VASCULAR FLORA AND PLANT COMMUNITIES OF DEAD HORSE KNOB (RUCKER'S KNOB), MADISON COUNTY, KENTUCKY

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ABSTRACT

A descriptive floristic study was conducted during the growing seasons of 2010–2011 and spring 2012 at Dead Horse Knob (Rucker's Knob), an isolated 2.6 ha steep eroded hill with a 312 m conical summit in southern Madison County, Berea, Kentucky. This Dead Horse Knob survey is the first comprehensive flora of a solitary knob in the Knobs Region of east-central Kentucky. The knob is comprised of four residual and colluvial soils from weathering of Devonian black shales. Dry-Mesic Oak-Hickory Forest with interspersed planted pines is the major forest type. Plant communities have been altered through the anthropogenic effects of excessive land use, livestock disturbances, and the presence of naturalized invasive species. The vascular flora is comprised of 291 species (this total includes infraspecific taxa), in 191 genera from 67 families, which consists of two Monilophytes, five Gymnosperms, and 284 Angiosperms (71 Monocots; 213 "Dicots"). One hundred and sixteen species (39.9% of the total flora) were exotic and 52 were invasive, with *Lonicera maackii* as the most detrimental.

RESUMEN

Un estudio florístico descriptivo que se llevó a cabo durante las temporadas de crecimiento de 2010–2011 y la primavera de 2012 en Dead Horse Knob (Rucker's Knob), una colina aislada de 2,6 ha , empinada y erosionada con una cumbre cónica de 312 m en el sur del condado de Madison, en Berea, Kentucky. Este estudio de Dead Horse Knob es la primera flora exhaustiva de un "knob" o loma aislada en la Región de Lomitas del centro-este de Kentucky. El "knob" está compuesto de cuatro suelos residuales y coluviales del desgaste de la pizarra arcillosa negra del Devónico. El tipo principal de bosque es el Seco-Mésico de *Quercus-Carya* con *Pinus* sembrados intercalados. Las comunidades vegetales han sido alteradas por los efectos antropogénicos del uso excesivo de la tierra, perturbaciones del ganado y la presencia de especies invasoras naturalizadas. La flora vascular comprende 291 especies (un total que incluye los taxa infraespecíficos), de 191 géneros y 67 familias, que consiste en dos Monilofitas, cinco Gimnospermas y 284 Angiospermas (71 monocotiledóneas, 213 "dicotiledóneas"). Ciento dieciséis especies (39,9% de la flora total) eran exóticas y 52 eran invasoras, con *Lonicera maackii* como la más perjudicial.

Key Words: Dead Horse Knob, Rucker's Knob, *Lonicera maackii*, invasives, vascular flora, Kentucky

INTRODUCTION

Dead Horse Knob (or Rucker's Knob), hereafter DHK or "knob," is an isolated 2.6 ha steep hill in east-central Kentucky, 1.6 km north of the Berea Ridge in southern Madison County (Fig. 1). DHK is between 37.582° and 37.584° latitude, and -84.298°and -84.300° longitude within the zoned Berea city limits. Elevations in the immediate vicinity range from nearly level terrain at 297 m on the western foot slope of DHK to 312 m at the eroded, cone-shaped summit (Weir 1967). It is surrounded by 270 ha of agricultural field and pasture farmland of the Berea College Farm that is managed through Berea College (Thompson et al. 2008).

DHK is located within the Knobs Physiographic Region, an area of remnant low peaks derived from the erosion of the Cumberland Plateau of the Appalachian Mountain highlands. These low scattered hills form a mountain chain of Devonian black shale in a 5957 km^2, horseshoe-shaped belt, 15–25 km wide, interspersed between the limestone Ordovician Outer Bluegrass Region, Mississippian Plateau, and Cumberland Plateau of central Kentucky (Burroughs 1926; Newell 1981).

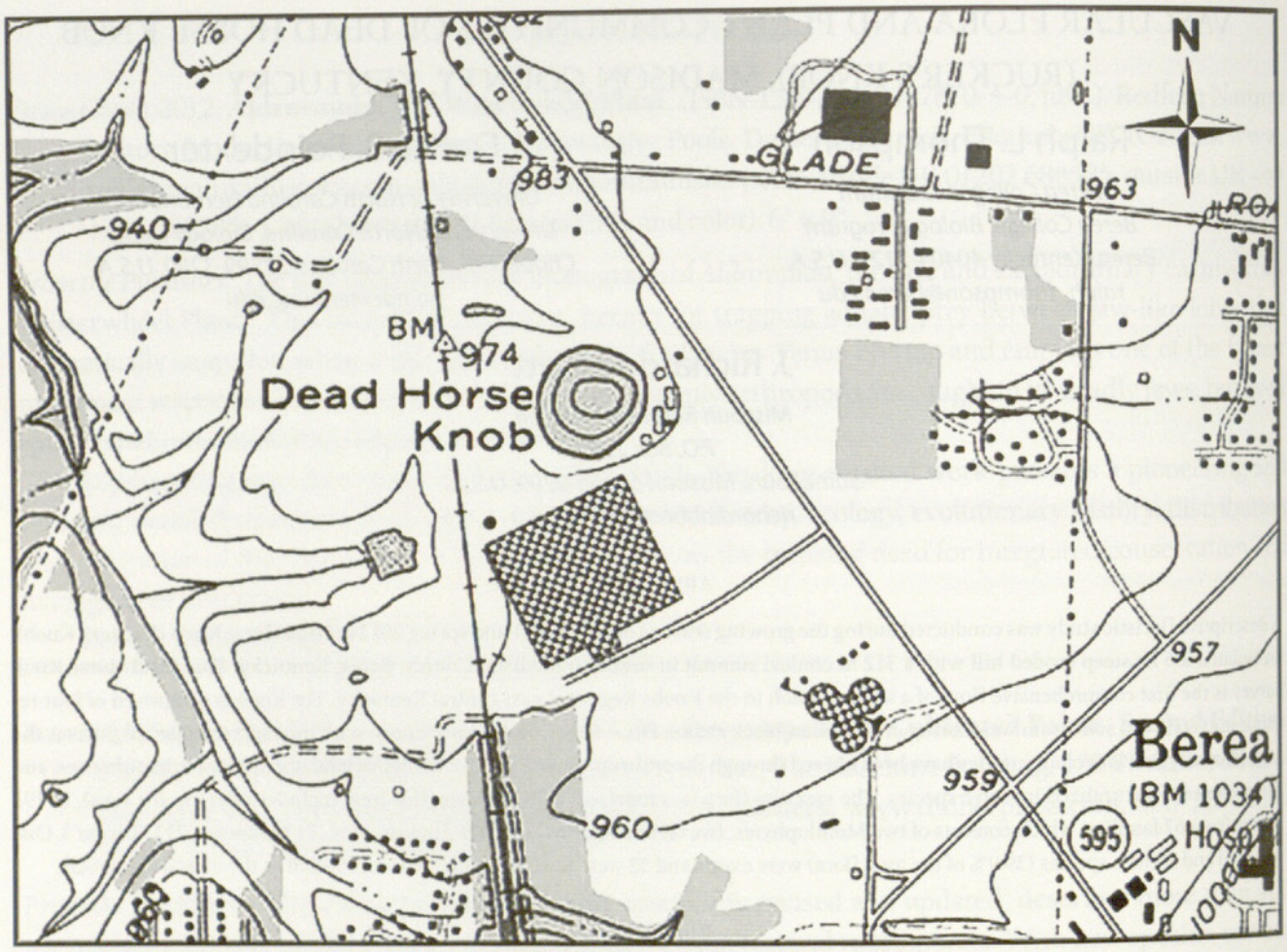

Fig. 1. Dead Horse Knob (DHK), Madison County, Kentucky. Map is modified from the Berea Quadrangle 7.5-minute topographic series (Map scale 1:24,000), 1970, photo-revised 1979, U.S. Geological Survey, Washington, DC. DHK geology and environs are entirely Devonian New Albany Shale (Weir 1967).

This survey is the first comprehensive flora from an individual peak in the Knobs Region of south-central Kentucky and provides additional information to augment the rich natural history of southern Madison County (e.g., Grossman & Pittillo 1962; Jones & Thompson 1986; Wade & Thompson 1990; Thompson & Fleming 2004; Thompson 2005; Thompson 2008). Furthermore, DHK serves as an area of historic and cultural importance due to a small private Revolutionary War cemetery at the summit and the remnants of an old clay pit area at the westernmost foot slope, which was used in the past for the brick and tile industry of Berea College.

The objectives of our descriptive study were to: 1) document the vascular plants growing at DHK through collection of representative voucher specimens for deposit in the Berea College Herbarium (BEREA); 2) discuss the present effects of invasive species and livestock disturbance on the native flora and forest vegetation; 3) designate plant communities and describe plant habitats with characteristic associated species; and 4) increase our understanding of vascular plant diversity in preparation of a future publication of the Madison County flora. Additionally, all of these objectives provide a reference baseline for future comparative studies and potential land management decisions.

THE STUDY AREA

History

Pullins-Rucker Cemetery.—Dead Horse Knob on topographic maps by Weir (1967) was historically known as Rucker's Knob to acknowledge two pioneer families who initially colonized and farmed the immediate surrounding land. A unique feature at the knob summit is an abandoned small private cemetery, the Pullins-

Rucker Cemetery. Descendants of the Pullins and Rucker families intermarried and used the graveyard as a burial ground for their relatives. The cemetery dates from Revolutionary War times, with the interment of Loftus Pullins, Jr. (1764–1841), a Revolutionary War soldier with the Virginia Militia who served in the regiment of Colonel Sampson Matthew under General George Washington at the Battle of Yorktown in 1781. After his Revolutionary War service, Loftus Pullins, Jr. received a small pension in Kentucky, and he moved to southern Madison County with his family in 1787 (E.T. Pullins, pers. comm. 2010). His grandson, Alva Pullins, Jr., married Alma Rucker, a descendant of Jeremiah Rucker, Jr. and Susan Ann Morton, owners of the land that encompassed Rucker's Knob in the 1860s. One of their sons, John Morton Rucker, farmed the land until it was sold to Joseph and Sallie Coyle in 1888.

On September 27, 1898, Berea College acquired "the Jeremiah Rucker Place" of 15.8 ha from the Coyle family including the knob, which then became known as "Rucker's Knob" (S. Wilson, pers. comm. 2011). Among the few markers in the Pullins-Rucker Cemetery, only Loftus Pullins, Jr. (1764–1841), Celia Pullins (1775–1841), Samuel Pullins (1807–1832), James Pullins (1794–1854), and Susan A. (Morton) Rucker (1815–1855), are identified. The Daughters of the American Revolution placed an additional marble commemorative marker on the Loftus Pullins grave site on November 8, 1981 (E.T. Pullins, pers. comm. 2010).

Brick and Tile Yard.—Another significant historic feature of Dead Horse Knob was the presence of gray clay from weathered New Albany Shale in the vicinity of the western foot slope. This clay was excavated from a group of shallow pits that were used for brick and tile making by Berea College workers in the early 1900s. These obliterated clay cavities range from 1.0–2.0 m in depth and now lie in the concave flatlands contiguous to the western foot slope of Rucker's Knob (Foerste 1906).

During the 19th century, Berea College building campaigns needed great quantities of bricks for college buildings and as a labor industry for many male students (Boyce 2006). In 1901, Berea College created a large Brick and Tile Yard adjacent to the western side of Rucker's Knob where bricks were hand-made by students. In 1902, a brick machine and kiln increased the operation to a high capacity of several thousand bricks per day. By 1906, because of higher production needs, the brickyard industry created up to 25,000 bricks per day from four kilns with excess bricks shipped to other regional cities by a switch line of the Louisville & Nashville Railroad. The Berea College Brick and Tile Yard operation at Rucker's Knob was closed down in January 1911 (Boyce 2006). Among college buildings constructed with the red bricks from the clay pits at Rucker's Knob, were the Edwards Building (Men's Industrial Building/College Square) in 1902–1903, the Phelps Stokes Chapel (Main Chapel) during 1903–1906, and the Frost Building (originally Carnegie Library) in 1904–1907 (Boyce 2006).

