

# A Rapid Terrestrial Ecological Assessment of Kessler Mountain Reserve

## City of Fayetteville, Washington County, Arkansas



A shale barrens community in a saddle on the main ridge of Kessler Mountain supports prairie grasses including little bluestem (*Schizachyrium scoparium*) and big bluestem (*Andropogon gerardii*), as well as a rich diversity of sun-loving wildflowers growing under old, stunted post oak (*Quercus stellata*), northern red oak (*Quercus rubra*), Shumard oak (*Quercus shumardii*), and chinquapin oak (*Quercus muehlenbergii*) trees. This area represents one of the most unusual and highest quality natural communities in the reserve, containing post oak trees more than 250 years old.

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**Arkansas Natural Heritage Commission**

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# **A Rapid Terrestrial Ecological Assessment of Kessler Mountain Reserve City of Fayetteville, Washington County, Arkansas**

**By Theo Witsell, Arkansas Natural Heritage Commission**

## **Executive Summary**

The Arkansas Natural Heritage Commission (ANHC), under contract with the Fayetteville Natural Heritage Association (FNHA), conducted a rapid ecological assessment of the Kessler Mountain Reserve from April through October 2014. This report summarizes findings based on six separate inventory trips to the reserve (15 days total) by Theo Witsell, Botanist and Ecologist with the ANHC. This inventory documented 11 natural communities or habitats and 544 plant species present in the study area. Five areas or habitats were identified as being especially ecologically significant to the site. Populations of at least nine plant and animal species of state conservation concern (rare species) were documented, at least two of them considered to be of global concern. One globally rare plant species, Missouri ground-cherry, had not been documented from Arkansas in more than 60 years. A second, Church's wild rye, was not previously known from Washington County. This report presents an ecological overview of the site, descriptions of the natural communities present, maps and brief descriptions of ecologically significant areas, maps of known occurrences of species of conservation concern, and an annotated list of plant species documented from the study area. It also makes recommendations for ecological management and provides an annotated list of those non-native invasive plant species present that are considered to be a threat to the integrity of natural communities on the reserve.

## **Background and History**

Kessler Mountain Reserve (Figs. 1, 2, & 3) is owned by the City of Fayetteville and includes 376 acres on Kessler Mountain. This tract is adjacent to additional city-owned property and private lands, some affiliated with Mt. Kessler Greenways, an advocacy group that maintains trails and works to ensure protection and compatible development of the area. In 2014, prior to planning for trails and other development, the Fayetteville Natural Heritage Association (FNHA) contracted with the Arkansas Natural Heritage Commission (ANHC) to conduct a rapid ecological assessment of the reserve in order to identify any significant ecological communities and/or sensitive areas and species. The ANHC is a key resource in providing data to identify such areas and provide technical assistance regarding their management needs.

Six trips (15 days total) were made to the site by ANHC staff, partners, and volunteers in April, May, June, September, and October 2014 to conduct field inventory for this assessment. Dates of these field trips were as follows:

23 April 2014 – Theo Witsell (ANHC Botanist/Ecologist) with Joe Neal, Joan Reynolds, and David Oakley

24 April 2014 – Theo Witsell (ANHC Botanist/Ecologist) with David Oakley

25 April 2014 – Theo Witsell (ANHC Botanist/Ecologist) with Mitchell Pruitt

28 May 2014 – Theo Witsell (ANHC Botanist/Ecologist)

29 May 2014 – Theo Witsell (ANHC Botanist/Ecologist) & Mike Slay (Ozark Karst Program Director, The Nature Conservancy)

30 May 2014 – Theo Witsell (ANHC Botanist/Ecologist)

18 June 2014 – Theo Witsell (ANHC Botanist/Ecologist)

10 September 2014 – Theo Witsell (ANHC Botanist/Ecologist)

11 September 2014 – Theo Witsell (ANHC Botanist/Ecologist)

12 September 2014 – Theo Witsell (ANHC Botanist/Ecologist)

24 September 2014 – Theo Witsell (ANHC Botanist/Ecologist)

25 September 2014 – Theo Witsell (ANHC Botanist/Ecologist)

26 September 2014 – Theo Witsell (ANHC Botanist/Ecologist)

30 October 2014 – Theo Witsell (ANHC Botanist/Ecologist)

31 October 2014 – Theo Witsell (ANHC Botanist/Ecologist)

Data gathered during these site visits provided the basis for this ecological assessment. However, it should be understood that this was a rapid assessment and that not all areas of the reserve were visited in all seasons or during all trips. As such, this inventory should not necessarily be considered comprehensive. Some plant species, for example, are visible and/or identifiable only during certain times of the year. Also, while the inventory of the flora and plant communities was thorough, no detailed or methodical survey of the fauna was performed.

## **Methods**

The study area consisted of the reserve tract plus a narrow corridor along the Rock City Trail from the trailhead to the reserve (this trail was walked to access the reserve from the north), and a small area east of the tract on adjacent city property, southwest of the water tanks (this area was walked to access the lower bluffs on the east side of the reserve).

GIS (Geographic Information Systems) software (ArcGIS 10) was used to analyze a variety of aerial imagery (from 1965 to 2014) as well as topographic, soils, and geologic data to determine where various plant communities or habitats were likely to occur. Representative sites of each potential community were visited multiple times during the growing season from April to October 2014. Concepts of what plant communities and habitats were present evolved as field work progressed and efforts were made to explore the full range of ecological and geological variation present on the site. All established trails were walked multiple times and all major blufflines (above and below bluffs), all major drainages, and the powerline right-of-way near the northern boundary of the tract were all walked at least once (many several times). Multiple transects were also walked across more remote areas of the tract to ensure that there was adequate coverage of the area.

Records were kept on all vascular (higher) plant species encountered and the habitat(s) in which they grew. These data are summarized in Appendix G. GPS coordinates were taken to record the locations of all populations of species of conservation concern and detailed data (date, population size and condition, habitat, associated species, etc.) were collected for each occurrence. These data are being provided to the FNHA and the City of Fayetteville. More than 100 plant specimens were collected to confirm difficult identifications and/or document interesting or unusual species. These will be deposited at the herbarium of the Arkansas Natural Heritage Commission (ANHC), the University of Arkansas Herbarium (UARK), and/or other state and regional herbaria to serve as a permanent record. Non-vascular plants such as bryophytes (mosses, liverworts, and hornworts) and algae were not inventoried, nor were fungi or lichens.

Individuals and organizations knowledgeable about Kessler Mountain were consulted about the history and ecology of the area and about any interesting or unusual areas of the reserve that they were aware of. This included members of the FNHA, Northwest Arkansas Audubon Society, Northwest Arkansas Master Naturalists, and Arkansas Native Plant Society. Members of these organizations accompanied me on several early field trips and are listed in the acknowledgments section. Several experts in various disciplines (geology, karst ecology, reptiles and amphibians, and certain taxonomic groups) were consulted and are also listed in the acknowledgments. Several groundwater-fed wetlands (seeps and springs) were sampled for invertebrates by Mike Slay (Ozark Karst Program Director for The Nature Conservancy) on 29 May 2014. Dr. J. D. Willson (U of A Dept. of Biological Sciences) provided a summary of his reptile and amphibian inventory work at Kessler Mountain, most of which was conducted as part of BioBlitz events.

## **Site Description**

### ***General Description***

Kessler Mountain Reserve (Figs. 1, 2, & 3) contains 376 acres and is located southwest of Fayetteville, Arkansas, at the northwestern edge of the Boston Mountains Ecoregion, at its boundary with the Springfield Plateau Ecoregion, which lies just off the mountain to the north and west. The tract lies

north of Kessler Mountain Road and southwest of the end of West Finger Road. Approximate centrum coordinates for the tract are N36.02695, W94.21660.

Kessler Mountain is one of a series of hills (representing the northwestern edge of the Boston Mountains) sitting on top of the Springfield Plateau surface. The terrain of these hills is steep and rugged, with many of the hills fringed by sheer bluffs. The terrain of the surrounding plains is flat to rolling.

Kessler Mountain Reserve contains approximately 480 feet of topographic relief (Fig. 3), with elevations ranging from roughly 1820 feet just north of the radio tower on the north side of Kessler Mountain Road (near the southwest corner of the property) to roughly 1340 feet where an ephemeral creek leaves the western edge of the property (about 0.15 mile east of Archie Watkins Road). The tract sits on a north-south trending ridge (Kessler Mountain), and includes parts of two shorter, perpendicular secondary ridges that project out to the east. All slopes and aspects are present to some degree though there is little southwest-facing aspect on the tract.

The reserve is almost entirely forested with the majority of the tract appearing to have been selectively logged in the past but otherwise kept in forest cover. Several areas, however, show signs of past human use (Fig. 17) including old roads, stone walls, remnants of fences, a root cellar, artificial ponds, stumps, and stump-sprouted trees. Several areas were cleared for pasture or other agricultural use historically and have reverted to forest cover of varying ages (Fig. 8). In a 1965 aerial photograph, flat areas on the tops of both of the smaller, secondary ridges on the east side of the tract still showed signs of earlier clearing (though they were already in succession to forest by this time). In a 1968 aerial photo the field on the southern-most of these two ridges had evidently been recently cleared and expanded (brush piles from this clearing are still visible in the image) (Fig. 16f). By 1994 (the next image available) this field was already covered in young forest again. Additional areas below the bluffs on the east and west sides of the tract also show signs of earlier clearing in both the 1965 and 1968 photograph, and a small area on the top of the main ridge along the Trent Trail also shows signs of earlier clearing. Small pockets of “old growth” trees remain in scattered areas of the reserve and are often associated with steep and/or rocky sites.

## ***Geology, Soils, and Hydrology***

### **Geology**

The geology of Kessler Mountain (Fig. 4) is comprised of Mississippian- and Pennsylvanian-aged limestones, sandstones, and shales (King et al. 2001; McFarland 2004). The strata are flat to nearly flat with no major faults located on the tract. From base to top, the primary geologic units are the Fayetteville Shale (including the Lower Fayetteville Shale, Wedington Sandstone, and Upper Fayetteville Shale), the Pitkin Limestone, the Hale Formation (including both the Cane Hill and Prairie Grove Members), the Bloyd Formation (including the Brentwood Limestone, the Woolsey Member, and the Kessler Limestone), and the Atoka Formation (including the Trace Creek Shale and the Atoka Sandstone) (King et al. 2001; McFarland 2004). These geologic units create both calcareous (alkaline) and acidic

soils, each with their own characteristic plant communities. While limestones reliably produce calcareous soils, the chemistry of the sandstones and shales on the reserve is not necessarily straightforward. At least some areas or formations support vegetation indicative of a high (calcareous) pH and others support vegetation indicative of a low (acidic) pH.

The main bluff-forming units on the tract are the Brentwood Limestone (Fig. 18d) and Prairie Grove Sandstone (Figs. 9a & 18a-c) (mainly on the west side of the mountain) and the Cane Hill Member (Fig. 20) (on both the east and west sides of the mountain). The Kessler Limestone (Fig. 9f) outcrops locally in a series of low bluffs or ledges along the Eggbeater Trail on the west side near the top of the mountain. Several formations on the tract include various marine fossils (Fig. 9b-d).

Permanent or semi-permanent (wet at least into the early summer) seeps and springs (Figs. 23 & 24) occur at the base of the Kessler Limestone, at contacts between limestone and shale layers within the Cane Hill Member of the Hale Formation, at the base of the Pitkin Limestone, and associated with the Wedington Sandstone Member of the Fayetteville Shale.

## **Soils**

Seven soil units are mapped on the tract by the Natural Resources Conservation Service (Fig. 5). Enders-Allegheny Complex (clayey to loamy soils with pH ranging from 4.6 to 5.0, weathered from acid shale and sandstone) is the main soil type present. The steeper class of this type on the tract, 20 to 40% slopes, occupies nearly the entire ridge of Kessler Mountain within the tract, and extends below the main bluffs on both the east and west sides of the mountain. A less steep class, 8 to 20% slopes, occurs on both the east and west sides of the mountain below the bluffs in the southern part of the tract. Allen Stony Loam (loamy soils with a pH averaging about 5.0, weathered from sandstone and shale), 12 to 35% slopes, occurs on the west side of the mountain below the bluff in the southern part of the tract. Fayetteville Fine Sandy Loam (loamy soils with a pH averaging 6.1, weathered from calcareous sandstone), 3 to 8% slopes, occurs on a flat bench (formerly cleared) at the northeast corner of the tract. Hector-Mountainburg Gravelly Fine Sandy Loam (loamy soils with a pH ranging from 5 to 5.8, weathered primarily from sandstone), 3 to 8% slopes, occurs on a flat bench (formerly cleared) in the southeastern part of the tract. Hector-Mountainburg Stony Fine Sandy Loam, 3 to 40% slopes, occurs on steeper areas associated with bluffs in the northeastern and southeastern parts of the tract. Elsay Cobbly Soils (gravelly alluvium with a pH averaging 6.1) occur on the terrace of the largest stream on the tract, just north of the southern boundary near the southeast corner. All of these soils, however, are mapped at a fairly coarse scale and give only a general account of soils on the tract. The presence of limestones in particular seems to give rise to localized areas of higher pH soils.

## **Hydrology**

Several small streams occur on the tract, but only one, an unnamed tributary of Cato Springs Branch on the east side of the mountain along the southern boundary (N36.02247, W94.20863), has even semi-perennial flow and a developed riparian plant community (Fig. 15a). All other streams on the property are ephemeral to intermittent and typically dry by mid-summer (Figs. 15b-c). Groundwater is prominent

in the karst geologic formations and there are a number of small ephemeral and perennial seeps and springs on the tract (Figs. 23 & 24).

Three ponds occur on the tract. Two of these (located at N36.02875, W94.21529 and N36.02361, W94.21552) are on the eastern slope of the mountain and are clearly man-made (Fig. 17d). Neither of these ponds is situated in an obvious drainage and both occur between 1680 and 1700 feet in elevation, which corresponds to the contact between the Kessler Limestone and the Woolsey (shale) members of the Bloyd Formation, suggesting they are groundwater-fed. The third pond (located at N36.03096, W94.21722) occurs at the low point in a saddle over shale of the Trace Creek Member of the Atoka Formation (Fig. 25). This pond has obviously been dug out and deepened (with a significant berm of spoils deposited on its east, north, and west sides) but appears to be the site of a naturally occurring wet depression or “saddle pond”. See the Shale Barrens community description below for more discussion on this pond.

Another significant hydrologic aspect of Kessler Mountain is that the main ridge is the divide between the Illinois River watershed and the White River watershed – the two major watersheds in the region. Since the Trent Trail and part of the Rock City Trail follow the high point of the main ridge, there are places along them (Fig. 9e) where you can literally stand with one foot in the Illinois River watershed (to the west) and one foot in the White River watershed (to the east). This provides an outstanding and somewhat unique interpretive opportunity for environmental education.

### ***Ecological Significance***

Kessler Mountain sits on the boundary between the Springfield Plateau Ecoregion and the Boston Mountains Ecoregion. It is ecologically and biologically diverse, with elements of both the (former) tallgrass prairies of the flat Springfield Plateau surface to the north and west and the lush forests of the Boston Mountains to the south. It also forms the watershed divide between the Illinois River Basin and the White River Basin, with part of the reserve property located in each watershed.

The tract supports 11 distinct plant communities or terrestrial habitats: 1) Shale Barrens, 2) Dry Oak Woodland, 3) Dry-Mesic Oak-Hickory Forest and Woodland, 4) Mesic Hardwood Forest, 5) Riparian Forest, 6) Old Field/Successional Forest, 7) Bluffs, 8) Seeps and Springs, 9) Ponds, 10) Pasture/Field, and 11) Disturbed Areas. Each of these is described below in the section on plant communities. The shale barrens are particularly interesting and represent an unusual and poorly known community type that is apparently uncommon to rare in the Ozarks. Bluff communities on the tract are highly diverse and include globally rare plant species. Seeps and springs occur on the tract and include groundwater-obligate invertebrates restricted to karst areas of the Ozark Highlands.

The native plant communities over most of the property are in a moderately degraded condition but are, for the most part, restorable. Several areas support mature forests or woodlands dominated by large trees but the shrub and herbaceous (ground cover) layers are often encroached by non-native invasive species. Woodland and barrens communities in particular are denser with woody vegetation

than they were historically, a departure from their natural (more open) condition that has led to reduced biodiversity (Miller 1972; Nelson 2005; Nowacki & Abrams 2008; Rudolph et al. 2006).

At least six plant species of state conservation concern occur on the site in a variety of habitats, with at least two also considered of global conservation concern (ANHC 2015). Three animal species of state conservation concern were also found on the site, all associated with small groundwater wetlands. No federally listed species (species listed as Threatened or Endangered under the U.S. Endangered Species Act) were found during the present study. See Appendix D for a complete list of plant species of conservation concern found in the study area.

Kessler Mountain is also close to a metropolitan area, has an accessible system of trails, and thus could provide excellent environmental education opportunities for the public.

### ***Historical Vegetation***

There are three lines of evidence that provide insight into the early historical vegetation of the area on and around Kessler Mountain: 1) data from the original General Land Office (GLO) survey, 2) historical plant specimens collected from Kessler Mountain, and 3) the presence of certain relict species in the area today. All three lines of evidence indicate that prior to Euro-American settlement most of the area around Kessler Mountain was a mosaic of prairie, oak savanna, and open oak woodland (Miller 1972). Closed canopy mesic, or moderately moist, forest was probably restricted to larger stream bottoms and topographically rugged upland areas where steep slopes, bluffs, ravines, and small streams interrupted frequent landscape scale fires (Foti & Witsell 2013; Miller 1972; Nelson 2005). This would indicate that, while there were certainly some areas of closed canopy mesic hardwood forest on Kessler Mountain historically, most of the area on the mountain would have been fairly open oak woodland, with the lowest slopes supporting savanna and even prairie.

### **GLO Survey Data**

Perhaps the most insightful line of evidence of the early historical vegetation of the area is data from the General Land Office (GLO) Survey, which was conducted locally in the early 1830s. At this time surveyors established and traversed the local portion of the Township, Range, and Section (TRS) grid that is still used as the basis for land surveys today. This grid is laid out in a one mile by one mile array with survey lines running north-south and east-west. The grid is subdivided into square “townships”, each consisting of 36 one square mile sections (6 sections on a side). As these lines were surveyed the surveyors recorded observations on the vegetation and soil, noted the locations of houses and fields, and marked the precise locations of streams, roads, bluffs, and transitions from one major vegetation type to another. For each section line they also recorded the precise location, species, and diameter of line trees (trees intercepted by the survey line) and four “witness trees” used to mark the location of each section corner (where survey lines intersected). They also recorded these data for two to four trees at each quarter section corner (points located halfway between section corners along each line). Ecologists can use the distances recorded from the corner and quarter corner points to the witness trees

to extrapolate an estimate of the density of a forest or woodland at the time of the survey. They can also use the species recorded to understand the composition of historical plant communities.

Related to the GLO survey notes is another excellent resource for data on the early historical vegetation of the area – a 1972 master’s thesis by Henry M. Miller, then an anthropology graduate student at the University of Arkansas. Miller’s thesis, entitled *A Vegetal Reconstruction of Early Historic Northwest Arkansas*, uses data from the GLO survey in conjunction with topographic data to create a map of the vegetation of Benton and Washington counties at the time of the survey (1831 to 1838). Miller used the information in the survey notes to split the vegetation into five broad communities: 1) upland prairie, 2) lowland prairie, 3) oak barrens (savanna), 4) upland forest, and 5) lowland forest.

Miller’s maps (Figs. 6 & 7) of the vegetation for the two townships that contain the City’s land on Kessler Mountain (T16N R30W and T16N R31W) appear over a modern topographic map in Appendix A. Most of the landscape in these townships was mapped by Miller as oak barrens, with extensive prairies in the valleys on both sides of Kessler Mountain. Only the upper parts of Kessler Mountain, Washington Mountain, South Mountain, and Mt. Sequoyah were mapped as upland forest, with lowland forest occurring only along major streams of the Illinois River system to the west and the White River system to the east.

Despite Miller’s use of the term “upland forest” for these areas, it is clear both from the vegetation on the mountain (today and at the time of the survey) and from the broader landscape context that much of this upland forest was fairly open. In modern ecological terminology, it would be best described as “woodland”, a term meaning a wooded area with an open canopy (and a robust layer of herbaceous plants on the ground). Indeed, the GLO survey notes from 19 November 1831 describe the land on the northern half of the east side of Section 36, T16N, R31W (the east side of the reserve between the Crazy Mary Trail and the bluff top to the east) as follows:

*Land along the east side of mountain, poor and rocky, timber white, black and post oak, hickory, etc. Undergrowth oak, black locust, grassy woods, etc. Not fit for cultivation. Fayetteville bears N 51 deg. E.*

In addition, the line and witness trees listed for the section lines within the reserve, in order of frequency are: “post oak” (4 trees), “hickory” (3), “black oak” (2), “red oak” (2), “white oak” (2), “blackjack oak” (1), and “black locust” (1). The timber summary given for the sections of the lines in the reserve is uniformly “white oak, black oak, post oak, hickory” and the “undergrowth” description is, also in decreasing order of abundance: “oak” (2 mentions), “black locust” (1), “dogwood” (1), “hickory” (1), “sassafras” (1), “vines” (1). There is also the qualitative description of the woods being “grassy” as referenced above. These data indicate that, at least along the section lines, most of this area historically supported the communities described in this report as “dry oak woodland” and “dry-mesic oak-hickory woodland and forest”.

## Historical Plant Specimens

The University of Arkansas Herbarium (UARK) contains approximately 125,000 plant specimens dating as far back as the 1870s. Most specimens in the collection are from Arkansas and many were collected in Washington County since that is where the University is located. Unfortunately the collection is not fully databased at this time so no attempt was made to do a comprehensive search for specimens from Kessler Mountain. However, a project is underway to image and database the entire collection over the next two years, so that data should be easily searchable in the future.

That said, all specimens of species of state conservation concern in the UARK collection have been databased and this dataset contains several specimens of rare species collected on or near Kessler Mountain. A specimen of Missouri ground-cherry (*Physalis missouriensis*) was collected from “Kessler Mountain, Washington County” by W. Giles on October 6, 1934 and a specimen of eastern yampah (*Perideridia americana*) was collected “on Kessler Mountain in southwest Fayetteville” by A. D. Love on June 5, 1984. Both of these species were found again during the present study and are described in detail in Appendix D.

Other specimens of rare species were collected off of city property but reference the mountain or were made nearby. These include a specimen of plains poppy-mallow (*Callirhoe alcaeoides*) collected along Cato Springs Road just east of the mountain by Phil Hyatt on April 29, 1990, and a specimen of western rock-jasmine (*Androsace occidentalis*), collected by Dr. Dwight Moore “near Kessler Mountain, Washington County” on April 3, 1942. The rock-jasmine is typically found in flat grasslands and was probably collected in a prairie below the foot of the mountain.

The most puzzling rare plant specimen from Kessler Mountain is a collection of Ouachita bluestar (*Amsonia hubrichtii*) made by R. G. French from “Parksdale, Washington County. Open fields, base Kessler Mtn.” on June 11, 1950. Aside from this one anomalous specimen, that species is known only from rocky, open stream banks in a section of the Ouachita Mountains in west-central Arkansas and eastern Oklahoma. What it was doing in Washington County is considered something of a mystery. It is possible that there was some sort of mix-up with the label or other error. Dr. Ed Smith, former curator of the U of A Herbarium annotated the specimen in 1984 writing “Label info seems doubtful; or possibly a transplant of some wildflower enthusiast.” But it is also possible that it naturally occurred there (and may still). There are two instances of Letterman’s ironweed (*Vernonia lettermannii*), another rare species otherwise endemic to Ouachita Mountain stream banks (and a frequent associate of Ouachita bluestar), being collected in prairies outside of the Ouachitas, once in Faulkner County and once in Prairie County. Unfortunately most prairies were destroyed before they could be thoroughly explored by botanists so we really don’t know all the rare species that occurred in them. The *Amsonia* record is mentioned here in hopes that people will develop a search image and that someone may notice any remaining plants that may be in the area.

Several other old Kessler Mountain specimens were encountered in the course of other research work in the herbarium. Among these were a few “conservative heliophytes” (“conservative” = species that depend on high quality, undisturbed sites and cannot tolerate soil disturbance or heavy grazing;

“heliophytes” = sun-loving species of open grasslands like prairies, glades, savannas and open woodlands) that were not relocated in the present study. These include a specimen of winecups (*Callirhoe digitata*) collected from “woods – Kessler Mountain” on 11 June 1950 and a specimen of purple prairie clover (*Dalea purpurea*) collected from “fields – Kessler Mountain” on 18 June 1950. In general these kinds of species were more common in the past and have declined rangewide today as open habitats have been converted to human uses and/or become denser with woody vegetation.

### **Clues in Today’s Flora**

Similarly, there are a number of these long-lived conservative heliophytes present in low numbers in forested areas of the reserve today. Some of these are most common in a powerline right-of-way (Fig. 12e) or in the few areas where there is still some openness to the canopy. Others (Fig. 13a) appear to be barely hanging on, a few individuals persisting in a vegetative (non-flowering) condition in the shade of a closed canopy and thick shrub layer. Examples of such struggling species encountered on the reserve in 2014 include Indian-plantain (*Arnoglossum plantagineum*), butterfly milkweed (*Asclepias tuberosa*), stiff tickseed (*Coreopsis palmata*), yellow star-grass (*Hypoxis hirsuta*), sensitive-brier (*Mimosa quadrivalvis* var. *nuttallii*), marbleseed (*Onosmodium bejariense* var. *subsetosum*), wild quinine (*Parthenium integrifolium*), foxglove beardtongue (*Penstemon digitalis*), prairie rattlesnake-root (*Prenanthes aspera*), early buttercup (*Ranunculus fascicularis*), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), and Culver’s-root (*Veronicastrum virginicum*). These species are persisting from more open times in the past and would not be present unless the habitat was considerably more open historically.

### **Plant Communities**

The following plant communities or terrestrial habitats were identified at Kessler Mountain Reserve:

1. Shale Barrens
2. Dry Oak Woodland
3. Dry-Mesic Oak-Hickory Forest and Woodland
4. Mesic Hardwood Forest
5. Riparian Forest
6. Old Field/Successional Forest
7. Bluffs
8. Seeps and Springs
9. Ponds
10. Pasture/Field
11. Disturbed Areas

NOTE: In the following community descriptions, species with an asterisk (\*) following the scientific name are considered non-native.

## 1) Shale Barrens

The most unusual ecological feature on the tract is an area of “shale barrens” situated in a shallow saddle on the main north-south trending ridge of Kessler Mountain (coordinates = N36.03177, W94.21739). The ridgetop to the north and south of this area is underlain by Atoka Sandstone while the saddle has been eroded through the sandstone and into the underlying Trace Creek Shale. A second lobe of open barrens (coordinates = N36.03185, W94.21851) exists downslope and slightly to the west, on shale of the Woolsey Member of the Bloyd Formation.

This community is a mosaic of small, grassy to rocky glade-like openings surrounded by dry oak woodlands (Figs. 10 & 11). Canopy structure ranges from very open (savanna) to less open (woodland) along gradients of soil depth and moisture availability. Based on the flora present, the pH here ranges from acidic on the higher ground to more calcareous toward the western edge of the saddle near the contact with the underlying Kessler Limestone. While this area is referred to locally as a “shale glade”, the term “glade” is something of a misnomer here since there is little hard bedrock exposed and no extensive treeless areas. Instead the substrate, in all but the most disturbed and eroded areas, consists mainly of loose, weathered shale. There are definite glade affinities though and this community is distinct both floristically and ecologically from surrounding dry oak woodlands. In light of these distinctions this community is being referred to here as “shale barrens”.

The canopy is dominated by old, open-grown post oak (*Quercus stellata*) trees, with scattered individuals of chinquapin oak (*Quercus muehlenbergii*), Shumard oak (*Quercus shumardii*), northern red oak (*Quercus rubra*), blackjack oak (*Quercus marilandica*), and white ash (*Fraxinus americana*). Trees are widely spaced and stunted in the areas of thinnest soils and taller and more dense as soils become deeper. A post oak tree in these barrens cored by Alan Edmondson and Dr. David Stahle from the University of Arkansas Tree-Ring Laboratory was more than 250 years old. Several small oak trees (Fig. 35) in two different areas have features consistent with maple-leaf oak (*Quercus acerifolia*), a globally rare but somewhat taxonomically controversial species recognized from just a few sites in the Ouachita Mountains and Arkansas Valley of west-central Arkansas. See discussion in Appendix D for more discussion of these trees.

Scattered smaller trees and shrubs include gum-bumelia (*Sideroxylon lanuginosum*), black locust (*Robinia pseudoacacia*), Carolina rose (*Rosa carolina*), redbud (*Cercis canadensis*), dwarf hackberry (*Celtis tenuifolia*), deerberry (*Vaccinium stamineum*), rusty blackhaw (*Viburnum rufidulum*), and serviceberry (*Amelanchier arborea*).

The herbaceous layer (ground flora) is diverse, containing a number of prairie, glade, and woodland species. This layer is dominated by little bluestem (*Schizachyrium scoparium*), poverty-oats (*Danthonia spicata*), gum-plant (*Grindelia lanceolata*), and wild quinine (*Parthenium integrifolium*). Other species common in the herbaceous layer include woodland sunflower (*Helianthus hirsutus*), prairie aster (*Symphotrichum turbinellum*), manyray aster (*Symphotrichum anomalum*), late purple aster (*Symphotrichum patens*), wand beard-tongue (*Penstemon tubiflorus*), gray goldenrod (*Solidago nemoralis*), elm-leaf goldenrod (*Solidago ulmifolia*), showy goldenrod (*Solidago petiolaris*), wild hyacinth

(*Camassia scilloides*), yellow pimpernel (*Taenidia integerrima*), yellow star-grass (*Hypoxis hirsuta*), pencil flower (*Stylosanthes biflora*), horsetail milkweed (*Asclepias verticillata*), fourleaf milkweed (*Asclepias quadrifolia*), sundrops (*Oenothera fruticosa*), dwarf skullcap (*Scutellaria parvula*), heartleaf skullcap (*Scutellaria ovata*), long-bracted wild indigo (*Baptisia bracteata*), Russell's beebalm (*Monarda russeliana*), violet wood sorrel (*Oxalis violacea*), Ohio spiderwort (*Tradescantia ohiensis*), stiff coreopsis (*Coreopsis palmata*), tall thoroughwort (*Eupatorium altissimum*), whorled milkwort (*Polygala verticillata*), bird's-foot violet (*Viola pedata*), clustered fescue (*Festuca paradoxa*), and many more.

More extreme and sparsely vegetation areas support some classic "glade species" such as gum plant, hairy wild petunia (*Ruellia humilis*), pleat-leaf knotweed (*Polygonum tenue*), prairie-tea (*Croton monanthogynus*), blue waxweed (*Cuphea viscosissima*), nits-and-lice (*Hypericum drummondii*), false spotted St. John's-wort (*Hypericum pseudomaculatum*), nailwort or forked-chickweed (*Paronychia fastigiata* var. *fastigiata*), churchmouse three-awn (*Aristida dichotoma* var. *dichotoma*), wiry witchgrass (*Panicum flexile*), grass-leaf rush (*Juncus marginatus*), and side-flowering rush (*Juncus secundus*).

The central portion of the higher of the two main barrens is heavily disturbed and eroded, especially where trails converge at the "fire ring" area. Herbaceous vegetation here is probably unnaturally sparse and the thin soil is mostly eroded away. The margins of this opening, as well as the less disturbed openings in the western, lower lobe of complex, have thin soils supporting a mostly continuous perennial groundcover with small areas of exposed, loose shale fragments.

A pond has been dug in the southern part this community at the low point of the saddle. Based on the amount of water that accumulates in the trail just west of this pond (where there is no artificial impoundment) and on some of the flora present, this was likely a naturally wet place where water ran off the slopes above and accumulated at the surface of the ground. The impermeable nature of the underlying shale keeps water at the surface for extended periods. Such natural mountaintop depression wetlands (sometimes called "saddle ponds") often support uncommon or rare species of plants, amphibians, and insects. These habitats are rare in the landscape and many examples, like the one at Kessler Mountain, have been heavily impacted by past attempts to develop them for water sources, despite their small watersheds and often ephemeral nature. Remnant seasonally-wet depressions outside this pond (to its south and west) support several species characteristic of ephemeral wetlands including clammy hedge-hyssop (*Gratiola neglecta*), chaffweed (*Anagallis minima*), water starwort (*Callitriche heterophylla*), and several rushes (*Juncus* spp.).

This Ozark shale barrens community type is poorly known and understood and may represent an undescribed entity based on discussions with ecologists in Arkansas and Missouri. I am aware of one other site that appears very similar to the barrens on Kessler Mountain – a site called "The Slatey Place" (N36.04505, W93.30559) within the Ponca Wilderness Area (Buffalo National River) in Newton County. There, a very similar plant community occurs in an almost identical landscape position (a shallow saddle in a north-south trending ridge with similar geology). This site also has a small excavated pond situated in the lowest point of the saddle, also presumably a modified natural wetland.

Analysis of aerial photos and geologic maps of the Boston Mountains indicates that there are other examples scattered on several shale-bearing rock formations in the region, including a number in the vicinity of Fayetteville. One such site, about 2.5 miles north-northeast from the Kessler Mountain barrens, just east of the intersection of North Mountain Ranch Rd. and Technology Way (N36.06874, W94.20558), was viewed from the road in 2014 and appears to be the same basic community. Unfortunately, this site was fragmented and partially lost to development in recent years, and the remainder appears to be slated for development in the future. There do appear to be other, more intact examples in the general vicinity which should be explored in the future. High quality examples could be protected as the region plans for growth.

**Species of Concern:** Several small oak trees (Fig. 35) in two different areas have features consistent with maple-leaf oak (*Quercus acerifolia*), a globally rare but somewhat taxonomically controversial species recognized from just a few sites in the Ouachita Mountains and Arkansas Valley of west-central Arkansas. See discussion in Appendix D for more discussion of these trees.

**Management Recommendations:** 1) Control non-native invasive plant species. 2) Control encroaching native woody species like eastern red-cedar and black locust. 3) Implement prescribed fire management. 4) Consider control of some of the hardwood mid-story in surrounding woodlands by herbicide injection or cutting and treating stumps with herbicide. 5) Consider re-routing trails around this community or confining traffic through it to a narrow corridor. Reducing soil disturbance, compaction, and erosion will allow thin barrens soils to recover over time.

## 2) Dry Oak Woodland

Dry oak woodland (Figs. 12 & 13a) is one of the most common and widespread communities on the reserve. It occurs primarily on ridgetops and upper south- and west-facing slopes but also on the gentle east-facing slope of the mountain between the ridgetop and the bluffline, and at scattered other sites. Both calcareous and acidic dry oak woodlands occur in the reserve, with calcareous examples usually dominated by chinquapin oak (*Quercus muehlenbergii*) and acidic examples usually dominated by post oak (*Quercus stellata*). Other common canopy species include blackjack oak (*Quercus marilandica*), black oak (*Quercus velutina*), and black hickory (*Carya texana*). Northern red oak (*Quercus rubra*), white oak (*Quercus alba*), and Shumard oak (*Quercus shumardii*) may also occur in the canopy.

Common understory species include winged elm (*Ulmus alata*) and rusty blackhaw (*Viburnum rufidulum*). Farkleberry (*Vaccinium arboreum*), deerberry (*Vaccinium stamineum*), and lowbush blueberry (*Vaccinium pallidum*) may be common in more acidic examples. Ground cover is characteristic of dry, open woodlands and includes little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), poverty oat grass (*Danthonia spicata*), Muhlenberg's sedge (*Carex muehlenbergii* var. *enervis*), sensitive-brier (*Mimosa quadrivalvis* var. *nuttallii*), wild quinine (*Parthenium integrifolium*), tall thoroughwort (*Eupatorium altissimum*), blue waxweed (*Cuphea viscosissima*), whorled milkweed (*Asclepias verticillata*), stiff coreopsis (*Coreopsis palmata*), cream wild indigo (*Baptisia bracteata* var. *leucophaea*), and several species of rosette grasses (*Dichanthelium linearifolium*, *D. oligoanthes* subsp. *scribnerianum*, *D. acuminatum*, *D. dichotomum*, etc.), goldenrods (*Solidago*

*nemoralis*, *S. ulmifolia* var. *ulmifolia*, and *S. petiolaris*), asters (*Symphyotrichum anomalum*, *S. patens*, and *S. turbinellum*), and bush-clovers (*Lespedeza* spp.).

A powerline right-of-way (Fig. 12e) in the northern part of the tract traverses both dry oak woodland and dry-mesic oak-hickory forest and woodland habitats. Because it is maintained in an open condition, this powerline provides habitat for components of these communities that need sunlight. While these species are thriving in the open right-of-way, they should be more common throughout the woodland understory.

**Species of Concern:** Prairie rattlesnake-root (*Prenanthes aspera*), eastern yampah (*Perideridia americana*), and prairie trout-lily (*Erythronium mesochoreum*) are species of state conservation concern found in this habitat on the reserve.

**Management Recommendations:** 1) Control non-native invasive plant species. 2) Control encroaching native woody species like eastern red-cedar and black locust. 3) Implement prescribed fire management. 4) Consider control of some of the hardwood mid-story by herbicide injection or cutting and treating stumps with herbicide.

### 3) Dry-Mesic Oak-Hickory Forest and Woodland

Dry-mesic oak-hickory forest and woodland (Fig. 13b-d) is another matrix community in the reserve, common on soils that aren't as thin and dry as those that support dry oak woodlands. This community is transitional between dry oak woodland and mesic hardwood forest and can also be acidic or calcareous depending on the local geology. The canopy is typically dominated by white oak (*Quercus alba*), and mockernut hickory (*Carya alba*) but often has a significant component of post oak (*Quercus stellata*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), chinquapin oak (*Quercus muehlenbergii*), pignut hickory (*Carya glabra*), black gum (*Nyssa sylvatica*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), and black locust (*Robinia pseudoacacia*).

Common understory species include flowering dogwood (*Cornus florida*), Carolina buckthorn (*Frangula caroliniana*), sassafras (*Sassafras albidum*), winged elm (*Ulmus alata*), and fragrant sumac (*Rhus aromatica* var. *aromatica*). Acidic examples often include low-bush blueberry (*Vaccinium pallidum*) and deerberry (*Vaccinium stamineum*). Ground cover often includes hairy woodland brome (*Bromus pubescens*), rocky muhly (*Muhlenbergia sobolifera*), dittany (*Cunila origanoides*), stalked wild petunia (*Ruellia pedunculata*), hawkweed (*Hieracium gronovii*), Muhlenberg's sedge (*Carex muehlenbergii* var. *enervis*), a sedge (*Carex albicans*), nut-rush (*Scleria oligantha*), and several species of rosette grasses (*Dichanthelium* spp.), goldenrods (*Solidago* spp.), asters (*Symphyotrichum* spp.), bush-clovers (*Lespedeza* spp.) and tick-trefoils (*Desmodium* spp.).

As the name implies, this community can exist in more open (woodland) and more closed (forest) phases depending on the site and fire regime. More open conditions, however, support more species diversity. Sugar maple (*Acer saccharum* var. *saccharum*) is commonly found in the mid-story and understory in this community on the reserve (but rarely in the canopy). This indicates that it is spreading into this community from more mesic forests (where it is often a component of the canopy).

This is another line of evidence documenting the slow densification and “mesophication” of upland woodland communities following the interruption of historical fire regimes (Nowacki & Abrams 2008).

**Species of Concern:** Prairie rattlesnake-root (*Prenanthes aspera*), eastern yampah (*Perideridia americana*), and prairie trout-lily (*Erythronium mesochoreum*) are species of state conservation concern found in this habitat on the reserve.

**Management Recommendations:** 1) Control non-native invasive plant species. 2) Implement prescribed fire management. 3) Consider control of some of the hardwood mid-story by herbicide injection or cutting and treating stumps with herbicide. Sugar maple in particular is colonizing this community from adjacent mesic forests and changing its character. Prescribed fire will help check sugar maple but mechanical and/or chemical control of larger stems may be needed as well.

#### 4) Mesic Hardwood Forest

Mesic, or moderately moist, forest (Fig. 14) is associated primarily with lower north- and east-facing slopes and areas below bluffs but it may occur on all aspects in narrow valleys. It also occurs in steep, rocky drainages and on the ridgetop and upper slopes (above bluffs) at the north end of the reserve, where it extends off the tract along the Spellbound and Wino trails to the south. In general, mesic forests occur in more moist, protected sites where fires would not burn too frequently or intensely historically (Foti & Witsell 2013). Bluffs, streams, and in some cases elevation are factors that influence where mesic forests are found. Mesic forests usually have a closed canopy of deciduous hardwood trees and species found in the understory are adapted to shaded conditions during the growing season (Nelson 2005). Many forbs found in mesic forests are spring ephemerals that do most of their growing, and often their flowering, in the early spring before the hardwood trees leaf out and shade the forest floor. Many of these species disappear by summer while others may persist in the shaded understory.

The canopy is typically dominated by northern red oak (*Quercus rubra*), white oak (*Quercus alba*), sugar maple (*Acer saccharum* var. *saccharum*), and shagbark hickory (*Carya ovata*). It often also includes bitternut hickory (*Carya cordiformis*), mockernut hickory (*Carya alba*), red maple (*Acer rubrum*), basswood (*Tilia americana*), black walnut (*Juglans nigra*), red mulberry (*Morus rubra*), slippery elm (*Ulmus rubra*), and other hardwood species. Common shrubs and woody vines include spicebush (*Lindera benzoin*), pawpaw (*Asimina triloba*), bladdernut (*Staphylea trifolia*), hop-hornbeam (*Ostrya virginiana*), moonseed (*Menispermum canadense*), Missouri gooseberry (*Ribes missouriense*), and wild hydrangea (*Hydrangea arborescens*).

A rich herbaceous layer includes a variety of shade-adapted ferns, forbs, grasses, and sedges. Characteristic ferns include northern maidenhair fern (*Adiantum pedatum*), southern bladder fern (*Cystopteris protrusa*), broad beech fern (*Phegopteris hexagonoptera*), and Christmas fern (*Polystichum acrostichoides*). Conspicuous forbs include green trillium (*Trillium viridescens*), wakerobin (*Trillium sessile*), large-flower bellwort (*Uvularia grandiflora*), Jack-in-the-pulpit (*Arisaema triphyllum*), wild ginger (*Asarum canadense* var. *reflexum*), bloodroot (*Sanguinaria canadensis*), white snakeroot (*Ageratina altissima*), wild blue phlox (*Phlox divaricata* subsp. *laphamii*), blue violet (*Viola sororia*), downy yellow violet (*Viola pubescens*), Joe-Pye-weed (*Eutrochium purpureum*), goldenseal (*Hydrastis canadensis*),

Dutchman's-breeches (*Dicentra cucullaria*), Ernest's spiderwort (*Tradescantia ernestiana*), green-violet (*Hybanthus concolor*), Solomon's-seal (*Polygonatum biflorum*), false Solomon's seal (*Maianthemum racemosum*), yellow giant-hyssop (*Agastache nepetoides*), tall bellflower (*Campanula americana*), toothwort (*Cardamine concatenata*), dwarf larkspur (*Delphinium tricorne*), yellow trout-lily (*Erythronium rostratum*), wreath goldenrod (*Solidago caesia*), blue wood aster (*Symphotrichum drummondii*), and carpenter's-square (*Scrophularia marilandica*).

Less showy, but equally characteristic forbs of mesic forests on the reserve include honewort (*Cryptotaenia canadensis*), aniseroot (*Osmorhiza longistylis*), clustered black snakeroot (*Sanicula odorata*), lopseed (*Phryma leptostachya*), sweet-scent bedstraw (*Galium triflorum*), nodding rattlesnake-root (*Prenanthes crepidinea*), beggar's-lice (*Hackelia virginiana*), and enchanter's-nightshade (*Circaea canadensis* subsp. *canadensis*). Bearded shorthusk (*Brachyelytrum erectum*), hairy woodland brome (*Bromus pubescens*), river-oats (*Chasmanthium latifolium*), woodland blue grass (*Poa sylvestris*), nodding fescue (*Festuca subverticillata*), bottlebrush-grass (*Elymus hystrix*), and Virginia wild rye (*Elymus virginicus*) are common grasses. Many sedges are found in mesic forests on Kessler Mountain including *Carex albursina*, *Carex jamesii*, *Carex blanda*, *Carex amphibola*, *Carex planispicata*, and *Carex oligocarpa*.

Mesic forests on Kessler Mountain have been especially hard-hit by invasive species (Figs. 38 & 39). The canopy, especially on or below bluffs, has been heavily broken up by various disturbance events such as ice and wind storms (Fig. 14f). This, along with the naturally open conditions often associated with bluffs and a healthy population of birds (which disperse seeds), has allowed a variety of non-native invasive plants to become established. In some areas, such as in the forest below the bluff north of the old farmhouse, these invasive species have become the dominant species present.

Common woody invasives in this community include tree-of-heaven (*Ailanthus altissima*\*), Amur or bush honeysuckle (*Lonicera maackii*\*), Japanese honeysuckle (*Lonicera japonica*\*), burning-bush (*Euonymus alatus*\*), winter-creeper (*Euonymus fortunei*\*), perfumed cherry (*Prunus mahaleb*\*), nandina (*Nandina domestica*\*), Chinese privet (*Ligustrum sinense*\*), callery pear (*Pyrus calleryana*\*), and multiflora rose (*Rosa multiflora*\*). Non-native invasive herbaceous plants in mesic forests on Kessler Mountain include common burdock (*Arctium minus*\*), beefsteak-plant (*Perilla frutescens*\*), and Japanese stilt grass (*Microstegium vimineum*\*).

**Species of Concern:** No species of conservation concern were documented from mesic forests in the study area.

**Management Recommendations:** 1) Control invasive species so that natives can replace natives in areas of canopy loss and native species can thrive in the herbaceous layer. 2) Manage prescribed fire in such a way that it is not forced to burn intensely in mesic forest habitat (it can instead be 'backed down' into ravines and steep slopes from above) and avoid burning these areas in the spring after mesic forest herbaceous plants have begun growth.

## 5) Riparian Forest

Riparian forests (Fig. 15) occur along streams, where increased moisture and flatter topography often support a more mesic community than that of surrounding uplands. These are often closed canopy forests with a shade tolerant understory. Riparian forests differ from upland mesic hardwood forests in part by the presence of a number of wetland species dependent on the hydrology of the stream. Habitat along the stream banks and channel, if the stream is wide enough, is often more open and can support a variety of sun-loving species.

On the reserve, riparian forest is best developed along a wooded stream on the east side of Kessler Mountain near the southern boundary (N36.02247, W94.20863) (Fig. 15a). It also occurs, but is less developed, along a smaller, steeper ephemeral stream on the west side of the mountain near the western boundary (N36.02788, W94.22347) (Figs. 15b-c). Riparian forest along the upper reaches of these streams may differ little from surrounding upland forest in terms of tree canopy, though the herbaceous layer and even the shrub layer may be noticeably different, responding to increased moisture levels (Nelson 2005).

