

The Vascular Flora of Mill Springs Battlefield National Monument: Final Report

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Alaina Krakowiak

Overview

Mill Springs Battlefield (MISP) is an approximately 900-acre National Monument near Nancy, Kentucky. A floristic survey was conducted across the 2024 growing season, yielding 289 taxa across 201 genera and 83 families. Sixty-nine (about 24%) of the documented taxa were non-native. Recommendations for restoration efforts in native habitats, as well as ideas for a grassland “reconstruction” project are discussed. Though much of Mill Springs Battlefield National Monument has been converted to agricultural land or is otherwise degraded, our findings demonstrate that the park still harbors areas of native biodiversity and presents an interesting opportunity for grassland reconstruction in Kentucky’s Pennyroyal region.



A massive, open-grown post-oak (*Quercus stellata*) can be found near Last Stand Hill (Tour Stop #3) at Mill Springs Battlefield National Monument. While *Q. stellata* is not particularly rare, it is a great “storyteller species” in that its presence is a strong indicator that an area was formerly open woodland or savanna. ALAINA KRAKOWIAK

Introduction

Mill Springs Battlefield National Monument (Mill Springs Battlefield National Monument) is an approximately 900-acre historical site that was established in 2019. It protects several key sites associated with the Battle of Mill Springs, the first significant Union victory of the Civil War (Mill Springs Battlefield 2024). While much is known about the human history of Mill Springs Battlefield National Monument, less is known about its natural history. The purpose of this project was to conduct an inventory of the vascular flora of Mill Springs Battlefield National Monument to fill this gap.

Mill Springs Battlefield National Monument is in the Pennyroyal Plateau (often spelled “Pennyrile”) physiographic region of Kentucky (Jones 2005). This region gets its name from *Hedeoma pulegiodes*, the American pennyroyal (Figure 1), a native grassland plant in the mint family once found here in abundance. Contrary to many people’s understandings of what the Southeastern United States looked like prior to European colonization, the flatter, western Pennyroyal was formerly dominated by open, nearly treeless grasslands (Noss 2013). It famously contains the “Big Barrens,” which once formed the largest continuous area of open grassland in the Mid-South at 3.7 million acres (Estes 2015). The eastern Pennyroyal, where Mill Springs is located, is more rugged and naturally wooded, forming the foothills of the Cumberland Plateau (Jones 2005). Grasslands would still have been found here, but as small patches within a matrix community of woodland and forest.



Figure 1. The American pennyroyal (*Hedeoma pulegiodes*). ALAINA KRAKOWIAK

Another common name for the Pennyroyal Plateau is the “Mississippian Plateau,” named after the Mississippian geologic period during which it was formed. During the Mississippian Period, shallow seas covered most of North America. A deep layer of limestone was formed over the course of millions of years as ancient marine invertebrates, such as crinoids, died, and bits of their shells settled down to the sea floor and eventually lithified (turned into solid rock; Jones 2005; The Mississippian Plateau 2012). Mill Springs Battlefield National Monument is underlain by various types of Mississippian-age limestone. St. Louis Limestone is the most prevalent throughout the park, with Borden Formation limestones, shales, and siltstones in the deep gorges around Zolicofer Park, Salem and Warsaw limestones around the edges of the Cumberland River, and “terrace deposits” in a few portions of the southern end of the park (Kentucky Geologic Map Service 2020).

Many of the best grassland remnants found in the park are associated with the sandy, unconsolidated soils of these terrace deposits. These are soils deposited by the ancestral, Pleistocene-Pliocene age Cumberland River, when water volume was significantly higher due to melting glacial ice to the north (McDowell and Newell 2001). Thus, these soils are found hundreds of feet above the modern level of the river (a good example of these loose, sandy soils can be seen at Tour Stop #7, Confederate Fortified Camp at Beech Grove). The grassland remnants found in these areas should be a high priority for conservation. Due to their small size and tenuous existence—most exist as narrow strips along roadsides and/or in powerline right-of-ways (ROWS)—it would be wise to collect and store seeds from these remnants. A grassland “reconstruction,” or the planting of a native grassland from seed, in one of the park’s large fallow fields is an additional goal.

Methods

The author led three collecting trips throughout the 2024 growing season: in late April, early July, and late September. The timing of these trips was intended to capture maximum floristic diversity within a limited amount of survey time by focusing on key phenological “hotspots” throughout the year. On each trip, the author surveyed all the primary driving tour stops with several additional roadside stops made in between. At each stop, surveys were made on foot. Most plants were identified in the field using the Flora of the Southeastern United States (Weakley et al. 2024). For species that required a microscope for full identification, a sample specimen was collected using standard field and herbarium techniques (under NPS collecting permit #Mill Springs Battlefield National Monument-2024-SCI-0001). Most specimens were discarded after identification, though select specimens of interest were saved as vouchers (Table 1 in Appendix A) and will be deposited at the Austin Peay State University Herbarium (APSC) and labeled according to NPS protocol.

Results and Discussion

Floristic Summary

Two-hundred eighty-nine taxa were documented, comprising 201 genera and 83 families. The author’s efforts were thorough, but it is suspected that additional species exist in areas of the park not yet acquired by the National Park Service, which the author was not able to intensively survey. The most well represented family was Asteraceae (asters) with 43 species, about 15% of the taxa. The

second largest family was Poaceae (grasses) with 29 species (10%), and the third largest was Fabaceae (peas) with 21 species (7%). The dominance of asters and grasses in the flora is not surprising—these are two of the largest plant families in Kentucky, and include many species commonly found in open areas, such as old fields. Members of the pea family at Mill Springs Battlefield National Monument include invasive clovers (*Melilotus* and *Trifolium* spp.), as well as native forbs (herbaceous flowering plants other than grasses) such as partridge peas (*Chamaecrista* spp.), tick-trefoils (*Desmodium* spp.) and *Lespedeza* spp. Historically, native forbs in the pea family were a dominant component of the ground cover in Kentucky’s open woodlands and savannas (Bryant et al. 1980). Of the taxa documented, 220 were native, and 69 introduced (about 24% of the total). This is a high percentage of non-native species, which reflects the highly altered or degraded nature of much of the park’s vegetation.

Plant Communities

Many parts of the park were found to be fallow fields, or currently in soybean or hay production. As these plant communities are unnatural, modern assemblages formed due to human disturbance (or intentionally planted), the National Vegetation Classification (NVC) does not have a perfect classification for them, but [Eastern Exotic Ruderal Grassland](#) would be the best fit available. This vegetation alliance encompasses herbaceous vegetation found on sites that have been cleared or otherwise disturbed by human actions, and consists of a mix of mostly non-native invasives and with some weedy natives (NatureServe 2024). In a few places, such as on the downhill slope before the woodland, the balance shifts towards weedy natives dominating the species mix. These areas can be described as [Eastern Native Ruderal Grassland](#) (NatureServe 2024). Common species here include broomsedge (*Andropogon virginicus*), small white aster (*Symphyotrichum racemosum*), redtop (*Tridens flavus*), and ironweed (*Vernonia gipantea*).

On the unmowed margins of these fields, shrubs have grown up to form dense thickets. In shrubby areas dominated by exotic species like Japanese honeysuckle (*Lonicera japonica*), Amur honeysuckle (*Lonicera maackii*) and multiflora rose (*Rosa multiflora*), [Northern & Central Exotic Ruderal Old-field Shrubland](#) is the closest fitting vegetation alliance (NatureServe 2024). In woody thickets dominated by weedy native blackberry (*Rubus*) species (Allegheny blackberry, *R. allegheniensis*; black raspberry, *R. occidentalis*; Pennsylvania blackberry, *R. pensilvanicus*), [Eastern Ruderal Native Shrubland](#) is a closer approximation (NatureServe 2024). While these areas can provide cover for native birds to some extent, it is low quality habitat, and the berries produced by the species common to these areas have low nutritional value.

Much of the park consists of closed canopy woodland and forest. The mesic, beech (*Fagus grandifolia*) dominated forest in the steep, dissected terrain around Zolicofer Park can be described as [Interior Low Plateau Mesic Forest](#), a common forest type throughout the Interior Low Plateau ecoregion (where Mill Spring occurs; EPA 2013). Other common trees in this association include sugar maple (*Acer saccharum*), black gum (*Nyssa sylvatica*), and red oak (*Quercus rubra*) in the overstory, with pawpaw (*Asimina triloba*), Eastern redbud (*Cercis canadensis*), and flowering dogwood (*Benthamidia florida*) in the midstory. However, due to the extensive Japanese stilt grass (*Microstegium vimineum*) infestation in this area, the forest is lacking one of its characteristic

features: a diverse array of forbs in the understory (NatureServe 2024). A few such species can still be found, such as cutleaf toothwort (*Cardamine concatenata*), Northern horsebalm (*Collinsonia canadensis*), may apple (*Podophyllum peltatum*), yellow snake root (*Sanicula odorata*), sweet betsy (*Trillium cuneatum*), and perfoliate bellwort (*Uvularia perfoliata*), albeit in very low density.