Physiography

Fenneman (1938) classified the physiographic region comprising Dead Horse Knob as the Kentucky Knobs Region within the Interior Low Plateaus Physiographic Province. Braun (1950) described the southern Kentucky Knobs Border Area of the Interior Low Plateaus from Berea to Frenchburg to be included within the Hill Section of the Norman Uplands. Quarterman and Powell (1978) designated this hilly region as the Knobstone Escarpment of the Interior Low Plateaus. Keys et al. (1995) classified the ecological unit, which would include DHK, into the Eastern Knobs Transitional Subsection of the Interior Low Plateau, Highland Rim Section of the Eastern Broadleaf Forest Province.

Based on the most recent classification per Woods et al. (2002), the knobs of southern Madison County are located entirely within the 400 million-year-old Knobs-Norman Upland Ecoregion of the Interior Plateau Physiographic Province. These Uplands are interspersed among the western and eastern Outer Bluegrass Ecoregion, the southern Hills of the Bluegrass Ecoregion, the northeastern Cumberland Plateau Ecoregion, and the Northern Forested Plateau Escarpment of the Western Alleghany Plateau (Woods et al. 2002). The rugged terrain of the Knobs is characterized by colluvial and residual shale, limestone, and sandstone slopes with the higher ridgetops often capped by vertical conglomeratic sandstone cliffs inclining down steep V-shaped hills and ridges into broad U-shaped valleys. These landscapes are subsequently drained by numerous dissected intermittent first order and flowing second order streams. In the Knobs Region, vast open agriculture and pasture lands adjoin and surround the moderately hilly terrain (Woods et al. 2002).

Geology

The Knobs-Norman Uplands are underlain by Silurian, Devonian, Mississippian, and Pennsylvanian-aged sedimentary bedrock (Woods et al. 2002). At DHK, the bedrock is entirely underlain by the New Albany Shale Formation of the Middle and Upper Devonian System (Weir 1967). To the north and west of DHK, the Knobs-Norman Uplands intergrade into the Outer Bluegrass Ecoregion. The Outer Bluegrass is characterized by broad rolling hills consisting of Upper Ordovician limestone bedrock on open, flatland topography dissected by shallow, narrow streams (Woods et al. 2002).

The New Albany shale of southern Madison County consists of carbonaceous, black shale about 24 to 30 m thick containing sparsely crystalline pyrite and concretions of fine-grained calcitic and iron-rich or phosphatic material. When weathered, this black shale is typically brownish-black to yellowish-brown often with a few thin seams (2.5–4.0 cm)of yellowish-green shales, which locally form abundant chips and plates on outcrops (Campbell 1946). Megafossils are scarce and are mainly comprised of small brachiopods, fish plates, plant parts, and spores (Campbell 1946). In the vicinity of DHK, basal content is evident where shale rests concordantly above the Middle Devonian Boyle Dolomite.

Although the DHK summit is only 312 m above sea level, it is unique in being the only solitary, isolated knob to be separate from other higher elevated peaks of the Berea College Forest (BCF). Within the adjacent BCF in southern Madison County, higher knob summits range from Welch Mountain (383 m), West Pinnacle or Barton Knob (453 m), East Pinnacle (458 m), Robe Mountain (465 m), and Pinnacle Knob (487 m) to Bear Mountain (504 m), the highest point in Madison County (Weir 1967; Weir et al. 1971). Within the city of Berea proper on the Devonian black shale Berea Ridge, elevations vary from 267 m at Silver Creek to 316 m on the Berea College campus to 324 m in the Dogwood Heights subdivision (Thompson et al. 2008).

Forest Vegetation

Deciduous forest vegetation of southern Madison County mainly consists of Oak-Hickory Forest (Küchler 1964; Woods et al. 2002; Thompson 2008). Braun (1950) classified some forest vegetation of more separated hills in the Knobs Region as examples of Oak-Hickory communities within the Western Mesophytic Forest Region, a transitional mosaic of Oak-Hickory Forest and Mixed Mesophytic Forest. Evans (1991) characterized vegetation in the Knobs Region as Acidic Sub-Xeric Forest based on topographic moisture, slope aspect, and dominant forest vegetation consisting of Oak-Hickory components with a poorly-developed understory and sparse herbaceous cover.

In the oil-bearing Devonian black shale Knobs Region, Wharton (1945) described five upland forest types: oak, oak-pine, chestnut oak-scarlet oak, white oak, and mixed mesophytic, while Muller and McComb (1986) reported white oak, chestnut oak, scarlet oak, and mesophytic hardwoods forest types in their study of upland forests of the Knobs Region. Vegetation studies in the Knobs Region have emphasized the correlation of forest types with soils, site moisture characters, slope position, topographic aspect, and physiognomy over time (Wharton 1945; Braun 1950; Fedders 1983; Muller & McComb 1986; Woods et al. 2002; Thompson 2008). Dry-Mesic Oak-Hickory Forest is the major vegetation, albeit altered, of DHK from the knob summit down to interspersed planted pines stands of upper slopes, middle slopes, lower slopes, and foot slopes at the boundary, with the perimeter being grassland pasture habitat.

Soils

As mapped by the Web Soil Survey (Soil Survey Staff 2012) from Newton et al. (1973), the 2.6 ha of DHK is comprised of four major forest soil series (Fig. 2). The knob residual and colluvial soils belong to the Coyler-Weikert-Captina Association. These series are characteristically shallow, moderately well-drained, acid in reaction (4.5–5.0 pH) from the summit down all steep slope aspects to foot slopes (Newton et al. 1973).

Coyler shaley silt loam (CoF) comprises the shallow soils of 0.8 ha (of the total 2.6 ha DHK site), for 31.6% of the area on the summit and upper western-trending slopes. Coyler soils are clayey-skeletal residuum weathered from New Albany Shale on steep 12 to 50 percent slopes. This soil is very strongly acidic in reaction, excessively well-drained, channery silt clay loam from 0 to 51.0 cm to the shale bedrock. The soil profile of the A surface horizon is 0 to 12.7 cm deep, brown, friable, fine granular channery shaley silt loam with small black

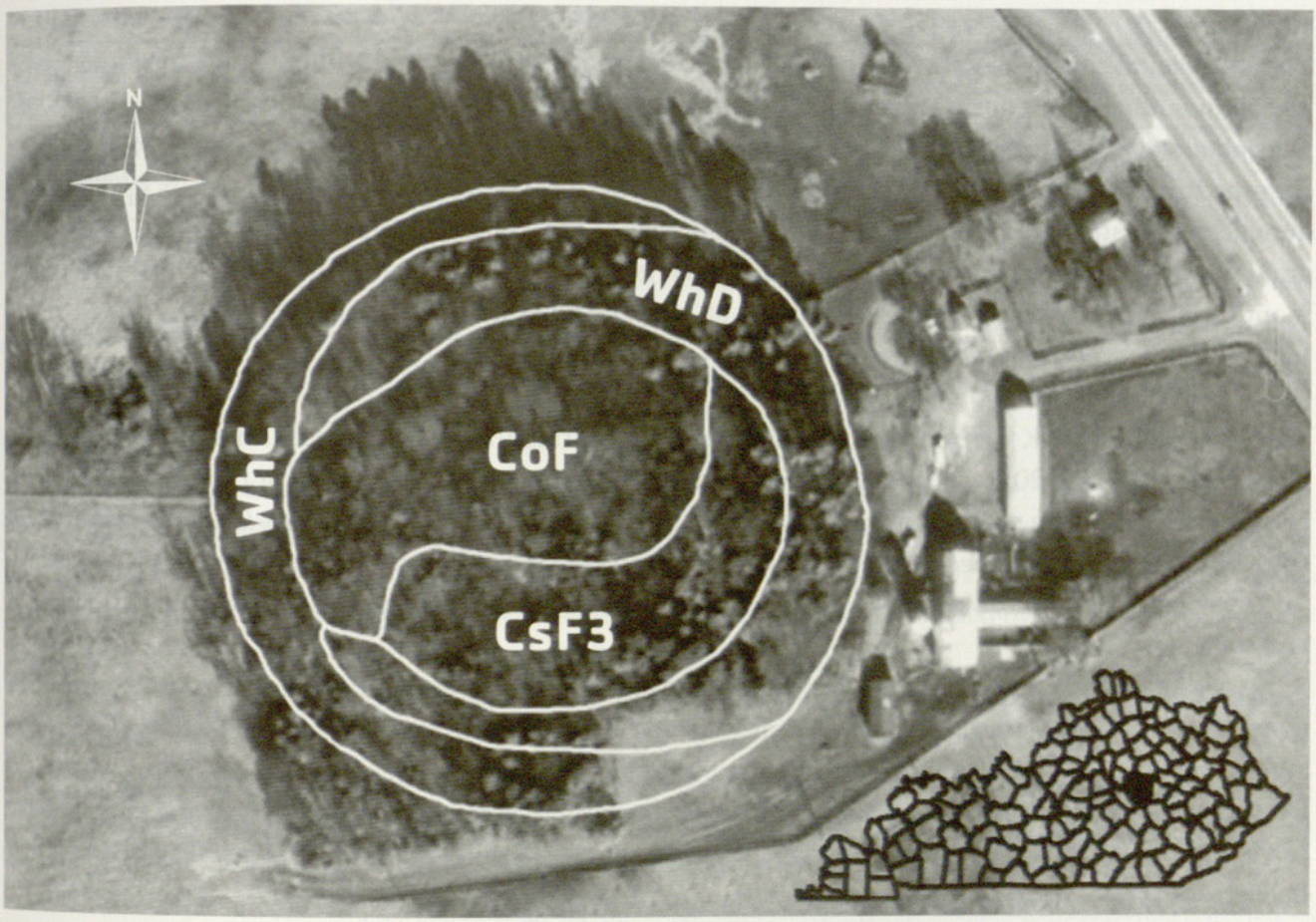

Fig. 2. Soils of Dead Horse Knob, Madison County, Kentucky. Map unit symbol, unit name, slope and area percentages adapted from Soil Survey Staff (2012): CoF (Colyer shaley silt loam, 12–50% slopes, 0.81 ha, area 31.6%); CsF3 (Colyer shaley silty clay loam, 12–50% slopes, severely eroded; 0.57 ha, area 21.8%); WhC (Whitley silt loam, 6 to 12% slopes; 0.45 ha, area 16.8%); and WhD (Whitley silt loam, 12 to 20% slopes; 0.77 ha, area 29.8%).

shale fragments; the B horizon varies from 12.7–38.1 cm deep, yellowish-brown, friable to firm, very heavy channery silty clay with 35 percent black shale fragments; the C horizon is 38.1–50.8 in depth, brown heavy silty clay with 75 percent highly weathered black shale layers down to the unweathered hard, brittle, black shale bedrock of the R horizon (Newton et al. 1973; Fig. 2).

The highly eroded Coyler shaley silty clay loam (CsF3) is the principal soil of another 0.6 ha, for 21.8% of the area, on southern and eastern upper and middle 12 to 50 percent slopes. Coyler shaley silty clay loams are different in composition from CoF in having the top brown surface layer lost through erosion and a surface layer of exposed yellowish-brown silty clay loam present (Newton et al. 1973; Fig. 2).

Whitley silt loam soils (WhC) comprise the deep soils of a circular, crescent-shaped band of 0.5 ha, for 16.8% of the site, on the southern and western middle slopes, lower slopes, and foot slopes. Whitley silt loam is fine-silty colluvium derived from weathered New Albany Shale on 6 to 12 percent slopes. This weathered soil is very strongly acid, deep, well-drained, silt loam to gravelly silty clay loam from 0 to 122 cm to shale bedrock. The soil profile is an A horizon from 0–23 cm deep, dark yellowish-brown, friable granular silt loam; the B horizon ranges from 23–91.4 cm deep, brown to yellowish-brown, moderate to fine and medium blocky heavy silt loam with a few, small black concretions; and the C horizon ranges is 91.4–122 cm in depth of yellowish-brown silty clay loam with fine, distinct light, brownish gray clay mottles with an abrupt smooth boundary. The R horizon beyond 122 cm consists of highly fissured black shale bedrock (Newton et al. 1973; Fig. 2).

