Devonian Ohio Shale. Rowan Co., *915.*

***Vicia villosa* Roth**
Bottomland field. Silurian upper Crab Orchard clay-shale. Fleming Co., *1222.*

FAGACEAE

***°Castanea dentata* (Marshall) Borkh. (E)**
Forested E-W ridgeline. Mississippian Nancy shale. Fleming Co., *624.*

***Fagus grandifolia* Ehrh.**
Bottomland swamp forest. Quaternary alluvium. Fleming Co., *541.*

***Quercus bicolor* Willd.**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *431.*

***Quercus coccinea* Muenchh.**
Forested dry ridgetop. Mississippian Farmers sandstone. Fleming Co., *567.*

***Quercus falcata* Michx.**
Forested roadside, lower SW slope; forested broad ridgetop, E slope. Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Rowan Co., *865*; *1070.*

***Quercus imbricaria* Michx.**
Forested lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *823.*

***Quercus macrocarpa* Michx.**
Old field, regrown with young woods, lower SE slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *820.*

***Quercus marilandica* Muench.**
Forested upper SW slope. Mississippian Nancy shale. Rowan Co., *879.*

***Quercus muehlenbergii* Engelm.**
Old fields with scattered wooded areas. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *584.*

***Quercus palustris* Muenchh.**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *420.*

***Quercus prinus* L.**
Forested dry ridgetop. Mississippian Farmers sandstone. Fleming Co., *566.*

***Quercus rubra* L.**
Forested lower NNE slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Fleming Co., *1129.*

***Quercus shumardii* Buckley**
Forested lower NW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *822.*

***Quercus stellata* Wangenh.**
Old fields with scattered wooded areas; along road through bottomland. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; near contact between Quaternary alluvium and Devonian Ohio Shale. Fleming Co., *581*; Rowan Co., *1443*.

***Quercus velutina* Lam.**
Forested dry ridgetop. Mississippian Farmers sandstone. Fleming Co., *568*.

FUMARIACEAE

***Corydalis flavula* (Raf.) DC.**
Bottomland riverside woods; roadside bottomland; forested upper SW slope; forested lower NE slopes. Quaternary alluvium (2); Devonian Ohio Shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *310*; *317*; Fleming Co., *336*; Rowan Co., *491*.

GENTIANACEAE

***Frasera caroliniensis* Walter**
Forested roadside, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1065*.

***Gentiana saponaria* L.**
Lake edge, E slope; forested oxbow and seep. Silurian lower Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *1420*; *1506*.

***Sabatia angularis* (L.) Pursh**
Bottomland field. Quaternary alluvium. Lewis Co., *1254*.

GERANIACEAE

***Geranium carolinianum* L.**
Mowed field, lower slopes of drain; powerline right-of-way, bottomland. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *479*; *969*.

***Geranium maculatum* L.**
Forested lower SSE slope. Devonian Ohio Shale. Rowan Co., *354*.

GROSSULARIACEAE

***Ribes missouriense* Nutt.**
Reforested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *904.*

HAMAMELIDACEAE

***Hamamelis virginiana* L.**
Forested dry ridgetop. Mississippian Farmers sandstone. Fleming Co., *570.*

***Liquidambar styraciflua* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *504.*

HIPPOCASTANACEAE

***Aesculus flava* Aiton**
Forested lower SSE slope; riparian zone of forested bottomland; forested bottomland, creekside and edge of field. Devonian Ohio Shale; Quaternary alluvium (2.). Rowan Co., *353*; Lewis Co., *406*; Rowan Co., *660.*

***Aesculus glabra* Willd.**
Forested creekside and lower SSW slope. Near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Fleming Co., *936.*

HYDROPHYLLACEAE

***Hydrophyllum canadense* L.**
Forested lower SE slope. Devonian Ohio Shale. Rowan Co., *977.*

***Hydrophyllum macrophyllum* Nutt.**
Forested lower NE slopes. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *488.*

***Phacelia purshii* Buckley**
Forested bottomland; reforested old field, lower W slope. Quaternary alluvium; Silurian lower Crab Orchard clay-shale. Rowan Co., *368*; Fleming Co., *910.*

JUGLANDACEAE

***Carya cordiformis* (Wangenh.) K. Koch**
Logged forest, lower NNW slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1143.*

***Carya glabra* (Miller) Sweet**
Forested upper NNE slope; thin forest, lower NE slope. Mississippian Sunbury Shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *454*; Fleming Co., *1513*.

***Carya laciniosa* (Michx. f.) Loudon**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *422*.

***Carya ovata* (Miller) K. Koch**
Roadway through field; bottomland oxbow. Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *574*; *760*.

***Carya tomentosa* (Poiret) Nutt.**
Forested roadside, lower W slope; forested lower to middle W slope. Silurian upper Crab Orchard clay-shale (2). Fleming Co., *1064*; *1299*.

°*Juglans cinerea* L. (S)
Forested creekside and lower SSW slope. Near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Fleming Co., *937*.

***Juglans nigra* L.**
Forested creekside. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *836*.

LAMIACEAE

***Collinsonia canadensis* L.**
Forested middle slope flats, S facing; gasline right-of-way, E slope; forested roadside. Mississippian Farmers sandstone; near contact between Devonian Ohio Shale and Mississippian Sunbury Shale; near contact between Quaternary alluvium and Devonian Ohio Shale. Fleming Co., *743*; Rowan Co., *1380*; Lewis Co., *1482*.

***Cunila origanoides* (L.) Britton**
Forested upper SW slope; roadside, lower SSW slope. Mississippian Nancy shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *882*; Fleming Co., *1499*.

****Glechoma hederacea* L.**
Forested bottomland; reforested old field, lower E slope. Quaternary alluvium; Silurian lower Crab Orchard clay-shale. Rowan Co., *369*; Fleming Co., *907*.

***Hedeoma pulegioides* (L.) Pers.**
Forested lower E slope; powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale (2). Fleming Co., *1228*; *1289*.

****Lamium purpurem* L.**
Roadside bottomland. Quaternary alluvium. Rowan Co., *316*.

***Lycopus americanus* Muhl.**
Gasline right-of-way through bottomland; forested creekside. Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Rowan Co., *687*; Fleming Co., *845*.

***Lycopus virginicus* L.**
Forested middle slope flats, S facing; forested creekside. Mississippian Farmers sandstone; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *744*; *844*.

****Mentha* X *piperita* L.**
Along drain running through field, lower E slope; forested spring-seep area, lower E slope. Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale. Fleming Co., *786*; *1184*.

***Monarda fistulosa* L.**
Old fields with scattered wooded areas; forested roadside, lower W slope; forested lower E slope; old field with young trees. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale; Silurian lower Crab Orchard clay-shale. Fleming Co., *577*; *1061*; *1179*; *1246*.

****Prunella vulgaris* L.**
Along drain running through field, lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *785*.

***Pycnanthemum loomisii* Nutt.**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1368*.

***Pycnanthemum pycnanthemoides* (Leavenw.) Fern.**
Powerline right-of-way, middle S slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *728*.

***Pycnanthemum tenuifolium* Schrader**
Gasline right-of-way through bottomland; old field, regrown with young woods, lower SE slope; old field with young cedar, lower SE slope; ridgetop field. Quaternary alluvium; Silurian lower Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Rowan Co., *510*; Fleming Co., *826*; *1260*; Rowan Co., *1351*.

***Salvia lyrata* L.**
Forested creekside and lower SSW slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *943*.

***Scutellaria elliptica* Muhl.**
Forested dry ridgetop, thin canopy; bottomland, cleared with scattered trees; powerline right-of-way on ridgetop; forested lower to middle S slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Quaternary alluvium; Mississippian Nancy shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *446*; Lewis Co., *639*; Fleming Co., *1329*; Rowan Co., *1096*.

***Scutellaria incana* Biehler**
Old fields with scattered wooded areas; forested creekside; forested creekside-roadside; open meadow on edge of bottomland swamp forest; forested creek floodplain. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; Devonian Ohio Shale; Quaternary alluvium; near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *585*; *846*; *1308*; *1326*; *1484*.

***Scutellaria integrifolia* L.**
Forested roadside, lower S slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1138*.

***Scutellaria lateriflora* L.**
Natural drainage ditch in forested bottomland; forested bottomland, creekside; forested oxbow and seep. Quaternary alluvium (3). Lewis Co., *645*; Fleming Co., *776*; *1504*.

***Scutellaria nervosa* Pursh**
Forested lower SE slope; thin forest, lower NE slope. Devonian Ohio Shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *980*; Fleming Co., *1124*.

***Scutellaria ovata* Hill**
Forested middle to lower NNE slope; forested ridgetop. Devonian Ohio Shale; Mississippian Farmers sandstone. Fleming Co., *1197*; *1239*.

***Scutellaria parvula* Michx.**
Old field with scattered wooded area. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *580*.

°***Scutellaria saxatilis* Riddell (T)**
Forested lower to middle NNE slope; gap of ridgeline, mid elevation; forested lower SE slope; forested middle N slope; along creek of forested lower W slope; forested middle W slope; forested middle E slope. Devonian Ohio Shale (3); near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Devonian Ohio Shale; base of Devonian Ohio Shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *467*; Fleming Co., *571*; *1128*; *1134*; *1206*; *1304*; *1531*.

***Stachys cordata* Riddell**
Wet area on forested lower E slope; forested drain, lower SW slope. Devonian Ohio Shale; Silurian lower Crab Orchard clay-shale. Fleming Co., *1178*; *1452*.

***Teucrium canadense* L.**
Forested bottomland; forested creekside (2). Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale; Quaternary alluvium. Lewis Co., *648*; Fleming Co., *841*; Lewis Co., *1255*.

***Trichostema dichotomum* L.**
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1295*.

LAURACEAE

***Lindera benzoin* (L.) Blume**
Bottomland riverside woods. Quaternary alluvium. Rowan Co., *321*.

***Sassafras albidum* (Nutt.) Nees**
Forested dry ridgetop; forested roadside, lower SW slope. Mississippian Farmers sandstone; Silurian upper Crab Orchard clay-shale. Fleming Co., *569*; Rowan Co., *864*.

LENTIBULARIACEAE

***Utricularia gibba* L.**
Pond. Mississippian Nancy shale. Rowan Co., *1345.*

LINACEAE

***Linum medium* (Planchon) Britton**
Old field with young cedar, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1261.*

***Linum striatum* Walt.**
Powerline right-of-way, head of drain on ridge-top. Mississippian Nancy shale. Fleming Co., *594.*

LYTHRACEAE

***Cuphea viscosissima* Jacq.**
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1294.*

***Lythrum alatum* Pursh**
Oxbow and seep, edge of forested area. Quaternary alluvium. Fleming Co., *1279.*

MAGNOLIACEAE

***Liriodendron tulipifera* L.**
Forested lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *794.*

***Magnolia tripetala* (L.) L.**
Forested lower N slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1518.*

MALVACEAE

***Hibiscus moscheutos* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *875.*

***Malva neglecta* Wallr.**
Roadway through pasture, lower E slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1114.*

Sida spinosa* **L.
Bottomland, cleared with scattered trees; edge of cultivated field in bottomland (2); cultivated field in bottomland. Quaternary alluvium (4). Lewis Co., *640*; Rowan Co., *698*; *699*; Fleming Co., *765*.

MELASTOMACEAE

***Rhexia mariana* L.**
Bottomland, edge of woods and pasture; gasline right-of-way, drainhead on ridgetop. Quaternary alluvium; Mississippian Nancy shale. Rowan Co., *662*; *1383*.

***Rhexia virginica* L.**
Bottomland, cleared with scattered trees. Quaternary alluvium. Lewis Co., *638*.

MENISPERMACEAE

***Menispermum canadense* L.**
Bottomland, edge of old opening in woods near creek; forested bottomland, creekside. Quaternary alluvium (2). Lewis Co., *399*; Fleming Co., *1019*.

MOLLUGINACEAE

Mollugo verticillata* **L.
Forested lower E slope. Mississippian Farmers sandstone. Fleming Co., *1343*.

MORACEAE

Maclura pomifera* **(Raf.) C. K. Schneider
Forested creekside and lower SSW slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1231*.

***Morus rubra* L.**
Old field, regrown with young woods, lower SE slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *810*.

NYSSACEAE

Nyssa sylvatica **Marshall**
Forested bottomland; bottomland, edge of oxbow and wet field. Quaternary alluvium (2). Rowan Co., *503*; Fleming Co., *1056*.

OLEACEAE

***Chionanthus virginicus* L.**
Powerline right-of-way on ridgetop, edge of woods. Mississippian Farmers sandstone. Rowan Co., *1095.*

***Fraxinus americana* L.**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *421.*

***Fraxinus pennsylvanica* Marshall**
Riparian zone of forested bottomland; bottomland oxbow. Quaternary alluvium (2). Lewis Co., *401*; Fleming Co., *761.*

***Fraxinus quadrangulata* Michx.**
Young forest, lower N slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *922.*

****Ligustrum vulgare* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *673.*

ONAGRACEAE

***Circaea lutetiana* L.**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *560.*

***Gaura biennis* L.**
Powerline right-of-way, pasture; reforested old field, lower E slope. Silurian lower Crab Orchard clay-shale (2). Fleming Co., *806*; *1424.*

***Ludwigia palustris* (L.) Elliot**
Wet area in cultivated field in bottomland. Quaternary alluvium. Fleming Co., *1328.*

***Oenothera biennis* L.**
Bottomland, low ground of mowed field. Quaternary alluvium. Rowan Co., *867.*

***Oenothera fruticosa* L.**
Forested roadside, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1058.*

***Oenothera tetragona* Roth**
Forested roadside. Mississippian Nancy shale. Fleming Co., *553.*

OROBANCHACEAE

***Conopholis americana* (L.) Wallr.**
Forested steep slope just above creek in head of hollow. Devonian Ohio Shale. Fleming Co., *931*.