Another forest type common throughout the park is [Interior Low Plateau Calcareous Oak Forest](#). This alliance includes dry-mesic forests typically dominated by sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), and chinquapin oak (*Quercus muehlenbergii*; NatureServe 2024). Throughout the midwestern and eastern United States, ash trees (*Fraxinus* spp.) are dying off due to infestation by emerald ash borer (EAB), an invasive beetle that lives underneath the bark of American ash species, eventually killing them (Larson and Crocker 2022). However, sapling-age *Fraxinus* individuals can still frequently be found. This forest type includes many fire-adapted/fire-tolerant species, and in the absence of fire, has grown to become more dense. Historically, it may have been more of a woodland, with a slightly more open canopy and a higher diversity of forbs in the understory.

A vegetation alliance that was probably once common throughout rolling, upland areas of the park is [Interior Low Plateau Dry & Dry-mesic Oak Woodland](#). Examples of this alliance that remain in the park are highly degraded due to the absence of natural wildfire. This type of woodland was dominated by white oak (*Quercus alba*), Southern red oak (*Quercus falcata*), and post oak (*Quercus stellata*), and would have formerly had a somewhat open canopy with a diverse assemblage of heliophytic (sun-loving) grasses and forbs in the understory (NatureServe 2024). In fact, these three oak species were some of the most frequently encountered in the park during this inventory effort. The author documented several extremely large individuals that showed signatures of open-growth (large, low branches and wide-spreading canopy—see cover photo of this report for example—or numerous knobs along lower parts of the trunk, where low branches were eventually aborted due to the closing canopy). The fact that these species were the largest, oldest seeming trees in these areas, but were surrounded by a dense canopy of much younger trees, provides evidence that the shift in composition of these forests is relatively recent (Figure 2). The Southeastern Grasslands Institute commonly refers to these trees as “storyteller species” for their ability to paint the picture of what the landscape used to look like.



Figure 2. Left: A massive post oak (*Quercus stellata*) surrounded by young trees tells a story about the former vegetation of the landscape. Right: *Quercus stellata* at Zolicoffer Park—perhaps the Zolicoffer tree was actually a post oak! ALAINA KRAKOWIAK

The best grassland remnants in the park were found to be concentrated along a one mile stretch of Mill Springs Battlefield Rd. in the southern end of the park: from where the powerline ROW crosses Mill Springs Battlefield Rd. just north of its junction with Musket Dr., south to Tour Stop #7 (Confederate Fortified Camp at Beech Grove). Some of the native species found to be typical of these remnants include grasses such as splitbeard bluestem (*Andropogon ternarius*), deer tongue grass (*Dichanthelium clandestinum*), bottlebrush grass (*Elymus hystrix*), purple lovegrass (*Eragrostis spectabilis*), silver plume grass (*Erianthus alopecuroides*), and little bluestem (*Schizachyrium scoparium*), and forbs such as thimbleweed (*Anemone virginiana*), butterfly milkweed (*Asclepias tuberosa*), blue mistflower (*Conoclinium coelestinum*), hyssop-leaved thoroughwort (*Eupatorium hyssopifolium*), late boneset (*Eupatorium serotinum*), Torrey’s thoroughwort (*Eupatorium torreyanum*), Appalachian pinweed (*Lechea racemulosa*), Virginia lespedeza (*Lespedeza virginica*), lion’s foot (*Nabalus serpentaria*), *Pycnanthemum incanum* var. *incanum* (hoary mountain mint), black-eyed Susan (*Rudbeckia hirta* var. *pulcherrima*), rose pink (*Sabatia angularis*), gray goldenrod (*Solidago nemoralis*), and common blue curls (*Trichostema dichotomum*; Figure 3).

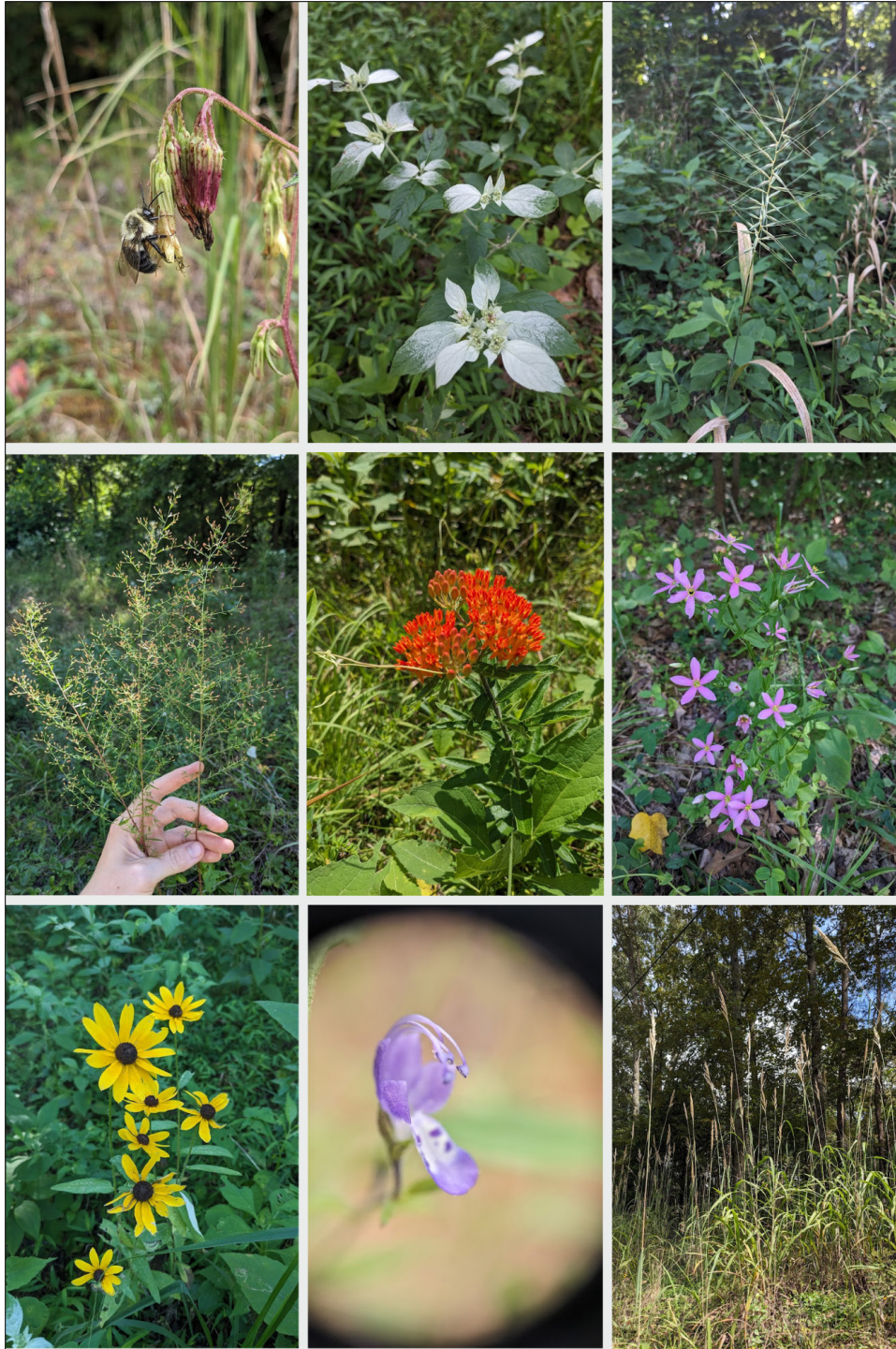


Figure 3. Common species of roadside grassland remnants in Mill Springs Battlefield National Monument. From left to right, top to bottom: lion's foot (*Nabalus serpentaria*) (with common Eastern bumblebee, *Bombus impatiens*), hoary mountain mint (*Pycnanthemum incanum* var. *incanum*), bottlebrush grass (*Elymus hystrix*), Appalachian pinweed (*Lechea racemulosa*), butterfly milkweed (*Asclepias tuberosa*), rose pink (*Sabatia angularis*), black-eyed Susan (*Rudbeckia hirta* var. *pulcherrima*), common blue curls (*Trichostema dichotomum*), and silver plume grass (*Erianthus alopecuroides*).
ALAINA KRAKOWIAK

These remnants do not fall cleanly into an NVC alliance. They could represent narrow slivers of [Interior Low Plateau Post Oak Barrens](#) that are lacking the characteristic open canopy of post oaks (*Quercus stellata*) due to mowing (although infrequent mowing is undoubtedly the only reason these remnants still exist; NatureServe 2024). This provisional vegetation alliance has not yet been described in great detail, though, so it is difficult to make this categorization with confidence. In fact, most of the NVC vegetation groups, alliances, and associations of Southeastern grasslands are either understudied or totally underdescribed.