Whitley silt loam (WhD) soils are in colluvial areas totaling 0.7 ha, for 29.8% of the area, at the base of 12 to 20 percent foot slopes at the northern and eastern aspects and part of the southern mid-slope. The WhD soil profile is similar to the WhC soils but differs in a 7.6 cm thick yellowish-brown silt loam surface layer intermixed with clayey subsoil material (Newton et al. 1973; Fig. 2).

Climate

The continental climate of Kentucky has warm to hot summers, mild to cold winter temperatures, and generally abundant moisture during all seasons (Trewartha & Horn 1980). Kentucky climatic data for 1971–2000 were obtained from the Berea College Weather Station-150619 (Midwest Climate Center 2011). Mean length of the growing season is 194 days. Median first frost is October 22 and the median last frost occurs April 10. Mean annual precipitation is 120.2 cm with the highest in May at 13.4 cm and the lowest in October at 7.8 cm. Mean annual snowfall approximates 29.7 cm. Mean annual temperature of Berea is 13.6°C with January the coldest month at 1.5°C and August the warmest month at 24.3°C (Midwest Climate Center 2011).

METHODS AND MATERIALS

Vascular plants at DHK were collected from 26 field trips during the growing seasons of 2010 (11 trips), 2011 (10 trips) and spring 2012 (5 trips). A complete voucher specimen set is deposited at the Berea College Herbarium (BEREA) and a partial duplicate set is filed at the University of North Carolina-Chapel Hill Herbarium (NCU). In the annotated species list, the following data are assigned for each taxon: origin (native vs. exotic), invasive plant pest status, Madison County distribution records, relative abundance, habitat(s) of occurrence, and collection number(s).

Gleason and Cronquist (1991), Jones (2005), and Weakley (2011) were the primary manuals consulted for taxon identification. Madison County records were determined based on Campbell and Medley (2012), Clark and Weckman (2008), USDA, NRCS (2012), and from herbarium searches of BEREA and Eastern Kentucky University Herbarium (EKY). A relative abundance value was assessed for each taxon utilizing the definitions of Thompson (2007). Each taxon was assigned a single comprehensive value inclusive for all plant community habitats.

Nomenclature follows Weakley (2011), with two exceptions mentioned later. Assigned exotic status was also based on Weakley (2011), except where origin was dubious and the species are considered invasive in Kentucky (e.g., *Chenopodium album*, *Dysphania ambrosioides*). Invasive pest plant status is from the current list from the Kentucky Exotic Plant Pest Council (KY-EPPC 2012).

Plant communities were delineated through field reconnaissance and sampling data of characteristic associated and/or dominant species in conjunction with physical factors (general topography, slope aspect, moisture regimes, soil types, geology) and anthropogenic influences (livestock disturbance, invasive plant impact, farming practices).

Diameter at Breast Height (DBH) measurements were made on selected canopy trees with Haglöf Swedish Mantax Black Calipers® and transverse core samples for age determination of the largest pine species using a Haglöf Swedish Increment Borer®.

RESULTS AND DISCUSSION

Taxonomic Summary

The vascular flora of Dead Horse Knob consists of 291 species (this total includes infraspecific taxa) in 191 genera from 67 families (Table 1). The flora includes two Monilophytes (0.69%), five Gymnosperms (1.72%), and 284 Angiosperms (97.59%), comprised of 71 Monocots (24.40%) and 213 "Dicots" (73.20%), the latter including eudicots and the paraphyletic grade of "basal angiosperms." The six largest families in species are the Poaceae (43), Asteraceae (39), Cyperaceae (17), Brassicaceae (15), Fabaceae (15), and Rosaceae (13). *Carex* is the largest genus with 15 taxa, followed by *Quercus* with 8 taxa. The 116 exotic taxa (39.86% of the total flora) are all Angiosperms (27 Monocots and 89 "Dicots"). Pyšek (1998) reported that the Poaceae, Asteraceae, Fabaceae, and Brassicaceae are the four families that accounted for the greatest percentage of exotic species in local floras from 26 regions in a worldwide survey, and indeed, the DHK flora follows the same trend, as the four families with the most naturalized species are Poaceae (24), Asteraceae (13), Brassicaceae (12), and Fabaceae (11). No state-listed rare, endangered, or threatened species according to the Kentucky State Nature Preserves Commission list (KSNPC 2010) are present.

Table 1. Taxonomic distribution of vascular plants of the Dead Horse Knob, Kentucky.

Clade	Families	Genera	Taxa*	Native	Exotic	Percent of Total Flora
Monilophytes	2	2	2	2	0	0.69
Gymnosperms	2	2	5	5	0	1.72
Angiosperms	63	187	284	168	116	97.59
Monocots	9	40	71	44	27	24.40
"Dicots"	54	147	213	124	89	73.20
Totals:	67	191	291	175	116	100.00

*Note: The number of taxa is equal to the number of species.

Madison County Records

Nine taxa (3.09% of the total flora) are new county distribution records for Madison County based on map data from Campbell and Medley (2012), Clark and Weckman (2008), USDA, NRCS (2012). The USDA, NRCS (2012) map distributions for Kentucky counties were mainly from atlas map data provided by Campbell and Medley (2006).

1. *Carex gravida* L.H. Bailey.—Campbell and Medley (2012) map Heavy Sedge for Campbell County (*Naczi CGE 45, 06 June 1996*, KNK) and Trigg County (*Thompson and Poindexter 04-412, 08 May 2004*, BEREA) from Thompson and Poindexter (2006). This sedge is not listed for Kentucky by the USDA, NRCS (2012).

2. *Carex umbellata* Schkuhr ex Willd.—Campbell and Medley (2012) list 26 counties for Parasol Sedge and remark that it is often overlooked in scattered, dry open woods. We found several populations on the dry western lower slope and foot slope in a mixed *Juniperus virginiana* var. *virginiana* and *Pinus echinata* stand.

3. *Carex texensis* (Torr. ex L.H. Bailey) L.H. Bailey.—Campbell and Medley (2012) record the Texas Sedge for 14 counties with our specimen listed for Madison County. Our collection was rare under *Pinus echinata* on a western lower-slope.

4. *Crataegus macrosperma* Ashe.—Clark and Weckman (2008) record 12 counties for the Fanleaf Hawthorn mostly from eastern Kentucky, while Campbell and Medley (2012) confirm it from seven counties. The USDA, NCRS (2012) lists only Harlan and Letcher counties.

5. *Galium divaricatum* Pourr. ex Lam.—Campbell and Medley (2012) catalog Lamarck's Bedstraw for Campbell, Estill, and Powell Counties. USDA, NRCS (2012) record Campbell and Estill Counties, from records in Campbell and Medley (2006). Medley (1993) does not list *G. divaricatum* for Kentucky.

6. *Malus baccata* (L.) Borkh.—The complexity of Siberian Crabapple cultivars is discussed in Clark and Weckman (2008), but the taxon is not mapped. Campbell and Medley (2012) record Siberian Crabapple for Fayette, Floyd, and Jefferson Counties. The USDA, NRCS (2012) map Fayette and Floyd Counties. Our documented taxon appeared to be spontaneous, rather than planted, from a single fertile tree on the eastern aspect near the knob crest. Jones (2005) notes that the flowering crabapples, especially *M. baccata*, may occasionally escape in Kentucky.

7. *Malus prunifolia* (Willd.) Borkh.—Although the Chinese Plum-leaf Crabapple tends to escape and become locally established from cultivation (Campbell and Medley 2012), neither Clark and Weckman (2008) nor Campbell and Medley (2012) map Chinese Crabapple for Kentucky. Gleason and Cronquist (1991) corroborate that Chinese and Siberian Crabapples occasionally escape from cultivation. Several uneven-age specimens of this crabapple (including fruiting and flowering material) were documented from the western foot slope, so even if it might originally have been planted in the area, it is now clearly naturalized.

8. *Quercus phellos* L.—Willow Oak is documented from 22 counties according to Campbell and Medley (2012) and from 19 Kentucky counties by the USDA, NRCS (2012). A single, mature individual at DHK is present, although its origin is not clear. Given the long history of human presence in the area, this tree may be derived from a local source, or it may be a natural volunteered tree.

9. Ranunculus bulbosus L.—The naturalized Bulbous Buttercup is confirmed for 10 Kentucky counties in Campbell and Medley (2012) and also is listed for 10 counties by the USDA, NRCS (2012).

Invasive Plants

Fifty-two of the exotic species from Dead Horse Knob are considered naturalized invasive plant pests for Kentucky (KY-EPPC 2012). Based on our intensive observations, the most deleterious species on the peak appear to be the Old World woody plants: *Ailanthus altissima*, *Celastrus orbiculatus*, *Elaeagnus umbellata*, *Euonymus alatus*, *E. fortunei*, *Ligustrum obtusifolium* var. *obtusifolium Lonicera japonica*, *L. maackii*, and *Rosa multiflora*, all of which were deliberately introduced to the United States as ornamentals. Reichard and White (2001) discussed the role of ornamental horticulture in the spread of invasive plant introductions in the United States. Major horticultural sources of naturalized and invasive taxa include plant nurseries, landscaping enterprises, botanical gardens and arboreta, city and state parks, individual gardeners and farmers, and soil erosion control measures by state and governments agencies (Reichard & White 2001). We have no means of determining if any of these taxa were deliberately introduced at DHK, but there is no disputing that these ornamental taxa are now naturalized invasives having a profound impact on the vegetation in the area.

These same woody invasive taxa were the most significant woody plant pests in a comprehensive vascular plant survey of the Berea College Forest (Thompson 2008). At the knob, all nine of these invasive woody plants clearly meet the criteria of being "novel, invasive colonizers," i.e., the true invaders *sensu* Davis and Thompson (2000), aggressively expanding their geographical range and constituting a severe impact on the natural native flora and vegetation. Without doubt, the most aggressive invasive species with the greatest deleterious impact on the total vegetation and native plants of the knob is *Lonicera maackii*. This omnipresent species comprises a dense understory cover throughout all slope aspects of the Dry-Mesic Oak-Hickory Forest. Reichard and Hamilton (1997) noted that invasive woody plants are frequently more capable of vegetative reproduction than native woody plants in North America, but it is not clear how much, if at all, *L. maackii* spreads vegetatively at DHK. While it certainly regenerates readily when cut back, the clumps are of uneven sizes and ages, do not appear to be connected via rhizomes, and fruit copiously, which indicate that *L. maackii* may be spreading primarily by seed.

Invasive herbaceous plants with significant impact on the native flora and vegetation of the Dry-Mesic Oak-Hickory Forest include *Alliaria petiolata*, *Commelina communis*, *Microstegium vimineum*, *Persicaria longiseta*, *Schedonorus arundinaceus*, and *Stellaria media*, among several others. *Stellaria media* in the spring, *Commelina communis* and *Persicaria longiseta* (in the summer) and *Microstegium vimineum* (in the fall) are especially abundant throughout the entire knob forested habitats.

Plant Communities

Plant communities are defined as an assemblage of associated species with a definite floristic composition and a uniform physiognomy under rather consistent habitat conditions as detectable through field reconnaissance and sampling data (Thompson & Jones 2010). The DHK study area is completely bisected by a four-wired electric fence from the eastern foot slope aspect to the knob summit down through the western aspect foot slope. This nearly equivalent division of the study area into southern and northern halves was useful for delineating southern, western, northern, and eastern slope aspect habitats. The circular knob perimeter is surrounded by barbed wire fences where all foot slope aspects adjoin nearly level agricultural grassland pasture. We define essentially two community types here: a highly altered Dry-Mesic Oak-Hickory Forest Community comprised of five specific habitats and a heavily disturbed Culturally-Derived Ruderal Community composed of two habitats.