In riparian forest along the larger stream, canopy cover varies but typical species include sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), red maple (*Acer rubrum*), box elder (*Acer negundo*), hackberry (*Celtis occidentalis*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), bitternut hickory (*Carya cordiformis*), basswood (*Tilia americana*), black walnut (*Juglans nigra*), green ash (*Fraxinus pennsylvanica*), black cherry (*Prunus serotina*), persimmon (*Diospyros virginiana*), and other hardwood species. Several bur oaks (*Quercus macrocarpa*) reach canopy height here. Common woody species in the understory include spicebush (*Lindera benzoin*), deciduous holly (*Ilex decidua*), Carolina buckthorn (*Frangula caroliniana*), and hop-hornbeam (*Ostrya virginiana*). Other species include wahoo (*Euonymus atropurpureus*), Amur or bush honeysuckle (*Lonicera maackii*\*), elderberry (*Sambucus canadensis*), and Osage-orange (*Maclura pomifera*).

Shade-tolerant grasses and sedges are common in riparian forests and include river-oats (*Chasmanthium latifolium*), hairy wild rye (*Elymus villosus*), Virginia wild rye (*Elymus virginicus* var. *virginicus*), bottlebrush-grass (*Elymus hystrix*), bearded shorthusk (*Brachyelytrum erectum*), woodland muhly (*Muhlenbergia sylvatica*), and many species of sedges (*Carex* spp.). Common ferns and forbs include Christmas fern (*Polystichum acrostichoides*), rattlesnake fern (*Botrychium virginianum*), yellow ironweed (*Verbesina alternifolia*), frostweed (*Verbesina virginica*), bear's-foot (*Smallanthus uvedalius*), wild blue phlox (*Phlox divaricata* subsp. *laphamii*), blue violet (*Viola sororia*), mountain houstonia (*Houstonia purpurea* var. *purpurea*), tall rattlesnake-root (*Prenanthes altissima*), Joe-Pye-weed (*Eutrochium purpureum*), bloodroot (*Sanguinaria canadensis*), wild ginger (*Asarum canadense* var. *reflexum*), giant ragweed (*Ambrosia trifida*), white woodland aster (*Symphotrichum lateriflorum*), tall white aster (*Symphotrichum lanceolatum*), honewort (*Cryptotaenia canadensis*), clustered black-snakeroot (*Sanicula odorata*), wild potato vine (*Ipomoea pandurata*), smooth wild petunia (*Ruellia strepens*), and pale Indian-plantain (*Arnoglossum atriplicifolium*).

**Species of Concern:** No species of conservation concern were documented from riparian forests in the study area.

**Management Recommendations:** 1) Control invasive species so that natives can replace natives in areas of canopy loss and native species can thrive in the herbaceous layer.

## 6) Old Field/Successional Forest

This community occurs in several old fields that were abandoned and allowed to go through succession back to forest (Figs. 8, 16c-d, & 17b-c). The forests in these areas, however, are very different from surrounding natural forests and can be recognized in the field because they are dominated by weedy, early successional tree species and have trees that are all or nearly all the same size and age. Those fields that were abandoned long ago, before non-native invasive species were widespread in the landscape, are generally dominated by native species. More recently abandoned fields are often dominated or co-dominated by non-native invasive species. This is evident at Kessler Mountain, with the examples on the eastern side of the mountain and the ridgetop having a higher proportion of non-native species.

Typical canopy species in this community on the reserve are eastern red-cedar (*Juniperus virginiana*), black locust (*Robinia pseudoacacia*), honey locust (*Gleditsia triacanthos*), hackberry (*Celtis occidentalis*), sassafras (*Sassafras albidum*), red mulberry (*Morus rubra*), and tree-of-heaven (*Ailanthus altissima*\*). Sugar maple (*Acer saccharum* var. *saccharum*) and green ash (*Fraxinus pennsylvanica*) are common in some areas. A dense shrub and woody vine layer is typically weedy and is usually dominated by coral-berry (*Symphoricarpos orbiculatus*) and often Amur or bush honeysuckle (*Lonicera maackii*\*). Other common species include Japanese honeysuckle (*Lonicera japonica*\*), grape vines (*Vitis* spp.), and blackberries (*Rubus* spp.).

Common forbs include frostweed (*Verbesina virginica*), purple dead-nettle (*Lamium purpureum*\*), common chickweed (*Stellaria media*\*), rock buttercup (*Ranunculus micranthus*), Johnny-jump-up (*Viola bicolor*), corn speedwell (*Veronica arvensis*\*), cleavers (*Galium aparine*), yellow wood-sorrel (*Oxalis dillenii*), Carolina crane's-bill (*Geranium carolinianum*), wild chervil (*Chaerophyllum tainturieri*), cornsalad (*Valerianella radiata*), crow-poison (*Nothoscordum bivalve*), field garlic (*Allium vineale*\*), purple-top tridens (*Tridens flavus* var. *flavus*), spotted St. John's-wort (*Hypericum punctatum*), field hedge-parsely (*Torilis arvensis*\*), daisy fleabane (*Erigeron annuus*), black-bindweed (*Fallopia convolvulus*\*), horseweed (*Conyza canadensis*), and bristly lady's-thumb (*Persicaria longiseta*\*). Common grasses include hairy woodland brome (*Bromus pubescens*), bald brome (*Bromus racemosus*\*), Leavenworth's sedge (*Carex leavenworthii*), annual blue grass (*Poa annua*\*), and Kentucky blue grass (*Poa pratensis*\*).

**Species of Concern:** No species of conservation concern were documented from old field/successional forests in the study area.

**Management Recommendations:** 1) Control non-native invasive species. Management of these areas is a lower priority than management of areas with intact native natural communities. However, these old fields serve as seed sources for non-native invasives to spread to nearby restored areas, so they shouldn't be ignored. Selective control of non-native invasives in these areas will allow natives to survive and become dominant in the canopy and shrub layers. 2) These successional forests also provide good interpretive opportunities to discuss succession and invasive species. The ones along the Trent Trail and the Serpentine Trail are especially accessible.

## 7) Bluffs

Bluffs (Figs. 18, 19, 20, & 21) are common on Kessler Mountain and when taken to include the band of steep, rocky slopes at their tops and the band of loose, rocky talus at their bases, represent the most ecologically and biologically diverse habitat on the reserve. These bluffs support many if not most of the species in adjacent communities (both the drier communities above the bluffs and the more mesic ones below them) but also include specialized species not found in other habitats.

Bluffs are classified according to their rock type and both acidic and calcareous bluffs occur on Kessler Mountain. Bluffs also vary with aspect and degree of exposure. In general south- and west-facing bluffs are drier and more exposed while north- and east-facing bluffs are more mesic and shaded. Some bluffs are permanently or at least seasonally moist or wet with groundwater seepage. Furthermore, bluffs generally support several different microhabitats. There are flat bluff tops and ledges, vertical cliff faces, steep slopes, areas of loose scree or talus (usually at the bases of sheer cliffs), cracks and pits, and even the occasional overhanging bluff shelter or 'rockhouse' (Figs. 19 & 20). These various conditions and microhabitats are important factors in the presence or absence of many species (Nelson 2005; Yatskievych 1999).

Bluffs are also ecologically significant because they serve as important refugia as species move in response to climate change (Foti & Witsell 2013). In this sense, dry, exposed bluffs can be thought of as having 'caught' various western 'desert species' during past hot dry periods and given them the needed habitat to persist to the present day. Similarly, moist, protected bluffs have 'caught' northern temperate species during cold periods like past glaciations and given them habitat into the present. Other species, such as the Church's wild rye (*Elymus churchii*) (Fig. 28) and Missouri ground-cherry (*Physalis missouriensis*) (Figs. 31 & 32) at Kessler, are endemic to a narrow region and grow only in specialized habitats, often associated with bluffs.

In addition to the broad diversity of trees and shrubs that also grow in adjacent habitats, several species on the reserve are found primarily in association with bluffs. These include yellow-wood (*Cladrastis kentukea*), downy service-berry (*Amelanchier arborea*), gum bumelia (*Sideroxylon lanuginosum*), bladdernut (*Staphylea trifolia*), rough-leaf dogwood (*Cornus drummondii*), wild hydrangea (*Hydrangea arborescens*), black raspberry (*Rubus occidentalis*), and Missouri gooseberry (*Ribes missouriensis*). Woody vines common on bluffs within the reserve include cross-vine (*Bignonia capreolata*), poison-ivy (*Toxicodendron radicans*), Virginia-creeper (*Parthenocissus quinquefolia*), grape vines (*Vitis* spp.), false grape (*Ampelopsis cordata*), Catesby's virgin's-bower (*Clematis catesbyana*), Carolina snailseed

(*Cocculus carolinus*), moonseed (*Menispermum canadense*), bristly greenbrier (*Smilax hispida*), yellow honeysuckle (*Lonicera flava*), and prairie rose (*Rosa setigera*).

Characteristic perennial ferns, grasses, and forbs found in the reserve primarily on bluffs include northern maidenhair fern (*Adiantum pedatum*), ebony spleenwort (*Asplenium platyneuron*), three-flower melic (*Melica nitens*), white snakeroot (*Ageratina altissima*), leather-flower (*Clematis viorna*), erect dayflower (*Commelina erecta*), marbleseed (*Onosmodium bejariense* var. *subsetosum*), Buckley's goldenrod (*Solidago buckleyi*), Harvey's buttercup (*Ranunculus harveyi*), white leafcup (*Polymnia canadensis*), American alumroot (*Heuchera americana* var. *hirsuticaulis*), and Ernest's spiderwort (*Tradescantia ernestiana*). A number of other ferns (Figs. 22 & 27) are rock outcrop or bluff specialists and are found only in appropriate microhabitats with the proper pH, moisture, and exposure. These include maidenhair spleenwort (*Asplenium trichomanes*), black-stem spleenwort (*Asplenium resiliens*), walking fern (*Asplenium rhizophyllum*), Tennessee bladder fern (*Cystopteris tennesseensis*), southern bladder fern (*Cystopteris protrusa*), blunt-lobed cliff fern (*Woodisa obtusa*), purple-stem cliff-brake (*Pellaea atropurpurea*), Alabama lip fern (*Cheilanthes alabamensis*), and powdery cloak fern (*Argyrochosma dealbata*), a species of state conservation concern.

Bluffs are also home to specialized communities of annual and biennial plants that are adapted to grow in the thin soil atop ledges and on talus. Examples of such communities on drier and more exposed sites within the reserve include lace grass (*Eragrostis capillaris*), nimblewill (*Muhlenbergia schreberi*), wiry witch grass (*Panicum flexile*), short-pod whitlow-grass (*Draba brachycarpa*), tansy-mustard (*Descurainia pinnata* subsp. *brachycarpa*), wild poinsettia (*Euphorbia cyathophora*), American false pennyroyal (*Hedeoma pulegioides*), blue waxweed (*Cuphea viscosissima*), western daisy (*Astranthium ciliatum*), Canadian rockcress (*Boechera canadensis*), smooth rockcress (*Boechera laevigata*), small-flower bittercress (*Cardamine parviflora* var. *arenicola*), Venus'-looking-glass (*Triodanis perfoliata*), one-seed mercury (*Acalypha monococca*), Virginia copperleaf (*Acalypha virginica*), and nailwort or forked-chickweed (*Paronychia fastigiata* var. *fastigiata*).

Examples on more mesic and shaded sites include clearweed (*Pilea pumila*), beggar's-lice (*Hackelia virginica*), Spanish-needles (*Bidens bipinnata*), enchanter's-nightshade (*Circaea canadensis* subsp. *canadensis*), pellitory (*Parietaria pensylvanica*), woodland goosefoot (*Chenopodium standleyanum*), maple-leaf goosefoot (*Chenopodium simplex*), pale corydalis (*Corydalis flavula*), tall bellflower (*Campanula americana*), big-seed scorpion-grass (*Myosotis macrosperma*), Canada forked-chickweed (*Paronychia canadensis*), autumn bent grass (*Agrostis perennans*), downy ground-cherry (*Physalis pubescens*), and black nightshade (*Solanum ptycanthum*).

Pits, cracks, and overhanging bluff shelters or "rockhouses" (Figs. 19 & 20) in bluffs provide important habitat elements for a variety of animal species. Numerous times during surveys on the reserve various animal species were observed utilizing bluff habitats. This included several close and sudden encounters with roosting Black Vultures, startling surveyors and birds alike.

Bluffs on Kessler Mountain are especially hard-hit by invasive species. The tree canopy in the vicinity of the bluffs has been heavily broken up by various disturbance events such as ice and wind storms (Fig.

14f). This, along with the naturally open conditions often associated with bluffs and a healthy population of birds (which disperse seeds), has allowed a variety of non-native invasive plants to become established. In some areas these invasive species have become the dominant species present (Figs. 37, 38, & 39).

Common woody invasives in this community include tree-of-heaven (*Ailanthus altissima*\*), Amur or bush honeysuckle (*Lonicera maackii*\*), Japanese honeysuckle (*Lonicera japonica*\*), burning-bush (*Euonymus alatus*\*), winter-creeper (*Euonymus fortunei*\*), perfumed cherry (*Prunus mahaleb*\*), nandina (*Nandina domestica*\*), Chinese privet (*Ligustrum sinense*\*), callery pear (*Pyrus calleryana*\*), and multiflora rose (*Rosa multiflora*\*). Non-native invasive herbaceous plants in mesic bluff communities on Kessler Mountain include common burdock (*Arctium minus*\*), beefsteak-plant (*Perilla frutescens*\*), and Japanese stilt grass (*Microstegium vimineum*\*).

**Species of Concern:** Powdery cloak fern (*Argyrochosma dealbata*), Church's wild rye (*Elymus churchii*), prairie trout-lily (*Erythronium mesochoreum*), eastern yampah (*Perideridia americana*), and Missouri ground-cherry (*Physalis missouriensis*) are species of conservation concern found in bluff habitat on the reserve.

**Management Recommendations:** 1) Control invasive species so that natives can replace natives in areas of canopy loss and native species can thrive in the herbaceous layer. 2) Manage prescribed fire in such a way that it is not forced to burn intensely in mesic habitats (it can instead be 'backed down' into ravines and steep slopes from above) and avoid burning these areas in the spring after mesic forest herbaceous plants have begun growth.

## 8) Seeps and Springs

Seeps and springs (Figs. 23 & 24) are groundwater-fed wetlands that generally occur where a porous rock layer like limestone or sandstone overlies an impermeable layer like shale. Water moves through the porous layer and emerges at or near the contact between the two units. The cool, constant flow of groundwater sometimes supports species that rarely, if ever, occur in wetlands without groundwater influence (Nelson 2005). Seeps are wetlands where groundwater emerges over a diffuse area, literally seeping up through the soil or, in some cases, out of a rock face. Springs are point sources of groundwater and often feed a spring-fed stream or rivulet called a spring run. Seeps and springs can be perennial (flowing all year) or intermittent (flowing seasonally during the wet season). Both types are present on Kessler Mountain but only those that appear to be perennial, or nearly so, are mapped in Fig. 46.

Plants found in seeps and springs on the reserve include spotted jewelweed (*Impatiens capensis*), dotted smartweed (*Persicaria punctata*), golden ragwort (*Packera aurea*), fowl manna grass (*Glyceria striata*), bulrush (*Scirpus georgianus*), rice cut grass (*Leersia oryzoides*), bog rush (*Juncus biflorus*), Michigan lily (*Lilium michiganense*), deer-tongue rosette grass (*Dichanthelium clandestinum*), Short's sedge (*Carex shortiana*), limestone meadow sedge (*Carex granularis*), hooked buttercup (*Ranunculus recurvatus*), tall goldenrod (*Solidago altissima*), winged monkey-flower (*Mimulus alatus*), and short-tooth mountain-mint (*Pycnanthemum muticum*).

Several of the seeps and springs in the reserve are heavily encroached with Amur or bush honeysuckle (*Lonicera maackii*\*) and multiflora rose (*Rosa multiflora*\*), to the detriment of native species dependent on this habitat.

**Species of Concern:** Three animal species of conservation concern were found in seeps and springs on the reserve. Two are groundwater-obligate invertebrates: an amphipod in the genus *Stygobromus* (Fig. 24b) and an isopod in the genus *Caecidotea* (Fig. 24c). The other is the Ozark Zigzag Salamander (*Plethodon angusticlavius*) (Fig. 24f).

Though no plants on the official list of species of state conservation concern were found in this habitat, a single population of Michigan lily (*Lilium michiganense*) was found in a small seasonally-wet seep along the Eggbeater Trail. This species is on an informal “watch list” maintained by the ANHC of species that might be of conservation concern in the state but about which more data are needed to make that determination. Like most populations of this species I have seen, the plants at Kessler appear to be growing in too much shade to flower. Also, short-tooth mountain-mint (*Pycnanthemum muticum*), though not a species of state conservation concern, was a somewhat surprising find. This species is usually found in wet prairies and other moist, open habitat southeast of the Ozarks. It was found on the reserve at a single spot in an open seep in the powerline, believed to be flowing from the base of the Kessler Limestone. It was not previously known from Washington County and this may be the northwestern-most population in the United States (ANHC 2015; Kartesz 2014).

**Management Recommendations:** 1) Remove invasive shrubs from around seeps, springs, and spring runs so native plants can thrive. Clearing dense honeysuckle and multiflora rose thickets from around seeps and springs not only restores light to the ground, but can also increase water output by freeing up water being used by the invasive shrubs. 2) Implement prescribed fire management.

## 9) Ponds

Three ponds occur on the reserve. Two of these (located at N36.02875, W94.21529 and N36.02361, W94.21552) are on the eastern slope of the mountain and are clearly man-made (Fig. 17d). Neither is situated in an obvious drainage and both occur between 1680 and 1700 feet in elevation, which corresponds to the contact between the Kessler Limestone and the Woolsey (shale) members of the Bloyd Formation, suggesting they are groundwater-fed. The southern-most of these two ponds, just below the Crazy Mary Trail, is clearly fed by a small intermittent spring at its upper end.

The third pond (located at N36.03096, W94.21722) occurs at the low point in a saddle over shale of the Trace Creek Member of the Atoka Formation (Fig. 25). This pond has obviously been dug out and deepened, with a significant berm of dark shale spoils deposited on its east, north, and west sides, but appears to be the site of a naturally occurring wet depression or “saddle pond”. See the Shale Barrens community description above for more discussion on this pond.

Ponds on the tract are not particularly diverse, but are fringed by various wetland species including rice cut grass (*Leersia oryzoides*), bulrush (*Scirpus georgianus*), dotted smartweed (*Persicaria punctata*), spike-rush (*Eleocharis lanceolata*), beggar-ticks (*Bidens frondosa*), Virginia bugleweed (*Lycopus*

*virginicus*), black willow (*Salix nigra*), American barnyard grass (*Echinochloa muricata* var. *muricata*), red-top panic grass (*Panicum rigidulum*), broomsedge (*Andropogon virginicus*), multiflora rose (*Rosa multiflora*\*), false nettle (*Boehmeria cylindrica*), late boneset (*Eupatorium serotinum*), common ragweed (*Ambrosia artemisiifolia*), seedbox (*Ludwigia alternifolia*), and a sedge (*Carex annectens*). The largest pond, on the edge of the shale barrens area, is also the most diverse. It is covered by a dense growth of the tiny floating water-meal (*Wolffia brasiliensis*), the smallest vascular plant in the state.

**Species of Concern:** No species of conservation concern were documented from ponds on the reserve.

**Management Recommendations:** 1) Control non-native invasive species.

## 10) Pasture/Field

Only one recent pasture or field (Fig. 16a-c) occurs on the reserve property. It is located just west of a sharp bend in County Road 200 and includes a portion on both sides of this road as well as various disturbed areas around the old house and field. This is not really a natural community in the strict sense, but a habitat that is largely man-made, dominated by non-native species and dependent on periodic mowing or grazing to prevent succession to woodland or forest. These processes have been interrupted here in recent years and there is already evident encroachment by woody species. Like most pastures and hayfields in the area, this site was historically “improved” by the planting of various non-native grasses and legumes, some of them “cool season” species, to lengthen the growing season and the supply of fresh grass available as forage. However, some native species which existed in the original woodland and/or prairie habitat have also persisted.

Common grass species include tall fescue (*Schedonorus arundinaceus*\*), Bermuda grass (*Cynodon dactylon*\*), Johnson grass (*Sorghum halepense*\*), purple-top tridens (*Tridens flavus* var. *flavus*), smooth crabgrass (*Digitaria ischaemum*\*), Kentucky blue grass (*Poa pratensis*\*), and broomsedge (*Andropogon virginicus*). A number of weedy forbs also occur in these fields including Queen Anne’s lace (*Daucus carota*\*), sericea lespedeza (*Lespedeza cuneata*\*), ox-eye daisy (*Leucanthemum vulgare*\*), small-flower buttercup (*Ranunculus parviflorus*\*), sticky mouse-ear chickweed (*Cerastium glomeratum*\*), curly dock (*Rumex crispus*\*), yellow-rocket (*Barbarea vulgaris*\*), musk thistle (*Carduus nutans*\*), sweet-clover (*Melilotus albus*\* and *M. officinalis*\*), common vetch (*Vicia sativa*\*), Piedmont bedstraw (*Cruciata pedemontana*\*), common dandelion (*Taraxacum officinale*\*), cornsalad (*Valerianella radiata*), purple dead-nettle (*Lamium purpureum*\*), and field garlic (*Allium vineale*\*).

Woody species in thickets and fencerows include loblolly pine (*Pinus taeda*\*), winged elm (*Ulmus alata*), eastern red-cedar (*Juniperus virginiana*), Chinese wisteria (*Wisteria sinensis*\*), Japanese honeysuckle (*Lonicera japonica*\*), Amur honeysuckle (*Lonicera maackii*\*), Chinese privet (*Ligustrum sinense*\*), blackberry (*Rubus* spp.), black locust (*Robinia pseudoacacia*), wild goose plum (*Prunus munsoniana*), and perfumed cherry (*Prunus mahaleb*\*).

Old fields that have undergone succession to forest are described above under “old field/successional forest”).

**Species of Concern:** No species of conservation concern were documented from pasture/field habitat in the reserve.

**Management Recommendations:** 1) Consider excluding this area from the conservation easement unless it is needed for access or some other purpose. The area of this habitat within the reserve is small, fragmented, and is dominated by non-native invasive plant species. It will be expensive and labor-intensive to restore and manage and it is unlikely that much would be gained (in terms of biodiversity) for the expense and effort. It would probably be better to trade the easement opportunity on this area for one on some other area with more value as a natural area. 2) If this area is retained, control the non-native species and either interpret succession or attempt a small-scale prairie restoration (the GLO notes indicate that this area was at the edge of an open prairie).

## 11) Disturbed Areas

Though they occupy a small fraction of the total area, a variety of recently disturbed habitats occur at scattered sites within the reserve, and these are important habitats for many early-successional “weedy” species (Yatskievych 1999). The largest concentration of these occurs around a small lobe of land on the east side of the tract associated with an abandoned house and field. This area is located just west of a sharp bend in County Road 200 and includes a portion of the roadside on both sides of this road as well as various disturbed areas around the old house and field (this area was accessed by heavy equipment and used to deposit brush, stumps, and other debris from adjacent city property in 2014).

Other examples of disturbed habitats in the reserve include certain areas within a powerline right-of-way in the northern part of the tract and along the various multi-use trails (Fig. 37a). These areas all provide habitat for weedy species, native and introduced, that benefit from various kinds of disturbance. Such disturbance may be associated with any activity which removes existing vegetation or physically disturbs or exposes the soil. It can occur at a variety of spatial scales. Most plant species in this habitat are herbaceous annuals, though some herbaceous perennials and woody species specialize in colonizing disturbed habitat. Disturbed areas that aren’t intensively maintained, especially roadsides and powerline rights-of-way, often retain vegetation typical of the natural communities that they border.

Examples of disturbance-adapted species found along trails include path rush (*Juncus tenuis*), smooth crabgrass (*Digitaria ischaemum\**), green bristle grass (*Setaria viridis\**), white grass (*Leersia virginica*), annual bluegrass (*Poa annua\**), bald brome (*Bromus racemosus\**), hairy bittercress (*Cardamine hirsuta\**), black-seed plantain (*Plantago rugelii*), common chickweed (*Stellaria media\**), Japanese bush-clover (*Kummerowia striata\**), Asiatic dayflower (*Commelina communis\**), bristly ladies’-thumb (*Persicaria longisetia\**), corn speedwell (*Veronica arvensis\**).

**Species of Concern:** No species of conservation concern were documented disturbed habitats in the reserve.

**Management Recommendations:** 1) Excluding the lobe of disturbed pasture/field on the northeast side of the reserve would get rid of much of the disturbed habitats. 2) The trails should be monitored for

invasive species, which should be controlled as needed. 3) If possible, FNHA and the city should work with the power company that maintains the powerline right-of-way in the northern part of the tract to have this maintained without the use of broad spectrum foliar herbicides. This area has a lot of value as a surrogate for open woodland habitat and supports some interesting and locally uncommon sun-loving plant species. Both the power company and these plants want no woody plant encroachment in the right-of-way, but the means to this end makes a big difference. Unfortunately the typical right-of-way management is often to spray the area with an herbicide that kills all broadleaf plants. This has the effect of wiping out many desirable native species while encouraging a wide range of non-native weedy annual species and invasive grasses such as Japanese stilt grass (*Microstegium vimineum*) (Fig. 37c). Alternatives are to cut invading woody plants and treat the stumps directly with herbicide, inject them, or use a “basal bark treatment” where herbicide is mixed with an oil-based penetrant and applied to the exterior of the lower stem. Whatever method is used though, the black locust needs to be controlled as it is choking out the right-of-way.

## ***Plant Diversity***

Kessler Mountain is botanically diverse, with 544 vascular plant species documented in 2014 from the study area. A detailed annotated plant list is provided in Appendix G. Of these, at least six, and possibly a seventh, are listed by the ANHC as species of state conservation concern in Arkansas. Furthermore, at least two, and possibly three, of these are considered to be of global conservation concern, with conservation status ranks of G3 (globally vulnerable) or higher. Detailed information on these species of conservation concern is provided in Appendix D and Figs. 27-35. Non-vascular plants such as bryophytes (mosses, liverworts, and hornworts) and algae were not inventoried, nor were fungi or lichens.

A total of 76 species (14.0% of the total) are considered not native to Arkansas with at least one additional species, loblolly pine (*Pinus taeda*), considered not native to northwest Arkansas. Of the non-native species present, at least 16 are invasive or have the potential to become invasive in natural communities on the tract (not counting the pasture/field and disturbed areas). These species are included in Appendix F and should receive priority for control.

The reserve is diverse for its size and landscape context. It supports elements of a more northern and eastern flora in its mesic bluffs and ravines and elements of an endemic and more western flora in its barrens, dry bluffs, and woodlands. Of particular interest are a number of conservative heliophytes or “prairie species” found on the tract, a testament to both the site’s proximity to the (former) tallgrass prairies of the Springfield Plateau and the historically more open condition of woodlands on the site.

## ***Reptiles and Amphibians***

*This summary was provided by Dr. J. D. Willson, University of Arkansas:*

Reptile and amphibian surveys at Kessler Mountain, primarily conducted in conjunction with BioBlitz events, have documented 26 species thus far (not necessarily all on the reserve tract), including eight frogs, four salamanders, eight snakes, two turtles, and four lizards. The reptile and amphibian

assemblage at Kessler (Fig. 36) is typical of mature forested habitats in the Boston Mountains and high abundances of woodland salamanders and small fossorial snakes are an indication of the healthy condition of the ecosystem; these species are generally intolerant of habitat alteration and are among the first to disappear following forest clearing. Also of note is the presence of a thriving vernal pool at the Rock City trailhead that hosts a breeding population of hundreds of spotted salamanders, frogs, and other amphibians. Many reptile and amphibian species, especially snakes, are extremely secretive, and there are a number of species that are almost certainly present, but have not yet been detected. Glade habitat along the ridgeline deserves particular attention in future surveys, as this is preferred habitat for several uncommon snakes species that have yet to be documented (e.g., Great Plains Ratsnake, Milk Snake, Eastern Hognose Snake, and Pigmy Rattlesnake). Likewise, additional surveys are needed to assess whether any of the karst-associated salamanders (Cave Salamander, Grotto Salamander, Longtail Salamander) are present at the site.

Here is a list of the species documented at Kessler Mountain to date by Dr. Willson:

<b>AMPHIBIANS</b>	
<b>Common Name</b>	<b>Scientific Name</b>
Leopard Frog	<i>Lithobates sphenocephalus</i>
Bullfrog	<i>Lithobates catesbeianus</i>
Green Frog	<i>Lithobates clamitans</i>
Spring Peeper	<i>Pseudacris crucifer</i>
Cajun Chorus Frog	<i>Pseudacris fouquettei</i>
Blanchard's Cricket Frog	<i>Acris blanchardi</i>
Northern Gray Treefrog	<i>Hyla versicolor</i>
American Toad	<i>Anaxyrus americanus</i>
Spotted Salamander	<i>Ambystoma maculatum</i>
Oklahoma Salamander	<i>Eurycea tynerensis</i>
Slimy Salamander	<i>Plethodon albagula</i>
Ozark Zigzag Salamander *	<i>Plethodon angusticlavius*</i>
<b>REPTILES</b>	
<b>Common Name</b>	<b>Scientific Name</b>
Eastern Box Turtle	<i>Terrapene carolina</i>
Common Snapping Turtle	<i>Chelydra serpentina</i>
Five-lined Skink	<i>Plesiodon fasciatus</i>
Broadhead Skink	<i>Plesiodon laticeps</i>
Ground Skink	<i>Scincella lateralis</i>
Fence Lizard	<i>Sceloporus undulatus</i>
Ringneck Snake	<i>Diadophis punctatus</i>
Western Worm Snake	<i>Carphophis vermis</i>
Smooth Earth Snake	<i>Virginia valeriae</i>
Common Garter Snake	<i>Thamnophis sirtalis</i>

Brown Snake	<i>Storeria dekayi</i>
Rat Snake	<i>Pantherophis obsoletus</i>
Speckled Kingsnake	<i>Lampropeltis getula</i>
Copperhead	<i>Agkistrodon contortrix</i>

\* = species of state conservation concern

## Ecological Stresses

Three major ecological stresses on the reserve’s terrestrial natural communities were identified during field work for this assessment. These are:

- 1) Fire Suppression
- 2) Non-native Invasive Plant Species
- 3) Human-caused Disturbances

A fourth ecological stress, though apparently not a major factor within the reserve at present, is included here because it is likely to become an issue as land use changes around the mountain in the future:

- 4) Deer Pressure

These stresses are often interrelated and have worked together to produce the current condition of the reserve’s natural communities.

### **Fire Suppression**

Whether ignited by lightning or by Native Americans, landscape scale fire is widely understood to be an ecological process that played a major role in shaping nearly all upland habitats and plant communities in the Ozark Plateau (Chapman et al. 2006; Engbring et al. 2008; Foti & Glenn 1992; Guyette & Spetich 2003; Guyette et al. 2006; Miller 1972; Nowacki & Abrams 2008; Petersen & Drewa 2006; Rudolph et al. 2006). Fires regularly burned across the Ozark landscape before European settlement and the structure and species composition of natural communities was shaped in large part by the frequency and intensity of these fires in a given spot. The main effects of fire on habitats in the region were 1) to periodically remove leaves and other dead plant material from the ground and 2) to maintain open conditions by arresting the growth of woody vegetation. The degree of habitat openness in the pre-settlement landscape varied with geographic location, landform, local climate, and other factors. Conditions ranged from open prairie and savanna on the flat surface of the Springfield Plateau surrounding Kessler Mountain (where fires were more frequent and intense) to lush closed canopy hardwood forests in protected hollows and more rugged terrain in the Boston Mountains to the south (where fires were less frequent and intense) (Miller 1972). However, much of the upland landscape on Kessler Mountain and other hills in the area was probably somewhere in between savanna and closed forest – a mosaic of

open and semi-open woodlands where periodic fires allowed some light to reach the ground and sustained diverse carpets of sun-loving grasses and wildflowers.

As fires were suppressed and the landscape was fragmented following settlement, these open habitats, along with the species that depended on them, declined across the region. Consequently, many species that were more common historically are rare today and many upland oak-hickory forests in the region have sterile understory vegetation with little diversity. Prescribed fire, or the intentional ignition and management of “controlled burns”, is widely used today (where appropriate) to manage for healthy and diverse woodlands, prairies, glades, and other plant communities.

### ***Non-native Invasive Plant Species***

Kessler Mountain is home to a wide variety of non-native invasive plants (Figs. 37, 38, & 39), a consequence of its location on the edge of an urban area and past disturbance to at least some of its natural communities. Intense use of parts of the reserve by humans, both presently and historically have likely contributed to the colonization and spread of certain invasive plant species. The unchecked growth of these species, combined with other factors, has displaced native species and altered the structure and species composition of natural communities in some areas of the reserve.

Appendix F presents a table of non-native invasive plant species on the tract that are negatively impacting native habitats, or that have the potential to negatively impact native habitats in the future. This list includes information about the life form (forb, grass, woody vine, shrub, tree, etc.) of each species, as well as the habitat(s) they occupy on the tract. Following this table is an annotated list with site-specific information on each species.

### ***Human-Caused Disturbances***

Parts of Kessler Mountain have had a history of human alteration (Figs. 16 & 17) and natural communities in some areas have been highly altered by these activities. Examples include fragmentation of forests and woodlands by utility rights-of-way, past logging and/or clearing forests for pastures, spraying of herbicides in utility rights-of-way, the excavation of a “saddle pond” depression wetland, and compaction and erosion of thin soils by concentrated use in shale barrens (vicinity of the “fire ring”). More subtle disturbances also have lasting effects, such as the spread of certain non-native species along trails.

### ***Deer Pressure***

Deer do not appear to be heavily impacting vegetation at present on Kessler Mountain but this could easily change and become a problem now that the area is protected. A similar study conducted in 2013 and early 2014 at Lake Atalanta Park in Rogers, where no hunting is allowed, found that deer are having a substantial negative impact on the native flora there. Large deer herds can cause populations of many plant species to decline over time or even become extirpated locally as deer consume most or all the plants of certain species. Deer may also encourage certain unpalatable invasive species by avoiding them while eating the native species that formerly occupied the same habitat. The reserve should be

monitored in the future for signs of deer impact and regulated hunting should be considered as a management tool if needed to protect the overall biological diversity of the site.

## **Additional Inventory Recommendations**

Additional inventory of the reserve and surrounding areas is likely to yield more occurrences of species of conservation concern. In addition to the species already documented, the following plant species of conservation concern are possible on Kessler Mountain (based on the habitats present on the reserve and data from similar sites nearby): rock-jasmine (*Androsace occidentalis*) in flat barren areas, Mexican white sage (*Artemisia ludoviciana* subsp. *mexicana*) in dry open woodlands and barrens, lobed spleenwort (*Asplenium pinnatifidum*) on sandstone bluffs, plains poppy-mallow (*Callirhoe alcaeoides*) in dry open woodlands and barrens, yellow monkey-flower (*Mimulus floribundus*) on mesic ledges of bluffs, Drummond's sandwort (*Minuartia drummondii*) in dry open woodlands and barrens, and ovate-leaf catchfly (*Silene ovata*) on mesic talus slopes and shaded ledges.

Additional seeps and springs are likely and might be found if the contacts at the bases of the spring-bearing geologic units were walked out. It is also possible that cave openings exist but were obscured by boulders and /or vegetation during the 2014 field work. The search for seeps, springs, and caves is often most successful in the winter, when deciduous vegetation is dormant and temperatures are below freezing. Cold temperatures often reveal areas of seepage (ice is visible) and, if conditions are right, can aid in finding caves (look for patches of melted snow or steam rising from a cave entrance).

Likely shale barrens sites identified from aerial photos should be inventoried if landowner permission can be obtained. This community is highly unusual, is poorly known, and may harbor additional species of conservation concern.

## **Summary of Management Recommendations**

In our highly fragmented landscape, with its long list of non-native invasive species, ecological management of protected areas is essential if we want to preserve native biodiversity. McCarty (2005) sums up the importance of ecological management as follows:

*Whether to rectify results of past land use, or sustain or emulate important ecological processes that no longer occur, management is a must in most modern natural communities. This management goes beyond understanding what natural communities are to seeking out how they work and what it takes to keep them properly functioning, even when everything around them is altered. Without management, natural communities will be pushed down entirely different pathways and many will not persist.*

Management recommendations are made for each community or habitat on the reserve in the plant community description section, but a summary is provided here. The most important management goals for the Kessler Mountain Reserve should be 1) to restore more open conditions to the barrens, woodlands, and bluff/talus communities and 2) to combat non-native invasive species throughout the

reserve. The two most effective and important management actions that can be taken to meet those goals are to 1) establish an aggressive invasive species management program, and 2) implement a prescribed burn program and return fire to the area at regular intervals.

- 1) **Invasive Species Control** – Non-native invasive plants, especially shrubs and trees, are severely altering some of the natural communities in the reserve. Appendix F has a list of 16 species that are causing (or are likely to cause) the most damage to the important natural communities in the reserve. Sites and/or species should be prioritized in some way so as to get the most impact for the money and effort. Areas of light infestation and/or areas around rare species or habitats might be treated first.

Mesic habitats may need extra attention in regard to mechanical and chemical invasive species control since they are not likely to burn in prescribed fires. When woody plants like tree-of-heaven, Chinese privet, burning-bush, and bush honeysuckle are removed, the stumps (or stems) should be treated with an herbicide. Experience has shown that failure to do this will result in more stems from resprouts and an equally big or bigger problem in the future.

- 2) **Prescribed Fire** – Prescribed fire should be implemented in the barrens and woodlands communities. The existing trail system would serve as a good network of fire lines for an experienced burn crew. If additional fire lines need to be installed on property boundaries, this should be done by hand crew with chainsaws and leaf blowers rather than a bulldozer in order to minimize soil disturbance and the spread of invasive species.

Mesic forests typically do not burn intensely (or in many cases at all) under moderate conditions, which is why they occur where they do. While they do not need to be excluded from burn units, fire should be managed in such a way that it is not forced to burn in mesic forest habitat (it can instead be ‘backed down’ into ravines and steep slopes from above). It may also be wise to avoid burning these areas in the spring after mesic forest herbaceous plants have begun growth.

Ideal first burn units might be 1) the area bound by the Eggbeater and Trent trails and 2) the area bound by the Trent, Serpentine, and Crazy Mary trails (or some part thereof). These areas are predominantly dry and dry-mesic woodland/forest, include part of the shale barrens, and don’t include much mesic forest.

- 3) **Opening Woodlands** – Land managers in Arkansas attempting to restore open woodlands with prescribed fire are often disappointed with the results from fire alone. The overly dense woodlands we see on the landscape today took many decades to develop and it often is not possible to get to the desired condition with fire alone, at least not in a safe manner. One strategy that has yielded good results is to mechanically remove (cut) some of the shrubs and smaller diameter trees in order to let more light reach the ground. Hardwood trees and shrubs, however, will resprout from the stumps and either have to be burned frequently enough to keep the bushy resprouts under control or have the stumps treated with herbicide to prevent resprouting. Another strategy is to girdle trees or inject them with herbicide and leave them

standing (provided they are not near a trail or fire line). These mid-story thinnings are often called “timber stand improvement” (TSI) or “wildlife stand improvement” (WSI) treatments.

- 4) **Protecting the Shale Barrens** – The main shale barrens (in the “fire ring” area) has been heavily degraded by excessive traffic. This has led to a loss of vegetation and subsequent erosion. Consider re-routing trails around this community or confining traffic through it to a narrow corridor with some kind of barrier and signage. Reducing soil disturbance, compaction, and erosion will allow the thin barrens soils and vegetation to recover over time.
- 5) **Develop Thoughtfully** – When trails or other infrastructure elements are being planned, sensitive areas and the locations of rare species should be taken into account. Trails should avoid rare species and sensitive habitats like seeps and springs. Trails should cross spring runs and small streams on elevated bridges. Routine trail maintenance should include survey and treatment of invasive species, which often spread along trail corridors.
- 6) **Manage the Powerline Right-of-Way** – FNHA and the city should work with the power company that maintains the powerline right-of-way in the northern part of the tract to have this maintained without the use of broad spectrum foliar herbicides. This corridor has a lot of value as a surrogate for open woodland habitat and supports some interesting and locally uncommon sun-loving plant species. Both these plants and the power company need woody plant encroachment controlled within the right-of-way, but the means to this end makes a big difference for the plants. Unfortunately the typical right-of-way management is often to spray the area with an herbicide that kills all broadleaf plants. This has the effect of wiping out many desirable native species while encouraging a wide range of non-native weedy annual species and invasive grasses such as Japanese stilt grass (*Microstegium vimineum*). Alternatives are to cut invading woody plants and treat the stumps directly with herbicide, inject them, or use a “basal bark treatment” where herbicide is mixed with an oil-based penetrant and applied directly to the exterior of the lower stem. Whatever method is used though, the black locust and other woody species need to be controlled as they are choking out herbaceous plants in the right-of-way.

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Jennifer Ogle (U of A Herbarium), Burnetta Hinterthuer (Northwest Arkansas Community College), and Joan Reynolds (Northwest Arkansas Master Naturalists) provided information on plants they observed in the early spring before my field work started. Matthew Mihalevich, Michael Morissette, and Greg Mitchell (all with the City of Fayetteville) provided geospatial data and other information. Dr. Stephen Boss (U of A Dept. of Geosciences) provided detailed geology shapefiles. Angela Chandler (Arkansas Geological Survey) and Dr. Walter Manger (U of A Dept. of Geosciences) provided helpful information on the geology of the area. Should any misinterpretation of the geology exist, it is solely mine and in no way reflective of them. Cindy Osborne and Scotty Winningham (both with the ANHC) provided GIS assistance and Samantha Scheiman took care of contract administration. Bob Caulk (FNHA), Jeremy Pate (City of Fayetteville), Terri Lane (FNHA and Northwest Arkansas Land Trust), and Joe Woolbright (FNHA and Ozark Ecological Restorations Inc.) all provided useful background and input. Mike and Christy Slay were gracious enough to house and feed me when the big motorcycle rally prevented me from getting a motel room anywhere near the government rate. Special thanks are due to Frank Sharp (Mt. Kessler Greenways) for hosting a lunch party at the beginning of my field work and most of all for his tireless and important conservation work on Kessler Mountain.

## About the Author and the Arkansas Natural Heritage Commission

**Theo Witsell** is the senior botanist and ecologist for the Arkansas Natural Heritage Commission and a Research Associate at the Botanical Research Institute of Texas. He has also worked as a contract botanist for a number of agencies and organizations including the USDA Forest Service, the National Park Service, the United States Department of Defense, The Nature Conservancy, NatureServe, the U.S. Army Corps of Engineers, the Lady Bird Johnson Wildflower Center (University of Texas at Austin), and the Gates Rogers Foundation. He serves as a regional reviewer for the Flora of North America Project and is co-editor of the recently published *Atlas of the Vascular Plants of Arkansas*. He is currently

working on a number of projects including floristic studies of Arkansas grasslands, a field guide to the woody plants of Arkansas, and the description of several undescribed species. A native Arkansan, he holds a master's degree in botany from the University of Arkansas at Little Rock. His research interests include the ecology and conservation of rare plants and their habitats, restoration of degraded ecosystems, and anything to do with the shale barrens of the Ouachita Mountains. He is also an avid native plant gardener.

The **Arkansas Natural Heritage Commission (ANHC)** focuses on science-based conservation to protect the state's biological diversity. As the central repository for data on rare plants, animals, and natural communities in Arkansas, we work to provide up-to-date information for sound and timely conservation decisions. Our System of Natural Areas provides long-term protection to some of the state's most ecologically significant lands. Through outreach and education programs we strive to deepen the ecological literacy of Arkansans. These efforts, combined with an array of conservation partnerships, are all aimed at ensuring that Arkansas's biological diversity and natural heritage are not lost.

The ANHC also houses the Arkansas Natural Heritage Program, a team of scientists and data managers that gather, interpret, and share information on the state's biological diversity. The Heritage Program's biodiversity data are useful to a wide range of groups and are commonly used for:

**Biodiversity Assessment:** The Arkansas Heritage Program's standardized methodology provides a consistent process for evaluating the relative imperilment of native species and natural communities. The result is a dynamic process that updates the conservation status and ranks of rare elements of biodiversity as new data become available.

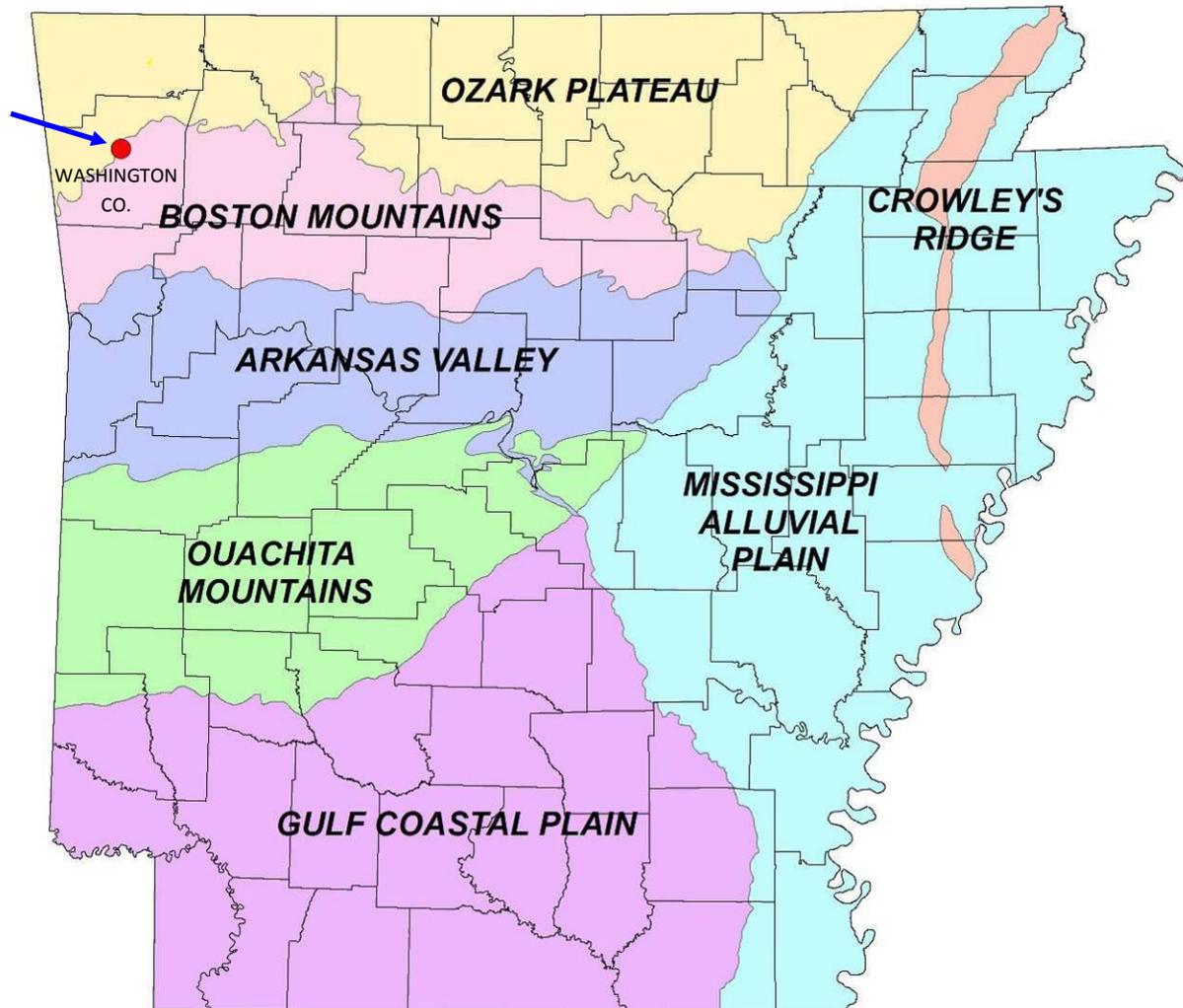
**Land Management Planning:** ANHC uses Arkansas Heritage Program data as the primary tool in the location and identification of ecologically significant lands most in need of protection. Data are also provided to government agencies and other land management organizations specific to their respective holdings. With this data in hand, rare species and natural communities can be factored into land management plans.

