National Park Service
U.S. Department of the Interior

Science Report NPS/SR—2026/374
https://doi.org/10.36967/2315976

Richmond National Battlefield Park

Grassland Inventory and Assessment



Several field units as observed from Malvern Hill Union artillery line, November 27, 2023.
J.C. LUDWIG

Richmond National Battlefield Park: Grassland Inventory and Assessment

Science Report NPS/SR—2026/374

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Please cite this publication as:

Ludwig, J.C., P.A. Barlow, and T. Witsell. 2026. Richmond National Battlefield Park: Grassland Inventory and Assessment. Science Report NPS/SR—2026/374. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/2315976

NPS 367/198636, January 2026

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Abstract

This report summarizes the results of plant, insect, and bird inventory and monitoring work conducted in several units at Richmond National Battlefield Park (RICH) between June 2022 and April 2024, with the integration of supplemental plant data from fire effects monitoring transects collected prior to 2022. Study sites included open field units at Malvern Hill Battlefield (plants, insects, birds) and Gaines' Mill Battlefield (plants, insects, birds), and a woodland unit at Cold Harbor Battlefield (insects). Annotated lists are provided for each group, documenting species occurrence in each unit. Current grassland condition assessments, desired future conditions, management recommendations, and future assessment protocols are provided for each unit based on assessments of the species groups and comparisons to reference sites. This report also includes background information on grasslands in Virginia, including information on grassland classification, protection, restoration, and management, and grassland research and monitoring needs. It includes nine figures, six tables, and eight appendices.

Acknowledgments

We are grateful to Kristen Allen, Integrated Resources Program Manager at Richmond National Battlefield Park, for her insight, field coordination, and assistance. We also appreciate the staff of the Virginia Natural Heritage Program for their high-quality data on the biodiversity of Virginia which informed this work. The National Park Service Natural Resource Condition Assessment Program provided funding for this project.



Left: Southeastern Grasslands Institute (SGI) logo; Right: Austin Peay State University.
SGI

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Introduction

It is becoming increasingly understood that although eastern grasslands require anthropogenic disturbance to sustain them, they are a significant natural habitat harboring numerous threatened or rare bird and insect species as well as a large diversity of grassland-endemic grasses and forbs. As described in a 2012 Valley Forge technical report, grasslands and meadows have unique significance for biological diversity conservation (Latham 2012). Worldwide, the ratio of area destroyed to area protected is ten to one for temperate grasslands and shrublands, which is five times higher than for tropical rainforest (Hoekstra et al. 2004). The situation is even more critical in eastern North America, where native grasslands have faced extreme pressure for more than 300 years, with most areas converted to agricultural, residential, commercial, and other uses. Numerous grassland bird species are classified as endangered, threatened, or rare, and nearly all have undergone significant declines in recent decades. Among Lepidoptera species classified as endangered, threatened or rare, a large percentage depend on grassland and meadow habitats (Latham and Thorne 2007).

At Richmond National Battlefield Park (RICH), over 120 acres of cultural landscape have been managed as native grassland since 2006. While these acres were historically used for agriculture at the time of the Civil War, cultural landscape advisors recognize that native grassland habitat can replicate the look and feel of agricultural land while providing valuable habitat and helping to conserve declining natural communities. Grassland acres will likely increase in the park in future years, as many newly acquired agricultural fields are not suited to crops. Existing grassland patches can be found at three different battlefield units, ranging from 6 acres to 70 acres. These patches were established using a variety of methods over the years, including disking and seeding, treating non-native hayfield species, and allowing native plants to naturally colonize. The park manages the sites by mimicking natural disturbance patterns at slightly different frequencies, employing prescribed burning every 2 to 3 years and/or bush hogging during non-burn years. Additionally, the park maintains a log detailing the establishment and annual management activities for each site.

RICH's grasslands were identified in the park's Resource Stewardship Strategy (RSS) and Natural Resource Condition Assessment (NRCA). The RSS identified several high-priority activities to achieve the short-term goal of managing meadows to support a diverse community of native grassland vegetation, which in turn provides quality habitat for pollinators and other species, including grassland bird species. This goal also emphasizes maintaining large, intact tracts of meadow habitat where possible.

The 2012 NRCA established several "vital signs/indicators" and "reference conditions," although these were established with minimal background knowledge or expertise (Schneider et al. 2012). While the park collects annual data on grassland birds and the Shenandoah National Park Fire Effects Crew conducts regular vegetation surveys, lack of staff expertise has limited the park's understanding of the ecological condition of its grasslands. Research has shown that diversity of grassland plants and animals is highly dependent on management frequency and regimes, suggesting that the full ecological value of these critical habitats may not be fully realized.

The park's goals are to enhance knowledge of grassland site conditions and to use this understanding to develop desired outcomes and re-evaluate vital sign indicators for effective site monitoring. To accomplish these goals, the objectives for this two-year project were established as follows:

1. Survey 7 RICH grasslands (approximately 110 acres) for plant diversity and assemblage structure.
2. Survey 7 RICH grasslands (approximately 110 acres) for invertebrate diversity and assemblage structure.
3. Use survey results, other existing park data, and information from reference sites and models to assess grassland condition with an emphasis on birds, insects and plant species information.
4. Develop biodiversity indices with an emphasis on plant species information.
5. Recommend desired conditions and monitoring indicators that are based on site physical conditions and park cultural landscape mandates.

To accomplish these goals, the park contracted with Austin Peay State University's Southeastern Grasslands Institute (SGI). SGI assembled a team of experts that included local Virginia botanist Chris Ludwig to conduct the botanical surveys and the Mississippi Entomological Museum (Mississippi State University) to conduct the invertebrate surveys. This report presents and discusses the results of this field work.

Background on Grasslands in and near Virginia

For much of the 20th century, it was believed that the Virginia landscape, along with much of the Eastern U.S., was mostly dominated by an uninterrupted forest covering vast areas. This was, in part, shaped by early accounts from European settlers, who described deep impenetrable forests when compared to their relatively-tamed European landscapes. Other settler accounts describing open landscapes were largely ignored or dismissed. This landscape view was further supported because a stunningly successful fire-suppression campaign had allowed large portions of the landscape to succeed into forest by the mid-1900s.

This view is perhaps best illustrated by the often-repeated myth that a squirrel could travel from the Atlantic Ocean to the Mississippi River via tree branches in unbroken forest without ever having to touch the ground.

However, over the last 50 years, a new picture has emerged. Recent scientific investigations have revealed that grasslands were not only present, but also prevalent and ecologically significant in the eastern U.S. before widespread European settlement. Rather than solid forest, the vegetation of Virginia and the East is now believed to have been a mosaic of forest amid more open, herbaceous-dominated habitats. The mounting evidence for this revelation comes from multiple lines including pollen records, fire scar/tree ring analysis, the natural distribution of plants and animals, and conclusions from quantitative vegetation ecology (Estes et al. 2016; Fleming and Patterson 2021; Latham 2012; Noss 2013).

These eastern herbaceous-dominated habitats are now collectively termed grasslands as summarized in Reed Noss's seminal 2013 book "Forgotten Grasslands of the South". To paraphrase: "… a grassland is any natural community or ecosystem in which the herbaceous layer is dominated by grasses, other graminoid (grass-like) plants such as sedges or rushes, and associated forbs. This definition … does not exclude trees so long as the tree canopy is not dense enough to shade-out the graminoid-dominated ground layer." Noss's definition is broad, including diverse states of open vegetation in the east such as salt marshes, bogs, rocky glades, open pinelands, and intermountain prairies.

Research on Classifying, Protecting, Restoring, and Managing Grasslands

As this new grassland paradigm has taken hold with conservationists, land managers, field biologists, and academics, grassland preservation and restoration efforts have flourished throughout the eastern United States. Government agencies, NGOs, universities, and private stakeholders have united around the goal of protecting, restoring, and creating grasslands. As a result, a great deal of research has been conducted to gain a better understanding of grasslands in Virginia and surrounding regions.

Within the region, a majority of the grassland research conducted to date has been aimed at identifying and describing the remaining naturally occurring and anthropogenic (human-maintained) grasslands. The state-funded Virginia Natural Heritage Program has led efforts to study and describe the natural grassland communities of Virginia. Since 1988, vegetation ecologists from the Heritage

Program have identified natural grassland communities throughout the Commonwealth. Using a variety of techniques including aerial photography and geologic maps, ecologists have discovered thousands of grasslands in Virginia, including many with state and national significance. Quantitative vegetation plot sampling was used in these inventories, with over 2,500 plots assessed in naturally maintained grasslands. These grasslands include estuarine, palustrine, and terrestrial sites maintained primarily by hydrological and edaphic factors. In this region, fire and grazing by native herbivores are no longer dominant drivers of natural grasslands, although recent fire reintroduction efforts have begun by several land managing agencies.

The plot data gathered by the Virginia Natural Heritage Program has been combined with similar data from adjacent states to create a state classification of grassland communities (VNHP 2021). This classification is maintained by the Virginia Natural Heritage Program and is also used by NatureServe (the umbrella organization of state natural heritage programs) to support their broader U.S. natural community classification (NatureServe 2024). All Virginia plot data are stored in VegBank, a national repository of vegetation plot data maintained by the Ecological Society of America (Peet et al. 2013).

In contrast to the comprehensive work done on the natural grassland communities, no similar exhaustive inventory or classification effort has been conducted for anthropogenic (human-maintained) grasslands in the greater Virginia region. However, several private, non-governmental organizations, most notably the Clifton Institute and the Piedmont Discovery Center (formerly the Center for Urban Habitats), have been conducting inventories and vegetation plot sampling to better understand these areas (Clifton Institute 2024; Piedmont Discovery Center 2024). In addition, an inventory for rare plants on transmission and distribution powerline rights-of-ways has been conducted by Virginia Natural Heritage in partnership with Dominion Power. This inventory has led to customized management of numerous large, human-maintained grassland sites, which may contain remnant flora of formerly more extensive natural grasslands.

Research on the management of grasslands has also been studied, though not as exhaustively, and many management questions remain.

The Clifton Institute has been actively researching anthropogenic (human-maintained) grassland systems and is currently conducting a study to determine best management practices for planted native meadows. Numerous national parks, including Richmond National Battlefield Park and others in Virginia and nearby states, have explored how best to manage their grassland units. While the role of fire in grassland management has been studied in the region, there has been very little research on this topic specifically in Virginia.

In natural grasslands, the Virginia Natural Heritage Program has studied visitor impacts on xeric outcrop grasslands, both on its own State Natural Areas Preserves and in partnership with the National Park Service in Shenandoah National Park. Additionally, Virginia Natural Heritage has been studying the effects of groundwater levels on the maintenance of herbaceous wetland communities.

Research on Grassland Flora in the Region

It is important to recognize that robust botanical research serves as the foundation for effectively characterizing and understanding grasslands. In Virginia, this research is primarily driven by six key groups: The Flora of Virginia Project, the Virginia Natural Heritage Program, the Virginia Botanical Associates, the Flora of the Southeast team, the Virginia Native Plant Society, and the academic community, which includes expanding herbaria at numerous state and regional institutions. Botanists within this large community provide essential information to guide ecologists and land managers in the inventory and restoration of the region's grassland systems.

Research on Grassland Fauna in the Region

In addition to the botanical components of grassland communities, much work has been directed towards the zoological components of grasslands. The loss of grasslands and its negative effects on birds and pollinators have been widely recognized and have further consolidated conservationists around the concept of grassland conservation, restoration, and creation. One example of this movement has been to incentivize developers to plant solar farms with native grassland species including wildflowers that can be used by pollinators (DeBerry et al. 2019). The Xerces Society for Invertebrate Conservation has played a central role in catalyzing efforts to conserve grassland insects (Xerces 2024).

Regarding grassland birds, there is a growing focus on the conservation of northern bobwhite quail (*Colinus virginianus*) and their habitats (Quail Forever 2024). Locally, the Virginia Grassland Bird Initiative, a cooperative project run through the Smithsonian Conservation Biology Institute, is working to address grassland bird declines in Virginia (Virginia Grassland Bird Initiative 2024). Myriad other conservation efforts benefiting grassland animals are also gaining momentum.

Grassland Management Research Needs

This solid foundation of botanical knowledge combined with quantitative classifications of our natural communities in the Virginia region provides the basis for successful grassland restoration and creation practices. However, grassland restoration and creation can be challenging and complex, and more research is still needed.

Current literature on best management practices for grassland restoration and creation is often incomplete, lacking critical information necessary for success. Land managers frequently encounter negative trajectories in grassland community development, such as declining native species diversity or outbreaks of invasive species that are difficult to control. Key questions remain, particularly regarding the timing and intensity of fire needed to achieve desired conditions, as well as the strategic use of herbicides (product, quantity, mixtures, timing) in various contexts. Much more research in these areas is needed.

Botanical Inventory and Assessment

Survey Sites and Methods

Botanical Field Surveys

From June 6 to June 19, 2022, all 10 field/meadow units (Figure 1), 9 at Malvern Hill and 1 at Gaines' Mill, were visited on foot. The perimeter of each unit was walked while recording all species of vascular plants that were identifiable in that season. Particular attention was paid to invasive taxa that were conspicuous or dominant over large areas of a given unit. Additionally, it was noted when invasive species were conspicuous/dominant over discrete areas where control was possible. In addition to identifying the total flora and invasive species, areas of higher-quality native vegetation were noted and marked with GPS coordinates.



Figure 1. Botanical study sites. Left: Malvern Hill—all field units (7, 8, 9, 10, 13, 15, 16, 17, and 18). Right: Gaines' Mill field unit shown in solid light green.
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After taking notes while walking the perimeter of each unit, forays were made into the interior to further examine the flora, looking especially for the elements listed above. During these field surveys, other vegetation/habitat features were sought including wetlands, thickets, savannas, and other features. The flora of these areas (making up less than 1% of the grassland areas in total) was not included in the flora of the unit nor was it recorded in its entirety. Kristen Allen, Integrated Resources Program Manager at Richmond National Battlefield Park, joined the field survey of June 14 when data were collected on unit 9.

When areas of discrete invasive species outbreaks or higher-quality native vegetation were found during these walks, their location was recorded using phone-enabled GPS.

Each unit was again visited from September 2 to September 14, 2022, in order to identify additional species that may not have been identified during the June visits. This included numerous members of the composite family (Asteraceae), bean and pea family (Fabaceae), and grass family (Poaceae) that are more easily identified later in the season. When new taxa were recorded in 2023 during bird and incidental surveys, their identity and field unit(s) were also recorded.