Dry-Mesic Oak-Hickory Forest Community

The major vegetation of the knob is a substantially human-influenced second and third growth stand of Dry-Mesic Oak-Hickory from the knob summit with mixed oaks and hickory down to upper, middle, and lower slopes where oaks and hickories are intermixed with planted pines on all four directional slope aspects. Indicator oak and hickory and other characteristic hardwoods in varying quantities are typically found in all size-age

classes from seedlings, saplings, pole-size, and mature trees. Three interplanted pine species, *Pinus echinata*, *P. strobus*, and *P. taeda*, are mainly mature-sized trees that exhibit little to no seedling recruitment. We estimated the occurrence of these pine stand plantings at approximately 22% of the total canopy cover of the forested knob, which included the entire study area and other communities/habitats described below.

Herbaceous and woody vegetation development has been considerably disturbed by livestock and by the severe influences of naturalized woody invasive plants. The overall effects on the flora and vegetation from cattle grazing, browsing, and trampling activities are currently more evident on the fenced northern half of the knob; nevertheless, the southern half has also been affected in species richness (number of plant species) and species diversity (types of plant species). The Dry-Mesic Oak Community is described from four slope aspect-delineated habitats: Knob Summit, Southern and Eastern Aspects, and Northern and Eastern Aspects, and a seasonal Western Foot Slope Seep.

1. Knob Summit.—Soils are mostly Coyler shaley silt loams at the DHK mountain crest (Fig. 2). Vegetation is comprised of Dry-Mesic Oak-Hickory Forest without planted pines. This dry, open-canopied knob summit habitat is typified by a sparse native herb layer, a very dense nearly impenetrable *Lonicera maackii* understory shrub layer and some tree seedlings and saplings in a canopy overstory of mature *Quercus* and *Carya* species. Important indicator trees are *Carya ovata*, *C. glabra*, *Quercus alba*, *Q. falcata*, *Q. stellata*, and a hardwood mixture of *Acer rubrum* var. *rubrum*, *Fraxinus americana*, *Nyssa sylvatica*, *Prunus serotina* var. *serotina*, *Quercus velutina*, and *Robinia pseudoacacia*. The two largest *Quercus alba* at the knob crest are 100.3 and 102.5 cm DBH, while the two largest *Q. stellata* are 103.1 and 105.8 cm DBH.

Besides *Lonicera maackii*, other naturalized woody plants include *Euonymus alatus*, *E. fortunei*, *Ligustrum obtusifolium* var. *obtusifolium*, and a single *Pyrus calleryana*. *Symphoricarpos orbiculatus* and *Rubus pensilvanicus* are typical native shrubs. The preeminent woody vines are *Lonicera japonica* and *Toxicodendron radicans* var. *negundo*. Characteristic native woody vines are *Parthenocissus quinquefolia*, *Smilax bona-nox*, *S. glauca*, and *Vitis vulpina*.

The herbaceous layer of the knob summit is sparse mainly due to the deleterious effects of *Lonicera maackii* and the dry topographic-moisture gradient from high insolation. The abundant exotic annual *Stellaria media* forms a nearly continuous spring ground cover. Important native graminoids are *Agrostis perennans*, *Carex blanda*, *C. glaucodea*, *C. swanii*, *Danthonia spicata*, *Dichanthelium acuminatum* var. *fasciculatum*, and *Sphenopholis intermedia*. Among the few native dicot herbaceous species are *Cardamine concatenata*, *Corydalis flava*, *Erigeron annuus*, *Galium aparine*, *Oxalis violacea*, *Paronychia canadensis*, *Penstemon brevisepalus*, *Phytolacca americana*, and *Potentilla simplex*.

At the Knob Summit during May 2011, Thompson and Poindexter (2011) conducted a quantitative floristic study of species richness within the Pullins-Rucker Cemetery after the removal of *Lonicera maackii* and other understory shrubs and tree saplings from a 30 × 15 m area with a chain saw and hand clippers. In September 2011, frequency data were determined through a 20 × 12 m test cemetery macroplot with thirty (1 × 1 m^2) quadrats randomly placed after *Lonicera maackii* removal. Likewise, frequency data were gathered through a reference macroplot in an adjacent *L. maackii* thicket using the same parameters (Thompson & Poindexter 2011).

Species richness in the 30 cemetery test quadrats contained 51 different species with nine additional taxa recorded outside the quadrats for a total of 60 taxa within the test macroplot. In order of decreasing frequency, taxa with 50% or greater frequency across the quadrats, were *Phytolacca americana*, *Oxalis stricta*, *Solanum ptychanthum*, *Erechtites hieraciifolius*, *Persicaria longiseta*, and *Ailanthus altissima* (Thompson & Poindexter 2011).

Twenty-one species were documented in the 30 quadrats of the reference *Lonicera maackii* macroplot, and only *L. maackii* and *L. japonica* had 50% or greater frequency (Thompson & Poindexter 2011).

A field trip in October 2011 after the September 2011 inventory within the cemetery macroplot revealed the additional presence of *Ageratina altissima*, *Clematis virginiana*, and *Symphyotrichum lateriflorum* for a total of 63 taxa. In March 2012, the cemetery macroplot was dominated by a thick cover of *Stellaria media* with in-

termixed *Lamium purpureum*, *Cardamine hirsuta*, *Galium aparine*, and *Taraxacum officinale* in order of relative abundance with several volunteer and resprouted *Lonicera maackii* seedlings and a few *Ailanthus altissima*, *Celastrus orbiculatus*, and *L. japonica* sprouts. During the monthly surveys in March through June 2012, 32 more species were discovered within the cemetery macroplot for an overall 95volunteering taxa. These new additions consisted of *Ambrosia trifida* var. *trifida*, *Anthoxanthum odoratum*, *Aralia spinosa*, *Arctium minus*, *Cardamine hirsuta*, *Carex swanii*, *Cerastium glomeratum*, *Cirsium discolor*, *C. vulgare*, *Corydalis flava*, *Daucus carota*, *Dichanthelium acuminatum* var. *fasciculatum*, *Erigeron philadelphicus*, *Galium aparine*, *Holcus lanatus*, *Juglans nigra*, *Juncus effusus* ssp. *solutus*, *J. tenuis*, *Lactuca serriola*, *Leersia virginica*, *Lepidium virginicum*, *Morus rubra*, *Packera glabella*, *Poa pratensis* ssp. *pratensis*, *Ranunculus abortivus*, *Rumex obtusifolius*, *Sanicula canadensis* var. *canadensis*, *Schedonorus arundinaceus*, *Solidago altissuma* var. *altissima*, *Torilis arvensis*, *Ulmus rubra*, and *Verbascum thapsus*.

These 95 species within the cemetery test macroplot comprised a noteworthy 32.65% of the total DHK species richness after additional collections from October 2011 and monthly collections during March-June 2012. Among these individuals, 10 of the colonizing herbaceous species were found only in the cemetery macroplot and nowhere else: *Acalypha rhomboidea*, *Ageratina altissima*, *Chamaesyce maculata*, *Cirsium discolor*, *Commelina diffusa*, *Conoclinum coelestinum*, *Eclipta prostrata*, *Eupatorium serotinum*, *Packera glabella*, and *Passiflora incarnata*. Most of the 60 species prior to the October 2011 collection were also observed during the 2012 trips.

A majority of the herbaceous species colonizing the cemetery macroplot are annuals and biennials from seeds and fruit propagules in the existing seed bank and from light, wind-carried diaspores of the seed rain (e.g., members of the Asteraceae). Most of these early successional annuals are not expected to persist as secondary succession continues in time with the presence of *Lonicera maackii* (Thompson & Poindexter 2011).

The plot sampling data from September 2011 revealed that a high density of *Lonicera maackii* was significantly correlated with lowered species richness of both exotic and native annual and perennial herbs, shrubs, and tree seedlings. Much greater species richness was evident in the cleared cemetery macroplot. The cemetery macroplot is being reinvaded by *L. maackii* and as predicted, it will result in a corresponding decrease in species richness and species diversity and comprise another thicket in a relatively short period of time without significant control measures (Thompson & Poindexter 2011).

2. Southern and Western Aspects.—The forested southern slope aspect from the summit down to foot slope is primarily composed of Coyler shaley silty clay loam soil, while the western slope aspect adjoining the summit inclining to foot slope is comprised mostly of Whitley silty clay loam (Fig. 2). The canopy composition on the drier southern and western slopes consists of Dry-Mesic Oak-Hickory Forest comparable to that at the knob summit with the addition of the interplanted *Pinus echinata*, *P. strobus*, and *P. taeda*, a few more native and exotic shrubs, and several more herbaceous species.

Most pines are mature canopy trees with some recruitment of Eastern White Pine seedlings and saplings evident, but no regeneration from Shortleaf Pine and Loblolly Pine. A few *Pinus virginiana* scattered throughout the southern and western slopes have sparse regeneration along with *Juniperus virginiana* var. *virginiana*. The three intermixed pine plantations were planted in 1962, according to information from the individual who supervised the plantings (C.L. Gentry, pers. comm. 2012). Most pines were planted on the southern, western, and northern middle slopes to lower slopes. Representative pine tree ages were confirmed by eight core samples on the southern aspect from four *Pinus strobus* and four *P. taeda*. The sample cores of the largest *Pinus strobus* of the southern aspect ranged from 47–49 yr old (41.5–55.0 cm DBH). Similarly, cores from the four largest *Pinus taeda* were 48–49 yr old (44.9–49.5 cm DBH). *Juniperus virginiana* var. *virginiana* is the most important coniferous indicator species among the oaks and hickories on the more open southwestern aspects. The largest *Quercus falcata* have DBHs of 103.3 and 105.8 cm. *Quercus imbricaria* is also an important additional species of the southern and western slopes with the two largest 66.7 and 77.0 cm DBH. Other characteristic trees are *Acer rubrum* var. *rubrum*, *Diospyros virginiana*, *Fraxinus americana*, *Nyssa sylvatica*, *Prunus serotina* var. *serotina*, *Robinia pseudoacacia*, and *Sassafras albidum*. *Lonicera maackii* is less prevalent on the drier southern and western slopes than the mesic northern and eastern aspects. Subcanopy trees and other shrubs

of varying abundances are *Amelanchier arborea*, *Cornus florida*, *Frangula caroliniana*, *Ilex opaca*, *Rhus copallinum* var. *latifolia*, *R. glabra*, *Rosa multiflora*, *Rubus pensilvanicus*, *Vaccinium stamineum*, and *Viburnum rafinesquianum*. *Symphoricarpos orbiculatus* is the most widespread native shrub. Important woody vines include *Campsis radicans*, *Lonicera japonica*, *Parthenocissus quinquefolia*, *Smilax bona-nox*, *S. glauca*, and the ubiquitous *Toxicodendron radicans* var. *negundo*.

Characteristic native herbs on the southern and western slopes down to the foot slopes adjoining the fence line and the grassland pasture are *Agrostis perennans*, *Andropogon virginicus* var. *virginicus*, *Carex leavenworthii*, *C. swanii*, *C. texensis*, *C. umbellata*, *Chimaphila maculata*, *Danthonia spicata*, *Dichanthelium acuminatum* var. *fasciculatum*, *Elymus virginicus* var. *virginicus*, *Juncus tenuis*, *Panicum anceps*, *Paronychia fastigiata*, *Penstemon brevisepalus*, *Phytolacca americana*, *Potentilla simplex*, *Sisyrinchium angustifolium*, and *Symphyotrichum dumosum* var. *dumosum*. *Tipularia discolor*, the only orchid species present, and *Polygonatum biflorum* var. *biflorum* are scarce at the western-trending middle slope.

3. Northern and Eastern Aspects.—The soil at the upper northern slope from the knob summit habitat is mostly Colyer shaley silt loam and on the lower slope to foot slope is Whitley silt loam soil. The eastern aspect is comprised of Coyler shaley silt loam that adjoins the summit and intergrades into the Whitley silt loam soils (Fig. 2). The canopy vegetation of the northern and eastern aspect slopes also consists of Dry-Mesic Oak-Hickory Forest interspersed with mixed pine plantings, as in the case of the southern and western-trending aspects (Fig. 2). Pine regeneration here is basically non-existent. A significant, marked difference between the mesic northern and eastern slope aspects is the presence of greater species richness of the herbaceous and woody plants than the southern and western slopes, although mature canopy trees tend to be smaller-sized. The higher native and exotic species richness of the northern and eastern topographic aspects is related to greater canopy shade, more available soil moisture, and deeper soils.

