The Vascular Flora of Camp Nelson National Monument: Final Report

Submitted: 20 December 2024

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Overview

Camp Nelson National Monument (CANE) is a 465-acre park near Nicholasville, Kentucky. A floristic survey was conducted across the 2024 growing season, yielding 250 taxa across 184 genera and 79 families. Sixty-eight (about 27%) of the documented taxa were non-native. Two rare species were documented: cliff diamond flower (*Houstonia rupestris*) and Kentucky wild pink (*Silene caroliniana* var. *wherryi*). Recommendations for restoration of native habitats, as well as ideas for a grassland "reconstruction" project are discussed. Though much of Camp Nelson National Monument has been converted back to agricultural land or is otherwise degraded, findings demonstrate that the park still has natural areas that would benefit from restoration, and that it could present an interesting opportunity for grassland reconstruction in Kentucky's Bluegrass region.



Native grassland wildflowers like New England aster (*Symphyotrichum nova-angliae*) and goldenrod (*Solidago* spp.) put on a colorful show in early fall in a few special areas at Camp Nelson National Monument, such as near the benches where the Long Fort Trail meets the Fort Jones Overlook Trail. ALAINA KRAKOWIAK

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Introduction

Camp Nelson National Monument (CANE) is a 465-acre historical site established in 2018. Camp Nelson National Monument served as a depot for the U.S. Army during the Civil War and served as a recruiting/training ground for new soldiers, many of whom were formerly enslaved African Americans (Camp Nelson National Monument 2024). While the human history of Camp Nelson National Monument is well studied, less is known about the park's natural history. The purpose of this project was to conduct an inventory of the vascular flora of the park to begin to fill this gap.

Camp Nelson National Monument occurs in the Bluegrass physiographic region of Kentucky (Jones 2005). Prior to European colonization, the vegetation of the Bluegrass region of Kentucky largely consisted of open oak-savanna (Noss 2013). This habitat is basically a type of treed grassland: imagine an open, sunny landscape with a lush, highly diverse suite of grasses and wildflowers at your feet, and enormous, widely branching trees scattered throughout (Figure 1). It is sadly ironic that this once incredibly biodiverse region of native grasslands is now named after the non-native, European grass that is emblematic of its demise–Poa pratensis, commonly known as Kentucky bluegrass. The highly fertile soils that characterize this area took well to agriculture and the planting of pasture grasses like P. pratensis for horse farms. Very little remnant (original) grassland habitat remains (Noss 2013).



Figure 1. This 1904 photograph, taken near Versailles, Kentucky, shows a good example of how the oak-savannas of Kentucky were once structured. Native grassland plants are extremely rich in vitamins and minerals and are adapted to withstand grazing (as they evolved to fuel large grazing mammals like bison). Non-native cool-season grasses like Kentucky bluegrass (*Poa pratensis*) are not necessarily superior pasturage. KNIGHT, T.A. AND N.L. GREENE. 1904. COUNTRY ESTATES OF THE BLUE GRASS. BRITTON PRINT CO., CLEVELAND, OHIO

Camp Nelson National Monument straddles two Level IV ecoregions as designated by the EPA (2013): the majority of the park is in the Inner Bluegrass, with a small portion of the eastern side in the Hills of the Bluegrass. The Inner Bluegrass ecoregion is relatively flat, while the Hills of the Bluegrass is more rugged and hilly. Both are underlain by limestone. More specifically, Camp Nelson National Monument is underlain by three types of limestone, all of Middle Ordovician age: Lower part of Lexington Limestone underlies the majority of the park's flat, open upland areas, Tyrone Limestone and Oregon Formation underlies the lower, rolling portions of the park's open areas as well as the sloping, southeast-facing woodlands on the eastern side of the park, and Camp Nelson Limestone makes up the cliff line above Hickman Creek (Kentucky Geologic Map Service 2020).

The eastern, wooded portion of the park contains the most significant natural habitat that remains at Camp Nelson National Monument. This area is part of the Kentucky River Palisades, a series of dramatic river gorges and limestone outcroppings found along the Kentucky River and its tributaries (such as Hickman Creek) in Central Kentucky. The Palisades are home to several rare species of plants (Martin et al. 1979), two of which were documented at the park. This area should be the highest priority for restoration. A grassland "reconstruction," or the planting of a native grassland from seed, in the park's flat upland area 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 walked throughout the park, but focused more heavily on certain areas depending on the time of the year (for example, the wooded area in the back of the park was most intensely surveyed during the spring trip, as this is when the majority of woodland wildflowers bloom). 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 #CANE-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 and fifty taxa were documented, comprising 184 genera and 79 families. The author's inventory efforts were thorough, though it is suspected that additional heliophytic (sun-loving) species reside in the soil seed bank that could become re-established in response to restoration efforts. The most well-represented family was Asteraceae (asters) with 33 species, about 13% of the total taxa. The second largest family was Poaceae (grasses) with 22 species (9%), and the third

largest was Rosaceae (roses) with 12 species (5%). 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 rose family at Camp Nelson National Monument include some native forbs (herbaceous flowering plants other than grasses) and several weedy native and exotic woody species. Of all the taxa documented, 182 were native, and 68 introduced (about 27%). 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

The open areas of Camp Nelson National Monument (which make up most of the park) are mostly devoid of native plant communities. Parts of this area are dominated by Johnson grass (*Sorghum halapense*), an invasive species. Other areas are dominated by weedy native grasses such as redtop (*Tridens flavus*) and broomsedge (*Andropogon virginicus*), with sparse native forbs like tall goldenrod (*Solidago altissima*), ironweed (*Vernonia gigantea*), and false boneset (*Brickellia eupatoriodes*) (Figures 2 and 3). These areas fall into the National Vegetation Classification (NVC) Eastern Native Ruderal Grassland Alliance–a modern grassland assemblage of weedy native species that grows in areas that have been disturbed by humans (NatureServe 2024).



Figure 2. An example of ruderal grassland at Camp Nelson National Monument. ALAINA KRAKOWIAK

While the former vegetation composition of this area can only be surmised, it was likely open oak-savanna, which is described in the Bluegrass Savanna and Woodland alliance. These were deep-soiled, fertile savannas of the Inner Bluegrass ecoregion of Kentucky that had a diverse ground cover of grasses and forbs, with fire-resistant oak species such as bur oak (*Quercus macrocarpa*) scattered widely throughout (Bryant et al. 1980). This habitat was historically maintained in an open state by a combination of factors, including grazing by large herds of bison, natural wildfire, cultural burning by Native Americans, and periodic drought (NatureServe 2024).

While oak-savanna probably formed the matrix vegetation of Camp Nelson National Monument, in areas around drainages, such as around Officers' Spring, tree cover would have been higher, with a slightly different composition of herbaceous species, perhaps even including river cane (*Arundinaria gigantea*). Additionally, small inclusions of Interior Low Plateau Limestone Glade could have occurred in areas with open bedrock, such as around the former bakery where Eastern prickly pear (*Opuntia cespitosa*) can still be observed (Figure 3). Limestone Glade Seeps could also have been associated with glade inclusions, but today might look like nothing more than an area of thin, perpetually muddy soil (NatureServe 2024).