Incorporation of Fire Effects Transect Data

For eight of the field units at Malvern Hill, 30 meter transects were used by the National Park Service Fire Effects Monitoring Crew to collect species frequencies from 2004 to present. The list of species collected from this transect data was provided at the outset of this study and additional clarifying information was provided through correspondence with Lane Gibbons, Regional Biological Science Technician for the National Park Service, Interior Region 1. In 2023, the transect data were distilled and incorporated into Appendices A–C.

Coefficients of Conservatism (C Values)

Coefficients of Conservatism, or C values, are values assigned to a plant species that provides a 0–10 rank of a given species' fidelity to an undisturbed natural habitat. Species found only in high-quality, undisturbed native grasslands have higher C values, compared to species that can thrive in a wide range of conditions, including disturbed or degraded environments. For example, a rare native orchid that only grows in an intact calcareous fen with consistent water levels would be given a high C value (7–10) whereas a generalist grass that can grow freely along a roadside or disturbed site would be given a low C value (0–3). In Virginia, these values were assigned via consensus by a group of botanists and the results have been published (DeBerry et al. 2021). These values provide a reliable measure of habitat quality and have been used in the assessment of plant community quality, particularly in the assessment of wetland restoration efforts.

These values are incorporated into Appendix B.

Grassland Fidelity Index (GFI)

In addition to field work and development of the data in Appendices A and B, a Grassland Fidelity Index (GFI) value was assigned for all native Virginia vascular plant species (Appendix C). Grassland Fidelity Index, or Heliophily, scores for individual species are a new concept being developed by SGI and Dr. Alan Weakley (North Carolina Botanical Garden) with funding from the National Park Service Southeast Region. These values, which range from 1 to 9, reflect a species' inherent preference for shade or sun, with a value of 1 indicating that a species is dependent on deep shade and a value of 9 indicating that a species is restricted to habitats in full sun. Values were assigned at the species level for the entire Southeast and represent the consensus of a team of expert reviewers. These values (as "heliophily scores") have been published in the online version of the Flora of the Southeastern U.S. (Weakley and Southeastern Flora Team 2024).

These values are being compiled for the entire flora of the southeast U.S. and may be used in later analyses to inform various initiatives including assessing desired future conditions for natural communities by providing a measure of the degree to which the flora of a site reflects "grassland", "woodland", or "forest" vegetation.

Results

A total of 307 vascular plant taxa were observed in the meadow units between field work for the present study (2022–2023) and previous fire-effects monitoring (2005-present)—241 natives and 66 non-natives. A summary breakdown by major group, study, and native and non-native status is provided in Table 1.

Table 1. Totals for all plant taxa found during Richmond National Battlefield Park grassland study and fire effects monitoring plots, broken down by major group, study, and native and non-native taxa.

Group	2022 native	2022 non-native	Additional native species from fire effects monitoring	Additional non-native species from fire effects monitoring	Total
Ferns	5	0	0	0	5
Graminoids	56	16	11	6	89
Forbs (Wildflowers)	105	28	27	8	168
Woody plants	33	7	4	1	45
TOTALS	**199**	**51**	**42**	**15**	**307**

More detailed results are reported in detailed annotated species lists in appendices A, B, and C. Taxonomy follows Weakley et al. (2012).

Appendix A: Master Plant List: The master species list noting all taxa observed in each field unit.

Appendix B: Mean Coefficient of Conservatism (C value): The master species list with C values presented by field unit with averages for sites and units.

Appendix C: Mean GFI: The master species list with GFI values presented by field unit with averages for sites and units.

Discussion

There are a number of concerning issues regarding invasive species in the field units. Foremost are the invasive species that will be difficult if not impossible to suppress without drastic action. These infestations were noted for each unit and are summarized in Table 2.

Table 2. Infestations of invasive plants that will be difficult to control.

Species	Units (M = Malvern Hill, G = Gaines' Mill)
Anthoxanthum odoratum	M7, M9, M10, M17, G
Arthraxon hispidus var. *hispidus*	M17
Lespedeza cuneata	M7, M8, M9, M17, M18, G
Lonicera japonica	M7, M8, M9, M15, M16, M18, G
Microstegium vimineum	M9, M10
Schedonorus arundinaceus	M7, M9, M10, G

The second issue is much more tractable. There are potentially severe but limited outbreaks of invasive species populations that may be able to be controlled if dealt with immediately. These were noted for each field (listed in Table 3) and GPS points for the outbreaks were submitted to the park. As a result, in late 2022, work began on control of these limited outbreaks.

Table 3. Infestations of invasive plants that are still feasible to control.

Species	Units (M = Malvern Hill, G = Gaines' Mill)
Carduus nutans	M7, M8, M15
Elaeagnus umbellata	M10
Hemerocallis fulva	M8
Lespedeza cuneata	M13
Persicaria extremioreintalis	M8
Rubus pascuus	M7, M8, M16
Securigera varia	M15
Sorghum halepense	M7, M9, M10, M17, M18, G

Both the Grassland Fidelity Index (GFI) scores and the Coefficient of Conservatism (C value) scores are included in Appendices A–C.

The average GFI value for all taxa recorded in the grasslands was 7.15, meaning that the vegetation present is relatively sun-loving and is indicative of grassland or savanna vegetation. This makes sense since these open habitats would be expected to gather plant species that are known to occur in relatively sunny sites. The mean GFI value for each field unit was also calculated, with a relatively tight clustering of values between 6.97 and 7.64. One interpretation of this result is that these sites support a mix of disturbance-adapted weedy species of open habitats and sun-loving native species of former savannas and open woodlands in the region. Further analysis looking for correlation between these values and the characteristics of the units was not undertaken and is beyond the scope of this project.

An identical analysis of the C values was also performed. The average C value for all taxa recorded in the grasslands was 2.44. This makes sense since most of the field units have been managed as native grasslands for only the last few decades (formerly most acreage was forest, woodland, or agriculture) and so the plant species that have colonized these fields are relatively non-conservative. The mean C value for each field unit was also calculated, with a relatively tight clustering of values between 1.89 and 2.88. As with GFI values, further analysis looking for correlation between these values and the characteristics of the units was not undertaken and is beyond the scope of this project.

While assessing C and GFI values to the flora of the park's grasslands by unit was not a part of this project, there is value in assigning these to enable further quantitative analysis of community structure as the grasslands of the site are managed and mature. See the desired future condition discussion below.

Insect Inventory and Assessment

Survey Sites and Methods

Insect Field Surveys

Research areas within Richmond National Battlefield Park consisted of three separate sites with a total of eight plots (Table 4, Figures 2–5). Four separate collection events took place, on 14-June-2023, 12-Aug-2023, 13-Oct-2023, and 10-April-2024. Site 1 was located at Gaines' Mill Battlefield (RICH A) which had 3 plots. RICH A-1 was a low growing pasture while RICHA-2 and A-3 were more botanically diverse meadows based on visual assessment. Site 2 was Cold Harbor Battlefield (RICH B) with 2 total plots. RICH B-1 and B-2 were relatively botanically similar, located in a wooded area with *Vaccinium* spp., pine (*Pinus* spp.), and oak (*Quercus* spp.). Site 3 was set at Malvern Hill Battlefield (RICH C) with 3 plots. RICH C-1, RICH C-2, and RICH C-3 had similar grassland and meadow-like vegetation across all 3 plots.

Table 4. Insect survey site coordinates and associated insect and botanical site codes.

Site	Coordinates	Insect Site Code	Botanical Site Code
Gaines' Mill Battlefield	37.5737, −77.2894	RICH A-1	GM
Gaines' Mill Battlefield	37.5740, −77.2919	RICH A-2	GM
Gaines' Mill Battlefield	37.5731, −77.2922	RICH A-3	GM
Gaines' Mill Battlefield	37.5734, −77.2899	Blue Vane 1	GM
Gaines' Mill Battlefield	37.5741, −77.2927	Malaise	GM
Cold Harbor Battlefield	37.5911, −77.2861	RICH B-1	N/A
Cold Harbor Battlefield	37.5905, −77.2857	RICH B-2	N/A
Cold Harbor Battlefield	37.5909, −77.2855	UV light trap	N/A
Malvern Hill Battlefield	37.4174, −77.2469	RICH C-1	M15
Malvern Hill Battlefield	37.4204, −77.2536	RICH C-2	M7
Malvern Hill Battlefield	37.4201, −77.2522	RICH C-3	M13
Malvern Hill Battlefield	37.4177, −77.2466	Blue Vane 2	M15

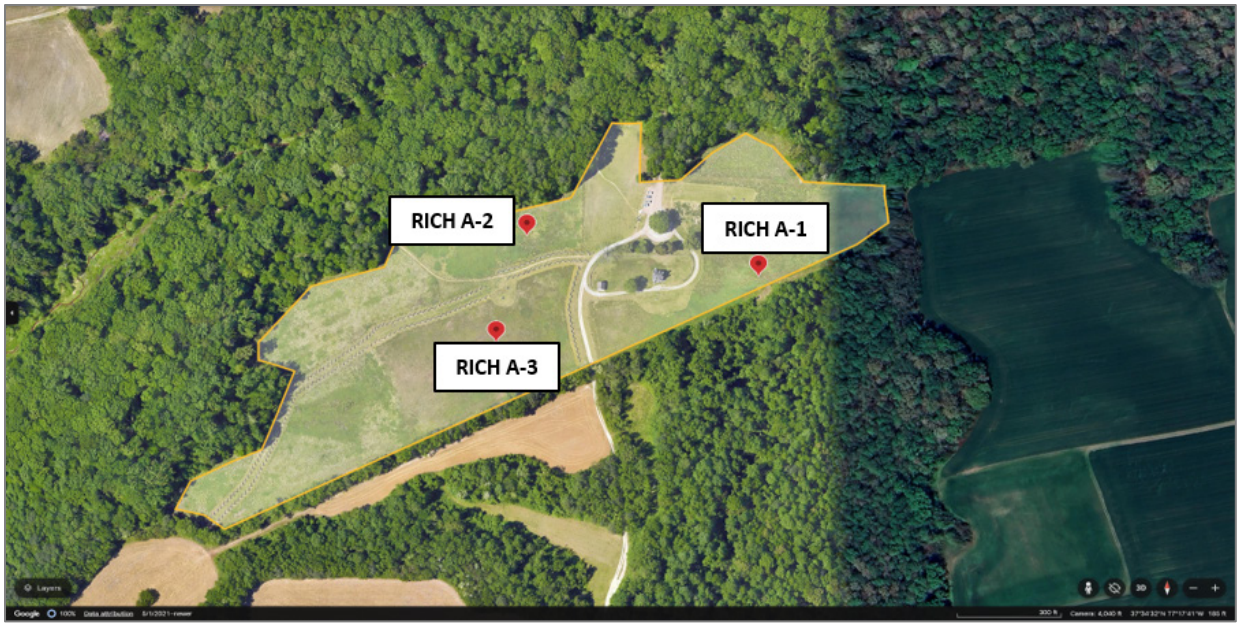


Figure 2. Gaines' Mill Battlefield insect study site RICH-A. RICH A-1: (37.5737, −77.2894), RICH A-2: (37.5740, −77.2919), and RICH A-3: (37.5731, −77.2922).

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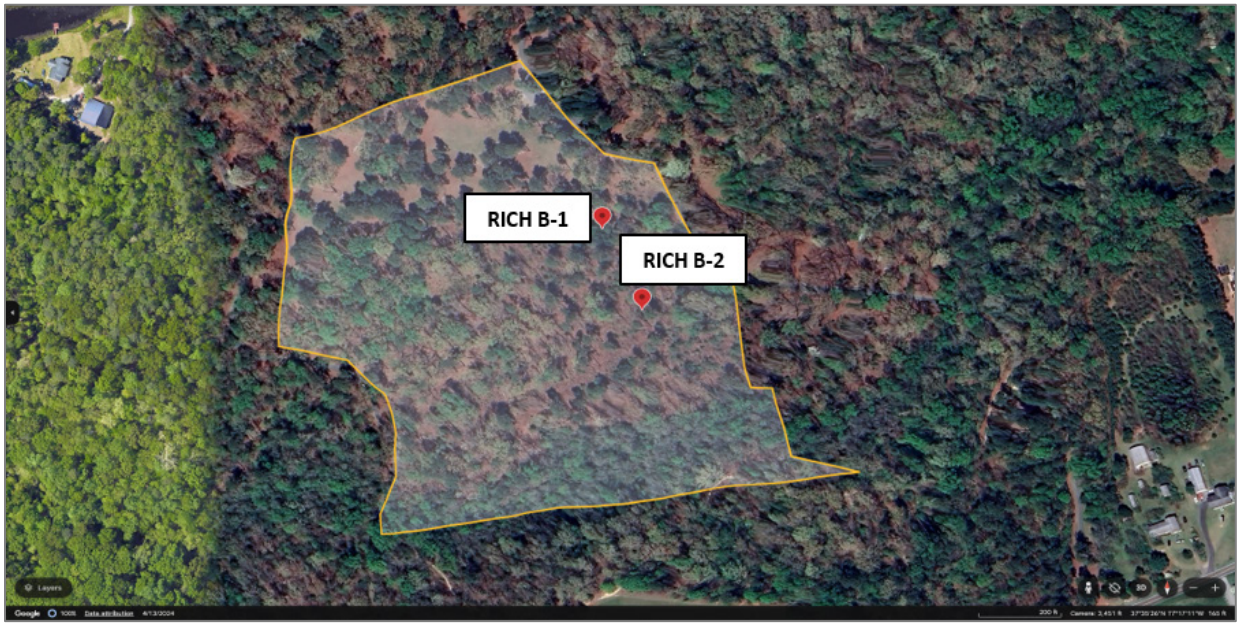


Figure 3. Cold Harbor Battlefield insect study site RICH-B. RICH B-1: (37.5911, −77.2861) and RICH B-2: (37.5905, −77.2857).