At DHK, slope aspect differences result in greater vegetation diversity and richness on the northern and eastern aspects but larger trees on the southern and western aspects. These data are congruent with recent slope aspect data from an Appalachian watershed study in West Virginia by Desta et el. (2004). More pronounced cattle grazing and trampling on the northern and eastern aspects have also influenced the presence of more abundant exotic herbs and shrubs than on the southern and western aspects with lesser livestock impact.

Major canopy trees are mainly those mentioned above for the Oak-Hickory knob crest and southern and western aspects. The largest trees of this area are *Acer rubrum* var. *rubrum* (74.1 cm DBH), *Prunus serotina* (87.4 cm), and *Robinia pseudoacacia* (91.2 cm). Other mature trees include *Acer negundo* var. *negundo*, *A. saccharum*, *Ailanthus altissima*, *Aralia spinosa*, *Celtis occidentalis*, *Fraxinus pennsylvanica*, *Morus rubra*, *Ulmus americana* var. *americana*, and *U. rubra*. A few *Quercus montana* are located on the northern mid-slope and *Liquidambar styraciflua* is present on the eastern lower slope.

Naturalized woody shrubs on the northern and eastern slopes are *Elaeagnus umbellata* var. *parviflora*, *Ligustrum obtusifolium* var. *obtusifolium*, *Lonicera maackii*, and *Rosa multiflora*, with the invasive woody vines, *Celastrus orbiculatus*, *Euonymus fortunei*, and *Lonicera japonica*. A marked difference is the lesser abundance of *Lonicera maackii* due to browsing and trampling by livestock on the fenced northern half of the knob. Characteristic native shrubs include *Rubus pensilvanicus*, *Sambucus canadensis*, and *Symphoricarpos orbiculatus*. *Toxicodendron radicans* var. *negundo* is the predominant native woody vine with fewer *Campsis radicans*, *Clematis virginiana*, *Parthenocissus quinquefolia*, *Smilax rotundifolia*, and *Vitis vulpina*. A few clumps of *Phoradendron leucarpum* ssp. *leucarpum* are found in three *Prunus serotina* var. *serotina* trees and a single *Gleditsia triacanthos* on the northern upper slope.

The herbaceous layer on the mesic northern and eastern aspects predictably has a high species richness and species diversity. *Carex amphibola*, *C. blanda*, and *C. grisea* are important sedges on the rich leaf mold soil litter layer. *Asplenium platyneuron* is scarce on the northern and northeast-trending mid-slopes. Other characteristic native herbs of various abundance are *Bidens bipinnata*, *Dichanthelium clandestinum*, *Elymus villosus*, *Erigeron annuus*, *Galium aparine*, *Paronychia canadensis*, *Phytolacca americana*, *Pilea pumila*, *Sanicula canadensis* var. *canadensis*, and *Symphyotrichum lateriflorum* var. *lateriflorum*. Invasive exotic herbs forming a signifi-

cant seasonal groundcover include vast amounts of *Commelina communis*, *Microstegium vimineum*, *Persicaria longiseta*, and *Stellaria media*.

4. Western Foot Slope Seep.—A small, seasonal seep habitat exists at a convex western foot slope near the area of the old clay pits formerly used for brick-making by Berea College (Fig. 2). The clay soil of the seep is comprised of eroded shaley Whitley silt loam. The few woody species at the seep edge include *Acer negundo* var. *negundo*, *Aralia spinosa*, *Clematis virginiana*, *Fraxinus pennsylvanica*, *Rubus pensilvanicus*, and *Sambucus canadensis*. The seasonal wetland habitat supports several graminoids, i.e., Cyperaceae, Juncaceae, and Poaceae. Indicator wetland sedges and rushes are *Carex annectans*, *C. frankii*, *C. lurida*, *C. tribuloides* var. *tribuloides*, *C. vulpinoidea*, *Cyperus strigosus*, and *Juncus effusus* ssp. *solutus*. Wetland grasses include *Agrostis gigantea*, *Echinochloa muricata* var. *muricata*, *Leersia virginica*, and *Phalaris arundinacea*. Other wetland plants include *Ambrosia trifida* var. *trifida*, *Commelina communis*, *Diodia virginiana*, *Hypericum mutilum* var. *mutilum*, *Persicaria longiseta*, *P. pennsylvanica*, and *P. punctata*.

Culturally-Derived Ruderal Communities

Two anthropogenic-derived communities are directly and indirectly influenced by activities of Berea College farm workers and disturbances caused by their livestock. In the case of the Berea College Farm agricultural enterprise, farm workers typically sow pasture and grain crops, mow pastureland, harvest hay and ensilage, and maintain Black Angus cattle and Kiko Spanish Cross goats, not to mention other undocumented historic events. These human and animal activities have resulted in significant influences on the composition of the native flora and vegetation below the junction bordering the Dry-Mesic Oak-Hickory Forest. Moreover, a significant impact on species richness and species diversity of native herbaceous plants in the Culturally-Derived Community is the consequence of the naturalized herbaceous plants now classified as invasive plant pests by the KY-EPPC (2012).

1. Southern Foot Slope Pasture and Feedlot.—A culturally-derived or ruderal habitat is present within a 0.17 ha triangular-shaped area lying between the circular southern lower slope and foot slope and a barbed wire fence border. Whitley silt loam is the predominant soil here (Fig. 2). This ruderal area serves as year-around livestock pasture and as a winter and spring feedlot. Tractor track paths from hay distribution and nearby crop cultivation create bare ground, which also influences plant colonization. Cattle continually create bare ground from disturbances through grazing, feeding on hay, manure deposition, and heavy ground trampling throughout the year.

Plant coverage is highly correlated with the seasonal patterns and respective phenology of the plant species and the highest species richness at DHK exists in this ruderal habitat. The surface ground area ranges from a mosaic of scattered bare to sparsely-vegetated to fully vegetated during the late summer and fall growing season, which have the greatest growth of weedy herbs. The floristic composition and coverage are dominated by a rich assemblage of many native and naturalized annual and perennial ruderal weedy species with very few woody taxa.

Important families with the largest number of exotic species from the southern foot slope pasture and feedlot, in descending order by number of species, are the Poaceae, Asteraceae, Brassicaceae, Fabaceae, Caryophyllaceae, and Polygonaceae. Naturalized grasses in the livestock-disturbed pasture and feedlot habitat include *Anthoxanthum odoratum*, *Dactylis glomerata*, *Digitaria ischaemum*, *D. sanguinalis*, *Echinochloa crus-galli* var. *crus-galli*, *Eleusine indica*, *Eragrostis cilianensis*, *Holcus lanatus*, *Poa annua*, *P. pratensis* ssp. *pratensis*, *Schedonorus arundinaceus*, *Setaria faberi*, *S. pumila* ssp. *pumila*, and *Sorghum halepense*, among other taxa. *Juncus tenuis* and *Plantago rugelii* are important native perennials of cattle paths and tractor tracks. Exotic dicots fluctuating in seasonal abundance include *Barbarea vulgaris*, *Cerastium fontanum* var. *vulgare*, *Cichorium intybus*, *Kummerowia striata*, *Plantago lanceolata*, *Persicaria longiseta*, *P. maculata*, *Ranunculus bulbosus*, *Rumex obtusifolius*, *Sonchus asper*, *Stellaria media*, *Trifolium campestre*, *T. dubium*, *T. pratense*, *T. repens*, *Veronica arvensis*, *V. persica* ssp. *persica*, and *Vicia sativa* ssp. *nigra*. Coarse rank-scented dicot weeds typical of feedlots and barnyards are *Abutilon theophrasti*, *Ambrosia artemisiifolia*, *Amaranthus hybridus*, *A. spinosus*, *Anthemis cotula*, *Chenopodium album*, *Datura stramonium*, *Dysphania ambrosioides*, *Matricaria discoidea*, *Sisymbrium officinale*, *Solanum*

ptychanthum, and *Xanthium strumarium*. Consistent with the information provided here, Daehler (1998) found that over-represented families among agricultural weeds tended to be mostly herbaceous annuals represented within the Asteraceae, Fabaceae, and Poaceae. Typically, these three families are characterized by rapid reproduction, abiotically dispersed diaspores, and adaptation to disturbed habitats.

2. *Perimeter Foot Slope Grassland Pasture*.—The open grassy pasture habitat is a narrow band between the fenced boundary and the circular eastern, northern, and western foot slope borders. Whitley silt loam is the predominant soil series (Fig. 2). Many of the notable weedy exotic and native annuals present in the southern pasture and feedlot are also established here. Herbaceous perennials constitute the major plant species of this grassy livestock grazing land with several grasses and legumes planted by Berea College Farm workers. The perimeter grassy pasture is predominately a thick cover of the introduced and now invasive Tall Fescue, *Schedonorus arundinaceus*. Other graminoids naturalized through agricultural sowing are *Dactylis glomerata*, *Phalaris arundinacea*, *Phleum pratense* ssp. *pratense*, and *Poa pratensis* ssp. *pratensis*. Perennials interspersed among Tall Fescue include other graminoids, *Paspalum laeve* var. *laeve*, *Setaria parviflora*, *Tridens flavus*, and the perennial forbs, *Plantago lanceolata*, *P. rugelii*, *Rumex crispus* ssp. *crispus*, *Solidago altissima* var. *altissima*, *Symphyotrichum dumosum* var. *dumosum*, *S. pilosum* var. *pilosum*, *Taraxacum officinale*, *Trifolium pratense*, *T. repens*, *Verbena urticifolia*, *Vernonia gigantea*, and *Viola sororia* var. *sororia*.

ANNOTATED PLANT LIST

An asterisk (*) before a scientific name signifies a naturalized exotic taxon. A double asterisk (**) before a scientific name designates a Kentucky invasive pest plant listed by the Kentucky Invasive Exotic Plant Pest Council (KY-EPPC 2012). A superscript circle (°) denotes a Madison County distribution record.

Nomenclature and taxonomic concepts for plant families and respective taxa follow Weakley (2011), with the exceptions of *Phoradendron leucarpum* ssp. *leucarpum*, which follows a recent nomenclatural correction (Abbott and Thompson 2011), and *Penstemon brevisepalus* (D. Estes, *in litt.*). Families are organized within the categories: MONILOPHYTES, GYMNOSPERMS, and ANGIOSPERMS, with angiosperms separated into MONOCOTS and "DICOTS," the latter a non-monophyletic assemblage that includes eudicots and the Lauraceae, a member of the paraphyletic basal grade of "primitive angiosperms."

Scientific names are followed by a common name, a relative abundance value, habitat designation, and voucher collection number(s), which concludes each taxon entry. Relative abundance is defined as follows: R (Rare)—1–4 plants or colonies, very difficult to find in one or two locations; S (Scarce)—5–10 plants or colonies, difficult to find; I (Infrequent)—11–30 plants or colonies, scattered; O (Occasional)—31–100 plants or colonies, widely scattered; F (Frequent)—101–1000 plants or colonies, easily found; and, A (Abundant)—greater than 1000 plants or colonies, a diagnostic indicator or dominant species.

The four *Dry-Mesic Oak-Hickory Forest Community* habitats are abbreviated as: KS=Knob Summit (includes cemetery macroplot); N-E=Northern and Eastern Aspects, S-W=Southern and Western Aspects; and WS=Western Foot Slope Seep. The two *Culturally-Derived Ruderal Community* habitats are condensed as: GP=Perimeter Foot Slope Grassland Pasture and PF=Southern Foot Slope Pasture and Feedlot. All habitats are listed alphabetically by abbreviation. Voucher specimen(s) are in an italicized *year-number* (e.g., *10-828*; *11-610*) format.