Figure 3. Left: Ironweed (*Vernonia gigantea*), a common component of ruderal grassland at Camp Nelson National Monument, attracts butterflies like great spangled fritillary and variegated fritillary. Right: A lone patch of Eastern prickly pear (*Opuntia cespitosa*), a native cactus species, can be found on an outcropping of limestone at Camp Nelson National Monument. ALAINA KRAKOWIAK

The sloping, southeast-facing woodlands at Camp Nelson National Monument historically would likely have consisted of Interior Low Plateau Chinquapin Oak - Blue Ash Woodlands. This vegetation alliance describes dry woodlands found on shallow soils derived from limestone that are dominated by chinquapin oak (*Quercus muehlenbergii*) and blue ash (*Fraxinus quadrangulata*) (NatureServe 2024). While these two species are found in abundance in the woodlands at Camp Nelson National Monument, *F. quadrangulata* is mostly only found in its sapling stage, likely 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). Additionally, fire suppression has led to the increase of more mesic-adapted tree species, such as sugar maple (*Acer saccharum*), black maple (*Acer nigrum*), and red oak (*Quercus rubra*), creating a positive feedback-loop of "mesophication" (Nowacki and Abrams 2008), the process by which a naturally dry habitat shifts to become more mesic (moderately moist).

Particularly in the northeast portion of the woodlands at Camp Nelson National Monument, woodlands can be found that appear to be naturally more mesic, perhaps due to minor differences in topography, aspect, and/or soil moisture. These would best be described as Interior Low Plateau Calcareous Oak Forest (NatureServe 2024). These are the areas of the park with the richest assemblage of spring ephemeral wildflowers, such as yellow fumewort (*Corydalis flavula*), dwarf larkspur (*Delphinium tricorne*), dutchman's britches (*Dicentra cucullaria*), white trout lily (*Erythronium albidum*), Eastern Solomon's plume (*Maianthemum racemosum*), fernleaf phacelia (*Phacelia bipinnatifida*), Miami mist (*Phacelia purshii*), Eastern blue phlox (*Phlox divaricata*), may apple (*Podophyllum peltatum*), and rue anemone (*Thalictrum thalictroides*). In one location, yellow snake root (*Sanicula odorata*) forms the dominant ground cover. Elsewhere, impressively large stands of the native grass Eastern beak grain (*Diarrhena americana*) can be observed (Figure 4). Chinquapin oak (*Quercus muehlenbergii*) and sugar maple (*Acer saccharum*) are the dominant tree species of this vegetation alliance.



Figure 4. A large stand of Eastern beak grain (*Diarrhena americana*) in calcareous oak forest at Camp Nelson National Monument. ALAINA KRAKOWIAK

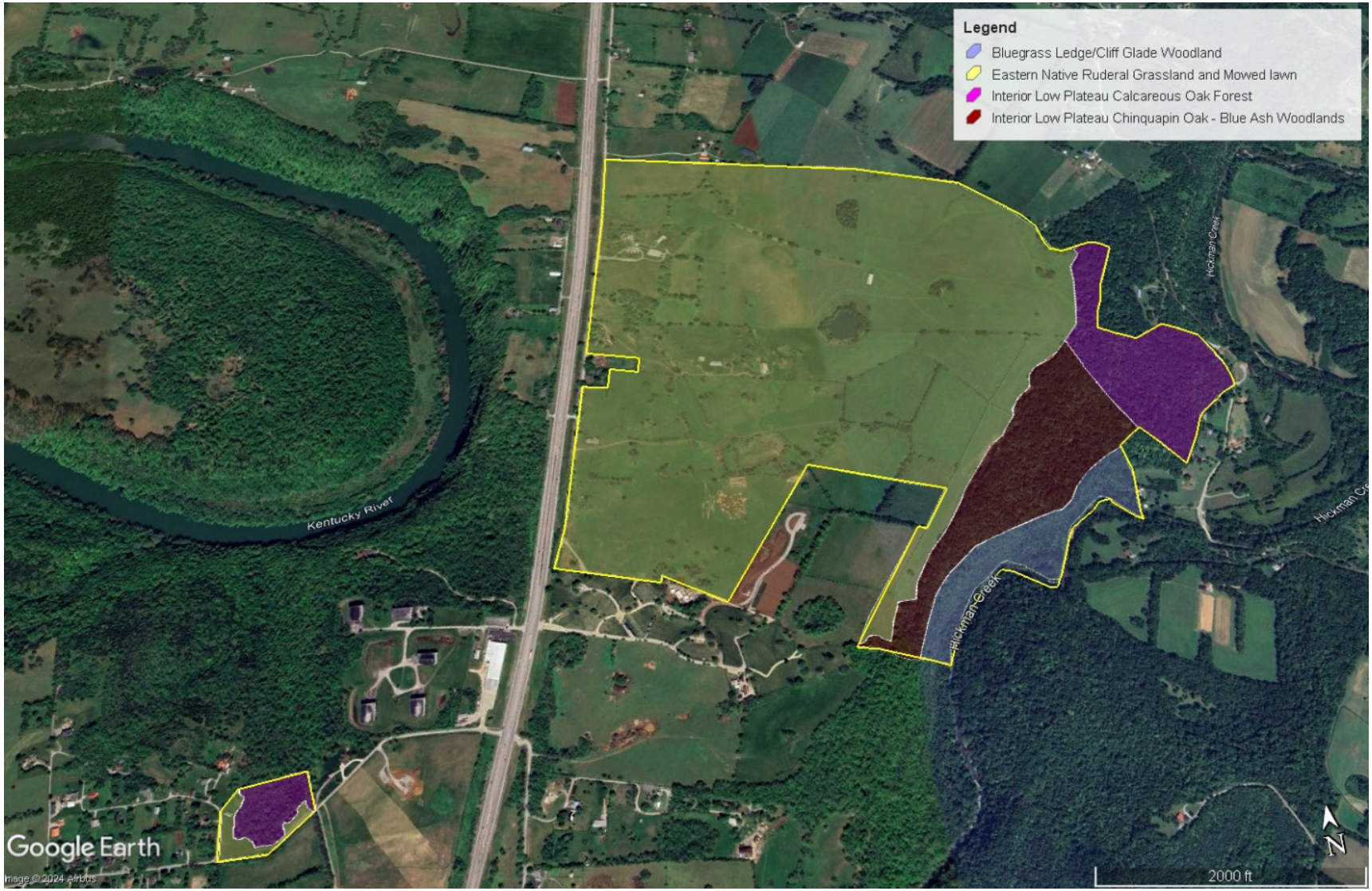


Figure 5. Plant communities of Camp Nelson National Monument. Due to the degraded nature of much of the park's vegetation, outlines of communities are not exact. ALAINA KRAKOWIAK (Google Earth)

The far eastern edge of these woodlands, just prior to where the cliff drops off steeply, supports degraded remnants of Bluegrass Ledge/Cliff Glade Woodland, a globally imperiled (G2) vegetation association first described in the Jessamine Gorge (Campbell and Meijer 1989). This vegetation association is endemic to Middle Ordovician aged limestone outcrops of the Inner Bluegrass region of Kentucky. Species characteristic of this association include Eastern red cedar (*Juniperus virginiana*), blue ash (*Fraxinus quadrangulata*), and aromatic aster (*Symphyotrichum oblongifolium*) (NatureServe 2024). Many of the other forbs characteristic of this association are lacking from Camp Nelson National Monument, likely having been outcompeted by invasive species.