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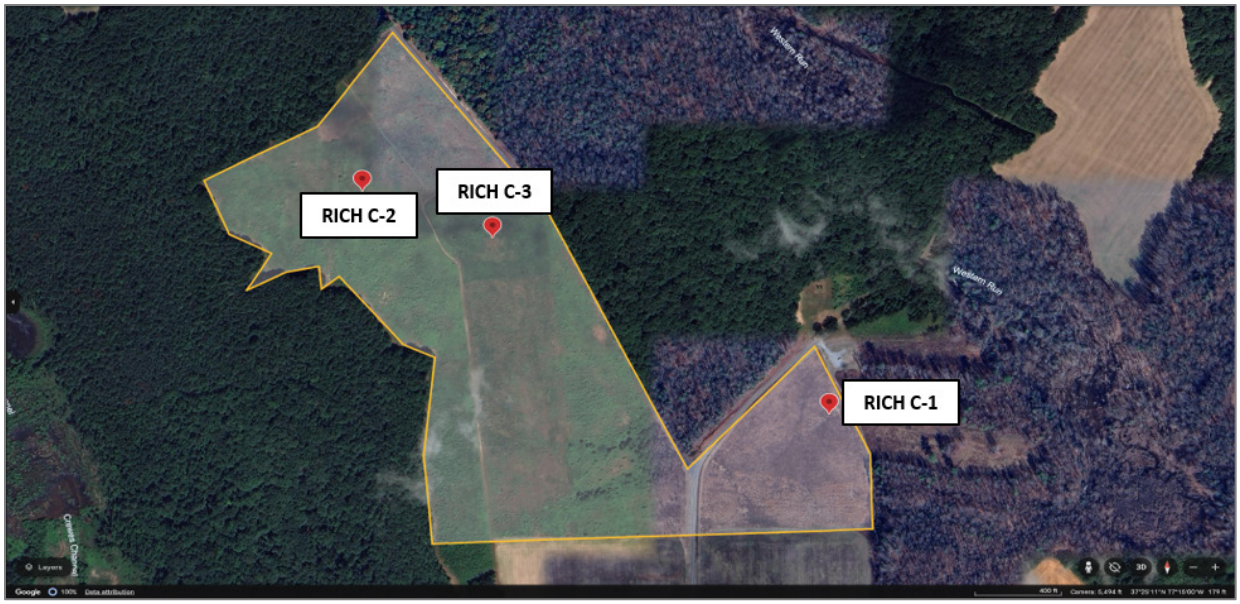


Figure 4. Malvern Hill Battlefield insect study site RICH-C. RICH C-1: (37.4174, −77.2469), RICH C-2: (37.4204, −77.2536), and RICH C-3: (37.4201, −77.2522).

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Figure 5. Passive traps used for insect collection. A) Pecan sandie bait station used to collect ants. B) UV light trap with chloroform used to collect nocturnal Lepidoptera. C) Bee bowl traps set with fluorescent blue, yellow, and white cups filled with unscented soapy water. D) Blue vanes are fluorescent blue and yellow traps filled with unscented soapy water. E) Malaise traps are flight intercept traps set with 70% ethanol.

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Each plot was set and replicated with the following methodology throughout this study (Figures 6 and 7). Plots were 20 m × 20 m squares consisting of two transects crossing at the center point of the plot. At each corner and center point, fluorescent blue, yellow, and white bee bowl traps were set with unscented soapy water for 24 hours. After the five bee bowl traps were set, a pecan sandie bait station was deployed for 15 minutes at the base of each bee bowl trap to collect ants. These bait stations contained a pecan sandie cookie placed in a plastic vial with a snap lid. Targeted bee and Lepidoptera netting occurred simultaneously for 15 minutes after bait stations were collected. Sweep netting for Orthoptera was the final sampling method within a plot. Sweep netting took place along both transects, with the collector sweeping from corner to corner in the shape of an X. All collected samples from traps or nettings were placed in separate containers with a field label.

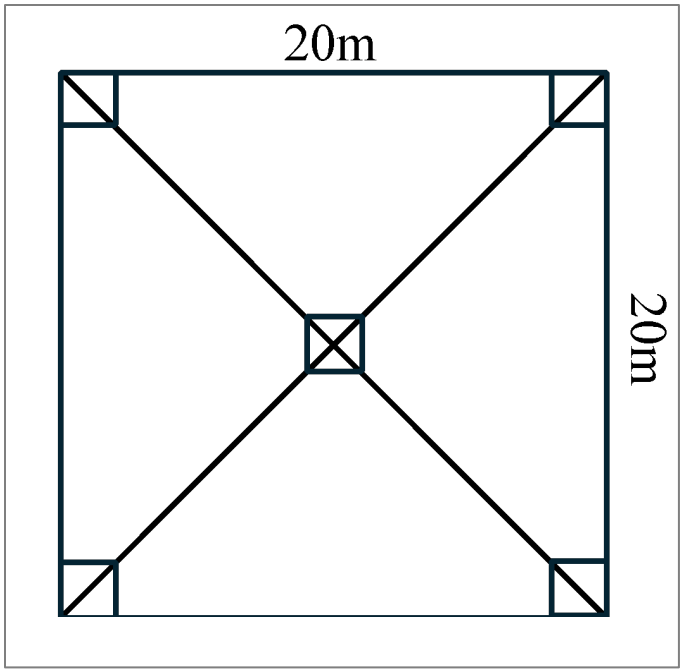


Figure 6. Diagram of insect study plots with two transects overlapping in the center. Each smaller square represents where bee bowls and ant bait stations were placed. All netting took place within the 20 m × 20 m study plot.

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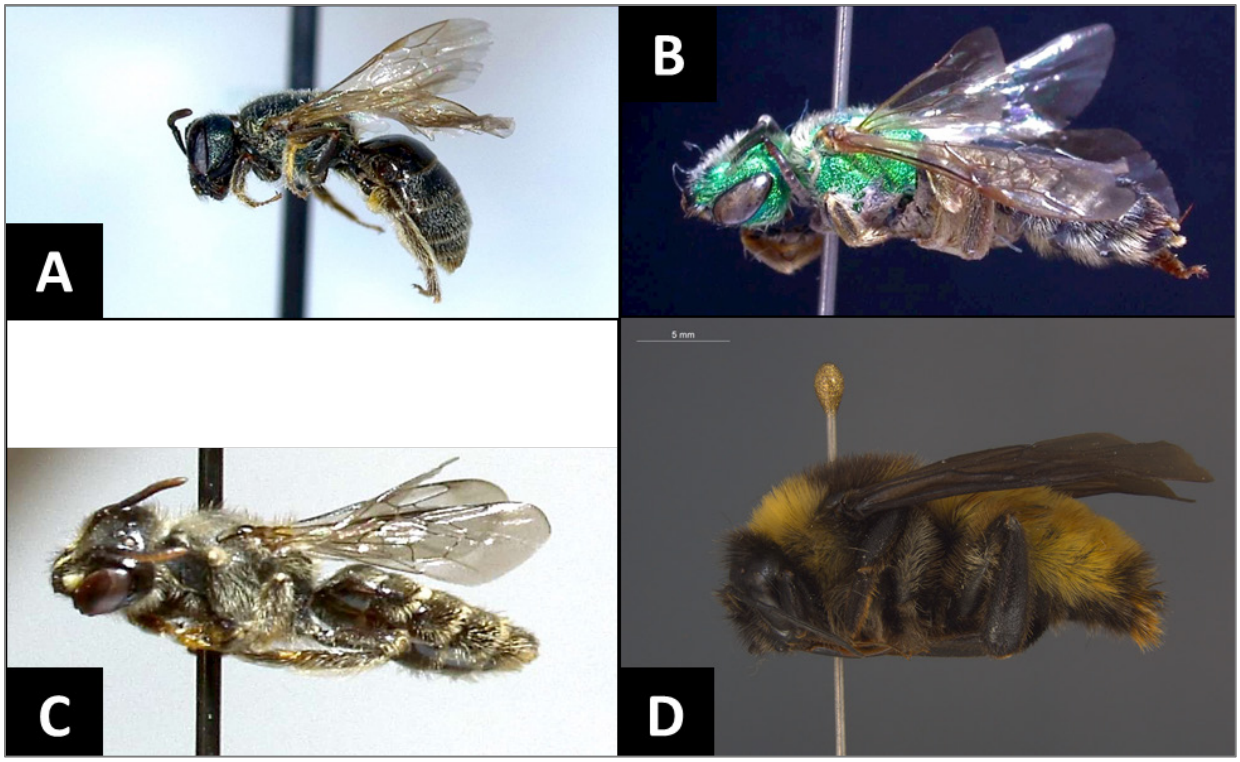


Figure 7. Some bees caught during sampling at Richmond National Battlefield Park. A) *Lasioglossum* sp. (Apoidea: Halictidae) collected with bee bowl traps at site RICH A-1. *Lasioglossum* spp. are also known as sweat bees. These bees pollinate and visit a wide range of plants. Sweat bees are taxonomically of note because the genus *Lasioglossum* is one of the largest genera of bees. B) *Agapostemon virescens* (Apoidea: Halictidae) collected with bee bowl traps at site RICH B-1. *Agapostemon* spp. are in the family of Halictidae which is one of the most speciose families of bees. These bees nest in semi-social female groups underground. C) *Calliopsis andreniformis* (Apoidea: Andrenidae) collected with a net at site RICH C-3. *Calliopsis andreniformis* is unique morphologically due to its yellow markings on its face, making it easily identified by researchers and citizen scientists alike. It has a general distribution across Eastern North America. This bee can be found on plants such as Asclepias and Coreopsis. D) *Bombus pensylvanicus* (Apoidea: Apidae) collected with a net at site RICH-A3. *Bombus pensylvanicus* is ranked as a G3: vulnerable species.

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Additional site-specific collection methods were used outside of the study plots, including a Malaise trap, blue vane traps, and an ultraviolet light trap (Figure 6). Malaise traps are flight intercept traps, and one was set for 24 hours with 70% ethanol upon arrival at each site. Two blue vane traps were set with unscented soapy water for 24 hours to collect additional bee data. From sunset to sunrise, an ultraviolet light trap set with chloroform was used to collect nocturnal Lepidoptera. These site-specific traps were set outside designated study plots for each site to avoid compromising plot replication.

Results and Discussion

Gaines' Mill Battlefield

Current Site Condition

Gaines' Mill Battlefield (RICH A) consisted of three plots: RICH A-1, A-2, and A-3. RICH A-1 was a low-cut pasture consisting of mostly white clover (*Trifolium repens*), buttercups (*Ranunculus* sp.), and turf grasses. RICH A-2 and A-3 were more botanically diverse meadows that were mowed in late winter to early spring. These plots contained blackberry (*Rubus* sp.), dogbane (*Apocynum cannabinum*), purple passion flower (*Passiflora incarnata*), bluestem (*Andropogon* sp.), milkweed (*Asclepias* sp.), goldenrod (*Solidago* sp.), and other composites (Asteraceae).

Apoidea

At Gaines' Mill Battlefield, 52 Apoidea specimens representing 26 total species were documented with a combination of passive and active collection methods (Appendix D). RICH A-1 had a total of 23 Apoidea specimens representing 14 species, making up almost half the total bees collected at Gaines' Mill Battlefield. A total of 19 specimens representing 12 species were recorded at RICH A-2. RICH A-3 had a total of 10 specimens representing 10 species. The plot with the most documented species of bees at Gaines' Mill Battlefield was RICH A-1.

Formicidae

At Gaines' Mill Battlefield, a total of 51 Formicidae specimens representing eight species were collected (Appendix E). RICH-A1 had 35 specimens representing five species. RICH A-2 had six specimens representing one species, while RICH A-3 had 10 specimens representing four species. The plot with the most documented species of Formicidae at Gaines' Mill Battlefield was RICH A-1.

Orthoptera

At Gaines' Mill Battlefield, a total of 46 Orthoptera specimens were collected with seven species representing three families documented (Appendix F). RICH A-1 had five specimens collected representing three species and one family. RICH A-2 had 26 specimens collected representing four species and one family. RICH A-3 had 15 specimens collected with six species representing one family. The plot with the most documented species of Orthoptera at Gaines' Mill Battlefield was RICH A-3.

Lepidoptera

At Gaines' Mill Battlefield a total of 30 Lepidoptera specimens were collected representing 12 species and three families (Appendix G). RICH A-1 had 10 specimens collected representing four species and three families. RICH A-2 had 11 specimens collected representing five species and one family. RICH A-3 had nine specimens collected representing six species and one family. The plot with the most documented species of Lepidoptera at Gaines' Mill Battlefield was RICH A-3.

Cold Harbor Battlefield

Current Site Condition

Cold Harbor Battlefield (RICH B) included two insect sampling plots: RICH B-1 and B-2. Both plots were heavily wooded with pine and oak. RICH B-1 had a more open understory dominated by native *Vaccinium* spp. (blueberries), *Chimaphila maculata* (spotted wintergreen), and an individual *Cypripedium acaule* (pink lady's slipper). RICH B-2 had less botanical diversity with a dense understory of pine and oak regeneration.

Apoidea

At Cold Harbor Battlefield, a total of 24 bee (Apoidea) specimens representing 13 species were collected using passive and active collection methods (Appendix D). RICH B-1 had 12 specimens representing 10 species. RICH B-2 had 12 specimens representing 6 species. The plot with the most documented species of Apoidea at Cold Harbor Battlefield was RICH B-1.

Formicidae

At Cold Harbor Battlefield, a total of 15 ant specimens representing five species were collected using passive methods (Appendix E). RICH B-1 had eight ant specimens representing one species, while RICH B-2 had seven specimens representing four species. The plot with the most documented species of Formicidae at Cold Harbor Battlefield was RICH B-2.

Orthoptera

At Cold Harbor Battlefield, RICH B-1 and RICH B-2 had no recorded Orthoptera specimens. We believe this is due to lack of native Poaceae and a heavily forested environment.

Lepidoptera

At Cold Harbor Battlefield, a total of three Lepidoptera specimens representing three species were collected using active collection methods (Appendix G). RICH B-1 had three Lepidoptera specimens representing three species. RICH B-2 had no collected specimens. The plot with the most documented species of Lepidoptera at Cold Harbor Battlefield was RICH B-1.

Malvern Hill Battlefield

Current Site Condition

Malvern Hill Battlefield (RICH C) consisted of three plots: RICH C-1, C-2, and C-3. All three plots resembled a traditional meadow or native grassland. RICH C-1 consisted of *Apocynum cannabinum* (dogbane), *Rubus* sp. (blackberry), *Asclepias* sp. (milkweed), Poaceae (grasses), *Solidago* sp. (goldenrod), and other Asteraceae (composites). RICH C-2 had *Apocynum cannabinum* (dogbane), *Solidago* sp. (goldenrod), *Rubus* sp. (blackberry), Asteraceae (composites), and Poaceae (native grasses). Asteraceae and *Solidago* sp. were less abundant in plot RICH C-2 than in plots RICH C-1 and RICH C-3, while native grasses and dogbane were denser here than in other plots around Malvern Hill Battlefield. Vegetation at RICH C-2 was generally thinner and shorter than the other two plots. RICH C-3 included very dense goldenrod, dogbane, grasses, and various Asteraceae. RICH C-3 had very little open ground and dense vegetation over 2 meters tall in most areas.