A slightly different kind of grassland habitat was found around the Ferry Landing Site (Tour Stop #8). A few species typical of rocky riverbanks and/or dry rocky woodlands were found here and nowhere else in the park: tall indigo bush (*Amorpha fruticosa*), pink thoroughwort (*Fleischmannia incarnata*), widow's cross (*Sedum pulchellum*), whorled rosinweed (*Silphium asteriscus* var. *trifoliatum*), hairy skullcap (*Scutellaria elliptica*), and glade blue curls (*Trichostema coeruleum*; Figure 4). This vegetation is also challenging to classify. It is probably best described as a highly degraded example of [Central Interior Riverscours Prairie](#), though many of the key diagnostic species of this alliance are missing, such as big bluestem (*Andropogon gerardii*) or switchgrass (*Panicum virgatum*; NatureServe 2024). “Riverscour” is defined as open, grassland-like habitats found on stable substrates along rivers where periodic high-energy flows and edaphic factors (extremely thin soils over bedrock) inhibit the growth of woody vegetation (Estes et al. 2023). Riverscour habitat was likely once abundant along the Cumberland River and its tributaries, but the construction of the Wolf Creek Dam in 1952, which formed the massive Lake Cumberland (Wolf Creek Dam 2024), has led to their near total elimination.



Figure 4. Grassland species associated with the dry, rocky soils around the Ferry Landing, Mill Springs Battlefield National Monument. From left to right, top to bottom: whorled rosinweed (*Silphium asteriscus* var. *trifoliatum*), tall indigo bush (*Amorpha fruticosa*) (photographed by the author in a different location as individual in Mill Springs Battlefield National Monument was not seen in flower), pink thoroughwort (*Fleischmannia incarnata*), glade blue curls (*Trichostema coeruleum*). ALAINA KRAKOWIAK

Rare Species

The Office of Kentucky Nature Preserves assigns all plant species in the state a ranking from S1 to S5, with S1 being extremely rare and critically imperiled and S5 being abundant (Rodgers et al. 2022). For this report, any species with a ranking of S3 and below would be considered rare. No rare species were documented at Mill Springs Battlefield National Monument.

Coefficient of Conservatism

Coefficients of Conservatism (C-values) are numerical values from between 0 and 10 assigned to plant species by a panel of botanical experts used to rank species' fidelity to habitat quality and/or stability in a region. In most states, non-native species are given a C-value of 0 (Witsell et al. 2024). Species with C-values of 1–3 are considered to be ruderal or “weedy” natives tolerant of highly altered, degraded, natural communities. Species given a C-value between 4–7 have a moderate ability to tolerate anthropogenic disturbance and habitat degradation. Species with C-values in the 8–10 range are characteristic of high-quality natural communities and typically intolerant of anthropogenic disturbance (DeBerry et al. 2021; Witsell et al. 2024). As Kentucky does not yet have a published list of C-values for the state's flora, C-values for the flora of Mill Springs Battlefield National Monument were taken from the Tennessee-Kentucky Plant Atlas. Values in the Atlas are based on averages across numerous databases from various states, weighted for states bordering Tennessee and Kentucky (Shaw et al. 2023).

The distribution of C-values for the flora of Mill Springs Battlefield National Monument is shown in Figure 5. The most frequently assigned value was 0 (non-native taxa), followed by 5 (native species with moderate fidelity to intact, stable habitat with some tolerance for anthropogenic disturbance). Fourteen high C-value species ($C \geq 8$) were found; these are summarized in Table 2 in Appendix B. The only species found with a C-value of 10, pennywort (*Obolaria virginica*), was found in two very different places: in the forest west of Mill Springs Battlefield Rd. at the southern end of the park (along the gently used trail accessed from the small pull-off just past Tour Stop #7), and, interestingly, throughout the mowed front area of Zolicoffer Park in the vicinity of the monuments (Figure 6).

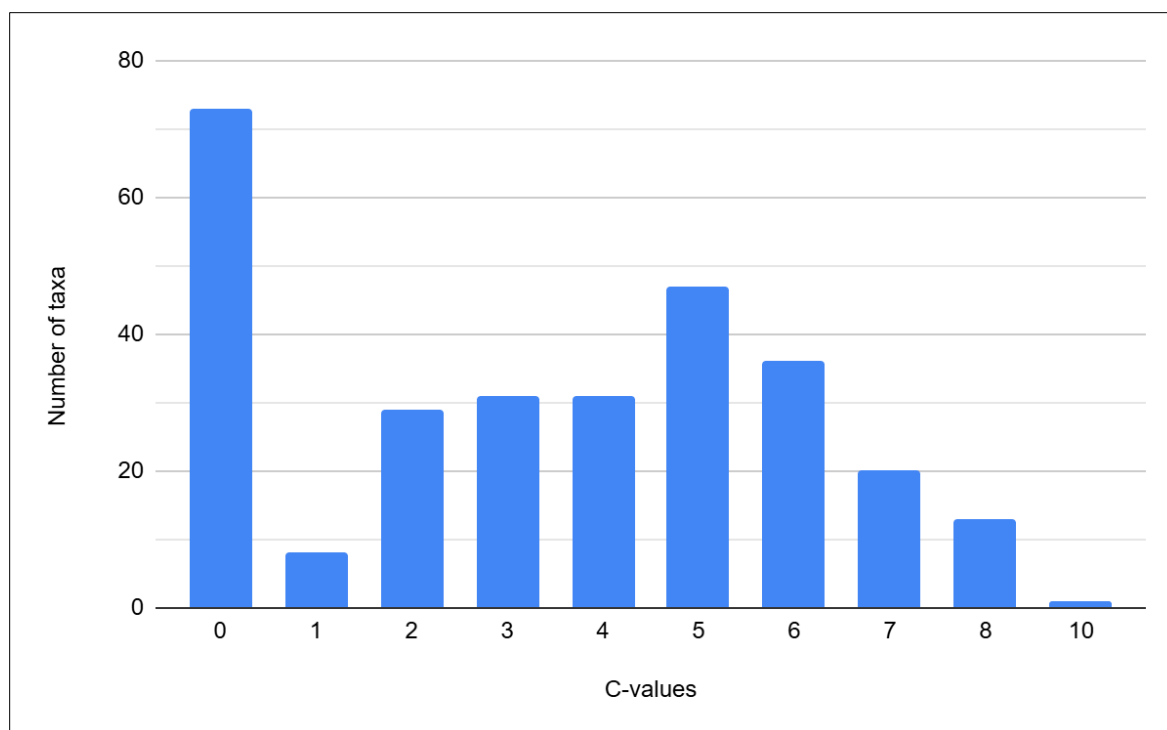


Figure 5. Distribution of C-values for the vascular flora of Mill Springs Battlefield National Monument. ALAINA KRAKOWIAK



Figure 6. Pennywort (*Obolaria virginica*) in a forest at the southern end of the park (left) and among non-native lawn weeds at Zolicoffer Park (right). ALAINA KRAKOWIAK

To assess the floristic quality of a site, the C-values of all species found can be averaged to produce the mean C-value ($\bar{C}$). It is generally accepted that a $\bar{C}$ greater than 3.5 is an indicator of at least marginal natural quality, and $\bar{C}$ greater than 4.5 is indicative of “remnant” quality habitat, as in a stable habitat with an intact native flora that hasn’t been significantly degraded by anthropogenic disturbance (Rothrock and Homoya 2005; Witsell et al. 2024). The $\bar{C}$ for the flora of Mill Springs Battlefield National Monument is 3.42, indicating it is slightly below the rank of marginal, natural quality habitat.