***Epifagus virginiana* (L.) Barton**
Forested lower E slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Fleming Co., *798*.

***Orobanche uniflora* L.**
Forested lower SSE slope. Devonian Ohio Shale. Rowan Co., *357*.

OXALIDACEAE

***Oxalis dillenii* Jacq.**
Powerline right-of-way through bottomland field. Quaternary alluvium. Fleming Co., *1055*.

***Oxalis grandis* Small**
Powerline right-of-way, bottomland. Quaternary alluvium. Rowan Co., *964*.

***Oxalis stricta* L.**
Forested upper NE slope, edge of soybean field; cultivated field in bottomland. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Quaternary alluvium. Rowan Co., *443*; Fleming Co., *762*.

***Oxalis violacea* L.**
Forested upper SSE slope. Mississippian Farmers sandstone. Rowan Co., *365*.

PAPAVERACEAE

***Sanguinaria canadensis* L.**
Bottomland riverside woods. Quaternary alluvium. Rowan Co., *322*.

***Stylophorum diphyllum* (Michx.) Nutt.**
Forested N facing hollow, lower NW slope. Devonian Ohio Shale. Fleming Co., *889*.

PASSIFLORACEAE

***Passiflora lutea* L.**
Powerline right-of-way, NW slope. Mississippian Nancy shale. Fleming Co., *600*.

PHYTOLACCACEAE

***Phytolacca americana* L.**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Fleming Co., *612*.

PLANTAGINACEAE

***Plantago aristata* Michx.**
Roadway through field; along drain running through field, lower E slope. Silurian upper Crab Orchard clay-shale (2). Fleming Co., *573*; *788*.

****Plantago lanceolata* L.**
Forested upper NE slope, edge of soybean field. Near contact between Farmers sandstone and Mississippian Nancy shale. Rowan Co., *439*.

***Plantago rugelii* Decne.**
Old house site along creek. Devonian Ohio Shale. Fleming Co., *1188*.

***Plantago virginica* L.**
Mowed field, lower slopes of drain. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *478*.

PLATANACEAE

***Platanus occidentalis* L.**
Bottomland, along stream. Quaternary alluvium. Rowan Co., *373*.

POLEMONIACEAE

***Phlox divaricata* L.**
Bottomland riverside woods. Quaternary alluvium. Rowan Co., *350*.

***Phlox glaberrima* L.**
Forested head of drain. Mississippian Nancy shale. Fleming Co., *615*.

***Phlox maculata* L.**
Rock outcropping, open canopy; forested drain along roadbed; gasline right-of-way, drainhead on ridgetop. Mississippian Farmers sandstone; Devonian Ohio Shale; Mississippian Nancy shale. Fleming Co., *536*; *617*; Rowan Co., *1396*.

***Phlox paniculata* L.**
Forested bottomland; forested creekside-roadside. Quaternary alluvium; Devonian Ohio Shale. Lewis Co., *649*; Fleming Co., *1312*.

***Phlox pilosa* L.**
Forested roadside, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1063*.

***Polemonium reptans* L.**
Forested lower SSE slope. Devonian Ohio Shale. Rowan Co., *356*.

POLYGALACEAE

***Polygala sanguinea* L.**
Bottomland swamp forest; powerline right-of-way, head of drain on ridgetop. Quaternary alluvium. Mississippian Nancy shale. Fleming Co., *545*; *604*.

***Polygala verticillata* L.**
Along drain running through field, lower E slope; forested lower E slope. Silurian upper Crab Orchard clay-shale (2). Fleming Co., *783*; *1227*.

POLYGONACEAE

***Polygonum arifolium* L.**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *994*.

***Polygonum cespitosum* Blume**
Forested bottomland, creekside. Quaternary alluvium. Fleming Co., *781*

***Polygonum convolvulus* L.**
Forested ridgetop; forested creekside-roadside. Mississippian Farmers sandstone; Devonian Ohio Shale. Fleming Co., *1241*; *1313*.

***Polygonum cuspidatum* Sieb. & Zucc.**
Forested roadside. Silurian upper Crab Orchard clay-shale. Rowan Co., *1494*.

***Polygonum hydropiperoides* Michx.**
Bottomland oxbow; bottomland, wet area at edge of oxbow and field; forested oxbow and seep. Quaternary alluvium (3). Fleming Co., *753*; *1270*; *1503*.

***Polygonum pensylvanicum* L.**
Edge of cultivated field in bottomland; low ground of mowed field, bottomland (2). Quaternary alluvium (3). Rowan Co., *697*; *868*; *869*.

***Polygonum persicaria* L.**
Cultivated field. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1265*.

***Polygonum sagittatum* L.**
Forested bottomland; forested streamside. Quaternary alluvium; near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Rowan Co., *506*; Fleming Co., *720*.

***Polygonum scandens* L.**
Forested roadside, lower SW slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *861*.

***Polygonum virginianum* L.**
Forested bottomland; young forest, lower N slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Rowan Co., *672*; Fleming Co., *923*.

****Rumex acetosella* L.**
Edge of cultivated field in bottomland. Quaternary alluvium. Rowan Co., *496*.

****Rumex crispus* L.**
Bottomland oxbow, open mowed area. Quaternary alluvium. Fleming Co., *1035*.

PORTULACACEAE

***Claytonia virginica* L.**
Forested drain (2). Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *311*; *351*.

PRIMULACEAE

***Lysimachia ciliata* L.**
Forested oxbow and seep (2). Quaternary alluvium (2). Fleming Co., *1278*; *1509*.

***Lysimachia lanceolata* Walter**
Forested bottomland; along bottom of upper end of drain bottom. Quaternary alluvium; near contact between Mississippian Sunbury Shale and Mississippian Farmers sandstone. Rowan Co., *520*; *659*.

****Lysimachia nummularia* L.**
Forested bottomland; bottomland oxbow, open mowed area. Quaternary alluvium (2). Rowan Co., *674*; Fleming Co., *1033*.

***Lysimachia quadrifolia* L.**
Gasline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1087*.

***Samolus floribundus* HBK**
Forested bottomland, creekside. Quaternary alluvium. Fleming Co., *773*.

RANUNCULACEAE

***Actaea alba* (L.) Miller**
Forested middle NW slope. Devonian Ohio Shale. Rowan Co., *392*.

***Anemone virginiana* L.**
Edge of woods along roadside; forested creekside and lower SSW slope. Devonian Ohio Shale; near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *534*; *1233*.

***Anemonella thalictroides* L.**
Forested drain. Devonian Ohio Shale. Rowan Co., *312*.

***Aquilegia canadensis* L.**
Forested creekside and lower SSW slope. Near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Fleming Co., *938*.

***Cimicifuga racemosa* Nutt.**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *555*.

***Clematis viorna* L.**
Along old roadbed on forested NW slope; open bottomland. Near contact between Devonian Ohio Shale and Mississippian Sunbury Shale; near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *621*; *1174*.

***Clematis virginiana* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *671*.

***Delphinium tricorne* Michx.**
Bottomland riverside woods. Quaternary alluvium. Rowan Co., *349*.

***Hepatica americana* (DC.) Ker**
Forested E-W drain, lower drain. Near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Rowan Co., *1472*.

***Hydrastis canadensis* L.**
Forested middle E slope; forested N facing hollow, lower NW slope. Devonian Ohio Shale (2). Fleming Co., *558*; *894*.

***Ranunculus abortivus* L.**
Bottomland riverside woods; forested lower E slope, partially cleared. Quaternary alluvium; Devonian Ohio Shale. Rowan Co., *348*; *963*.

***Ranunculus hispidus* Michx.**
Bottomland forest, recently selectively logged; lake edge, E slope; forested lower NNE slope. Quaternary alluvium; Silurian lower Crab Orchard clay-shale; Devonian Ohio Shale. Lewis Co., *429*; Fleming Co., *902*; Rowan Co., *1152*.

***Ranunculus recurvatus* Poir.**
Along old roadbed on forested lower NE slope; along old roadbed on forested lower E slope. Devonian Ohio Shale (2). Rowan Co., *375*; *377*.

***Thalictrum dioicum* L.**
Along creek floodplain of forested N facing hollow. Devonian Ohio Shale. Fleming Co., *888*.

***Thalictrum revolutum* DC.**
Forested bottomland, creekside. Silurian upper Crab Orchard clay-shale. Fleming Co., *1177*.

RHAMNACEAE

***Ceanothus americanus* L.**
Forested roadside, lower W slope; gasline right-of-way. Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Fleming Co., *1059*; Rowan Co., *1090*.

***Rhamnus caroliniana* Walter**
Forested streamside; old field, regrown with young woods, lower SE slope; old field with young trees. Silurian lower Crab Orchard clay-shale (3). Fleming Co., *719*; *817*; *1245*.

***Rhamnus lanceolata* Pursh**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *957*.

ROSACEAE

***Agrimonia parviflora* Aiton**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *1413*.

***Agrimonia rostellata* Wallr.**
Forested middle W slope. Base of Devonian Ohio Shale. Fleming Co., *1305.*

***Amelanchier arborea* (Michx.) Fern.**
Forested, dry middle W slope. Devonian Ohio Shale. Rowan Co., *331.*

***Aronia melanocarpa* (Michx.) Elliot**
Gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale. Rowan Co., *1173.*

***Aruncus dioicus* (Walter) Fern.**
Forested lower E drain. Mississippian Nancy shale. Fleming Co., *1336.*

***Crataegus crus-galli* L.**
Field above oxbow and seep, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1092.*

***Crataegus pruinosa* (Wendl.) K. Koch**
Forested lower S slope; field above oxbow and seep, lower SE slope. Silurian upper Crab Orchard clay-shale (2). Fleming Co., *945*; *1093.*

***Crataegus phaenopyrum* (L. f.) Medicus**
Forested upper SW slope. Mississippian Nancy shale. Rowan Co., *880.*

***Geum canadense* Jacq.**
Forested bottomland, creekside and edge of field; forested creekside and lower SSW slope. Quaternary alluvium; near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Lewis Co., *655*; Fleming Co., *1232.*

***Geum vernum* (Raf.) T. & G.**
Along old roadbed on forested lower E slope. Devonian Ohio Shale. Rowan Co., *376.*

***Porteranthus stipulatus* (Muhl.) Britton**
Forested dry ridgetop; along old roadbed on forested NW slope. Mississippian Farmers sandstone; near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Fleming Co., *563*; *622.*

***Potentilla canadensis* L.**
Forested ridgetop. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *364.*

***Potentilla simplex* Michx.**
Logged forest, upper E slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *917*.

***Prunus americana* Marshall**
Old field with scattered wooded areas; forested streamside; forested creek floodplain. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *582*; *716*; *956*.

***Prunus serotina* Ehrh.**
Forested bottomland, creekside. Quaternary alluvium. Fleming Co., *1021*.

***Rosa carolina* L.**
Forested interstate right-of-way. Mississippian Nancy shale. Rowan Co., *1080*.

****Rosa multiflora* Thunb.**
Forested bottomland. Quaternary alluvium. Rowan Co., *975*.

***Rosa palustris* Marshall**
Forested streamside; forested oxbow and seep; forested seep area, lower NE slope; forested spring-seep area, lower E slope. Silurian lower Crab Orchard clay-shale; Quaternary alluvium; Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale. Fleming Co., *718*; *1042*; *1115*; *1186*.

***Rubus hispidus* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *519*.

***Rubus occidentalis* L.**
Open bottomland. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1175*.

***Rubus pensilvanicus* Poir.**
Edge of bottomland field. Quaternary alluvium. Rowan Co., *971*.

***Spiraea tomentosa* L.**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *686*.

RUBIACEAE

***Cephalanthus occidentalis* L.**
Natural drainage ditch in forested bottomland. Quaternary alluvium. Lewis Co., *646*.

***Diodia teres* Walter**
Bottomland field near oxbow. Quaternary alluvium. Fleming Co., *1272.*

***Diodia virginiana* L.**
Bottomland, edge of woods and pasture. Quaternary alluvium. Rowan Co., *661.*

***Galium aparine* L.**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *432.*

***Galium circaezans* Michx.**
Forested lower NE slopes. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *490.*

***Galium concinnum* T. & G.**
Forested lower E slope; along creek of forested lower W slope. Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale. Fleming Co., *792*; *1208.*

***Galium lanceolatum* Torr.**
Forested lower NNE slope. Devonian Ohio Shale. Rowan Co., *1147.*

***Galium obtusum* Bigelow**
Forested bottomland; bottomland swamp forest; forested lower NNE slope. Quaternary alluvium (2); Devonian Ohio Shale. Rowan Co., *507*; *984*; *1146.*

****Galium pedemontanum* All.**
Forested upper NE slope, edge of soybean field; seep area in field, lower SE slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *444*; Fleming Co., *951.*

***Galium triflorum* Michx.**
Forested spring-seep area, lower E slope. Devonian Ohio Shale. Fleming Co., *1183.*

***Hedyotis caerulea* (L.) Hook.**
Forested ridgetop. Mississippian Nancy shale. Rowan Co., *366.*

***Hedyotis canadensis* (Willd.) Fosb.**
Forested upper SSE slope. Mississippian Sunbury Shale. Rowan Co., *359.*

***Hedyotis purpurea* (L.) T. & G.**
Forested lower to middle NNE slope. Devonian Ohio Shale. Rowan Co., *462.*

***Mitchella repens* L.**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *982.*

RUTACEAE

***Zanthoxylum americanum* Mill.**
Forested roadside; forested creekside. Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale. Fleming Co., *629*; *960*.