Apoidea

At Malvern Hill Battlefield, 63 specimens representing 30 total Apoidea species were documented with a combination of passive and active collection methods (Appendix D). RICH-C1 had 18 specimens representing 10 species. RICH C-2 had 31 specimens representing 16 species. RICH C-3 had 14 specimens representing 11 species. The plot with the most documented species of Apoidea at Malvern Hill Battlefield was RICH C-2.

Formicidae

At Malvern Hill Battlefield, 268 specimens representing seven total ant species were documented with passive collection methods (Appendix E). RICH C-1 had 124 specimens representing three species. RICH C-2 had 109 specimens representing five species. RICH C-3 had 35 specimens representing four species. The plot with the most documented species of Formicidae at Malvern Hill Battlefield was RICH C-2.

Orthoptera

At Malvern Hill Battlefield, 14 specimens representing six total Orthoptera species were documented with active collection methods (Appendix F). RICH C-1 had two specimens representing two species. RICH C-2 had six specimens representing two species. RICH C-3 had six specimens representing five species. The plot with the most documented species of Orthoptera at Malvern Hill Battlefield was RICH C-3.

Lepidoptera

At Malvern Hill Battlefield, a total of 31 Lepidoptera specimens were collected representing 14 species and two families (Appendix G). RICH-C1 had 12 specimens collected representing four species and one family. RICH C-2 had 10 specimens collected representing nine species and one family. RICH C-3 had nine specimens collected representing four species and one family. The plot with the most documented species of Lepidoptera at Malvern Hill Battlefield was RICH C-2.

Additional Site-Specific Collection Methods (Outside of Study Plots)

Additional insect data were collected using a Malaise, blacklight, and two blue vane traps (Figure 5). These traps were set around Richmond National Battlefield Park, unassociated with our study plots. The Malaise and blue vane traps were set for 24 hours while the blacklight trap was set from sunset to sunrise.

Blue Vane 1

1. 3 specimens of 2 bee species

Blue Vane 2

1. 6 specimens of 4 bee species
2. 1 specimen of 1 ant species

Malaise

1. 5 specimens of 3 bee species
2. 1 specimen of 1 ant species
3. 1 specimen of 1 Orthoptera species
4. 1 specimen of 1 Lepidoptera species

Blacklight

1. 1 specimen of 1 Orthoptera species
2. 182 specimens of 66 Lepidoptera species

Bird Inventory and Assessment

Methods

Due to increased concern about grassland bird decline, the grassland habitat at Richmond National Battlefield Park was preliminarily evaluated for grassland bird use. Three data sources were considered: 1) volunteer transects run from 2010 to present, 2) eBird reporting (both Malvern Hill and Gaines' Mill are hotspots), and 3) personal observations during 2022 vegetation work and 2023 visits.

The eBird data from the Malvern Hill hotspot, with 572 complete checklists from 1998 to present, and the Gaines Mill hotspot, with 74 complete checklists from 2013 to present, provided the strongest data set and results from this source provide the following information. Because the sampling intensity is not equal, with Malvern Hill more frequently visited, the information below should be considered preliminary. eBird had 176 species recorded at Malvern Hill as opposed to the 105 at Gaines' Mill.

Results and Discussion

For this analysis, 33 ephemeral species (seen <5 times) and 28 waterbirds were eliminated. This leaves 116 bird species that were considered. Ninety-five of these taxa were recorded at both sites, while 21 were unique to Malvern Hill. No unique species were recorded at Gaines' Mill. A full list of the species considered in this analysis is found in Appendix H.

Of the 21 unique species, 17 species were grassland and shrubland taxa. Nine of these are breeding birds as shown in Table 5.

Table 5. Grassland and shrubland birds unique to the Malvern Hill grassland units at Richmond National Battlefield Park.

Species	Breeding Status
Cooper's Hawk	Breeding
Broad-winged Hawk	–
Merlin	–
Horned Lark	Breeding
Purple Martin	Breeding
Northern Rough-winged Swallow	Breeding
Cliff Swallow	Breeding
American Pipit	–
Purple Finch	–
Grasshopper Sparrow	Breeding
Fox Sparrow	–
White-crowned Sparrow	–
Savannah Sparrow	–

Table 5 (continued). Grassland and shrubland birds unique to the Malvern Hill grassland units at Richmond National Battlefield Park.

Species	Breeding Status
Yellow-breasted Chat	Breeding
Orchard Oriole	Breeding
Rusty Blackbird	–
Yellow Warbler	Breeding

While there is a disparity in sampling, it is not surprising that Malvern Hill has a much larger list of grassland and shrubland taxa considering the much larger expanse of grassland habitat.

Current Grassland Condition Assessment, Desired Future Conditions, Management Recommendations, and Future Assessment Protocols

On April 30, 2024, researchers involved with this project as well as members of the Southeastern Grasslands Institute (SGI), and the National Park Service met to discuss the study results and desired future conditions for the grasslands of the park.

Current Grassland Condition Assessment

In general, the grasslands of the park are a mixture of native and non-native heliophytic (sun-loving) herbaceous species with a mix of woody species (mostly native) that, if not managed, would certainly dominate the grasslands with an expected succession to woodland and forest. Fire, mowing, and controlled grazing were woody control measures observed during the 2022–2023 work. The park has employed fire and mowing as woody control measures for some 20 years in addition to targeted herbicide treatments to control woody and invasive species. Typical appearance of the grasslands are shown in Figures 8 and 9.



Figure 8. General aspect of grassland vegetation at Richmond National Battlefield Park. Photo taken of multiple contiguous units at Malvern Hill, September 2023.
J.C. LUDWIG

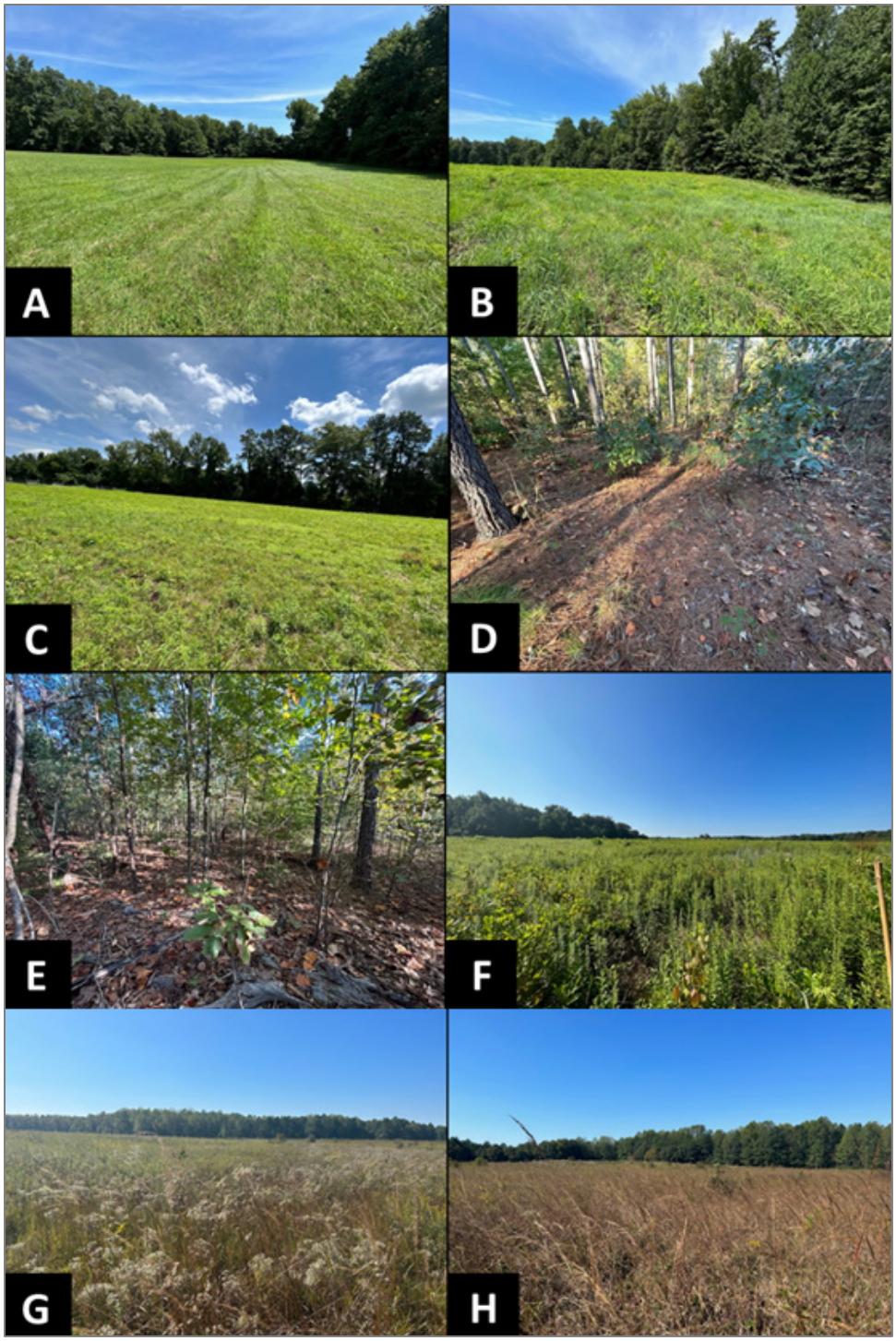


Figure 9. Photos of current conditions at insect survey sites. A) Gaines' Mill Battlefield pasture site RICH-A1, August 12, 2023. B) Gaines' Mill Battlefield meadow site RICH-A2, August 12, 2023. C) Gaines' Mill Battlefield meadow site RICH-A3, August 12, 2023. D) Cold Harbor Battlefield woodland site RICH-B1, October 13, 2023. E) Cold Harbor Battlefield woodland site RICH-B2, October 13, 2023. F) Malvern Hill Battlefield meadow RICH-C1, August 12, 2023. G) Malvern Hill Battlefield meadow RICH-C3, October 15, 2023. H) Malvern Hill Battlefield meadow RICH-C2, October 15, 2023.

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While the grassland of Richmond National Battlefield Park can be generalized by the characteristics mentioned above, details of each unit are presented in Table 6, pointing out unit-specific characteristics.

Table 6. Unit-specific flora information for fields at Richmond National Battlefield Park.

Unit	Plant Species all/native/non	Mean C	Mean GFI	Habitat notes/invasive issues point [A]/ mostly native vegetation points found
MALVERN 7	175/141/34	2.76	7.01	Large Bracken Fern clone at 37.418383BN, 77.253224W. Uncontained invasives: *Anthoxanthum*, *Lespedeza*, *Lonicera*, *Schedonorus*. Mostly native vegetation at 37.42084N, 77.25313W.
MALVERN 8	134/102/32	2.36	7.19	Wet roadside thickets excluded from sampling. Uncontained invasives: *Lespedeza*, *Lonicera*. Mostly native vegetation at 37.41584N, 77.24921W and 37.41765N, 77.24997W.
MALVERN 9	110/81/29	2.34	6.97	Uncontained invasives: *Lespedeza*, *Lonicera*, *Microstegium*, *Schedonorus*. Mostly native vegetation at 37.41678N, 77.24374W.
MALVERN 10	119/87/32	2.25	7.01	Uncontained invasives: *Microstegium*, *Schedonorus*. Mostly native vegetation at 37.41855N, 77.24644W.
MALVERN 13	75/60/15	2.44	7.64	No uncontained invasives. Mostly native vegetation not identified in this unit.
MALVERN 15	122/92/30	2.33	7.26	Herbicide drift mortality noted from adjacent agricultural field. Uncontained invasives: *Lonicera*. Mostly native vegetation at 37.41576N, 77.24770W.
MALVERN 16	93/78/15	2.88	6.99	Southern savanna in unit excluded from sampling. Small wetland at 37.24554N, 77.15110W excluded from floristic sampling. Uncontained invasives: *Lonicera*. Mostly native vegetation at 37.41564N, 77.25239W.
MALVERN 17	56/43/13	2.38	7.5	Unlike all other units of the park, this is dominated by a dense stand of big bluestem (*Andropogon gerardii*). Woody “draws” in field were not included in vegetation sampling. Uncontained invasives: *Arthraxon*, *Lespedeza*. Mostly native vegetation at 37.41030N, 77.25510W.
MALVERN 18	67/58/9	2.67	7.27	Uncontained invasives: *Lespedeza*, *Lonicera*. Mostly native vegetation at 37.42039N, 77.25266W.
GAINES’ MILL	87/61/24	1.89	7.02	Uncontained invasives: *Lespedeza*, *Lonicera*, *Schedonorus*. Mostly native vegetation at 37.57248N, 77.29286W.

[A] Anthoxanthum = A. odoratum, Arthraxon = A. hispidus, Lespedeza = L. cuneata, Lonicera = L. japonica, Microstegium = M. vimineum, Schedonorus = S. arundinaceus.

Insect Specific Assessment of Current Conditions Based on Desired Conditions for Insects

Gaines' Mill Battlefield

The habitat at RICH-A1 was hospitable to the most Apoidea and Formicidae diversity out of all three plots at Gaines' Mill Battlefield. We believe this is due to high concentrations of specific nectar sources, low cut vegetation, and reduced organic material. Highly abundant nectar sources with low diversity like *Trifolium repens* (white clover) and *Ranunculus* sp. (buttercups) allow pollinators to be more productive when scavenging. Bees also prefer open ground with reduced organic matter when nesting. RICH A-3 had the most diverse plot for Orthoptera and Lepidoptera species. We believe this is because of the height and abundance of native grasses (family Poaceae) and higher botanical diversity.

Cold Harbor Battlefield

RICH B-1 had the most documented Apoidea and Lepidopteran species at Cold Harbor Battlefield, while RICH B-2 had the most documented ant species. There were no documented Orthoptera in either plot at Cold Harbor Battlefield. We believe RICH B-1 had the most species for bees and Lepidoptera because of its more available nectar sources. RICH B-1 was more open whereas RICH B-2 was more densely wooded. The lack of Orthoptera at Cold Harbor Battlefield correlates to a lack of native grass and suitable habitat.