Non-Native Species

Sixty-nine (about 24%) of the documented taxa were non-native. The Kentucky Exotic Pest Plant Council (KY-EPPC) compiles a list of the most concerning non-native plants in the state. It includes three categories, from most to least severe: Severe Threat, Significant Threat, and Moderate Threat. A fourth category includes Watch List species, comprising exotic plants that have not been observed in Kentucky, but have invaded native plant communities in neighboring states (KY-EPPC 2013). For this report, the author focused on the Severe Threat, Significant Threat, and Watch List categories, as these are exotic species that most readily invade native plant communities and displace native vegetation. Moderate Threat species (and unranked non-natives) are more typically found in heavily disturbed areas and less readily invade native habitat, or are typical agronomic weeds. The author documented 17 Severe Threats (Table 3 in Appendix B), 11 Significant Threats (Table 4 in Appendix B), and four Watch List species (Table 5 in Appendix B).

One invasive species in particular poses the most severe threat to native habitat at Mill Springs Battlefield National Monument: Japanese stilt grass (*Microstegium vimineum*). *Microstegium vimineum* is an invasive annual grass that can quickly form a dense monoculture along the forest floor, outcompeting all native species in its path. This species was observed frequently throughout Mill Springs Battlefield National Monument, but the most severe infestation occurs in Zolicoffer Park, where it covers several acres of forest floor. Another large patch was observed at Moulden’s Hill (Figure 7). If left untreated, this species will continue to increase at an exponential rate. Treatment options are discussed in the following section.



Figure 7. Japanese stilt grass (*Microstegium vimineum*) at Mill Springs Battlefield National Monument. Top left: *Microstegium vimineum* infestation at Moulden's Hill. Top right: Close up of *M. vimineum*. Bottom: Massive *M. vimineum* population at Zolicoffer Park—the low growing grass seen in the photo is *M. vimineum*. ALAINA KRAKOWIAK

Restoration Recommendations

One of the worst invasive species issues at Mill Springs Battlefield National Monument is the extensive carpet of Japanese stilt grass (*Microstegium vimineum*) at Zolicoffer Park. This is a challenging issue to tackle, because the problem has become so extreme that the density of remaining native forbs is very low. Thus, even if all the *M. vimineum* is eradicated, it will take a long time for native species to recolonize, and the area could succumb to other invasive pressures in the process. If native species don't rebound after treatment, the site would need to be overseeded with native understory species, which could be an expensive and time-consuming project. It could be worth trying to restore this popular, highly-visited forest. But, with limited time and resources, it might not be feasible.

Microstegium vimineum is an annual, meaning its life cycle begins and ends over the course of one year. So, if it is weed-whacked in the fall (late enough in the season that it won't have the chance to grow up and produce more seed, but early enough that it hasn't produced seeds yet), the plants have effectively been killed. However, weed whacking is not necessarily a tenable option in such a large population. Another option is foliar application of grass-specific herbicide (such as clethodim, but always follow label instructions when using herbicide). This method is best done in summer before plants have set seed, as the addition of another year's worth of seeds to the seedbank will slow down restoration efforts. *Microstegium vimineum* can be described as "wimpy," as it is relatively easy to kill with herbicide. Unfortunately, *M. vimineum* seeds can remain viable in the seedbank for several years, so it will take multiple rounds of treatment to fully eradicate.

Despite their small size, the roadside and powerline ROW grassland remnants at Mill Springs seem to be doing well. The author recommends mowing/bushhogging them infrequently, perhaps once per year during the dormant season (late fall through winter, when plants are not actively green and growing). It is critical they are not sprayed with herbicide, this will lead to the local extirpation of species. A long-term goal might be to collect seeds from some of the key species of these habitats, which could be used for future reintroduction efforts if needed. It will take several seasons of seed collection to achieve any significant amounts, as populations of grassland plants in these areas are small. Another goal could be to widen these grassland strips by killing woody species along their back edges using the cut-stump method.

The best way to permanently kill small, woody species is the cut-stump method. To do this, cut the trunk(s) as close to the ground as possible, then immediately spray cut areas with a mixture of triclopyr, water, and blue dye (so it is obvious which stumps have been treated; Figure 8). As always, follow label instructions when using herbicide. Many invasive shrubs like Amur honeysuckle (*Lonicera maackii*) or multiflora rose (*Rosa multiflora*) have multiple trunks, and each trunk must be individually cut and treated or else it will vigorously resprout. Cut-stump treatment works because plants draw herbicide from the cut area down into their root system, which subsequently kills them. So, this technique works when plants are most actively drawing carbohydrates downward—during the late summer and fall. In the spring, plants are busy producing leaves and flow is mostly upward, and in the winter plants are dormant.



Figure 8. Cut-stump treatment. Left: Multi-trunked invasive shrub cut with a reciprocating saw and treated with an herbicide mixture using a handheld spray bottle. Right: Woody sapling cut with loppers and treated with herbicide via a “bingo dauber.” ALAINA KRAKOWIAK

An additional goal at Mill Springs Battlefield National Monument could be to reconstruct (plant) a native grassland in one of the park’s open, fallow fields or in a former soybean field. This would involve multiple rounds of aggressive herbicide treatment (via boom sprayer) followed by seeding with a diverse mix of regionally appropriate native species (Table 6 in Appendix C). There are multiple factors to consider when selecting a site for grassland reconstruction. First, if the area chosen for planting is being used for soybean production and could be taken out of production at an appropriate time of year for seeding, no site preparation would be needed. A fallow field of grasses would also work, but it would require three to five rounds of aggressive herbicide treatment (via boom sprayer). The selected site should be relatively flat and easily accessible by large equipment like tractors, as these will be needed for the seeding process. Additionally, the site should ideally not directly border a wooded area, as it would be at an increased risk of invasion by woody species. If prescribed fire is a possibility for long-term maintenance, it would also be important to choose a site around which fire lines could easily be established prior to a burn. The Southeastern Grasslands Institute (SGI) typically creates a mowed border at least 10 feet (3 meters) in width for fire lines.

Once a site is selected, thorough site preparation is one the most important steps to achieving a successful grassland reconstruction. Depending on the initial condition of the site, three to five rounds of herbicide application will be needed to eradicate the initial vegetation of the site and create

a “blank slate” for seeds. If site preparation is incomplete, few seeds will germinate, and native species will eventually be outcompeted by weedy and/or invasive species or just grow in very low density, resulting in a grassland that is less attractive and less functional for pollinators.

Another critical step is designing the right seed mix. There are several factors to consider when designing a seed mix. First, the budget will dictate the level of diversity that can be achieved. Fifteen species would be a good minimum, though more is always better. It is critical to choose species that are appropriate for the eastern Pennyroyal/Eastern Highland Rim. This is a challenge in an area where so little native vegetation remains, but the small, roadside remnants found along parts of Mill Springs Battlefield Road could be used as “reference sites” to develop a seed mix for Mill Springs Battlefield National Monument (Table 7 in Appendix C). However, not all species are commercially available. Roundstone Native Seed, based in Upton, Kentucky is an excellent source for regionally-sourced native seed, and could be contracted to do the site preparation and planting. Seeds should be planted from late fall to early winter to allow for natural stratification, maximizing rates of germination.

A common adage about grassland plantings is that in year one they “sleep,” in year two they “creep,” and in year three they “leap.” This summarizes the fact that grassland reconstructions take time to fully establish. In year one the site will look mostly green. Perennial wildflowers spend most of their energy during this time developing their root systems, and most species will not flower right away. In year two the site will look more “filled in,” and a few faster-growing species might flower in abundance. At this point, people sometimes mistakenly think most of their species mix has failed. By year three, many different species will flower and the true diversity of the seed mix will become apparent. It is important to manage the public’s expectations of grassland reconstructions and to be proactive with education campaigns.

The type of grasslands historically found in the Pennyroyal region of Kentucky required disturbance to remain open and free from excessive woody vegetation (NatureServe 2024; Noss 2013). In the modern day, this is optimally achieved through prescribed burning (ideally in the fall or early winter). Once the reconstructed grassland is well established (after at least three years), it could be burned every two years or so, adjusting the frequency of burns based on site response. The next best option is haying, as the removal of thatch from the ground is a closer approximation to fire than mowing or bushhogging. The litter left on the ground by mowing can eventually alter soil conditions and inhibit the growth of native species.

Conclusions

While much of Mill Springs Battlefield National Monument has been converted to ruderal fields, the park still supports a relatively high number of native plant species. Forests in the southern portion of the park are somewhat intact, and roadside grassland remnants harbor several interesting species. Additionally, open areas of the park pose an exciting opportunity for grassland reconstruction. Very little native grassland vegetation of the eastern Pennyroyal region remains, so if Mill Springs Battlefield National Monument can meet the challenge of combining historical preservation with the

conservation and reconstruction of native vegetation on the diverse landscapes it protects, it would be impactful.