SALICACEAE

****Populus alba* L.**
Roadside bottomland. Quaternary alluvium. Lewis Co., *1257*.

***Populus grandidentata* Michx.**
Forested E-W ridgeline. Mississippian Nancy shale. Fleming Co., *625*.

***Salix nigra* Marshall**
Bottomland oxbow. Quaternary alluvium. Fleming Co., *758*.

***Salix sericea* Marshall**
Wet meadow in bottomland; creekside. Quaternary alluvium; Silurian lower Crab Orchard clay-shale. Rowan Co., *703*; Fleming Co., *900*.

SAURURACEAE

***Saururus cernuus* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *523*.

SAXIFRAGACEAE

***Heuchera americana* L.**
Forested ridgetop. Near contact between Devonian Ohio Shale and Mississippian Farmers sandstone. Fleming Co., *1242*.

***Hydrangea arborescens* L.**
Forested roadside. Mississippian Nancy shale. Fleming Co., *552*.

***Penthorum sedoides* L.**
Natural drainage ditch in forested bottomland. Quaternary alluvium. Lewis Co., *642*.

***Tiarella cordifolia* L.**
Forested steep slope just above creek in head of hollow. Devonian Ohio Shale. Fleming Co., *927*.

SCROPHULARIACEAE

***Agalinus fasciculata* (Elliot) Raf.**
Area around pond; gasline right-of-way, drainhead on ridgetop; powerline right-of-way on ridgetop, drainhead low area. Mississippian Nancy shale (3).
Rowan Co., *1347*; *1398*; *1434*.

***Agalinus purpurea* (L.) Pennell**
Wet area in bottomland field. Quaternary alluvium. Lewis Co., *1475*.

***Agalinus tenuifolia* (M. Vahl) Raf.**
Forested roadside, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1405*.

***Aureolaria laevigata* (Raf.) Raf.**
Forested lower E slope; forested lower E slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Mississippian Farmers sandstone. Fleming Co., *797*; *1340*.

***Chelone glabra* L.**
Forested oxbow and seep. Quaternary alluvium. Fleming Co., *1508*.

***Gratiola neglecta* Torr.**
Forested bottomland, along small drainage ditch; bottomland oxbow, open mowed area; forested seep area, lower NE slope. Quaternary alluvium (2); Silurian upper Crab Orchard clay-shale. Lewis Co., *413*; Fleming Co., *1039*; *1116*.

***Gratiola virginiana* L.**
Growing in mud in small drainage ditch running through forested bottom. Quaternary alluvium. Lewis Co., *410*.

°*Gratiola viscidula* Pennell (S)
Gasline right-of-way. Quaternary alluvium. Rowan Co., *1546*.

***Leucospora multifida* (Michx.) Nutt.**
Powerline right-of-way, seep area, lower W slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1296*.

***Lindernia dubia* (L.) Pennell**
Powerline right-of-way, head of drain on ridgetop; forested bottomland, creekside. Mississippian Nancy shale; Quaternary alluvium. Fleming Co., *595*; *774*.

***Mimulus alatus* Aiton**
Natural drainage ditch in forested bottomland. Quaternary alluvium. Lewis Co., *643*.

***Mimulus ringens* L.**
Forested middle slope flats, S facing. Mississippian Farmers sandstone. Fleming Co., *742*.

***Pedicularis canadensis* L.**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1097*.

***Penstemon canescens* (Britton) Britton**
Powerline right-of-way. Silurian lower Crab Orchard clay-shale. Fleming Co., *590*.

***Penstemon digitalis* Nutt.**
Roadside, wet area; powerline right-of-way; forested roadside, lower W slope. Quaternary alluvium; Silurian lower Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *493*; Fleming Co., *588*; *1062*.

***Scrophularia marilandica* L.**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1193*.

***Verbascum thapsus* L.**
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1285*.

***Veronica arvensis* L.**
Mowed field, lower slopes of drain; reforested old field, lower W slope; powerline right-of-way, bottomland. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Silurian lower Crab Orchard clay-shale; Quaternary alluvium. Rowan Co., *475*; Fleming Co., *913*; Rowan Co., *970*.

***Veronica officinalis* L.**
Forested upper NE slope, edge of soybean field; along old roadbed on forested NW slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Rowan Co., *438*; Fleming Co., *620*.

***Veronica peregrina* L.**
Bottomland oxbow, open mowed area. Quaternary alluvium. Fleming Co., *1040*.

SOLANACEAE

***Datura stramonium* L.**
Low ground of mowed field, bottomland. Quaternary alluvium. Rowan Co., *872.*

***Physalis pubescens* L.**
Reforested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1422.*

***Solanum americanum* Mill.**
Cultivated field in bottomland. Quaternary alluvium. Fleming Co., *764.*

***Solanum carolinense* L.**
Pasture, lower E slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1113.*

***Solanum nigrum* L.**
Old house site along creek. Devonian Ohio Shale. Fleming Co., *1202.*

STAPHYLEACEAE

***Staphylea trifolia* L.**
Lake edge, E slope. Near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Fleming Co., *908.*

TILIACEAE

***Tilia americana* L.**
Forested middle NE slope. Devonian Ohio Shale. Fleming Co., *932.*

ULMACEAE

***Celtis occidentalis* L.**
Forested roadside. Silurian upper Crab Orchard clay-shale. Fleming Co., *630.*

***Ulmus americana* L.**
Roadside bottomland. Quaternary alluvium. Rowan Co., *318.*

***Ulmus rubra* Muhl.**
Bottomland oxbow. Quaternary alluvium. Fleming Co., *757.*

URTICACEAE

***Boehmeria cylindrica* (L.) Sw.**
Bottomland swamp forest. Quaternary alluvium. Fleming Co., *544*.

***Laportea canadensis* (L.) Wedd.**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *561*.

***Parietaria pensylvanica* Muhl.**
Forested ridgetop. Mississippian Farmers sandstone. Fleming Co., *1237*.

***Pilea pumila* (L.) Gray**
Bottomland oxbow. Quaternary alluvium. Fleming Co., *769*.

VALERIANACEAE

***Valerianella radiata* (L.) Dufr.**
Forested upper NE slope, edge of soybean field. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *445*.

***Phryma leptostachya* L.**
Along creek of forested lower W slope; forested ridgetop. Devonian Ohio Shale; Mississippian Farmers sandstone. Fleming Co., *1207*; *1236*.

***Phyla lanceolata* (Michx.) Greene**
Forested bottomland, creekside and edge of field. Quaternary alluvium. Lewis Co., *652*.

***Verbena hastata* L.**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *499*.

***Verbena urticifolia* L.**
Old fields with scattered wooded areas; forested bottomland, creekside. Silurian lower Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *579*; *771*.

VIOLACEAE

***Hybanthus concolor* (T. Forster) Spreng.**
Forested creekside and lower SSW slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *942*.

Viola blanda **Willd.**
Forested drain; young forest, lower N slope. Devonian Ohio Shale; Silurian upper Crab Orchard clay-shale. Rowan Co., *916*; Fleming Co., *924*.

Viola canadensis **L.**
Forested N facing hollow, lower NW slope. Devonian Ohio Shale. Fleming Co., *893*.

Viola cucullata **Aiton**
Forested bottomland. Quaternary alluvium. Lewis Co., *855*.

Viola palmata **L.**
Forested middle to lower SW slope; forested upper NNE slope. Devonian Ohio Shale; Mississippian Sunbury Shale. Fleming Co., *337*; Rowan Co. *460*.

Viola primulifolia **L.**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *989*.

Viola pubescens **Aiton**
Forested upper N slope. Devonian Ohio Shale. Fleming Co., *334*.

Viola rafinesquii **Greene**
Bottomland, field edge and riverside woods. Quaternary alluvium. Rowan Co., *325*.

Viola rostrata **Pursh**
Forested middle NE slope. Devonian Ohio Shale. Fleming Co., *935*.

Viola sagittata **Aiton**
Thin forest, lower NE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1123*.

Viola sororia **Willd.**
Forested creekside and lower SSW slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *941*.

Viola striata **Aiton**
Roadside cedar forest, lower SE slope. Near contact between Ordovician clay-shale and Silurian lower Crab Orchard clay-shale. Fleming Co., *896*.

VITACEAE

Parthenocissus quinquefolia **(L.) Planch.**
Forested lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *795*.

Vitis aestivalis **Michx.**
Forested middle slope flats, S facing; forested roadside, lower SW slope. Mississippian Farmers sandstone; Silurian upper Crab Orchard clay-shale. Fleming Co., *747*; Rowan Co., *860*.

Vitis vulpina **L.**
Forested bottomland (2); forested streamside; old field, regrown with young woods, lower SE slope; oxbow and seep; forested lower E slope; powerline right-of-way on ridgetop, forest edge-fence line. Quaternary alluvium (2); Silurian lower Crab Orchard clay-shale (2); Quaternary alluvium; Mississippian Farmers sandstone; Mississippian Nancy shale. Rowan Co., *675*; *678*; Fleming Co., *717*; *811*; *1094*; *1338*; Rowan Co., *1427*.

LILIOPSIDA; MONOCOTYLEDONS

AGAVACEAE

Agave virginica **L.**
Cedar glade area with shallow soils. Silurian upper Crab Orchard clay-shale. Fleming Co., *714*.

ALISMATACEAE

Sagittaria australis **(J. G. Smith) Small**
Lake edge, E slope; forested creek floodplain. Silurian lower Crab Orchard clay-shale; near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1421*; *1486*.

Sagittaria calycina **Engelm.**
Pond, lower SW slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Lewis Co., *1481*.

Sagittaria latifolia **Willd.**
Shallow ditch in forested bottomland. Quaternary alluvium. Rowan Co., *663*.

ARACEAE

Acorus calamus **L.**
Open roadside ditch. Mississippian Nancy shale. Fleming Co., *550*.

***Arisaema dracontium* (L.) Schott**
Reforested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *906.*

***Arisaema triphyllum* (L.) Schott**
Forested N facing hollow, lower NW slope. Devonian Ohio Shale. Fleming Co., *891.*

COMMELINACEAE

****Commelina communis* L.**
Forested creekside-roadside. Devonian Ohio Shale. Fleming Co., *1310.*

***Commelina virginica* L.**
Forested bottomland (2). Quaternary alluvium (2). Rowan Co., *667*; *1495.*

CYPERACEAE

***Carex albolutescens* Schwein.**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *987.*

***Carex albursina* Sheldon**
Forested middle E slope. Devonian Ohio Shale. Fleming Co., *1209.*

***Carex amphibola* Steudel**
Powerline right-of-way, bottomland (2); forested bottomland, creekside; seep area below pond. Quaternary alluvium (3); Mississippian Nancy shale. Rowan Co., *965*; *968*; Fleming Co., *1017*; Rowan Co., *1074.*

***Carex annectens* (E. P. Bicknell) E. P. B.**
Gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale. Rowan Co., *1168.*

***Carex blanda* Dewey**
Bottomland forest, recently selectively logged; forested bottomland. Quaternary alluvium. Lewis Co., *435*; Rowan Co., *1012.*

***Carex brevior* (Dewey) Mackenzie**
Forested upper NE slope, edge of soybean field. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *441.*

***Carex caroliniana* Schwein.**
Bottomland forest, recently selectively logged; forested bottomland. Quaternary alluvium (2). Lewis Co., *415*; Rowan Co., *974*.

***Carex cephalophora* Muhl.**
Forested upper NE slope, edge of soybean field; forested lower NNE slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *442*; Fleming Co., *1131*.

***Carex complanata* Torr. & Hook.**
Forested upper NNE slope; rock outcropping, open canopy; seep area below pond; powerline right-of-way on ridgetop, low drain area; gasline right-of-way, drainhead on ridgetop. Mississippian Sunbury Shale; Mississippian Farmers sandstone; Mississippian Nancy shale (3). Rowan Co., *457*; Fleming Co., *539*; Rowan Co., *1077*; *1108*; *1170*.

***Carex conjuncta* F. Boott**
Edge of field and forested creekside in bottomland (2). Quaternary alluvium (2). Fleming Co., *1022*; *1023*.

***Carex crinita* Lam.**
Bottomland forest, recently selectively logged; forested bottomland. Quaternary alluvium (2). Lewis Co., *427*; Rowan Co., *874*.