Malvern Hill Battlefield

RICH C-2 was responsible for the most Apoidea, Lepidoptera, and Formicidae diversity at Malvern Hill Battlefield. Although RICH C-2 had less abundant Asteraceae, dogbane (*Apocynum cannabinum*) was more abundant. Vegetation height and organic matter was reduced at RICH C-2 in comparison to RICH C-1 and RICH C-3. RICH C-3 had the most Orthoptera species at Malvern Hill Battlefield. We believe this is due to ideal grasshopper habitat and dense native grasses.

Context for Insect Surveys

For the most part, the insect taxa documented at RICH are common, generalist species and groups for this area. To provide additional context to insect results from the field units at RICH, we compared RICH survey data to the results of other surveys conducted in higher quality grassland habitats. These are presented below by group.

Insect abundance and species richness are used to assess habitat quality at the site level. Rare or imperiled species are considered noteworthy because their presence can be used to infer habitat quality. Their presence alone, however, can't be used for a quantitative comparison to a reference site. Indicator species studies will have higher predictive power as the scale of examination and time scale of relevant processes increase (McGeoch 1998). It should be noted that, in general, short duration studies do not present an accurate picture of the insect populations on a site, but simply provide a glimpse of the species diversity and abundance within the time frame of the study. Insects are ephemeral and transient. Ideally, biodiversity indicator studies should be conducted over the long-term to document biodiversity turnover and the impact of land management and other biological stressors on a site (McGeoch 1998; Montgomery et al. 2021). Site visits distributed over a multi-year study period generally detect more species than the same number of site visits distributed over a

single year. Ratios between richness and abundance should be interpreted carefully when used to make decisions for restoration, as data gathered over multiple years is likely to reflect a different ratio than data gathered in a single year.

Apoidea Context

After one year of surveys at RICH we collected a total of 153 Apoidea specimens and 48 species. Bee diversity at Richmond National Battlefield Park is relatively high given the lower number of specimens collected. The presence of a vulnerable (G3) species, *Bombus pensylvanicus*, was documented at the Gaines' Mill Battlefield site, suggesting higher potential site quality. To provide context, a 3-year Apoidea survey in high-quality Black Belt Prairie remnants in Mississippi found a total of 6,140 specimens across 107 species (Smith 2008). An unpublished data set from a 4-year study in Tennessee's Cumberland Plateau found 2,104 specimens and 103 bee species.

Ant Context

Ant surveys at Richmond National Battlefield Park found 15 ant species out of 336 individuals. All collected ant species are native and have a secure (G5) conservation status rank. To provide context, a 1-year ant survey in Tennessee cedar glades and xeric limestone prairies found a total of 26 species across both habitats (Hill 2012a). Abundance was not reported for ants in this publication. An unpublished data set from a 2-year study in Tennessee's Cumberland Plateau conducted by Zach Brown and JoVonn Hill of the Mississippi Entomological Museum collected a total of 12,573 individual ants across 77 species.

Grasshopper Context

At RICH 11 Orthopteran species and 3 morphogroups identified to family were documented out of the 62 individuals collected. Out of this group, 7 species and 55 specimens in the family Acrididae were documented. All collected grasshopper species are native and have a secure (G5) conservation rank. To provide context, Acridid grasshopper surveys in Tennessee cedar glades, xeric limestone prairies, and cedar hardwoods found a total of 25 species across those three habitats (Hill 2012b).

Lepidoptera Context

At Richmond National Battlefield Park 82 Lepidoptera species were collected out of 247 total individuals. The presence of a vulnerable (G3) species, *Xestia dilucida*, was documented at this location. To provide context, a 5-year macrolepidoptera survey in the Mississippi Black Belt Prairie resulted in a final inventory of 544 species out of 8,983 individuals (Pollock 2000).

Bird Specific Assessment of Current Conditions Based on Desired Conditions for Birds

In almost all species of birds, habitat preference is dictated or extremely influenced by vegetation structure (also known as physiognomy). Overall, both of the meadows at Gaines' Mill Battlefield and Malvern Hill Battlefield have had similar vegetation structure though there has been temporal variation due to timing of cutting and burning which varies due to numerous factors. Since vegetation structure within the meadows has been similar, another explanation that would explain the preponderance of grassland bird species at Malvern Hill would be the size of the habitat. Grassland birds are known to like larger open habitat patches. As noted by the USDA (NRCS 2010):

- Many grassland birds are area sensitive. Thus, management of habitat for grassland birds on parcels of grass less than 25 acres will result in lower species diversity, as many of the species that require larger patches will not be present. However, 10-acre fields will still support some of the more common species of grassland birds.
- The composition of the landscape surrounding the field is also important. Fields that are surrounded by forests and developments support lower densities of grassland birds.

Malvern Hill has relatively large fields and units 8, 13, 15, and 16 abut agricultural fields. Gaines' Mill has a single small unit with less than 15 acres managed as a grassland. It follows that under current conditions, the bird diversity known from these sites shows a much greater number of grassland bird species using the fields at Malvern Hill. Looking forward, the desired future condition of grassland maintenance in these park units will perpetuate this trend.

If greater grassland bird abundance and diversity is desired, then the expansion of habitat at Malvern Hill could be considered. This could be accomplished by expanding the existing grassland into agricultural leases to the southeast of the existing fields or by converting the surrounding forest to open conditions.

Desired Future Conditions

Native Vegetation

It was agreed that the desired future condition of the park's grasslands is ***vegetation with a diverse native heliophytic flora that is mostly shrub- and tree-free and provides habitat for the native birds, insects, and other organisms that use this open, sunny habitat.*** Subsequent floristic surveys of similar or greater intensity to those used in this project can be used to compare the current and future condition. A part of this analysis may include the quantitative use of the GFI- and C-values included in this report.

Ideally, desired future conditions for the fields at RICH would be informed by local, or at least ecoregional, remnant grasslands on similar soils and landforms. Unfortunately, these are hard to come by in the area surrounding Richmond. However, a recently-discovered area of remnant grassland vegetation in a powerline right-of-way at Parker's Battery, located at 37.34884, −77.39535, on one of the southern-most tracts of Richmond National Battlefield Park, may serve as a good local reference site. However, it should be noted that this site is south of the James River, which is considered to be the "rough boundary" between the "northern and southern divisions of the [Coastal Plain] province" (Fleming 2012). There are several plant species and natural communities, including longleaf pine/scrub oak sandhills and pond pine woodlands and pocosins, that are confined to the region south of the James River. Plant species documented from this powerline grassland remnant by the Piedmont Discovery Center and the Virginia Natural Heritage Program in 2023 and 2024 include many grassland and savanna species that might be considered desirable components of grassland restorations in the park (iNaturalist 2024; S. Cave, Piedmond Discovery Center, pers. comm. 2024). However, if a strictly ecoregionally-based restoration approach is desired, any plant species found in

remnants south of the river should be researched to be sure that their natural range extends north of the James.

The grassland and savanna/open woodland species known from this powerline remnant are listed in the following paragraph, with species that were also documented in field units in the park annotated with an asterisk (*).

Grasses reported from the powerline remnant site include *Andropogon ternarius*, Aristida purpurascens*, *Danthonia sericea*, Danthonia spicata*, Dichanthelium aciculare*, *Dichanthelium depauperatum*, Dichanthelium meridionale*, Dichanthelium sphaerocarpon*, Digitaria cognata*, *Elymus glabriflorus*, *Eragrostis hirsuta*, and *Schizachyrium scoparium**. Forbs reported include *Acalypha gracilens*, Asclepias amplexicaulis*, *Asclepias tuberosa*, *Chrysopsis mariana*, Eupatorium hyssopifolium*, Eupatorium rotundifolium*, Eupatorium torreyanum*, Euphorbia corollata*, *Euthamia caroliniana*, Fragaria virginiana*, *Galactia regularis*, *Houstonia pusilla*, *Hypericum stragulum*, Lechea tenuifolia*, *Lespedeza procumbens*, Lespedeza repens*, Lespedeza stuevei*, *Lespedeza virginica*, Liatris pilosa*, *Liatris spicata* var. *resinosa*, *Packera anonyma*, Pityopsis aspera*, *Potentilla simplex*, Pycnanthemum muticum*, *Pycnanthemum tenuifolium*, *Silphium compositum*, *Solidago erecta*, *Solidago odora*, Solidago pinetorum*, Tephrosia spicata*, and *Trichostema dichotomum**. Shrubs and trees reported include *Crataegus uniflora*, *Rosa carolina*, and *Pinus echinata*. Adding the species not already known to the RICH fields and increasing the abundance of the others listed are good goals for the future. Inventory of the more extensive powerline corridor network outside of the park on flat to gently-rolling land surfaces in the vicinity of this remnant may yield more remnants and grassland/savanna species.

In the absence of suitable data from local remnants, other sites, both remnant and reconstructed, that have been well-inventoried and analyzed using C-values can be used to inform desired future condition.

Bach and Kleiman (2021), in a 20-year study of remnant and planted prairie at Nachusa Grasslands (Illinois), found mean C to range from 6 to 8 in higher quality remnant prairie transects and from 1 to 4 in planted prairie, with statistically significant increases in mean C in half of the transects studied in planted prairies over 20 years. Leahy et al. (2020), in a 20-year study of reconstructed and restored prairie at Pawnee Prairie Natural Area (Missouri), found mean C to range from 1 to 4 and cover-weighted mean C to range from <1 to 4, with statistically significant increases in both over 20 years. Newbold et al. (2020), in a 17-year study of reconstructed prairie at Prairie Fork Conservation Area (Missouri), found mean C to range from <1 to 4, with statistically significant increases in both over 17 years, but also found that neither method resulted in plant community compositions that converged with those of reference sites (remnant prairie) over time.

Until mean C-values, GFI scores, and species richness data have been collected from local/ecoregional grassland remnants, a good target is to get mean C-values up to around 4.0 as in the aforementioned long-term restorations in Illinois and Missouri.

It was also agreed that there is an opportunity to explore expansion of the grassland habitat into adjacent agricultural fields and/or forested areas. Regarding expansion into adjacent forested areas, the habitat goal would be towards savanna or woodland physiognomy that also provides sufficient light for grassland plant species.

Non-Native Invasive Plant Species

While the goal for both the number of non-native invasive plant species and the relative cover of these invasives is zero, this is generally not realistic or achievable. Our recommendation is to aim for no more than 5% of the total number of species and 5% of the total cover to be non-native invasives.

Insects and Birds

As with plants, in the absence of good comparable data from local or ecoregional reference sites, the goal should be to trend toward more grassland-dependent species and more individuals of grassland-dependent species.

Management Recommendations

About Grassland Restoration and Management

To create and maintain grasslands on most sites, one or more above-ground disturbance processes will need to be periodically applied to the area to stop the encroachment of trees and shrubs. Without such disturbance, most grasslands at our longitude (where rain is generally plentiful) will undergo degradation/succession to shrubland and eventually to closed forest. Historically, the primary disturbance process in Virginia grasslands was fire, and ecologically speaking, reintroduction of fire (in the form of prescribed or controlled burns) is considered the best tool for restoration of degraded sites that retain any inherent restoration potential. However, haying, mowing, the judicious cutting of trees, and the appropriate use of herbicides can also be beneficial and may in fact be needed, especially during the restoration phase, during which the decades-long tide of woody and/or non-native invasive plant encroachment is being reversed. But it should be understood that grassland and open woodland ecosystems in this region evolved with fire and there are some benefits from burning that cannot be achieved from these surrogate treatments.

While a generalized step-by-step plan is useful for guiding the restoration and management of an area, such work should follow an “adaptive management” strategy. In adaptive management, the results of each management activity performed influence the next step(s) to be taken. For example, if an herbicide treatment on existing tall fescue (*Schedonorus arundinaceus*) releases another invasive species such as Callery pear (*Pyrus calleryana*), the pear will need to be removed before it can out-compete slower-growing desirable native species released by the same treatment. In ecological restoration, each management action is accompanied by a reaction from the ecosystem being managed. Each site is different, and these effects cannot always be foreseen, so some flexibility is needed to address the unforeseen as well as the predictable consequences of management activities.

Specific Management Recommendations for Richmond National Battlefield Park Grasslands

It is clear that current management has created a trajectory of the vegetation moving towards the desired future condition. Management recommendations were briefly discussed during the April 30 meeting and are expanded upon below:

1. Continue controlling woody plant species (this management is currently being employed). Should the intensity of this management increase there is a greater likelihood that the density/diversity of woody species will slowly decrease.

SGI recommends that cut stems of undesirable woody plants be treated with herbicide (25% Triclopyr mixed with 75% penetrant applied in summer or fall within 10 minutes of cutting is recommended). Alternatively, smaller diameter stems can be treated with a basal bark application of this same mixture and cut later in the season after they die. We recommend removing cut brush or stacking it for later burning.

2. Burn or hay area at a one- to two-year interval (in alternating units so as to leave refugia for wildlife).

Timing of fire or other disturbance is critical to the health of grassland systems. SGI recommends burning in the time period that most closely mimics typical historical disturbance regimes. For most grassland systems outside of the southern portions of the outer coastal plain, the optimal time to burn for most grassland biodiversity is fall through early winter. Burning too often outside of this window can lead to increased long-term woody plant encroachment and the elimination of early season plant species. To reduce negative impacts to desirable plants, insects, and other wildlife populations, we suggest dormant or cool-season burning (October through February).

Leaving unburned refugia is also important for many plant and animal populations. Sites should be divided into two or more equal units with no more than half of the units burned in a given year. To allow insect and plant populations to recover, recently burned areas should not be burned for 2 or 3 years (Panzer 2002).

3. Continue to control non-native invasive plant species. During 2022/2023 surveys, established invasive species populations were found that require intense, direct action if native plant species diversity is to increase. These are listed by unit in Table 5. In addition, during the 2022/2023 work, potentially severe but limited outbreaks of invasive species populations were discovered and treated. This work should continue before more severe outbreaks can occur.

SGI recommends spot spraying broad-leaf invasives with a foliar application of 1.5 to 2% Triclopyr mixed with an adjuvant as needed throughout the growing season (application is recommended for May or June, before daytime high temperatures reach 90 degrees F).

SGI recommends invasive grasses be controlled with a narrow spectrum grass-specific herbicide when possible. Non-native cool-season grasses such as tall fescue can be sprayed once they begin growth (one month of growth after burning or mowing is recommended). SGI recommends treating

with Clethodim* herbicide during a warm week in the winter or very early spring (before native warm season grasses begin growth)—avoid areas of standing water (wetland areas will need to be carefully spot sprayed with an aquatic safe herbicide such as Rodeo).