Acknowledgements

The author thanks Ben Goddard for his assistance with the critical (but tedious) task of adding data to the spreadsheet of species documented at the park, including plant family, native status, C-value, and whether they represent a county record. The author also wishes to thank park staff for their help in directing her towards points of potential botanical interest in the park, and their dedication to the beautiful landscapes protected here.



Looking across a savanna-like landscape (in structure, but not species composition) towards Last Stand Hill. ALAINA KRAKOWIAK

Appendix A. Voucher Specimens Collected at Mill Springs Battlefield National Monument

Table 1. Voucher specimens collected at Mill Springs Battlefield National Monument. Coll.=Collector, AK=Alaina Krakowiak, Coll. Date=Collection date.

Accession #	Coll.	Coll. date	Family	Scientific name	Common name	County	Native/ Exotic	Locality	Lat., Long.	Reason for collection
MISP-0001	AK	28 Apr. 2024	Cyperaceae	<i>Carex retroflexa</i>	reflexed sedge	Wayne	Native	Mill Springs Battlefield National Monument, Nancy, KY. Oak forest overlooking Lake Cumberland, west of Confederate Fortified Camp at Beech Grove (Tour Stop #7).	36.952639, -84.788736	County record
MISP-0002	AK	10 July 2024	Cyperaceae	<i>Carex muehlenbergii</i> var. <i>enervis</i>	Muhlenberg's sedge	Pulaski	Native	Mill Springs Battlefield National Monument, Nancy, KY. Disturbed edge of beech-dominated forest at Zolicoffer Park, about 275 m from parking lot along trail (headed clockwise).	37.056878, -84.737322	County record
MISP-0003	AK	11 July 2024	Poaceae	<i>Desmodium laevigatum</i>	smooth tick trefoil	Wayne	Native	Mill Springs Battlefield National Monument, Nancy, KY. Grassland remnant on east side of Mill Springs Battlefield Rd., 0.2 mi south of Moulden's Hill (Tour Stop #6).	36.958669, -84.781189	County record
MISP-0004	AK	11 July 2024	Poaceae	<i>Dichanthelium dichotomum</i> var. <i>dichotomum</i>	forked witch grass	Wayne	Native	Mill Springs Battlefield National Monument, Nancy, KY. Grassland remnant on east side of Mill Springs Battlefield Rd., 0.2 mi north of Confederate Fortified Camp at Beech Grove (Tour Stop #7).	36.954936, -84.781689	County record

Accession #	Coll.	Coll. date	Family	Scientific name	Common name	County	Native/ Exotic	Locality	Lat., Long.	Reason for collection
MISP-0005	AK	11 July 2024	Poaceae	<i>Dichanthelium sphaerocarpon</i>	round-fruited witch grass	Wayne	Native	Mill Springs Battlefield National Monument, Nancy, KY. Grassland remnant on east side of Mill Springs Battlefield Rd., 0.2 mi north of Confederate Fortified Camp at Beech Grove (Tour Stop #7).	36.954936, -84.781689	County record
MISP-0006	AK	11 July 2024	Poaceae	<i>Coleataenia anceps</i> ssp. <i>anceps</i>	beaked panic grass	Wayne	Native	Mill Springs Battlefield National Monument, Nancy, KY. Grassland remnant on east side of Mill Springs Battlefield Rd., 175 m north of Confederate Fortified Camp at Beech Grove (Tour Stop #7).	36.953725, -84.782628	County record

Appendix B. Floristic Findings at Mill Springs Battlefield National Monument

Table 2. High C-value species (≥ 8) found at Mill Springs Battlefield National Monument.

C-value	Scientific name	Common name	Habit
8	<i>Aplectrum hyemale</i>	puttyroot	forb
8	<i>Asclepias quadrifolia</i>	whorled milkweed	forb
8	<i>Carex pensylvanica</i>	Pennsylvania sedge	graminoid
8	<i>Collinsonia canadensis</i>	Northern horsebalm	forb
8	<i>Conopholis americana</i>	bear corn	forb
8	<i>Fraxinus quadrangulata</i>	blue ash	tree
8	<i>Houstonia canadensis</i>	Canada bluet	forb
8	<i>Iris cristata</i>	dwarf crested iris	forb
8	<i>Packera anonyma</i>	Appalachian ragwort	forb
8	<i>Phegopteris hexagonoptera</i>	broad beech fern	fern
8	<i>Sanicula smallii</i>	Southern sanicle	forb
8	<i>Silphium asteriscus</i> var. <i>trifoliatum</i>	whorled rosinweed	forb
8	<i>Trillium sessile</i>	sessile trillium	forb
10	<i>Obolaria virginica</i>	pennywort	forb

Table 3. Kentucky Exotic Pest Plant Council (KY-EPPC) “Severe Threat” species of Mill Springs Battlefield National Monument.

Scientific name	Common name	Habit
<i>Arthraxon hispidus</i>	basket grass	graminoid
<i>Carduus nutans</i>	musk thistle	forb
<i>Conium maculatum</i>	poison hemlock	forb
<i>Elaeagnus umbellata</i>	autumn olive	shrub
<i>Euonymus fortunei</i>	winter creeper	woody vine
<i>Glechoma hederacea</i>	ground ivy	forb
<i>Lespedeza cuneata</i>	sericea lespedeza	forb
<i>Ligustrum sinense</i>	Chinese privet	shrub/small tree
<i>Lonicera japonica</i>	Japanese honeysuckle	woody vine
<i>Lonicera maackii</i>	Amur honeysuckle	shrub
<i>Melilotus alba</i>	white sweet clover	forb
<i>Melilotus officinalis</i>	yellow sweet clover	forb
<i>Microstegium vimineum</i>	Japanese stilt grass	graminoid
<i>Pyrus calleryana</i>	Callery pear	small tree
<i>Rosa multiflora</i>	multiflora rose	shrub
<i>Stellaria media</i>	common chickweed	forb
<i>Sorghum halapense</i>	Johnson grass	graminoid

Table 4. KY-EPPC “Significant Threat” species of Mill Springs Battlefield National Monument.

Scientific name	Common name	Habit
<i>Agrostis stolonifera</i>	creeping bentgrass	graminoid
<i>Albizia julibrissin</i>	mimosa	tree
<i>Cirsium vulgare</i>	bull thistle	forb
<i>Daucus carota</i>	Queen Anne’s lace	forb
<i>Leucanthemum vulgare</i>	oxeye daisy	forb
<i>Medicago lupulina</i>	black medick	forb
<i>Mosla dianthera</i>	mosla	forb
<i>Perilla frutescens</i>	beefsteak plant	forb
<i>Setaria faberi</i>	giant foxtail grass	graminoid
<i>Verbascum thapsus</i>	mullein	forb
<i>Vinca minor</i>	periwinkle	forb

Table 5. KY-EPPC “Watch List” species of Mill Springs Battlefield National Monument.

Scientific name	Common name	Habit
<i>Arundo donax</i>	giant reed	graminoid
<i>Trifolium pratense</i>	red clover	forb
<i>Trifolium repens</i>	white clover	forb
<i>Vicia sativa</i>	common vetch	forb

Annotated List of Plant Taxa of Mill Springs Battlefield National Monument

Key to taxon annotations:

* = Introduced taxa (TNKY Plant Atlas).

**= Introduced taxa that are a “significant threat” to ecosystems in Kentucky (KY-IPC 2013).

***= Introduced taxa that are a “severe threat” to ecosystems in Kentucky (KY-IPC 2013).

State Ranking: S3, S2, or S1; listed if S3 or below (NatureServe 2024).

Key to relative abundance abbreviations:

c= common

u=uncommon

r= rare

Key to county record abbreviations:

Pcr=species not previously documented in Pulaski County (SERNEC 2024).

Wer=species not previously documented in Wayne County (SERNEC 2024).