***Carex cristatella* Britton**
Forested creekside. Near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Fleming Co., *840*.

***Carex cumberlandensis* Naczi, Kral, and Bryson**
Forested lower to middle NNE slope. Devonian Ohio Shale. Rowan Co., *473*.

***Carex debilis* Michx.**
Forested bottomland (2); powerline right-of-way on ridgetop, low drain area. Quaternary alluvium (2); Mississippian Nancy shale. Rowan Co., *515*; *521*; *1107*.

***Carex digitalis* Willd.**
Open woods, upper N slope; forested lower to middle NNE slope; powerline right-of-way, bottomland. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *387*; *468*; *966*.

***Carex festucacea* Willd.**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *414*.

***Carex flaccosperma* Dewey**
Forested upper NNE slope; forested seep area, lower NE slope; gasline right-of-way, ridgetop. Mississippian Sunbury Shale; Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale. Rowan Co., *456*; Fleming Co., *1118*; Rowan Co., *1161*.

***Carex frankii* Kunth**
Forested roadside, lower S slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1142*.

***Carex gracilescens* Steudel**
Forested upper NW slope; bottomland forest, recently selectively logged; forested creek floodplain. Mississippian Nancy shale; Quaternary alluvium; near contact between Quaternary alluvium and Silurian lower Crab Orchard clay-shale. Rowan Co., *390*; Lewis Co., *417*; Fleming Co., *961*.

***Carex granularis* Muhl.**
Bottomland forest, recently selectively logged. Quaternary alluvium. Lewis Co., *424*.

***Carex grayi* Carey**
Forested bottomland; bottomland, creekside. Quaternary alluvium (2). Rowan Co., *676*; *1014*.

***Carex hirtifola* Mackenzie**
Forested lower NNE slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Fleming Co., *1133*.

***Carex hitchcockiana* Dewey**
Forested lower NNE slope; forested seep area, lower E slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Devonian Ohio Shale. Fleming Co., *1130*; *1190*.

***Carex intumescens* Rudge**
Forested bottomland. Quaternary alluvium. Rowan Co., *851*.

***Carex jamesii* Schwein**
Forested lower to middle NNE slope; forested bottomland. Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *472*; *973*.

Carex laxiculmis Schwein.
Forested lower NNE slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Fleming Co., *1156.*

***Carex laxiflora* Lam.**
Bottomland riverside woods; forested upper SSE slope; forested lower E slope; forested lower to middle NNE slope; mowed field, lower slope of drain; logged forest, upper E slope. Quaternary alluvium; Mississippian Sunbury Shale; Devonian Ohio Shale (2); near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *346*; *360*; *379*; *464*; *480*; *918.*

***Carex louisianica* L. Bailey**
Bottomland swamp forest; forested oxbow and seep. Quaternary alluvium (2). Rowan Co., *985*; Fleming Co., *1044.*

***Carex lupulina* Muhl.**
Forested bottomland; bottomland oxbow, open mowed area. Quaternary alluvium (2). Rowan Co., *677*; Fleming Co., *1038.*

***Carex lurida* Wahlenb.**
Bottomland forest, recently selectively logged; seep area below pond. Lewis Co., *423*; Rowan Co., *1075.*

***Carex muehlenbergii* Willd.**
Forested dry ridgetop, thin canopy. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *449.*

***Carex nigromarginata* Schwein**
Logged forest, upper E slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co. *921.*

***Carex normalis* Mackenzie**
Gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale. Rowan Co., *1171.*

***Carex pensylvanica* Lam.**
Forested ridgetop; forested lower E slopes; logged forest, upper E slope. Mississippian Sunbury Shale; Devonian Ohio Shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *371*; *381*; *920.*

***Carex platyphylla* Carey**
Forested lower to middle NNE slope. Devonian Ohio Shale. Rowan Co., *474.*

***Carex prasina* Wahlenb.**
Forested seep area, lower NE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1155.*

***Carex purpurifera* Mackenzie**
Forested lower NNE slope. Devonian Ohio Shale. Rowan Co., *1151.*

***Carex rosea* Schk.**
Forested middle NW slope; bottomland forest, recently selectively logged; forested upper NE slope, edge of soybean field; forested lower NE slopes; forested bottomland; forested creek floodplain; forested lower SE slope; forested middle E slope. Devonian Ohio Shale; Quaternary alluvium; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Quaternary alluvium; Silurian upper Crab Orchard clay-shale; Devonian Ohio Shale (2). Rowan Co., *395*; Lewis Co., *419*; Rowan Co., *440*; *492*; *516*; Fleming Co., *926*; Rowan Co., *981*; Fleming Co., *1211.*

***Carex scoparia* Schk.**
Gasline right-of-way through bottomland (2). Quaternary alluvium (2). Rowan Co., *993*; *1135.*

°***Carex seorsa* Howe (S)**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *997.*

***Carex squarrosa* L.**
Forested bottomland; bottomland swamp forest. Quaternary alluvium (2). Rowan Co., *524*; Fleming Co., *548.*

***Carex stipata* Muhl.**
Bottomland forest, recently selectively logged; powerline right-of-way, bottomland. Quaternary alluvium (2). Lewis Co., *434*; Rowan Co., *967.*

***Carex stipata* var. *maxima* Chapman**
Forested oxbow and seep. Quaternary alluvium. Fleming Co., *1045.*

°***Carex straminea* Willd. (T)**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *988.*

***Carex striatula* Michx.**
Forested upper E slope. Devonian Ohio Shale. Fleming Co., *1212.*

***Carex swanii* (Fern.) Mackenzie**
Forested upper NNE slope; mowed field, lower slopes of drain; gasline right-of-way through bottomland. Mississippian Sunbury Shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *459*; *487*; *509.*

***Carex torta* Boott**
Forested creekside. Devonian Ohio Shale. Rowan Co., *914.*

***Carex tribuloides* Wahlenb.**
Mowed field, lower slopes of drain; forested bottomland; bottomland oxbow; bottomland oxbow, open mowed area. Near contact between Silurian upper Crab Orchard shale and Devonian Ohio Shale; Quaternary alluvium (3). Rowan Co., *486*; *517*; Fleming Co., *770*; *1032.*

***Carex typhina* Michx.**
Bottomland forest, recently selectively logged (2); forested bottomland; bottomland swamp forest. Quaternary alluvium (4). Lewis Co., *416*; *428*; Rowan Co., *522*; Fleming Co., *549.*

***Carex umbellata* Schk.**
Forested upper SSW slope. Quaternary alluvium. Rowan Co., *326.*

***Carex virescens* Muhl.**
Forested upper NNE slope; powerline right-of-way on ridgetop; forested lower NNE slope. Mississippian Sunbury Shale; Mississippian Nancy shale; near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *458*; Fleming Co., *608*; *1132.*

***Carex vulpinoidea* Michx.**
Gasline right-of-way through bottomland; bottomland, edge of oxbow and wet field; forested seep area, lower NE slope. Quaternary alluvium (2); Silurian upper Crab Orchard clay-shale. Rowan Co., *991*; Fleming Co., *1051*; *1119.*

***Carex willdenovii* Schk.**
Forested ridgetop; forested lower to middle NNE slope; logged forest, upper E slope; forested lower NNE slope. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Devonian Ohio Shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; near contact

between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *363*; *463*; *919*; Fleming Co., *1157*.

***Cyperus flavescens* L.**
Pond, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1402*.

***Cyperus odoratus* L.**
Powerline right-of-way on ridgetop, drainhead low area. Mississippian Nancy shale. Rowan Co., *1432*.

***Cyperus strigosus* L.**
Along roadside, low area of bottomland. Quaternary alluvium. Fleming Co., *1280*.

***Eleocharis obtusa* (Willd.) Schultes**
Along drain running through field, lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *784*.

***Eleocharis ovata* (Roth) Roemer & Schultes**
Powerline right-of-way, ridgetop; area around pond; pond, lower NE slope. Mississippian Nancy shale (2); near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *610*; Rowan Co., *1346*; Fleming Co., *1517*.

***Eleocharis tenuis* (Willd.) Schultes**
Forested bottomland. Quaternary alluvium. Rowan Co., *513*.

***Fimbristylis autumnalis* (L.) Roemer & Schultes**
Open meadow on edge of bottomland swamp forest. Quaternary alluvium. Fleming Co., *1323*.

***Rhynchospora capitellata* (Michx.) Vahl**
Powerline right-of-way, ridgetop (3); powerline right-of-way, ridgetop, wet soil (2). Mississippian Nancy shale (4). Fleming Co., *606*; *739*; Rowan Co., *1361*; *1442*.

***Scirpus atrovirens* Willd.**
Old fields with scattered wooded areas; forested seep area, lower NE slope; forested lower E drain; gasline right-of-way, drainhead on ridgetop. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale; Mississippian Nancy shale (2). Fleming Co., *586*; *1117*; *1337*; Rowan Co., *1397*.

***Scirpus cyperinus* (L.) Kunth**
Bottomland meadow; lake edge, E slope; powerline right-of-way on ridgetop, drainhead low area; pond, ridgetop. Quaternary alluvium; Silurian lower Crab Orchard clay-shale; Mississippian Nancy shale (2). Rowan Co., *877*; Fleming Co., *1419*; Rowan Co., *1433*; *1459*.

***Scirpus pendulus* Muhl.**
Old fields with scattered wooded areas; forested seep area, lower NE slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *576*; *1120*.

***Scirpus polyphyllus* Vahl**
Forested bottomland; forested seep area, lower NE slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Rowan Co., *518*; Fleming Co., *1510*.

***Scirpus tabernaemontanii* K. C. Gmel.**
Pond, lower NE slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1515*.

***Scleria oligantha* Michx.**
Powerline right-of-way on ridgetop, low drain area. Mississippian Nancy shale. Rowan Co., *1109*.

***Scleria triglomerata* Michx.**
Powerline right-of-way; gasline right-of-way on ridgetop. Silurian lower Crab Orchard clay-shale; Mississippian Nancy shale. Fleming Co., *592*; Rowan Co., *1091*.

DIOSCOREACEAE

***Dioscorea villosa* L.**
Forested middle E slope; forested bottomland. Devonian Ohio Shale; Quaternary alluvium. Fleming Co., *562*; Rowan Co., *1013*.

HALORAGACEAE

***Proserpinaca palustris* L.**
Pond, lower S slope. Silurian upper Crab Orchard clay-shale. Rowan Co., *1493*.

IRIDACEAE

****Belamcanda chinensis* (L.) DC.**
Field, lower S slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *850*.

***Iris cristata* Aiton**
Along drain on forested upper S slopes. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *386*.

***Iris virginica* L.**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *998*.

***Sisyrinchium angustifolium* P. Miller**
Forested bottomland, along small drainage ditch; gasline right-of-way through bottomland. Quaternary alluvium (2). Lewis Co., *408*; Rowan Co., *990*.

JUNCACEAE

***Juncus acuminatus* Michx.**
Bottomland oxbow, open mowed area; seep area below pond; gasline right-of-way through bottomland; wet area in cultivated field in bottomland; pond, ridgetop; wet area along roadside, bottom of drain; pond, lower NE slope. Quaternary alluvium; Mississippian Nancy shale; Quaternary alluvium (2); Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale; near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1034*; Rowan Co., *1076*; *1136*; Fleming Co., *1327*; Rowan Co., *1460*; Fleming Co., *1500*; *1516*.

***Juncus brachycarpus* Engelm.**
Gasline right-of-way, drainhead on ridgetop; gasline right-of-way, ridgetop. Mississippian Nancy shale (2). Rowan Co., *1169*; *1376*.

***Juncus effusus* L.**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *511*.

***Juncus marginatus* Rostk.**
Power right of way, head of drain on ridgetop (2); gasline right-of-way, drainhead on ridgetop; forested creek floodplain; forested oxbow and seep. Mississippian Nancy shale (3); near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *596*; *597*; Rowan Co., *1167*; Fleming Co., *1487*; *1505*.

***Juncus tenuis* Willd.**
Gasline right-of-way through bottomland; bottomland, edge of oxbow and wet field; wet area along roadside, bottom of drain. Quaternary alluvium (2); Silurian upper Crab Orchard clay-shale. Rowan Co., *512*; Fleming Co., *1050*; *1501*.

***Luzula multiflora* (Retz.) Lej.**
Forested middle to lower SW slope; forested lower SW slope; forested upper S slopes; riparian zone of forested bottomland. Devonian Ohio Shale; Silurian upper Crab Orchard clay-shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Quaternary alluvium. Fleming Co., *340*; *343*; Rowan Co., *384*; Lewis Co., *402*.

LEMNACEAE

***Lemna* sp.**
Pond. Silurian lower Crab Orchard clay-shale. Fleming Co., *1160*.

LILIACEAE

***Aletris farinosa* L.**
Gasline right-of-way, upper slope of ridgetop. Mississippian Nancy shale. Rowan Co., *1154*.

***Allium canadense* L.**
Forested bottomland. Quaternary alluvium. Rowan Co., *1009*.

***Allium cernuum* Roth**
Old fields with scattered wooded areas; old field with young cedar, lower SE slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale (2). Fleming Co., *587*; *1234*.

****Allium sativum* L.**
Forested creekside and lower SSW slope. Near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Fleming Co., *1234*.