Rare Species

Two rare species were found during the study: cliff diamond flower (*Houstonia rupestris*; Figure 6) and Kentucky wild pink (*Silene caroliniana* var. *wherryi*; Figure 7). 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 (NatureServe 2024; Rodgers et al. 2022). For the purpose of this report, species with a ranking of S3 and below were considered to be rare. One S3 species was found, as well as one unranked but undoubtedly rare species (Table 2 in Appendix B).

Houstonia rupestris is a low-growing, multi-stemmed perennial wildflower with numerous narrow, dark green leaves. It has tiny, white, four-petaled flowers, which bloom over a long period: from May to October (Weakley et al. 2024; Figure 6). This species was found in just one location in the entire park: a small opening of bare limestone on the southernmost overlook along the Fort Jones Overlook Trail (Figure 8). Less than five individuals were observed in this location. Additional individuals were sought throughout the length of the clifftop along the park's eastern margin, but none were found.

Houstonia rupestris is endemic to limestone cliff-tops along the Kentucky River Palisades and the Cumberland River in KY and TN, meaning it occurs in these areas and nowhere else on the planet (Weakley et al. 2024). Prior to this study, *H. rupestris* had not been documented in Jessamine County (Shaw et al. 2023). The population at Camp Nelson National Monument is surrounded by invasive species and weedy natives, and could easily be outcompeted and extirpated from the site if management actions are not taken (see Restoration Recommendations section). Trampling from hikers may also pose a threat to this species' continued existence. Ironically, however, the low-level of disturbance produced by hikers may be the only reason that this particular rock outcrop has been maintained in a more open state than other areas of the park, and thus why it supports the park's only occurrence of *H. rupestris*. This species has not been ranked by the Office of Kentucky Nature Preserves as it has only recently been recognized as distinct from the more common glade bluet (*Houstonia nigricans*). However, given its nine-county global range (Shaw et al. 2023) and strict habitat requirements, it is undoubtedly rare and likely at moderate to high risk of extinction.



Figure 6. Cliff diamond flower (*Houstonia rupestris*) at Camp Nelson National Monument. Top: *Houstonia rupestris* was found in very thin, rocky soil on a limestone outcrop. Left top: Close-up to show the fuzzy interior margin of a *H. rupestris* flower. Left bottom: A wider view of the rock outcrop where the small population of *H. rupestris* was found. Right: Image of the entire plant showing diagnostic traits. ALAINA KRAKOWIAK



Figure 7. Kentucky wild pink (*Silene caroliniana* var. *wherryi*) at Camp Nelson National Monument. Top left: 1938 specimen of *S. caroliniana* var. *wherryi* collected by the famous botanist/ecologist Lucy Braun from Camp Nelson National Monument (SERNEC 2024 [https://sernecportal.org/portal/index.php]). Top right, bottom: Images showing diagnostic traits. ALAINA KRAKOWIAK

Silene caroliniana var. *wherryi* is a low-growing, somewhat sprawling perennial wildflower with pale green leaves that are widest near the tip, and delicate, pink, five-petaled flowers which emerge from a soft-hairy calyx (green parts directly below the flower; Figure 7). It generally flowers throughout April and May (Weakley et al. 2024). This species was found near the eastern margin of the park, in the sloping, southeast-facing oak woodlands east of the Fort Jones Overlook Trail, between the two marked side trails which lead to overlooks. Less than five individuals were found across an approximately 30-meter (98.4 feet) span.

Silene caroliniana var. *wherryi* is ranked S3 in Kentucky, meaning it is considered vulnerable and at moderate risk of extirpation from the state (Rodgers et al. 2022). Globally it has a rank of T3, meaning that this particular variety (*wherryi*) is vulnerable across its range, which includes Alabama, Kentucky, Missouri, and Ohio. The greatest number of occurrences of this species are known from the Kentucky River Palisades, but populations in this area are severely threatened by the invasion of bush honeysuckle species, such as *Lonicera maackii* (NatureServe 2024), which is extremely pervasive at Camp Nelson National Monument.



Figure 8. Map of locations of cliff diamond flower (*Houstonia rupestris*) and Kentucky wild pink (*Silene caroliniana* var. *wherryi*) at Camp Nelson National Monument. ALAINA KRAKOWIAK (Google Earth)

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 that are 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 that are 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 Camp Nelson 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 Camp Nelson National Monument is shown in Figure 9. The most frequently assigned value was 0 (non-native species), followed by 6 (native species with moderate fidelity to intact, stable habitat with some tolerance for anthropogenic disturbance). Eighteen high C-value species ($C \geq 8$) were found; these are summarized in Table 3 in Appendix B.

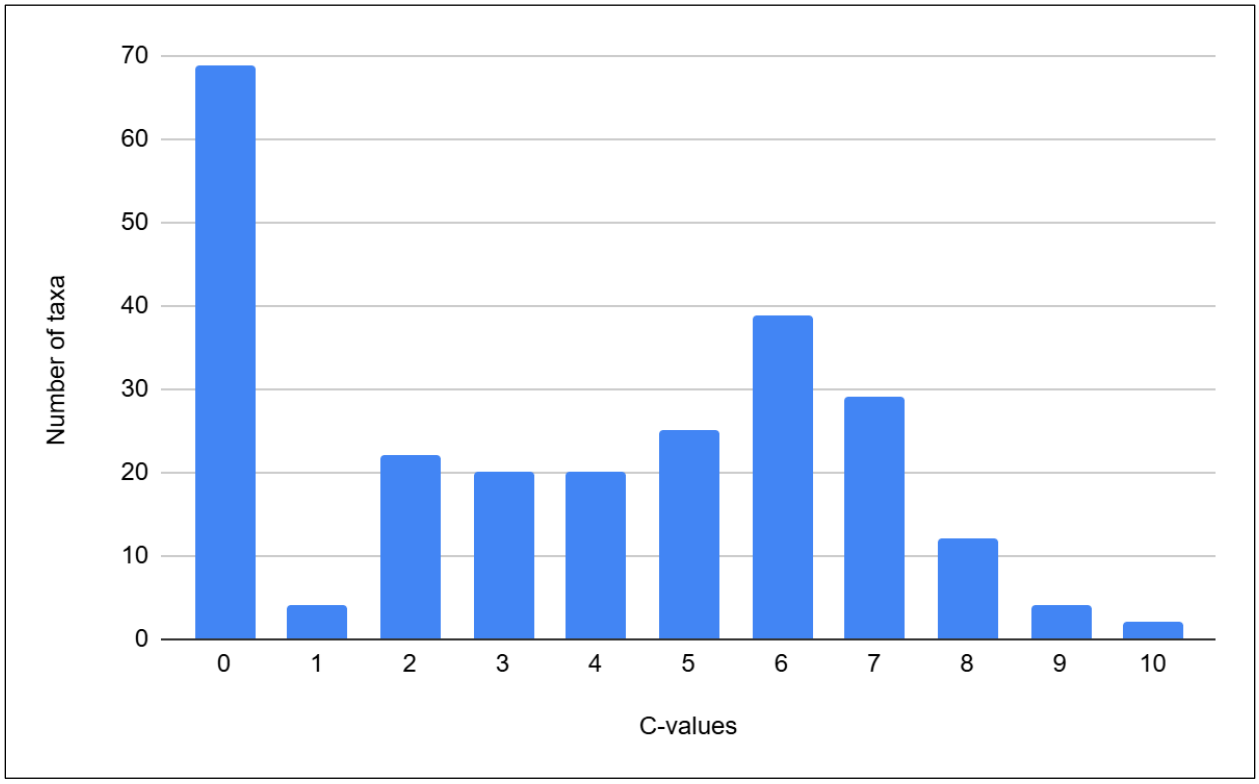


Figure 9. Distribution of C-values for the vascular flora of Camp Nelson National Monument. ALAINA KRAKOWIAK