**Environmental Review/Information Sharing:** Data from the Arkansas Heritage Program are used by ANHC staff in the review of specific project-related impacts through the state environmental review process. Examples include commercial and residential developments, transportation projects, utility construction, landfills, mining, and flood control projects. Data are also provided to private developers and public land use planners to notify them of the location of rare species or biologically sensitive areas early in the planning process.

**APPENDIX A:**

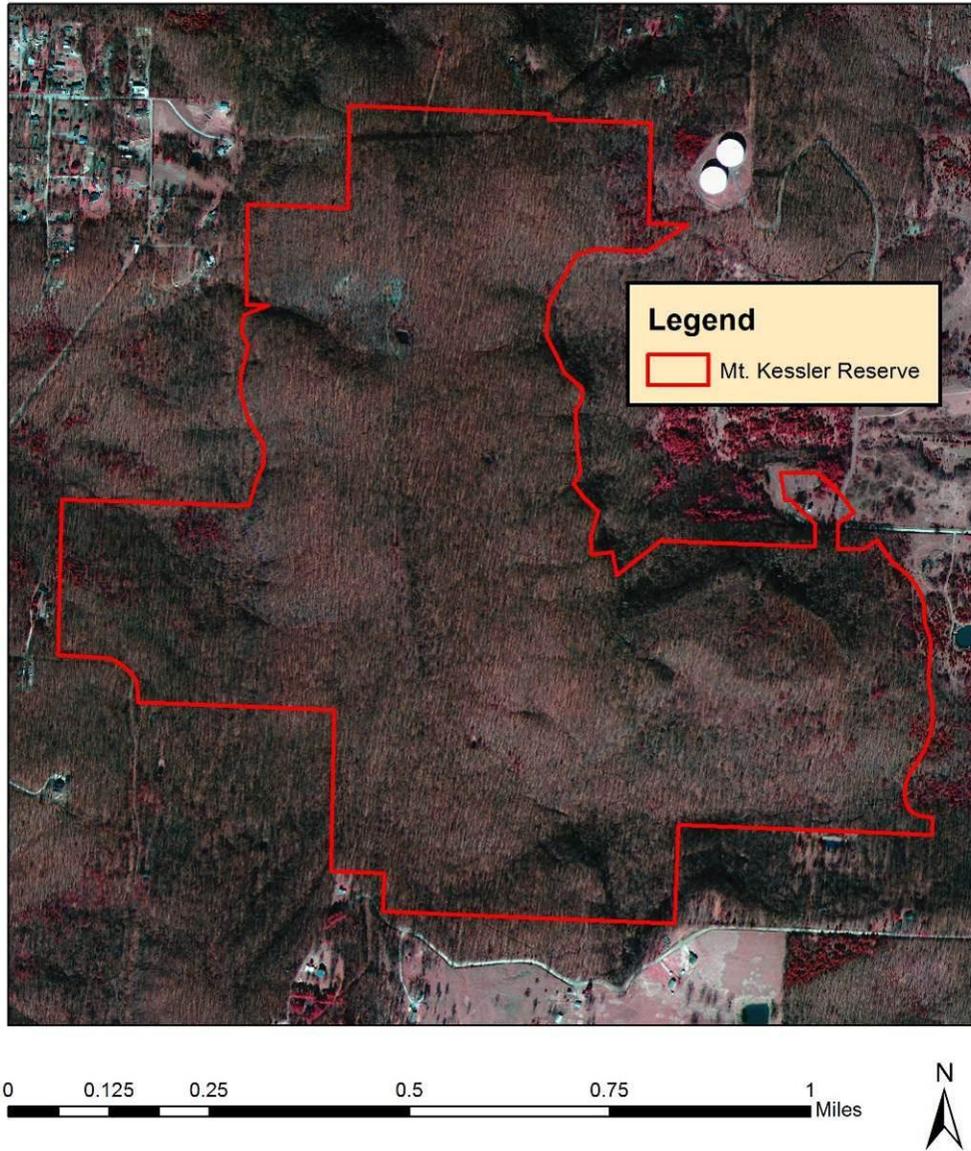
**AERIAL PHOTO AND MAPS OF KESSLER MOUNTAIN RESERVE**

## *Location of Kessler Mountain Reserve*



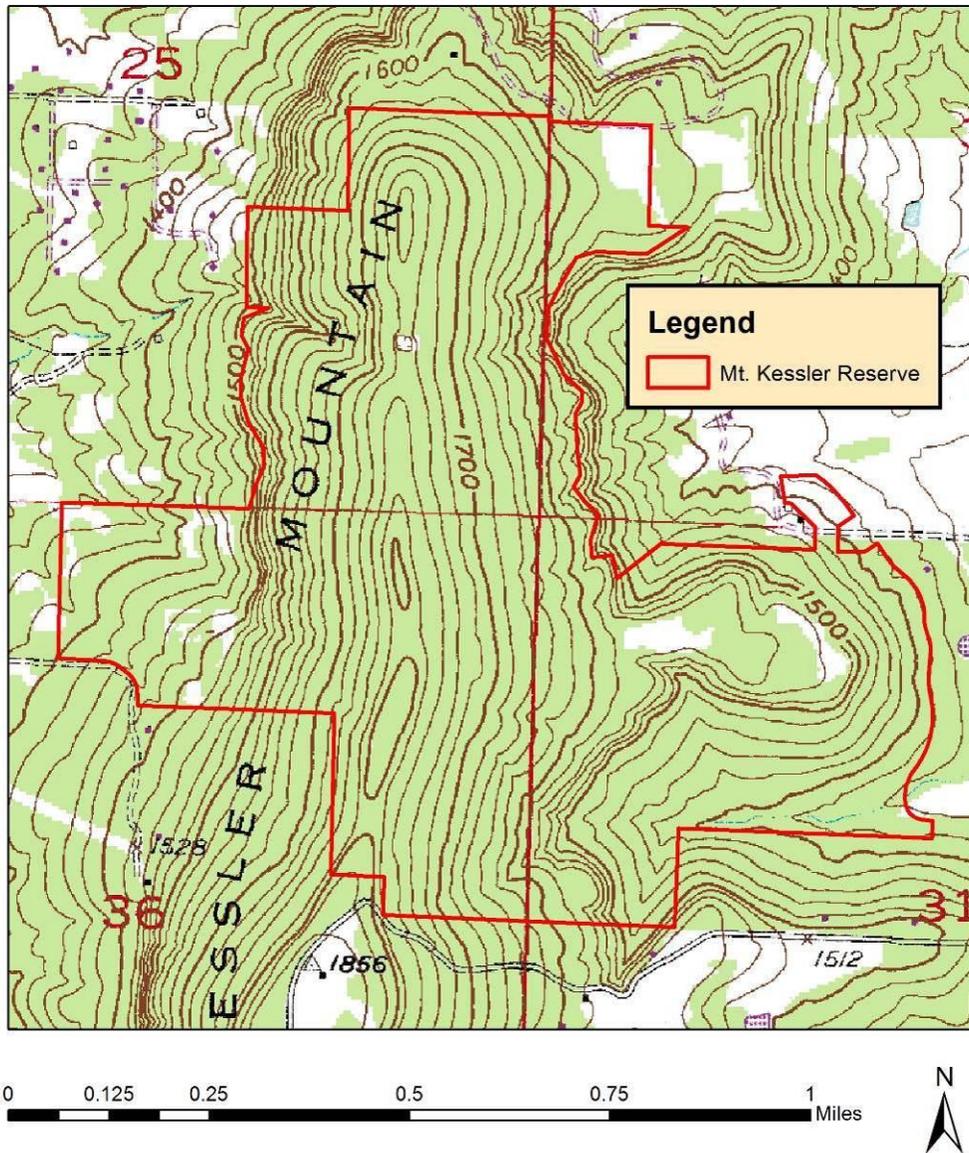
**FIGURE 1.** Location of Kessler Mountain Reserve, Washington County, Arkansas, on map with EPA Level III Ecoregions. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

*Kessler Mountain Reserve – Aerial Photo*



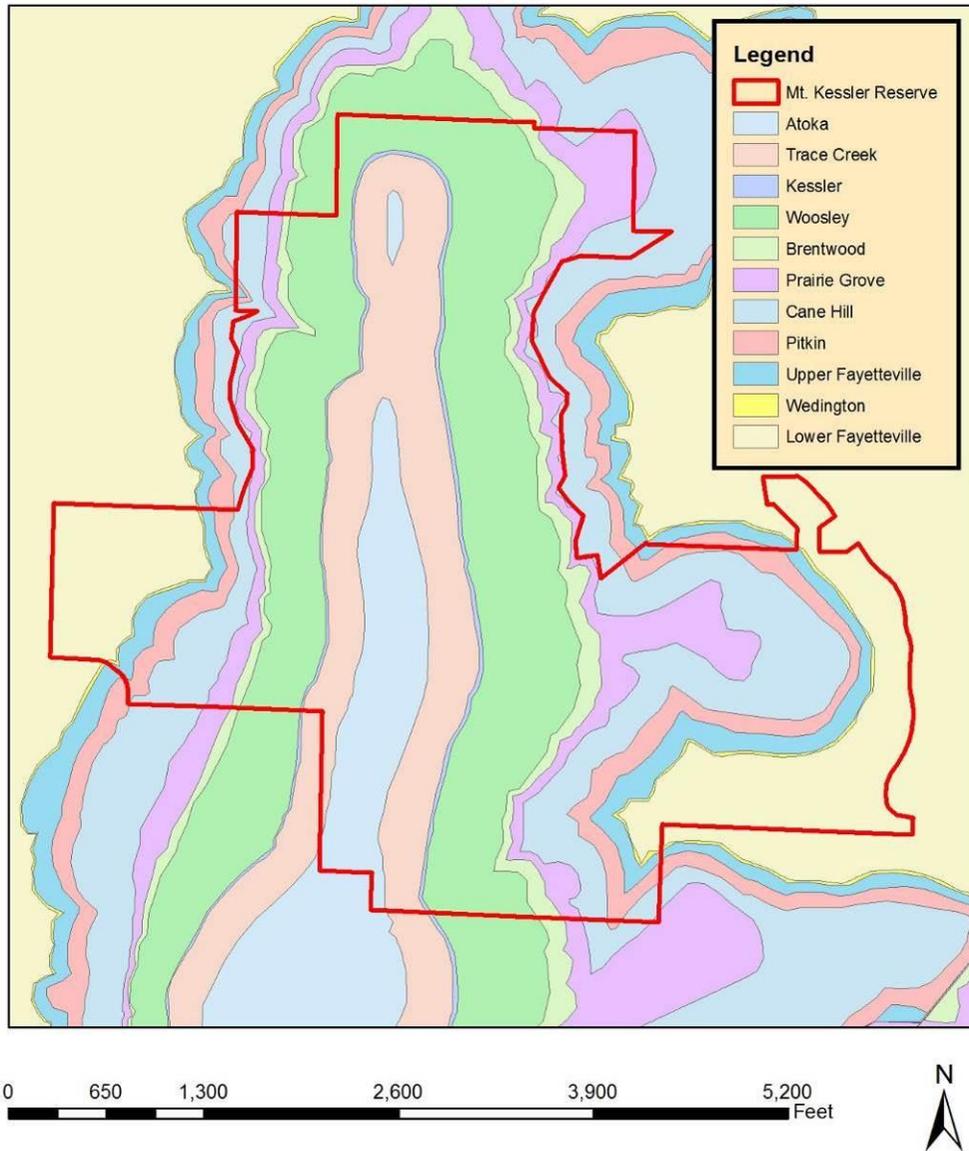
**FIGURE 2.** Map of Kessler Mountain Reserve on 2006 color-infrared aerial photo. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

## Kessler Mountain Reserve – Topographic Map



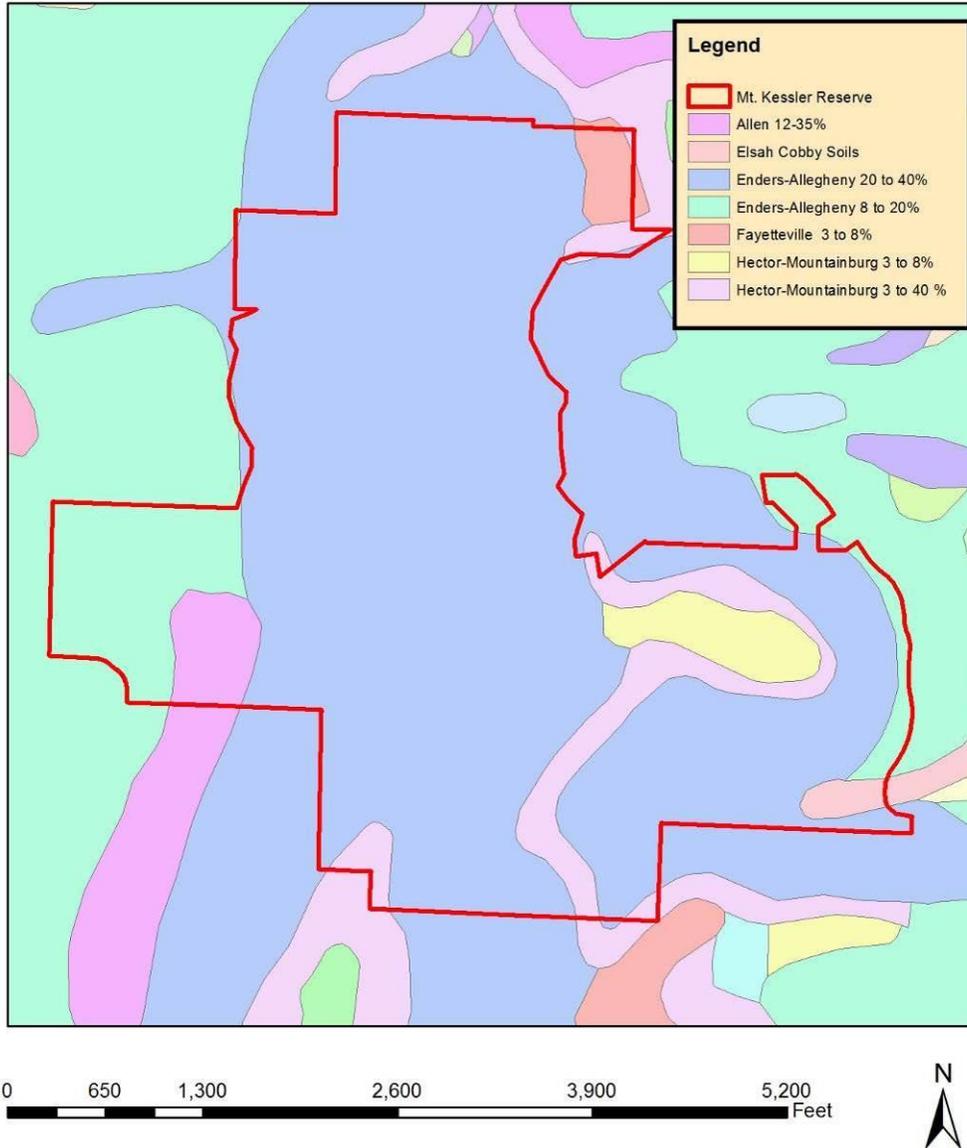
**FIGURE 3.** Map of Kessler Mountain Reserve on USGS topographic map from Fayetteville 7.5' quadrangle. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

## Kessler Mountain Reserve – Geologic Map



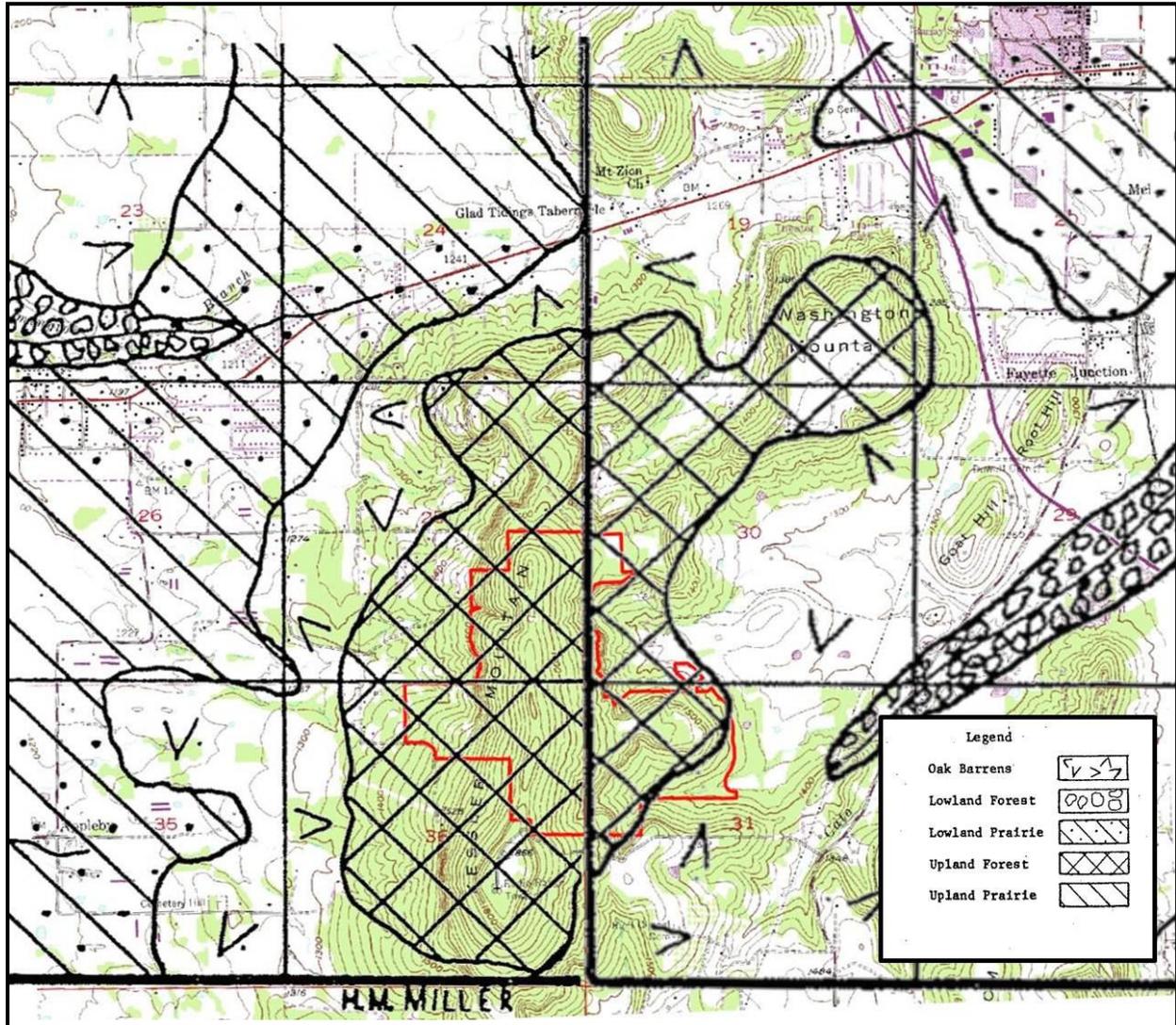
**FIGURE 4.** Geologic map of Kessler Mountain Reserve. Geology data courtesy of Dr. Steve Boss, University of Arkansas at Fayetteville Department of Geosciences. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

## Kessler Mountain Reserve – Soils Map



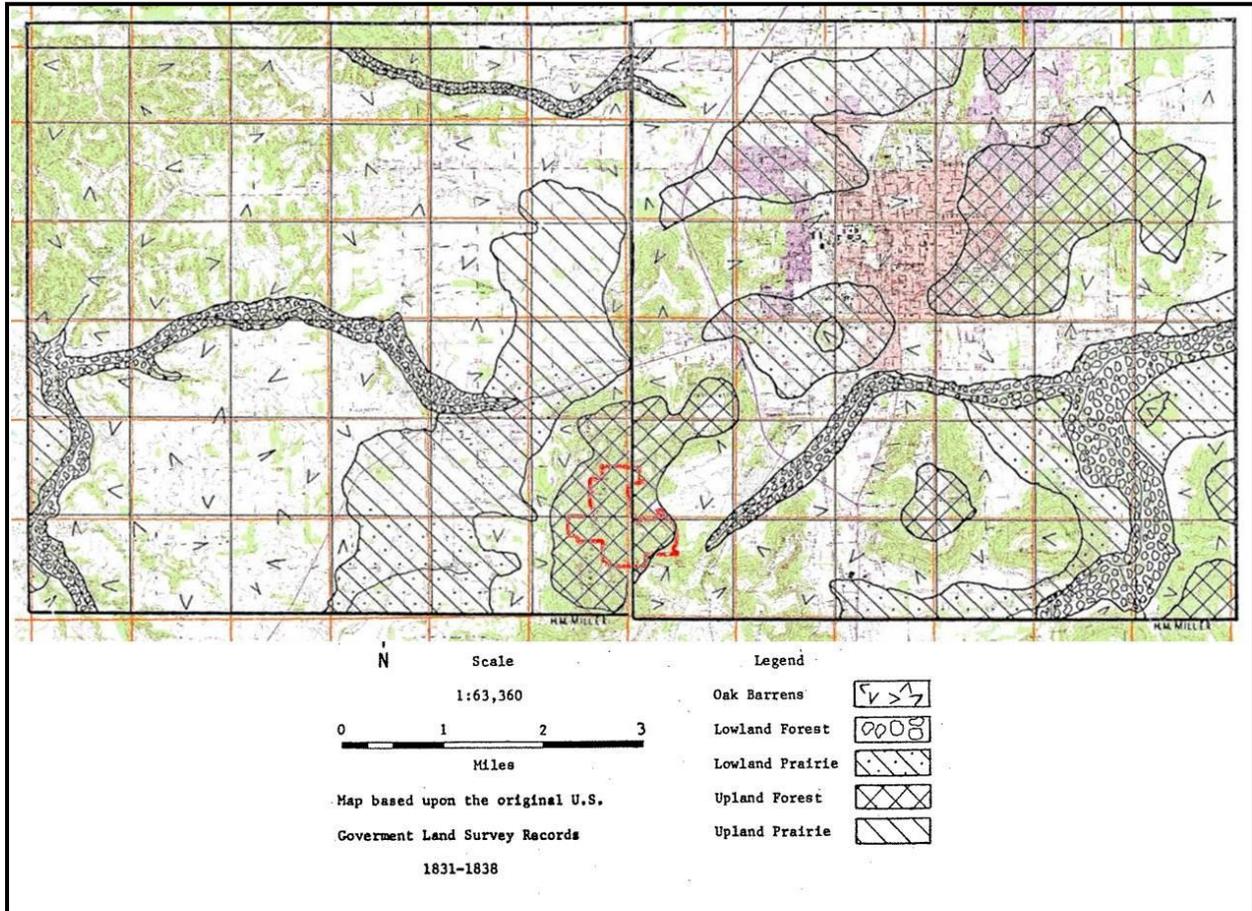
**FIGURE 5.** Soils map of Kessler Mountain Reserve. Soils data courtesy of USDA Natural Resources Conservation Service. NOTE: Only soils shown within the reserve boundary are listed in the legend. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

## Kessler Mountain Reserve – Historical Vegetation Map



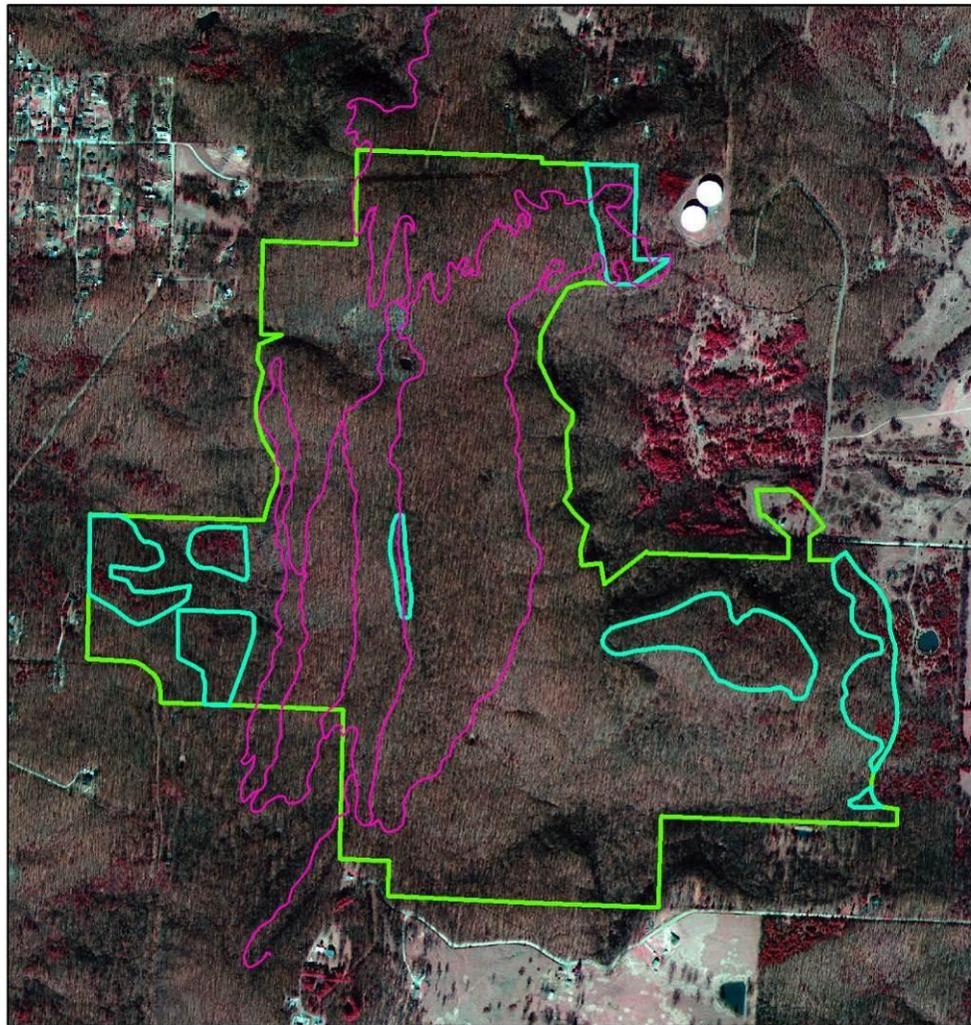
**FIGURE 6.** Historical vegetation map of Kessler Mountain Reserve and vicinity over USGS topographic map. Historical vegetation overlay from analysis by Henry M. Miller (1972) of GLO land survey data from 1831. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

## *Greater Fayetteville Region – Historical Vegetation Map*



**FIGURE 7.** Historical Vegetation Map of T16N R30W and T16N R31W (including Kessler Mountain Reserve in lower center, outlined in red) over USGS topographic map. Historical vegetation from analysis by Miller (1972) of GLO land survey data from 1831-1838. Map by Theo Witsell, Arkansas Natural Heritage Commission, 2015.

*Kessler Mountain Reserve – Old Field/Successional Forest Areas*



0 0.125 0.25 0.5 0.75 1 Miles

**Legend**

-  Trails
-  Mt. Kessler Reserve
-  Old Fields



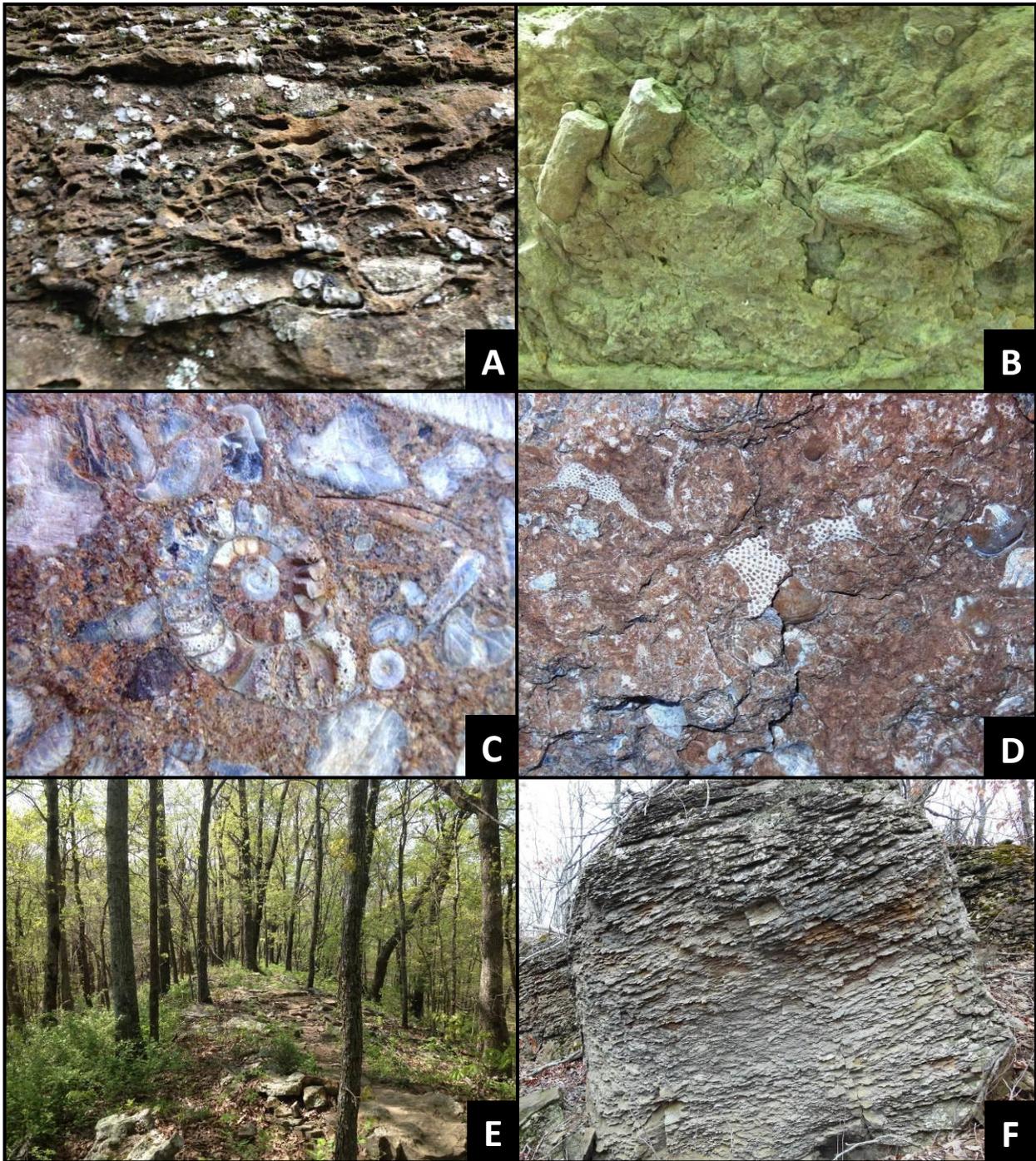
*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 8.** Map of Old Field/Successional Forest areas at Kessler Mountain Reserve.

## **APPENDIX B:**

# **PHOTOGRAPHS OF SPECIES AND HABITATS AT KESSLER MOUNTAIN RESERVE**

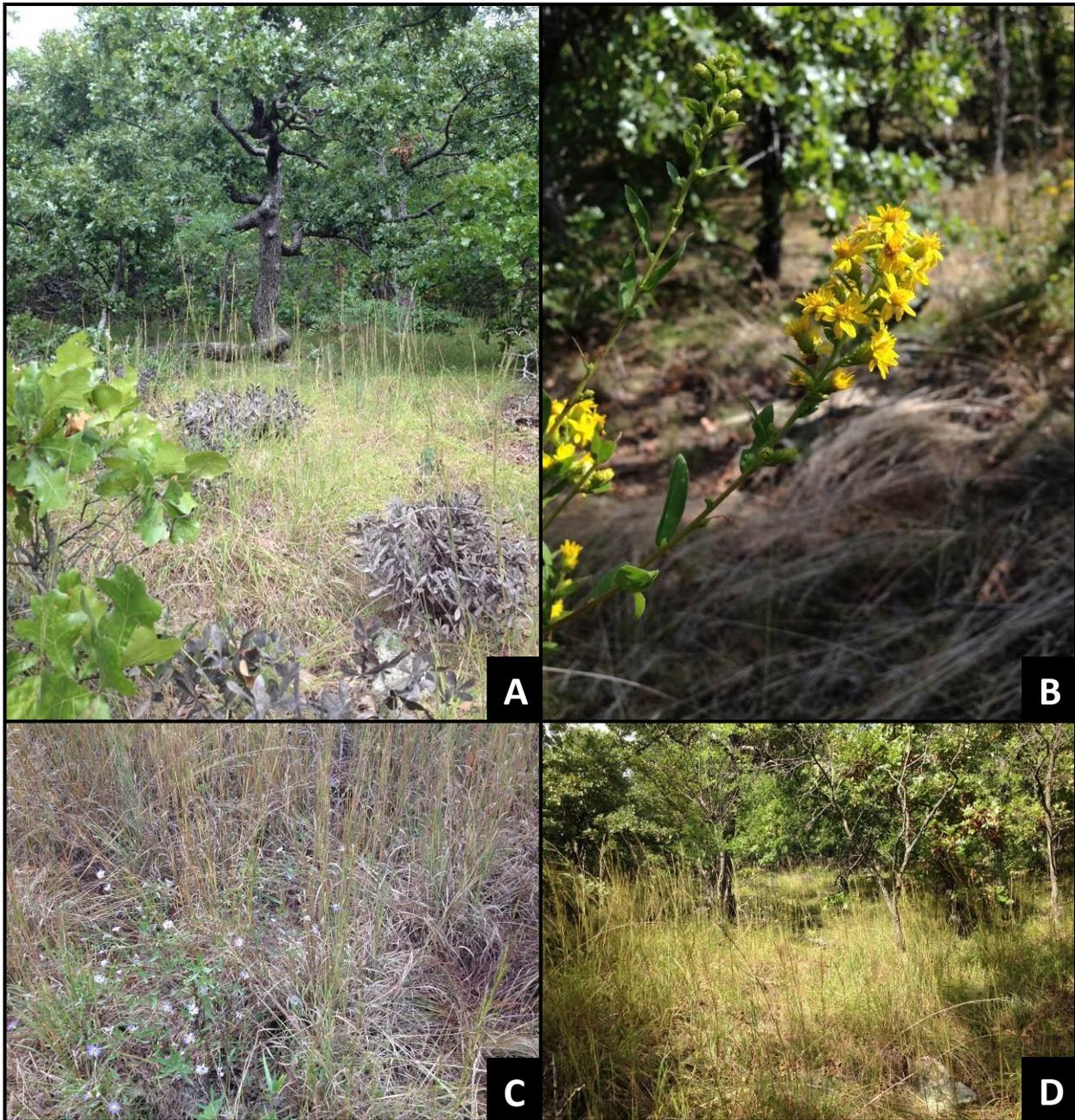
All photos taken by Theo Witsell from April to October 2014 unless otherwise noted. All photos from Kessler Mountain unless otherwise noted.



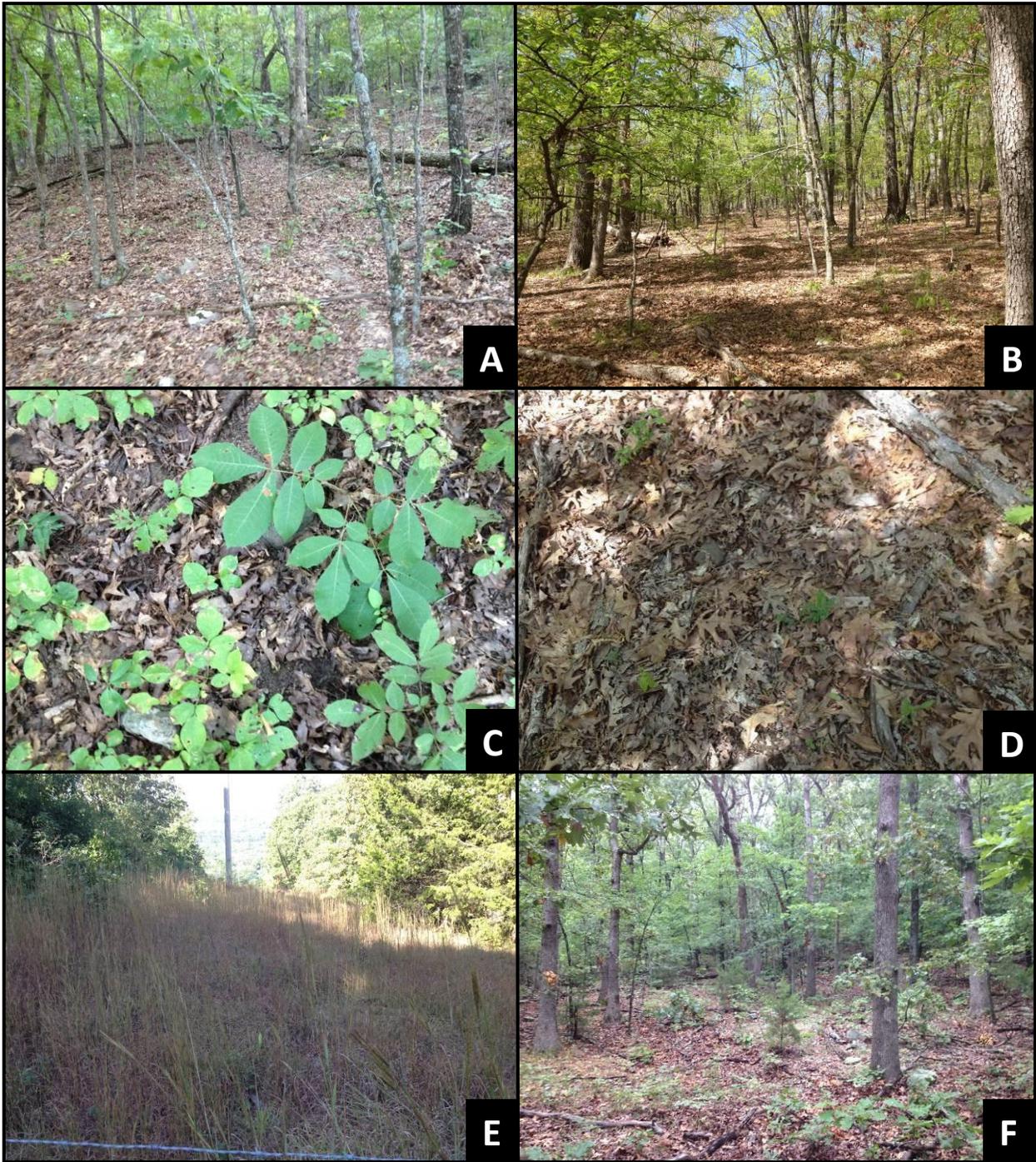
**FIGURE 9. A.** Detail of the Prairie Grove Sandstone on a bluff face on the west side of the tract showing the surface pitting characteristic of that formation. **B.** Trace fossils of marine worm burrows in a sandstone bluff on the east side of the mountain. **C.** Ammonoid fossil in a bluff near Rock City. Photo by Joe Neal. **D.** Bryozoan fossils in a bluff near Rock City. Photo by Joe Neal. **E.** The narrow ridge at “Rocky Crest” near the southern end of the Rock City Trail is an isolated remnant of the Atoka Sandstone, the youngest rock type on the mountain. This point is also the divide between the Illinois River watershed and the White River watershed. **F.** Outcrop of the Kessler Limestone on the west side of the mountain along the Eggbeater Trail. Photo by Joe Neal.



**FIGURE 10.** A. and B. Stunted post oak (*Quercus stellata*) trees, some as old as 250 years, grow scattered among prairie grasses in shale barrens in a saddle on the top of Kessler Mountain. C. The ground flora of these shale barrens is diverse, containing a wide variety of prairie and woodland species like these scattered clumps of cream wild indigo (*Baptisia bracteata*) growing among little bluestem (*Schizachyrium scoparium*).



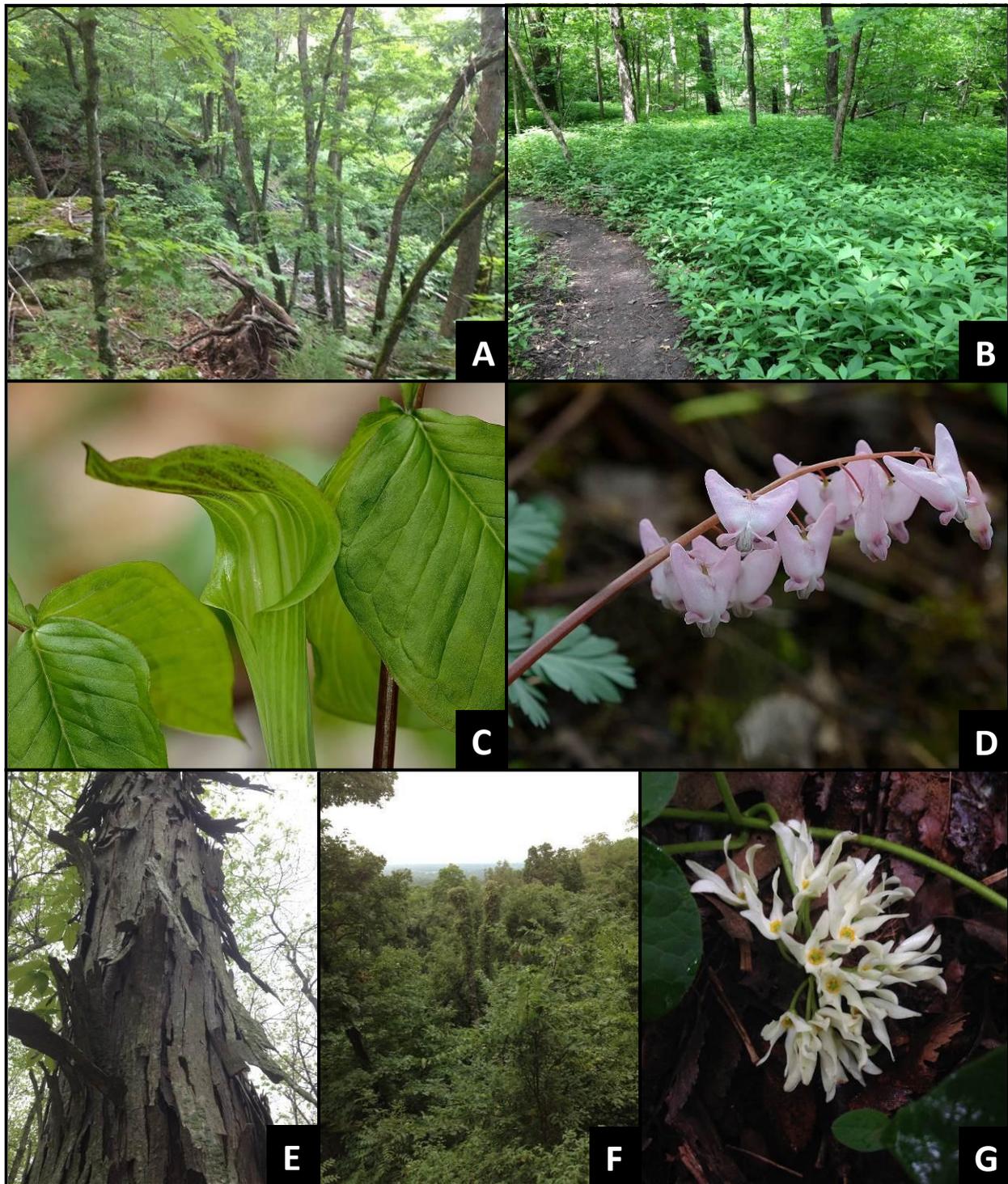
**FIGURE 11.** Shale Barrens. **A.** An old post oak with little bluestem, cream wild indigo, and blackjack oak (*Quercus marilandica*) in the foreground. **B.** Downy ragged goldenrod (*Solidago petiolaris*) in shale barrens atop Kessler Mountain. **C.** Prairie aster (*Symphotrichum turbinellum*), Scribner's rosette-grass (*Dichanthelium oligoanthes* subsp. *scribnerianum*), and little bluestem. **D.** Big bluestem (*Andropogon gerardii*) and little bluestem dominate the ground flora in better quality areas of the shale barrens.



**FIGURE 12.** A. and B. Typical closed canopy dry oak woodland on Kessler Mountain with depauperate herbaceous layer and thick accumulation of leaf litter. C. Ground cover is sparse, low diversity, and consists primarily of woody plant seedlings like these mockernut hickory (*Carya alba*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), northern red oak (*Quercus rubra*), and Virginia-creeper (*Parthenocissus quinquefolia*). A lack of flowering plants means no nectar, fruit, or seed resource for insects, birds, and other wildlife. D. Decades of accumulated oak leaf litter acts as a blanket suppressing herbaceous plant growth. E. Powerline right-of-way through this same upland woodland showing a diversity of herbaceous prairie and woodland plants providing food and cover resources for wildlife. F. Fire-suppressed post oak woodland showing older, widely spaced, open-grown oaks but heavy encroachment of younger woody plant growth, thick leaf litter, and few herbaceous plants. This is the common condition of these communities throughout the region today.