****Allium vineale* L.**
Mowed field, lower slopes of drain. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *476*.

***Camassia scilloides* (Raf.) Cory**
Reforested old field, lower E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *911*.

***Disporum lanuginosum* (Michx.) Nichol**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1201*.

***Erythronium albidum* Nutt.**
Hardwood-cedar forest, lower SE slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *899*.

***Erythronium americanum* Ker**
Bottomland riverside woods; forested creekside and lower SSW slope. Quaternary alluvium; near contact between Silurian lower Crab Orchard clay-shale and Silurian upper Crab Orchard clay-shale. Rowan Co., *323*; Fleming Co., *944*.

****Hosta* sp.**
Forested spring-seep area, lower E slope. Devonian Ohio Shale. Fleming Co., *1181*.

***Hypoxis hirsuta* (L.) Cov.**
Forested upper S slopes. Near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *385*.

***Lilium* sp.**
Forested creek floodplain. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1485*.

***Medeola virginiana* L.**
Forested seep area, lower E slope. Devonian Ohio Shale. Fleming Co., *1189*.

****Ornithogalum umbellatum* L.**
Field, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *948*.

***Polygonatum canaliculatum* (Muhl.) Purs.**
Forested roadside. Silurian upper Crab Orchard clay-shale. Fleming Co., *632*.
***Smilacina racemosa* (L.) Desf.**
Forested middle slope of E facing drain. Devonian Ohio Shale. Rowan Co., *437*.

***Trillium erectum* L.**
Along creek floodplain of forested N facing hollow. Devonian Ohio Shale. Fleming Co., *859*.

***Trillium grandiflorum* (Michx.) Salis.**
Forested lower SSE slope. Devonian Ohio Shale. Rowan Co., *358*.

***Trillium sessile* L.**
Bottomland riverside woods. Quaternary alluvium. Rowan Co., *352*.

Uvularia grandiflora **J.E. Smith**
Forested N facing hollow, lower NW slope. Devonian Ohio Shale. Fleming Co., *890.*

Uvularia perfoliata **L.**
Forested lower E slopes. Devonian Ohio Shale. Rowan Co., *378.*

NYMPHAEACEAE

Nuphar advena **(Aiton) W. T. Aiton**
Pond, lower SW slope; pond, lower S slope. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Silurian upper Crab Orchard clay-shale. Lewis Co., *1480*; Rowan Co., *1492.*

ORCHIDACEAE

Corallorhiza odontorhiza **(Willd.) Nutt.**
Forested lower E slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *796.*

Goodyera pubescens **(Willd.) R. Br.**
Forested upper NE slope. Mississippian Farmers sandstone. Rowan Co., *658.*

Habenaria lacera **(Michx.) Lodd.**
Bottomland swamp forest. Quaternary alluvium. Fleming Co., *540.*

Liparis lilifolia **(L.) Rich.**
Forested drain, lower SW slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *1451.*

Orchis spectabilis **L.**
Old field, regrown with young woods, lower SE slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *827.*

Spiranthes cernua **(L.) Rich.**
Powerline right-of-way on ridgetop, wet soil. Mississippian Nancy shale. Rowan Co., *1441.*

Tipularia discolor **(Pursh) Nutt.**
Forested middle NE slope. Devonian Ohio Shale. Fleming Co., *933.*

POACEAE

Agrostis elliottiana **Schultes**
Bottomland, edge of oxbow and wet field. Quaternary alluvium. Fleming Co., *1049.*

Agrostis gigantea* **Roth
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1291.*

Agrostis hyemalis **(Walter) BSP**
Powerline right-of-way on ridgetop; bottomland, edge of oxbow and wet field; powerline right-of-way, lower W slope. Mississippian Nancy shale; Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Fleming Co., *737*; *1047*; *1287.*

Agrostis perennans **(Walter) Tuckerman**
Forested bottomland, creekside; powerline right-of-way, lower W slope. Quaternary alluvium; Silurian upper Crab Orchard clay-shale. Fleming Co., *777*; *1286.*

Andropogon gerardii **Vitman**
Powerline right-of-way on ridgetop (2). Mississippian Nancy shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Fleming Co., *748*; Rowan Co., *1373.*

Andropogon ternarius **Michx.**
Forested-cedar glade area, lower SW slope; powerline right-or-way, ridgetop (2). Silurian upper Crab Orchard clay-shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale; Mississippian Nancy shale. Fleming Co., *1450*; *1522*; Rowan Co., *1530.*

Andropogon virginicus **L.**
Powerline right-of-way on ridgetop; ridgetop field; powerline right-of-way. Mississippian Nancy shale (2); near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Rowan Co., *1437*; *1462*; Fleming Co., *1521.*

Anthoxanthum odoratum* **L.
Bottomland, wet open field. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Lewis Co., *397.*

Aristida oligantha **Michx.**
Cedar glade area with shallow soils. Silurian upper Crab Orchard clay-shale. Fleming Co., *713.*

Brachyelytrum erectum **(Schreber) P. Beauv.**
Forested creek floodplain. Silurian upper Crab Orchard clay-shale. Fleming Co., *1205.*

Bromus commutatus* **Schrader
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1104.*

***Bromus pubescens* Muhl.**
Forested middle E slope; bottomland oxbow, open mowed area; old house site along creek; forested creekside-roadside. Devonian Ohio Shale; Quaternary alluvium; Devonian Ohio Shale (2). Fleming Co., *559*; *1031*; *1203*; *1311*.

****Bromus racemosus* L.**
Roadside, lower slope; edge of field and forested creekside in bottomland. Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Rowan Co., *1004*; Fleming Co., *1026*.

***Chasmanthium latifolium* (Michx.) Yates**
Forested bottomland. Quaternary alluvium. Rowan Co., *666*.

***Cinna arundinacea* L.**
Bottomland oxbow; forested oxbow and seep. Quaternary alluvium (2). Fleming Co., *756*; *1276*.

***Dactylis glomerata* L.**
Bottomland field; edge of field and forested creekside in bottomland. Quaternary alluvium (2). Rowan Co., *976*; Fleming Co., *1025*.

***Danthonia spicata* (L.) F. Beauv.**
Forested upper NNE slope; gasline right-of-way on ridgetop; powerline right-of-way on ridgetop. Mississippian Sunbury Shale; Mississippian Nancy shale (2). Rowan Co., *455*; *1083*; *1103*.

***Diarrhena americana* P. Beauv.**
Forested seep area, lower E slope; forested middle W slope. Devonian Ohio Shale; base of Devonian Ohio Shale. Fleming Co., *1191*; *1306*.

****Digitaria ischaemum* (Schreber) Muhl.**
Powerline right-of-way on ridgetop; low ground of mowed field, bottomland; powerline right-of-way on ridgetop, edge of drainhead low area. Mississippian Nancy shale; Quaternary alluvium; Mississippian Nancy shale. Fleming Co., *738*; Rowan Co., *870*; *1436*.

****Echinochloa crusgalli* (L.) P. Beauv.**
Lake edge. Quaternary alluvium. Fleming Co., *1491*.

***Echinochloa muricata* (Beauv.) Fern.**
Low ground of mowed field, bottomland; along drain running through field, lower SE slope; wet area in bottomland field. Quaternary alluvium; Silurian lower Crab

Orchard clay-shale; Quaternary alluvium. Rowan Co., *871*; Fleming Co., *1445*; Lewis Co., *1477*.

***Eleusine indica* (L.) Gaertn.**
Cultivated field. Near contact between Quaternary alluvium and Silurian upper Crab Orchard clay-shale. Fleming Co., *1266*.

***Elymus hystrix* L.**
Forested lower E slope. Devonian Ohio Shale. Fleming Co., *1180*.

***Elymus virginicus* L.**
Forested bottomland, creekside and edge of field; bottomland oxbow. Quaternary alluvium (2). Lewis Co., *654*; Fleming Co., *755*.

***Eragrostis capillaris* (L.) Nees.**
Bottomland, field near oxbow. Quaternary alluvium. Fleming Co., *755*.

***Erianthus giganteus* (Walter) Muhl.**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1440*.

***Festuca elatior* L.**
Mowed field, lower slopes of drain; edge of field and forested creekside in bottomland. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *485*; Fleming Co., *1024*.

***Festuca* pratense Hudson**
Powerline right-of-way, ridgetop. Mississippian Nancy shale. Rowan Co., *1105*.

***Festuca subverticillata* (Pers.) E. Alexeev.**
Mowed field, lower slopes of drain; forested bottomland, creekside. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale; Quaternary alluvium. Rowan Co., *484*; Fleming Co., *1020*.

***Glyceria septentrionalis* A. Hitchcock**
Old creek channel running through forested bottomland; bottomland oxbow, open mowed area; forested oxbow and seep. Quaternary alluvium (3). Lewis Co., *400*; Fleming Co., *1036*; *1046*.

***Glyceria striata* (Lam.) A. Hitchcock**
Bottomland forest, recently selectively logged; bottomland oxbow, open mowed area; seep area below pond. Quaternary alluvium (2); Mississippian Nancy shale. Lewis Co., *425*; Fleming Co., *1037*; Rowan Co., *1078*.

***Holcus lanatus* L.**
Gasline right-of-way through bottomland; powerline right-of-way on ridgetop. Quaternary alluvium; Mississippian Nancy shale. Rowan Co., *498*; *1100*.

***Leersia oryzoides* (L.) Swartz**
Pond, lower SE slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1403*.

***Leersia virginica* Willd.**
Forested middle slope flats, S facing. Mississippian Farmers sandstone. Fleming Co., *746*.

***Lolium perenne* L.**
Powerline right-of-way on ridgetop, edge of drainhead, low area. Mississippian Nancy shale. Rowan Co., *1435*.

***Microstegium vimineum* (Trin.) A. Camus**
Powerline right-of-way on ridgetop, edge of woods, shallow drain. Mississippian Nancy shale. Rowan Co., *1371*.

***Muhlenbergia frondosa* (Poiret) Fern.**
Forested creekside-roadside. Devonian Ohio Shale. Fleming Co., *1315*.
***Muhlenbergia tenuiflora* (Willd.) BSP**
Forested middle slope flats, S facing. Mississippian Farmers sandstone. Fleming Co., *745*.

***Panicum anceps* Michx.**
Powerline right-of-way; gasline right-of-way through bottomland; along drain running through field, lower E slope; old field, regrown with young woods, lower NW slope; powerline right-of-way on ridgetop. Mississippian Nancy shale; Quaternary alluvium; Silurian upper Crab Orchard clay-shale; Silurian lower Crab Orchard clay-shale; Mississippian Nancy shale. Fleming Co., *607*; Rowan Co., *694*; Fleming Co., *789*; *830*; Rowan Co., *1363*.

***Panicum boscii* Poir.**
Powerline right-of-way, head of drain on ridge-top; forested bottomland. Mississippian Nancy shale; Quaternary alluvium. Fleming Co., *602*; Rowan Co., *972*.

***Panicum dichotomum* L.**
Gasline right-of-way through bottomland; forested broad ridgetop, E slope; gasline right-of-way on ridgetop; ridgetop field; powerline right-of-way on ridgetop. Quaternary alluvium; Mississippian Nancy shale (4). Rowan Co., *502*; *1073*; *1084*; *1353*; *1360*.

***Panicum flexile* (Gattinger) Scribn.**
Powerline right-of-way. Near contact between Devonian Ohio Shale and Mississippian Sunbury Shale. Fleming Co., *1523.*

***Panicum latifolium* L.**
Powerline right-of-way, head of drain on ridgetop. Mississippian Nancy shale. Fleming Co., *601.*

***Panicum linearifolium* Scribn.**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1102.*

***Panicum polyanthes* Schultes**
Powerline right-of-way, head of drain on ridgetop; forested lower E slope. Mississippian Nancy shale; Silurian upper Crab Orchard clay-shale. Fleming Co., *598*; *1229.*

***Panicum rigidulum* Nees.**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *690.*

***Panicum verrucosum* Muhl.**
Powerline right-of-way on ridgetop, edge of woods, shallow drain. Mississippian Nancy shale. Rowan Co., *1372.*

***Panicum villossisimum* Nash**
Wet meadow in bottomland. Quaternary alluvium. Rowan Co., *705.*

***Panicum xanthophysum* A. Gray**
Gasline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1085.*

***Paspalum laeve* Michx.**
Open meadow on edge of bottomland swamp forest. Quaternary alluvium. Fleming Co., *1325.*

***Phalaris arundinacea* L.**
Gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale. Rowan Co., *1172.*

****Phleum pratense* L.**
Gasline right-of-way, ridgetop. Mississippian Nancy shale. Rowan Co., *1164.*

***Poa alsodes* A. Gray**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *996.*

***Poa annua* L.**
Bottomland swamp forest. Quaternary alluvium. Rowan Co., *995*.

***Poa autumnalis* Vahl**
Wet meadow in bottomland. Quaternary alluvium. Rowan Co., *707*.

***Poa compressa* L.**
Thin forest, lower NE slope; forested ridgetop. Silurian upper Crab Orchard clay-shale; Mississippian Farmers sandstone. Fleming Co., *1122*; *1238*.