MONILOPHYTES

ASPLENIACEAE

Asplenium platyneuron (L.) B.S.P., Ebony Spleenwort. S; N-E.*10-828*

OPHIOGLOSSACEAE

Sceptridium dissectum (Spreng.) Lyon, Dissected Grape Fern. R.; KS. *11-610*

GYMNOSPERMS

CUPRESSACEAE

Juniperus virginiana L. var. *virginiana*, Eastern Red Cedar. F; S-W. *10-904*

PINACEAE

Pinus echinata P. Miller, Shortleaf Pine. O; S-W. *10-430*

Pinus strobus L., Eastern White Pine. O; N-E, S-W. *10-19*

Pinus taeda L., Loblolly Pine. O; N-E, S-W. *10-152*

Pinus virginiana P. Miller, Virginia Pine. I; S-W. *10-827*

ANGIOSPERMS: MONOCOTS

ALLIACEAE

**Allium vineale* L., Field Garlic. O; GP, PF, S-E. *10-411*

COMMELINACEAE

****Commelina communis** L., Asiatic Dayflower. A; KS, WS. *10-427; 11-650*

***Commelina diffusa** Burm. f., Creeping Dayflower. S; KS. *11-652*

CYPERACEAE

Carex amphibola Steud., Eastern Narrow-leaf Sedge. F; N-E. *10-253*

Carex annectens (E.P. Bickn.) E.P. Bickn., Yellow-fruited Sedge. O; PS, S-E. *10-409*

Carex blanda Dewey, Eastern Woodland Sedge. A; KS, N-E, S-W. *10-354; 12-366*

Carex frankii Kunth, Frank's Sedge. O; WS. *10-864*

Carex glaucodea Tuckerm. ex Olney, Blue Sedge. O; N-E. *10-405*

°*Carex gravida* L.H. Bailey, Heavy Sedge. R; S-W. *10-230; 10-352*

Carex grisea Wahlenb., Inflated Narrow-leaved Sedge. I; N-E. *10-353*

Carex leavenworthii Dewey, Leavenworth's Sedge. O; GP, S-W. *10-351, 11-118*

Carex lurida Wahlenb., Yellow-green Sedge. O; WS. *10-419*

Carex normalis Mack., Greater Straw Sedge. I; GP, S-W. *10-406*

Carex swanii (Fern.) Mack., Swan's Sedge. F; KS, S-W. *11-453; 12-365*

°*Carex texensis* (Torrey ex L.H. Bailey) L.H. Bailey, Texas Sedge. S; S-W. *10-248*

Carex tribuloides Wahlenb. var. *tribuloides*, Blunt Broom Sedge. O; WS. *10-829*

°*Carex umbellata* Schkuhr ex Willd., Parasol Sedge. F; KS, S-W. *11-120*

Carex vulpinoidea Michx., Fox Sedge. O; WS. *10-420*

Cyperus echinatus (L.) A.W. Wood, Globe Flatsedge. I; GP, PF. *10-899; 11-468*

Cyperus strigosus L., False Nutsedge. O; GP, KS, WS. *10-936; 11-651*

IRIDACEAE

Sisyrinchium angustifolium P. Miller, Narrowleaf Blue-eyed Grass. I; S-W. *10-238*

JUNCACEAE

Juncus effusus L. ssp. *solutus* (Fern. & Wieg.) Hämet-Ajto, Soft Rush. I; KS, WS. *12-838*

Juncus tenuis Willd., Slender Path Rush. F; PF, S-W, WS. *10-434*

ORCHIDACEAE

Tipularia discolor (Pursh) Nuttall, Cranefly Orchid. S; S-W. *10-18; 11-536*

POACEAE

***Agrostis gigantea** Roth, Redtop. O; GP, WS. *10-830*

Agrostis perennans (Walter) Tuckerm., Autumn Bent. F; KS, S-W. *10-891*

Andropogon virginicus L. var. *virginicus*, Old-field Broomsedge. O; S-W. *10-1067*

***Anthoxanthum odoratum** L., Sweet Vernal Grass. O; KS, PF. *11-107; 12-149*

***Bromus commutatus** Schrad., Meadow Brome. F; PF. *10-347*

Coleataenia anceps Michx. ssp. *anceps*, Beaked Panic-grass. O; GP, PF. *10-851*

***Dactylis glomerata** L., Orchard Grass. O; PF, GP. *10-190*

Danthonia spicata (L.) P. Beauv ex Roem. & J.A. Schult., Poverty Oat Grass. A; KS, S-E. *10-412*

Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *fasciculatum* (Torr.) Freckmann, Western Panic Grass. A; KS, S-W. *10-843; 12-710*

Dichanthelium clandestinum (L.) Gould, Deer-tongue Panic Grass. I; N-E. *10-896*

***Digitaria ischaemum** (Schreb.) Muhl., Smooth Crabgrass. F; KS, PF. *11-612*

***Digitaria sanguinalis** (L.) Scop., Hairy Crabgrass. A; KS, PF. *11-644*

****Echinochloa crus-galli** (L.) P. Beauv. var. *crus-galli*, Common Barnyard-grass. O; KS, PF. *11-637*

Echinochloa muricata (P. Beauv.) Fernald var. *muricata*, Rough Barnyard-grass. I; WS. *10-933*

****Eleusine indica** (L.) Gaertn., Goose-grass. O; PF. *10-886*

***Elymus repens** (L.) Gould, Quackgrass. S; PF. *10-838*

Elymus villosus Muhl. ex Willd., Hairy Wild-rye. I; N-E. *10-859*

Elymus virginicus L. var. *virginicus*, Virginia Wild-rye. S; S-W. *10-813*

****Eragrostis cilianensis** (All.) Vignolo ex Janch., Strong-scented Lovegrass. O; PF. *10-927*

Eragrostis pectinacea (Michx.) Nees ex Steud., Tufted Lovegrass. O; PF. *10-930*

****Holcus lanatus** L., Common Velvet Grass. O; GP, KS, PF. *10-348; 12-408*

Hordeum pusillum L., Little Barley. O; PF, S-W. *10-349*

Leersia virginica Willd., White Cutgrass. F; KS, WS. *10-863; 12-711*

****Lolium perenne** L. var. *aristatum* Willd. Italian Rye-grass. I; PF. *10-431*

****Microstegium vimineum** (Trin.) A. Camas, Nepalese Browntop. A; KS, N-E, S-W, WS. *10-941*

Muhlenbergia schreberi J.F. Gmel., Nimblewell Muhly. O; GP, N-E. *10-1055*

Panicum dichotomiflorum Michx., var. *dichotomiflorum*, Fall Panic-grass. O; KS, PE. *11-636*

Paspalum laeve Michx. var. *laeve*, Field Bead-grass. A; GP. *10-928*

***Phalaris arundinacea** L., Reed Canary-grass. I; GP, WS. *10-340*

***Phleum pratense** L. ssp. *pratense*, Timothy. O; GP. *10-417*

****Poa annua** L., Annual Bluegrass. A; PF. *10-154*

****Poa compressa** L., Canada Bluegrass. F; GP. *11-455*

****Poa pratensis** L. ssp. *pratensis*, Kentucky Bluegrass. A; GP, KS, PF. *10-191; 11-456; 12-147*

***Poa trivialis** L. ssp. *trivialis*, Rough Bluegrass. I; N-E. *10-438*

****Schedonorus arundinaceus** (Schreb.) Dumort, Tall Fescue. A; GP, KS, PF. *10-187; 12-407*

***Secale cereale** L., Cereal Rye. R; PF. *11-159*

****Setaria faberi** R.A.W. Herrm., Nodding Foxtail. O; KS, PF. *10-841; 11-643*

Setaria parviflora (Poir.) Kerguélen, Knotroot Foxtail. O; GP. *11-540*

***Setaria pumila** (Poir.) Roem. & Schult. ssp. *pumila*, Yellow Foxtail. O; KS, PF. *10-1044; 11-620*

****Sorghum halepense** (L.) Pers., Johnson Grass. O; GP, PF. *10-843*

Sphenopholis intermedia (Rydb.) Rydb. Slender Wedgegrass. O; KS, S-W. *10-242*

Tridens flavus (L.) A.S. Hitchc., Purpletop Tridens. O; GP, PF. *10-883*

***Triticum aestivum** L., Common Wheat. R; PF. *11-158*

RUSCACEAE

Polygonatum biflorum (Walter) Elliott var. *biflorum*, Smooth Solomon's-seal. I; S-W. *11-119*

SMILACACEAE

Smilax bona-nox L., Saw Greenbrier. O; KS, N-E, S-W. *10-1056*

Smilax glauca Walter, Glaucous Catbrier. F; KS, N-E, S-W. *10-918*

Smilax rotundifolia L., Common Roundleaf Greenbrier. I; N-E. *10-1045*

ANGIOSPERMS: "DICOTS" (including Lauraceae, a "basal angiosperm")

ADOXACEAE

Sambucus canadensis L., Common Elderberry. I; KS, N-E, WS. *10-402*

Viburnum rafinesquianum J.A. Schult., Downy Arrow-wood. R; S-W. *10-944*

ALTINGIACEAE

Liquidambar styraciflua L., Sweetgum. R; N-E. *10-856*

AMARANTHACEAE

***Amaranthus hybridus** L., Smooth Amaranth. F; PF. *11-649*

***Amaranthus spinosus** L., Spiny Amaranth. O; PF. *11-539*

****Chenopodium album** L., Lamb's Quarters. O; PF. 10-251

**Dysphania ambrosioides* (L.) Mosyakin & Clements, Mexican Tea. F, PF. *10-922*

ANACARDIACEAE

Rhus copallinum L. var. *latifolia* Engler, Eastern Winged Sumac. I; S-W. *10-814*

Rhus glabra L., Smooth Sumac. R; S-W. *10-1065*

Toxicodendron radicans (L.) Kuntze var. *negundo* (Greene) Reveal, Midwestern Poison Ivy. A; KS, N-E, S-W. *10-220*

APIACEAE

Chaerophyllum tainturieri Hooker var. *tainturieri*, Southern Chervil. O; N-E, PF. *10-196*

**Conium maculatum* L., Poison Hemlock. I; KS, PF. *10-410; 12-364*

**Daucus carota* L., Queen-Anne's-lace. F; GP, KS, PF. *10-840; 12-405*

Sanicula canadensis L. var. *canadensis*, Black Snakeroot. O; KS, N-E, S-W. *12-718*

**Torilis arvensis* (Hudson) Link, Field Hedge Parsley. R; KS, PF. *12-410; 12-724*

APOCYNACEAE

Apocynum cannabinum L., Indian Hemp. S; S-W. *10-819*

Cyanchum laeve (Michx.) Pers., Honeyvine. I; N-E. *11-469*

AQUIFOLIACEAE

Ilex opaca Aiton var. *opaca*, American Holly. I; N-E, S-W. *10-815*

ARALIACEAE

Aralia spinosa L., Spiny Aralia. R; KS, N-E, WS. *10-818; 12-154*

ASTERACEAE

Achillea millefolium L., Common Yarrow. O; GP, PF. *10-250; 12-723*

Ageratina altissima (L.) R.M. King & H. Robinson, White Snakeroot. R; KS. *11-679*

Ambrosia artemisiifolia L., Annual Ragweed. A; GP, KS, PF. *11-611*

Ambrosia trifida L. var. *trifida*, Great Ragweed. O; KS, PF, WS. *11-622; 12-712*

**Anthemis cotula* L., Mayweed. F; GP,PF. *12-721*

**Arctium minus* Bernh., Common Burdock. I; KS, N-E, PF. *10-852; 12-355*

Bidens bipinnata L., Spanish Needles. F; KS, N-E, S-W. *11-618*

Bidens frondosa L., Devil's Beggar-ticks. O; KS, WS. *11-641*

Bidens polylepis S.F. Blake, Ozark Tickseed-sunflower. I; GP. *10-920; 10-1061*

**Carduus nutans* L., Nodding Musk Thistle. I; KS, PF. *10-424; 12-354*

**Cichorium intybus* L., Chicory. F; GP, PF. *11-525*

Cirsium discolor (Muhl. ex Willd) Spreng, Glaucous Field Thistle. R; KS. *12-353*

**Cirsium vulgare* (Savi) Tenore, Bull Thistle. R; KS, PF. *11-544; 12-352*

Conoclinum coelestinum (L.) DC., Blue Mistflower. R; KS. *11-653*

Conyza canadensis (L.) Cronquist var. *canadensis*, Common Horseweed. O; GP, KS, PF. *11-616*