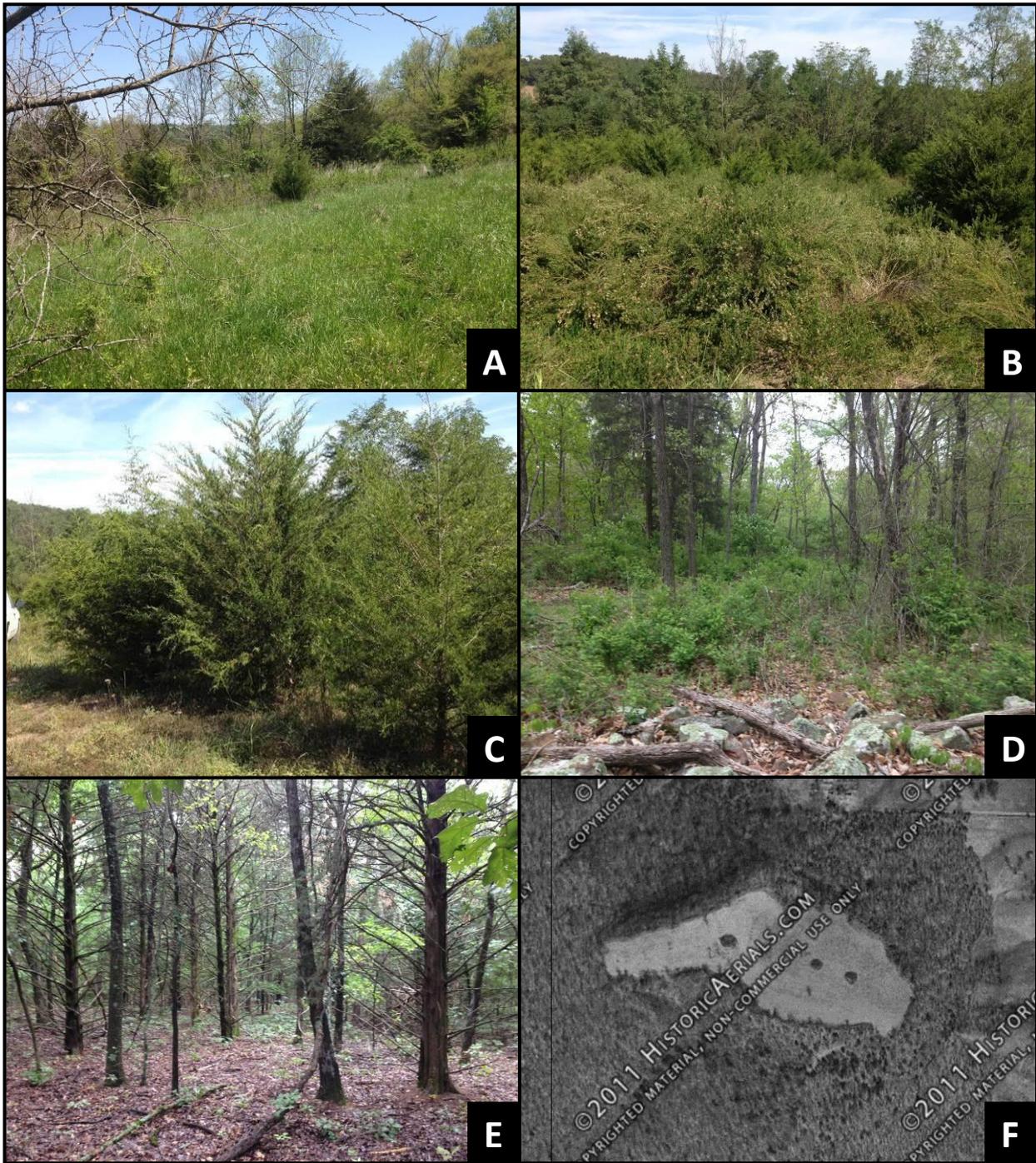
**FIGURE 13.** A. Thick, leathery leaves of pale Indian-plantain (*Arnoglossum plantagineum*), a species of prairies and open oak savannas, persisting in a closed canopy dry oak woodland on the east side of Kessler Mountain near the Crazy Mary Trail. Even in fire-suppressed, closed canopy woodlands, pockets of perennial open woodland and prairie plants sometimes hang on in a vegetative state, waiting for enough light to flower. There are many such species of sun-loving plants in the woodlands at Kessler, persisting from times when conditions were more open. B., C., and D. Pockets of more open dry-mesic woodlands with a lush and diverse herbaceous layer still persist in a few areas, especially where the soil is thin and rocky. These examples are from an exposed area above the bluffs on the east side of the tract.



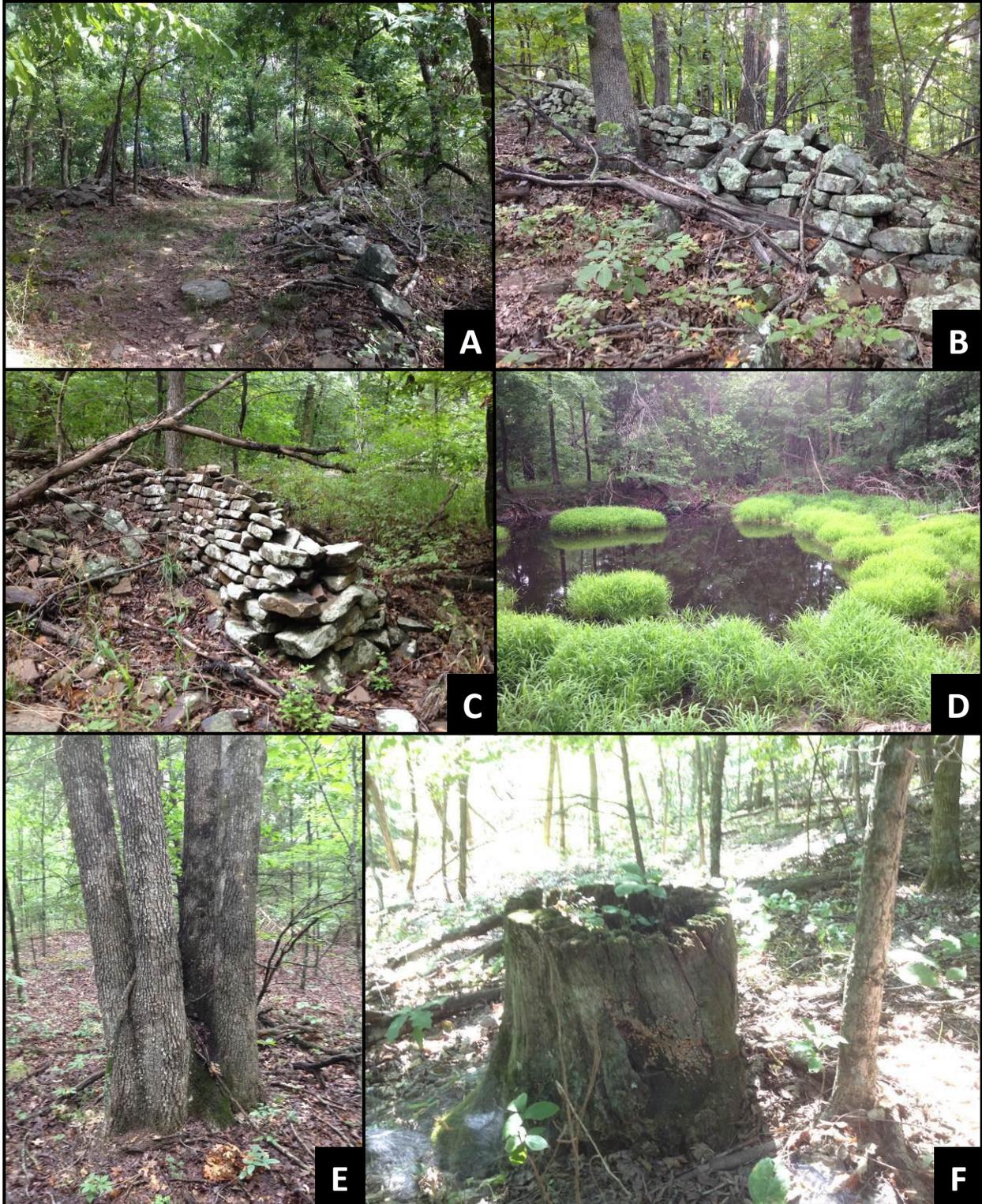
**FIGURE 14.** A. Mesic hardwood forests occur in protected sites that weren't prone to frequent or intense fires historically. B. Dense stand of green violet (*Hybanthus concolor*) along the Spellbound Trail just north of the reserve. C. Jack-in-the-pulpit (*Arisaema triphyllum*) and D. Dutchman's-breeches (*Dicentra cucullaria*) are common spring wildflowers of mesic forests on Kessler. Photos by David Oakley. E. Mature specimens of shagbark hickory (*Carya ovata*) are easily recognized by their platy, peeling bark, which provides important shelter for roosting bats. F. Mesic forests below bluffs on Kessler Mountain have seen heavy damage to the canopy in recent ice and wind events. G. Climbing-milkweed (*Matelea baldwyniana*) below bluffs.



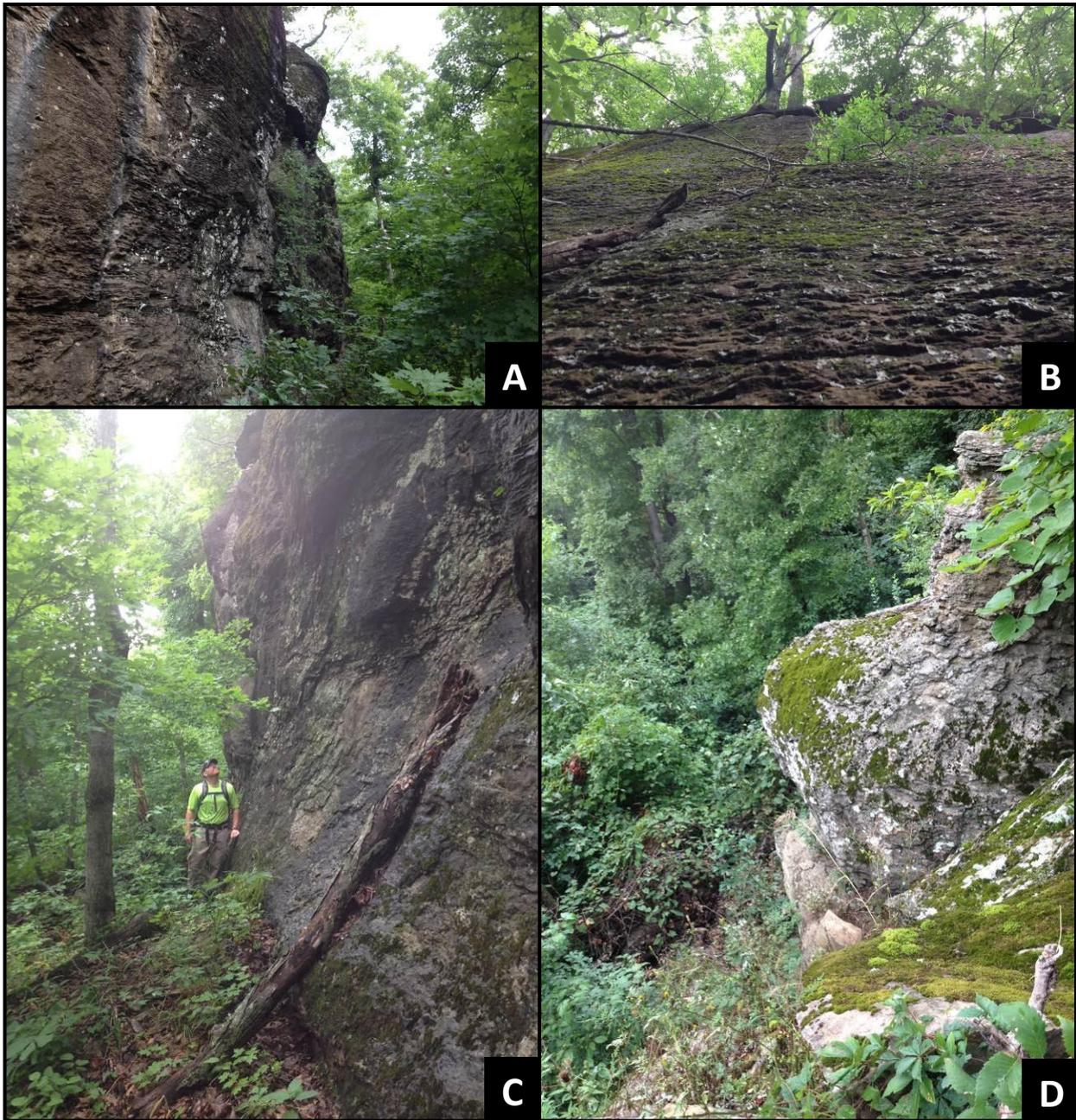
**FIGURE 15.** **A.** This riparian forest along an unnamed tributary of Cato Springs Branch supports sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), American elm (*Ulmus americana*), and other moisture-loving trees. Located on the east side of the mountain near the southern boundary, this stream is the largest on the reserve and the only one with flow into the summer. **B.** and **C.** Other streams on the reserve, such as these on the west side of the mountain, are ephemeral and only flow in the wet season or for brief periods after rain.



**FIGURE 16.** **A.** Pasture/old field dominated by tall fescue (*Schedonorus arundinaceus*) with woody plant encroachment. **B.** Pasture/old field infested with sericea lespedeza (*Lespedeza cuneata*), a non-native invasive species of open habitats. **C.** Eastern red-cedar (*Juniperus virginiana*) encroaching into a field on the east side of the tract. **D.** This area of shrubby forest still showed signs of being an open field in aerial photographs from the 1960s. **E.** Dense area of cedar forest in former open field below the bluffs on the west side of the tract. Note the sparse flora. **F.** 1968 aerial photo of the eastern side ridge of the reserve showing it as a recently cleared field. Note brush piles. This area was forested again in a 1994 photograph.



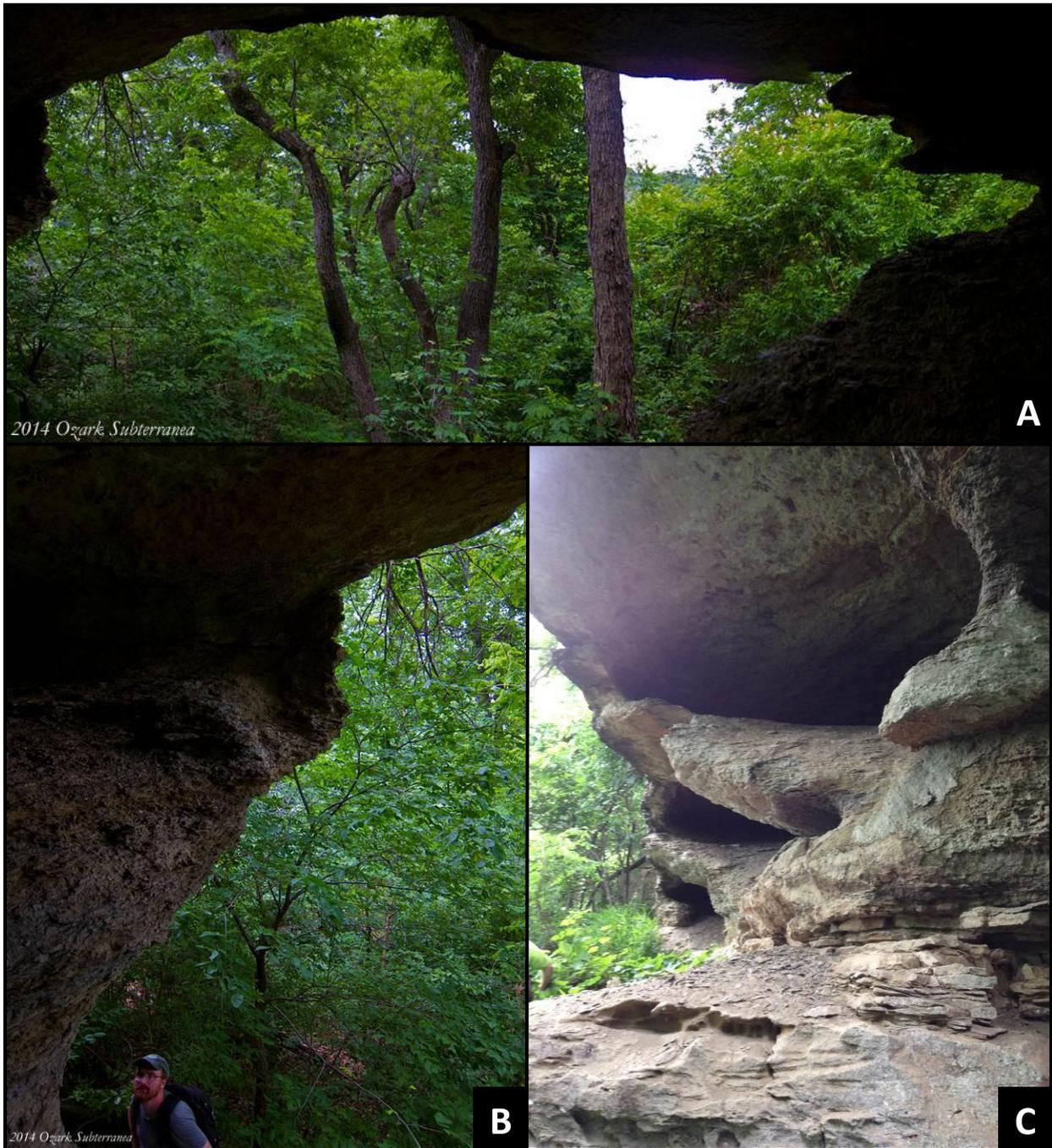
**FIGURE 17.** Signs of past disturbance and human use on Kessler Mountain. **A.** Old road along main ridge (Trent Trail) with rocks removed. **B.** and **C.** Stone walls, now surrounded by forest, are found scattered in several areas on Kessler Mountain. **D.** A small manmade pond with clumps of rice cutgrass (*Leersia oryzoides*), surrounded by forest. Three such ponds are found on the tract. **E.** Areas with multi-trunked stump-sprouted hardwood trees and **F.** stumps indicate former logging.



**FIGURE 18.** Bluffs are one of the most important and biologically diverse habitats at Kessler Mountain, supporting several rare species. **A.** and **B.** Massive cliff faces of Prairie Grove Sandstone (Hale Formation) on the west side of the tract. **C.** Mike Slay of The Nature Conservancy surveying for caves and springs along a bluff on the west side of the tract. **D.** Bluff of the Brentwood Limestone (Bloyd Formation) on the west side of the tract.



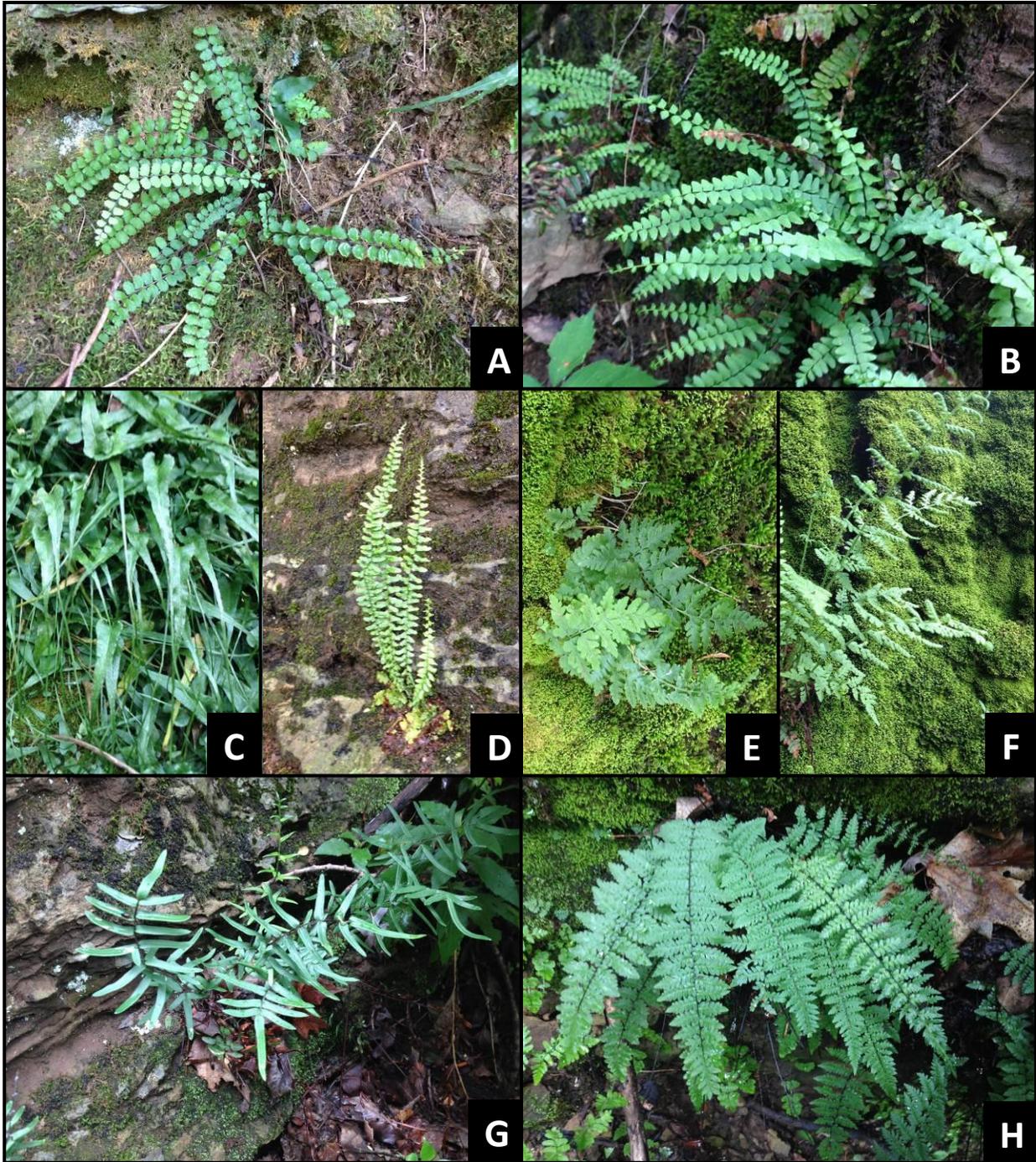
**FIGURE 19.** Sheltered cracks, crevices, and bluff shelters or “rockhouses” in bluffs on the tract provide unique habitats for a number of species. **A.** Massive boulders have broken from bluffs on the tract in several places, forming narrow slots such as this one on the west side of Kessler Mountain. **B.** The beginnings of this process can be seen in this long vertical crack, west side of Kessler Mountain. **C.** and **D.** Small overhanging ledges provide sheltered habitats for a variety of wildlife.



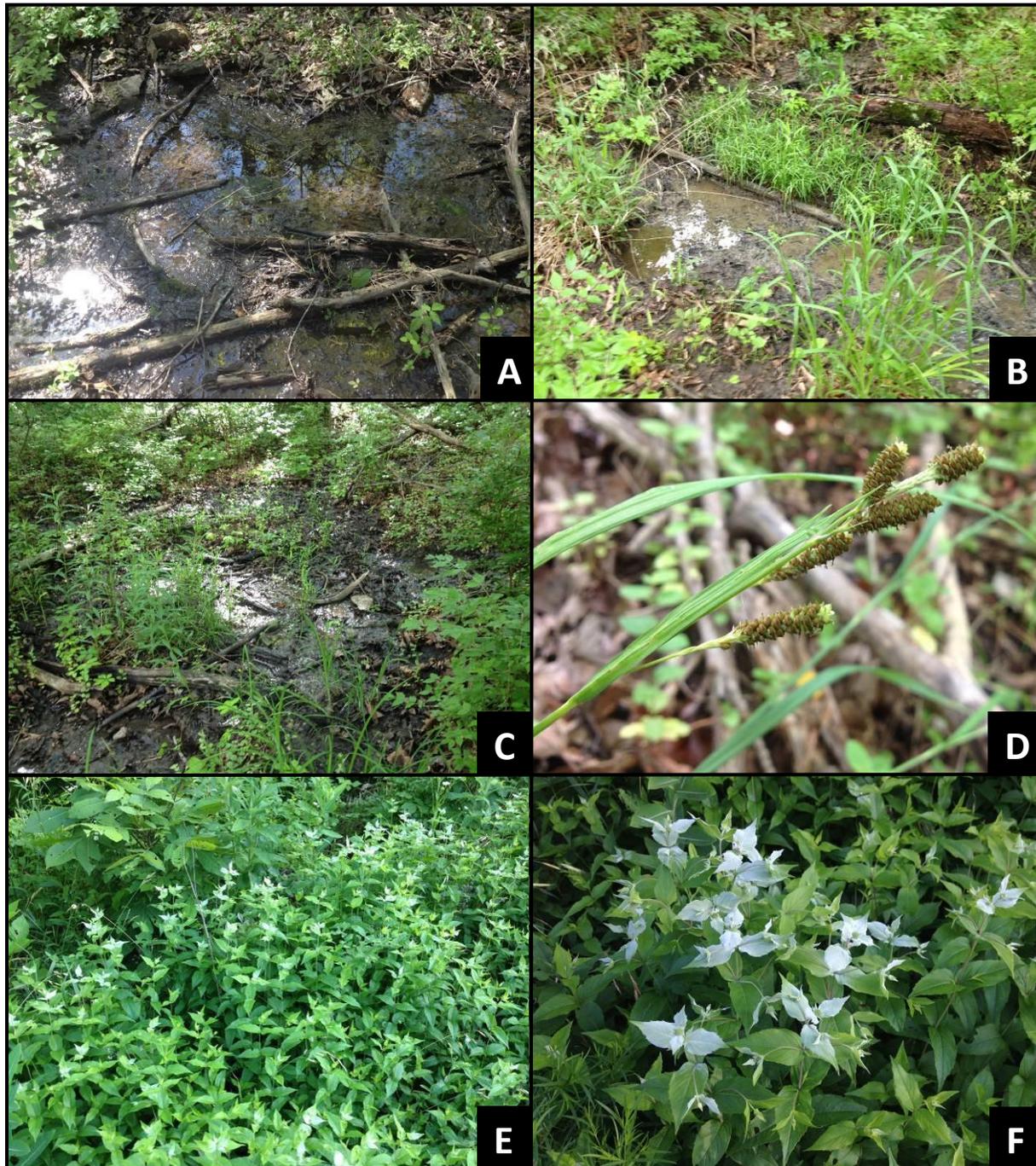
**FIGURE 20.** Bluff shelters or “rockhouses” in bluffs on the tract provide unique habitats for a number of animal species, most definitely including Black Vultures. **A.** View looking out from a significant bluff shelter on the east side of Kessler Mountain. Photo by Mike Slay. **B.** The author at the base of this same bluff shelter. Photo by Mike Slay. **C.** Bluff shelter with three large cavities in the back wall, east side of Kessler Mountain.



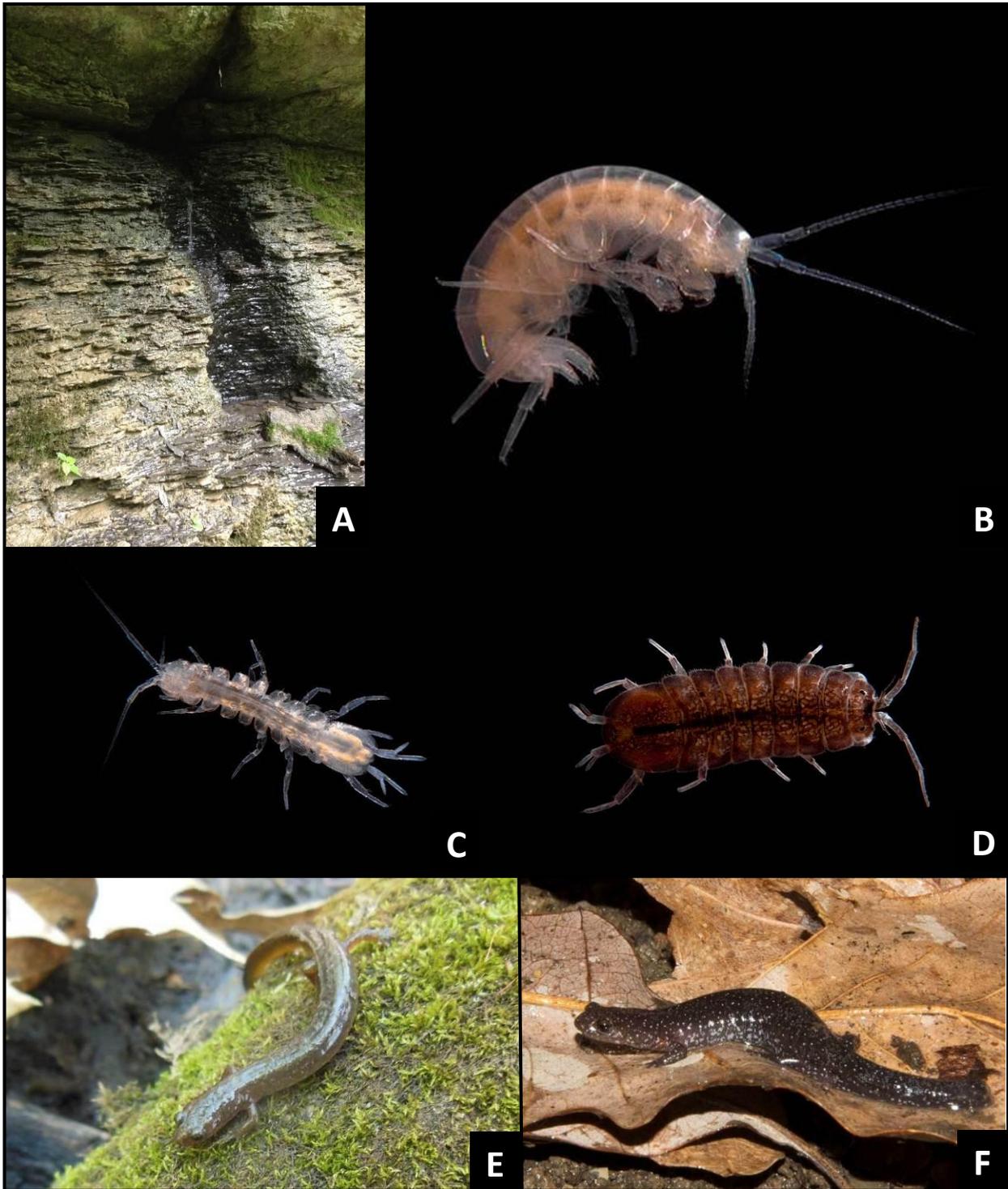
**FIGURE 21.** A. Low bluffs, or ledges, often provide enough of a topographic break to create a light gap in the canopy and provide important habitat for sun-loving species. B. Ernest's spiderwort (*Tradescantia ernestiana*) growing atop ledges. C. Talus, the steep slope of loose rock and soil below many bluffs, is critical habitat for a number of species including Missouri ground-cherry (*Physalis missouriensis*), a species of global conservation concern. D. Rock outcrop ferns such as this group of walking fern (*Asplenium rhizophyllum*), black-stem spleenwort (*Asplenium resiliens*), and purple-stem cliff-brake (*Ptelea atropurpurea*) are found on limestone bluffs and ledges.



**FIGURE 22.** Some ferns of bluffs and rock outcrops at Kessler Mountain. **A.** Maidenhair spleenwort (*Asplenium trichomanes*). **B.** Black-stem spleenwort (*Asplenium resiliens*). **C.** Walking fern (*Asplenium rhizophyllum*). **D.** Ebony spleenwort (*Asplenium platyneuron*). **E.** Tennessee bladder fern (*Cystopteris tennesseensis*). **F.** Blunt-lobed cliff fern (*Woodisa obtusa*). **G.** Purple-stem cliff-brake (*Pellaea atropurpurea*). **H.** Alabama lip fern (*Cheilanthes alabamensis*). All photos taken at Kessler Mountain in 2014.



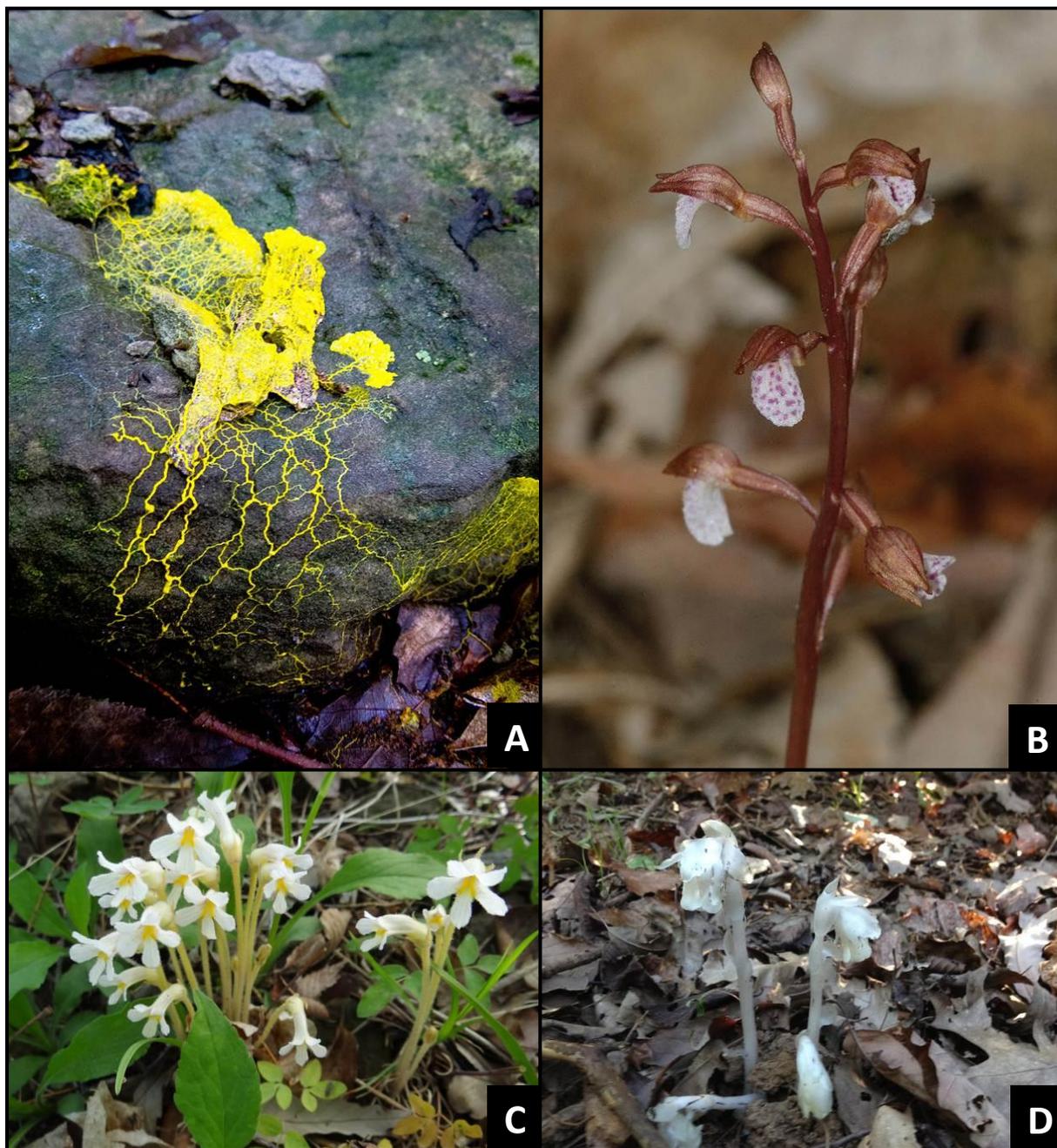
**FIGURE 23.** Seeps and Springs. **A.** This mucky spring below bluffs on the east side of the tract was wet throughout 2014. **B.** and **C.** Sedges and other wetland plants grow in a complex of seeps and springs near the north end of the tract. **D.** Short's sedge (*Carex shortiana*) growing along a spring run near the southern edge of the tract. **E.** and **F.** Short-tooth mountain mint (*Pycnanthemum muticum*) growing in a seep in an open powerline right-of-way near the north end of the tract. This intensely fragrant mint is usually found in wet prairies and other moist, open habitat to the southeast. It was not previously known from Washington County and this may be the northwestern-most population in the United States.



**FIGURE 24.** Spring emerging from the contact between limestone (above) and shale (below) in a bluff on the east side of the tract. **B.** Groundwater amphipod (*Stygobromus* sp.) Photo by Mike Slay. **C.** Groundwater isopod (*Caecidotea* sp.). Photo by Mike Slay. **D.** Spring isopod (*Lirceus* sp.). This is not a groundwater-obligate and not adapted to life underground (note pigment and eyes). Photo by Mike Slay. **E.** Oklahoma Salamander (*Eurycea tynerensis*) was found in a single spring on the east side of Kessler Mountain. Photo by Joe Neal. **F.** Ozark Zigzag Salamander (*Plethodon angusticlavius*) was found in a spring run on the east side of Kessler Mountain. Photo by Mitchell Pruitt. All photos (or all specimens in photos) from Kessler Mountain.



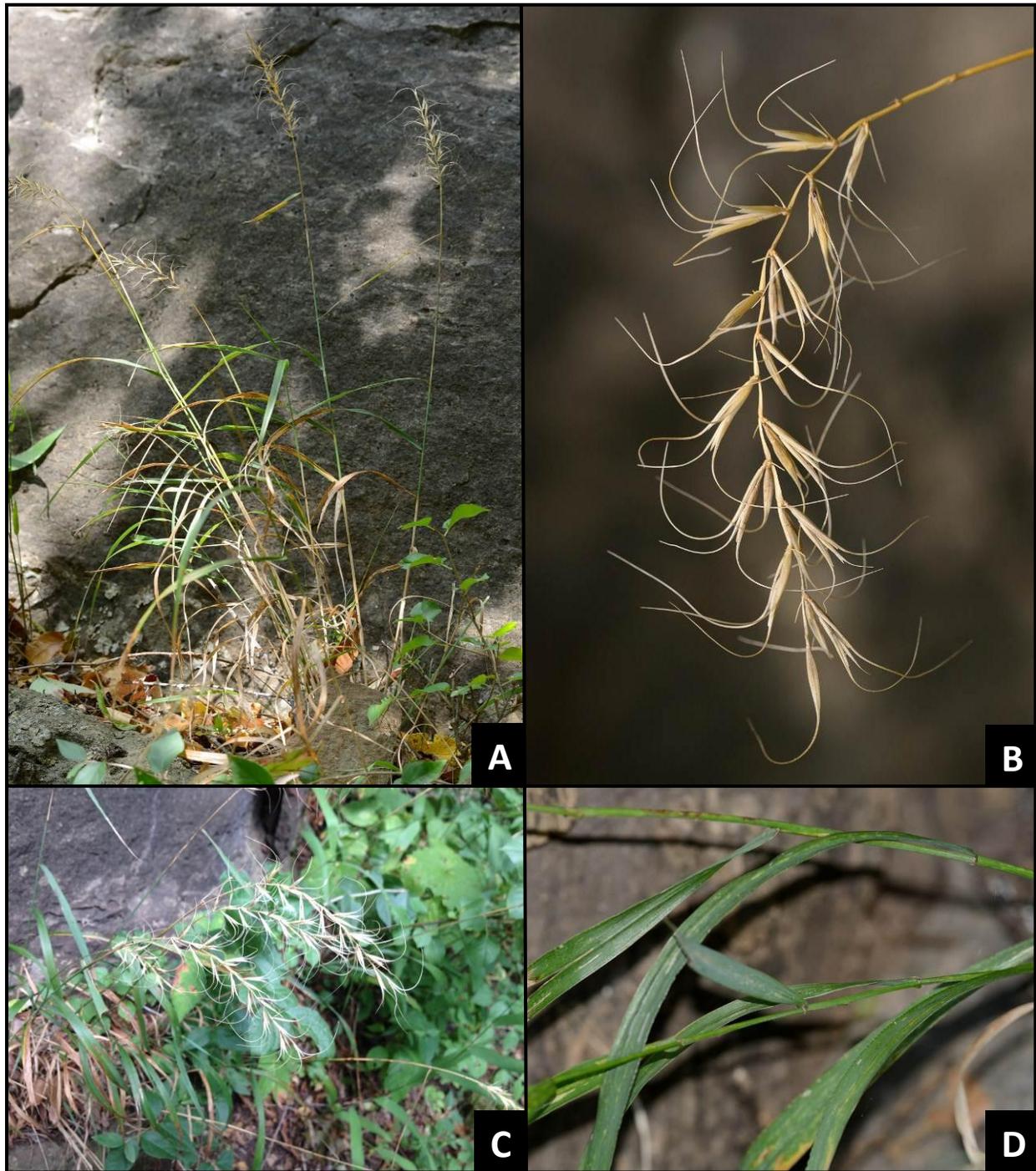
**FIGURE 25.** Pond located at the low point in the saddle just south of the shale barrens. While this pond has clearly been dug out and artificially deepened, it appears to be in the site of a natural seasonally-wet depression or “saddle pond”, and supports some interesting wetland plants both within the pond’s banks and outside them. **A.** and **B.** Pond margins support rice cutgrass (*Leersia oryzoides*), dotted smartweed (*Persicaria punctata*), bulrush (*Scirpus georgianus*), Virginia bugleweed (*Lycopus virginicus*), and other wetland plants. **C.** Black willow (*Salix nigra*) growing on pond margin. The green film on the water is a dense mat of countless individual plants of water-meal (*Wolffia brasiliensis*), the smallest flowering plant in Arkansas, less than one millimeter in size.



**FIGURE 26.** Some interesting or unusual species from the tract. **A.** A brilliant yellow slime mold growing on a rock outcrop at the base of a bluff on the west side of Kessler Mountain. Photo by Mike Slay. **B.** Spring coral-root orchid (*Corallorhiza wisteriana*), a saprophytic species with little to no chlorophyll that gets its energy from soil fungi that break down decaying organic matter in the soil. Photo by David Oakley. **C.** One-flower cancer-root (*Orobanche uniflora*), a parasitic plant with no chlorophyll that gets nutrients from various host plants, growing at the margin of shale barrens atop the Kessler Limestone Formation. Photo by Joan Reynolds. **D.** Indian pipe or ghost flower (*Monotropa uniflora*), another plant with no chlorophyll that derives its nutrients from soil fungi, growing along the Crazy Mary Trail. Photo by Theo Witsell.



**FIGURE 27.** Powdery cloak fern (*Argyroschisma dealbata*) **A.** Grows from pits or cracks in sheer or overhanging dry calcareous bluffs. Photo by Theo Witsell. **B.** Characteristic blue-green fronds with reddish-brown to black stalks. Photo by David Oakley. **C.** Underside of pinnae (leaflets) are coated in a white, powder-like substance not found on any other species of fern in Arkansas. Photo by David Oakley. **D.** Underside of pinnae (leaflets) with powdery coating. Photo by Theo Witsell. All photos taken on Kessler Mountain.



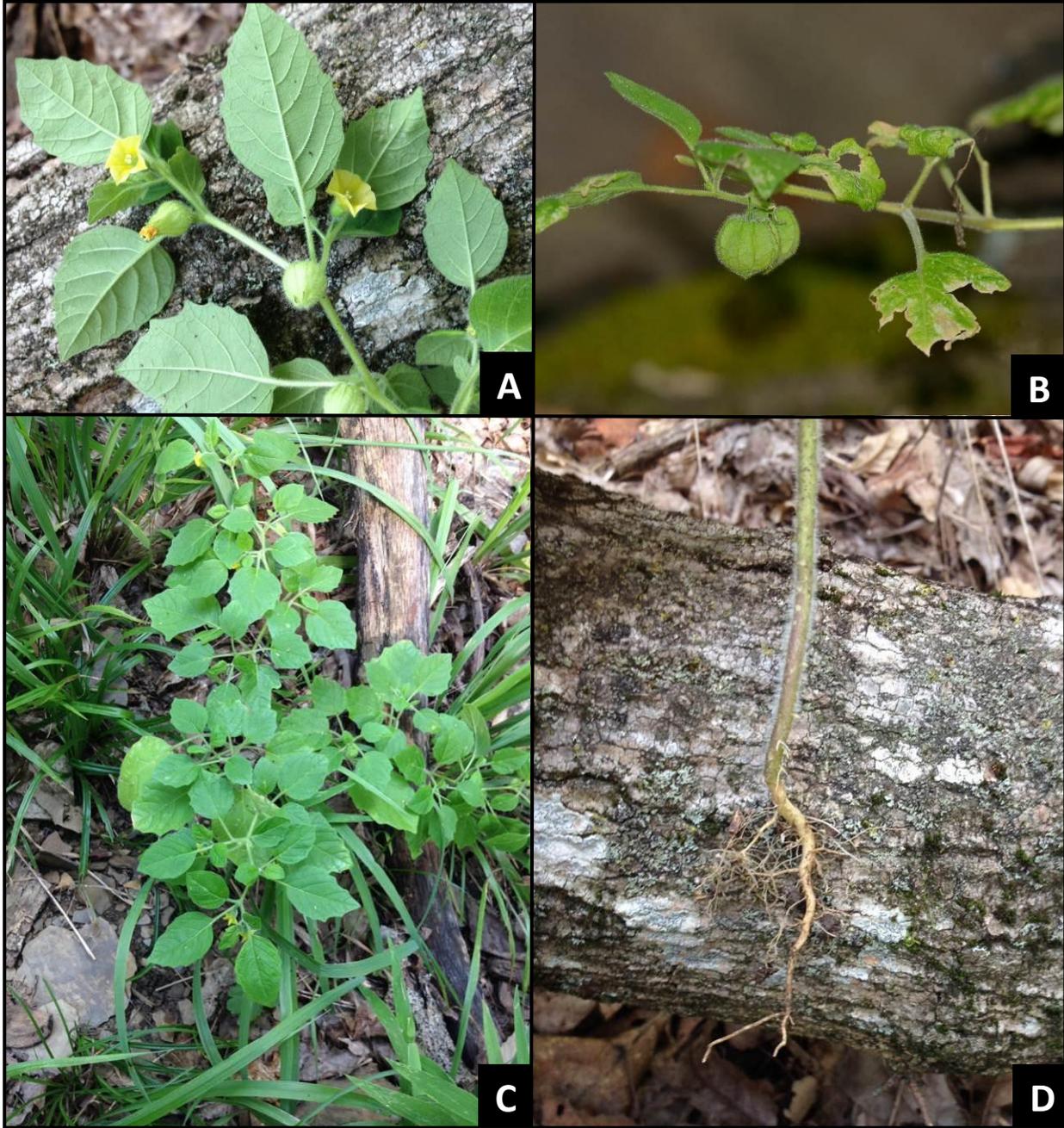
**FIGURE 28.** Church's wild rye (*Elymus churchii*). **A.** Whole plant. **B.** Fruiting head. Note ascending spikes and curved awns (vs. widely spreading spikes and straight awns in the common bottlebrush grass (*Elymus hystrix*)). **C.** Fruiting plants. Note nodding heads. **D.** Detail of leaves and stem. Photos A, B, and D by David Oakley. All photos from Kessler Mountain.