***Poa cuspidata* Nutt.**
Forested upper SSE slope. Mississippian Sunbury Shale. Rowan Co., *361*.

***Poa sylvestris* A. Gray**
Forested lower to middle NNE slope; forested lower NNE slope. Devonian Ohio Shale (2). Rowan Co., *470*; *1148*.

***Poa trivialis* L.**
Forested spring-seep area, lower E slope. Devonian Ohio Shale. Fleming Co., *1185*.

***Schizachyrium scoparium* (Michx.) Nash**
Around an old pond in field, ridgetop; powerline right-of-way, ridgetop. Mississippian Nancy shale; near contact between Mississippian Farmers sandstone and Mississippian Nancy shale. Rowan Co., *801*; *1374*.

***Setaria faberii* R. Herrm.**
Edge of cultivated field in bottomland. Quaternary alluvium. Rowan Co., *696*.

***Setaria geniculata* (Lam.) P. Beauv.**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *695*.

***Setaria glauca* (L.) P. Beauv.**
Powerline right-of-way, lower W slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *1293*.

***Sorghastrum nutans* (L.) Nash**
Around an old pond in field, ridgetop; ridgetop field; gasline right-of-way, drainhead on ridgetop. Mississippian Nancy shale (3). Rowan Co., *800*; *1348*; *1382*.

***Sorghum halepense* (L.) Pers.**
Roadside drain. Ordovician clay-shale. Fleming Co., *1249*.

***Sphenopholis obtusata* (Michx.) Scribn.**
Mowed field, lower slopes of drain. Near contact between Silurian upper Crab Orchard clay-shale and Devonian Ohio Shale. Rowan Co., *483.*

***Tridens flavus* (L.) A. Hitchcock**
Powerline right-of-way, middle S slope; bottomland, edge of oxbow and field. Silurian upper Crab Orchard clay-shale; Quaternary alluvium. Fleming Co., *725*; *1269.*

***Vulpia bromoides* (L.) S. F. Gray**
Gasline right-of-way through bottomland. Quaternary alluvium. Rowan Co., *992.*

******Vulpia myuros* **(L.) C. Gmelin.**
Powerline right-of-way on ridgetop. Mississippian Nancy shale. Rowan Co., *1101.*

***Vulpia octoflora* (Walter) Rydb.**
Bottomland, edge of oxbow and wet field. Quaternary alluvium. Fleming Co., *1048.*

POTAMOGETONACEAE

***Potamogeton nodosus* Poiret**
Pond. Silurian lower Crab Orchard clay-shale. Fleming Co., *1159.*

***Potamogeton pectinatus* L.**
Pond. Silurian lower Crab Orchard clay-shale. Fleming Co., *1158.*

SMILACACEAE

***Smilax glauca* Walter**
Powerline right-of-way, middle S slope. Silurian upper Crab Orchard clay-shale. Fleming Co., *733.*

***Smilax herbacea* L.**
Forested middle to lower NNE slope. Devonian Ohio Shale. Fleming Co., *1198.*

***Smilax hispida* Muhl.**
Riparian zone of forested bottomland. Quaternary alluvium. Lewis Co., *404.*

***Smilax rotundifolia* L.**
Forested E-W ridgeline. Mississippian Nancy shale. Fleming Co., *626*

SPARGANIACEAE

***Sparganium americanum* Nutt.**
Pond, ridgetop. Mississippian Nancy shale. Rowan Co., *1461*.

TYPHACEAE

***Typha angustifolia* L.**
Along creek in open field. Silurian lower Crab Orchard clay-shale. Fleming Co., *1223*.

***Typha latifolia*.**
Lake edge, E slope. Silurian lower Crab Orchard clay-shale. Fleming Co., *901*.

APPENDIX B

The following maps show the location of the 45 sites with in eight areas at which quantitative sampling was conducted. The initial map shows an overview of the location of the eight areas within the Tablelands.

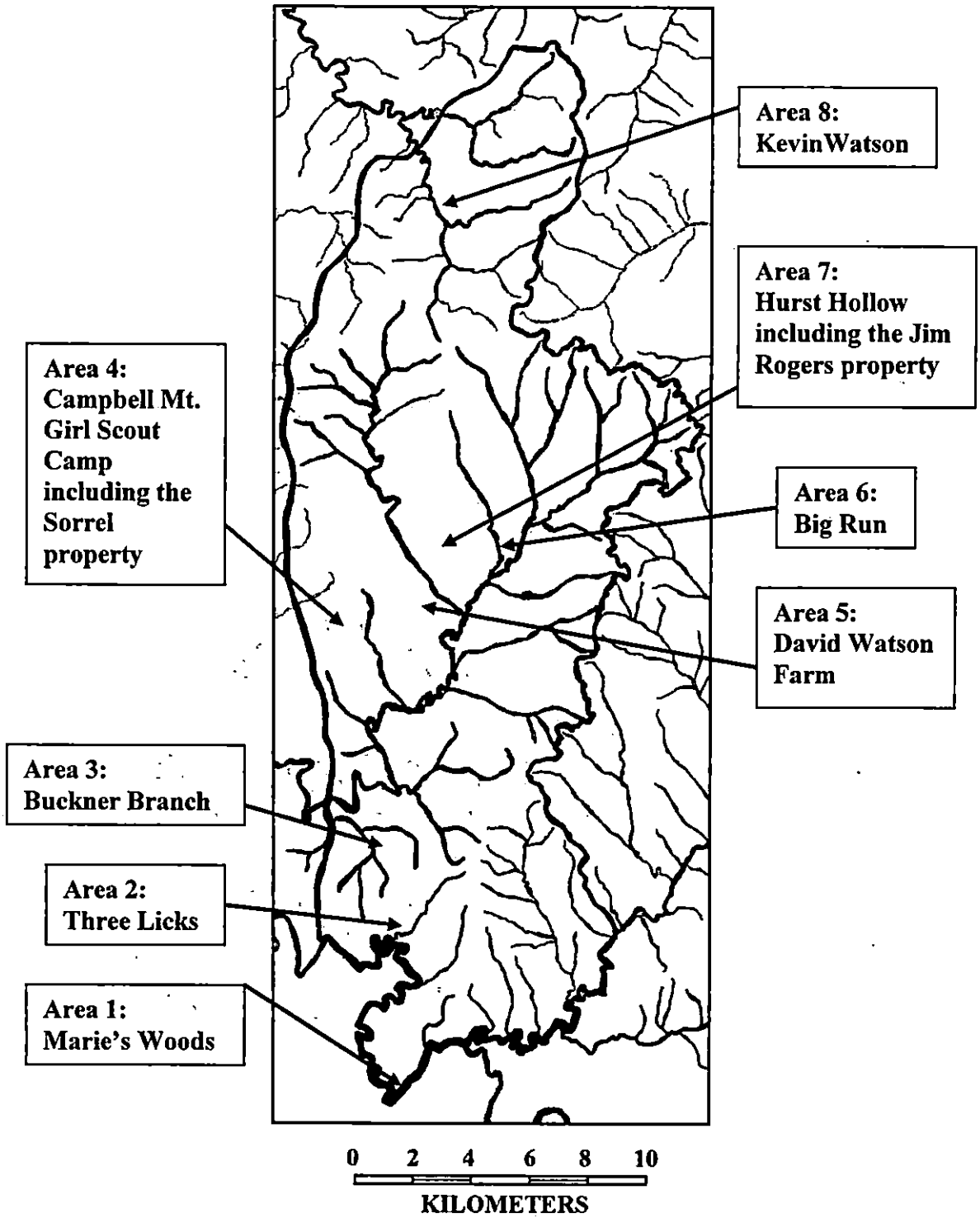

Figure 22. Eight areas in which sampling sites were located.

Area 1: Marie's Woods

One Quaternary alluvium site was located in the bottomlands of the Licking River in the hardwood bottomland forest herein known as Marie's Woods. The area is located approximately 1.4 km (0.9 mi) west-northwest of Midland in Rowan County on the Farmers Quadrangle (Figure 21).

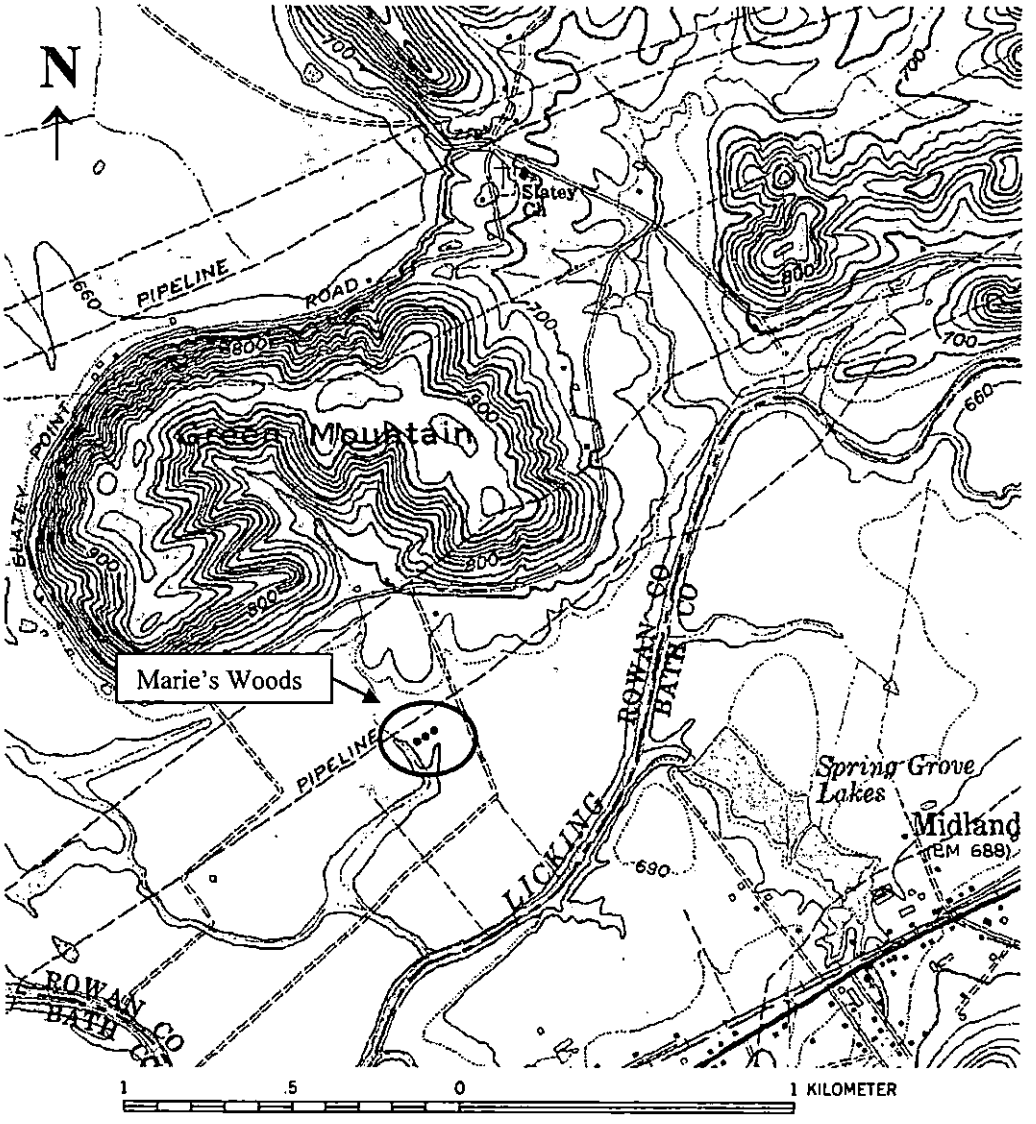

Figure 23. Marie's Woods. One sampling site on Quaternary alluvium. Three plots were sampled at the one site.

Area 2: Three Lick Branch

Three Lick Branch is located 3.7 km (2.3 mi) northeast of Moores Ferry in Rowan County on the Farmers Quadrangle.