**Clethodim will kill grasses but will not kill broadleaf plants, sedges, or rushes that are green at the same time, making it ideal for controlling non-native cool season grasses in native grasslands without harming desirable native sedges or forbs.*

4. Assess potential to reduce or eliminate big bluestem domination in Malvern Hill unit 17.
5. Consider introducing additional native species that provide resources for various taxa throughout the growing season. This can be done by overseeding following prescribed fire, supplementing existing vegetation with plugs, and/or replanting low quality areas entirely.

If desired, fields can be enhanced by planting local/ecoregional genotype seeds from nearby remnant grasslands or other areas of local native vegetation (or purchased from seed producers, if available) following burns. Plants salvaged from other sites in the region that are going to be impacted by development can also be transplanted to the area. These are good opportunities for public engagement.

In some instances, and if funding allows, it may be beneficial to remove low-quality vegetation and start from scratch with a grassland reconstruction from seed or plugs. To do this, SGI suggests treating the site 3–5 times with a broad-spectrum herbicide to remove the current vegetation and prepare a seed bed for the planting of a diverse grassland seed mix, either with a seed drill or pendulum spreader, followed by rolling the area to ensure good soil/seed contact. We recommend seeding between December 1st and May 15th to ensure adequate rainfall to support developing seedlings but have seen successful seeding as late as June 30th. We recommend planting plugs between November and April to ensure adequate rainfall for root establishment. If these guidelines are followed and precipitation is within expected norms no supplemental watering should be required. Weed control will likely be necessary following planting.

6. Consider thinning woodlands adjacent to grassland units to increase sunlight reaching the ground and create a gradual grassland/woodland ecotone.

The degree of thinning can be determined based on park objectives, but SGI recommends the following best practices:

Hardwood midstory can be thinned using a “hack and squirt”, “cut stump”, or “cut and paint” method. The hack and squirt method involves making a series of downward hacks or cuts through the bark and cambium (using a hatchet or machete) followed by squirting herbicide solution into the cut. For trees under 10 inches diameter, SGI recommends using a 25%:75% Triclopyr:methylated seed oil mix and conducting the treatment outside of the growing season. Standard rate is one hack per 3" diameter at breast height (more hacks are always better). The cut and paint method involves cutting the tree down (as close to ground as possible) followed by treatment with the same mixture to the cambium layer. SGI recommends treating within 10 minutes of hacking or cutting.

Cedar and pine can be cut and do not require herbicide treatment. If cut material is to be left on site SGI recommends bucking up cut trees so that the trunks and branches get good ground contact. This will help them break down or be consumed during prescribed burns. Burning with large fuel loads from cut trees and shrubs can create undesirably high fire intensity and kill or otherwise damage desirable trees a manager wishes to leave.

Any thinning or other management-related disturbance should be followed by careful monitoring for invasive species.

Unit Specific Management Recommendations Based on Desired Conditions for Insects

Gaines' Mill Battlefield

We suggest adding more native plants and converting the low diversity pasture areas into a more traditional native meadow. Plants such as mountain mints (*Pycnanthemum* spp.), Joe-pye weed (*Eutrochium fistulosum*), and milkweeds (*Asclepias* spp.) would increase the variety of insects in these plots. Increase nectar availability throughout the year by introducing native plants with different bloom windows than the current flora. Mowing and burning should take place at times when flowering and floral growth are at their lowest (fall and early winter).

Cold Harbor Battlefield

We suggest adding more native plants and creating a more open structure typical of native grasslands. This location is currently dominated by pine and oak with minimal grassland plant species. Plants such as mountain mints (*Pycnanthemum* spp.), goldenrods (*Solidago* spp.), blazing stars (*Liatris* spp.), phlox (*Phlox* spp.), and plants in the bean and pea family (Fabaceae) should be added. Thinning and prescribed burning should take place at times when flowering and floral growth are at their lowest (fall and early winter).

Malvern Hill Battlefield

We suggest adding a wider variety of native plants to extend nectar availability for insects. This could include plants such as mountain mints (*Pycnanthemum* spp.), blazing star (*Liatris* spp.), phlox (*Phlox* spp.), purple passion flower (*Passiflora incarnata*), and plants in the bean and pea family (Fabaceae). Reduce dense populations of fast-growing opportunistic plant species including all non-native invasive plant species (*Anthoxanthum odoratum*, *Schedonorus arundianceus*, *Sorghum halapense*, etc.) to open areas for new species to grow. Thinning and prescribed burning should take place at times when flowering and floral growth are at their lowest (fall and early winter).

Future Assessment Protocols

While these were not discussed in the limited time of the April 30, 2024, meeting, the following methods could be employed for future assessment of grasslands at Richmond National Battlefield Park:

1. Continue fire-effects vegetation monitoring using established transects.
2. Establish yearly monitoring for invasive species outbreaks.

3. Conduct periodic floristic assessment of grassland units providing for additional evaluation of woody encroachment, GFI, and C values.
4. Employ eBird to further evaluate bird use of the park's grasslands. This can be done on a periodic basis using seasonal phenology graphs and time periods as provided on the eBird interface.
5. Continue volunteer bird surveys.
6. Continue to conduct periodic BioBlitz events and use biodiversity documentation apps such as iNaturalist for staff and citizen scientists to assess park conditions going forward.
7. Continue general survey of pollinators. Diversity should increase as herbaceous native species are recruited into grasslands.

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Appendix A. Flora of Field Units at Richmond National Battlefield Park.

Table 7 presents the total list of plant species documented from each field at Richmond National Battlefield Park with Virginia Natural Heritage Program/Native Plant Society Invasive Rank, Grassland Fidelity Index, and Coefficient of Conservatism.

Table 7. Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Ferns	*Asplenium platyneuron*	X	–	X	–	–	–	–	–	–	–	–	4	4
	Athyrium asplenioides	–	–	–	X	–	–	–	–	–	–	–	3	4
	Onoclea sensibilis	–	X	–	X	–	–	–	–	–	–	–	5	4
	Polystichum acrostichoides	–	X	–	–	–	–	–	–	–	–	–	3	4
	Pteridium aquilinum	X	–	–	–	–	–	–	–	–	X	–	6	3
Graminoids	*Agrostis perennans*	X	–	–	X	X	–	X	X	–	–	–	5	4
	Agrostis gigantea [A,B]	X	–	–	X	–	–	–	–	–	–	–	8	0
	Andropogon gerardii	X	–	–	–	–	X	–	X	–	X	–	9	7
	Andropogon ternarius	X	X	–	–	–	–	X	–	–	–	–	9	5
	Andropogon virginicus	X	X	X	X	X	X	X	X	X	X	–	9	3
	Anthoxanthum odoratum [A]	X	X	X	X	X	X	X	X	X	X	–	8	0
	Arthraxon hispidus var. *hispidus* [A]	–	–	–	–	–	–	–	X	–	–	Medium	7	−3
	Arrhenatherum elatius var. *elatius* [A]	–	–	–	–	–	–	–	–	–	X	–	8	0
	Brachyelytrum erectum [B]	X	–	–	–	–	–	–	–	–	–	–	2	6
	Bromus arvensis [B]	X	X	–	–	–	–	–	–	–	–	–	9	0

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Bromus japonicus/secalinus* [A]	–	X	X	X	X	X	–	X	–	–	–	8	0
	Bromus racemosus	–	–	–	–	–	–	–	–	–	–	–	–	0
	Carex albolutescens	–	X	X	–	–	X	X	–	X	–	–	5	5
	Carex annectens	–	–	–	X	–	–	X	–	–	–	–	7	5
	Carex blanda	X	–	–	–	–	–	–	–	–	–	–	5	4
	Carex cephalophora	X	–	X	–	–	–	–	–	–	–	–	5	5
	Carex complanata	–	–	–	–	–	–	X	–	–	–	–	6	4
	Carex lurida	–	X	–	–	–	–	–	–	–	–	–	6	4
	Carex mesochorea	–	–	–	–	–	–	–	X	–	–	–	6	6
	Carex radiata	–	–	–	X	–	–	–	–	–	–	–	3	5
	Carex squarrosa	X	–	–	–	–	–	X	–	–	–	–	5	6
	Carex swanii/hirsutella	X	X	X	–	–	X	X	–	X	–	–	5	5
	Carex umbellata	X	–	–	–	–	–	–	–	–	–	–	5	5
	Chasmanthium laxum	X	X	–	–	–	–	X	–	–	–	–	5	4
	Cinna arundinacea	–	–	–	–	X	–	–	–	–	–	–	5	5
	Coleataenia anceps ssp. *anceps*	X	X	X	X	X	–	–	X	–	X	–	7	4
	Coleataenia rigidula ssp. *rigidula* [B]	X	X	X	X	–	–	–	–	–	–	–	8	4
	Cynodon dactylon [A]	–	X	–	X	X	X	–	–	–	–	–	9	0
	Cyperus echinatus	X	–	X	–	–	X	X	–	X	X	–	7	4
	Cyperus erythrorhizos	–	–	–	–	X	–	–	–	–	–	–	9	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Cyperus ca. hystricinus*	X	–	–	X	–	–	–	X	–	–	–	7	7
	Cyperus iria [A]	X	–	–	–	–	–	–	–	–	–	–	7	0
	Cyperus odoratus var. *odoratus*	–	–	–	–	–	X	–	–	–	–	–	8	3
	Cyperus retrorsus [B]	–	–	X	–	–	–	–	–	–	–	–	9	5
	Dactylis glomerata [A]	X	–	X	X	–	–	–	–	–	X	–	7	0
	Danthonia sericea	–	X	–	–	–	–	X	–	X	–	–	7	5
	Danthonia spicata	X	–	–	–	–	–	–	–	–	–	–	6	4
	Dichanthelium acuminatum var. *acuminatum*	X	X	X	–	X	–	X	–	–	–	–	8	4
	Dichanthelium acuminaturm var. *lindheimeri*	X	X	–	–	–	–	X	–	–	–	–	8	5
	Dichanthelium boscii	X	–	–	–	–	–	–	–	–	–	–	4	5
	Dichanthelium clandestinum	X	X	X	–	X	X	X	–	–	X	–	5	3
	Dichanthelium commutatum var. *commutatum*	X	–	X	–	–	–	X	–	–	–	–	5	5
	Dichanthelium depauperatum [B]	–	–	–	–	–	X	–	–	–	–	–	8	5
	Dichanthelium dichotomum var. *dichotomum* [B]	X	X	X	–	–	–	X	–	–	–	–	5	4
	Dichanthelium latifolium	–	–	–	–	–	–	–	–	–	–	–	4	7
	Dichanthelium laxiflorum	X	X	–	–	–	X	X	–	–	–	–	5	4
	Dichanthelium meridionale	X	–	–	–	–	–	–	–	–	–	–	6	5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Dichanthelium oligosanthes* var. *oligosanthes* [B]	X	–	–	X	–	–	–	–	–	–	–	8	6
	Dichanthelium polyanthes	X	–	–	–	–	–	–	–	–	–	–	7	5
	Dichanthelium scoparium	X	X	X	X	X	X	X	–	X	–	–	8	4
	Dichanthelium sphaerocarpon [B]	X	–	–	–	–	X	–	–	–	–	–	7	4
	Dichanthelium villosissimum var. *villosissimum* [B]	X	X	–	–	–	–	–	–	–	–	–	8	6
	Digitaria ciliaris/sanguinalis [A]	X	X	–	–	X	X	X	X	–	–	–	8	0
	Echinochloa crusgalli var. *crusgalli* [A]	–	X	–	–	–	X	–	–	–	–	–	8	0
	Elymus virginicus	–	–	–	–	–	X	–	–	–	–	–	5	4
	Eragrostis capillaris	X	X	–	–	–	–	–	–	X	–	–	9	4
	Eragrostis spectabilis	X	X	X	–	X	X	X	–	X	X	–	9	4
	Erianthus contortus	X	–	–	X	X	–	X	–	X	–	–	8	4
	Festuca trachyphylla [A,B]	–	–	–	–	X	–	X	–	–	–	–	8	0
	Festuca rubra [A]	X	–	X	X	X	X	X	–	–	–	–	9	4
	Juncus coriaceus	X	–	–	–	–	–	X	–	X	–	–	7	5
	Juncus effusus	X	–	–	X	–	–	X	X	–	X	–	7	3
	Juncus tenuis	X	X	X	X	X	X	X	X	X	–	–	6	2
	Leersia virginica	X	–	–	–	–	–	–	–	–	–	–	5	4
	Microstegium vimineum [A]	X	X	X	X	–	X	X	X	–	–	High	5	−5

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Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Muhlenbergia schreberi*	X	X	X	X	–	X	–	–	–	–	–	5	1
	Panicum capillare	–	–	–	–	X	–	–	–	–	–	–	9	3
	Panicum dichotomiflorum var. *dichotomiflorum*	X	–	–	–	–	X	X	–	–	–	–	8	2
	Panicum virgatum	X	X	–	–	–	X	–	X	–	X	–	9	4
	Paspalum floridanum	X	–	–	–	–	–	–	–	–	X	–	9	4
	Paspalum laeve	X	–	X	–	–	X	–	–	–	–	–	8	3
	Pennisetum glaucum [A,B]	X	–	X	X	–	–	–	–	–	–	–	–	0
	Phleum pratense [A,B]	–	X	–	X	–	–	–	–	–	–	Low	8	−1
	Poa compressa [A,B]	–	X	–	X	–	–	–	–	–	–	Medium	7	−3
	Poa pratensis ssp. *pratensis* [A,B]	–	–	X	X	–	–	–	–	–	–	–	7	0
	Saccharum brevibarbe var. *contortum*	X	–	–	–	–	–	–	–	–	–	–	9	4
	Saccharum sp.	–	–	X	–	–	–	–	–	–	–	–	–	–
	Schedonorus arundinaceus [A]	X	X	X	X	X	X	X	–	X	X	–	8	0
	Schizachyrium scoparium var. *scoparium*	X	X	X	X	X	X	X	X	–	–	–	8	5
	Scirpus cyperinus [B]	–	X	–	–	–	–	X	–	–	–	–	9	2
	Scleria pauciflora var. *pauciflora* [B]	–	–	–	–	–	–	X	–	–	–	–	8	6
	Setaria faberi [A]	X	X	–	–	X	X	X	–	–	X	–	8	0
	Setaria parviflora	X	X	X	X	X	X	X	–	X	X	–	8	3