To assess the floristic quality of a site, the C-values of all species found can be averaged to produce the mean C-value ($\underline{C}$). It is generally accepted that a $\underline{C}$ greater than 3.5 is an indicator of at least marginal natural quality, and $\underline{C}$ is 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 $\underline{C}$ for the flora of Camp Nelson National Monument is 3.67, indicating that it is slightly above the rank of marginal, natural quality habitat.

Non-Native Species

Sixty-eight (about 27%) 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 or well-documented 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 11 Severe Threats (Table 4 in Appendix B), 10 Significant Threats (Table 5 in Appendix B), and five Watch List species (Table 6 in Appendix B).

Two invasive species in particular pose the most severe threats to native habitat at Camp Nelson National Monument: Amur honeysuckle (*Lonicera maackii*) and Japanese stilt grass (*Microstegium vimineum*). *Lonicera maackii* is abundant in the wooded back portion of the park. This invasive, deciduous shrub grows densely in the mid-story of woodlands and forests, shading out native herbaceous plants that occur in the understory. It is most easily identified in early spring, as it leafs out prior to any native species. It has oval-shaped, opposite leaves, small, fragrant white flowers, and produces a large amount of bright red berries in the fall (Figure 10). These berries have low nutritional value to native birds, though they readily eat them and disperse the seeds. *Microstegium vimineum* is an invasive annual grass that can quickly form a dense monoculture along the forest floor, outcompeting native species (Figure 11). During the time of this study, it was found sparsely throughout the wooded portion of the park, but it will likely increase at an exponential rate if left untreated. Treatment techniques for these two species are described in the following section.

Restoration Recommendations

The primary restoration goal at Camp Nelson National Monument should be to restore and stabilize the woodlands in the eastern portion of the park. This area supports most of the native species at Camp Nelson National Monument, including two rare species and a globally rare vegetation alliance (NatureServe 2024). The author suggests taking a cautious, multi-step approach to tackling this complex issue (Table 7 in Appendix C).

First and foremost, invasive bush honeysuckle (*Lonicera maackii*) needs to be treated. The best time to identify and mark individuals is in the early spring, as it is the first woody plant to leaf out. *Lonicera maackii* is also easily recognized in the fall by its bright red berries (Figure 8). Small individuals can be hand-pulled when the soil is moist, but this approach should be used with caution as it causes soil disturbance, which could lead to other invasive species issues. Small areas of disturbed soil can be tamped down by foot.



Figure 10. Left: Bush honeysuckle (*Lonicera maackii*) in fruit. Right: A small *L. maackii* individual growing over top one of the park's rare species, Kentucky wild pink (*Silene caroliniana* var. *wherryi*). ALAINA KRAKOWIAK



Figure 11. Left: A large population of Japanese stilt grass (*Microstegium vimineum*) forming a monoculture over the forest floor (photo taken at Mill Springs Battlefield). Right: Close-up shot of *M. vimineum*. ALAINA KRAKOWIAK

The best way to permanently kill invasive woody species like *L. maackii* is the cut-stump method (Figure 12). 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). As always, follow label instructions when using herbicide. This species typically has multiple trunks (hence the name "bush" honeysuckle), 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 12. 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 important consideration will be what to do with all the woody debris. While debris could be left on-site, it may take a long time for it to fully break down, and in the meantime it would still potentially be smothering native plants in the understory. While labor intensive, it would be best to move debris off-site if possible, perhaps into an open area of the park where it could be arranged into a manageable burn pile.

After *Lonicera maackii* is removed, invasive herbaceous species like *Microstegium vimineum* that currently occur in low levels may undergo a population boom. While *M. vimineum* poses a major threat due to its ability to spread quickly, it is manageable if dealt with early. This species 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. Unfortunately, *M. vimineum* seeds can remain viable in the seedbank for several years, so it may take multiple rounds of treatment to fully eradicate. Another option is foliar application of grass-specific herbicide (such as clethodim), though great caution must be taken when using this method to avoid killing native grasses. 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.

Another restoration goal is to target invasive species around the cliff edge, particularly in areas with open outcroppings of limestone, such as where cliff diamond flower (*Houstonia rupestris*) occurs. When working around rare species, it is vital to take a "scalpel approach" to invasive species removal, meaning that extreme caution must be taken to avoid harming non-target species. "Bingo daubers" can be used to apply herbicide to small woody stems in a highly precise way (Figure 12). Non-native herbaceous plants occurring in the proximity of rare native species will pose the biggest challenge.

An additional goal at Camp Nelson National Monument could be to reconstruct a native grassland in the park's upland front country area. 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 8 in Appendix C). There are multiple factors to consider when selecting a site for grassland reconstruction. Firstly, site preparation would be easier in an area of native, ruderal species than somewhere heavily dominated by Johnson grass (*Sorghum halapense*), as this species is particularly hard to kill. The site should also be easily accessible by large equipment like tractors, as these will be needed for the seeding process. Additionally, the site should not directly border the back woodland, 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. Firstly, the budget will dictate the level of diversity that can be achieved.

Fifteen species would be a good minimum, though more is always better. Additionally, it is important to determine the desired stature of plants–for example, park superintendent Ernie Price mentioned to the author that he would not want to plant an area with head-height tallgrass prairie species, as these would impede the sweeping views that Camp Nelson National Monument is known for. It is also critical to choose species that are appropriate for the Bluegrass region. This is a challenge in an area where so little native vegetation remains, but regional protected natural areas can be used as "reference sites." Crooked Creek State Nature Preserve and Pine Creek Barrens Nature Preserve both occur in the Bluegrass physiographic region of Kentucky; the flora of these sites could be analyzed to develop a species mix for Camp Nelson National Monument. 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 also 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 start to look more "filled in," and a few faster-growing species might flower in abundance. At this point, people sometimes mistakenly think that 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 Bluegrass 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.