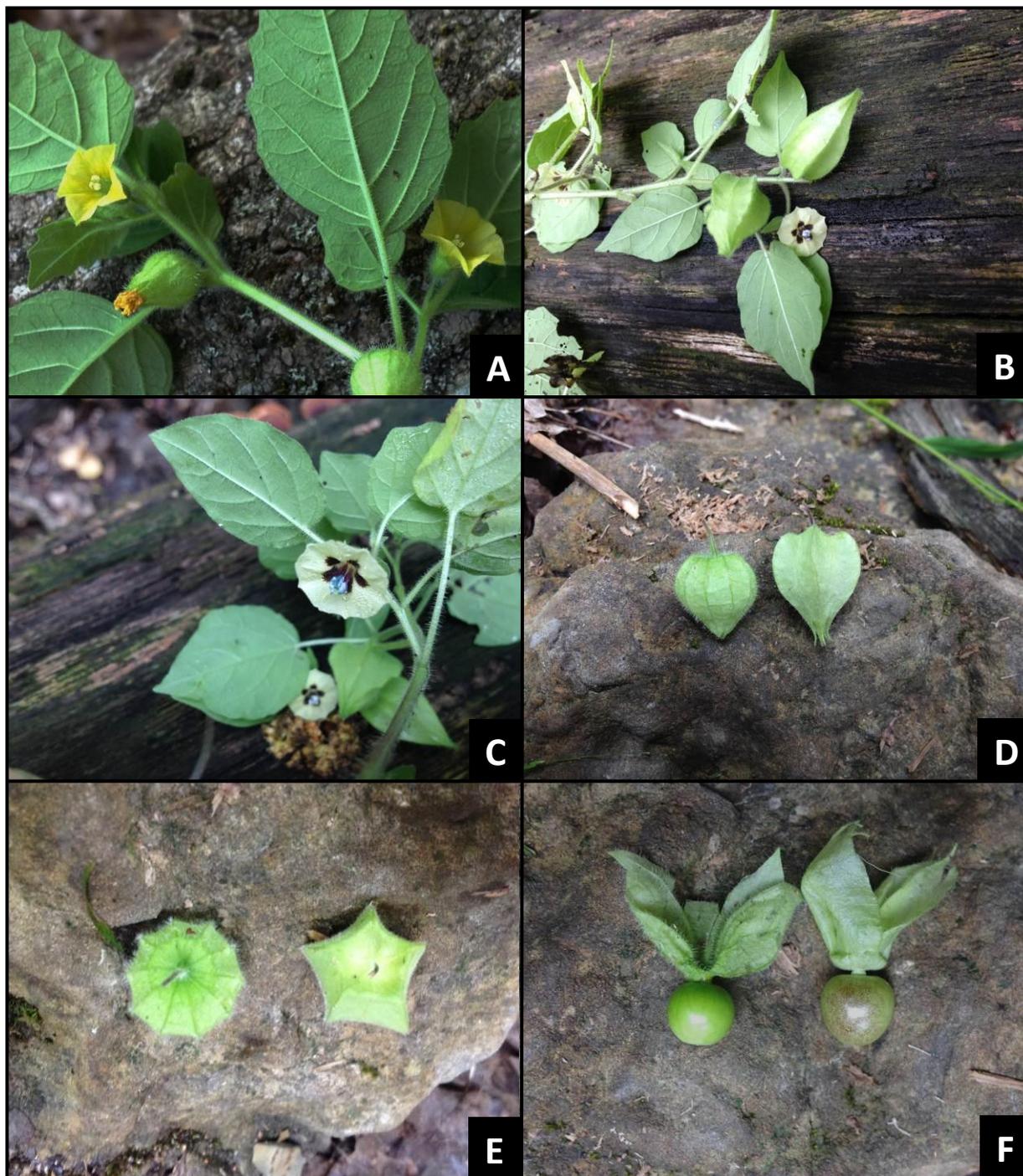
**FIGURE 29.** Prairie trout-lily (*Erythronium mesochoreum*). **A.** Plants occurring singly or in tight clumps, not in loose colonies like the common white trout-lily (*Erythronium albidum*). Leaves folded in half, not flat as in common white trout-lily. Photo by David Oakley, 28 February 2014. **B.** Mature leaves with sparse mottling, fruiting stalk lying on the ground, not erect as in common white trout-lily. Photo by Joan Reynolds, 12 April 2014. Both photos from Kessler Mountain.



**FIGURE 30.** Eastern yampah (*Perideridia americana*). **A.** Upper 2/3 of plant. **B.** Young stem, still elongating, showing basal leaves. **C.** Mid-stem leaf. Note deep dissection. **D.** Flowers, arranged in a compound umbel. All photos taken at Kessler Mountain by David Oakley.



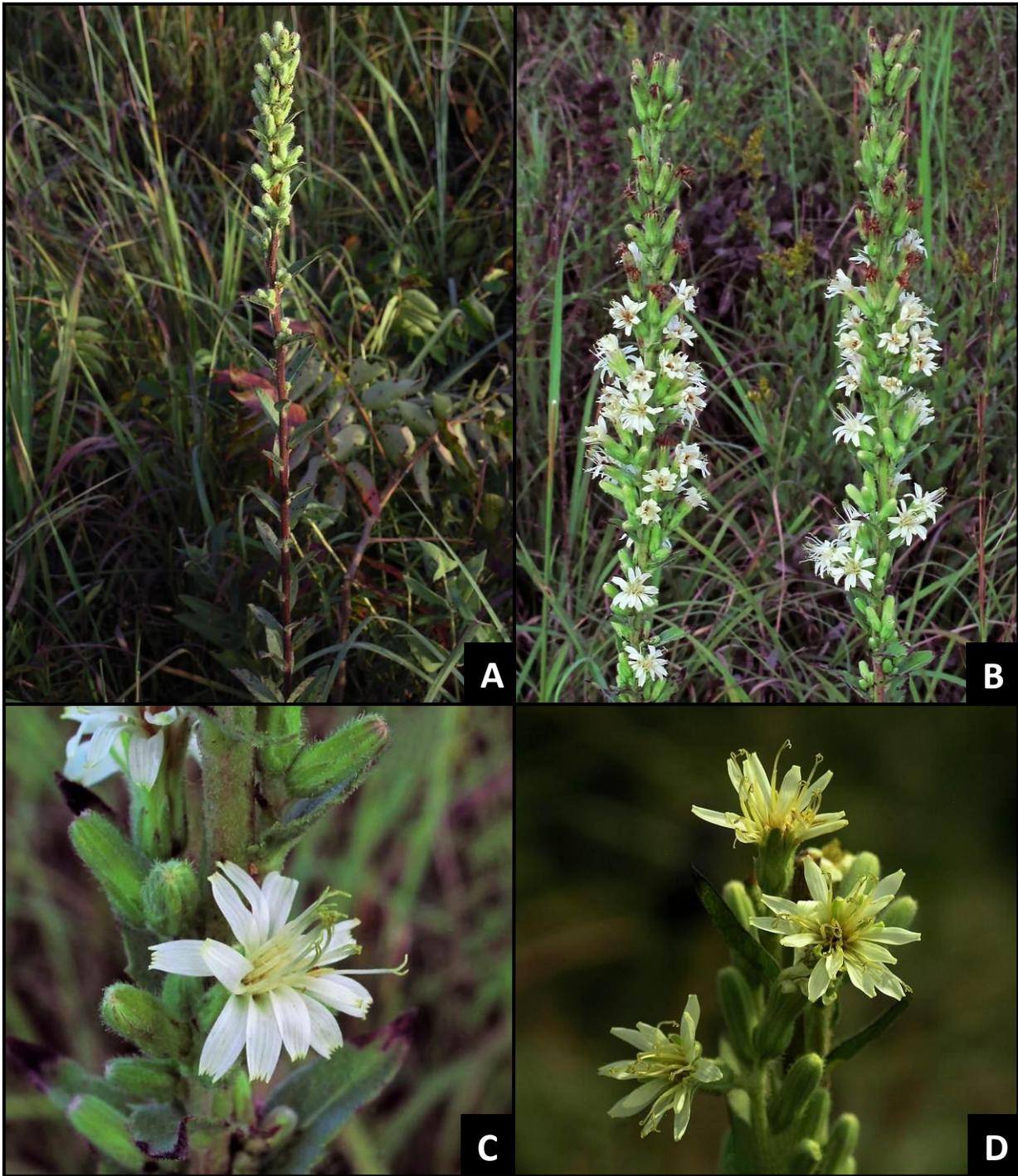
**FIGURE 31.** Missouri ground-cherry (*Physalis missouriensis*), a species of global conservation concern found on talus at the base of bluffs on the reserve, had not been documented in Arkansas for more than 60 years. **A.** Flowers, developing fruit, and lower side of leaves. **B.** Mature fruit. Photo by David Oakley. **C.** Whole plant from above, growing on loose talus below a bluff on the west side of Kessler Mountain. **D.** Hairy lower stem and taproot (Missouri ground-cherry is an annual species).



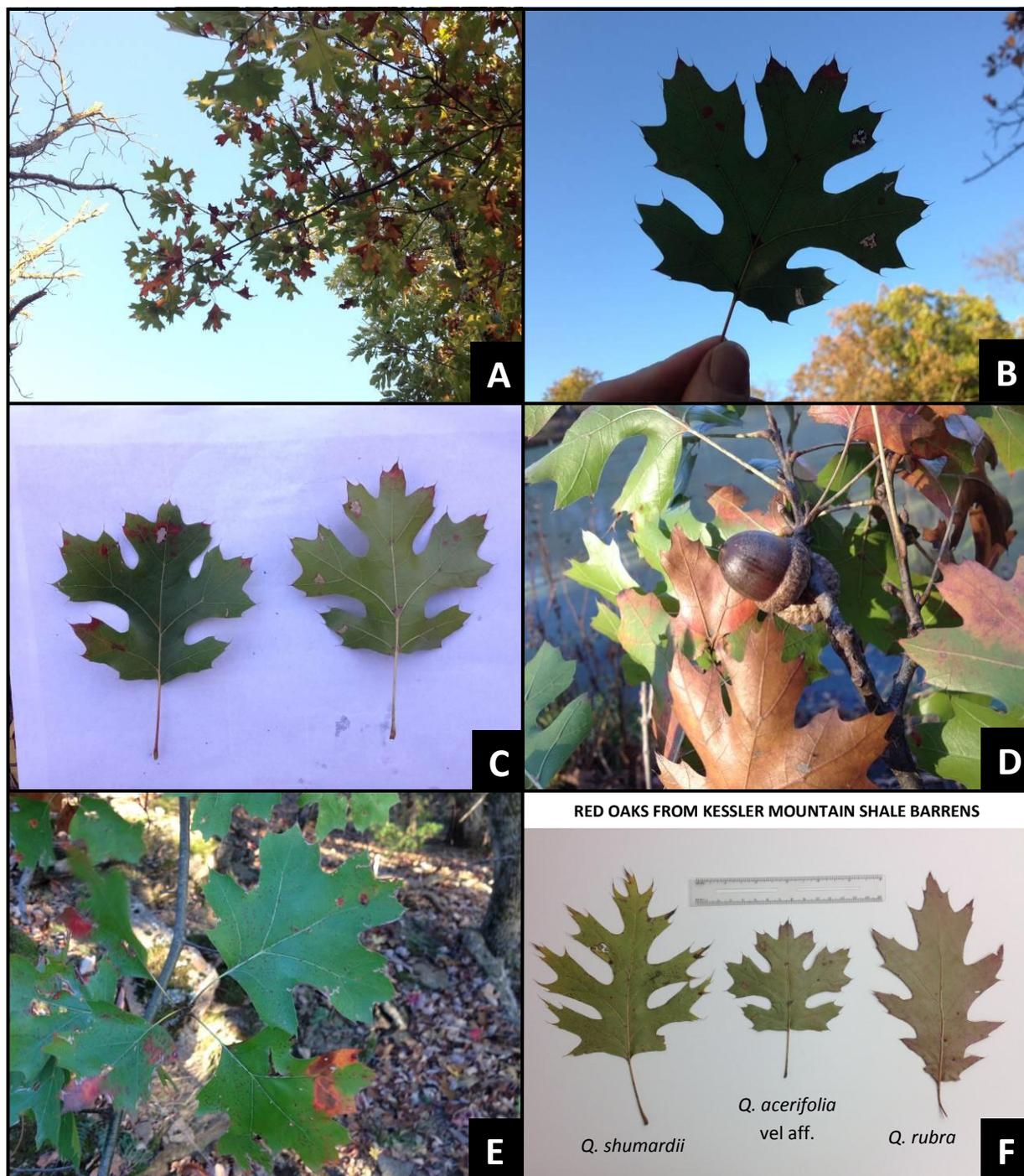
**FIGURE 32.** Comparison of the rare Missouri ground-cherry (*Physalis missouriensis*) and the common downy ground-cherry (*Physalis pubescens*) which grow together on Kessler Mountain. **A.** Missouri ground-cherry has bright yellow flowers with no dark central spots and has yellow stamens. **B.** and **C.** Downy ground-cherry has pale yellow flowers with five dark purple spots near the center and has blue or purple stamens. **D.** Side view of fruit (with inflated calyx) of Missouri ground-cherry (left) and downy ground-cherry (right). **E.** Top view of fruit (with inflated calyx) of Missouri ground-cherry (left) and downy ground-cherry (right). Missouri ground-cherry calyx is 10-ribbed and round in cross section while downy ground-cherry calyx is 5-ribbed and star-shaped in cross-section. **F.** Side view of fruit (with calyx removed) of Missouri ground-cherry (left) and downy ground-cherry (right). All photo by Theo Witsell from Kessler Mountain.



**FIGURE 33.** Prairie rattlesnake-root (*Prenanthes aspera*) **A.** Colony of basal (sterile) leaves showing distinctive clustered group or patch of plants. Photo by Theo Witsell. **B.** Thick, lettuce-like basal leaf with a prominent pale midvein. Photo by David Oakley. **C.** Young, sterile plant showing undersurface of leaf, tuber, and roots. Photo by Joan Reynolds. **D.** Mid-stem detail. Photo by Craig Fraiser. Photos A, B, and C taken at Kessler Mountain. Photo D taken at Cherokee Prairie Natural Area, Franklin County, Arkansas. No patches of this species found at Kessler Mountain seemed to have enough sunlight to flower.



**FIGURE 34.** Prairie rattlesnake-root (*Prenanthes aspera*) **A.** Upper half of flowering stem (in bud). **B.** Two flowering stems. **C.** Flower detail (white form). **D.** Flower detail (yellow form). Photos by Craig Fraiser, taken at Cherokee Prairie Natural Area, Franklin County, Arkansas. No patches of this species found at Kessler Mountain seemed to have enough sunlight to flower.



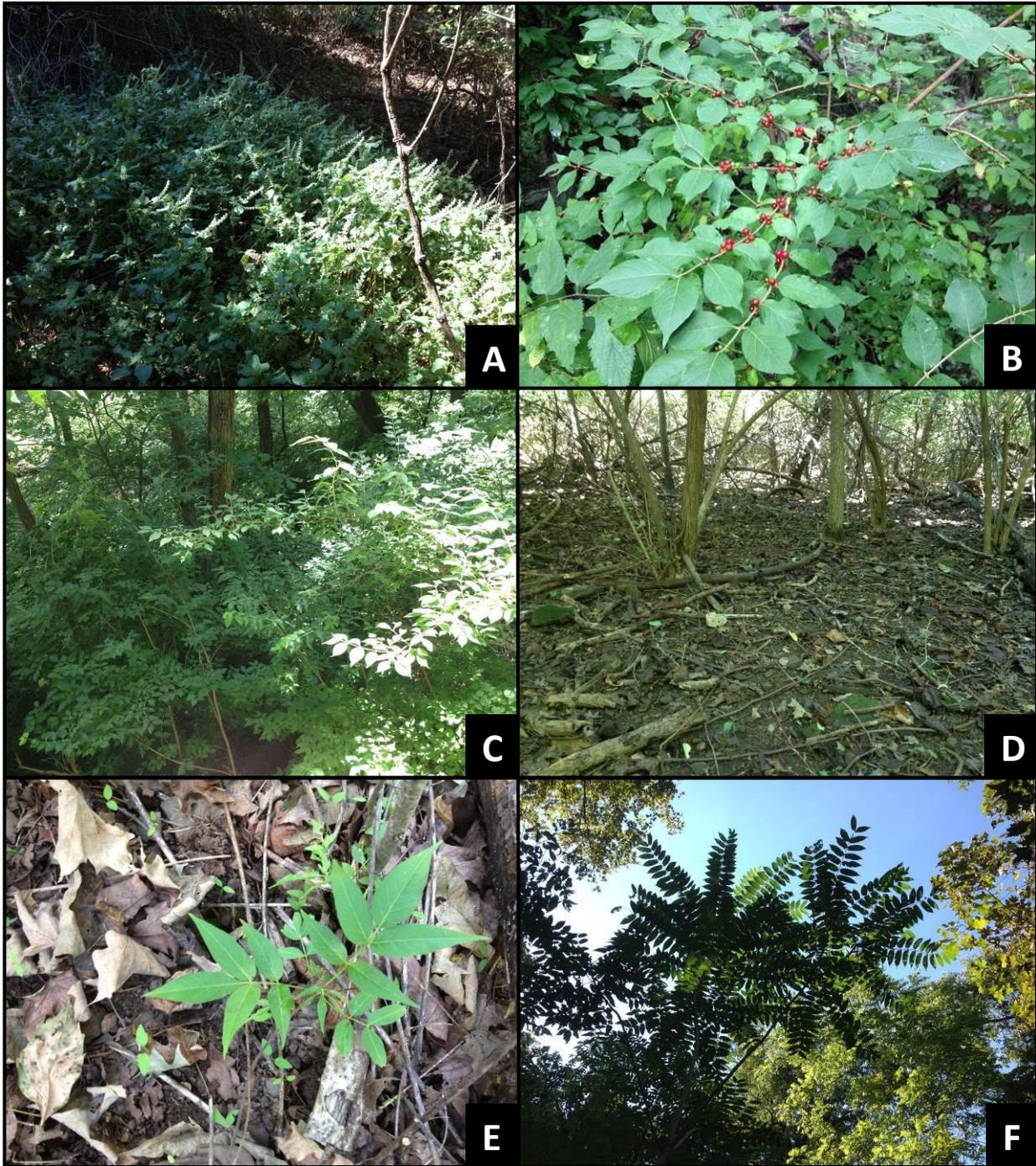
**FIGURE 35.** Maple-leaf oak? (*Quercus acerifolia* vel aff.) **A – E.** Several small oak trees in the shale barrens have features consistent with maple-leaf oak (*Quercus acerifolia*), a globally rare species recognized only from a few sites in the Ouachita Mountains and Arkansas Valley. **F.** The trees at Kessler have a consistent morphology and are distinct from both Shumard oak (*Quercus shumardii*) and northern red oak (*Quercus rubra*) that occur nearby. Similar plants have been found at several other glade sites in the White River Hills Ecoregion of both the Arkansas and Missouri Ozarks. These trees clearly warrant additional study and perhaps detailed genetic analysis to determine if they are maple-leaf oak or a different, perhaps undescribed entity. See Appendix D for additional discussion of these plants.



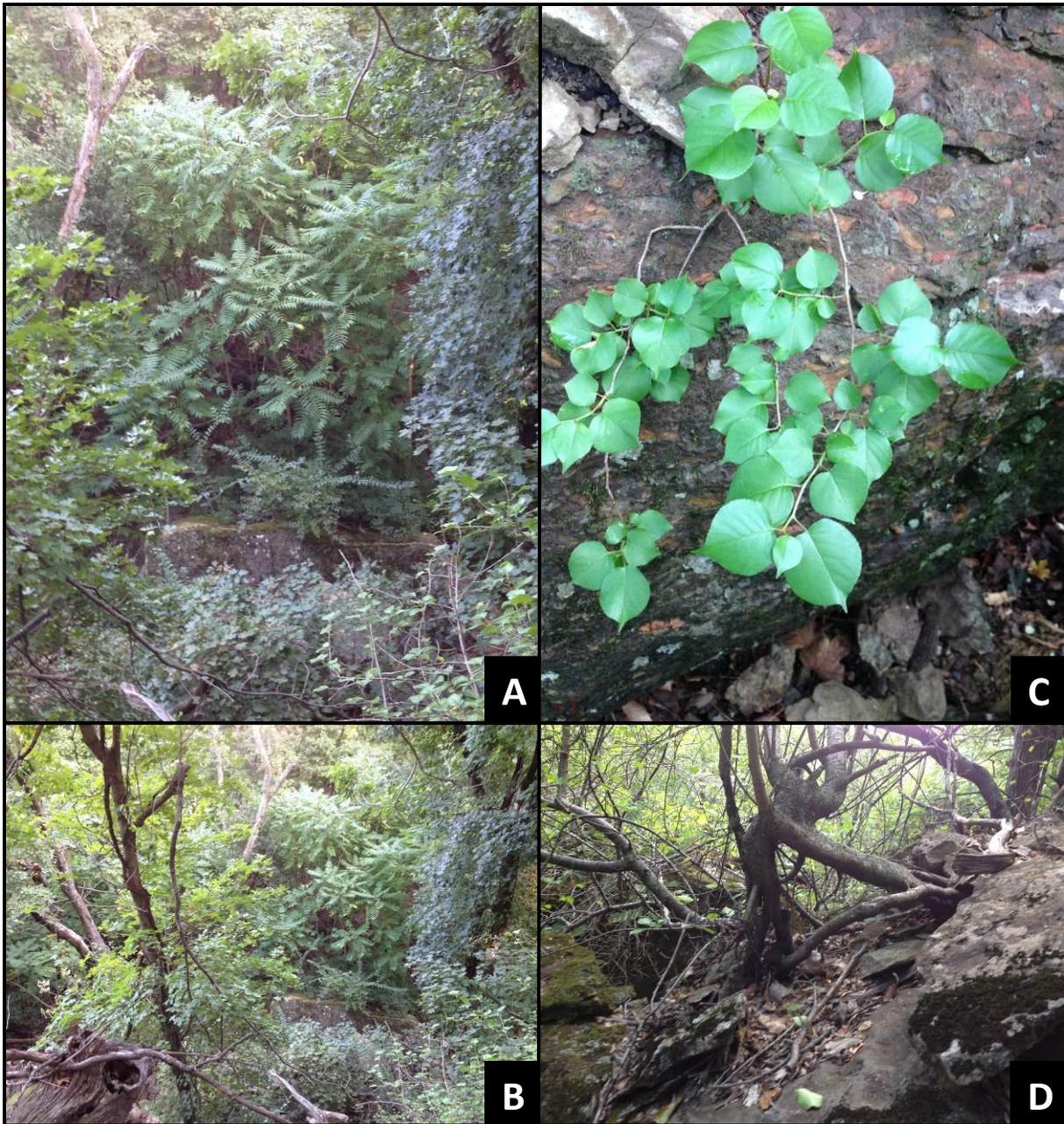
**FIGURE 36.** Some reptiles and amphibians found on Kessler Mountain. **A.** Western Smooth Earth Snake (*Virginia valeriae elegans*). Photo by Mitchell Pruitt. **B.** Western Worm Snake (*Carphophis vermis*). Photo by Mitchell Pruitt. **C.** Southern Copperhead (*Agkistrodon contortrix*). Photo by Mike Slay. **D.** Ozark Zigzag Salamander (*Plethodon angusticlavius*), dusky morph. Photo by Mitchell Pruitt. **E.** Oklahoma Salamander (*Eurycea tynerensis*). Photo by Joe Neal. **F.** Spotted Salamander (*Ambystoma maculatum*). Photo by David Oakley. All photos from Kessler Mountain.



**FIGURE 37.** **A.** Non-native green foxtail (*Setaria viridis*) and smooth crabgrass (*Digitaria ischaemum*) in disturbed soil along trails. **B.** Heavenly-bamboo or nandina (*Nandina domestica*), a non-native invasive shrub, growing on talus below a bluff on the east side of Kessler Mountain. **C.** Japanese stilt grass (*Microstegium vimineum*), one of the worst invasive plants in the Ozarks, growing in a powerline right-of-way near the north end of the tract. **D.** Beefsteak plant (*Perilla frutescens*), an invasive plant, is locally common in disturbed sites but also on talus below bluffs on Kessler Mountain.



**FIGURE 38.** **A.** A stand of invasive beefsteak plant (*Perilla frutescens*) dominating a mesic talus slope at the base of a north-facing bluff on the east side of Kessler Mountain. **B.** Bush honeysuckle (*Lonicera maackii*), spread by birds, is one of the worst non-native invasive shrubs in Northwest Arkansas. It is capable of taking over the entire forest understory in mesic forests and woodlands, displacing native species and drastically altering habitat. **C.** Dense thicket of bush honeysuckle below bluffs on the east side of Kessler Mountain. **D.** The ground below this dense stand of older bush honeysuckle plants on the east side of Kessler Mountain is heavily shaded and supports few if any native plant species. **E.** Seedlings of invasive tree-of-heaven (*Ailanthus altissima*) are common in several areas of Kessler Mountain, especially below bluffs. **F.** The long, pinnately-compound leaves of tree-of-heaven are reminiscent of native sumac species but the plants reach tree size.



**FIGURE 39.** A. and B. Tree-of-heaven replacing large native oaks in a light-gap below a bluff on the east side of Kessler Mountain. Native trees along bluffs in the area appear to have been especially hard hit by the 2009 ice storm and/or other recent disturbance events. Non-native invasives like tree-of-heaven, bush honeysuckle, and perfumed cherry have been quick to move in. C. A young perfumed cherry (*Prunus mahaleb*), one of the most prevalent non-native invasive shrubs on bluffs at Kessler Mountain, growing from a crack in a bluff on the west side of the mountain. D. Lower trunk and roots of a large perfumed cherry, growing from a pile of loose rocks at the base of a bluff on the west side of the mountain.



**FIGURE 40. A.** View of Fayetteville from a bluff top on the east side of the reserve. **B.** View of Farmington from a bluff top on the west side of the reserve.

**APPENDIX C:**

**ECOLOGICALLY SIGNIFICANT AREAS AT KESSLER MOUNTAIN  
RESERVE**

## ***Ecologically Significant Areas and Habitats***

Five ecologically significant areas or habitats were identified at Kessler Mountain Reserve:

1. Shale Barrens
2. Bluffs
3. Old Growth Post Oak Woodland
4. Riparian Habitat
5. Seeps and Springs

An ecologically significant area or habitat is defined here as an area with relatively intact or high quality natural communities or a habitat that contributes significantly to the overall biological diversity of the site. These areas or habitats may include populations of species of conservation concern, provide habitat for groups of species not found elsewhere on the site, or may simply support relatively intact plant communities with high native species diversity and low levels of non-native invasive species. These may be thought of as those areas of the reserve that are the least altered in terms of their natural condition, and/or the most biologically diverse. These areas and habitats would likely be high priorities to restore and maintain in good condition.

**The designation of these areas or habitats as ecologically significant is not meant to indicate that other areas of the reserve are not ecologically significant or worthy of protection or management to enhance their natural values.** In particular, there are other areas that support populations of plant species of conservation concern but that are not identified here as ecologically significant areas due to their small size, altered condition, landscape context, or for other reasons. Furthermore, the matrix communities on the reserve (Dry Oak Woodland, Dry-Mesic Oak-Hickory Forest and Woodland, and Mesic Hardwood Forest) all could be restored to improve their quality (see management recommendations above).

This appendix contains brief descriptions and maps of each of these areas or habitats. Detailed descriptions, a justification of why each area or habitat was deemed ecologically significant, a description of the plant community or communities present, and management recommendations for each area is provided.

GIS shapefiles of these areas are being provided to the FNHA and the City of Fayetteville.

## SIGNIFICANT AREA 1: SHALE BARRENS

*NOTE: This section is repeated from the account in the Plant Communities section above.*

The most unusual ecological feature on the tract is an area of “shale barrens” situated in a shallow saddle on the main north-south trending ridge of Kessler Mountain (coordinates = N36.03177, W94.21739). The ridgetop to the north and south of this area is underlain by Atoka Sandstone while the saddle has been eroded through the sandstone and into the underlying Trace Creek Shale. A second lobe of open barrens (coordinates = N36.03185, W94.21851) exists downslope and slightly to the west, on shale of the Woolsey Member of the Bloyd Formation.

This community is a mosaic of small, grassy to rocky glade-like openings surrounded by dry oak woodlands (Figs. 10 & 11). Canopy structure ranges from very open (savanna) to less open (woodland) along gradients of soil depth and moisture availability. Based on the flora present, the pH here ranges from acidic on the higher ground to more calcareous toward the western edge of the saddle near the contact with the underlying Kessler Limestone. While this area is referred to locally as a “shale glade”, the term “glade” is something of a misnomer here since there is little hard bedrock exposed and no extensive treeless areas. Instead the substrate, in all but the most disturbed and eroded areas, consists mainly of loose, weathered shale. There are definite glade affinities though and this community is distinct both floristically and ecologically from surrounding dry oak woodlands. In light of these distinctions this community is being referred to here as “shale barrens”.

The canopy is dominated by old, open-grown post oak (*Quercus stellata*) trees, with scattered individuals of chinquapin oak (*Quercus muehlenbergii*), Shumard oak (*Quercus shumardii*), northern red oak (*Quercus rubra*), blackjack oak (*Quercus marilandica*), and white ash (*Fraxinus americana*). Trees are widely spaced and stunted in the areas of thinnest soils and taller and more dense as soils become deeper. A post oak tree in these barrens cored by Alan Edmondson and Dr. David Stahle from the University of Arkansas Tree-Ring Laboratory was more than 250 years old. Several small oak trees (Fig. 35) in two different areas have features consistent with maple-leaf oak (*Quercus acerifolia*), a globally rare but somewhat taxonomically controversial species recognized from just a few sites in the Ouachita Mountains and Arkansas Valley of west-central Arkansas. See discussion in Appendix D for more discussion of these trees.

Scattered smaller trees and shrubs include gum-bumelia (*Sideroxylon lanuginosum*), black locust (*Robinia pseudoacacia*), Carolina rose (*Rosa carolina*), redbud (*Cercis canadensis*), dwarf hackberry (*Celtis tenuifolia*), deerberry (*Vaccinium stamineum*), rusty blackhaw (*Viburnum rufidulum*), and serviceberry (*Amelanchier arborea*).

The herbaceous layer (ground flora) is diverse, containing a number of prairie, glade, and woodland species. This layer is dominated by little bluestem (*Schizachyrium scoparium*), poverty-oats (*Danthonia spicata*), gum-plant (*Grindelia lanceolata*), and wild quinine (*Parthenium integrifolium*). Other species common in the herbaceous layer include woodland sunflower (*Helianthus hirsutus*), prairie aster (*Symphyotrichum turbinellum*), manyray aster (*Symphyotrichum anomalum*), late purple aster (*Symphyotrichum patens*), wand beard-tongue (*Penstemon tubiflorus*), gray goldenrod (*Solidago*

*nemoralis*), elm-leaf goldenrod (*Solidago ulmifolia*), showy goldenrod (*Solidago petiolaris*), wild hyacinth (*Camassia scilloides*), yellow pimpernel (*Taenidia integerrima*), yellow star-grass (*Hypoxis hirsuta*), pencil flower (*Stylosanthes biflora*), horsetail milkweed (*Asclepias verticillata*), fourleaf milkweed (*Asclepias quadrifolia*), sundrops (*Oenothera fruticosa*), dwarf skullcap (*Scutellaria parvula*), heartleaf skullcap (*Scutellaria ovata*), long-bracted wild indigo (*Baptisia bracteata*), Russell's beebalm (*Monarda russeliana*), violet wood sorrel (*Oxalis violacea*), Ohio spiderwort (*Tradescantia ohioensis*), stiff coreopsis (*Coreopsis palmata*), tall thoroughwort (*Eupatorium altissimum*), whorled milkwort (*Polygala verticillata*), bird's-foot violet (*Viola pedata*), clustered fescue (*Festuca paradoxa*), and many more.

More extreme and sparsely vegetated areas support some classic "glade species" such as gum plant, hairy wild petunia (*Ruellia humilis*), pleat-leaf knotweed (*Polygonum tenue*), prairie-tea (*Croton monanthogynus*), blue waxweed (*Cuphea viscosissima*), nits-and-lice (*Hypericum drummondii*), false spotted St. John's-wort (*Hypericum pseudomaculatum*), nailwort or forked-chickweed (*Paronychia fastigiata* var. *fastigiata*), churchmouse three-awn (*Aristida dichotoma* var. *dichotoma*), wiry witchgrass (*Panicum flexile*), grass-leaf rush (*Juncus marginatus*), and side-flowering rush (*Juncus secundus*).

The central portion of the higher of the two main barrens is heavily disturbed and eroded, especially where trails converge at the "fire ring" area. Herbaceous vegetation here is probably unnaturally sparse and the thin soil is mostly eroded away. The margins of this opening, as well as the less disturbed openings in the western, lower lobe of complex, have thin soils supporting a mostly continuous perennial groundcover with small areas of exposed, loose shale fragments.

A pond has been dug in the southern part of this community at the low point of the saddle. Based on the amount of water that accumulates in the trail just west of this pond (where there is no artificial impoundment) and on some of the flora present, this was likely a naturally wet place where water ran off the slopes above and accumulated at the surface of the ground. The impermeable nature of the underlying shale keeps water at the surface for extended periods. Such natural mountaintop depression wetlands (sometimes called "saddle ponds") often support uncommon or rare species of plants, amphibians, and insects. These habitats are rare in the landscape and many examples, like the one at Kessler Mountain, have been heavily impacted by past attempts to develop them for water sources, despite their small watersheds and often ephemeral nature. Remnant seasonally-wet depressions outside this pond (to its south and west) support several species characteristic of ephemeral wetlands including clammy hedge-hyssop (*Gratiola neglecta*), chaffweed (*Anagallis minima*), water starwort (*Callitriche heterophylla*), and several rushes (*Juncus* spp.).

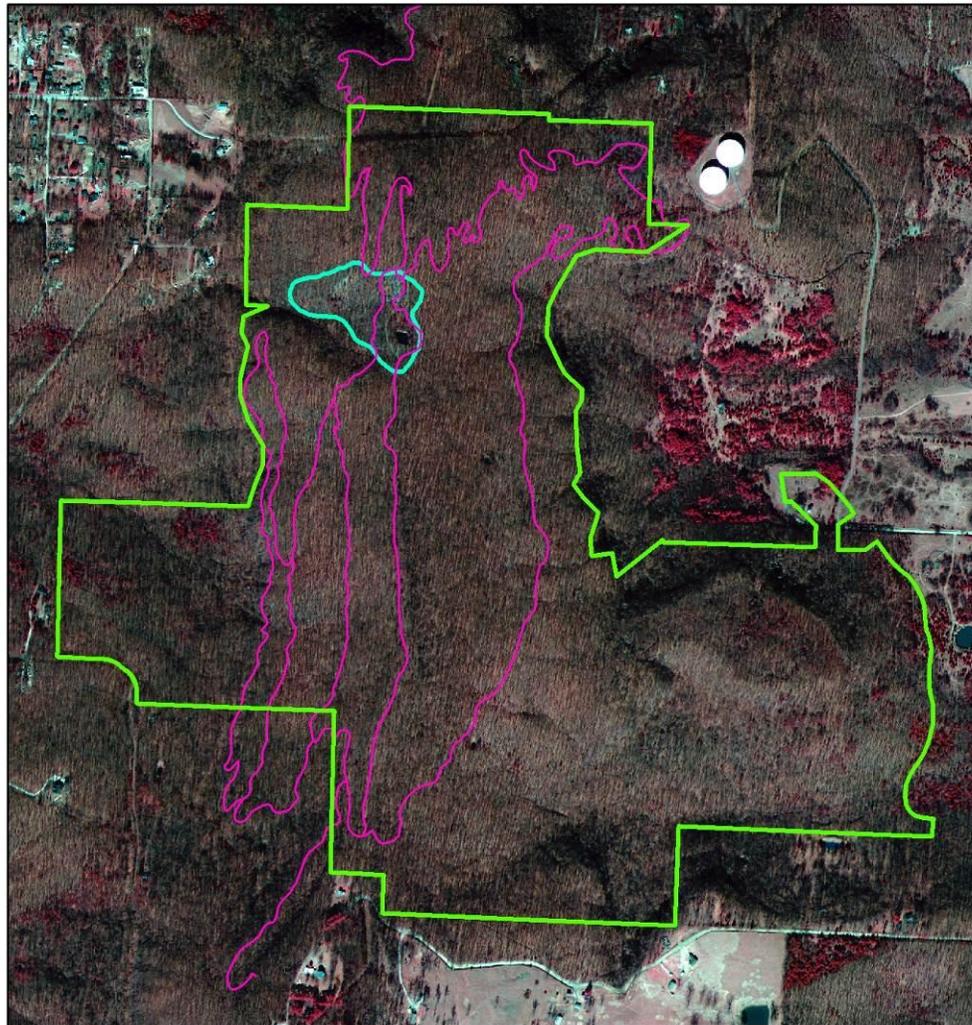
This Ozark shale barrens community type is poorly known and understood and may represent an undescribed entity based on discussions with ecologists in Arkansas and Missouri. I am aware of one other site that appears very similar to the barrens on Kessler Mountain – a site called "The Slatey Place" (N36.04505, W93.30559) within the Ponca Wilderness Area (Buffalo National River) in Newton County. There, a very similar plant community occurs in an almost identical landscape position (a shallow saddle in a north-south trending ridge with similar geology). This site also has a small excavated pond situated in the lowest point of the saddle, also presumably a modified natural wetland.

Analysis of aerial photos and geologic maps of the Boston Mountains indicates that there are other examples scattered on several shale-bearing rock formations in the region, including a number in the vicinity of Fayetteville. One such site, about 2.5 miles north-northeast from the Kessler Mountain barrens, just east of the intersection of North Mountain Ranch Rd. and Technology Way (N36.06874, W94.20558), was viewed from the road in 2014 and appears to be the same basic community. Unfortunately, this site was fragmented and partially lost to development in recent years, and the remainder appears to be slated for development in the future. There do appear to be other, more intact examples in the general vicinity which should be explored in the future. High quality examples could be protected as the region plans for growth.

**Species of Concern:** Several small oak trees (Fig. 35) in two different areas have features consistent with maple-leaf oak (*Quercus acerifolia*), a globally rare but somewhat taxonomically controversial species recognized from just a few sites in the Ouachita Mountains and Arkansas Valley of west-central Arkansas. See discussion in Appendix D for more discussion of these trees.

**Management Recommendations:** 1) Control non-native invasive plant species. 2) Control encroaching native woody species like eastern red-cedar and black locust. 3) Implement prescribed fire management. 4) Consider control of some of the hardwood mid-story in surrounding woodlands by herbicide injection or cutting and treating stumps with herbicide. 5) Consider re-routing trails around this community or confining traffic through it to a narrow corridor with some kind of barrier and signage. Reducing soil disturbance, compaction, and erosion will allow thin barrens soils to recover over time.

## SIGNIFICANT AREA 1: SHALE BARRENS



0 0.125 0.25 0.5 0.75 Miles

### Legend

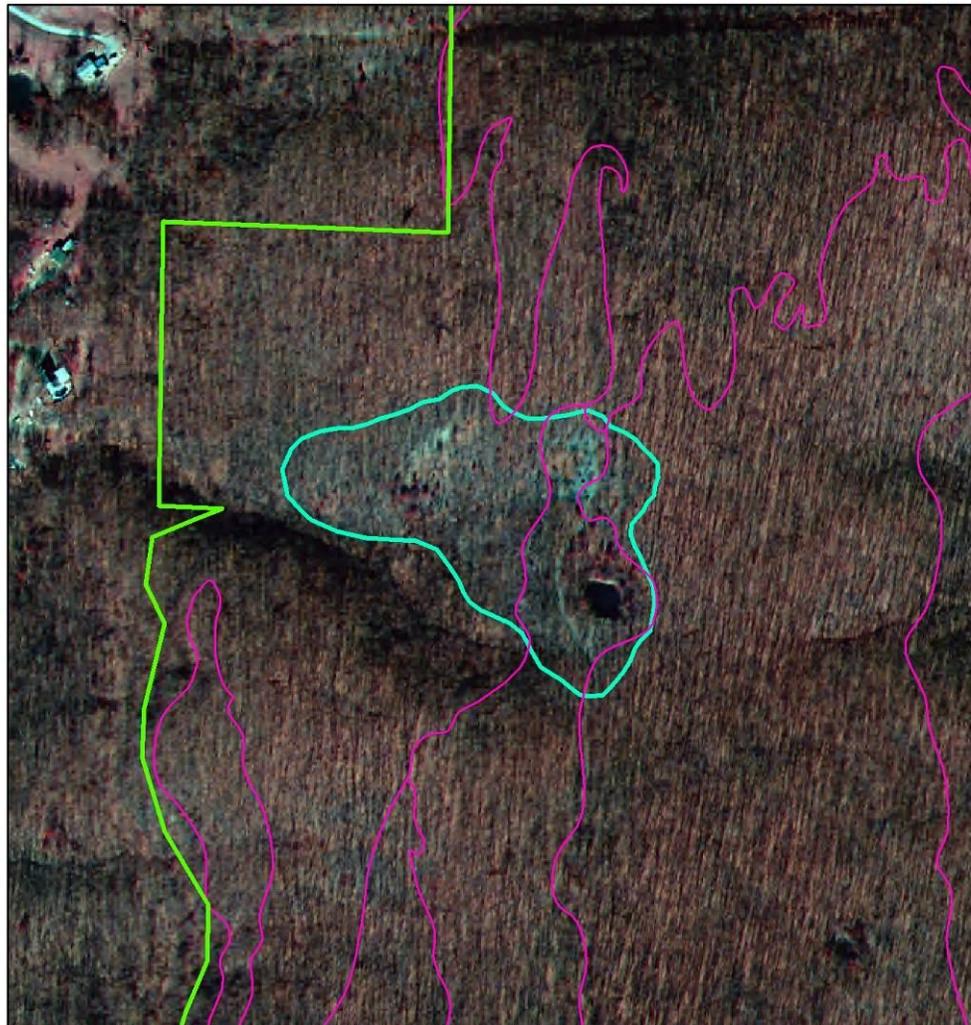
-  Mt. Kessler Reserve
-  Trails
-  Shale Barrens



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 41.** Map showing location of shale barrens community at Kessler Mountain Reserve on 2006 color-infrared aerial image.

## SIGNIFICANT AREA 1: SHALE BARRENS (DETAIL)



0 0.125 0.25 Miles

### Legend

-  Mt. Kessler Reserve
-  Trails
-  Shale Barrens



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 42.** Map showing detailed view of shale barrens community at Kessler Mountain Reserve on 2006 color-infrared aerial image.

## SIGNIFICANT AREA 2: BLUFFS

*NOTE: This section is repeated from the account in the Plant Communities section above.*

Bluffs (Figs. 18, 19, 20, & 21) are common on Kessler Mountain and when taken to include the band of steep, rocky slopes at their tops and the band of loose, rocky talus at their bases, represent the most ecologically and biologically diverse habitat on the reserve. These bluffs support many if not most of the species in adjacent communities (both the drier communities above the bluffs and the more mesic ones below them) but also include specialized species not found in other habitats.

Bluffs are classified according to their rock type and both acidic and calcareous bluffs occur on Kessler Mountain. Bluffs also vary with aspect and degree of exposure. In general south- and west-facing bluffs are drier and more exposed while north- and east-facing bluffs are more mesic and shaded. Some bluffs are permanently or at least seasonally moist or wet with groundwater seepage. Furthermore, bluffs generally support several different microhabitats. There are flat bluff tops and ledges, vertical cliff faces, steep slopes, areas of loose scree or talus (usually at the bases of sheer cliffs), cracks and pits, and even the occasional overhanging bluff shelter or 'rockhouse' (Figs. 19 & 20). These various conditions and microhabitats are important factors in the presence or absence of many species (Nelson 2005; Yatskievych 1999).

Bluffs are also ecologically significant because they serve as important refugia as species move in response to climate change. In this sense, dry, exposed bluffs can be thought of as having 'caught' various western 'desert species' during past hot dry periods and given them the needed habitat to persist to the present day. Similarly, moist, protected bluffs have 'caught' northern temperate species during cold periods like past glaciations and given them habitat into the present. Other species, such as the Church's wild rye (*Elymus churchii*) (Fig. 28) and Missouri ground-cherry (*Physalis missouriensis*) (Figs. 31 & 32) at Kessler, are endemic to a narrow region and grow only in specialized habitats, often associated with bluffs.

In addition to the broad diversity of trees and shrubs that also grow in adjacent habitats, several species on the reserve are found primarily in association with bluffs. These include yellow-wood (*Cladrastis kentukea*), downy service-berry (*Amelanchier arborea*), gum bumelia (*Sideroxylon lanuginosum*), bladdernut (*Staphylea trifolia*), rough-leaf dogwood (*Cornus drummondii*), wild hydrangea (*Hydrangea arborescens*), black raspberry (*Rubus occidentalis*), and Missouri gooseberry (*Ribes missouriensis*). Woody vines common on bluffs within the reserve include cross-vine (*Bignonia capreolata*), poison-ivy (*Toxicodendron radicans*), Virginia-creeper (*Parthenocissus quinquefolia*), grape vines (*Vitis* spp.), false grape (*Ampelopsis cordata*), Catesby's virgin's-bower (*Clematis catesbyana*), Carolina snailseed (*Cocculus carolinus*), moonseed (*Menispermum canadense*), bristly greenbrier (*Smilax hispida*), yellow honeysuckle (*Lonicera flava*), and prairie rose (*Rosa setigera*).

Characteristic perennial ferns, grasses, and forbs found in the reserve primarily on bluffs include northern maidenhair fern (*Adiantum pedatum*), ebony spleenwort (*Asplenium platyneuron*), three-flower melic (*Melica nitens*), white snakeroot (*Ageratina altissima*), leather-flower (*Clematis viorna*), erect dayflower (*Commelina erecta*), marbleseed (*Onosmodium bejariense* var. *subsetosum*), Buckley's

goldenrod (*Solidago buckleyi*), Harvey's buttercup (*Ranunculus harveyi*), white leafcup (*Polymnia canadensis*), American alumroot (*Heuchera americana* var. *hirsuticaulis*), and Ernest's spiderwort (*Tradescantia ernestiana*). A number of other ferns (Figs. 22 & 27) are rock outcrop or bluff specialists and are found only in appropriate microhabitats with the proper pH, moisture, and exposure. These include maidenhair spleenwort (*Asplenium trichomanes*), black-stem spleenwort (*Asplenium resiliens*), walking fern (*Asplenium rhizophyllum*), Tennessee bladder fern (*Cystopteris tennesseensis*), southern bladder fern (*Cystopteris protrusa*), blunt-lobed cliff fern (*Woodisa obtusa*), purple-stem cliff-brake (*Pellaea atropurpurea*), Alabama lip fern (*Cheilanthes alabamensis*), and powdery cloak fern (*Argyrochosma dealbata*), a species of state conservation concern.