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Graminoids (continued)	*Setaria pumila* ssp. *pumila* [A]	X	–	X	X	–	–	X	–	–	–	–	8	0
	Sorghum halapense [A]	X	–	X	X	–	–	–	X	X	X	–	8	−5
	Sorghastrum nutans	X	X	X	X	X	X	X	X	X	X	–	8	6
	Sphenopholis obtusata	X	X	–	–	–	–	X	–	X	–	–	6	3
	Tridens flavus	X	X	X	X	X	X	X	X	X	X	–	8	3
	Triticum aestivum [A]	–	X	–	–	X	X	–	–	–	–	–	9	–
Wildflowers (continued)	*Acalypha gracilens*	X	X	X	X	–	X	–	–	–	X	–	7	2
	Acalypha rhomboidea [B]	–	–	–	–	–	–	–	–	–	–	–	6	2
	Achillea millefolium	X	X	X	X	–	X	–	–	X	X	–	8	2
	Agalinis purpurea	X	X	X	X	X	–	X	X	–	–	–	8	5
	Agrimonia parviflora	–	–	X	X	X	–	–	X	–	–	–	6	4
	Agrimonia pubescens	–	–	X	–	–	–	–	–	–	–	–	5	6
	Aletris farinosa [B]	–	X	–	–	–	–	–	–	–	–	–	9	6
	Allium canadense var. *canadense* [B]	X	–	–	–	–	–	–	–	–	–	–	9	2
	Allium vineale [A]	X	X	X	X	–	X	X	X	X	X	–	8	0
	Ambrosia artemesiifolia	X	X	X	X	X	X	X	–	X	X	–	8	1
	Antennaria plantaginifolia [B]	X	–	–	–	–	–	–	–	–	–	–	6	5
	Apocynum cannabinum	X	X	X	X	X	X	X	X	X	X	–	8	2
	Arisaema triphyllum ssp. *triphyllum*	X	–	–	–	–	–	X	–	–	–	–	2	6
	Artemesia vulgaris [A,B]	–	X	–	–	–	–	–	–	–	–	–	8	0

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Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Asclepias syriaca*	–	–	–	X	–	X	–	X	–	–	–	8	3
	Bidens aristosa [A]	X	–	–	–	–	X	–	–	–	–	–	9	0
	Bidens bipinnata	X	–	X	–	–	–	–	–	–	X	–	7	1
	Bidens frondosa	X	–	–	–	–	–	X	–	–	–	–	6	2
	Bidens trichosperma [B]	–	–	–	–	–	X	–	–	–	–	–	9	3
	Boehmeria cylindrica	–	–	X	X	–	–	X	–	–	–	–	5	4
	Carduus nutans [A]	X	X	–	–	–	X	–	–	–	–	–	9	0
	Chamaecrista fasciculata var. *fasciculata*	–	X	–	–	–	X	–	X	–	–	–	8	2
	Chamaecrista nictatans var. *nictatans*	X	X	X	X	X	X	X	–	X	X	–	8	2
	Chrysopsis mariana	X	X	–	–	–	X	–	–	–	–	–	8	4
	Circaea canadensis ssp. *canadensis* [B]	X	–	–	–	–	–	–	–	–	–	–	3	6
	Cirsium discolor	–	–	X	X	–	–	–	–	–	–	–	8	3
	Commelina communis [A]	X	X	–	X	–	–	–	–	–	X	Low	7	−1
	Conoclinum coelestinum	–	X	–	–	–	–	–	–	–	–	–	7	4
	Conyza canadensis var. *canadensis*	X	X	–	X	X	X	X	X	–	X	–	8	1
	Croton glandulosus var. *septentrionalis*	X	–	–	–	–	–	–	–	–	X	–	9	0
	Cynanchum laeve	X	–	–	–	–	–	–	–	–	–	–	7	1

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Wildflowers (continued)	*Daucus carota* [A]	X	–	X	X	–	–	–	–	–	X	–	9	0
	Desmodium canescens [B]	–	–	X	X	–	–	–	–	–	–	–	9	4
	Desmodium ciliare	–	X	X	X	–	–	–	–	–	–	–	8	3
	Desmosdium glabellum [B]	–	–	X	X	–	–	–	–	–	–	–	7	3
	Desmodium laevigatum	–	X	–	–	–	–	–	–	–	–	–	7	5
	Desmodium nuttallii/perplexa	X	–	X	X	–	X	–	X	–	X	–	8	3
	Desmodium paniculatum var. *paniculatum*	X	X	X	X	X	X	X	X	X	X	–	8	4
	Dianthus armeria ssp. *armeria* [A]	X	–	–	–	–	X	–	–	–	–	–	9	0
	Diodia teres	X	–	–	–	X	–	–	–	–	–	–	9	1
	Diodia virginiana	–	–	–	–	X	–	–	–	–	–	–	8	3
	Dioscorea villosa	–	–	–	X	–	–	–	–	–	–	–	5	5
	Elephantopus carolinianus	X	–	X	X	–	–	–	–	–	X	–	5	3
	Elephantopus tomentosus	X	X	X	–	–	–	–	–	–	–	–	5	4
	Endodeca serpentaria	–	–	X	–	–	X	–	–	–	–	–	3	7
	Erechtites hieracifolia	X	X	–	–	X	X	–	–	X	–	–	6	2
	Erigeron anuus	X	X	X	X	–	X	–	X	X	X	–	8	2
	Erigeron pulchellus var. *pulchellus* [B]	X	–	–	–	–	–	–	–	–	–	–	5	6
	Erigeron stigosus var. *strigosus*	X	–	–	–	X	X	X	X	X	–	–	8	2
	Eryngium prostratum	X	–	–	–	–	–	–	–	X	–	–	7	4

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Wildflowers (continued)	*Eupatorium album* var. *album* [B]	X	–	–	–	–	–	–	–	–	–	–	8	6
	Eupatorium capillifolium	X	X	X	X	X	X	X	X	–	X	–	8	2
	Eupatorium hyssopifolium	X	X	X	–	X	X	X	–	X	X	–	8	4
	Eupatorium perfoliatum	–	–	–	X	–	–	–	–	–	–	–	7	6
	Eupatorium pilosum	X	X	–	–	–	–	X	–	X	–	–	8	6
	Eupatorium pubescens	X	X	–	–	–	X	X	–	X	–	–	7	4
	Eupatorium rotundifolium [B]	X	–	–	–	X	X	–	–	–	–	–	8	4
	Eupatorium serotinum	X	X	X	X	X	X	X	X	X	–	–	7	2
	Eupatorium torreyanum	–	X	X	–	X	–	–	–	–	–	–	8	4
	Euphorbia humistrata	–	–	–	–	X	–	–	–	–	–	–	8	0
	Euthamia caroliniana	X	X	–	–	–	X	X	X	X	–	–	8	3
	Euthamia graminifolia	X	X	X	X	X	X	X	X	X	–	–	8	4
	Galium mollugo [A,B]	–	X	–	–	–	–	–	–	–	–	–	8	0
	Galium pilosum	X	X	X	X	–	–	–	–	X	–	–	7	4
	Galium tinctorium	–	X	–	–	–	–	–	–	–	–	–	7	4
	Oenothera gaura [B]	–	–	–	X	–	–	–	–	–	–	–	8	3
	Gamochaeta purpurea/argyrinea	X	X	X	X	X	X	X	–	X	–	–	8	2
	Geum canadense	–	–	–	X	–	–	–	–	–	–	–	5	5
	Hedeoma pulegioides [B]	X	–	–	–	–	–	–	–	–	–	–	6	4
	Hemerocallus fulva [A]	–	X	–	–	–	–	–	–	–	–	–	7	0

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Wildflowers (continued)	*Heterotheca subaxillaris*	X	–	–	–	–	–	–	–	–	–	–	9	3
	Hieracium gronovii	X	X	–	X	–	–	–	–	–	–	–	7	4
	Hieracium paniculatum [B]	X	–	–	–	–	–	–	–	–	–	–	5	4
	Houstonia longifolia [B]	X	–	–	–	X	–	–	–	–	–	–	8	6
	Hypericum perforatum [A]	–	–	X	X	–	X	–	X	–	–	–	9	0
	Hypericum punctatum [B]	X	–	–	X	–	–	–	–	–	–	–	6	3
	Hypericum stragulum	X	X	X	X	–	–	X	X	X	–	–	6	5
	Hypochaeris radicata [A]	X	–	X	X	–	X	–	X	–	X	–	9	0
	Ipomoea hederacea	–	X	–	–	X	–	–	–	–	–	–	8	1
	Ipomoea lacunosa	–	–	–	–	X	X	–	–	–	X	–	8	3
	Krigia virginica	X	–	–	–	–	–	X	–	X	–	–	8	3
	Kummerowia stipulacea [A,B]	–	–	X	–	–	–	–	–	–	–	–	8	0
	Kummerowia striata [A]	X	X	X	X	–	X	X	–	X	X	–	8	0
	Lactuca canadensis	–	–	X	X	–	X	–	–	–	X	–	8	2
	Lathyrus pratensis [A,B]	–	–	X	–	–	–	–	–	–	–	–	–	–
	Lespedeza cuneata [A]	X	X	X	X	X	X	X	X	X	X	High	8	−5
	Lespedeza frutescens	–	–	–	X	–	–	–	–	–	–	–	7	6
	Lespedeza procumbens	X	X	X	X	X	X	–	–	–	–	–	7	4
	Lespedeza repens	–	–	–	–	X	X	–	–	–	–	–	7	5
	Lespedeza virginica	X	X	X	X	X	X	X	X	X	–	–	8	4

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Wildflowers (continued)	*Leucanthemum vulgare* [A]	X	X	X	X	X	X	X	X	X	X	–	8	0
	Lobelia inflata	X	–	X	X	–	X	–	–	–	–	–	6	2
	Lobelia puberula	–	X	X	–	–	–	–	–	–	–	–	8	4
	Ludwigia alternifolia	X	–	–	–	–	X	–	–	X	–	–	8	3
	Lycopus virginicus	–	–	–	X	–	–	–	–	–	–	–	5	4
	Mecardonia acuminata var. *acuminata*	–	–	–	X	–	–	–	–	–	–	–	7	5
	Melothria pendula	–	–	–	–	–	–	–	–	–	X	–	6	4
	Mikania scandens	–	–	–	X	–	–	–	–	–	–	–	6	3
	Mimulus ringens var. *ringens* [B]	–	X	–	–	–	–	–	–	–	–	–	7	5
	Mollugo verticillata [A,B]	X	–	–	–	–	–	–	–	–	–	–	9	0
	Monarda punctata [B]	–	–	–	X	–	–	–	–	–	–	–	8	5
	Nuttalanthus canadensis	X	X	–	–	–	–	–	–	X	–	–	9	2
	Oenothera biennis	–	X	X	–	–	X	–	–	–	–	–	8	1
	Oxalis dillenii	X	X	X	X	X	X	X	X	X	X	–	7	2
	Oxalis stricta [B]	–	–	X	–	–	–	–	X	–	–	–	7	2
	Packera anonyma	–	–	–	–	–	X	–	–	X	X	–	8	4
	Passiflora incarnata	X	X	X	X	X	X	–	–	–	X	–	8	2
	Persicaria extremiorientalis [A]	–	X	–	–	–	–	–	–	–	–	–	–	−3
	Persicaria longiseta [A]	X	–	–	–	–	X	–	–	–	–	Medium	6	−3

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Wildflowers (continued)	*Persicaria maculosa* [A,B]	–	–	–	–	–	X	–	–	–	–	–	7	0
	Persicaria virginiana	–	–	–	X	–	–	–	–	–	–	–	4	5
	Phyllanthus caroliniensis	–	–	–	–	X	–	–	–	–	–	–	6	2
	Physalis angulata var. *angulata*	–	X	–	–	X	–	–	–	–	–	–	9	2
	Physalis heterophylla	X	–	–	–	–	–	–	–	–	–	–	8	4
	Physalis pubescens	–	–	–	–	–	X	–	–	–	–	–	9	3
	Phytolacca americana var. *americana*	–	X	X	–	X	X	–	–	–	X	–	7	1
	Plantago lanceolata [A]	–	X	X	X	–	–	–	X	–	X	–	7	0
	Plantago virginica	X	X	–	–	–	X	–	–	–	–	–	7	2
	Polypremum procumbens [B]	–	X	–	–	–	–	–	–	–	–	–	8	2
	Potentilla canadensis var. *canadensis* [B]	–	X	X	–	–	–	–	–	–	–	–	5	4
	Potentilla simplex [B]	–	X	X	–	–	X	–	–	–	–	–	6	4
	Prunella vulgaris	–	–	X	X	–	–	–	–	–	–	–	8	2
	Psueodognaphalium obtusifolium	X	X	X	X	X	X	X	X	X	X	–	8	2
	Pycnanthemum tenuifolium	X	X	–	–	–	–	X	–	X	–	–	7	5
	Pyrrhopappus carolinianus	X	–	X	–	–	–	–	–	–	–	–	8	2
	Rhexia mariana	X	X	–	X	–	–	X	X	–	–	–	8	4
	Rudbeckia hirta	X	–	–	X	–	X	–	X	–	X	–	8	3
	Ruellia caroliniensis	X	–	–	X	–	–	–	X	–	–	–	7	4