If the park wished to reconstruct habitat that more closely resembled an oak savanna, as described earlier in this report, the site preparation and planting process would essentially be the same as above, with the addition of planting a small number of widely-spaced oak trees, such as bur oaks (*Quercus macrocarpa*). It would, of course, take many years for these trees to grow into the large, wide-branching individuals typical of historical oak savannas, but as the saying goes, "the best time to plant a tree is yesterday." The final goal would be to have about 15 mature oak trees per acre. If bare root saplings are used, the number of trees planted should take into consideration the approximately 40% mortality rates that can be expected with trees of this age. So, in a 1-acre (0.4 hectare) site, 25 bare root saplings should be planted to eventually achieve a density of 15 trees per

acre. Additionally, saplings should be planted in small clusters or "tree islands." If larger trees (≤ 10–15 gallons [37.9–56.8 liters]) are planted, much lower mortality rates can be expected. It is important to note that maintaining an oak savanna is slightly more complicated than maintaining a treeless grassland. Young oak trees will initially need to be protected from fire, haying, and/or mowing. Once the trees have matured enough to start dropping acorns, it will be very important to ensure that the site doesn't become overrun by oak saplings, which could choke out the native grasses and forbs in the understory.

Conclusions

While much of Camp Nelson National Monument has been converted to ruderal fields, the park still supports native plant species, especially in the wooded back portion of the park. This area hosts two rare species and a globally rare vegetation association, and with careful restoration, could be truly spectacular. Additionally, the open areas of the park pose an exciting opportunity for grassland reconstruction. Very little native vegetation of the Kentucky Bluegrass region remains, so if Camp Nelson National Monument can meet the challenge of combining historical preservation with the restoration and reconstruction of native vegetation on the sweeping landscapes it protects, it would be extremely 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.



A stormy, July afternoon at Camp Nelson National Monument provides a much-needed breeze at the end of a hot day of field work. ALAINA KRAKOWIAK

Appendix A. Voucher Specimens Collected at Camp Nelson National Monument

Table 1. Voucher specimens collected at Camp Nelson National Monument. Coll.=Collector, AK=Alaina Krakowiak, Coll. Date=Collection date. Locality note: “Camp Nelson National Monument, Nicholasville, KY” should be appended to the beginning of each locality string (was not included in table due to space constraints).

Accession #	Coll.	Coll. date	Family	Scientific name	Common name	County	Native/ Exotic	Locality	Lat., Long.	Reason for collection
CANE-0001	AK	24 Apr. 2024	Poaceae	*Anthoxanthum odoratum*	sweet vernal grass	Jessamine	Exotic	Fallow fields south of Long Fort Trail loop.	37.794, -84.590	County record
CANE-0002	AK	24 Apr. 2024	Cyperaceae	*Carex muehlenbergii* var. *enervis*	Muhlenberg’s sedge	Jessamine	Native	Fallow fields south of Long Fort Trail loop.	37.794, -84.590	County record
CANE-0003	AK	24 Apr. 2024	Caryophyllaceae	*Sabulina diffusa*	diffuse sandwort	Jessamine	Native	Limestone outcrop on Fort Jones Overlook Trail, just north of Fort Jones.	37.790675, -84.587308	Newly described sp.
CANE-0004	AK	24 Apr. 2024	Cyperaceae	*Carex hitchcockiana*	Hitchcock’s sedge	Jessamine	Native	Calcareous oak forest in vicinity of easternmost marked overlook along Fort Jones Overlook Trail.	37.789442, -84.588339	High C-value species
CANE-0005	AK	24 Apr. 2024	Cyperaceae	*Carex kraliana*	Kral’s sedge	Jessamine	Native	Calcareous oak forest in vicinity of easternmost marked overlook along Fort Jones Overlook Trail.	37.789, -84.589	County record
CANE-0006	AK	24 Apr. 2024	Cyperaceae	*Carex albursina*	white bear sedge	Jessamine	Native	Calcareous oak forest in vicinity of easternmost marked overlook along Fort Jones Overlook Trail.	37.789519, -84.588819	County record
CANE-0007	AK	24 Apr. 2024	Cyperaceae	*Carex albicans*	white-tinged sedge	Jessamine	Native	Calcareous oak forest in vicinity of Fort Jones, along Fort Jones Overlook Trail.	37.789933, -84.587175	County record

Accession #	Coll.	Coll. date	Family	Scientific name	Common name	County	Native/ Exotic	Locality	Lat., Long.	Reason for collection
CANE-0008	AK	9 Jul. 2024	Poaceae	*Agrostis gigantea*	redtop	Jessamine	Exotic	Moist soil just downstream of Officers' Spring.	37.795589, -84.601858	County record
CANE-0009	AK	9 Jul. 2024	Poaceae	*Elymus riparius*	Eastern riverbank wild rye	Jessamine	Native	Edge of calcareous oak forest, where the Long Fort Trail enters the woodland from the open fields.	37.793237, -84.587758	County record
CANE-0010	AK	9 Jul. 2024	Poaceae	*Setaria parviflora*	knotroot bristle grass	Jessamine	Native	Limestone outcrop overlooking Hickman Creek (westernmost marked overlook along Fort Jones Overlook Trail).	37.788456, -84.589736	County record
CANE-0011	AK	9 Jul. 2024	Rubiaceae	*Houstonia rupestris*	cliff diamond flower	Jessamine	Native	Limestone outcrop overlooking Hickman Creek (westernmost marked overlook along Fort Jones Overlook Trail).	37.788456, -84.589736	County record

Appendix B. Floristic Findings at Camp Nelson National Monument

Table 2. Rare species of Camp Nelson National Monument with state and global ranks.

Scientific name	Common name	State rank	Global rank
Houstonia rupestris	cliff diamond flower	not ranked*	not ranked
Silene caroliniana var. *wherryi*	Kentucky wild pink	S3	T3 variety

*(see explanation in Rare Species section)

Table 3. High C-value species (≥8) found at Camp Nelson National Monument.

C-value	Scientific name	Common name	Habit
8	*Asclepias quadrifolia*	whorled milkweed	forb
8	*Asplenium resiliens*	blackstem spleenwort	fern
8	*Carex albursina*	white bear sedge	graminoid
8	*Conopholis americana*	bear corn	forb
8	*Elymus riparius*	riverbank wild rye	graminoid
8	*Fraxinus quadrangulata*	blue ash	tree
8	*Geum virginianum*	cream avens	forb
8	*Phacelia bipinnatifida*	fern leaf phacelia	forb
8	*Phacelia purshii* var. *purshii*	Miami mist	forb
8	*Solidago sphacelata*	limestone goldenrod	forb
8	*Symphyotrichum novae-angliae*	New England aster	forb
8	*Trillium sessile*	sessile trillium	forb
9	*Corallorhiza wisteriana*	spring coral root	forb
9	*Pellaea atropurpurea*	purple cliff brake	fern
9	*Thalictrum dioicum*	early meadow rue	forb
9	*Woodsia obtusa*	blunt-lobed cliff fern	forb
10	*Carex hitchcockiana*	Hitchcock’s sedge	graminoid
10	*Ribes cynosbati*	prickly gooseberry	shrub

Table 4. Kentucky Exotic Pest Plant Council (KY-EPPC) “Severe Threat” species of Camp Nelson National Monument.

Scientific name	**Common name**	**Habit**
Ailanthus altissima	tree of heaven	tree
Alliaria petiolata	garlic mustard	forb
Carduus nutans	musk thistle	forb
Conium maculatum	poison hemlock	forb
Ligustrum sinense	Chinese privet	shrub/small tree
Lonicera maackii	Amur honeysuckle	shrub
Microstegium vimineum	Japanese stilt grass	graminoid
Pyrus calleryana	Callery pear	tree
Rosa multiflora	multiflora rose	shrub
Sorghum halapense	Johnson grass	graminoid
Stellaria media	common chickweed	forb

Table 5. KY-EPPC “Significant Threat” species of Camp Nelson National Monument.