Bluffs are also home to specialized communities of annual and biennial plants that are adapted to grow in the thin soil atop ledges and on talus. Examples of such communities on drier and more exposed sites within the reserve include lace grass (*Eragrostis capillaris*), nimblewill (*Muhlenbergia schreberi*), wiry witch grass (*Panicum flexile*), short-pod whitlow-grass (*Draba brachycarpa*), tansy-mustard (*Descurainia pinnata* subsp. *brachycarpa*), wild poinsettia (*Euphorbia cyathophora*), American false pennyroyal (*Hedeoma pulegioides*), blue waxweed (*Cuphea viscosissima*), western daisy (*Astranthium ciliatum*), Canadian rockcress (*Boechera canadensis*), smooth rockcress (*Boechera laevigata*), small-flower bittercress (*Cardamine parviflora* var. *arenicola*), Venus'-looking-glass (*Triodanis perfoliata*), one-seed mercury (*Acalypha monococca*), Virginia copperleaf (*Acalypha virginica*), and nailwort or forked-chickweed (*Paronychia fastigiata* var. *fastigiata*).

Examples on more mesic and shaded sites include clearweed (*Pilea pumila*), beggar's-lice (*Hackelia virginica*), Spanish-needles (*Bidens bipinnata*), enchanter's-nightshade (*Circaea canadensis* subsp. *canadensis*), pellitory (*Parietaria pensylvanica*), woodland goosefoot (*Chenopodium standleyanum*), maple-leaf goosefoot (*Chenopodium simplex*), pale corydalis (*Corydalis flavula*), tall bellflower (*Campanula americana*), big-seed scorpion-grass (*Myosotis macrosperma*), Canada forked-chickweed (*Paronychia canadensis*), autumn bent grass (*Agrostis perennans*), downy ground-cherry (*Physalis pubescens*), and black nightshade (*Solanum ptycanthum*).

Pits, cracks, and overhanging bluff shelters or "rockhouses" (Figs. 19 & 20) in bluffs provide important habitat elements for a variety of animal species. Numerous times during surveys on the reserve various animal species were observed utilizing bluff habitats. This included several close and sudden encounters with roosting Black Vultures, startling surveyors and birds alike.

Bluffs on Kessler Mountain are especially hard-hit by invasive species. The tree canopy in the vicinity of the bluffs has been heavily broken up by various disturbance events such as ice and wind storms (Fig. 14f). This, along with the naturally open conditions often associated with bluffs and a healthy population of birds (which disperse seeds), has allowed a variety of non-native invasive plants to become established. In some areas these invasive species have become the dominant species present (Figs. 37, 38, & 39).

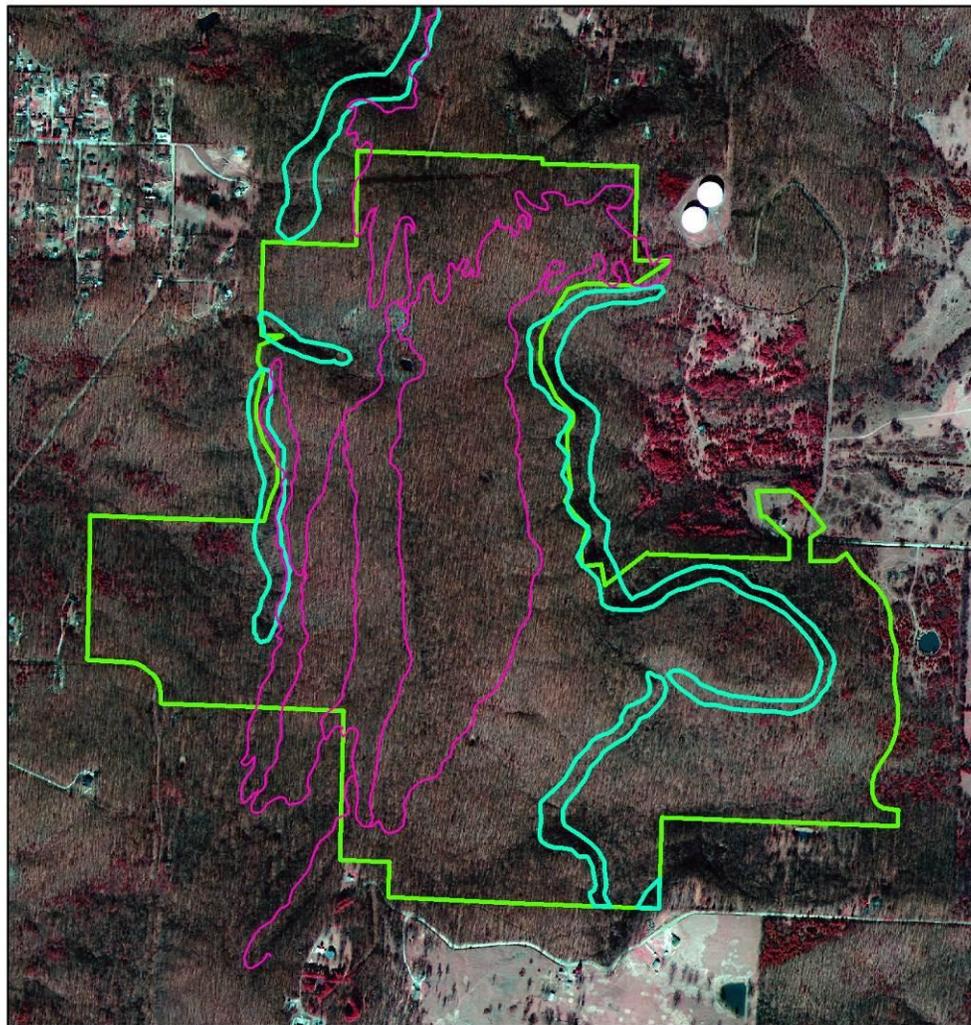
Common woody invasives in this community include tree-of-heaven (*Ailanthus altissima*\*), Amur or bush honeysuckle (*Lonicera maackii*\*), Japanese honeysuckle (*Lonicera japonica*\*), burning-bush

(*Euonymus alatus*\*), winter-creeper (*Euonymus fortunei*\*), perfumed cherry (*Prunus mahaleb*\*), nandina (*Nandina domestica*\*), Chinese privet (*Ligustrum sinense*\*), callery pear (*Pyrus calleryana*\*), and multiflora rose (*Rosa multiflora*\*). Non-native invasive herbaceous plants in mesic bluff communities on Kessler Mountain include common burdock (*Arctium minus*\*), beefsteak-plant (*Perilla frutescens*\*), and Japanese stilt grass (*Microstegium vimineum*\*).

**Species of Concern:** Powdery cloak fern (*Argyrochosma dealbata*), Church's wild rye (*Elymus churchii*), prairie trout-lily (*Erythronium mesochoreum*), eastern yampah (*Perideridia americana*), and Missouri ground-cherry (*Physalis missouriensis*) are species of conservation concern found in bluff habitat on the reserve.

**Management Recommendations:** 1) Control invasive species so that natives can replace natives in areas of canopy loss and native species can thrive in the herbaceous layer. 2) Manage prescribed fire in such a way that it is not forced to burn intensely in mesic habitats (it can instead be 'backed down' into ravines and steep slopes from above) and avoid burning these areas in the spring after mesic forest herbaceous plants have begun growth.

## SIGNIFICANT AREA 2: BLUFFS



0 0.125 0.25 0.5 0.75 1 Miles

### Legend

-  Trails
-  Bluffs
-  Mt. Kessler Reserve



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 43.** Map showing location of bluff habitats at Kessler Mountain Reserve on 2006 color-infrared aerial image.

### SIGNIFICANT AREA 3: OLD GROWTH POST OAK WOODLAND

An area of old growth post oak woodland was identified with the reserve on the east side of Kessler Mountain by Alan Edmondson and Dr. David Stahle from the University of Arkansas Tree-Ring Laboratory (Edmondson 2013). This area is mapped below based on personal communication with Alan Edmondson and GPS coordinates that he provided, plus some additional field reconnaissance. The downhill (southeastern) boundary of this area is not entirely obvious on the ground and could probably be refined by Edmondson and Stahle or others knowledgeable at reading the woods. Edmondson's excellent report summarizing his research at the reserve mentions that the larger post oaks in the area are in the 200 to 300 year old age class, with one of the oldest-looking trees cored estimated to be more than 300 years old. He also mentions that there are other areas of Kessler Mountain that still support pre-settlement trees, including the shale barrens area described above:

*There was also evidence of other areas of both relatively pristine and degraded old growth. These areas include a dwarfed post oak glade on the ridge of the mountain next to the pond where a core taken from a post oak was over 250 yrs old. There are other areas that are considered degraded old growth which appear to have been selectively logged for individual high quality trees. But these degraded old growth forest contain many pre-settlement oaks and hardwoods.*

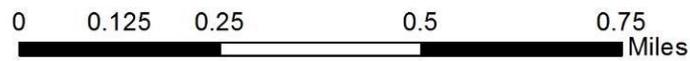
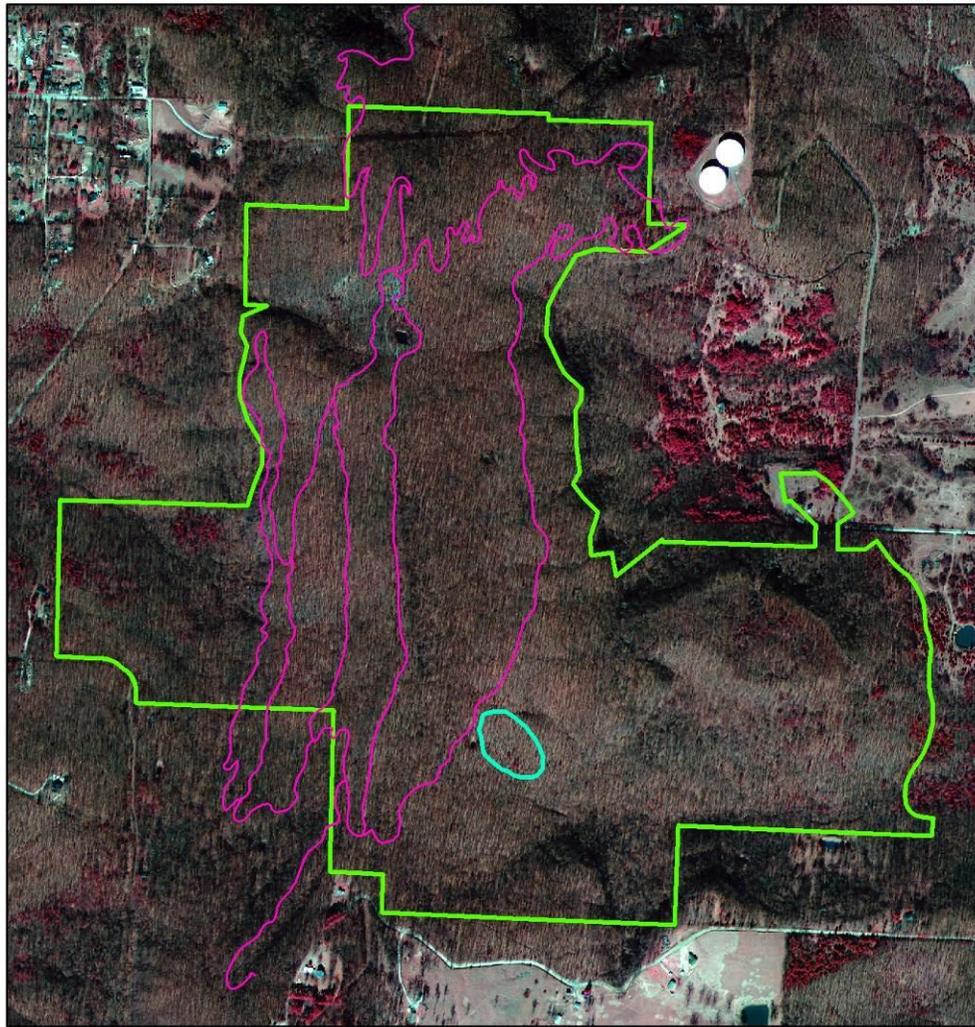
The area supports an example of the acidic dry oak woodland community described above in the Plant Communities section. It is located immediately east of a small pond below the Crazy Mary Trail and is situated on a moderately sloping hillside with a southeast-facing aspect between two small drainages. The area sits entirely on the Woolsey (shale) Member of the Bloyd Formation and is dominated by post oak (*Quercus stellata*) with smaller amounts of northern red oak (*Quercus rubra*), blackjack oak (*Quercus marilandica*), black oak (*Quercus velutina*), and white oak (*Quercus alba*) in the canopy. The area is encroached with a fairly dense shrub layer of various oaks, eastern red-cedar (*Juniperus virginiana*), winged elm (*Ulmus alata*), black locust (*Robinia pseudoacacia*), and other species. Beneath these are patches of lowbush blueberry (*Vaccinium pallidum*) which is not especially common on the reserve.

The herbaceous layer here is more diverse than in most of the (rather extensive) area of dry oak woodland in the reserve. Grasses and sedges include little bluestem (*Schizachyrium scoparium*), poverty oat grass (*Danthonia spicata*), slim-leaf rosette grass (*Dichantherium linearifolium*), Muhlenberg's sedge (*Carex muehlenbergii* var. *enervis*), and fuzzy sedge (*Carex hirsutella*). A number of fairly conservative sun-loving forbs are present in the more open areas including sensitive-brier (*Mimosa quadrivalvis* var. *nuttallii*), wild quinine (*Parthenium integrifolium*), whorled milkweed (*Asclepias verticillata*), stiff coreopsis (*Coreopsis palmata*), cream wild indigo (*Baptisia bracteata* var. *leucophaea*), little ladies'-tresses orchid (*Spiranthes tuberosa*), slender mountain-mint (*Pycnanthemum tenuifolium*), oldfield goldenrod (*Solidago nemoralis*), manyray aster (*Symphotrichum anomalum*), late purple aster (*Symphotrichum patens*), prairie aster (*Symphotrichum turbinellum*), pussytoes (*Antennaria parlinii*), dittany (*Cunila origanoides*), long-leaf bluet (*Houstonia longifolia*), hawkweed (*Hieracium gronovii*), slender bush-clover (*Lespedeza virginica*).

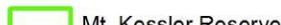
**Species of Concern:** No species of conservation concern were located within the area mapped but both prairie rattlesnake-root (*Prenanthes aspera*) and eastern yampah (*Perideridia americana*) were found immediately outside of it on the west and south edges. They may well occur in the area also, especially if it were managed with fire.

**Management Recommendations:** This area has excellent potential for the restoration of a diverse dry oak woodland, which could be done according to the following steps: 1) remove encroaching native woody species like eastern red-cedar, winged elm, black cherry, and black locust, 2) implement prescribed fire management, and 3) consider control of some of the hardwood mid-story by girdling, herbicide injection, and/or cutting and treating stumps with herbicide.

### SIGNIFICANT AREA 3: OLD GROWTH POST OAK WOODLAND



#### Legend

-  Trails
-  Mt. Kessler Reserve
-  Old Growth Post Oak Woodland



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 44.** Map showing location of old growth post oak area identified by Alan Edmondson and David Stahle at Kessler Mountain Reserve on 2006 color-infrared aerial image.

## SIGNIFICANT AREA 4: RIPARIAN HABITAT

Riparian habitat is not common on the reserve due to its upland setting but there is a small amount. Because it is so uncommon on the reserve, it adds greatly to the overall biodiversity of the site, which makes it significant. This habitat is best developed along a wooded stream on the east side of Kessler Mountain near the southern boundary (N36.02247, W94.20863) (Fig. 15a). It also occurs, but is less developed, along a smaller, steeper ephemeral stream on the west side of the mountain near the western boundary (N36.02788, W94.22347) (Figs. 15b-c). Riparian forest along the upper reaches of these streams may differ little from surrounding upland forest in terms of tree canopy, though the herbaceous layer and even the shrub layer may be noticeably different, responding to increased moisture levels (Nelson 2005).

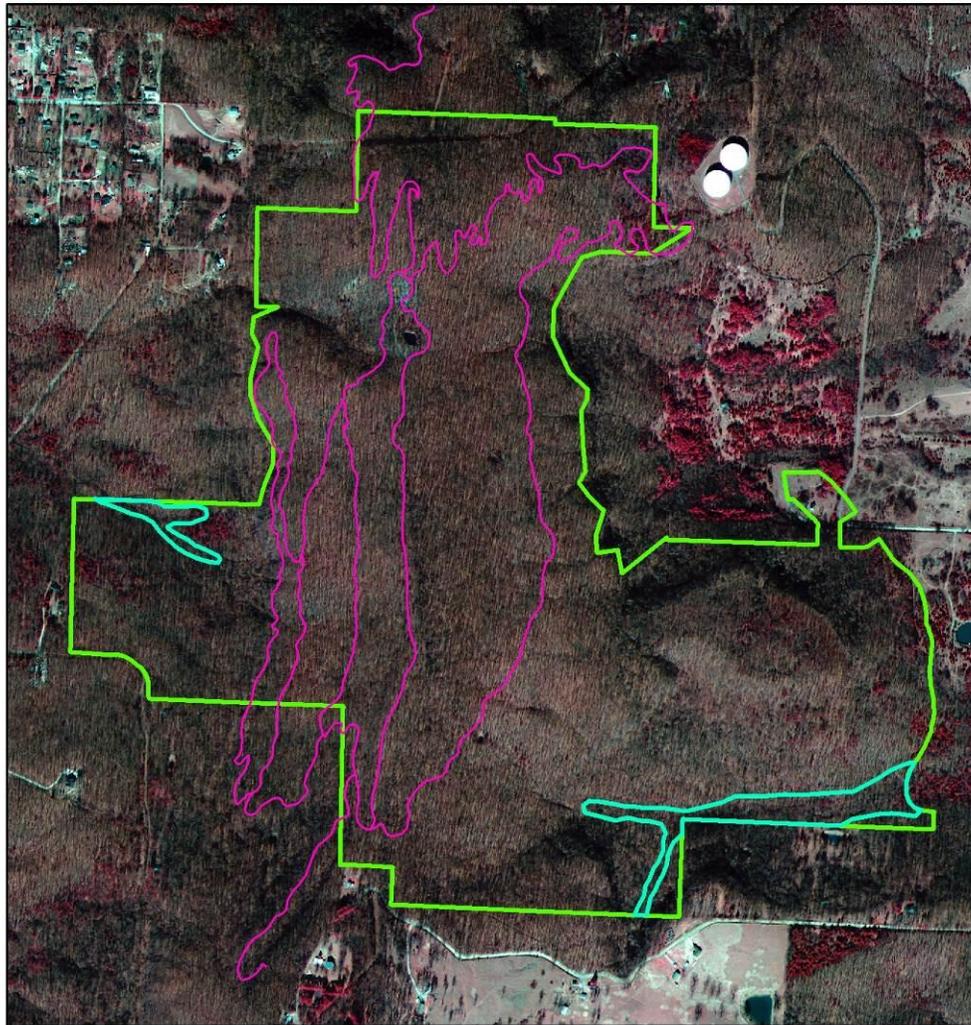
In riparian forest along the larger stream, canopy cover varies but typical species include sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), red maple (*Acer rubrum*), box elder (*Acer negundo*), hackberry (*Celtis occidentalis*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), bitternut hickory (*Carya cordiformis*), basswood (*Tilia americana*), black walnut (*Juglans nigra*), green ash (*Fraxinus pennsylvanica*), black cherry (*Prunus serotina*), persimmon (*Diospyros virginiana*), and other hardwood species. Several bur oaks (*Quercus macrocarpa*) reach canopy height here. Common woody species in the understory include spicebush (*Lindera benzoin*), deciduous holly (*Ilex decidua*), Carolina buckthorn (*Frangula caroliniana*), and hop-hornbeam (*Ostrya virginiana*). Other species include wahoo (*Euonymus atropurpureus*), Amur or bush honeysuckle (*Lonicera maackii*\*), elderberry (*Sambucus canadensis*), and Osage-orange (*Maclura pomifera*).

Shade-tolerant grasses and sedges are common in riparian forests and include river-oats (*Chasmanthium latifolium*), hairy wild rye (*Elymus villosus*), Virginia wild rye (*Elymus virginicus* var. *virginicus*), bottlebrush-grass (*Elymus hystrix*), bearded shorthusk (*Brachyelytrum erectum*), woodland muhly (*Muhlenbergia sylvatica*), and many species of sedges (*Carex* spp.). Common ferns and forbs include Christmas fern (*Polystichum acrostichoides*), rattlesnake fern (*Botrychium virginianum*), yellow ironweed (*Verbesina alternifolia*), frostweed (*Verbesina virginica*), bear's-foot (*Smallanthus uvedalius*), wild blue phlox (*Phlox divaricata* subsp. *laphamii*), blue violet (*Viola sororia*), mountain houstonia (*Houstonia purpurea* var. *purpurea*), tall rattlesnake-root (*Prenanthes altissima*), Joe-Pye-weed (*Eutrochium purpureum*), bloodroot (*Sanguinaria canadensis*), wild ginger (*Asarum canadense* var. *reflexum*), giant ragweed (*Ambrosia trifida*), white woodland aster (*Symphotrichum lateriflorum*), tall white aster (*Symphotrichum lanceolatum*), honewort (*Cryptotaenia canadensis*), clustered black-snakeroot (*Sanicula odorata*), wild potato vine (*Ipomoea pandurata*), smooth wild petunia (*Ruellia strepens*), and pale Indian-plantain (*Arnoglossum atriplicifolium*).

**Species of Concern:** No species of conservation concern were documented from riparian forests in the study area.

**Management Recommendations:** 1) Control invasive species so that natives can replace natives in areas of canopy loss and native species can thrive in the herbaceous layer.

## SIGNIFICANT AREA 4: RIPARIAN HABITAT



0 0.125 0.25 0.5 0.75 Miles

### Legend

-  Trails
-  Riparian
-  Mt. Kessler Reserve



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 45.** Map showing location of riparian habitat at Kessler Mountain Reserve on 2006 color-infrared aerial image.

## SIGNIFICANT AREA 5: SEEPS AND SPRINGS

*NOTE: This section is repeated from the account in the Plant Communities section above.*

Seeps and springs (Figs. 23 & 24) are groundwater-fed wetlands that generally occur where a porous rock layer like limestone or sandstone overlies an impermeable layer like shale. Water moves through the porous layer and emerges at or near the contact between the two units. The cool, constant flow of groundwater sometimes supports species that rarely, if ever, occur in wetlands without groundwater influence (Nelson 2005). Seeps are wetlands where groundwater emerges over a diffuse area, literally seeping up through the soil or, in some cases, out of a rock face. Springs are point sources of groundwater and often feed a spring-fed stream or rivulet called a spring run. Seeps and springs can be perennial (flowing all year) or intermittent (flowing seasonally during the wet season). Both types are present on Kessler Mountain but only those that appear to be perennial, or nearly so, are mapped in Fig. 46.

Plants found in seeps and springs on the reserve include spotted jewelweed (*Impatiens capensis*), dotted smartweed (*Persicaria punctata*), golden ragwort (*Packera aurea*), fowl manna grass (*Glyceria striata*), bulrush (*Scirpus georgianus*), rice cut grass (*Leersia oryzoides*), bog rush (*Juncus biflorus*), Michigan lily (*Lilium michiganense*), deer-tongue rosette grass (*Dichanthelium clandestinum*), Short's sedge (*Carex shortiana*), limestone meadow sedge (*Carex granularis*), hooked buttercup (*Ranunculus recurvatus*), tall goldenrod (*Solidago altissima*), winged monkey-flower (*Mimulus alatus*), and short-tooth mountain-mint (*Pycnanthemum muticum*).

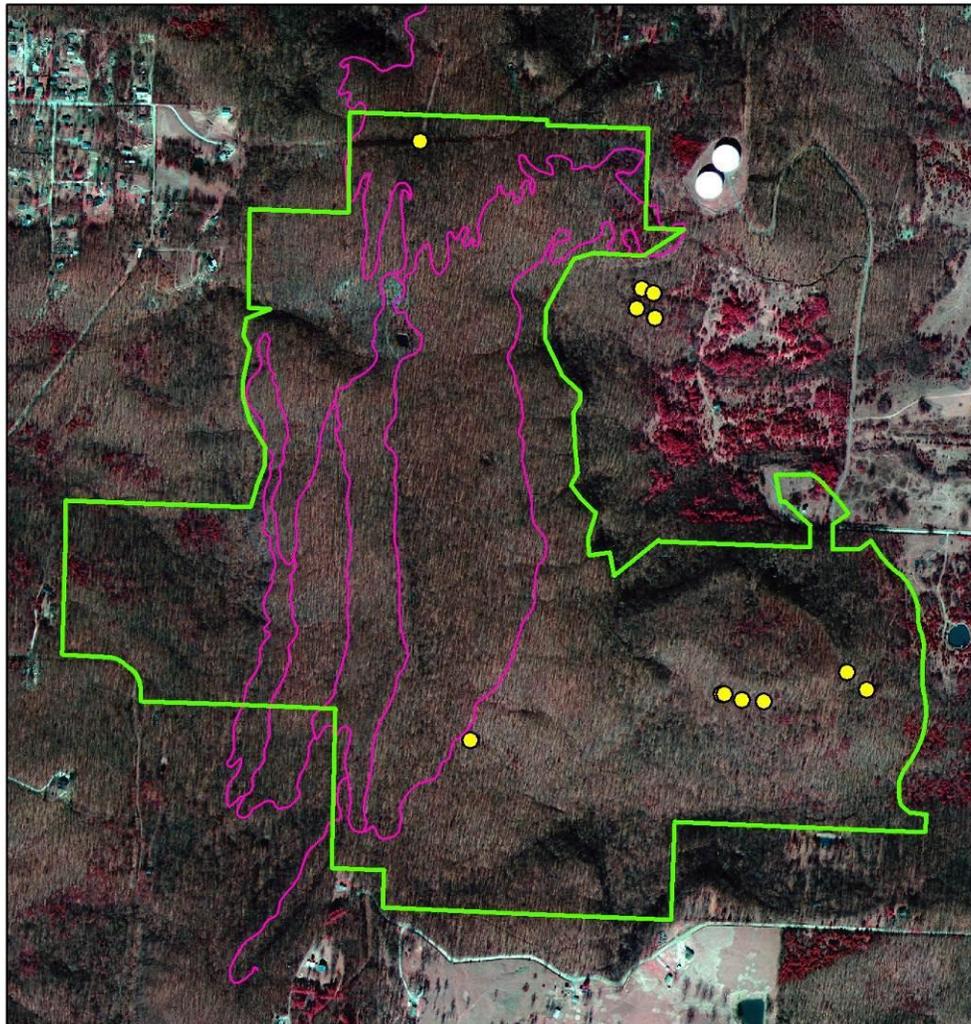
Several of the seeps and springs in the reserve are heavily encroached with Amur or bush honeysuckle (*Lonicera maackii*\*) and multiflora rose (*Rosa multiflora*\*), to the detriment of native species dependent on this habitat.

**Species of Concern:** Three animal species of conservation concern were found in seeps and springs on the reserve. Two are groundwater-obligate invertebrates: an amphipod in the genus *Stygobromus* (Fig. 24b) and an isopod in the genus *Caecidotea* (Fig. 24c). The other is the Ozark Zigzag Salamander (*Plethodon angusticlavius*) (Fig. 24f).

Though no plants on the official list of species of state conservation concern were found in this habitat, a single population of Michigan lily (*Lilium michiganense*) was found in a small seasonally-wet seep along the Eggbeater Trail. This species is on an informal "watch list" maintained by the ANHC of species that might be of conservation concern in the state but about which more data are needed to make that determination. Like most populations of this species I have seen, the plants at Kessler appear to be growing in too much shade to flower. Also, short-tooth mountain-mint (*Pycnanthemum muticum*), though not a species of state conservation concern, was a somewhat surprising find. This species is usually found in wet prairies and other moist, open habitat southeast of the Ozarks. It was found on the reserve at a single spot in an open seep in the powerline, believed to be flowing from the base of the Kessler Limestone. It was not previously known from Washington County and this may be the northwestern-most population in the United States (ANHC 2015; Kartesz 2014).

**Management Recommendations:** 1) Remove invasive shrubs from around seeps, springs, and spring runs so native plants can thrive. Clearing dense honeysuckle and multiflora rose thickets from around seeps and springs not only restores light to the ground, but can also increase water output by freeing up water being used by the invasive shrubs. 2) Implement prescribed fire management.

## SIGNIFICANT AREA 5: SEEPS AND SPRINGS



0 0.125 0.25 0.5 0.75 Miles

### Legend

-  Mt. Kessler Reserve
-  Trails
-  Seeps and Springs



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 46.** Map showing locations of significant seeps and springs found at Kessler Mountain Reserve on 2006 color-infrared aerial image.

**APPENDIX D:**

**SPECIES OF CONSERVATION CONCERN FOUND AT KESSLER  
MOUNTAIN RESERVE**

**The following species occurring in the study area have been identified by the Arkansas Natural Heritage Commission as being of conservation concern in Arkansas. Each species is presented with general information on its range and habitat followed by specific information on populations found on Kessler Mountain. Exact coordinates of locations of each species is being provided to the Fayetteville Natural Heritage Association and the City of Fayetteville. Each species is also given along with its global (G) and state (S) conservation status ranks. A legend explaining these rank codes is provided in appendix E.**

#### **PLANTS**

- 1) Powdery Cloak Fern (*Argyroschisma dealbata*) – G4G5S2
- 2) Church’s Wild Rye (*Elymus churchii*) – G2G3S2?
- 3) Prairie Trout-lily (*Erythronium mesochoreum*) – G4G5S1S2
- 4) Eastern Yampah (*Perideridia americana*) – G4S2
- 5) Missouri Ground-cherry (*Physalis missouriensis*) – G3?S1
- 6) Prairie Rattlesnake-root (*Prenanthes aspera*) – G4?S2S3
- 7) \* Maple-leaf oak? (*Quercus acerifolia* vel aff.) – G1S1

#### **ANIMALS**

- 8) Ozark Zig-zag Salamander (*Plethodon angusticlavius*) – G4S3
- 9) \*\* Groundwater Isopod (*Caecidotea* sp.) – G?S?
- 10) \*\* Groundwater Amphipod (*Stygobromus* sp.) – G?S?

\* See species account for discussion of taxonomic uncertainty regarding this species.

\*\* These groundwater crustaceans were collected by Mike Slay (Ozark Karst Program Director for The Nature Conservancy) in May and are awaiting full identification, but are believed to be species of conservation concern.

### **Powdery Cloak Fern (*Argyrochosma dealbata*) – G4G5S2**

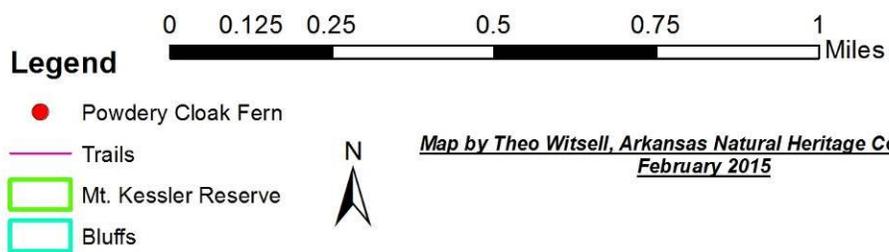
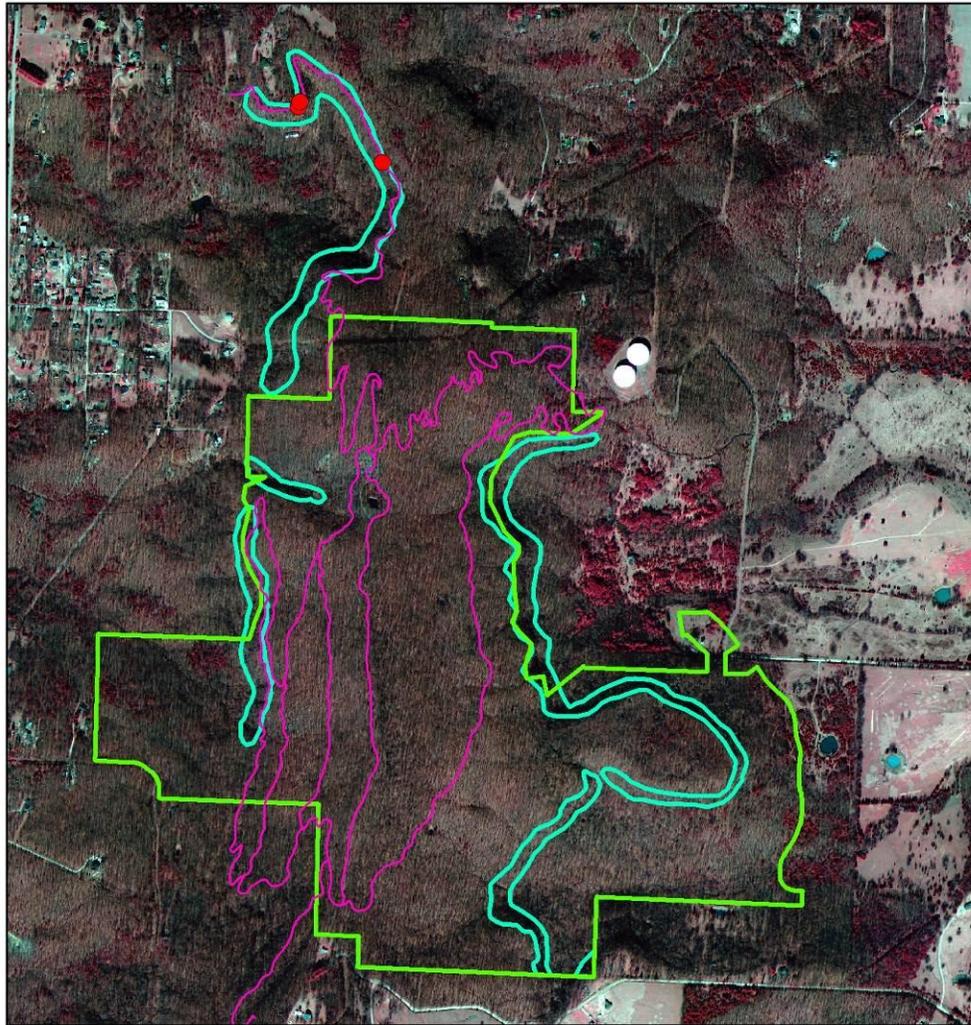
Powdery cloak fern (Fig. 27) is a distinctive, drought-adapted fern found on dry calcareous bluffs in eastern Kansas, and the western part of the Ozarks, and the Edwards Plateau of Texas. In Arkansas it is typically found on dolomite bluffs along the White River and its tributaries.

It is easily recognized by its characteristic blue-green fronds with reddish-brown to black stalks and by a white, powder-like substance coating the underside of pinnae (leaflets). This species is remarkable in that it grows from cracks and pits in dry, often overhanging bluffs with essentially no soil. Prior to its discovery on Kessler Mountain powdery cloak fern was known from Washington County only from old collections (1920s to 1940s) from bluffs near Savoy and Goshen (ANHC 2015).

At Kessler Mountain it is found on south- and west-facing outcrops of Prairie Grove Sandstone in the vicinity of Rock City and on a west-facing outcrop (perhaps of Brentwood Limestone) between Rock City and the reserve. Though no plants were found on the reserve, it is very possible that it is present there and would be found there with a comprehensive search.

Exact coordinates of Kessler Mountain populations are being provided to the FHNA and the City of Fayetteville.

## Locations of Powdery Cloak Fern (*Argyrochosma dealbata*)



**FIGURE 47.** Map showing locations of powdery cloak fern (*Argyrochosma dealbata*) at Kessler Mountain.

### **Church's Wild Rye (*Elymus churchii*) – G2G3S2?**

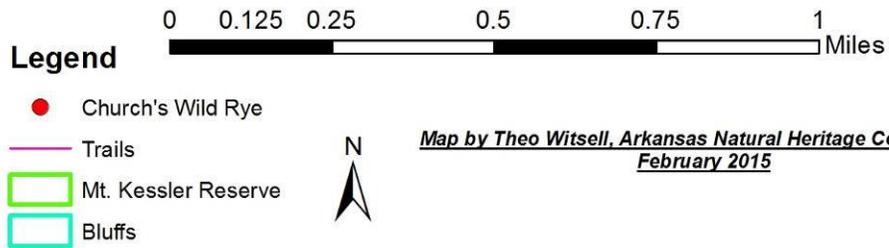
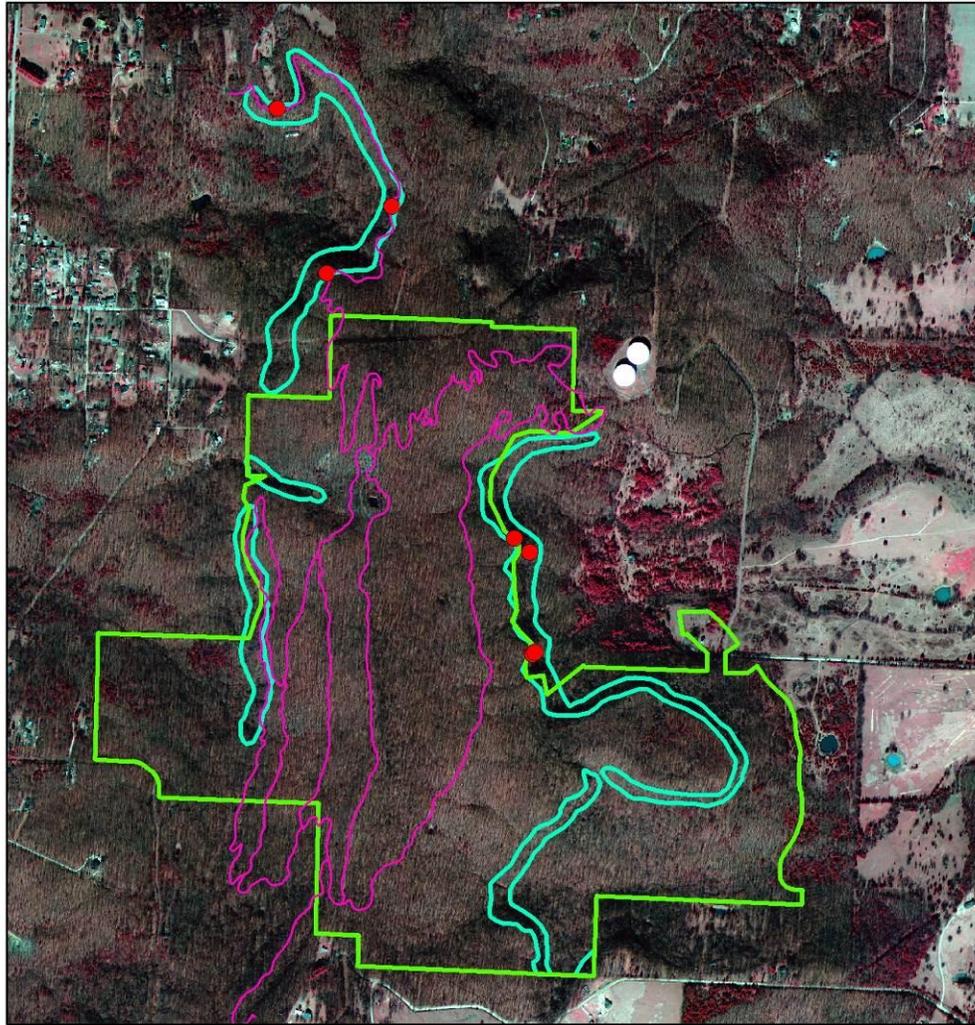
Church's wild rye (Fig. 28) is a rare grass species known only from the Interior Highlands (Ozark Plateau, Arkansas Valley, and Ouachita Mountains) in portions of Arkansas, Missouri, and Oklahoma. It was first described in 2006 and is tracked by the Arkansas Natural Heritage Commission as a species of state conservation concern. Typical habitat includes bluffs, margins of glades, and rocky, open woodlands on a variety of geologic substrates (ANHC 2015).

Church's wild rye is superficially similar to bottlebrush grass (*Elymus hystrix*), which is common on Kessler Mountain. It differs primarily in its ascending florets (vs. spreading in *E. hystrix*), curved awns (vs. straight in *E. hystrix*), more nodding stems, and more exposed, drier habitat.

Six distinct patches of Church's wild-rye were found associated with bluffs on Kessler Mountain. It was not previously known from Washington County (ANHC 2015; Gentry et al. 2013).

Exact coordinates of Kessler Mountain populations are being provided to the FHNA and the City of Fayetteville.

## Locations of Church's Wild Rye (*Elymus churchii*)



**FIGURE 48.** Map showing locations of Church's wild rye (*Elymus churchii*) at Kessler Mountain.

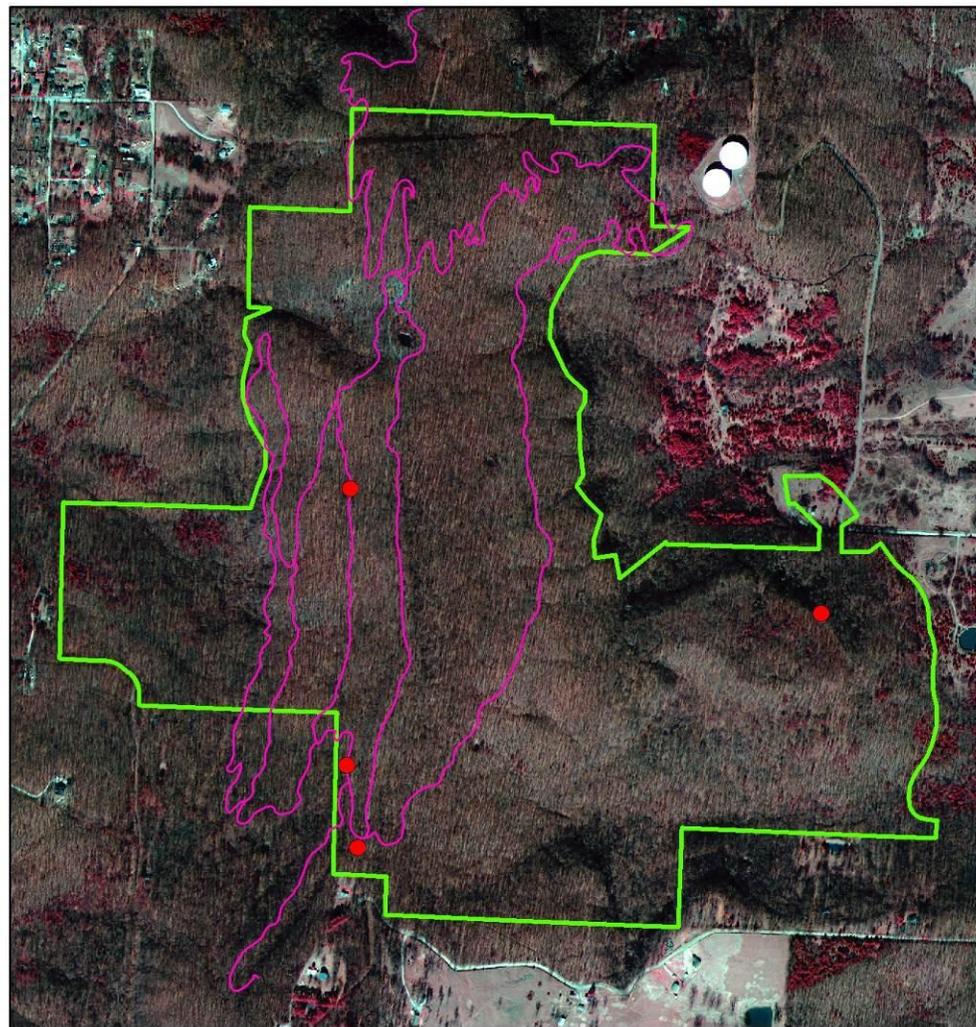
### **Prairie Trout-lily (*Erythronium mesochoreum*) – G4G5S1S2**

This Midwestern prairie species (Fig. 29) is found in upland prairies, glades, barrens, and dry to dry-mesic woodlands in the Interior Highlands of Arkansas. Most sites are in regions that historically supported large areas of open habitat (prairies and glades). Prairie trout-lily is distinguished from the more common and widespread white trout-lily (*Erythronium albidum*) by several characters: 1) its folded leaves (vs. flat in *E. albidum*), 2) its tendency to occur singly or in tight clumps (vs. forming dense colonies of vegetative plants in *E. albidum*), 3) its fruit that lay on the ground when mature (vs. fruits held erect when mature in *E. albidum*), and 4) and its preference for drier, more open habitat (vs. mesic, deeply shaded, and often riparian habitat for *E. albidum*). *E. mesochoreum* also has a diploid chromosome number, half that of the tetraploid *E. mesochoreum* (Yatskievych 1999).

This species blooms early in the year and had already flowered and set fruit by the time of the first site visit for this assessment. Fortunately local photographers made photographs of plants earlier in the spring of 2014 at various places on the mountain. These sites were associated with rocky woodlands and bluffs but exact locations of those plants were not documented. A survey in March or early April would further clarify its extent on the tract and would no doubt turn up more sites.

Exact coordinates of Kessler Mountain populations are being provided to the FHNA and the City of Fayetteville.

## Locations of Prairie trout-lily (*Erythronium mesochoreum*)



0 0.125 0.25 0.5 0.75 Miles

### Legend

- Prairie Trout-lily
- Trails
- Mt. Kessler Reserve



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

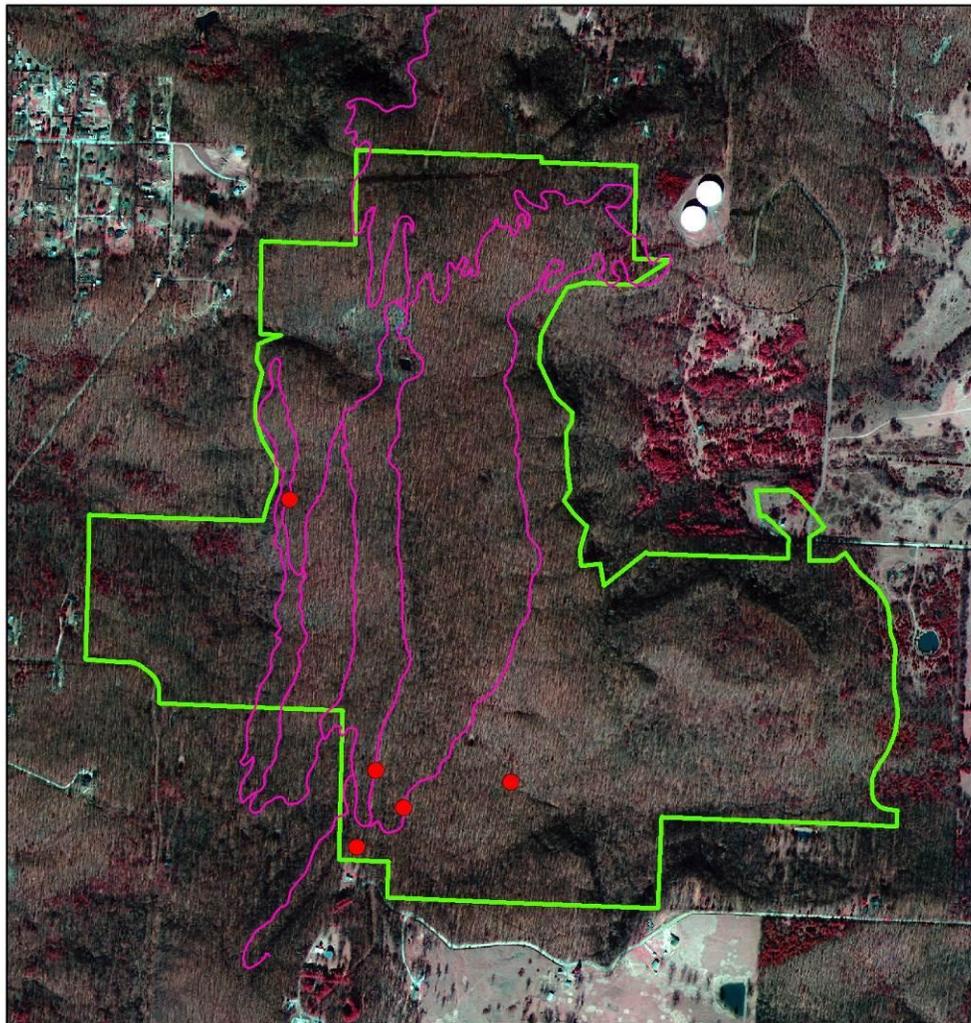
**FIGURE 49.** Map showing locations of prairie trout-lily (*Erythronium mesochoreum*) at Kessler Mountain.