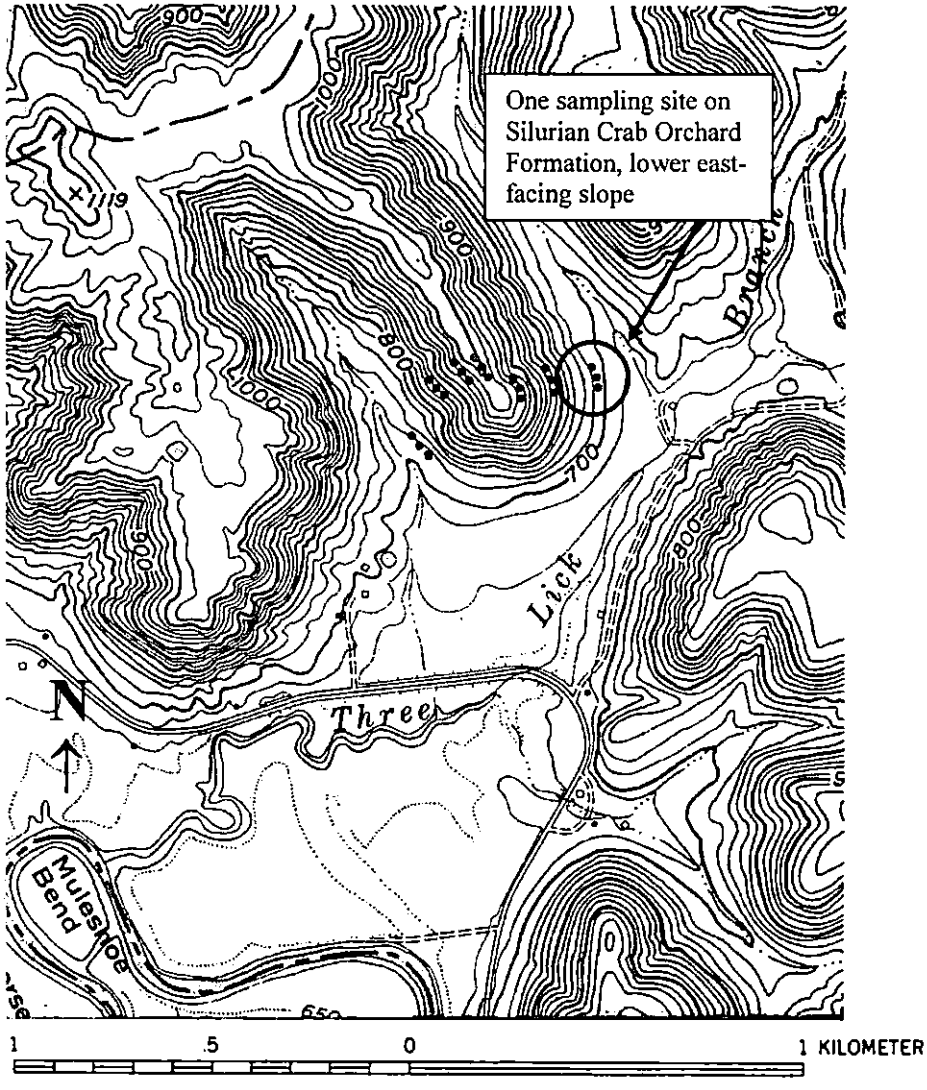

Figure 24. Three Lick Branch. Seven sampling sites were located at Three Lick Branch. These included three sites on east-facing slopes and three sites on west-facing slopes, one on each geologic unit (Silurian Crab Orchard Formation, lower slope; Devonian Ohio Shale, middle slope; and Mississippian Sunbury Shale, upper slope). One site was sampled on the ridgetop on Mississippian Farmers sandstone/Nancy shale. Three sampling plots were sampled at each site.

Area 3: Buckner Branch

Buckner Branch is located 4.6 km (2.9 mi) southwest of Sharkey in Fleming County on the Farmers Quadrangle.

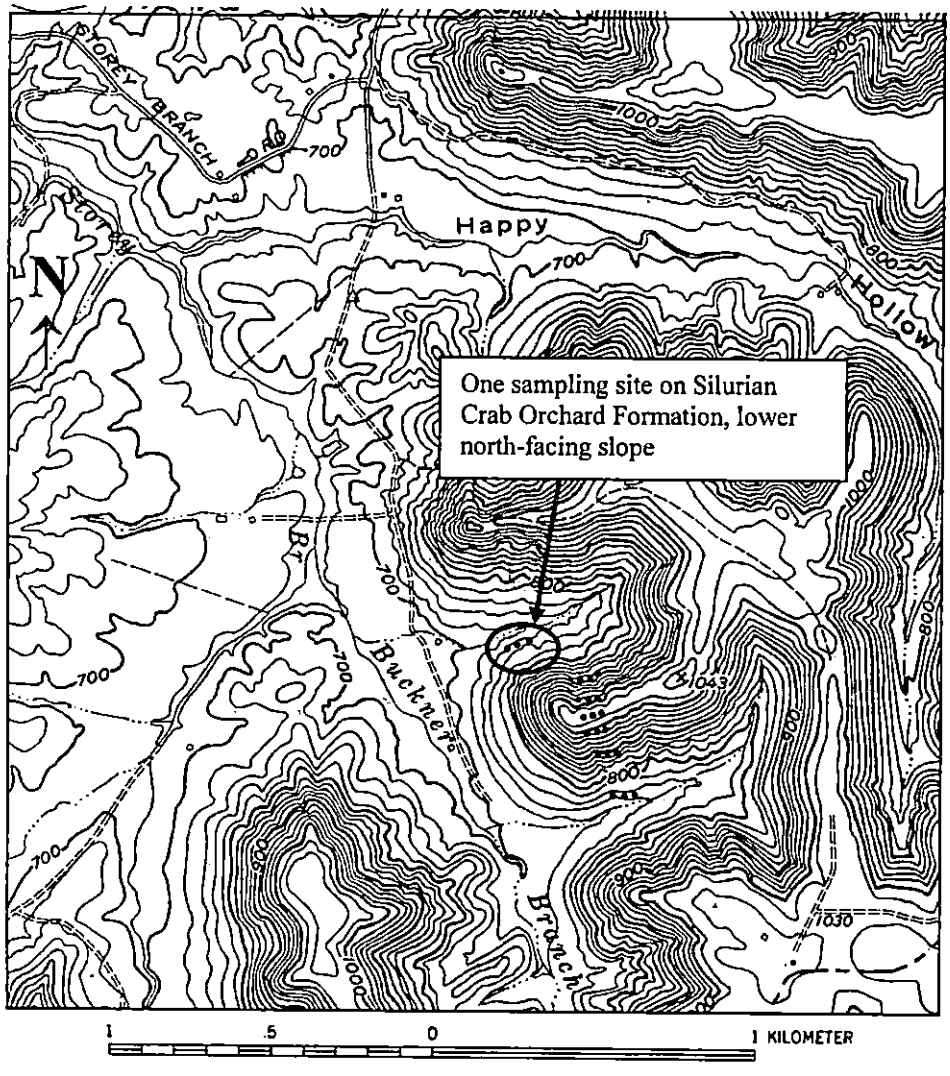

Figure 25: Buckner Branch. Seven sampling sites were located at Buckner Branch. These included three sites on north-facing slopes and three sites on south-facing slopes, one on each geologic unit (Silurian Crab Orchard Formation, lower slope; Devonian Ohio Shale, middle slope; and Mississippian Sunbury Shale, upper slope). One site was sampled on the ridgetop on Mississippian Farmers sandstone/Nancy shale. Three sampling plots were sampled at each site.

Area 4: Campbell Mountain Girl Scout Camp including the Sorrel property.

Campbell Mountain Girl Scout Camp and the Sorrel property are located 3.0 km (1.9 mi) northeast of Hillsboro in Fleming County on the Hillsboro Quadrangle.

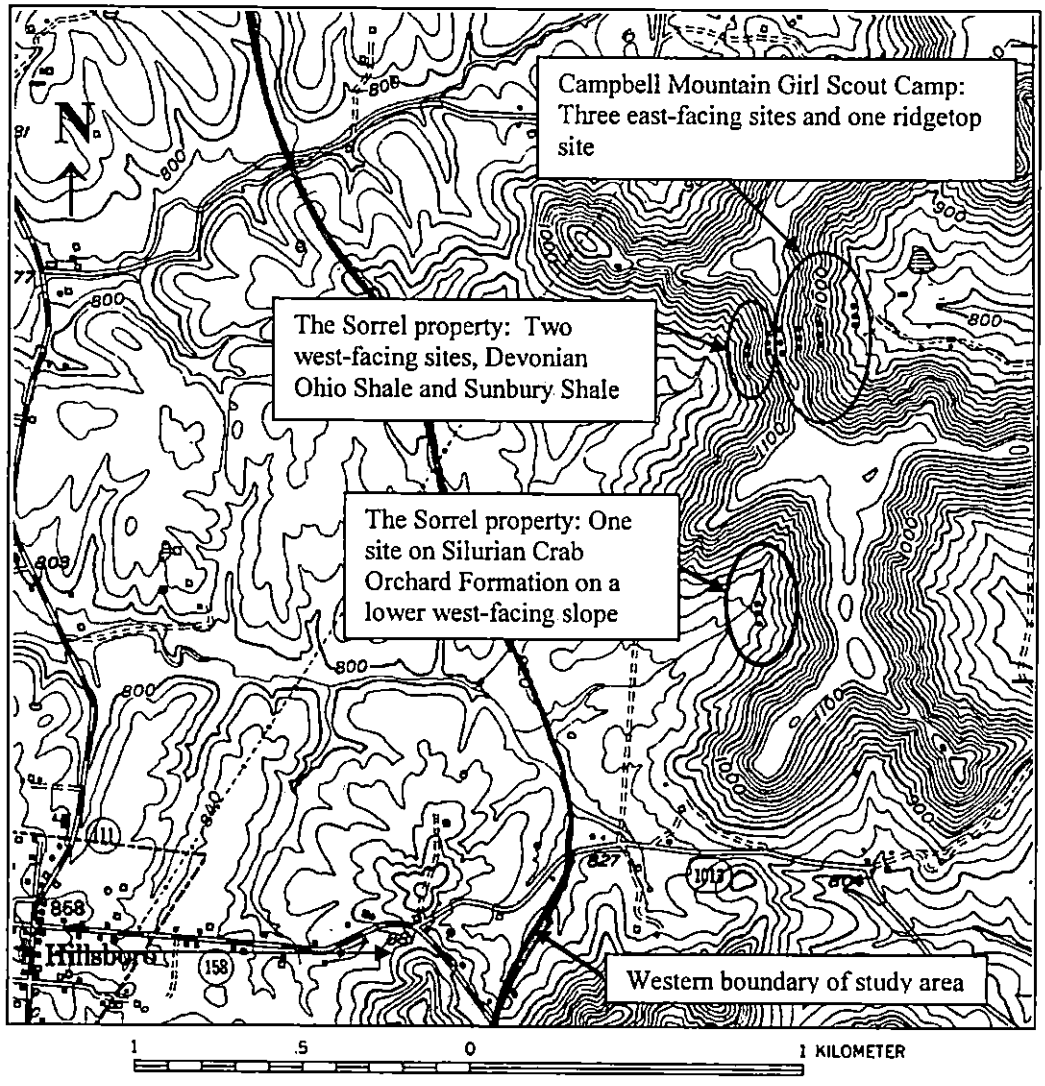

Figure 26. Campbell Mountain Girl Scout Camp including the Sorrel property. Four sites were located at Campbell Mountain Girl Scout Camp on east-facing slopes, one on each geologic unit (Silurian Crab Orchard Formation, lower slope; Devonian Ohio Shale, middle slope; and Mississippian Sunbury Shale, upper slope) and one on the ridgetop on Mississippian Farmers sandstone/Nancy shale. Three sites were located on the Sorrel property on west-facing slopes. Three plots were sampled at each site.

Area 5: David Watson Farm

The David Watson Farm is located approximately 1.8 km (1.1 mi) northwest of Plummers Mill in Fleming County.on the Plummers Landing Quadrangle.

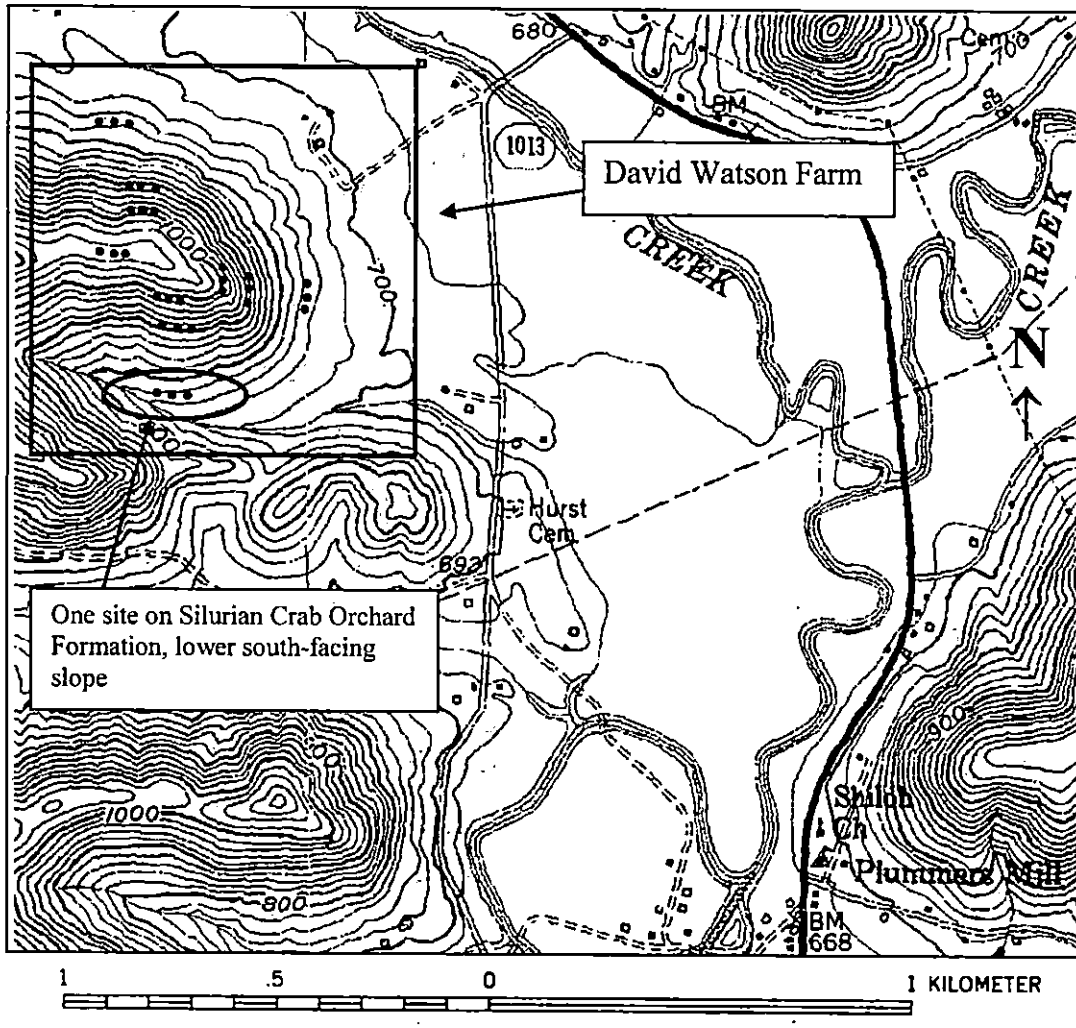

Figure 27. David Watson Farm. Ten sampling sites were located at the David Watson Farm. These included three sites on a north-facing slope and three sites on a south-facing slope, three sites on an east-facing slope, one on each geologic unit (Silurian Crab Orchard Formation, lower slope; Devonian Ohio Shale, middle slope; and Mississippian Sunbury Shale, upper slope). One site was sampled on the ridgetop on Mississippian Farmers sandstone/Nancy shale. Three plots were sampled at each site.