Scientific name	**Common name**	**Habit**
Daucus carota	Queen Anne’s lace	forb
Galium pedemontanum	Piedmont bedstraw	forb
Kummerowia striata	Japanese clover	forb
Leucanthemum vulgare	oxeye daisy	forb
Mentha xpiperata var. *piperata*	peppermint	forb
Morus alba	white mulberry	tree
Mummenhofia alliacea	garlic pennycress	forb
Ornithogalum umbellatum	star of bethlehem	forb
Poa pratensis	Kentucky bluegrass	graminoid
Verbascum thapsus	mullein	forb

Table 6. KY-EPPC “Watch List” species of Camp Nelson National Monument.

Scientific name	**Common name**	**Habit**
Hibiscus syriacus	rose of Sharon	shrub
Trifolium campestre	hop clover	forb
Trifolium pratense	red clover	forb
Trifolium repens	white clover	forb
Vicia sativa	common vetch	forb

Annotated List of Plant Taxa of Camp Nelson National Monument

Key to taxon annotations:

underline = species not previously documented in Jessamine county (SERNEC 2024).

* = Introduced species. (TNKY Plant Atlas).

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

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

!=Introduced species that are on the “watch list” for Kentucky (KY-EPPC 2013).

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

Key to habitat abbreviations:

fd=fields/open, treeless areas

wd=woodland in back portion of park

Key to relative abundance abbreviations:

c= common

u=uncommon

r= rare

FERNS & FERN ALLIES

Aspleniaceae

Asplenium platyneuron – wd; c

Asplenium resiliens – wd; u

Cystopteridaceae

Cystopteris tennesseensis – wd; u

Dryopteridaceae

Polystichum acrostichoides – wd; c

Ophioglossaceae

Botrypus virginianus – wd; u

Sceptridium dissectum – wd; u

Polypodiaceae

Pleopeltis michauxiana – wd; u

Pteridaceae

Pellaea atropurpurea – wd; r

Woodsiaceae

Woodsia obtusa – wd; c

GYMNOSPERMS

Cupressaceae

Juniperus virginiana – fd, wd; c

MONOCOTS

Alliaceae

Allium canadense – fd; u

**Allium vineale* – fd; u

Nothoscordum bivalve – fd; u

Araceae

Arisaema dracontium – wd; r

Arisaema triphyllum – fd; c

Lemna sp. – fd; r

Colchicaceae

Uvularia perfoliata – wd; u

Commelinaceae

**Commelina communis* – fd, wd; u

Cyperaceae

Carex albicans – wd; u

Carex albursina – wd; c

Carex amphibola – wd; u

Carex hitchcockiana – wd; u

Carex kraliana – fd; c

Carex leavenworthii – fd; u

Carex muehlenbergii var. *enervis* – fd, wd; u

Carex retroflexa – fd; u

Cyperus strigosus – fd; c

Dioscoreaceae

Dioscorea villosa – wd; c

Hyacinthaceae

***Ornithogalum umbellatum* – fd; r

Hypoxidaceae

Hypoxis hirsuta – wd; u

Liliaceae

Erythronium albidum – wd; c

Lilium sp. – wd; r

Orchidaceae

Corallorhiza wisteriana – wd; r

Tipularia discolor – wd; u

Poaceae

**Agrostis gigantea* – fd; c

Andropogon virginicus – fd; c

**Anthoxanthum odoratum* – fd; c

**Dactylis glomerata* – fd; c

Danthonia spicata – wd; c

Diarrhena americana – wd; c

Dichanthelium boscii – wd; u

Dichanthelium clandestinum – fd, wd; u

Elymus hystrix – wd; c

Elymus riparius – wd; u

Elymus villosus – wd; c

Elymus virginicus – wd; u

Eragrostis spectabilis – fd; r

***Microstegium vimineum* – wd; c

**Paspalum dilatatum* – fd; c

**Phleum pratense* – fd; c

***Poa pratensis* – fd; c

Schizachyrium scoparium – fd, wd; u

Setaria parviflora – fd, wd; u

**Setaria pumila* – fd; u

****Sorghum halapense* – fd; c

Tridens flavus – fd; c

Ruscaceae

Maianthemum racemosum – wd; c

Polygonatum biflorum var. *biflorum* – wd; c

Smilacaceae

Smilax bona-nox – wd; c

Smilax herbacea – wd; u

Smilax hispida – wd; c

Trilliaceae

Trillium sessile – wd; u

DICOTS

Acanthaceae

Ruellia caroliniensis – fd, wd; u

Adoxaceae

Sambucus canadensis – wd; u

Viburnum rufidulum – wd; c

Anacardiaceae

Rhus aromatica – wd; c

Toxicodendron radicans – wd; c

Annonaceae

Asimina triloba – wd; u

Apiaceae

Chaerophyllum tainturieri – fd, wd; c

****Conium maculatum* – fd; c

Cryptotaenia canadensis – fd, wd; u

***Daucus carota* – fd; c

Osmorhiza longistylis – fd, wd; c

Sanicula odorata – wd; c

**Torilis helvetica* – fd; c

Apocynaceae

Apocynum cannabinum – fd; c

Asclepias exaltata – wd; r

Asclepias quadrifolia – wd; u

Asclepias syriaca – fd; c

Asteraceae

Achillea gracilis – fd; u

Ageratina altissima – fd, wd; c

Ambrosia artemisiifolia – fd; c

Ambrosia trifida – fd; c

*<u>*Arctium minus*</u> – fd; u

Brickellia eupatorioides – fd; u

***<u>*Carduus nutans*</u> – fd; u

*<u>*Cichorium intybus*</u> – fd; c

Elephantopus carolinianus – fd, wd; u

Erigeron philadelphicus var. *philadelphicus* – fd; u

<u>*Erigeron strigosus*</u> – fd; u

Helianthus microcephalus – wd; c

*<u>*Lactuca serriola*</u> – fd; u

***Leucanthemum vulgare* – fd; c

*<u>*Matricaria discoidea*</u> – fd; r

Nabalus altissimus – wd; c

Packera obovata – wd; u

Polymnia canadensis – wd; c

Solidago altissima – fd; c

Solidago sphacelata – wd; r

Solidago ulmifolia – wd; c

Symphyotrichum lateriflorum – fd; u

Symphyotrichum novae-angliae – fd; r

Symphyotrichum oblongifolium – wd; r

Symphyotrichum ontarionis – fd, wd; u

Symphyotrichum pilosum var. *pilosum* – fd; c

Symphyotrichum racemosum var. *subdumosum* – fd; c

Symphyotrichum undulatum – wd; c

Symphyotrichum shortii – wd; r

**Taraxacum officinale* – fd; u

Verbesina occidentalis – fd, wd; c

Verbesina virginica – fd, wd; c

Vernonia gigantea – fd; c

Berberidaceae

Podophyllum peltatum – wd; c

Betulaceae

Ostrya virginiana – wd; u

Bignoniaceae

Bignonia capreolata – wd; c

Campsis radicans – fd; c

**Catalpa bignonioides* – fd; u

Boraginaceae

Andersonglossum virginianum – wd; u

**Buglossoides arvensis* – wd; c

Phacelia bipinnatifida – fd; u

Phacelia purshii var. purshii – fd; c

Brassicaceae

****Alliaria petiolata* – wd; c

**Barbarea vulgaris* – fd; c

Borodinia laevigata – wd; u

**Capsella bursa-pastoris* – fd; c

Cardamine concatenata – wd; c

**Cardamine hirsuta* – fd, wd; c

**Lepidium campestre* – fd; c

***Mummenhofia alliacea* – fd; c

Cactaceae

Opuntia cespitosa – fd; r

Campanulaceae

Campanulastrum americanum – wd; u

Lobelia inflata – wd; u

Cannabaceae

Celtis occidentalis – fd, wd; c

Caprifoliaceae

****Lonicera maackii* – wd; c

Symphoricarpos orbiculatus – wd; c

Valerianella radiata – fd; c

Caryophyllaceae

**Dianthus armeria* – fd; u

Sabulina diffusa – wd; r

Sabulina patula – wd; r

Silene caroliniana var. *wherryi* **(S3)** – wd; r

**Silene latifolia* – fd; u

***Stellaria media* – fd, wd; u

Celastraceae

Euonymus atropurpureus – wd; u

**Euonymus fortunei* – wd; c

Convolvulaceae

**Convolvulus arvensis* – fd; u

Convolvulus fraterniflorus – fd; r

Cornaceae

Cornus florida – wd; u

Crassulaceae

Sedum ternatum – wd; u

Fabaceae

Cercis canadensis – wd; c

Desmodium paniculatum – wd; u

Gleditsia triacanthos – fd, wd; u

Hylodesmum nudiflorum – wd; u

***Kummerowia striata* – fd; c

Lespedeza procumbens – wd; u

Robinia pseudoacacia – wd; c

!*Trifolium campestre* – fd; c

!*Trifolium pratense* – fd; c

!*Trifolium repens* – fd; c

!*Vicia sativa* – fd; u

Fagaceae

Fagus grandifolia – wd; u

Quercus muehlenbergii – wd; c

Quercus palustris – fd; r

Quercus rubra – wd; c

Geraniaceae

Geranium carolinianum – fd; c

Grossulariaceae

Ribes cynosbati – wd; r

Hypericaceae

**Hypericum perforatum* – fd; u

Hypericum punctatum – wd; u

Juglandaceae

Carya ovata – wd; c

Carya tomentosa – wd; c

Juglans nigra – fd, wd; u

Lamiaceae

**Lamium amplexicaule* – fd; c

**Lamium purpureum* – fd; u

***Mentha xpiperata* var. *piperata* – fd; r

Phryma leptostachya – wd; u

**Prunella vulgaris* – fd; c

Salvia lyrata – fd, wd; u

Lauraceae

Sassafras albidum – fd, wd; u

Malvaceae

!*Hibiscus syriacus* – fd; r

Menispermaceae

Menispermum canadense – fd; u

Montiaceae

Claytonia virginica – fd, wd; c

Moraceae

**Maclura pomifera* – fd; u

***Morus alba* – fd; u

Morus rubra – fd; u

Oleaceae

Fraxinus americana – wd; c

Fraxinus quadrangulata – wd; c

****Ligustrum sinense* – wd; u

Orobanchaceae

Aphyllon uniflorum – wd; r

Conopholis americana – wd; c

Dasistoma macrophylla – wd; u

Oxalidaceae

Oxalis dillenii – fd, wd; c

Oxalis violacea – wd; c

Papaveraceae

Corydalis flavula – wd; c

Dicentra cucullaria – wd; u

Passifloraceae

Passiflora incarnata – fd; c

Passiflora lutea – wd; r

Phytolaccaceae

Phytolacca americana – fd; c

Plantaginaceae

**Plantago lanceolata* – fd; c

Plantago virginica – fd; c

**Veronica arvensis* – fd; c

**Veronica hederifolia* – fd; c

Platanaceae

Platanus occidentalis – fd; u

Polemoniaceae

Phlox divaricata – wd; u

Polygonaceae

**Acetosa acetosella* – fd; c

Persicaria hydropiperoides – fd; r

**Persicaria maculosa* – fd; u

**Rumex crispus* – fd; u

Ranunculaceae

Delphinium tricorne – wd; u

**Ranunculus bulbosus* – fd; u

Ranunculus micranthus – fd, wd; u

Thalictrum dioicum – wd; u

Thalictrum thalictroides – wd; c

Aquilegia canadensis – wd; r

Clematis viorna – wd; u

Rhamnaceae

Frangula caroliniana – wd; c

**Rhamnus davurica* – fd; u

Rosaceae

Agrimonia parviflora – fd, wd; u

Fragaria virginiana – fd, wd; r

Geum canadense – fd; r

Geum vernum – wd; u

Geum virginianum – wd; u

**Potentilla indica* – fd; c

**Potentilla recta* – fd; c

Prunus serotina – wd; u