### **Eastern Yampah (*Perideridia americana*) – G4S2**

Eastern yampah (Fig. 30) is a white-flowered forb in the carrot family (Apiaceae). It is known in Arkansas only from a nine northern Ozark counties (Benton, Boone, Carroll, Lawrence, Marion, Newton, Randolph, Sharp, and Washington) where it is usually found in calcareous glades and in dry to dry-mesic open woodlands, often in association with surrounding glades (ANHC 2015; Gentry et al. 2013). It can be recognized by its deeply and finely dissected leaves and smooth, often glaucous (blue-green to whitish) stems. The population(s) at Kessler Mountain are the only ones known from the Boston Mountains in Arkansas (ANHC 2015).

Exact coordinates of Kessler Mountain populations are being provided to the FHNA and the City of Fayetteville.

## Locations of Eastern Yampah (*Perideridia americana*)



0 0.125 0.25 0.5 0.75 1 Miles

### Legend

- Eastern Yampah
- Trails
- Mt. Kessler Reserve



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 50.** Map showing locations of eastern yampah (*Perideridia americana*) at Kessler Mountain.

### Missouri Ground-cherry (*Physalis missouriensis*) – G3?S1

Prior to its rediscovery at Kessler Mountain in 2014, Missouri ground-cherry (Fig. 31) was known in Arkansas from just a handful of collections made between 1923 and 1953 in five Ozark region counties: Benton, Carroll, Fulton, Newton, and Washington (ANHC 2015; Gentry et al. 2013). One of these historical specimens was collected from “Kessler Mountain, Washington County” by W. Giles on October 6, 1934 but was not documented from that area of the state again until the present study, 80 years later.

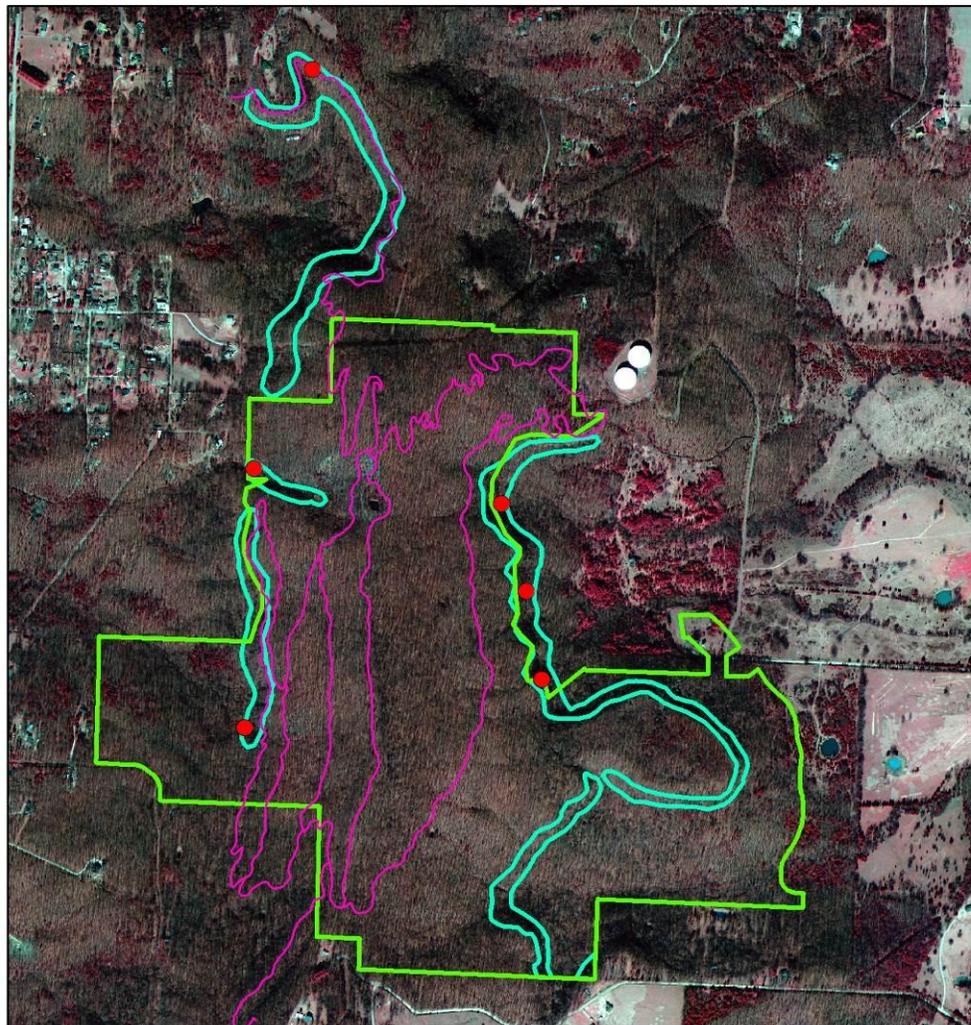
Arkansas isn't the only state where Missouri ground-cherry seems to have gone missing either. George Yatskievych, director of the Flora of Missouri Project, reports that only two of the Missouri records for the species are from after 1960 (G. Yatskievych, pers. comm.). Missouri is the center of the species' narrow range, which also includes northern Arkansas, part of eastern Kansas, two counties each in Oklahoma and Nebraska, and one county in Texas. Dr. Yatskievych also says that the species is “known almost entirely from historical collections across its range, which is troubling”. The cause of this apparent decline is unclear but much of the appropriate habitat for Missouri ground-cherry (areas of loose soil and rock (talus) at the base of calcareous bluffs) at Kessler Mountain has been choked out by two species of non-native invasive shrubs: bush honeysuckle (*Lonicera maackii*\*) and perfumed cherry (*Prunus mahaleb*\*). Encroachment by these and other invasive species in bluff and talus habitat is having a negative impact on native species across the Ozarks and may play a role in the scarcity of Missouri ground-cherry, at least in some areas.

Surveys of the bluffs at Kessler found six locations for the species, but it was not common at any of the sites, which ranged from single plants at several of the locations to a small population of 12 individuals at one site.

The Missouri ground-cherries at Kessler Mountain were growing with a related species, downy ground-cherry (*Physalis pubescens*) (Fig. 32), which is common across the state in a variety of habitats. Seeing the two species together provided an excellent opportunity to compare them and see how different they are, even though they occupied the same habitat and were growing within a few feet of one another at some sites. Both species are annuals, growing from a narrow taproot (Fig. 31d) and completing their life cycle in a single year. They are both also covered with sticky hairs but the Missouri ground-cherry has solid bright yellow flowers and yellow anthers (Fig. 32a) while the downy ground-cherry has pale yellow flowers with dark purple spots and blue anthers (Fig. 31b & c). Another obvious difference is the shape of the inflated sac, or fused calyx, that surrounds the fruit (Fig. 32d & e). Missouri ground-cherry has fruit surrounded by a small, round, 10-ribbed sac and downy ground-cherry has a larger, star-shaped, 5-ribbed sac surrounding the fruit.

Exact coordinates of Kessler Mountain populations are being provided to the FHNA and the City of Fayetteville.

## Locations of Missouri Ground-cherry (*Physalis missouriensis*)



0 0.125 0.25 0.5 0.75 1 Miles

### Legend

- Missouri Ground-cherry
- Trails
- ▭ Mt. Kessler Reserve
- ▭ Bluffs



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 51.** Map showing locations of Missouri ground-cherry (*Physalis missouriensis*) at Kessler Mountain.

### **Prairie Rattlesnake-root (*Prenanthes aspera*) – G4?S2S3**

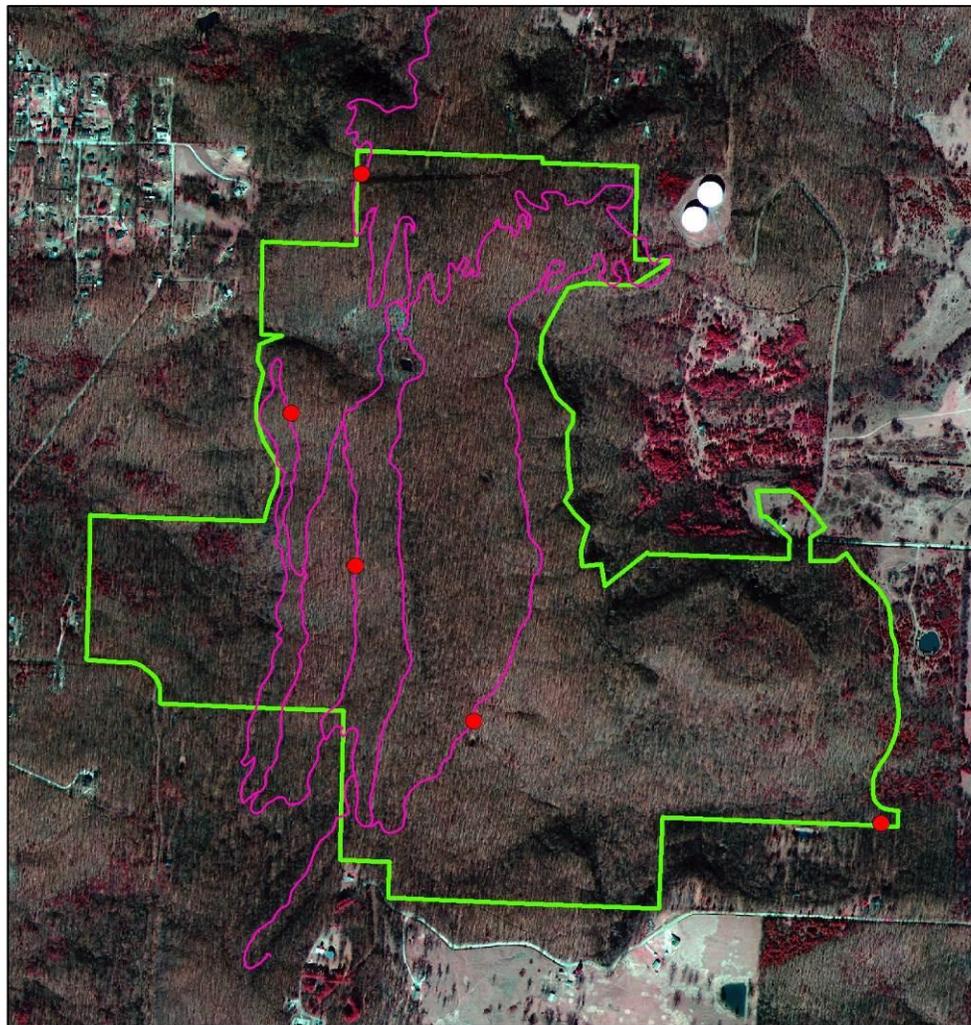
Prairie rattlesnake-root (Figs. 33 & 34) is a species of open grasslands (glades and prairies), savannas, and open woodlands. Like other species in the genus, it can persist for long periods in shaded conditions by forming vegetative colonies of single leaves but will not flower without sufficient light. It can be recognized by its distinctive patches of spoon-shaped leaves with a pale midvein originating from small tubers. The veins of the leaves bleed a milky white latex when broken (Yatskievych 2006).

It was found at five sites on Kessler Mountain (some sites supporting more than one small colony in close proximity), all in dry oak woodlands and dry-mesic oak-hickory forest and woodland habitats. However, none of the plants at Kessler appeared to have enough light for flowering and all consisted solely of small patches of vegetative leaves. Observations of this species and barbed rattlesnake-root (*Prenanthes barbata*), another rare species with similar ecology, on state natural areas over the last several years have shown that there is an increase in flowering following management with prescribed fire.

A single flowering individual of prairie rattlesnake-root was photographed in September 2013 at Pinnacle Prairie in Fayetteville by Joe Neal and others. This may have been the first time the species was documented with certainty from Washington County, though it is possible that a specimen at the U of A collected from “prairie, N.W. Ark.” in September of 1882 by Francis LeRoy Harvey (botany professor at the U of A) was made in the county (ANHC 2015).

Exact coordinates of Kessler Mountain populations are being provided to the FHNA and the City of Fayetteville.

## Locations of Prairie Rattlesnake-root (*Prenanthes aspera*)



0 0.125 0.25 0.5 0.75 1 Miles

### Legend

- Prairie Rattlesnake Root
- Trails
- Mt. Kessler Reserve



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 52.** Map showing locations of prairie rattlesnake-root (*Prenanthes aspera*) at Kessler Mountain.

## Maple-leaf oak? (*Quercus acerifolia* vel aff.) – G1S1

Several small oak trees (Fig. 35) in two different areas of the shale barrens have features consistent with maple-leaf oak (*Quercus acerifolia*), a globally rare species recognized from just a few sites in the Ouachita Mountains and Arkansas Valley of west-central Arkansas (ANHC 2015). The trees at Kessler have a consistent morphology and are distinct from both typical northern red oak (*Quercus rubra*) and Shumard oak (*Quercus shumardii*) that occur nearby (Fig. 35f). They appear to match very closely specimens of maple-leaf oak from the type locality (the site from which the species was first described) on Mt. Magazine in Logan County. Similar plants, however, have been found in recent years at several other glade sites in both the Arkansas and Missouri Ozarks, at a shale barrens site in the Ouachita Mountains (Hot Spring County, Arkansas), and at a glade site in Tennessee. The discovery of these other sites has prompted field botanists in Arkansas, Missouri, and Tennessee to re-examine plants from the type locality and consider how the various populations might be related to one another and to similar species.

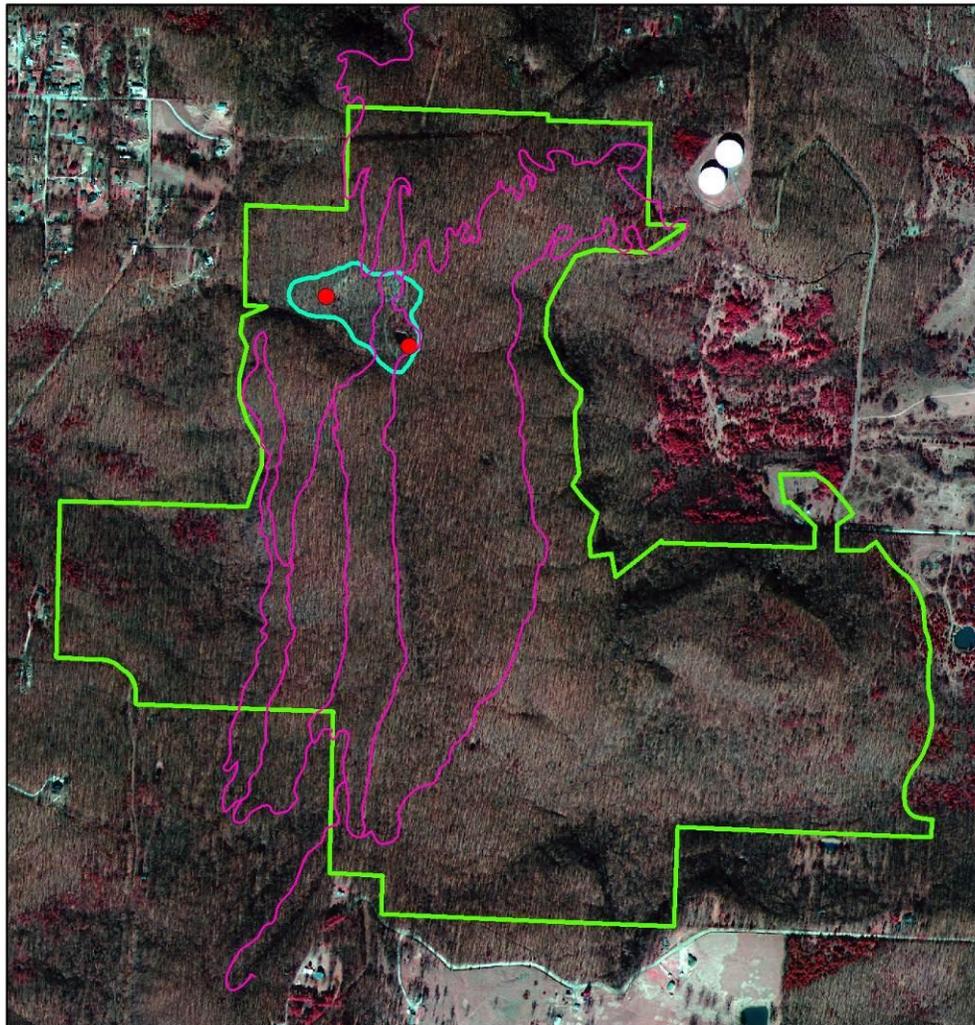
Studies are ongoing but the status of maple-leaf oak as a “good” species has become the matter of some debate and disagreement. A recent paper published by Ladd and Thomas (2015) takes the position that it is not worthy of recognition and that it should be considered an extreme form of what has traditionally been called Schneck’s oak (*Quercus shumardii* var. *schneckii*):

*The epithet acerifolium was long applied to an element thought to be endemic to the region near Magazine Mountain, Arkansas. But even on Magazine Mountain many of the trees include foliage that has both well-defined maple-like leaves as well as leaves more traditionally associated with what has been referred to as Q. shumardii var. schneckii and even typical Q. shumardii. Also, the extreme morphologies found on Magazine Mountain have recently been found on calcareous glades throughout the Missouri Ozarks, where they clearly grade into what has long been called Q. shumardii var. schneckii. It seems clear that there is a single taxon of the upland variant of Q. shumardii, and some individuals of this element have a predilection to reduced, maple-like leaves, particularly on dwarfed trees of exposed upland sites.*

Others disagree, or at least find this conclusion premature. It is clear though that these trees from across the range warrant additional study and perhaps detailed genetic analysis to determine if they are maple-leaf oak, Schneck’s oak, or a different, perhaps undescribed entity. In the meantime “*Quercus acerifolia*” followed by the modifier “vel aff.”, an abbreviation meaning essentially “or a close relative”, is used to refer to the Kessler plants. This population is relatively easy to access and would be convenient for a graduate student or professor at the U of A to study.

Exact coordinates of Kessler Mountain plants are being provided to the FHNA and the City of Fayetteville.

## Locations of Maple-leaf oak? (*Quercus acerifolia* vel aff.)



0 0.125 0.25 0.5 0.75 Miles

### Legend

- Maple Leaf Oak?
- Trails
- ▭ Mt. Kessler Reserve
- ▭ Shale Barrens



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

**FIGURE 53.** Map showing locations of maple-leaf oak? (*Quercus acerifolia* vel aff.) at Kessler Mountain.

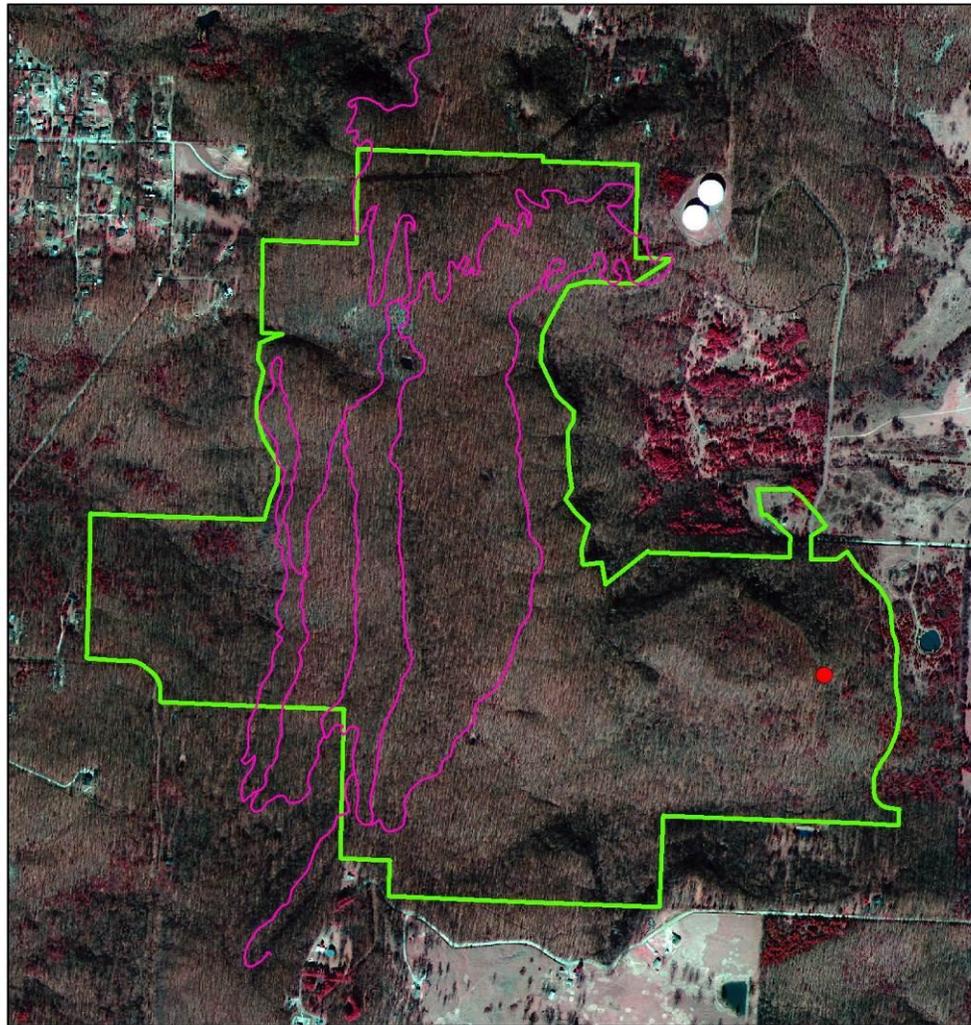
### **Ozark Zigzag Salamander (*Plethodon angusticlavius*) – G4S3**

A single Ozark Zigzag Salamander (Fig. 24f & 36d) was found during the study in a small seep emerging from the base of a bluff on the east side of Kessler Mountain by Mitchell Pruitt and Theo Witsell. This was something of an opportunistic discovery and no dedicated survey was made.

Trauth, Robison, & Plummer (2004) note that this species is usually associated with canyons, ravines, and escarpments, in exposures of naked rock and springs and seepage areas. They also note that deforestation and conversion of forest lands into urban and agricultural areas have eliminated many populations of this species.

A dedicated survey in appropriate habitats on the reserve would likely discover more individuals.

## Locations of Ozark Zigzag Salamander (*Plethodon angusticlavius*)



0 0.125 0.25 0.5 0.75 1 Miles

### Legend

- Ozark Zigzag Salamander
- Trails
- Mt. Kessler Reserve



*Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015*

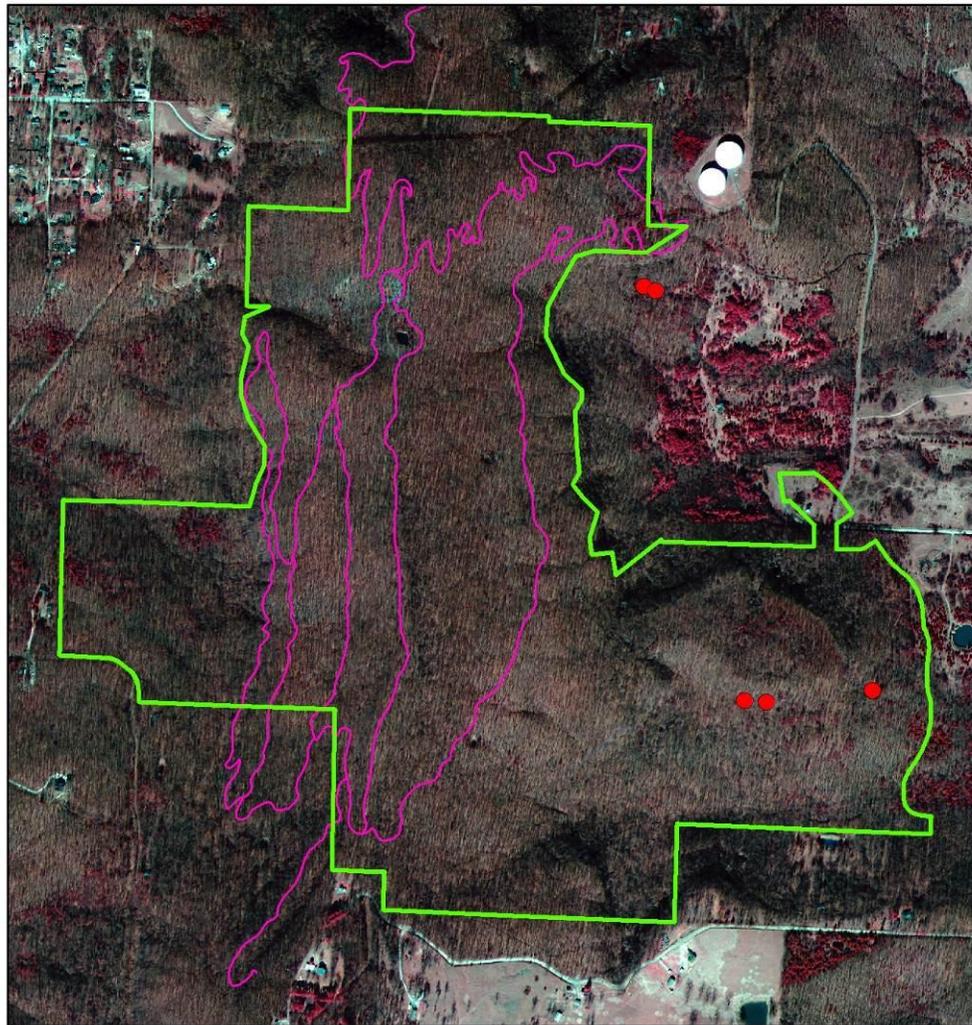
**FIGURE 54.** Map showing locations of Ozark Zigzag Salamander (*Plethodon angusticlavius*) at Kessler Mountain.

### **Groundwater Crustaceans (*Caecidotea* sp. and *Stygobromus* sp.) – G?S?**

Two groundwater-obligate invertebrates: an amphipod in the genus *Stygobromus* (Fig. 24b) and an isopod in the genus *Caecidotea* (Fig. 24c) were found in seeps and springs in the study area by Mike Slay of The Nature Conservancy. Though specimens of these are awaiting identification to the species level, they are believed to be species of conservation concern. Graening, Fenolio, & Slay (2011) list 11 species of cave- and groundwater-obligate species of *Caecidotea* known from Arkansas, all but one of which are either of state conservation concern or undescribed (new) species. They list seven cave- and groundwater-obligate species of *Stygobromus* known from Arkansas, all but one of which are either of state conservation concern or undescribed.

These species are considered “stygo-bionts”, or groundwater-obligates. They live underground in total darkness within the groundwater and are sometimes found in cave streams and drip pools. They are also occasionally found in seeps or springs where they have been flushed out from within the ground. These species exhibit obvious “troglomorphy”, specialized adaptations to life underground including a lack of pigment and reduced eyes (Graening, Fenolio, & Slay 2011).

## Locations of Groundwater Crustaceans (*Stygobromus* and *Caecidotea*)



0 0.125 0.25 0.5 0.75 Miles

### Legend

- Groundwater Crustaceans
- ▭ Mt. Kessler Reserve
- Trails

Map by Theo Witsell, Arkansas Natural Heritage Commission  
February 2015

**FIGURE 55.** Map showing locations of groundwater-obligate crustaceans (*Stygobromus* sp. and *Caecidotea* sp.) at Kessler Mountain.

**APPENDIX E:**

**CONSERVATION STATUS CODE/RANK LEGEND**

## DEFINITION OF RANKS

### GLOBAL RANKS

- G1** = **Critically Imperiled Globally.** At a very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- G2** = **Imperiled Globally.** At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
- G3** = **Vulnerable Globally.** At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
- G4** = **Apparently Secure Globally.** Uncommon but not rare; some cause for long-term concern due to declines or other factors.
- G5** = **Secure Globally.** Common, widespread and abundant.
- GH** = **Of Historical Occurrence, Possibly Extinct Globally.** Missing; known from only historical occurrences, but still some hope of rediscovery.
- GU** = **Unrankable.** Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- GX** = **Presumed Extinct Globally.** Not located despite intensive searches and virtually no likelihood of rediscovery.
- GNR** = **Unranked.** The global rank not yet assessed.
- GNA** = **Not Applicable.** A conservation status rank is not applicable.
- T-Ranks** = **T subranks are given to global ranks when a subspecies, variety, or race is considered at the state level.** The subrank consists of a "T" plus a number or letter (1, 2, 3, 4, 5, H, U, X) with the same ranking rules as a full species.

### STATE RANKS

- S1** = **Critically Imperiled in the State.** At a very high risk of extirpation due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- S2** = **Imperiled in the State.** At high risk of extirpation due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
- S3** = **Vulnerable in the State.** At moderate risk of extirpation due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
- S4** = **Apparently Secure in the State.** Uncommon but not rare; some cause for long-term concern due to declines or other factors.
- S5** = **Secure in the State.** Common, widespread and abundant.
- SH** = **Of Historical Occurrence, with Some Possibility of Rediscovery.** Its presence may not have been verified in the past 20-40 years. A species may be assigned this rank without the 20-40 year delay if the only known occurrences were destroyed or if it had been extensively and unsuccessfully sought.
- SU** = **Unrankable.** Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

**SX** = **Presumed Extirpated from the State.** Not located despite intensive searches and virtually no likelihood of rediscovery.

**SNR** = **Unranked.** The state rank not yet assessed.

**SNA** = **Not Applicable.** A conservation status rank is not applicable.

#### **GENERAL RANKING NOTES**

**Q** = A “Q” in the global rank indicates the element’s taxonomic classification as a species is a matter of conjecture among scientists.

**Ranges** = Ranges are used to indicate a range of uncertainty about the status of the element.

**?** = A question mark is used to denote an inexact numeric rank.

**APPENDIX F:**

**PROBLEMATIC NON-NATIVE INVASIVE PLANT SPECIES AT  
KESSLER MOUNTAIN RESERVE**

The following table is a list of non-native invasive plant species at Kessler Mountain Reserve with information on their life form, local severity (major, moderate, or minor), and habitat(s) occupied. This table is followed by an annotated list, organized by severity with more information on each species.

Scientific Name	Common Name(s)	Plant Type	Severity at Kessler Mountain	Habitat(s)
<i>Ailanthus altissima</i>	Tree-of-heaven	Tree	Major	Dry-mesic oak forest & woodland, mesic forest, riparian forest, old field forest, bluffs, pasture/field, disturbed areas
<i>Arctium minus</i>	Common burdock	Forb	Minor	Bluffs (talus), pasture/field, disturbed areas
<i>Clematis terniflora</i>	Sweet autumn virgin's-bower	Woody vine	Minor	Mesic forest, bluffs
<i>Euonymus alatus</i>	Burning-bush	Shrub	Moderate	Mesic forest, bluffs
<i>Euonymus fortunei</i>	Wintercreeper	Woody vine	Moderate	Mesic forest, riparian forest, old field forest, bluffs, disturbed areas
<i>Lespedeza cuneata</i>	Sericea lespedeza	Forb	Moderate	Riparian forest, old field forest, pasture/field, disturbed areas
<i>Ligustrum sinense</i>	Chinese privet	Shrub	Major	Mesic forest, riparian forest, old field forest, bluffs, pasture/field, disturbed areas
<i>Lonicera japonica</i>	Japanese honeysuckle	Woody vine	Major	Dry-mesic oak forest & woodland, mesic forest, riparian forest, old field forest, bluffs, pasture/field, disturbed areas
<i>Lonicera maackii</i>	Amur honeysuckle, bush honeysuckle	Shrub	Major	Dry-mesic oak forest & woodland, mesic forest, riparian forest, old field forest, bluffs, seeps/springs, pasture/field, disturbed areas
<i>Microstegium</i>	Japanese stiltgrass	Grass	Moderate	Mesic forest, riparian forest, bluffs, seeps/springs, disturbed

<i>vimineum</i>				areas
<i>Nandina domestica</i>	Nandina	Shrub	Minor	Bluffs (talus)
<i>Perilla frutescens</i>	Beefsteak plant	Forb	Moderate	Dry-mesic oak forest & woodland, mesic forest, riparian forest, old field forest, bluffs, pasture/field, disturbed areas
<i>Prunus mahaleb</i>	Perfumed cherry	Shrub/Tree	Major	Dry-mesic oak forest & woodland, mesic forest, bluffs, pasture/field
<i>Pyrus calleryana</i>	Callery pear	Tree	Moderate	Bluffs, pasture/field, disturbed areas
<i>Rosa multiflora</i>	Multiflora rose	Shrub	Major	Mesic forest, riparian forest, old field forest, bluffs, seeps/springs, ponds, pasture/field
<i>Sorghum halepense</i>	Johnson grass	Grass	Minor	Riparian forest, pasture/field

### **MAJOR SEVERITY INVASIVE SPECIES**

**Tree-of-heaven (*Ailanthus altissima*)** – Scattered throughout the reserve in old field forests, along bluffs, and in disturbed areas, tree-of-heaven (Figs. 38e-f & 39a-b)) is actively spreading into the more remote and intact areas of the reserve. It is known for colonizing forest edges at roadsides and utility rights-of-way and then taking advantage of local disturbances (such as gaps in the forest canopy that form when native trees die) to colonize the forest interior. This process was observed to be advanced in some areas of the reserve, especially in disturbed mesic forests below bluffs, where tree-of-heaven had become locally common to dominant in the canopy. It also spreads along stream corridors.

**Chinese Privet (*Ligustrum sinense*)** – One of the most widespread and aggressive invasive shrubs in Arkansas, Chinese privet is capable of forming a nearly solid semi-evergreen shrub layer that will displace native ground flora over time. It is scattered in the reserve, but especially common in disturbed mesic forests, around bluffs, along streams, and in old field successional forests.

**Japanese Honeysuckle (*Lonicera japonica*)** – This woody vine has become a dominant groundcover in many disturbed forests and woodlands throughout Arkansas. Where there is sufficient sunlight at forest edges along roads, fields, and powerlines, it climbs into the tree canopy where it flowers and fruits. On the reserve it is scattered to locally common in a variety of habitats including disturbed forests and woodlands, bluffs, and the pasture/field.

**Amur Honeysuckle, Bush Honeysuckle (*Lonicera maackii*)** – This non-native invasive shrub (Fig. 38b-d) favors mesic soils derived from limestone and is most abundant in Arkansas in urban woodlands of Benton and Washington counties. It often forms a dense, impenetrable shrub layer and excludes native flora. It is common in mesic habitats throughout the reserve and is most common along bluffs, streams, and on lower slopes. Of all the invasive species in the reserve, it has probably had the greatest negative impact on native species and communities.

**Perfumed Cherry (*Prunus mahaleb*)** – This shrub or small tree (Fig. 19c-d) is spreading rapidly in northwest Arkansas where it has escaped from ornamental plantings. The fruit are popular with birds, which spread the seed, and it can grow in very little soil – often from cracks in bedrock. These two factors lead to it being very invasive on and around bluffs. On Kessler Mountain, perfumed cherry and another invasive shrub, Amur or bush honeysuckle (*Lonicera maackii*) have heavily encroached on formerly open bluff and talus habitat to the detriment of native species.

**Multiflora Rose (*Rosa multiflora*)** – This shrub is a major invasive species across the Ozarks and is capable of making large quantities of seed, which are dispersed by birds and other animals. It is common in a variety of habitats including riparian forests, roadsides, powerline rights-of-way, and the shores of the lake.

#### **MODERATE SEVERITY INVASIVE SPECIES**

**Burning-bush (*Euonymus alatus*)** – This shrub is becoming common in mesic forests in northwest Arkansas where it forms dense understory thickets, shading out native ground flora and suppressing young native trees and shrubs. It is thinly scattered in mesic forest and bluff habitats in the reserve, especially on the southern end. The largest population observed at Kessler Mountain was along the Wino Trail south of the reserve.

**Wintercreeper (*Euonymus fortunei*)** – This creeping woody vine is common at scattered sites throughout the reserve. It commonly forms a solid evergreen groundcover but can only flower and fruit where it climbs trees, which it can eventually strangle, kill, and crush. It is most common on bluffs and in mesic, disturbed habitats.

**Sericea Lespedeza (*Lespedeza cuneata*)** – Introduced for erosion control and wildlife planting, this species (Fig. 16b) spreads aggressively in all but the wettest open habitat. Especially harmful in glades and prairies, it is very common across the state. At Kessler Mountain, it is dominant in areas of the pasture/field and can be found at scattered sites along old roads, powerlines, streams banks, and in old field forests.

**Japanese Stilt Grass (*Microstegium vimineum*)** – Japanese stilt grass is a very aggressive annual grass of mesic habitats that can rapidly displace native vegetation. It is locally common in small scattered areas of the reserve, especially in disturbed mesic forest and talus habitats. It is also locally common in areas of the powerline right-of-way through the reserve (Fig. 37c).

**Beefsteak Plant (*Perilla frutescens*)** – An abundant invasive across the state, beefsteak plant has become a common groundcover in forested areas with soil disturbance, on talus, in old field forests, and along old roads and other disturbed areas in the reserve (Figs. 37d & 38a).

**Callery Pear (*Pyrus calleryana*)** – Callery pear is an invasive colony-forming tree that is used as the rootstock for the widely-planted Bradford pear. Callery pear fruit are popular with birds and the seeds are spread far and wide. It is found at scattered locations in the reserve around bluffs and is locally common around the pasture/field and in disturbed areas.

#### **MINOR SEVERITY INVASIVE SPECIES**

**Common Burdock (*Arctium minus*)** – This large, non-native biennial forb is a common weed of disturbed soils but also readily colonizes mesic talus slopes. It occurs on the reserve both in disturbed areas and on talus. Common burdock has large fruit covered with barbed hooks that have been documented to ensnare and kill bats and small birds. The potential impact on bats is especially troubling because of its tendency to colonize talus slopes, a habitat that often occurs near the mouths of caves.

**Sweet Autumn Virgin's-bower (*Clematis terniflora*)** – This woody vine is a common species in urban areas, where it has escaped from planting as an ornamental. It is locally invasive in a variety of habitats across the state and is especially common along the Ouachita River corridor in west-central Arkansas. This species was not seen on the reserve proper but has naturalized in the vicinity of Rock City.

**Nandina (*Nandina domestica*)** – This evergreen ornamental shrub, widely planted in Arkansas, has naturalized extensively in some urban areas. The berries can be toxic to birds such as Cedar Waxwings when eaten in large quantities. It was observed at a few scattered locations on talus (Fig. 37b).

**Johnson Grass (*Sorghum halepense*)** – This invasive warm-season grass species is widespread throughout the region where it can dominate pastures, roadsides, utility rights-of-way, and other open habitats. It is found on the reserve in the old pasture/field and in riparian forest.

**APPENDIX G:**

**LIST OF PLANT SPECIES FOUND AT KESSLER MOUNTAIN  
RESERVE**

# Annotated Checklist of Vascular Plant Taxa Documented at Kessler Mountain Reserve

Nomenclature, with a few exceptions, according to Gentry et al., eds. 2013. *Atlas of the Vascular Plants of Arkansas*.