Area 6: Big Run Swamp Forest

The Big Run Swamp Forest is located approximately 2.3 km (1.4 mi) northeast of Plummers landing in Fleming County on the Plummers Landing Quadrangle.

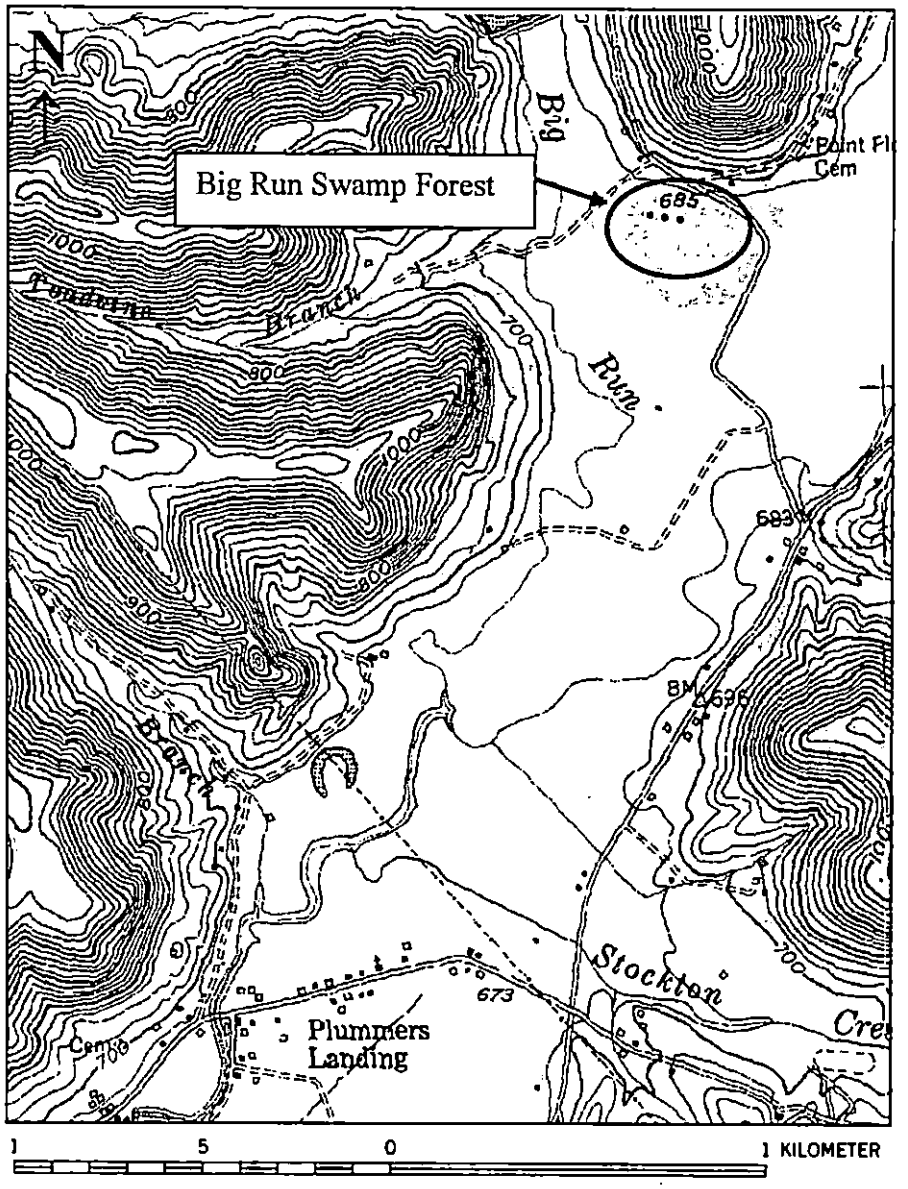

Figure 28. Big Run Swamp Forest. One sampling site on Quaternary alluvium. Three plots were sampled at the one site.

Area 7: Hurst Hollow including the Jim Rogers property

Hurst Hollow is located approximately 3.4 km (2.1 mi) northwest of Plummers Landing in Fleming County on the Plummers Landing Quadrangle.

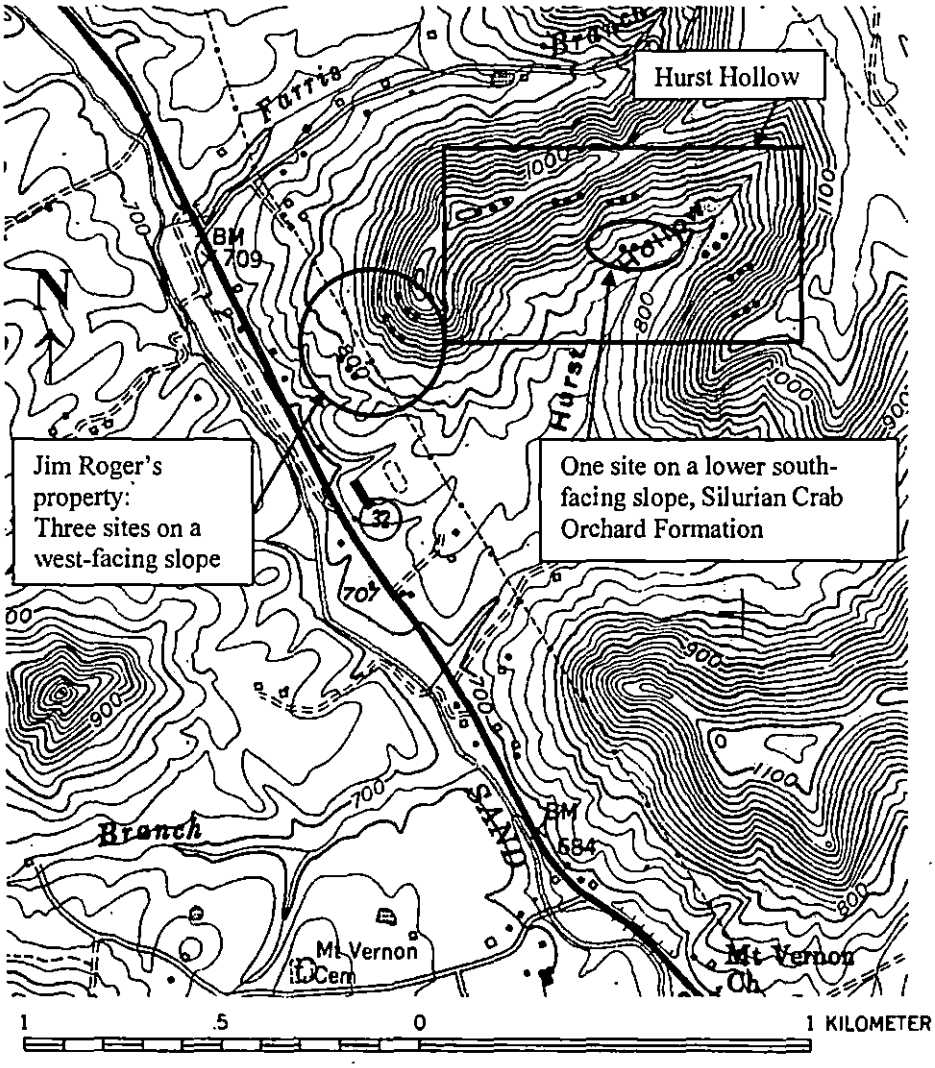

Figure 29: Hurst Hollow including Jim Rogers property. Seven sampling sites were located in Hurst Hollow. These included three sites on a north-facing slope and three sites on a south-facing slope, one on each geologic unit (Silurian Crab Orchard Formation, lower slope; Devonian Ohio Shale, middle slope; and Mississippian Sunbury Shale, upper slope). One site was sampled on the ridgetop on Mississippian Farmers sandstone/Nancy shale. Three sites were located on the Jim Rogers property on a west-facing slope. Three plots were sampled at each site.

Area 8: North Fork Licking River Bottomland Forest

The North Fork Licking River Bottomland Forest is located approximately 1.6 km (1.0 mi) southeast of Foxport in Lewis County on the Burtonville Quadrangle.

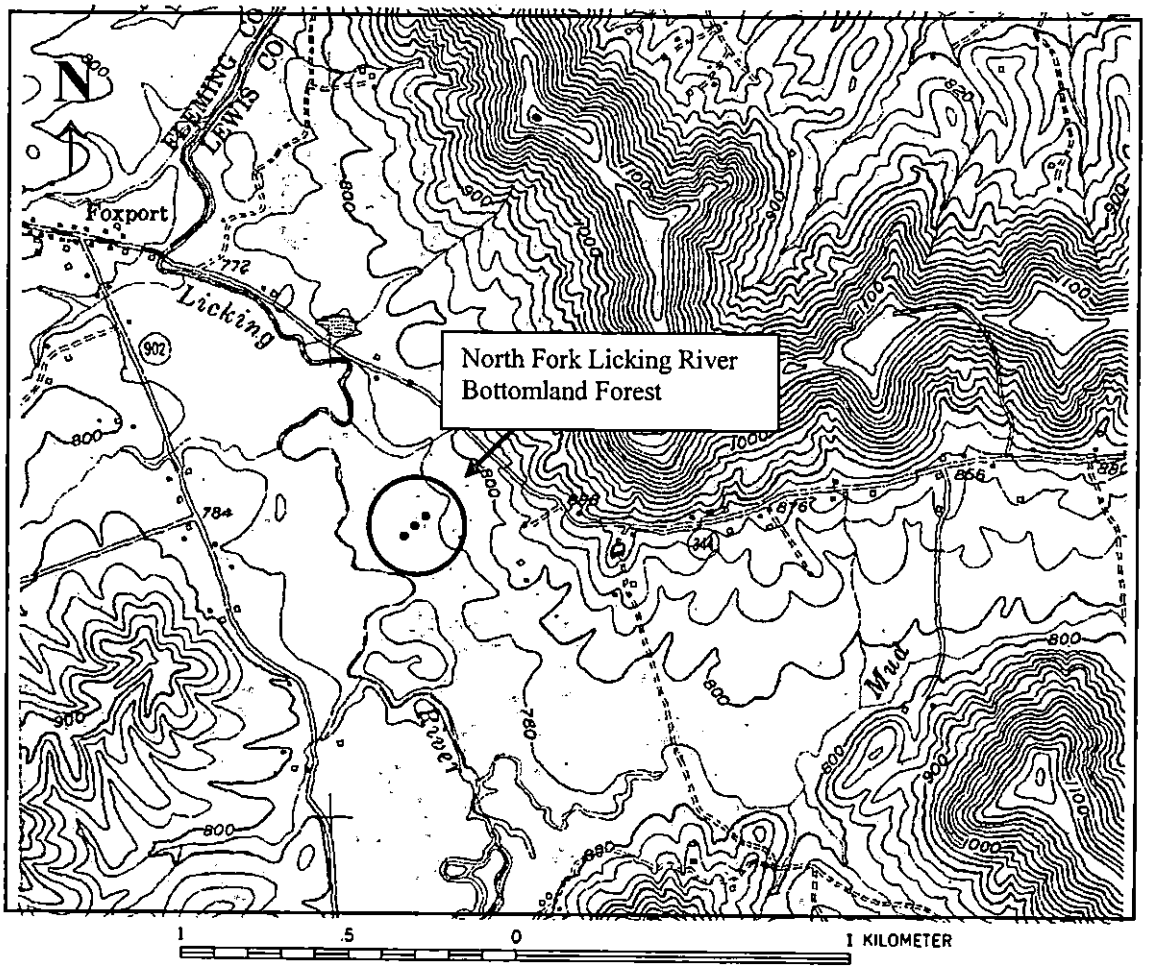

Figure 30. North Fork Licking River Bottomland Forest. One sampling site on Quaternary alluvium. Three plots were sampled at the one site.