****Pyrus calleryana* – fd; u

***Rosa multiflora – fd; c

Rubus allegheniensis – fd; c

Rubus flagellaris – fd; c

Rubiaceae

Galium circaezans – fd, wd; c

**Galium pedemontanum – fd; c

Galium triflorum – fd, wd; c

Houstonia rupestris **(SNR)** – wd; r

*Sherardia arvensis – fd; c

Sapindaceae

Acer negundo – wd; c

Acer nigrum – wd; u

Acer saccharum – wd; c

Aesculus flava – wd; u

Aesculus glabra – wd; r

Saxifragaceae

Micranthes virginiensis – wd; u

Scrophulariaceae

**Verbascum blattaria* – fd; r

***Verbascum thapsus* – fd; u

Simaroubaceae

****Ailanthus altissima* – fd, wd; u

Solanaceae

Solanum carolinense var. *carolinense* – fd; c

Ulmaceae

Ulmus rubra – wd; c

Verbenaceae

Verbena urticifolia – fd; u

Violaceae

**Viola arvensis* – fd; c

Viola palmata var. *palmata* – wd; c

Viola pubescens – wd; u

Vitaceae

Parthenocissus quinquefolia – fd, wd; c

Vitis vulpina – wd; c

Viola sororia – fd, wd; c

List of Plant Taxa of Camp Nelson National Monument Arranged by Growth Habit

FERNS & FERN ALLIES

Asplenium platyneuron

Asplenium resiliens

Botrypus virginianus

Cystopteris tennesseensis

Pellaea atropurpurea

Pleopeltis michauxiana

Polystichum acrostichoides

Sceptridium dissectum

Woodsia obtusa

TREES & SHRUBS

Acer negundo

Acer nigrum

Acer saccharum

Aesculus flava

Aesculus glabra

Ailanthus altissima

Asimina triloba

Carya ovata

Carya tomentosa

Catalpa bignonioides

Celtis occidentalis

Cercis canadensis

Cornus florida

Euonymus atropurpureus

Fagus grandifolia

Frangula caroliniana

Fraxinus americana

Fraxinus quadrangulata

Gleditsia triacanthos

Hibiscus syriacus

Juglans nigra

Juniperus virginiana

Ligustrum sinense

Lonicera maackii

Maclura pomifera

Morus alba

Morus rubra

Ostrya virginiana

Platanus occidentalis

Prunus serotina

Pyrus calleryana

Quercus muehlenbergii

Quercus palustris

Quercus rubra

Rhamnus davurica

Rhus aromatica

Ribes cynosbati

Robinia pseudoacacia

Rosa multiflora

Sambucus canadensis

Sassafras albidum

Symphoricarpos orbiculatus

Ulmus rubra

Viburnum rufidulum

WOODY VINES

Bignonia capreolata

Campsis radicans

Euonymus fortunei

Parthenocissus quinquefolia

Rubus allegheniensis

Rubus flagellaris

Smilax bona-nox

Smilax hispida

Toxicodendron radicans

Vitis vulpina

GRAMINOIDS

Agrostis gigantea

Andropogon virginicus

Anthoxanthum odoratum

Carex albicans

Carex albursina

Carex amphibola

Carex hitchcockiana

Carex kraliana

Carex leavenworthii

Carex muehlenbergii var. *enervis*

Carex retroflexa

Cyperus strigosus var. *strigosus*

Dactylis glomerata

Danthonia spicata

Diarrhena americana

Dichanthelium boscii

Dichanthelium clandestinum

Elymus hystrix

Elymus riparius

Elymus villosus

Elymus virginicus

Eragrostis spectabilis

Microstegium vimineum

Paspalum dilatatum

Phleum pratense

Poa pratensis

Schizachyrium scoparium

Setaria parviflora

Setaria pumila

Sorghum halapense

Tridens flavus

FORBS

Acetosa acetosella

Achillea gracilis

Ageratina altissima

Agrimonia parviflora

Alliaria petiolata

Allium canadense

Allium vineale

Ambrosia artemisiifolia

Ambrosia trifida

Andersonglossum virginianum

Aphyllon uniflorum

Apocynum cannabinum

Aquilegia canadensis

Arctium minus

Arisaema dracontium

Arisaema triphyllum

Asclepias exaltata

Asclepias quadrifolia

Asclepias syriaca

Barbarea vulgaris

Borodinia laevigata

Brickellia eupatorioides

Buglossoides arvensis

Campanulastrum americanum

Capsella bursa-pastoris

Cardamine concatenata

Cardamine hirsuta

Carduus nutans

Chaerophyllum tainturieri

Cichorium intybus

Claytonia virginica

Clematis viorna

Commelina communis

Conium maculatum

Conopholis americana

Convolvulus arvensis

Convolvulus fraterniflorus

Corallorhiza wisteriana

Corydalis flavula

Cryptotaenia canadensis

Dasistoma macrophylla

Daucus carota

Delphinium tricorne

Desmodium paniculatum

Dianthus armeria

Dicentra cucullaria

Dioscorea villosa

Elephantopus carolinianus

Erigeron philadelphicus var. *philadelphicus*

Erigeron strigosus

Erythronium albidum

Fragaria virginiana

Galium circaezans

Galium pedemontanum

Galium triflorum

Geranium carolinianum

Geum canadense

Geum vernum

Geum virginianum

Helianthus microcephalus

Houstonia rupestris

Hylodesmum nudiflorum

Hypericum perforatum

Hypericum punctatum

Hypoxis hirsuta

Kummerowia striata

Lactuca serriola

Lamium amplexicaule

Lamium purpureum

Lemna sp.

Lepidium campestre

Lespedeza procumbens

Leucanthemum vulgare

Lilium sp.

Lobelia inflata

Maianthemum racemosum

Matricaria discoidea

Menispermum canadense

Mentha xpiperata var. *piperata*

Micranthes virginiensis

Mummenhofia alliacea

Nabalus altissimus

Nothoscordum bivalve

Opuntia cespitosa

Ornithogalum umbellatum

Osmorhiza longistylis

Oxalis dillenii

Oxalis violacea

Packera obovata

Passiflora incarnata

Passiflora lutea

Persicaria hydropiperoides

Persicaria maculosa

Phacelia bipinnatifida

Phacelia purshii var. *purshii*

Phlox divaricata

Phryma leptostachya

Phytolacca americana

Plantago lanceolata

Plantago virginica

Podophyllum peltatum

Polygonatum biflorum var. *biflorum*

Polymnia canadensis

Potentilla indica

Potentilla recta

Prunella vulgaris

Ranunculus bulbosus

Ranunculus micranthus

Ruellia caroliniensis

Rumex crispus

Sabulina diffusa

Sabulina patula

Salvia lyrata

Sanicula odorata

Sedum ternatum

Sherardia arvensis

Silene caroliniana var. *wherryi*

Silene latifolia

Smilax herbacea

Solanum carolinense var. *carolinense*

Solidago altissima

Solidago sphacelata

Solidago ulmifolia

Stellaria media

Symphyotrichum lateriflorum

Symphyotrichum novae-angliae

Symphyotrichum pilosum var. pilosum

Symphyotrichum oblongifolium

Symphyotrichum ontarionis

Symphyotrichum racemosum var. *subdumosum*

Symphyotrichum shortii

Symphyotrichum undulatum

Taraxacum officinale

Thalictrum dioicum

Thalictrum thalictroides

Tipularia discolor

Torilis helvetica

Trifolium campestre

Trifolium pratense

Trifolium repens

Trillium sessile

Uvularia perfoliata

Valerianella radiata

Verbascum blattaria

Verbascum thapsus

Verbena urticifolia

Verbesina occidentalis

Verbesina virginica

Vernonia gigantea

Veronica arvensis

Veronica hederifolia

Vicia sativa

Viola arvensis

Viola pubescens

Viola palmata var. *palmata*

Viola sororia

Appendix C. Woodland Restoration and Grassland Reconstruction Recommendations

Table 7. Proposed timeline for woodland restoration.

Time	**Action**
Jan.-Feb. 2025	Scout/map areas open limestone outcroppings throughout eastern edge of woodlands (easiest during leaf off) to eventually prioritize for restoration.
Mar.-Apr. 2025	Mark *Lonicera maackii* individuals with spray paint or flagging tape.
Apr.-Jul. 2025	Survey for and map existing patches of *M. vimineum* that might respond strongly to *L. maackii* removal.
Jul.-Oct. (-Nov., or until dormant period) 2025	Heavily prioritize cut-stump treatment of *L. maackii.*
Dec. 2025	Burn woody debris in a safe area, when weather allows.
Mar.-Apr. 2026	Mark *Lonicera maackii* individuals with spray paint or flagging tape.
Apr.-Jul. 2026	Survey for newly developed large patches of *Microstegium vimineum.*
Jul.-Aug. 2026	Cut-stump treatment of *L. maackii*. Carefully treat woody species in/around priority limestone outcrops.
Aug.-Sep. 2026	Weed whack *M. vimineum* (before it produces seed, but late enough in the season that it won't have the chance to grow up and produce more seed)
Sep.-Oct. (-November, or until dormant period) 2026	Continue cut-stump treatment of *L. maackii*. Continue treatment of woody species in/around limestone outcrops.

Table 8. 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.
2026 - Nov. 2028	Monitor progress of planting. Spot treat invasive species as needed.
Nov./Dec. 2028	First prescribed burn or haying of reconstructed grassland.

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