Coreopsis tinctoria Nutt. var. *tinctoria*, Golden Tickseed. S; PF. *11-470; 12-726*

**Eclipta prostrata* (L.) L., Yerba-de-Tago. R; KS. *11-529*

Elephanotopus carolinianus Raeusch., Carolina Elephant's-foot. I; GP, KS, PF. *10-901*

Erechtites hieraciifolius (L.) Raf. ex DC., Fireweed. F; KS, PF. *10-932; 11-645*

Erigeron annuus (L.) Pers., Annual Daisy Fleabane. F; KS, N-E, S-W. *10-441*

Erigeron philadelphicus L. var. *philadelphicus*, Philadelphia Fleabane. O; GP. *11-112*

Eupatorium serotinum Michx., Late flowering Eupatorium. O; KS. *11-676*

**Galinsoga quadriradiata* Ruiz & Pavón, Common Peruvian Daisy. O; KS, PF. *10-440; 11-647*

Gamochaeta purpurea (L.) Cabrera, Spoonleaf Purple Everlasting. S, PF. *12-361*

Lactuca canadensis L., Wild Canada Lettuce. I; N-E. *10-812*

**Lactuca serriola* L., Prickly Lettuce. O; KS, PF. *11-531; 12-409*

***Leucanthemum vulgare* Lam., Oxeye Daisy. I; GP. *10-233*

**Matricaria discoidea* DC., Pineapple-weed. I; PF. *11-121; 12-363*

Packera glabella (Poir.) C. Jeffery, Yellowtop. R; KS. *12-156*

Solidago altissima L. var. *altissima*, Tall Goldenrod. A; KS, GP, PF. *10-1060; 12-713*

**Sonchus asper* (L.) Hill, Spinyleaf Sow-thistle. O; KS, PF. *10-415*

Symphyotrichum dumosum (L.) G.L. Nesom var. *dumosum*, Bushy Aster. O; S-W. *10-1068*

Symphyotrichum lateriflorum (Willd.) G.L. Nesom var. *lateriflorum*, Calico Aster. F; KS, N-E, S-W. *10-1069; 11-675*

Symphyotrichum pilosum (Willd.) G.L. Nesom var. *pilosum*, White Old-field Aster. I; GP. *10-1064*

**Taraxacum officinale* G.H. Weber ex Wiggers, Common Dandelion. O; GP, KS, PF. *11-678; 12-17*

**Tragopogon dubius* Scop., Yellow Salsify. S; GP. *10-339*

Verbesina alternifolia (L.) Britton ex Kearney, Common Crownbeard. R; KS. *11-642*

Vernonia gigantea (Walter) Trelease, Tall Ironweed. I; GP, KS, PF. *10-939; 11-646*

Xanthium strumarium L. var. *canadense* (P. Miller) Torr. & A. Gray, Rough Cocklebur. F; PF, WS. *10-919*

BIGNONIACEAE

Campsis radicans (L.) Seem. ex Bureau, Trumpet Creeper. O; N-E, S-W. *10-842*

BORAGINACEAE

***Buglossoides arvensis* (L.) I.M. Johnston ssp. *arvensis*, Corn Gromwell. S; PF. *11-64*

Myosotis macrosperma Engelm., Large-seeded Forget-me-Not. I; PF. *11-105*

BRASSICACEAE

***Alliaria petiolata* (M. Bieb.) Cavara & Grande, Garlic Mustard. F; S-W. *10-146; 10-198*

**Arabidopsis thaliana* (L.) Heynh., Mouse-ear Cress. I; PF. *11-55*

***Barbarea vulgaris* R. Brown, Yellow Rocket. I; GP, PF. *11-53*

**Capsella bursa-pastoris* (L.) Medik., Shepherd's Purse. O; PF. *11-49*

Cardamine concatenata (Michx.) O. Schwartz., Cutleaf Toothwort. S; KS. *11-51*

**Cardamine hirsuta* L., Hairy Bittercress. A; GP, KS, PF. *11-36; 12-13*

**Draba verna* L., Whitlow-grass. F; PF. *10-25*

**Erysimum repandum* L., Treacle Wallflower. O; PF. *11-48*

**Lepidium campestre* (L.) R. Brown, Common Fieldcress. O; PF. *11-115*

Lepidium virginicum L. var. *virginicum*, Virginia Pepperweed. O; GP, KS, PF. *10-422; 12-350*

***Microthlaspi perfoliatum* (L.) F.K. Mey., Perfoliate Pennycress. I; PF. *11-33*

Planodes virginicum (L.) Greene, Virginia Winged Rockcress. O; GP, PF. *10-134; 11-35*

**Sisymbrium officinale* (L.) Scop., Hedge Mustard. O; PF. *11-465; 12-146*

**Thlaspi alliaceum* L., Garlic Pennycress. S; PF. *11-31*

**Thlaspi arvense* L., Field Pennycress. O; GP, PF. *10-137; 11-114*

CAMPANULACEAE

Lobelia inflata L., Indian Tobacco. O; KS, PF, S-W. *10-810; 11-639*

Triodanis perfoliata (L.) Nieuwl., Venus' Looking Glass. I; PF. *10-236*

CANNABINACEAE

Celtis occidentalis L., Northern Hackberry. F; KS, N-E, S-W. *10-394; 12-841*

CAPRIFOLIACEAE

****Lonicera japonica** Thunb., Japanese Honeysuckle. A; KS, N-E, S-W. *10-223*

****Lonicera maackii** (Rupr.) Herder, Amur Honeysuckle. A; KS, N-E, S-W. *11-677; 12-358*

Symphoricarpos orbiculatus Moench, Indian Currant. A; KS, N-E, S-W. *10-1047*

CARYOPHYLLACEAE

****Arenaria serpyllifolia** L., Thymeleaf Sandwort. O; PF. *11-160*

***Cerastium fontanum** Baumg. ssp. *vulgare* (Hartman) Greuter & Burdet., Common Mouse-ear Chickweed. F; GP, PF. *10-396*

***Cerastium glomeratum** Thuill., Sticky Mouse-ear Chickweed. F; KS, PF, S-W. *10-206; 12-411*

****Dianthus armeria** L. ssp. *armeria*, Deptford Pink. S; PF. *10-882*

Paronychia canadensis (L.) A.W. Wood, Smooth Forked Chickweed. F; N-E, S-W. *11-464*

Paronychia fastigiata (Raf.) Fernald, Hairy Forked Chickweed. O; N-E, S-W. *10-946*

***Silene latifolia** Poiret, White Campion. S; PF. *10-245; 10-246*

****Stellaria media** (L.) Villars, Common Chickweed. A; KS, N-E, S-W. *11-59; 12-356*

CELASTRACEAE

****Celastrus orbiculatus** Thunb., Oriental Bittersweet. F; KS, N-E, S-W. *10-805; 12-715*

****Euonymus alatus** (Thunb.) Sieb., Winged Burning Bush. I; N-E, S-W. *10-439*

****Euonymus fortunei** (Turcz.) Hand.-Mazz., Wintercreeper. A; KS, N-E, S-W. *10-1049; 12-18*

CONVOLVULACEAE

****Ipomoea hederacea** Jacq., Ivy-leaf Morning-glory. O; PF. *10-879*

Ipomoea lacunosa L., White Morning-glory. O; PF. *11-625*

****Ipomoea purpurea** (L.) Roth, Common Morning-glory. I; PF. *10-916*

CORNACEAE

Cornus drummondii C.A. Meyer, Roughleaf Dogwood. R; N-E. *10-820*

Cornus florida L., Flowering Dogwood. O; KS, N-E, S-W. *10-150; 10-1037*

EBENACEAE

Diospyros virginiana L., American Persimmon. O; KS, N-E, S-W. *10-398*

ELAEAGNACEAE

****Elaeagnus umbellata** Thunb. var. *parviflora* (Wall. ex Royle) C.K. Schneid., Autumn Olive. O; N-E, S-W. *10-429*

ERICACEAE

Chimaphila maculata (L.) Pursh, Spotted Wintergreen. I; S-W. *10-823*

Vaccinium stamineum L., Deerberry. R; S-W. *11-116*

EUPHORBIACEAE

Acalypha rhombiodea Raf., Rhomboic Copperleaf. S; KS. *11-627*

Euphorbia maculata L., Spotted Spurge. S; KS. *11-640*

Euphorbia nutans Lag., Small Eyebane Spurge. O; PF. *11-530*

FABACEAE

Desmodium paniculatum (L.) DC., Panicled Tick-trefoil. O GP, PF. *10-925*

Desmodium perplexum Schubert, Dillenius' Tick-trefoil. I; PF, S-W. *10-1063*

Gleditsia triacanthos L., Honey Locust. I; KS, N-E, S-W. *11-458*

****Kummerowia striata** (Thunb.) Schindl., Japanese Lespedeza. A; GP, PF. *10-934*

****Lespedeza cuneata** (Dum.-Cours.) G. Don, Sericea Lespedeza. O; GP. *10-1058*

****Medicago lupulina** L., Black Medick. S; PF. *11-156*

****Melilotus officinalis** (L.) Pallas, Yellow Sweetclover. O; PF. *11-163*

Robinia pseudoacacia L., Black Locust. F; KS, N-E, S-W. *10-195; 11-452*

****Securigera varia** (L.) Lassen, Crown Vetch. O; PF. *11-162*

***Trifolium campestre** Schreb., Pinnate Hop-clover. F; GP, PF. *10-247*

***Trifolium dubium** Sibth., Low Hop-clover. A; PF. *11-106*

***Trifolium pratense** L., Red Clover. A; GP, PF. *10-254*

***Trifolium repens** L., White Clover. A; GP, PF. *10-414*

***Vicia sativa** L. ssp. *nigra* (L.) Ehrh., Common Vetch. O; PF. *11-56*

***Vicia villosa** Roth ssp. *varia* (Host) Corbière, Winter Vetch. O; PF. *10-335*

FAGACEAE

Quercus alba L., White Oak. A; KS, N-E, S-W. *10-1034*

Quercus falcata Michx., Southern Red Oak. F; KS, N-E, S-W. *10-400*

Quercus imbricaria Michx., Shingle Oak. F; N-E, S-W. *10-1050*

Quercus montana Willd., Chestnut Oak. I; N-E. *10-1046*

Quercus palustris Muenchh., Pin Oak. R; S-W. *10-948*

°*Quercus phellos* L., Willow Oak. R; S-W. *10-1036*

Quercus stellata Wangenh., Post Oak. F; KS, N-E, S-W. *10-1043*

Quercus velutina Lam., Black Oak. F; KS, N-E, S-W. *10-1041*

FUMARIACEAE

Corydalis flava (Raf.) DC., Pale Corydalis. F; KS, N-E. *10-143; 12-14*

GERANIACEAE

Geranium carolinianum L., Carolina Crane's-bill. F; GP, PF. *10-197*

***Geranium dissectum** L., Cutleaf Crane's-bill. I; KS, PF. *11-108; 12-359*

HYPERICACEAE

Hypericum mutilum L. var. *mutilum*, Dwarf St. John's-wort. I; WS. *10-862*

Hypericum punctatum Lam., Spotted St. John's-wort. I; S-W. *10-806*

JUGLANDACEAE

Carya cordiformis (Wangenh.) K. Koch, Bitternut Hickory. R; N-E. *10-1038*

Carya glabra (P. Miller) Sweet, Pignut Hickory. F; KS, N-E, S-W. *10-915*

Carya ovata (P. Miller) K. Koch, Shagbark Hickory. F; KS, N-E, S-W. *10-816*

Juglans nigra L., Black Walnut. I; KS, N-E. *10-870*

LAMIACEAE

****Glechoma hederacea** L., Ground-ivy. A; GP, N-E. *10-232*

Hedeoma pulegioides (L.) Pers., American Pennyroyal. O; PF. *10-938*

****Lamium amplexicaule** L. var. *amplexicaule*, Henbit Dead-nettle. F; PF. *11-32*

***Lamium purpureum** L., Purple Dead-nettle. F; KS, N-E, PF. *11-54; 12-16*

Prunella vulgaris L. var. *lanceolata* (Bart.) Fernald, American Self-heal. S; GP, PF. *10-897*