FERNS & FERN ALLIES

Aspleniaceae

Asplenium platyneuron – c

Dryopteridaceae

Polystichum acrostichoides – c

Lycopodiaceae

Diphasiastrum digitatum – u

Ophioglossaceae

Botrypus virginianus – u

Sceptridium bitermum – u; Wcr

Thelypteridaceae

Phegopteris hexagonoptera – r

GYMNOSPERMS

Cupressaceae

Juniperus virginiana – c

Pinaceae

Pinus echinata – u; Wcr

Pinus strobus – c

Pinus virginiana – u

MONOCOTS

Agavaceae

Yucca filamentosa – r

Alliaceae

**Allium vineale* – c

Araceae

Arisaema triphyllum – u

Colchicaceae

Uvularia perfoliata – r

Commelinaceae

**Commelina communis* –u; Pcr

Cyperaceae

Carex annectens – r; Pcr

Carex cephalophora – u; Wcr

Carex frankii – r

Carex hirsutella – u

Carex muehlenbergii var. *enervis* – u; Pcr, Wcr

Carex pennsylvanica – r

Carex retroflexa – u; Wcr

Carex rosea – u

Cyperus strigosus – c

Dioscoreaceae

Dioscorea villosa – u

Hypoxidaceae

Hypoxis hirsuta – r

Iridaceae

Iris cristata – r

Juncaceae

Juncus effusus – r

Juncus tenuis – c; Wcr

Orchidaceae

Aplectrum hyemale – r; Wcr

Goodyera pubescens – u

Poaceae

*******Agrostis stolonifera* – c

Andropogon ternarius – u; Wcr

Andropogon virginicus – c

********Arthraxon hispidus* – c; Pcr

**Arundo donax* – r; Pcr

Coleataenia anceps ssp. *anceps* – u; Wcr

**Cynodon dactylon* – c; Pcr

**Dactylis glomerata* – c

Danthonia spicata – u

Dichanthelium acuminatum var. *fasciculatum* – u

Dichanthelium clandestinum – u; Wcr

Dichanthelium dichotomum var. *dichotomum* – u; Wcr

Dichanthelium sphaerocarpon – u; Wcr

Elmyus hystrix – c; Wcr

**Eluesine indica* – c

Eragostris spectabilis – u

Erianthus alopecuroides – u; Wcr

**Hordeum pusillum* – u; Pcr

Leersia virginica – r; Wcr

**Lolium arundinaceum* – c

Melica mutica – u

****Microstegium vimineum* – c; Wcr

**Paspalum dilatatum* – c; Pcr

**Phleum pratense* – c

Schizachyrium scoparium – u; Pcr, Wcr

***Setaria faberi* – c

Setaria parviflora – u

****Sorghum halapense* – c

Tridens flavus – c; Wcr

Ruscaceae

Maianthemum racemosum – r

Polygonatum biflorum var. *commutatum* – r

Smilacaceae

Smilax bona-nox – c

Smilax ecirrhata – u

Smilax hispida – c

Smilax rotundifolia – c

Trilliaceae

Trillium cuneatum – u

Trillium sessile – r

DICOTS

Acanthaceae

Ruellia caroliniensis – u

Altingiaceae

Liquidambar styraciflua – c

Anacardiaceae

Rhus copallinum – u; Wcr

Toxicodendron radicans – c

Annonaceae

Asimina triloba – c

Apiaceae

****Conium maculatum* – c

*****Daucus carota* – c**

Osmorhiza longistylis – u; Per

Sanicula canadensis – u

Sanicula odorata – u

Sanicula smallii – r

****Torilis helvetica* – c; Per**

Apocynaceae

Asclepias quadrifolia – r

Asclepias syriaca – c

Asclepias tuberosa – u; Wcr

*****Vinca minor* – c; Wcr**

Aquifoliaceae

Ilex opaca – c

Araliaceae

Aralia spinosa – u

Asteraceae

Ageratina altissima – c; Wcr

Ambrosia artemesiifolia – c

Ambrosia trifida – c; Per

****Arctium minus* – u; Per**

Bidens aristosa – u; Per, Wcr

******Carduus nutans* – u**

****Cichorium intybus* – r**

Cirsium discolor – u; Per, Wcr

***Cirsium vulgare* – u
Conoclinium coelestinum – u
Elephantopus carolinianus – r
Erigeron canadensis – u
Erigeron philadelphicus – u
Erigeron strigosus – u
Eupatorium hyssopifolium – u; Wcr
Eupatorium serotinum – u; Wcr
Eupatorium torreyanum – u; Wcr
Fleischmannia incarnata – r
Gamochaeta purpurea – u
Hieracium venosum – r; Pcr
Iva annua – r; Pcr
Lactuca canadensis – c
***Leucanthemum vulgare* – c
Nabalus serpentaria – r; Wcr
Packera anonyma – u; Wcr
Packera glabella – u; Pcr
Pyrrhopappus carolinianus – u
Rudbeckia hirta var. *pulcherrima* – c; Wcr
Silphium asteriscus var. *trifoliatum* – r; Wcr
Smallanthus uvedelia – u
Solidago altissima – c
Solidago nemoralis – u; Wcr