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Acalypha monococca</i>	one-seed mercury	Forb	A,B,C,G	4	Witsell	
<i>Acalypha virginica</i>	Virginia copperleaf	Forb	A,B,C,E,F,G,J ,K	4		
<i>Acer negundo</i>	box elder	Tree	D,E,F,J	2		
<i>Acer rubrum</i>	red maple	Tree	C,D,E	2		
<i>Acer saccharum</i> var. <i>saccharum</i>	sugar maple	Tree	C,D,E,G	1	Witsell	
<i>Achillea millefolium</i>	yarrow	Forb	J	2		
<i>Adiantum pedatum</i>	northern maidenhair fern	Fern or Fern Ally	D,G	1		
<i>Agalinis gattingeri</i>	Gattinger's false foxglove	Forb	A,B	4	Witsell	
<i>Agastache nepetoides</i>	yellow giant-hyssop	Forb	D	2		
<i>Ageratina altissima</i>	white snakeroot	Forb	D,E,G	1		
<i>Agrimonia pubescens</i>	agrimony	Forb	D,G	9		
<i>Agrimonia rostellata</i>	agrimony	Forb	D,E,G	1	Witsell	
<i>Agrostis hyemalis</i>	winter bent grass	Graminoid	A,J	2		
<i>Agrostis perennans</i>	autumn bent grass	Graminoid	C,D,E,G	4		
<b><i>Ailanthus altissima</i></b>	tree-of-heaven	Tree	C,D,E,F,G,J,K	1		
<i>Allium canadense</i> var. <i>canadense</i>	wild onion	Forb	C,D,E,F,J	2		
<b><i>Allium vineale</i></b>	field garlic	Forb	J,K	1		
<i>Ambrosia artemisiifolia</i>	common ragweed	Forb	A,E,F,G,I,J,K	1		
<i>Ambrosia bidentata</i>	lance-leaf ragweed	Forb	A,B,J,K	4		
<i>Ambrosia trifida</i>	giant ragweed	Forb	E,J,K	2		
<i>Amelanchier arborea</i>	downy service-berry	Tree	A,C,G	1		
<i>Amorpha nitens</i>	shining indigo-bush	Shrub	C	2	Witsell 14-0128	
<i>Ampelopsis cordata</i>	false grape	Woody Vine	D,E,G,J	5		
<i>Amphicarpaea bracteata</i>	hog-peanut	Forb	C,D,G	4		
<i>Amsonia tabernaemontana</i>	eastern bluestar	Forb	C,E	1		
<i>Anagallis minima</i>	chaffweed	Forb	A,I	3	Witsell 14-0189	
<i>Andropogon gerardii</i>	big bluestem	Graminoid	A,B,C,G	4		
<i>Andropogon virginicus</i>	broomsedge	Graminoid	A,C,G,I,J,K	1		
<i>Anemone virginiana</i>	thimbleweed	Forb	C,E,G	1		
<i>Antennaria parlinii</i>	pussytoes	Forb	A,B,C	1		
<i>Apocynum cannabinum</i>	dogbane	Forb	C,E,F,G,J	4		
<b><i>Arctium minus</i></b>	common burdock	Forb	G,J,K	1		
<b><i>Arenaria serpyllifolia</i> var. <i>serpyllifolia</i></b>	thyme-leaf sandwort	Forb	J,K	7		
<b><i>Argyrochosma dealbata</i></b>	powdery cloak fern	Fern or Fern Ally	G	5	Witsell	
<i>Arisaema dracontium</i>	green-dragon	Forb	D,E	1		
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	Forb	D,G	1		
<i>Aristida dichotoma</i> var. <i>dichotoma</i>	church-mouse three-awn	Graminoid	A	4	Witsell	
<i>Aristida oligantha</i>	oldfield three-awn	Graminoid	A,J,K	5		
<i>Aristolochia reticulata</i>	Texas Dutchman's-pipe	Forb	B,C	1		
<i>Aristolochia serpentaria</i>	Virginia snakeroot	Forb	C,E,G	4		
<i>Arnoglossum atriplicifolium</i>	pale Indian-plantain	Forb	E	2		

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Arnoglossum plantagineum</i>	Indian-plantain	Forb	B,C	2		
<i>Asarum canadense</i> var. <i>reflexum</i>	wild ginger	Forb	D,F,G	1		
<i>Asclepias quadrifolia</i>	four-leaf milkweed	Forb	B,C	2		
<i>Asclepias tuberosa</i>	butterfly milkweed	Forb	B,J	5		
<i>Asclepias verticillata</i>	whorled milkweed	Forb	A,B	1		
<i>Asimina triloba</i>	pawpaw	Tree	D,E,G	1		
<i>Asplenium platyneuron</i>	ebony spleenwort	Fern or Fern Ally	C,E,F,G	1		
<i>Asplenium resiliens</i>	black-stem spleenwort	Fern or Fern Ally	G	1		
<i>Asplenium rhizophyllum</i>	walking fern	Fern or Fern Ally	G	1		
<i>Asplenium trichomanes</i>	maidenhair spleenwort	Fern or Fern Ally	G	1		
<i>Astragalus canadensis</i>	rattle-weed	Forb	C,G	2		
<i>Astranthium ciliatum</i>	western daisy	Forb	A,B,K	4		
<i>Aureolaria flava</i>	yellow false foxglove	Forb	B,C	1		
<i>Aureolaria grandiflora</i>	yellow false foxglove	Forb	C,G	2		
<i>Baptisia bracteata</i> var. <i>leucophaea</i>	cream wild indigo	Forb	A,B	1		
<b><i>Barbarea vulgaris</i></b>	yellow-rocket	Forb	J,K	1		
<i>Bidens aristosa</i>	tickseed-sunflower	Forb	E,H,I,J,K	5		
<i>Bidens bipinnata</i>	Spanish-needles	Forb	G,K	4		
<i>Bidens frondosa</i>	beggar-ticks	Forb	I	4		Witsell
<i>Bignonia capreolata</i>	cross-vine	Woody Vine	C,D,E,G	1		
<i>Boechera canadensis</i>	Canadian rockcross	Forb	C,G	1		
<i>Boechera laevigata</i>	smooth rockcross	Forb	D,G	1		
<i>Boehmeria cylindrica</i>	false nettle	Forb	E,H,I	1		
<i>Botrychium biternatum</i>	southern grape fern	Fern or Fern Ally	C,F,J	1		
<i>Botrychium dissectum</i>	cut-leaf grape fern	Fern or Fern Ally	C,E,F	4		
<i>Botrychium virginianum</i>	rattlesnake fern	Fern or Fern Ally	D,E	1		
<i>Brachyelytrum erectum</i>	bearded shorthusk	Graminoid	C,D,E,G	1		
<i>Brickellia eupatorioides</i>	false boneset	Forb	A,B,F	4		
<b><i>Bromus inermis</i></b>	smooth brome	Graminoid	J,K	5		
<i>Bromus pubescens</i>	hairy woodland brome	Graminoid	C,D,E,F,G	1		
<b><i>Bromus racemosus</i></b>	bald brome	Graminoid	F,J,K	2		
<i>Callitriche heterophylla</i>	water-starwort	Forb	A,I	3		
<i>Camassia scilloides</i>	wild hyacinth	Forb	A,B,C,D	1		
<i>Campanula americana</i>	tall bellflower	Forb	D,G	1		
<i>Cardamine concatenata</i>	toothwort	Forb	C,D,E,G	1		
<b><i>Cardamine hirsuta</i></b>	hairy bittercress	Forb	E,F,G,J,K	1		
<i>Cardamine parviflora</i> var. <i>arenicola</i>	small-flower bittercress	Forb	C,D,G	1		
<b><i>Carduus nutans</i></b>	musk thistle	Forb	F,G,J,K	4		
<i>Carex albicans</i> var. <i>albicans</i>	sedge	Graminoid	A,B,C,G	1		
<i>Carex albicans</i> var. <i>australis</i>	sedge	Graminoid	C,G	1		Witsell 14-0015
<i>Carex albursina</i>	sedge	Graminoid	D,E,G	2		Witsell 14-0119
<i>Carex amphibola</i>	sedge	Graminoid	C,D,E,F,G	2		Witsell 14-0125
<i>Carex annectens</i>	sedge	Graminoid	I	3		
<i>Carex blanda</i>	sedge	Graminoid	C,D,E,F,G,H	1		
<i>Carex bulbostylis</i>	sedge	Graminoid	C,D,F,G	2		Witsell 14-0194

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Carex cephalophora</i>	sedge	Graminoid	C,F,G	2		
<i>Carex digitalis</i> var. <i>digitalis</i>	sedge	Graminoid	D,E,F	2		
<i>Carex glaucoidea</i>	blue sedge	Graminoid	A,C,F,J	5		
<i>Carex granularis</i>	sedge	Graminoid	H	2		
<i>Carex hirsutella</i>	sedge	Graminoid	A,B,C,F,G	1		
<i>Carex jamesii</i>	James' sedge	Graminoid	C,D,E,G,H	1	Witsell 14-0123	
<i>Carex leavenworthii</i>	Leavenworth's sedge	Graminoid	A,J,K	1		
<i>Carex mesochorea</i>	sedge	Graminoid	C	2	Witsell 14-0121	
<i>Carex molesta</i>	sedge	Graminoid	C,D	2	Witsell 14-0126	
<i>Carex muehlenbergii</i> var. <i>enervis</i>	Muhlenberg's sedge	Graminoid	A,B,C,G,J	1	Witsell 14-0146	
<i>Carex oligocarpa</i>	sedge	Graminoid	C,D,G	1	Witsell 14-0124	
<i>Carex planispicata</i>	sedge	Graminoid	C,D,E,F,G	2	Witsell 14-0122	
<i>Carex retroflexa</i>	sedge	Graminoid	B,C,E	2		
<i>Carex shortiana</i>	Short's sedge	Graminoid	H	2		
<i>Carpinus caroliniana</i>	musclewood	Tree	E	1		
<i>Carya alba</i>	mockernut hickory	Tree	C,D,F,G	1		
<i>Carya cordiformis</i>	bitternut hickory	Tree	D,G	4		
<i>Carya glabra</i>	pignut hickory	Tree	B,C	4	Witsell	
<i>Carya ovata</i>	shagbark hickory	Tree	C,D,E,F	1		
<i>Carya texana</i>	black hickory	Tree	A,B,C,G	4	Witsell	
<i>Catalpa speciosa</i>	northern catalpa	Tree	D,J,K	2	Witsell 14-0114	
<i>Celtis laevigata</i>	sugarberry	Tree	C,D,F,J	5		
<i>Celtis occidentalis</i>	hackberry	Tree	C,D,E,F,G,J,K	1		
<i>Celtis tenuifolia</i>	dwarf hackberry	Tree	A,B,C,G	1		
<i>Cerastium glomeratum</i>	sticky mouse-ear chickweed	Forb	J,K	1		
<i>Cercis canadensis</i>	eastern redbud	Tree	A,B,C,D,E,F,G,J	1		
<i>Chaerophyllum procumbens</i>	spreading chervil	Forb	D,G	1		
<i>Chaerophyllum tainturieri</i>	wild chervil	Forb	D,E,F,J	1		
<i>Chasmanthium latifolium</i>	river-oats	Graminoid	D,E,G	1		
<i>Cheilanthes alabamensis</i>	Alabama lip fern	Fern or Fern Ally	G	2		
<i>Chenopodium simplex</i>	maple-leaf goosefoot	Forb	G	5		
<i>Chenopodium standleyanum</i>	woodland goosefoot	Forb	D,G	5	Witsell	
<i>Cichorium intybus</i>	chicory	Forb	J,K	5		
<i>Circaea canadensis</i> subsp. <i>canadensis</i>	enchanter's-nightshade	Forb	D,G	2		
<i>Cirsium altissimum</i>	tall thistle	Forb	B,C,E,F,J	2		
<i>Cirsium vulgare</i>	bull thistle	Forb	G,J,K	5		
<i>Cladrastis kentukea</i>	yellow-wood	Tree	D,G	5		
<i>Claytonia virginica</i>	spring-beauty	Forb	A,B,C,D,E,F,G	1		
<i>Clematis catesbyana</i>	Catesby's virgin's-bower	Woody Vine	C,D,G	1		
<i>Clematis terniflora</i>	sweet autumn virgin's-bower	Woody Vine	D,G	8		
<i>Clematis viorna</i>	leather-flower	Herbaceous Vine	C,G	2	Witsell 14-0130	
<i>Clitoria mariana</i>	butterfly-pea	Herbaceous Vine	B,C,G	4		
<i>Cocculus carolinus</i>	Carolina snailseed	Woody Vine	D,E,F,G,J,K	4		
<i>Commelina communis</i>	Asiatic dayflower	Forb	E,G,H,K	4		

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Commelina erecta</i>	erect dayflower	Forb	B,G	4		
<b><i>Conium maculatum</i></b>	poison-hemlock	Forb	J,K	2		
<i>Conyza canadensis</i>	horseweed	Forb	A,G,J,K	4		
<i>Corallorhiza wisteriana</i>	spring coralroot	Forb	C,D	1		
<i>Coreopsis palmata</i>	tickseed	Forb	B	4		
<i>Cornus drummondii</i>	rough-leaf dogwood	Shrub	E,G	2		
<i>Cornus florida</i>	flowering dogwood	Tree	C,D,F	1		
<i>Corydalis flavula</i>	pale corydalis	Forb	D,G	1		
<i>Crataegus</i>	crataegus		C,F	5		
<i>Crataegus spathulata</i>	pasture hawthorn	Tree	C,F	4		
<i>Croton capitatus</i>	woolly croton	Forb	A,J,K	4		
<i>Croton glandulosus var. septentrionalis</i>	tropic croton	Forb	J,K	4		
<i>Croton monanthogynus</i>	prairie-tea	Forb	A,J,K	4		
<b><i>Cruciata pedemontana</i></b>	Piedmont bedstraw	Forb	J,K	7		
<i>Cryptotaenia canadensis</i>	honestwort	Forb	D,E,G	2		
<i>Cunila origanoides</i>	dittany	Forb	A,B,C	1		
<i>Cuphea viscosissima</i>	blue waxweed	Forb	A,B,K	4		Witsell
<b><i>Cynodon dactylon</i></b>	Bermuda grass	Graminoid	J,K	5		
<i>Cynoglossum virginianum</i>	wild comfrey	Forb	C,D,E,F,G	1		
<i>Cyperus echinatus</i>	globe flatsedge	Graminoid	B,J	5		
<i>Cystopteris protrusa</i>	southern bladder fern	Fern or Fern Ally	D,G	1		
<i>Cystopteris tennesseensis</i>	Tennessee bladder fern	Fern or Fern Ally	G	2		Witsell 14-0134
<b><i>Dactylis glomerata</i></b>	orchard grass	Graminoid	F,J	5		
<i>Danthonia spicata</i>	poverty oat grass	Graminoid	A,B	1		
<b><i>Daucus carota</i></b>	Queen Anne's-lace	Forb	F,J,K	5		
<i>Delphinium tricornis</i>	dwarf larkspur	Forb	D,E	1		
<i>Descurainia pinnata subsp. brachycarpa</i>	tansy-mustard	Forb	G	1		Witsell 14-0019
<i>Desmanthus illinoensis</i>	Illinois bundleflower	Forb	G,J	5		
<i>Desmodium canescens</i>	hoary tick-trefoil	Forb	C	3		
<i>Desmodium cuspidatum</i>	tick-trefoil	Forb	C,D,G	4		
<i>Desmodium glabellum</i>	tick-trefoil	Forb	C,D,G	4		Witsell
<i>Desmodium glutinosum</i>	tick-trefoil	Forb	D,E,G	4		
<i>Desmodium nudiflorum</i>	naked-flower tick-trefoil	Forb	C,D	2		
<i>Desmodium nuttallii</i>	Nuttall's tick-trefoil	Forb	C,K	5		Witsell
<i>Desmodium paniculatum</i>	panicled tick-trefoil	Forb	C,J	4		
<i>Desmodium perplexum</i>	tick-trefoil	Forb	C,D,E,G	4		Witsell
<b><i>Dianthus armeria</i></b>	Deptford pink	Forb	J	1		
<i>Dicentra cucullaria</i>	Dutchman's-breeches	Forb	C,D,G	1		
<i>Dichantheium acuminatum subsp. acuminatum</i>	hairy rosette grass	Graminoid	A,B	2		Witsell 14-0120
<i>Dichantheium boscii</i>	Bosc's rosette grass	Graminoid	B,C	1		
<i>Dichantheium clandestinum</i>	deer-tongue rosette grass	Graminoid	E,H	2		
<i>Dichantheium commutatum</i>	variable rosette grass	Graminoid	C,D	2		
<i>Dichantheium dichotomum subsp. dichotomum</i>	forked rosette grass	Graminoid	A,B,C	2		Witsell 14-0117
<i>Dichantheium laxiflorum</i>	open-flower rosette grass	Graminoid	A,B,C,F	4		
<i>Dichantheium linearifolium</i>	slim-leaf rosette grass	Graminoid	A,B,G	1		

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Dichanthelium malacophyllum</i>	soft-leaf rosette grass	Graminoid	A,B,C,G	1		
<i>Dichanthelium oligosanthes subsp. scribnerianum</i>	Scribner's rosette grass	Graminoid	A,B,C,G	4		
<i>Dichanthelium polyanthes</i>	many-flower rosette grass	Graminoid	C,G,J	5		
<b><i>Digitaria ischaemum</i></b>	smooth crab grass	Graminoid	J,K	4		Witsell
<i>Dioscorea villosa</i>	wild yam	Herbaceous Vine	C,D,E,G	1		
<i>Diospyros virginiana</i>	persimmon	Tree	B,C,D,E,F,G,I J	1		
<i>Draba brachycarpa</i>	short-pod whitlow-grass	Forb	G	1		Witsell 14-0017
<i>Echinacea purpurea</i>	purple coneflower	Forb	C,D,E	2		
<i>Echinochloa muricata var. muricata</i>	American barnyard grass	Graminoid	A,I	4		Witsell
<i>Eleocharis lanceolata</i>	spike-rush	Graminoid	I	3		Witsell 14-0184
<i>Elephantopus carolinianus</i>	Carolina elephant's-foot	Forb	C,E	1		
<b><i>Elymus churchii</i></b>	Church's wild rye	Graminoid	G	4		Witsell
<i>Elymus glabriflorus</i>	southeastern wild rye	Graminoid	A,B,E,J	4		
<i>Elymus hystrix</i>	bottle-brush grass	Graminoid	C,D,G	3		
<i>Elymus villosus</i>	hairy wild rye	Graminoid	D,E,G	3		
<i>Elymus virginicus var. jejunos</i>	Virginia wild rye	Graminoid	A	2		
<i>Elymus virginicus var. virginicus</i>	Virginia wild rye	Graminoid	D,E,G,I,J	4		Witsell
<i>Eragrostis capillaris</i>	lace grass	Graminoid	G	4		Witsell
<i>Eragrostis hirsuta</i>	big-top love grass	Graminoid	B,J,K	5		Witsell
<i>Eragrostis pectinacea</i>	tufted love grass	Graminoid	K	5		Witsell
<i>Eragrostis spectabilis</i>	purple love grass	Graminoid	B,J,K	5		
<i>Erechtites hieraciifolius</i>	fireweed	Forb	C,F,G,K	5		
<i>Erigeron annuus</i>	daisy fleabane	Forb	F,J,K	5		
<i>Erigeron philadelphicus</i>	Philadelphia fleabane	Forb	F,J,G,J	1		
<i>Erigeron pulchellus var. pulchellus</i>	Robin's-plantain	Forb	C,D,E	1		
<i>Erigeron strigosus</i>	daisy fleabane	Forb	A,B,J	1		
<b><i>Erythronium mesochoreum</i></b>	prairie trout-lily	Forb	B,C,G	1		Witsell 14-0020
<i>Erythronium rostratum</i>	yellow trout-lily	Forb	D,E,G	1		
<b><i>Euonymus alatus</i></b>	burning-bush	Shrub	D,G	5		
<i>Euonymus atropurpureus</i>	wahoo	Shrub	D,E,G	1		
<b><i>Euonymus fortunei</i></b>	winter-creeper	Woody Vine	D,E,F,G,K	1		
<i>Eupatorium altissimum</i>	tall thoroughwort	Forb	A,B,G	1		
<i>Eupatorium serotinum</i>	late boneset	Forb	E,F,G,I,J,K	4		
<i>Eupatorium sessilifolium</i>	upland boneset	Forb	C	5		
<i>Euphorbia corollata</i>	flowering spurge	Forb	A,B,G	3		
<i>Euphorbia cyathophora</i>	wild poinsettia	Forb	B,G,K	4		Witsell
<i>Euphorbia dentata</i>	toothed spurge	Forb	A,G,K	4		
<i>Euphorbia maculata</i>	spotted spurge	Forb	A,K	5		
<i>Eutrochium purpureum</i>	Joe-pye-weed	Forb	D,G	3		
<b><i>Fallopia convolvulus</i></b>	black-bindweed	Herbaceous Vine	B,C,F,G,K	2		
<i>Festuca paradoxa</i>	clustered fescue	Graminoid	A,B	3		Witsell 14-0190
<i>Festuca subverticillata</i>	nodding fescue	Graminoid	D,E,G	3		
<i>Fleischmannia incarnata</i>	pink thoroughwort	Forb	D,E,G,H	4		
<i>Frangula caroliniana</i>	Carolina buckthorn	Tree	C,D,E,G	2		

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Fraxinus americana</i>	white ash	Tree	A,B,C,D,F,G	1		
<i>Fraxinus pennsylvanica</i>	green ash	Tree	D,E,I,J	5		
<i>Galium aparine</i>	cleavers	Forb	D,F,G,J,K	1		
<i>Galium arkansanum var. arkansanum</i>	Arkansas bedstraw	Forb	A,B,G,G	1		
<i>Galium circaezans</i>	wild licorice	Forb	C,D,E,G	1		
<i>Galium pilosum</i>	hairy bedstraw	Forb	B,C,G	1		
<i>Galium triflorum</i>	sweet-scent bedstraw	Forb	D,G	2		
<i>Gamochaeta purpurea</i>	purple cudweed	Forb	B,C,K	3		
<i>Gaura longiflora</i>	biennial gaura	Forb	J	5		
<i>Geranium carolinianum</i>	Carolina crane's-bill	Forb	G,J,K	1		
<i>Geum canadense</i>	white avens	Forb	D,E,G	1		
<i>Geum vernum</i>	spring avens	Forb	D,H,J	1		
<i>Geum virginianum</i>	cream avens	Forb	B,C,G	1		
<i>Gillenia stipulata</i>	American-ipecac	Forb	B	1		
<i>Gleditsia triacanthos</i>	honey locust	Tree	C,D,E,G,J	1		
<i>Glyceria striata</i>	fowl manna grass	Graminoid	H	3		
<i>Gratiola neglecta</i>	clammy hedge-hyssop	Forb	A,I	3	Witsell 14-0188	
<i>Grindelia lanceolata</i>	gum-plant	Forb	A,J	1		
<i>Hackelia virginiana</i>	beggar's-lice	Forb	D,G	1		
<i>Hedeoma pulegioides</i>	American false pennyroyal	Forb	C,G	5	Witsell	
<i>Helianthus hirsutus</i>	hairy woodland sunflower	Forb	A,B,C,G	1		
<i>Heuchera americana var. hirsuticaulis</i>	American alumroot	Forb	G	1	Witsell 14-0018	
<i>Hieracium gronovii</i>	hawkweed	Forb	B,C,G	1		
<b><i>Holosteum umbellatum</i></b>	jagged-chickweed	Forb	J,K	7		
<i>Houstonia longifolia</i>	long-leaf bluet	Forb	A,B	1		
<i>Houstonia purpurea var. purpurea</i>	mountain houstonia	Forb	E	1		
<i>Houstonia pusilla</i>	star-violet	Forb	A,J	1		
<i>Hybanthus concolor</i>	green-violet	Forb	D	2		
<i>Hydrangea arborescens</i>	wild hydrangea	Shrub	D,G	1		
<i>Hydrastis canadensis</i>	goldenseal	Forb	D	2		
<i>Hypericum drummondii</i>	nits-and-lice	Forb	A	3		
<i>Hypericum hypericoides subsp. multicaule</i>	St. Andrew's-cross	Shrub	A,B,G	3		
<i>Hypericum pseudomaculatum</i>	false spotted St. John's-wort	Forb	A	3		
<i>Hypericum punctatum</i>	spotted St. John's-wort	Forb	A,B,G,J	2		
<i>Hypoxis hirsuta</i>	yellow star-grass	Forb	A	1		
<i>Ilex decidua</i>	deciduous holly	Tree	D,E,F,G	1		
<i>Impatiens capensis</i>	spotted jewelweed	Forb	H	1		
<i>Ipomoea pandurata</i>	wild potato vine	Herbaceous Vine	B,G,J	5		
<b><i>Iris domestica</i></b>	blackberry-lily	Forb	F,J	2		
<b><i>Iris germanica</i></b>	garden iris	Forb	J	5		
<i>Juglans nigra</i>	black walnut	Tree	C,D,E,G,J	1		
<i>Juncus antheratus</i>	poverty rush	Graminoid	A,H,I	3	Witsell 14-0181	
<i>Juncus biflorus</i>	rush	Graminoid	H	5		
<i>Juncus marginatus</i>	grass-leaf rush	Graminoid	A,L	3		
<i>Juncus secundus</i>	rush	Graminoid	A	3	Witsell 14-0186	

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Juncus tenuis</i>	path rush	Graminoid	K	3		
<i>Juniperus virginiana</i>	eastern red-cedar	Tree	A,B,C,E,F,G,J	1		
<i>Krigia dandelion</i>	potato dwarf-dandelion	Forb	A,B,C,E,F,G,J	1		
<i>Krigia virginica</i>	Virginia dwarf-dandelion	Forb	A	1		
<i>Kummerowia stipulacea</i>	Korean bush-clover	Forb	J,K	5		
<i>Kummerowia striata</i>	Japanese bush-clover	Forb	J,K	3		
<i>Lactuca canadensis</i>	wild lettuce	Forb	A,B,G	1		
<i>Lactuca floridana</i>	Florida wild lettuce	Forb	D,E,G	4		
<i>Lactuca saligna</i>	willow-leaf wild lettuce	Forb	J,K	5		
<i>Lactuca serriola</i>	prickly wild lettuce	Forb	G,J,K	2	Witsell 14-0113	
<i>Lamium purpureum</i>	purple dead-nettle	Forb	G,J,K	1		
<i>Laportea canadensis</i>	wood-nettle	Forb	D,E,G,H	2		
<i>Lechea tenuifolia</i>	pinweed	Forb	A	1		
<i>Leersia oryzoides</i>	rice cut grass	Graminoid	H,I	4		
<i>Leersia virginica</i>	white grass	Graminoid	D,E,G,H,K	3		
<i>Lepidium virginicum</i>	Virginia pepper-grass	Forb	A,G,J,K	1		
<i>Lespedeza cuneata</i>	sericea lespedeza	Forb	E,F,J,K	4		
<i>Lespedeza frutescens</i>	violet bush-clover	Forb	A	4		
<i>Lespedeza hirta</i>	hairy bush-clover	Forb	A,B,G	4		
<i>Lespedeza procumbens</i>	trailing bush-clover	Forb	A,B,C	4		
<i>Lespedeza repens</i>	creeping bush-clover	Forb	A,B,C	4		
<i>Lespedeza stuevei</i>	tall bush-clover	Forb	A	2		
<i>Lespedeza violacea</i>	bush-clover	Forb	A,C,D,G	4	Witsell	
<i>Lespedeza virginica</i>	slender bush-clover	Forb	A,B,G	2		
<i>Leucanthemum vulgare</i>	ox-eye daisy	Forb	J,K	2		
<i>Ligustrum sinense</i>	Chinese privet	Shrub	D,E,F,G,J,K	2		
<i>Lilium michiganense</i>	Michigan lily	Forb	H	1		
<i>Lindera benzoin</i>	spicebush	Shrub	D,E,F,G,H	1		
<i>Lobelia spicata</i>	pale-spike lobelia	Forb	B,C	2	Witsell	
<i>Lonicera flava</i>	yellow honeysuckle	Woody Vine	G	1		
<i>Lonicera japonica</i>	Japanese honeysuckle	Woody Vine	C,D,E,F,G,J,K	1		
<i>Lonicera maackii</i>	Amur honeysuckle	Shrub	C,D,E,F,G,H,J, ,K	1		
<i>Ludwigia alternifolia</i>	seedbox	Forb	H,I	2		
<i>Luzula acuminata</i>	wood-rush	Graminoid	C,D,G	1		
<i>Lycopus virginicus</i>	Virginia bugleweed	Forb	I	4	Witsell	
<i>Maclura pomifera</i>	Osage-orange	Tree	D,E,F,J	2		
<i>Maianthemum racemosum</i>	false Solomon's-seal	Forb	D,G	1		
<i>Matelea baldwyniana</i>	climbing-milkweed	Herbaceous Vine	D,G	2		
<i>Medicago lupulina</i>	black medick	Forb	J,K	5		
<i>Melica nitens</i>	three-flower melic	Graminoid	G	4		
<i>Melilotus albus</i>	white sweet-clover	Forb	G,J,K	2		
<i>Melilotus officinalis</i>	yellow sweet-clover	Forb	J,K	2		
<i>Menispermum canadense</i>	moonseed	Woody Vine	D,G	1		
<i>Microstegium vimineum</i>	Japanese stilt grass	Graminoid	D,E,G,H,K	5		

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<i>Mimosa quadrivalvis</i> var. <i>nuttallii</i>	sensitive-brier	Herbaceous Vine	A,B	1		
<i>Mimulus alatus</i>	monkey-flower	Forb	H	4		
<i>Monarda bradburiana</i>	Bradbury's beebalm	Forb	B,C,G	2		
<i>Monarda russeliana</i>	Russell's beebalm	Forb	A,B,C,G	1		
<i>Monotropa uniflora</i>	Indian-pipe	Forb	C	5		
<i>Morus rubra</i>	red mulberry	Tree	D,E,F,G,J	1		
<i>Muhlenbergia schreberi</i>	nimblewill	Graminoid	D,E,F,G,H,J,K	4	Witsell	
<i>Muhlenbergia sobolifera</i>	rock muhly	Graminoid	A,B,C,G	4	Witsell	
<i>Muhlenbergia sylvatica</i>	woodland muhly	Graminoid	C,D,E,G	4	Witsell	
<i>Muhlenbergia tenuiflora</i>	slim-flower muhly	Graminoid	C	4	Witsell	
<i>Myosotis macrosperma</i>	big-seed scorpion-grass	Forb	C,D,G	2	Witsell 14-0112	
<b><i>Nandina domestica</i></b>	nandina	Shrub	G	3		
<i>Narcissus</i>	narcissus	Forb	E,F	2		
<i>Nothoscordum bivalve</i>	crow-poison	Forb	A,B,C,G,J,K	1		
<i>Nyssa sylvatica</i>	black-gum	Tree	B,C,E	2		
<i>Oenothera fruticosa</i>	sundrops	Forb	A	1		
<i>Onosmodium bejariense</i> var. <i>subsetosum</i>	marbleseed	Forb	B,C,G	4	Witsell	
<i>Orbexilum pedunculatum</i>	Sampson's-snakeroot	Forb	A,B,G	2		
<i>Orbanche uniflora</i>	cancer-root	Forb	A,B	1		
<i>Osmorhiza longistylis</i>	aniseroot	Forb	D	2	Witsell 14-0132	
<i>Ostrya virginiana</i>	hop-hornbeam	Tree	C,D,E,F,G	1		
<i>Oxalis dillenii</i>	yellow wood-sorrel	Forb	B,C,F,J,K	1		
<i>Oxalis stricta</i>	yellow wood-sorrel	Forb	C,D,G	4		
<i>Oxalis violacea</i>	violet wood-sorrel	Forb	A,B,C,G	1		
<i>Packera aurea</i>	golden ragwort	Forb	H	1		
<i>Panicum anceps</i>	beaked panic grass	Graminoid	B,C,G,H,I,J	4		
<i>Panicum dichotomiflorum</i>	fall panic grass	Graminoid	I,J,K	5		
<i>Panicum flexile</i>	wiry witch grass	Graminoid	A,B,G,K	4	Witsell	
<i>Panicum rigidulum</i>	red-top panic grass	Graminoid	I	4		
<i>Parietaria pensylvanica</i>	pellitory	Forb	C,D,G,K	1		
<i>Paronychia canadensis</i>	forked-chickweed	Forb	C,D,G	3	Witsell 14-0191	
<i>Paronychia fastigiata</i> var. <i>fastigiata</i>	forked-chickweed	Forb	A,G	3	Witsell 14-0187	
<i>Parthenium integrifolium</i>	wild quinine	Forb	A,B	1		
<i>Parthenocissus quinquefolia</i>	Virginia-creeper	Woody Vine	C,D,E,F,G	1		
<i>Paspalum floridanum</i>	Florida paspalum	Graminoid	J	5		
<i>Paspalum laeve</i>	field paspalum	Graminoid	J	5		
<i>Paspalum pubiflorum</i>	hairy-seed paspalum	Graminoid	J	5		
<i>Passiflora incarnata</i>	purple passion-flower	Herbaceous Vine	E,J	4		
<i>Passiflora lutea</i>	yellow passion-flower	Herbaceous Vine	C,D,F,G,J	4		
<i>Pellaea atropurpurea</i>	purple-stem cliff-brake	Fern or Fern Ally	G	1	Witsell	
<i>Penstemon digitalis</i>	foxglove beardtongue	Forb	B,G	2		
<i>Penstemon tubiflorus</i>	beardtongue	Forb	A	3		
<b><i>Perideridia americana</i></b>	eastern yampah	Forb	B,C,G	1	Witsell 14-0148	
<b><i>Perilla frutescens</i></b>	beefsteak-plant	Forb	C,D,E,F,G,J,K	4		
<b><i>Persicaria longiseta</i></b>	bristly lady's-thumb	Forb	F,K	3		

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<i>Persicaria punctata</i>	dotted smartweed	Forb	D,H,I,K	4	Witsell	
<i>Persicaria virginiana</i>	jumpseed	Forb	D,E,G,H	2		
<i>Phacelia hirsuta</i>	hairy scorpion-weed	Forb	A,B	1		
<i>Phegopteris hexagonoptera</i>	broad beech fern	Fern or Fern Ally	D,G	1		
<i>Phlox divaricata</i> subsp. <i>laphamii</i>	wild blue phlox	Forb	D,E	1		
<i>Phoradendron leucarpum</i>	mistletoe	Shrub	C,D,E,F,G	1		
<i>Phryma leptostachya</i>	lopseed	Forb	D,G	1		
<i>Physalis heterophylla</i>	clammy ground-cherry	Forb	C,G	2		
<b><i>Physalis missouriensis</i></b>	Missouri ground-cherry	Forb	G	4	Witsell	
<i>Physalis pubescens</i>	downy ground-cherry	Forb	G	4	Witsell	
<i>Physalis virginiana</i>	Virginia ground-cherry	Forb	A,B,C,G	2		
<i>Phytolacca americana</i> var. <i>americana</i>	poke	Forb	D,E,F,G,J,K	4		
<i>Pilea pumila</i>	clearweed	Forb	E,G,H	4		
<i>Pinus taeda</i>	loblolly pine	Tree	B,J	1		
<b><i>Plantago lanceolata</i></b>	English plantain	Forb	J,K	2		
<i>Plantago rugelii</i>	black-seed plantain	Forb	J,K	2		
<i>Plantago virginica</i>	hoary plantain	Forb	A,G,J,K	1		
<i>Platanus occidentalis</i>	sycamore	Tree	E	2		
<b><i>Poa annua</i></b>	annual blue grass	Graminoid	J,K	1		
<b><i>Poa pratensis</i></b>	Kentucky blue grass	Graminoid	J,K	2		
<i>Poa sylvestris</i>	woodland blue grass	Graminoid	D,G	2		
<i>Podophyllum peltatum</i>	May-apple	Forb	C,D,E	1		
<i>Polygala verticillata</i>	whorled milkwort	Forb	A	3	Witsell	
<i>Polygonatum biflorum</i>	Solomon's-seal	Forb	D	1		
<i>Polygonum tenue</i>	pleat-leaf knotweed	Forb	A	4	Witsell	
<i>Polymnia canadensis</i>	white leafcup	Forb	G	1		
<i>Polystichum acrostichoides</i>	Christmas fern	Fern or Fern Ally	C,D,E,G	1		
<b><i>Potentilla recta</i></b>	sulphur cinquefoil	Forb	J,K	2		
<i>Potentilla simplex</i>	oldfield cinquefoil	Herbaceous Vine	B,C,G,J	1		
<i>Prenanthes altissima</i>	tall rattlesnake-root	Forb	C,D,E	1		
<b><i>Prenanthes aspera</i></b>	prairie rattlesnake-root	Forb	B,C	1	Witsell 14-0013	
<i>Prenanthes crepidinea</i>	nodding rattlesnake-root	Forb	D	1		
<i>Prunella vulgaris</i> subsp. <i>lanceolata</i>	heal-all	Forb	E,F,G,H,J	2		
<b><i>Prunus mahaleb</i></b>	perfumed cherry	Tree	C,D,G,J	1	Witsell 14-0016	
<i>Prunus mexicana</i>	bigtree plum	Tree	B,C,E,F,G	2		
<i>Prunus munsoniana</i>	wild goose plum	Tree	J	5	Witsell	
<i>Prunus serotina</i>	black cherry	Tree	C,D,E,F,G,J	2		
<i>Pycnanthemum muticum</i>	short-tooth mountain-mint	Forb	H	3	Witsell 14-0192	
<i>Pycnanthemum tenuifolium</i>	slender mountain-mint	Forb	A,B,G,H	1		
<b><i>Pyrus calleryana</i></b>	Callery pear	Tree	G,J,K	5		
<b><i>Quercus acerifolia</i> vel aff.</b>	maple-leaf oak?	Tree	A	6	Witsell	
<i>Quercus alba</i>	white oak	Tree	B,C,D,E,G	1		
<i>Quercus falcata</i>	southern red oak	Tree	C,E,F,G	2		
<i>Quercus macrocarpa</i>	bur oak	Tree	C,E	2	14-0111	
<i>Quercus marilandica</i>	blackjack oak	Tree	A,B,G	1		

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<i>Quercus muehlenbergii</i>	chinquapin oak	Tree	A,B,C,D,E,G	1		
<i>Quercus rubra</i>	northern red oak	Tree	A,B,C,D,E,G	1	Witsell	
<i>Quercus shumardii</i>	Shumard's oak	Tree	A,B,C,D,E,G	1	Witsell	
<i>Quercus stellata</i>	post oak	Tree	A,B,C,G	1		
<i>Quercus velutina</i>	black oak	Tree	A,B,C,G	4		
<i>Ranunculus abortivus</i>	small-flower crowfoot	Forb	D,F,G,H,K	1		
<i>Ranunculus fascicularis</i>	early buttercup	Forb	A,B	2		
<i>Ranunculus harveyi</i>	Harvey's buttercup	Forb	D,G	1		
<i>Ranunculus micranthus</i>	rock buttercup	Forb	B,C,G,J	1		
<i>Ranunculus parviflorus</i>	small-flower buttercup	Forb	J,K	1		
<i>Ranunculus recurvatus</i>	hooked buttercup	Forb	D,G,H	1		
<i>Rhus aromatica var. aromatica</i>	fragrant sumac	Shrub	A,B,C,G	2		
<i>Rhus copallinum</i>	winged sumac	Shrub	J	5		
<i>Rhus glabra</i>	smooth sumac	Shrub	G,J	5		
<i>Ribes missouriense</i>	Missouri gooseberry	Shrub	C,D,G	1	Witsell	
<i>Robinia pseudoacacia</i>	black locust	Tree	A,B,C,E,F,G,J, ,K	1		
<i>Rosa carolina</i>	Carolina rose	Shrub	A,B,G	1		
<i>Rosa multiflora</i>	multiflora rose	Shrub	D,E,F,G,H,I,J	1		
<i>Rosa setigera</i>	climbing rose	Shrub	G,I,J	4		
<i>Rubus aboriginum</i>	dewberry	Woody Vine	C,G,J	2	Witsell 14-0131	
<i>Rubus alumnus</i>	high-bush blackberry	Shrub	C,D,E,G	2	Witsell 14-0115	
<i>Rubus laudatus</i>	high-bush blackberry	Shrub	C,D,E,G,J	2	Witsell 14-0116	
<i>Rubus occidentalis</i>	black raspberry	Shrub	C,D,G	2		
<i>Rubus roribaccus</i>	Lucretia dewberry	Woody Vine	C,D,G	2	Witsell 14-0110	
<i>Rubus serissimus</i>	everbearing blackberry	Shrub	J	5		
<i>Rudbeckia hirta</i>	black-eyed Susan	Forb	A,B,J,K	2		
<i>Rudbeckia triloba</i>	brown-eyed Susan	Forb	D,E,G	2		
<i>Ruellia humilis</i>	hairy wild petunia	Forb	A	4		
<i>Ruellia pedunculata</i>	stalked wild petunia	Forb	B,C,G	2		
<i>Ruellia strepens</i>	smooth wild petunia	Forb	D,E	2		
<i>Rumex acetosella</i>	sheep sorrel	Forb	J,K	5		
<i>Rumex crispus</i>	curly dock	Forb	J,K	1		
<i>Salix nigra</i>	black willow	Tree	I	1		
<i>Salvia lyrata</i>	lyre-leaf sage	Forb	F,G,J	1		
<i>Sambucus canadensis</i>	elderberry	Shrub	D,E,G,H	1		
<i>Sanguinaria canadensis</i>	bloodroot	Forb	D	1		
<i>Sanicula canadensis</i>	Canadian black-snakeroot	Forb	C,D,E,G	1	Witsell	
<i>Sanicula odorata</i>	clustered black-snakeroot	Forb	D,E,G	1		
<i>Sassafras albidum</i>	sassafras	Tree	C,D,E,F,G,J	2		
<i>Schedonorus arundinaceus</i>	tall fescue	Graminoid	E,J	1		
<i>Schizachyrium scoparium</i>	little bluestem	Graminoid	A,B,G	1		
<i>Scirpus georgianus</i>	bulrush	Graminoid	H,I	2	Witsell sn.	
<i>Scleria oligantha</i>	nut-rush	Graminoid	A,B,C,G	4		
<i>Scrophularia marilandica</i>	carpenter's-square	Forb	D,G	2		

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<i>Scutellaria ovata</i>	heart-leaf skullcap	Forb	A,B,C,G	2		
<i>Scutellaria parvula</i>	skullcap	Forb	A	2		
<i>Senna marilandica</i>	wild senna	Forb	C,E,F	4		
<i>Setaria faberi</i>	Chinese foxtail	Graminoid	J,K	5		
<i>Setaria parviflora</i>	knot-root bristle grass	Graminoid	A,J	5		
<i>Setaria pumila</i>	yellow bristle grass	Graminoid	J,K	4		
<i>Setaria viridis</i>	green bristle grass	Graminoid	K	4	Witsell	
<i>Sherardia arvensis</i>	field-madder	Forb	J,K	2		
<i>Sideroxylon lanuginosum</i>	gum bumelia	Tree	A,B,G	1		
<i>Silene stellata</i>	starry-campion	Forb	D,E	2		
<i>Silene virginica</i>	fire-pink	Forb	C,G	1		
<i>Smallanthus uvedalius</i>	bear's-foot	Forb	E,G	2		
<i>Smilax bona-nox</i>	saw greenbrier	Woody Vine	C,E,F,G,J	4		
<i>Smilax hispida</i>	bristly greenbrier	Woody Vine	D,E,G	1		
<i>Smilax lasioneura</i>	carrion-flower	Herbaceous Vine	D	5	Witsell	
<i>Smilax rotundifolia</i>	common greenbrier	Woody Vine	C,D,E,F,G,H,I	4		
<i>Solanum carolinense</i>	Carolina horse-nettle	Forb	J,K	2		
<i>Solanum ptychanthum</i>	black nightshade	Forb	G,K	2	Witsell 14-0133	
<i>Solanum sarrachoides</i>	hairy nightshade	Forb	J,K	4		
<i>Solidago altissima</i>	tall goldenrod	Forb	E,J	2		
<i>Solidago arguta subsp. caroliniana var. boottii</i>	Boott's goldenrod	Forb	C,D,G	2		
<i>Solidago buckleyi</i>	Buckley's goldenrod	Forb	G	2		
<i>Solidago caesia</i>	wreath goldenrod	Forb	D,G	2		
<i>Solidago gigantea</i>	late goldenrod	Forb	H,J	5		
<i>Solidago hispida</i>	hairy goldenrod	Forb	B,C	3		
<i>Solidago nemoralis</i>	oldfield goldenrod	Forb	A,B	1	Witsell	
<i>Solidago petiolaris</i>	goldenrod	Forb	A,B,G	1		
<i>Solidago ulmifolia var. ulmifolia</i>	elm-leaf goldenrod	Forb	A,B,C,G	1	Witsell	
<i>Sorghum halepense</i>	Johnson grass	Graminoid	E,J	5		
<i>Sphenopholis intermedia</i>	slender wedgescale	Graminoid	A,B,C,G	2	Witsell 14-0118	
<i>Spiranthes tuberosa</i>	little ladies'-tresses	Forb	A,B	4		
<i>Sporobolus vaginiflorus</i>	dropseed	Graminoid	A	5		
<i>Staphylea trifolia</i>	bladdernut	Shrub	D,G	5		
<i>Stellaria media</i>	common chickweed	Forb	D,E,F,G,J,K	1		
<i>Stellaria pallida</i>	lesser chickweed	Forb	J,K	7		
<i>Stylosanthes biflora</i>	pencil-flower	Forb	A	2		
<i>Symphoricarpos orbiculatus</i>	coral-berry	Shrub	C,D,E,F,G,J	1		
<i>Symphotrichum anomalum</i>	aster	Forb	A,B,C,G	2		
<i>Symphotrichum drummondii</i>	blue wood aster	Forb	D,E,G,J	2	Witsell	
<i>Symphotrichum lanceolatum</i>	tall white aster	Forb	E,H	2		
<i>Symphotrichum lateriflorum</i>	white woodland aster	Forb	E	2		
<i>Symphotrichum patens</i>	late purple aster	Forb	A,B,C,J	3		
<i>Symphotrichum pilosum</i>	white heath aster	Forb	J	1		
<i>Symphotrichum turbinellum</i>	prairie aster	Forb	A,B	3		
<i>Symphotrichum urophyllum</i>	white arrow-leaf aster	Forb	G	5		

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Taenidia integerrima</i>	yellow pimpernel	Forb	A,B,G	1		
<i>Taraxacum officinale</i>	common dandelion	Forb	J,K	1		
<i>Teucrium canadense</i>	American germander	Forb	C,E	1		
<i>Thalictrum</i>	thalictrum	Forb	D,G	9		
<i>Thalictrum thalictroides</i>	rue-anemone	Forb	C,D,E,G	1		
<i>Tilia americana</i>	basswood	Tree	D,G	1		
<i>Torilis arvensis</i>	field hedge-parsley	Forb	G,J,K	2		
<i>Toxicodendron radicans</i>	poison-ivy	Woody Vine	C,D,E,F,G,J	1		
<i>Tradescantia ernestiana</i>	Ernest's spiderwort	Forb	C,D,G	1		
<i>Tradescantia ohioensis</i>	Ohio spiderwort	Forb	A,B,G	2		
<i>Tragia cordata</i>	heart-leaf noseburn	Herbaceous Vine	E	2		
<i>Tragopogon dubius</i>	goat's-beard	Forb	J,K	2	Witsell 14-0147	
<i>Trichostema brachiatum</i>	false pennyroyal	Forb	A	5		
<i>Tridens flavus var. flavus</i>	purple-top tridens	Graminoid	J	4		
<i>Trifolium campestre</i>	hop clover	Forb	J,K	1		
<i>Trifolium dubium</i>	small hop clover	Forb	J,K	1		
<i>Trifolium pratense</i>	red clover	Forb	J	5		
<i>Trifolium repens</i>	white clover	Forb	J	2		
<i>Trillium sessile</i>	wakerobin	Forb	D,G	8		
<i>Trillium viridescens</i>	green trillium	Forb	D,G	2		
<i>Triodanis perfoliata subsp. biflora</i>	small Venus'-looking-glass	Forb	B,K	3		
<i>Triodanis perfoliata subsp. perfoliata</i>	clasping-leaf Venus'-looking-glas	Forb	C,G	1		
<i>Ulmus alata</i>	winged elm	Tree	A,B,C,D,E,F, G,J	1		
<i>Ulmus americana</i>	American elm	Tree	D,E,G,J	5		
<i>Ulmus rubra</i>	slippery elm	Tree	D,E,F,G	1		
<i>Uvularia grandiflora</i>	large-flower bellwort	Forb	D,G	2		
<i>Vaccinium arboreum</i>	farkleberry	Shrub	A,B,G	4		
<i>Vaccinium pallidum</i>	low-bush blueberry	Shrub	B,C,G	4		
<i>Vaccinium stamineum</i>	deerberry	Shrub	A,B,C,G	1		
<i>Valerianella radiata</i>	cornsalad	Forb	C,J,K	1		
<i>Verbascum thapsus</i>	woolly mullein	Forb	G,K	4		
<i>Verbena bracteata</i>	prostrate vervain	Forb	K	5		
<i>Verbena urticifolia</i>	white vervain	Forb	E,F,J	2		
<i>Verbesina alternifolia</i>	yellow ironweed	Forb	D,E	1		
<i>Verbesina helianthoides</i>	crownbeard	Forb	A,B,C,E,G	2		
<i>Verbesina virginica</i>	frostweed	Forb	C,D,E,F,J	1		
<i>Vernonia baldwinii</i>	Baldwin's ironweed	Forb	A,B,G	5	Witsell	
<i>Veronica arvensis</i>	corn speedwell	Forb	J,K	1		
<i>Veronica peregrina</i>	neckweed	Forb	A,I	2		
<i>Veronica polita</i>	field speedwell	Forb	J,K	7		
<i>Veronicastrum virginicum</i>	Culver's-root	Forb	C,H	1		
<i>Viburnum prunifolium</i>	blackhaw	Tree	D,E	2		
<i>Viburnum rufidulum</i>	rusty blackhaw	Tree	A,B,C,G	2		
<i>Vicia sativa</i>	common vetch	Herbaceous Vine	J,K	1		

Scientific Name*	Common Name	Growth Form	Habitat(s)	Source	Voucher	Herbarium
<i>Viola bicolor</i>	Johnny-jump-up	Forb	C,J,K	1		
<i>Viola palmata</i>	three-lobe violet	Forb	B,C	1		
<i>Viola pedata</i>	bird's-foot violet	Forb	A	1		
<i>Viola pubescens</i>	downy yellow violet	Forb	D,E	1		
<i>Viola sororia</i>	blue violet	Forb	C,D,E	1	Witsell 14-0014	
<i>Vitis aestivalis</i>	summer grape	Woody Vine	C,D,G	2		
<i>Vitis cinerea</i>	winter grape	Woody Vine	D,G	4		
<i>Vitis riparia</i>	river-bank grape	Woody Vine	G,J	2	Witsell 14-0129	
<i>Vitis vulpina</i>	frost grape	Woody Vine	G,J	4		
<b><i>Wisteria sinensis</i></b>	Chinese wisteria	Woody Vine	J	1		
<i>Wolffia brasiliensis</i>	water-meal	Forb	I	1	Witsell	
<i>Woodsia obtusa</i>	blunt-lobe cliff fern	Fern or Fern Ally	A,B,C,G	1		
<i>Xanthium strumarium</i>	cocklebur	Forb	G,J,K	5		

Total Taxa:

544

Growth Form:	Growth Form Description:
Forb	herbaceous flowering annual or perennial, non-graminoid and non-fern plant [herbaceous vines are treated separately]
Graminoid	herbaceous annual or perennial grass or grass-like plant [here defined including only true grasses (excluding bamboo members), sedges, and rushes]
Fern or Fern Ally	vascular, non-flowering plant that reproduces by spores rather than seeds via a life cycle consisting of separate and distinct gametophyte and sporophyte alternation of generations
Herbaceous Vine	herbaceous annual or perennial twining/climbing/trailing plant with relatively long stems [although evergreen perennial trailing plants, partridge-berry & periwinkles (Vinca spp.) are included here due to their resemblance to herbaceous plants]
Woody Vine	perennial, woody or semi-woody twining/climbing/trailing plant with relatively long stems [may not appear especially 'woody' but does not die back to ground in winter...e.g., dewberries (Rubus spp.), some greenbriers (Smilax spp.)]
Shrub	perennial, often multi-stemmed woody or semi-woody plant usually less than 5 meters (16 feet) in height at maturity [including bamboo members of the grass family (which may be taller), yuccas, blackberries (Rubus spp.), prickly-pears, dwarf palmetto]
Tree	perennial, often single- or relatively few-stemmed woody plant typically greater than 5 meters (16 feet) in height at maturity [including seedlings, saplings, and stunted individuals of such taxa]

**Habitats:**

A = Shale Barrens

B = Dry Oak Woodland

C = Dry-Mesic Oak-Hickory Forest &amp; Woodland

D = Mesic Hardwood Forest

E = Riparian Forest

F = Old Field/Successional Forest

G = Bluffs

H = Seeps and Springs

I = Ponds

J = Pasture/Field

K = Disturbed Areas

**Sources:**

1 = Theo Witsell, 23-25 April 2014 site visit.

2 = Theo Witsell, 28-30 May 2014 site visit.

3 = Theo Witsell, 18 June 2014 site visit.

4 = Theo Witsell, 10-11 September 2014 site visit.

5 = Theo Witsell, 24-26 September 2014 site visit.

6 = Theo Witsell, 30-31 October 2014 site visit.

7 = Joan Reynolds, specimens collected early spring 2014. ID by Theo Witsell.

8 = Jennifer Ogle, 4 April 2014 site visit.

9 = Burnetta Hinterthuer, 12 April 2014, Arkansas Native Plant Society field trip.