LAURACEAE

Sassafras albidum (Nuttall) Nees, Sassafras. F; KS, N-E, S-W. *10-441*

MALVACEAE

***Abutilon theophrasti** Medik., Indian Velvetleaf. O; PF. *10-949*

***Sida spinosa** L., Prickly Sida. F; PF. *11-624*

MORACEAE

***Morus alba** L., White Mulberry. R; N-E. *11-631*

Morus rubra L., Red Mulberry. I; KS, N-E, S-E. *10-421; 12-840*

NYSSACEAE

Nyssa sylvatica Marshall, Black gum. F; KS, N-E, S-W. *10-403*

OLEACEAE

Fraxinus americana L., White Ash. O; KS, N-E, S-W. *10-1062; 12-720*

Fraxinus pennsylvanica Marshall, Green Ash. I; N-E, WS. *11-467*

***Ligustrum obtusifolium** Sieb. & Zucc. var. *obtusifolium*, Border Privet. O; KS, N-E, S-W. *10-333*

OXALIDACEAE

Oxalis dillenii Jacq., Southern Yellow Wood-sorrel. F; N-E, PF, S-W. *10-202; 11-528*

Oxalis stricta L., Common Yellow Wood-sorrel. A; KS, N-E, S-W. *10-903; 11-628*

Oxalis violacea L, Violet Wood-sorrel. O; KS. *10-148*

PASSIFLORACEAE

Passiflora incarnata L., Maypops. R; KS. 11-617

Passiflora lutea L. var. glabriflora Fernald, Yellow Passion-flower. R; KS. 11-463

PHYTOLACCACEAE

Phytolacca americana L., Common Pokeweed. A; KS, N-E, PF, S-W. *10-868*

PLANTAGINACEAE

Penstemon brevisepalus Pennell, Appalachian Beard-tongue. O; KS, N-E, S-W. *10-342*

**Plantago lanceolata* L., English Plantain. F; GP, PF. *10-885*

Plantago rugelii Decne., Rugel's Plantain. F; GP, PF. *10-811*

**Veronica arvensis* L., Corn Speedwell. A; GP, PF. *10-212*

**Veronica peregrina* L. ssp. *peregrina*, Common Purslane speedwell. F; PF. *11-47*

**Veronica persica* Poiret, Bird's-eye Speedwell. I; GP. *11-37*

POLYGONACEAE

***Persicaria longiseta* (de Bruijn) Kitagawa, Asiatic Smartweed. A; KS, N-E, PF, S-W, WS. *10-839*

***Persicaria maculosa* S.F. Gray, Spotted Lady's-thumb. I; PF. *10-878*

Persicaria pensylvanica (L.) M. Gómez, Pennsylvania Smartweed. O; PF, WS. *10-926*

Persicaria punctata (Elliott) Small, Dotted Smartweed. F; KS, PF, WS. *10-895*

**Polygonum aviculare* L., Common Knotweed. O; PF. *11-537*

Polygonum erectum L., Erect Knotweed. S; PF. *10-1042*

***Rumex acetosella* L., Red Sheep Sorrel. O; PF, S-W. *10-213*

**Rumex crispus* L. ssp. *crispus*, Curly Dock. O; GP, PF. *10-252*

**Rumex obtusifolius* L., Bitter Dock. O; GP, KS, PF. *11-538; 12-719*

RANUNCULACEAE

Clematis virginiana L., Virgin's-bower. O; KS, N-E. *11-674; 12-716*

Ranunculus abortivus L., Kidneyleaf Buttercup. F; GP, KS, PF. *10-140; 12-15*

*°**Ranunculus bulbosus* L., Bulbous Buttercup. A; GP, KS, PF. *11-454; 12-412*

RHAMNACEAE

Frangula caroliniana (Walter) A. Gray, Carolina Buckthorn. O; S-W. *10-1039*

ROSACEAE

Amelanchier arborea (Michx. f.) Fernald, Common Serviceberry. S; S-W. *10-1040*

Crataegus crus-galli L., Cockspur Hawthorn. R; S-W. *10-850*

°Crataegus macrosperma Ashe, Fanleaf Hawthorn. R; N-E. *10-1057; 12-152*

Geum canadense Jacq., White Avens. O; N-E. *10-825*

*°*Malus baccata* (L.) Borkh., Siberian Crab-apple. R; N-E. *10-1051; 11-61*

*°*Malus prunifolia* (Willd.) Borkh., Plum-leaf Chinese Crab-apple. R; S-W. *10-1070; 11-62*

***Potentilla indica* (Andr.) T. Wolf, Indian Strawberry. A; N-E, PF. *10-249*

***Potentilla recta* L., Sulphur Cinquefoil. I; PF. *11-164*

Potentilla simplex L., Old-field Cinquefoil. O; KS, S-W. *10-20*

Prunus serotina Ehrh. var. *serotina*, Wild Black Cherry. F; KS, N-E, S-W. *11-117; 12-151*

**Pyrus calleryana* Decne., Bradford Pear. S; KS. *10-1035*

***Rosa multiflora* Thunb. ex Murr., Multiflora Rose. O; N-E, S-W. *10-209*

Rubus pensilvanicus Poiret, Pennsylvanica Blackberry. F; KS, N-E, S-W, WS. *12-360*

RUBIACEAE

Diodia virginiana L., Virginia Buttonweed. R; WS. *11-535*

Galium aparine L., Cleavers. A; KS, N-E, S-W. *10-144; 12-404*

*°*Galium divaricatum* Pourr. ex Lam., Lamarck's Bedstraw. R; PF. *10-393*

***Galium pedemontanum* (Bellardi) Ehrend., Piedmont Bedstraw. A; GP, PF. *10-341*

SAPINDACEAE

Acer negundo L. var. *negundo*, Box-elder Maple. S; N-E, WS. *10-900*

Acer rubrum L. var. *rubrum*, Red Maple. F; KS, N-E, S-W. *10-404*

Acer saccharum Marshall, Sugar Maple. F; KS, N-E. *10-192*

SCROPHULARIACEAE

**Verbascum blattaria* L., Moth Mullein. I; PF. *10-884*

**Verbascum thapsus* L., Common Woolly Mullein. I; KS, PF. *11-460; 12-834*

SIMAROUBACEAE

***Ailanthus altissima* (P. Miller) Swingle, Tree-of-Heaven. F; KS, N-E, S-W. *10-822*

SOLANACEAE

**Datura stramomium* L., Jimson-weed. O; PF. *10-950; 12-722*

Physalis angulata L. var. *angulata*, Smooth Ground-cherry. S; PF. *10-1048*

Solanum carolinense L. var. *carolinense*, Bull-nettle. O; KS, PF. *10-935*

Solanum ptychanthum Dunal, American Black Nightshade. O; KS, PF. *11-615*

ULMACEAE

Ulmus americana L. var. *americana*, American Elm. I; N-E, *10-1052*

Ulmus rubra Muhl., Slippery Red Elm. O; KS, N-E, S-W. *10-803; 12-406*

URTICACEAE

Pilea pumila (L.) A. Gray, Clearweed. F; N-E, WS. *10-887*

VERBENACEAE

Verbena urticifolia L., White Vervain.O; GP, KS, PF. *11-614; 12-725*

VIOLACEAE

**Viola arvensis* Murr., European Field-pansy. F; PF. *11-113; 12-148*

Viola bicolor Pursh, Wild Field-pansy. O; PF, S-W. *10-203; 11-47*

Viola sororia Willd. var. *sororia*, Common Blue Violet. F; GP, N-E, PF. *10-135*

VISCACEAE

Phoradendron leucarpum (Raf.) Reveal & M.C. Johnston. ssp. *leucarpum*, American Mistletoe. S; N-E. *10-1071* (hemiparasitic on *Prunus serotina* var. *serotina*); *11-457* (hemiparasitic on *Gleditsia triacanthos*)

VITACEAE

Parthenocissus quinquefolia (L.) Planchon, Virginia-creeper. F; KS, N-E, S-W. *10-343*

Vitis vulpina L., Frost Grape. O; KS, N-E, S-W. *10-1053*

CONCLUSIONS

With ties back to the Revolutionary War and even the bricks that make up part of the historic Berea College campus, Dead Horse Knob could be carefully managed in the years to come. Our study of the vascular flora and

altered plant habitats of Dead Horse Knob documents a heavily invaded modern landscape and provides a reference baseline for future comparative studies and data for potential land management decisions. The general trends supported by our data include:

1. The DHK has a high species richness for such a small site. The largest families in terms of taxa are the Poaceae, Asteraceae, Cyperaceae, Fabaceae, and Brassicaceae. Although the order of the families varies from site to site, this same trend is supported by other floristic surveys of anthropogenically-influenced areas in southern Madison County (e.g., Wade & Thompson 1990; Thompson & Fleming 2004; Thompson 2005; Thompson 2008). Directly correlated to this species richness trend, most exotics found in this study (116; 39.9% of the total flora) are members of the Asteraceae, Brassicaceae, Fabaceae, and Poaceae.

2. Fifty-two of the exotic taxa (17.9% of the total number of species) are also Kentucky-listed invasive plant pests. Woody Old World invasive taxa are the most influential in the Dry-Mesic Oak-Hickory Community, and invasive Eurasian herbaceous taxa are most important in the Culturally-Derived Communities.

3. The Asian shrub, *Lonicera maackii*, has the most detrimental impact overall on the native forest flora and vegetation and natural secondary succession. Although species composition and species richness of native forest herbs, shrubs, and trees are also affected by other woody invasives such as *Ailanthus altissima*, *Celastrus orbiculatus*, *Eleaegnus umbellatus*, *Euonymus fortunei*, *Ligustrum obtusifulium* var. *obtusifolium*, *Lonicera japonica*, and *Rosa multiflora*, the omnipresent *Lonicera maackii* will continue to dominate the shrubby understory over time through seed recruitment, succession adaptations, shade tolerance, and allelopathy without repeated anthropogenic control and management measures.

4. Ninety-five (32.65%) or nearly one-third of the total DHK flora have volunteered or colonized the 20× 12 m cemetery macroplot after *Lonicera maackii* removal in 2011. Most are annuals and biennials derived from seeds and fruit propagules within the existing seed bank within the macroplot and from light wind-transported diaspores through seed rain from the immediate environs.

5. The major plant community, Dry-Mesic Oak-Hickory Forest, can be delineated into four habitats and exhibits heterogeneity in species richness and relative abundance of the existing flora, related to topography, slope aspect, and historic land usage. Higher-insolated southern and western aspects habitats are drier, hotter, and sunnier. These areas exhibit less diversity, though some species are restricted to these conditions. Habitats on the mesic, shaded, northern and eastern slope aspects display greater species richness mainly as a result of a more growth conducive environment.

6. In addition to the human-mediated introduction of invasive exotics, historic and ongoing anthropogenic influences on vegetation structure include clearing the land (whether for a cemetery, brick-making, farming, or timber-harvest), planting pines, and introduction of cattle and goats. Livestock disturbances from grazing, browsing, and trampling on all four directional aspects of the knob continues to impact species composition of native herbs and woody plants in the Dry-Mesic Oak-Hickory Forest, as well as in the non-forested areas.

7. Culturally-Derived or Ruderal Communities are created and maintained through anthropogenic disturbances, primarily related to livestock trampling and grazing and agricultural farming practices. These two habitats support the highest ruderal weedy flora and are dominated by exotic and native annuals and perennials, especially within the Poaceae, Fabaceae, and Asteraceae.

8. Woody and herbaceous invasive plant colonizers at Dead Horse Knob are expected to continue to severely influence litter decomposition, disturb soil nutrient cycles, disrupt nitrogen-fixation, compete for resources, replace native flora and vegetation, change patterns of seedling germination, reproduction, and regeneration, and alter overall natural secondary plant succession. What this means for the native vegetation at the knob will only be known with certainty in the decades to come, but without active control of the exotics it certainly seems likely that the invasives will continue to increase in abundance, out competing the natives and reducing overall species diversity and species richness. This current study provides a reference baseline for future comparative work.

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