Symphyotrichum dumosum – c; Wcr

Symphyotrichum lateriflorum – u; Wcr

Symphyotrichum ontarionis – u; Pcr, Wcr

Symphyotrichum pilosum – c; Wcr

Symphyotrichum racemosum – c

**Taraxacum officinale* – c

Verbesina occidentalis – c

Verbesina virginica – u; Pcr, Wcr

Vernonia gigantea – u

**Veronica persica* – c

Xanthium chinense – c

Berberidaceae

Podophyllum peltatum – r

Bignoniaceae

Bignonia capreolata – c

Campsis radicans – c

Boraginaceae

Andersonglossum virginianum – u; Pcr

**Buglossoides arvensis* – c

Brassicaceae

Borodinia laevigata – u

**Capsella bursa-pastoris* – c

Cardamine concatenata – c

**Cardamine hirsuta* – c

**Lepidium campestre* – c

**Mummenhoffia alliacea* – c

**Sisymbrium officinale* – c; Pcr

Campanulaceae

Lobelia inflata – u

Cannabaceae

Celtis laevigata – u; Pcr

Caprifoliaceae

****Lonicera japonica* – c

****Lonicera maackii* – c; Pcr

Valerianella radiata – u

Caryophyllaceae

**Cerastium fontanum ssp. vulgare* – c; Pcr

****Stellaria media* – u; Pcr

Celastraceae

****Euonymus fortunei* – u; Pcr

Cistaceae

Lechea racemulosa – r; Wcr

Convolvulaceae

Convolvulus fraterniflorus – u; Pcr

**Ipomoea coccinea* – u

Ipomoea pandurata – u

Cornaceae

Benthamidia florida – c

Crassulaceae

Sedum pulchellum – r

Cucurbitaceae

Melothria pendula – r

Ebenaceae

Diospyros virginiana – c; Wcr

Elaeagnaceae

****Elaeagnus umbellata* – c; Pcr

Ericaceae

Chimaphila maculata – u

Oxydendrum arboreum – c

Euphorbiaceae

Croton capitatus – r; Wcr

Euphorbia corollata – u

Euphorbia nutans – u; Wcr

Fabaceae

***Albizia julibrissin* – u

Amorpha fruticosa – r; Wcr

Cercis canadensis – c

Chamaecrista fasciculata – u

Chamaecrista nictitans – u

Desmodium glabellum – u; Wcr

Desmodium laevigaetum – u; Wcr

Desmodium perplexum – u

**Glycine max* – c

Hylodesmum nudiflorum – u

****Lespedeza cuneata* – c; Pcr, Wcr

Lespedeza procumbens – u; Wcr

Lespedeza virginica – u; Wcr

***Medicago lupulina* – c

****Melilotus alba* – c; Wcr

****Melilotus officinalis* – c

**Securigera varia* – u; Wcr

**Trifolium arvense* – c; Pcr

**Trifolium pratense* – c

**Trifolium repens* – c

**Vicia sativa* – u

Fagaceae

Fagus grandifolia – c

Quercus alba – c

Quercus falcata – c

Quercus imbricaria – r; Wcr

Quercus marilandica – c; Pcr

Quercus muhlenbergii – c

Quercus rubra – c

Quercus stellata – c; Wcr

Quercus velutina – c

Gentianaceae

Obolaria virginica – u

Sabatia angularis – u

Geraniaceae

Geranium carolinianum – u

Hypericaceae

Hypericum hypericoides – Pcr

Hypericum mutilum – u

Hypericum punctatum – u

Hypericum stragulum – u

Juglandaceae

Carya glabra – c; Pcr

Carya ovalis – c; Pcr

Carya ovata – c

Carya tomentosa – c

Juglans nigra – c

Lamiaceae

Collinsonia canadensis – u; Pcr

****Glechoma hederacea* – u; Pcr

**Lamium purpureum* – c

***Mosla dianthera* – c; Wcr

***Perilla frutescens* – c; Pcr, Wcr

Phryma leptostachya – u

Prunella vulgaris var. *lanceolata* – u

**Prunella vulgaris* var. *vulgaris* – c

Pycnanthemum incanum var. *incanum* – u; Wcr

Salvia lyrata – c

Scutellaria elliptica – r

Trichostema coeruleum – r; Wcr

Trichostema dichotomum – u; Wcr

Lauraceae

Lindera benzoin – u

Sassafras albidum – c

Magnoliaceae

**Liriodendron tulipifera* – c

Magnolia acuminata – c

Montiaceae

Claytonia virginiana – c

Moraceae

Maclura pomifera – u; Pcr

Morus rubra – u

Nyssaceae

Nyssa sylvatica – c

Oleaceae

Fraxinus americana – u

Fraxinus quadrangulata – u

**Ligustrum obtusifolium* – c; Pcr, Wcr

****Ligustrum sinense* – c

Orobanchaceae

Conopholis americana – c

Epifagus virginiana – c; Wcr

Oxalidaceae

Oxalis dillenii – u

Oxalis violacea – u

Passifloraceae

Passiflora incarnata – c

Passiflora lutea – u

Phytolaccaceae

Phytolacca americana – c

Plantaginaceae

**Plantago lanceolata* – c

Plantago virginica – c; Pcr

Platanaceae

Platanus occidentalis – c

Polygonaceae

Persicaria hydropiperoides – u

Persicaria longiseta – c

Persicaria punctata – u

Persicaria virginiana – c; Pcr, Wcr

**Rumex crispus* – c

Ranunculaceae

Anemone virginiana – u

Ranunculus abortivus – u; Pcr

**Ranunculus bulbosus* – c; Pcr

Ranunculus recurvatus – u

Rhamnaceae

Frangula caroliniana – u

**Rhamnus davurica* – u; Pcr

Rosaceae

Agrimonia parviflora – u

Geum canadense – u

**Potentilla indica* – c; Pcr

Potentilla simplex – u; Wcr

Prunus serotina – u

****Pyrus calleryana* – u

**Pyrus communis* – r; Wcr

Rosa carolina – u

****Rosa multiflora* – c

Rubus allegheniensis – c

Rubus occidentalis – c

Rubus pensilvanicus – c

Rubiaceae

Galium aparine – Pcr

Galium circaezans – c

Galium pilosum – c

Galium triflorum – c

Hexasepalum teres – u

Houstonia caerulea – u

Houstonia canadensis – u

Houstonia purpurea – u; Wcr

Mitchella repens – u

**Sherardia arvensis* – c; Pcr

Salicaceae

Populus deltoides – u; Pcr

Sapindaceae

Acer rubrum – c

Acer saccharum – c

Aesculus glabra – u

Scrophulariaceae

***Verbascum thapsus* –

Solanaceae

Solanum carolinense – c

Ulmaceae

Ulmus alata – u

Ulmus rubra – u

Urticaceae

Pilea pumila – c; Pcr

Verbenaceae

Verbena urticifolia – c

Violaceae

Viola eriocarpa – u; Pcr

Viola palmata – u

Viola sororia – c

Viscaceae

Phoradendron leucarpum – u

Vitaceae

Parthenocissus quinquefolia – c

Vitis cinerea – u; Pcr

List of Plant Taxa of Mill Springs Battlefield National Monument Arranged by Growth Habit

FERNS

Asplenium platyneuron

Botrypus virginianus

Diphasiastrum digitatum

Phegopteris hexagonoptera

Polystichum acrostichoides

Sceptridium bitermatum

TREES & SHRUBS

Acer rubrum

Acer saccharum

Aesculus glabra

Albizia julibrissin

Amorpha fruticosa

Aralia spinosa

Asimina triloba

Benthamidia florida

Carya glabra

Carya ovalis

Carya ovata

Carya tomentosa

Celtis laevigata

Cercis canadensis

Diospyros virginiana
Elaeagnus umbellata
Fagus grandifolia
Frangula caroliniana
Fraxinus americana
Fraxinus quadrangulata
Ilex opaca
Juglans nigra
Juniperus virginiana
Ligustrum obtusifolium
Ligustrum sinense
Lindera benzoin
Liquidambar styraciflua
Liriodendron tulipifera
Lonicera maackii
Maclura pomifera
Magnolia acuminata
Morus rubra
Nyssa sylvatica
Oxydendrum arboreum
Pinus echinata
Pinus strobus
Pinus virginiana
Platanus occidentalis

Populus deltoides

Prunus serotina

Pyrus calleryana

Pyrus communis

Quercus alba

Quercus falcata

Quercus imbricaria

Quercus marilandica

Quercus muhlenbergii

Quercus rubra

Quercus stellata

Quercus velutina

Rhamnus davurica

Rhus copallinum

Rosa carolina

Rosa multiflora

Rubus allegheniensis

Rubus occidentalis

Rubus pensilvanicus

Sassafras albidum

Ulmus alata

Ulmus rubra

WOODY VINES

Bignonia capreolata

Campsis radicans

Euonymus fortunei

Lonicera japonica

Mitchella repens

Parthenocissus quinquefolia

Smilax bona-nox

Smilax hispida

Smilax rotundifolia

Toxicodendron radicans

Vitis cinerea

GRAMINOIDS

Agrostis stolonifera

Andropogon ternarius

Andropogon virginicus

Arthraxon hispidus

Arundo donax

Carex annectens

Carex cephalophora

Carex frankii

Carex hirsutella

Carex muehlenbergii var. *enervis*

Carex pennsylvanica

Carex retroflexa

Carex rosea

Coleataenia anceps ssp. *anceps*
Cynodon dactylon
Cyperus strigosus var. *strigosus*
Dactylis glomerata
Danthonia spicata
Dichanthelium acuminatum var. *fasciculatum*
Dichanthelium clandestinum
Dichanthelium dichotomum var. *dichotomum*
Dichanthelium sphaerocarpon
Eluesine indica
Elmyus hystrix
Eragostris spectabilis
Erianthus alopecuroides
Hordeum pusillum
Juncus effusus
Juncus tenuis
Leersia virginica
Lolium arundinaceum
Melica mutica
Microstegium vimineum
Paspalum dilatatum
Phleum pratense
Schizachyrium scoparium
Setaria faberi

Setaria parviflora

Sorghum halapense

Tridens flavus

FORBS

Ageratina altissima

Agrimonia parviflora

Allium vineale

Ambrosia artemesiifolia

Ambrosia trifida

Andersonglossum virginianum

Anemone virginiana

Aplectrum hyemale

Arctium minus

Arisaema triphyllum

Asclepias quadrifolia

Asclepias syriaca

Asclepias tuberosa

Bidens aristosa

Borodinia laevigata

Buglossoides arvensis

Capsella bursa-pastoris

Cardamine concatenata

Cardamine hirsuta

Carduus nutans

Cerastium fontanum ssp. *vulgare*

Chamaecrista fasciculata

Chamaecrista nictitans

Chimaphila maculata

Cichorium intybus

Cirsium discolor

Cirsium vulgare

Claytonia virginiana

Collinsonia canadensis

Commelina communis

Conium maculatum

Conoclinium coelestinum

Conopholis americana

Convolvulus fraterniflorus

Croton capitatus

Daucus carota

Desmodium glabellum

Desmodium laevigaetum

Desmodium perplexum

Dioscorea villosa

Elephantopus carolinianus

Epifagus virginiana

Erigeron canadensis

Erigeron philadelphicus

Erigeron strigosus
Eupatorium hyssopifolium
Eupatorium serotinum
Eupatorium torreyanum
Euphorbia corollata
Euphorbia nutans
Fleischmannia incarnata
Galium aparine
Galium circaezans
Galium pilosum
Galium triflorum
Gamochaeta purpurea
Geranium carolinianum
Geum canadense
Glechoma hederacea
Glycine max
Goodyera pubescens
Hexasepalum teres
Hieracium venosum
Houstonia caerulea
Houstonia canadensis
Houstonia purpurea
Hylodesmum nudiflorum
Hypericum hypericoides

Hypericum mutilum

Hypericum punctatum

Hypericum stragulum

Hypoxis hirsuta

Ipomoea coccinea

Ipomoea pandurata

Iris cristata

Iva annua

Lactuca canadensis

Lamium purpureum

Lechea racemulosa

Lepidium campestre

Lespedeza cuneata

Lespedeza procumbens

Lespedeza virginica

Leucanthemum vulgare

Lobelia inflata

Maianthemum racemosum

Medicago lupulina

Melilotus alba

Melilotus officinalis

Melothria pendula

Mosla dianthera

Mummenhoffia alliacea

Nabalus serpentaria
Obolaria virginica
Osmorhiza longistylis
Oxalis dillenii
Oxalis violacea
Packera anonyma
Packera glabella
Passiflora incarnata
Passiflora lutea
Perilla frutescens
Persicaria hydropiperoides
Persicaria longiseta
Persicaria punctata
Persicaria virginiana
Phoradendron leucarpum
Phryma leptostachya
Phytolacca americana
Pilea pumila
Plantago lanceolata
Plantago virginica
Podophyllum peltatum
Polygonatum biflorum var. *commutatum*
Potentilla indica
Potentilla simplex

Prunella vulgaris var. *lanceolata*
Prunella vulgaris var. *vulgaris*
Pycnanthemum incanum var. *incanum*
Pyrrhopappus carolinianus
Ranunculus abortivus
Ranunculus bulbosus
Ranunculus recurvatus
Rudbeckia hirta var. *pulcherrima*
Ruellia caroliniensis
Rumex crispus
Sabatia angularis
Salvia lyrata
Sanicula canadensis
Sanicula odorata
Sanicula smallii
Scutellaria elliptica
Securigera varia
Sedum pulchellum
Sherardia arvensis
Silphium asteriscus var. *trifoliatum*
Sisymbrium officinale
Smallanthus uvedelia
Smilax ecirrhata
Solanum carolinense

Solidago altissima
Solidago nemoralis
Stellaria media
Symphyotrichum lateriflorum
Symphyotrichum ontarionis
Symphyotrichum pilosum
Symphyotrichum dumosum
Symphyotrichum racemosum
Taraxacum officinale
Torilis helvetica
Trichostema coeruleum
Trichostema dichotomum
Trifolium arvense
Trifolium pratense
Trifolium repens
Trillium cuneatum
Trillium sessile
Uvularia perfoliata
Valerianella radiata
Verbascum thapsus
Verbena urticifolia
Verbesina occidentalis
Verbesina virginica
Vernonia gigantea

Veronica persica

Vicia sativa

Vinca minor

Viola eriocarpa

Viola palmata

Viola sororia

Xanthium chinense

Yucca filamentosa

Appendix C. Grassland Reconstruction Recommendations

Table 6. Example timeline for grassland planting.

Time	Action
Apr. 2025	Round one of herbicide spraying.
Jul. 2025	Round two of herbicide spraying.
Oct. 2025	Round three of herbicide spraying.
Nov./Dec. 2025	If site prep is complete (essentially no living plants remain on-site), plant seeds. Note: If a former soybean field is chosen for planting and is taken out of production by this time, the first three steps can be skipped.
2026 - Nov. 2028	Monitor progress of planting. Spot treat invasive species as needed.
Nov./Dec. 2028	First prescribed burn of reconstructed grassland.

Table 7. Grassland species found at Mill Springs Battlefield National Monument that could be components of a seed mix (though many may not currently be commercially available).

Scientific name	Common name	Habit
<i>Andropogon ternarius</i>	splitbeard bluestem	graminoid
<i>Carex hirsutella</i>	fuzzy wuzzy sedge	graminoid
<i>Danthonia spicata</i>	poverty oat grass	graminoid
<i>Dichanthelium clandestinum</i>	deer tongue grass	graminoid
<i>Elymus hystrix</i>	bottlebrush grass	graminoid
<i>Eragostris spectabilis</i>	purple love grass	graminoid
<i>Erianthus alopecuroides</i>	silver plume grass	graminoid
<i>Schizachyrium scoparium</i>	little bluestem	graminoid
<i>Anemone virginiana</i>	thimbleweed	forb
<i>Asclepias tuberosa</i>	butterfly milkweed	forb
<i>Conoclinium coelestinum</i>	blue mistflower	forb
<i>Eupatorium hyssopifolium</i>	hyssop-leaved thoroughwort	forb
<i>Eupatorium serotinum</i>	late boneset	forb
<i>Eupatorium torreyanum</i>	Torrey's thoroughwort	forb
<i>Lechea racemulosa</i>	Appalachian pinweed	forb
<i>Lespedeza virginica</i>	slender bush clover	forb
<i>Nabalus serpentaria</i>	lion's foot	forb
<i>Pycnanthemum incanum</i> var. <i>incanum</i>	hoary mountain mint	forb
<i>Rudbeckia hirta</i> var. <i>pulcherrima</i>	black-eyed Susan	forb
<i>Sabatia angularis</i>	rose pink	forb
<i>Silphium asteriscus</i> var. <i>trifoliatum</i>	whorled rosinweed	forb
<i>Solidago nemoralis</i>	gray goldenrod	forb
<i>Trichostema coeruleum</i>	glade blue curls	forb
<i>Trichostema dichotomum</i>	common blue curls	forb

Literature Cited

- Bryant, W. S., M. E. Wharton, W. H. Martin, W. H., and J. B. Varner. 1980. The Blue Ash-Oak Savanna: Woodland, a Remnant of Presettlement Vegetation in the Inner Bluegrass of Kentucky. *Castanea* 45(3): 149–165.
- DeBerry, D. A., J. A. Thompson, Z. R. Bradford, D. L. Davis, J. C. Ludwig, R.H. Simmons, and T. F. Wieboldt. 2021. Coefficients of Conservatism (C-values) for the Flora of Virginia. *Banisteria* 55: 112–149.
- Estes, D. 2015. The Pennyroyal Plain Prairie: A Vision For Restoring A Forgotten Ecosystem. Oak Woodlands & Forests Fire Consortium, <https://oakfirescience.com/video/the-pennyroyal-plain-prairie-a-vision-for-restoring-a-forgotten-ecosystem/>.
- Estes, D., C. Tracey, E. Zimmerman, W. Knapp, J. Vanderhorst, J. Singhurst, and T. Witsell. 2023. Riverscour Ecosystems of Eastern Unglaciaded North America: A Review. *Natural Areas Journal* 43(3): 148–168.
- Jones, R. L. Plant Life of Kentucky: An Illustrated Guide to the Vascular Flora. 2005. University Press of Kentucky, Lexington, Kentucky.
- Kentucky Exotic Pest Plant Council (KY-EPPC). 2013. Exotic Invasive Plants of Kentucky, 3rd edition.
- Kentucky Geologic Map Service. 2020. University of Kentucky Geological Survey, Lexington, Kentucky, <https://kgs.uky.edu/kygeode/geomap/>.
- Larson, J., and E. Crocker. 2022. “Emerald Ash Borer (EAB) Faqs for Kentuckians.” UK Department of Entomology, University of Kentucky, Lexington, Kentucky, <https://entomology.ca.uky.edu/ef453>.
- McDowell, R. C. and W. L. Newell. 2001. Contributions to the Geology of Kentucky: Quaternary System. United States Geological Survey, <https://pubs.usgs.gov/pp/p1151h/quat.html>.
- “Mill Springs Battlefield National Monument.” 2024. National Park Service, U.S. Department of the Interior, https://www.nps.gov/Mill_Springs_Battlefield_National_Monument/index.htm.
- NatureServe. 2024. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia, <https://explorer.natureserve.org/>.
- Noss, R. 2013. Forgotten Grasslands of the South: Natural History and Conservation. Island Press, Washington, D.C.
- Rodgers, D., T. Littlefield, and K. McDonald. 2022. Kentucky Rare Plant List, 2022 edition. Energy and Environment Cabinet, Office of Kentucky Nature Preserves, Frankfort, Kentucky.

- Rothrock, P. E. and M. A. Homoya. 2005. An Evaluation Of Indiana's Floristic Quality Assessment. Proceedings of the Indiana Academy of Science 114(1): 9–18
- “The Mississippian Plateau or Pennyroyal Region.” 2012. Kentucky Geologic Survey, University of Kentucky, <https://uky.edu/KGS/geoky/regionPennyroyal.html>.
- Shaw, J., D. Estes, B. Ruhfel, A. B. Morris, and T. R. Littlefield. 2023. Tennessee-Kentucky Plant Atlas, <https://tennessee-kentucky.plantatlas.usf.edu/>.
- U.S. Environmental Protection Agency (EPA). 2013. Level III and IV Ecoregions of the Continental United States. National Health and Environmental Effects Research Laboratory, Corvallis, OR, <https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states>.
- Weakley, A. S. and SE Flora Team. 2024. Flora of the Southeastern United States, <https://fsus.ncbg.unc.edu/>.
- Witsell, T., V. L. McDaniel, B. T. Baker, D. M. Zollner, G. L. De Jong, and S. L. Hooks. 2024. Coefficients of Conservatism For the Vascular Flora of Arkansas. Phytoneuron 46: 1–99.
- “Wolf Creek Dam.” 2024. Great Lakes and Ohio River Division. US Army Corps of Engineers, <https://www.lrd.usace.army.mil/Water-Information/Hydropower/Article/3642683/wolf-creek-dam/>.