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Wildflowers (continued)	*Rumex acetosella* [A]	X	X	X	X	–	X	X	–	–	X	Medium	–	−3
	Rumex conglomeratus [A]	–	–	–	X	–	–	–	–	–	–	–	7	0
	Rumex crispus [A]	–	X	X	X	X	X	–	X	–	X	Low	8	−1
	Sabatia angularis [B]	–	–	–	–	–	X	–	–	–	–	–	7	5
	Salvia lyrata	–	–	–	X	–	–	–	–	–	X	–	7	2
	Sanicula sp	–	–	–	–	–	X	–	–	–	–	–	–	–
	Scleranthus annuus [A]	X	–	–	–	–	–	–	–	–	–	–	9	0
	Scutellaria integrifolia	X	X	–	–	X	X	–	X	–	–	–	7	5
	Securigera varia [A]	–	–	–	–	–	X	–	–	–	–	–	8	−1
	Senna marilandica	X	–	–	–	–	–	–	–	–	–	–	7	5
	Sida spinosa [A]	–	–	–	–	X	–	–	–	–	–	–	8	0
	Sisyrinchium angustifolium	X	–	–	X	–	–	X	–	X	–	–	7	4
	Solanum carolliniense var. *caroliniense*	X	X	X	X	X	X	X	–	X	–	–	8	2
	Solanum ptychanthum	–	X	–	–	–	–	–	–	–	–	–	7	2
	Solidago altissima ssp. *altissima*	X	X	X	X	–	X	X	–	X	X	–	8	3
	Solidago canadensis	X	X	–	–	X	X	X	X	X	–	–	8	3
	Solidago gigantea	X	X	–	–	–	X	–	X	–	–	–	8	4
	Solidago odora	–	X	–	–	–	–	–	–	–	–	–	7	5
	Solidago pinetorum	X	–	–	X	–	–	–	–	–	–	–	8	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Solidago rugosa/ulmifolia*	X	X	–	X	X	X	X	–	X	–	–	6	4
	Stylosanthes biflora	–	X	–	–	X	–	–	–	–	–	–	7	4
	Symphyotrichum laeve var. *laeve* [B]	–	–	–	X	–	X	–	–	–	–	–	7	6
	Symphyotrichum lateriflorum [B]	–	–	–	X	–	–	–	–	–	–	–	5	6
	Symphyotrichum pilosum var. *pilosum* [B]	–	–	–	X	X	–	–	–	–	–	–	8	2
	Taraxacum officinale [A,B]	–	X	X	–	–	–	–	–	–	–	–	9	0
	Thyranthella difforme	X	–	X	–	–	–	–	–	–	–	–	5	5
	Tragopogon pratensis [A,B]	X	–	–	–	–	X	–	–	–	–	–	9	0
	Trifolium arvense [A]	X	X	–	–	–	–	–	–	–	–	–	8	0
	Trifolium dubium [A]	–	–	–	–	–	–	–	–	–	X	–	8	0
	Trifolium pratense [A]	–	X	–	X	–	X	–	–	–	X	–	8	0
	Trifolium repens [A]	–	–	X	–	–	X	–	–	–	X	–	8	0
	Trichostema dichotomum	X	–	–	–	–	–	X	–	–	–	–	8	4
	Triodanis perfoliata	X	X	–	X	X	X	X	–	X	X	–	8	1
	Verbascum blattaria [A]	–	–	–	X	–	–	–	–	–	–	–	8	0
	Verbascum thapsus [A]	X	X	X	–	X	X	–	–	X	X	–	8	0
	Verbena urticifolia [B]	–	–	–	–	–	–	–	–	–	–	–	6	3
	Verbesina occidentalis	X	X	X	X	X	X	X	–	X	X	–	7	2

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Vernonia noveboracensis*	–	–	–	–	X	–	–	X	–	–	–	8	6
	Veronica arvensis [A]	X	X	–	–	X	–	–	–	–	–	–	7	0
Woody plants	*Acer rubrum*	–	–	–	–	–	–	–	–	X	X	–	4	2
	Ailanthus altissima [A]	X	X	X	–	–	X	–	–	–	X	High	6	−5
	Arailia spinosa	X	–	–	X	–	–	X	–	–	X	–	5	3
	Campsis radicans	X	X	X	X	–	X	X	–	X	X	–	5	2
	Celastrus orbiculatus [A]	–	–	–	–	–	–	–	–	–	X	–	6	−5
	Carya sp.	X	X	X	X	–	X	–	–	X	–	–	–	–
	Diospyros virginiana	–	X	X	X	–	X	X	X	X	X	–	6	5
	Elaeagnus umbellata [A]	–	–	–	X	–	–	–	–	–	–	High	6	−5
	Fraxinus americana [B]	–	–	–	–	–	X	–	–	–	–	–	5	7
	Fraxinus pensylvanica [B]	–	–	–	–	–	X	–	–	–	–	–	5	6
	Hypericum hypericoides	X	X	X	–	–	–	X	–	–	–	–	5	4
	Ilex opaca var. *opaca*	–	–	X	–	–	–	–	–	–	X	–	4	5
	Juglans nigra	–	–	–	X	–	X	–	–	–	X	–	5	5
	Juniperus virginiana	–	–	–	–	–	–	–	–	–	X	–	7	3
	Ligustrum sinense [A]	–	–	X	X	–	–	–	–	–	–	High	5	−5
	Liquidambar styraciflua	X	X	X	X	X	X	X	X	–	X	–	5	3
	Liriodendron tulipifera	–	–	X	X	–	X	X	–	–	X	–	5	4
	Lonicera japonica [A]	X	X	X	X	–	X	X	–	X	X	High	6	−5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	*Lonicera morrowii* [A,B]	–	–	–	X	–	–	–	–	–	–	High	5	−5
	Morus alba [A]	–	–	–	–	–	–	–	–	–	X	Low	5	−1
	Parthenocissus quinquefolia	X	X	–	–	–	X	–	–	–	X	–	5	3
	Pinus taeda	X	–	–	–	–	X	X	–	–	X	–	6	3
	Pinus virginiana	–	–	–	–	–	–	X	–	–	–	–	8	2
	Prunus serotina var. *serotina*	X	X	X	X	–	–	–	–	X	X	–	5	3
	Quercus falcata	X	X	X	–	–	X	X	–	X	X	–	5	5
	Quercus phellos	X	X	X	X	–	X	X	–	–	X	–	5	4
	Quercus stellata	–	–	X	–	–	–	–	–	–	–	–	8	4
	Rhus copallinum var. *latifolia*	X	–	X	–	–	X	–	–	X	X	–	7	3
	Robinia pseudoacacia	–	–	–	–	–	–	–	–	–	X	–	7	2
	Rubus allegheniensis [B]	X	–	–	–	–	–	–	–	–	–	–	7	3
	Rubus cuneifolius [B]	X	–	–	–	X	X	X	X	–	–	–	7	3
	Rubus flagellaris	X	–	–	–	–	X	–	–	–	–	–	8	3
	Rubus pascuus [A]	X	X	–	–	–	–	X	–	–	–	–	8	–
	Rubus pensylvanicus	X	X	X	X	X	X	X	X	X	X	–	8	2
	Sambucus canadensis	–	–	–	–	–	–	–	–	–	X	–	6	4
	Sassafras albidum	–	X	–	–	–	X	–	–	–	X	–	5	4
	Smilax bona-nox	X	X	–	–	–	–	X	–	X	–	–	5	4
	Smilax glauca	X	X	X	–	–	–	–	–	X	–	–	6	5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 7 (continued). Plant species documented at each site in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	*Smilax rotundifolia*	X	–	–	X	–	X	X	–	–	X	–	5	3
	Toxicodendron radicans	X	X	X	X	–	X	–	X	–	X	–	5	2
	Ulmus alata	X	–	X	–	–	X	–	–	–	–	–	5	4
	Vaccinium stamineum	–	–	–	–	–	–	–	–	–	X	–	5	6
	Vitis cinerea var. *baileyana*	–	X	–	–	–	–	–	–	–	–	–	4	4
	Vitis rotundifolia var. *rotundifolia*	X	X	X	X	X	X	X	–	X	X	–	5	4
	Vitis vulpina	–	–	–	–	–	–	–	–	–	X	–	5	4
	Total taxa	**175**	**134**	**110**	**119**	**75**	**122**	**93**	**56**	**67**	**87**	**–**	–	–

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Appendix B. Mean Coefficient of Conservatism (C Value) for Flora of Field Units at Richmond National Battlefield Park.

Table 8 lists vascular plant species found in each plot with the coefficient of conservatism (C Value) for each species and the mean C Value for each plot.

Table 8. Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Ferns	*Asplenium platyneuron*	4	–	4	–	–	–	–	–	–	–	–	4	4
	Athyrium asplenioides	–	–	–	4	–	–	–	–	–	–	–	3	4
	Onoclea sensibilis	–	4	–	4	–	–	–	–	–	–	–	5	4
	Polystichum acrostichoides	–	4	–	–	–	–	–	–	–	–	–	3	4
	Pteridium aquilinum	3	–	–	–	–	–	–	–	–	3	–	6	3
Graminoids	*Agrostis perennans*	4	–	–	4	4	–	4	4	–	–	–	5	4
	Agrostis gigantea [A,B]	–	–	–	0	–	–	–	–	–	–	–	8	0
	Andropogon gerardii	7	–	–	–	–	7	–	7	–	7	–	9	7
	Andropogon ternarius	5	5	–	–	–	–	5	–	–	–	–	9	5
	Andropogon virginicus	3	3	3	3	3	3	3	3	3	3	–	9	3
	Anthoxanthum odoratum [A]	0	0	0	0	0	0	0	0	0	0	–	8	0
	Arthraxon hispidus var. *hispidus* [A]	–	–	–	–	–	–	–	−3	–	–	Medium	7	−3
	Arrhenatherum elatius var. *elatius* [A]	–	–	–	–	–	–	–	–	–	0	–	8	0
	Brachyelytrum erectum [B]	6	–	–	–	–	–	–	–	–	–	–	2	6

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Bromus arvensis* [B]	0	0	–	–	–	–	–	–	–	–	–	9	0
	Bromus japonicus/secalinus [A]	–	0	0	0	0	0	–	0	–	–	–	8	0
	Bromus racemosus	–	–	–	–	–	–	–	–	–	–	–	–	0
	Carex albolutescens	–	5	5	–	–	5	5	–	5	–	–	5	5
	Carex annectens	–	–	–	5	–	–	5	–	–	–	–	7	5
	Carex blanda	4	–	–	–	–	–	–	–	–	–	–	5	4
	Carex cephalophora	5	–	5	–	–	–	–	–	–	–	–	5	5
	Carex complanata	–	–	–	–	–	–	4	–	–	–	–	6	4
	Carex lurida	–	4	–	–	–	–	–	–	–	–	–	6	4
	Carex mesochorea	–	–	–	–	–	–	–	6	–	–	–	6	6
	Carex radiata	–	–	–	5	–	–	–	–	–	–	–	3	5
	Carex squarosa	6	–	–	–	–	–	6	–	–	–	–	5	6
	Carex swanii/hirsutella	5	5	5	–	–	5	5	–	5	–	–	5	5
	Carex umbellata	5	–	–	–	–	–	–	–	–	–	–	5	5
	Chasmanthium laxum	4	4	–	–	–	–	4	–	–	–	–	5	4
	Cinna arundinacea	–	–	–	–	5	–	–	–	–	–	–	5	5
	Coleataenia anceps ssp. *anceps*	4	4	4	4	4	–	–	4	–	4	–	7	4
	Coleataenia rigidula ssp. *rigidula* [B]	4	4	4	4	–	–	–	–	–	–	–	8	4
	Cynodon dactylon [A]	–	0	–	0	0	0	–	–	–	–	–	9	0
	Cyperus echinatus	4	–	4	–	–	4	4	–	4	4	–	7	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Cyperus erythrorhizos*	–	–	–	–	4	–	–	–	–	–	–	9	4
	Cyperus ca. hystricinus	7	–	–	7	–	–	–	7	–	–	–	7	7
	Cyperus iria [A]	0	–	–	–	–	–	–	–	–	–	–	7	0
	Cyperus odoratus var. *odoratus*	–	–	–	–	–	3	–	–	–	–	–	8	3
	Cyperus retrorsus [B]	–	–	5	–	–	–	–	–	–	–	–	9	5
	Dactylis glomerata [A]	0	–	0	0	–	–	–	–	–	0	–	7	0
	Danthonia sericea	–	5	–	–	–	–	5	–	5	–	–	7	5
	Danthonia spicata	4	–	–	–	–	–	–	–	–	–	–	6	4
	Dichanthelium acuminatum var. *acuminatum*	4	4	4	–	4	–	4	–	–	–	–	8	4
	Dichanthelium acuminaturm var. *lindheimeri*	5	5	–	–	–	–	5	–	–	–	–	8	5
	Dichanthelium boscii	5	–	–	–	–	–	–	–	–	–	–	4	5
	Dichanthelium clandestinum	3	3	3	–	3	3	3	–	–	3	–	5	3
	Dichanthelium commutatum var. *commutatum*	5	–	5	–	–	–	5	–	–	–	–	5	5
	Dichanthelium depauperatum [B]	–	–	–	–	–	5	–	–	–	–	–	8	5
	Dichanthelium dichotomum var. *dichotomum* [B]	4	4	4	–	–	–	4	–	–	–	–	5	4
	Dichanthelium latifolium	–	–	–	–	–	–	–	–	–	–	–	4	7
	Dichanthelium laxiflorum	4	4	–	–	–	4	4	–	–	–	–	5	4

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Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Dichanthelium meridionale*	5	–	–	–	–	–	–	–	–	–	–	6	5
	Dichanthelium oligosanthes var. *oligosanthes* [B]	6	–	–	6	–	–	–	–	–	–	–	8	6
	Dichanthelium polyanthes	5	–	–	–	–	–	–	–	–	–	–	7	5
	Dichanthelium scoparium	4	4	4	4	4	4	4	–	4	–	–	8	4
	Dichanthelium sphaerocarpon [B]	4	–	–	–	–	4	–	–	–	–	–	7	4
	Dichanthelium villosissimum var. *villosissimum* [B]	6	6	–	–	–	–	–	–	–	–	–	8	6
	Digitaria ciliaris/sanguinalis [A]	0	0	–	–	0	0	0	0	–	–	–	8	0
	Echinochloa crusgalli var. *crusgalli* [A]	–	0	–	–	–	0	–	–	–	–	–	8	0
	Elymus virginicus	–	–	–	–	–	4	–	–	–	–	–	5	4
	Eragrostis capillaris	4	4	–	–	–	–	–	–	4	–	–	9	4
	Eragrostis spectabilis	4	4	4	–	4	4	4	–	4	4	–	9	4
	Erianthus contortus	4	–	–	4	4	–	4	–	4	–	–	8	4
	Festuca trachyphylla [A,B]	–	–	–	–	0	–	0	–	–	–	–	8	0
	Festuca rubra [A]	4	–	4	4	4	4	4	–	–	–	–	9	4
	Juncus coriaceus	5	–	–	–	–	–	5	–	5	–	–	7	5
	Juncus effusus	3	–	–	3	–	–	3	3	–	3	–	7	3
	Juncus tenuis	2	2	2	2	2	2	2	2	2	–	–	6	2
	Leersia virginica	4	–	–	–	–	–	–	–	–	–	–	5	4
	Microstegium vimineum [A]	−5	−5	−5	−5	–	−5	−5	−5	–	–	High	5	−5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Muhlenbergia schreberi*	1	1	1	1	–	1	–	–	–	–	–	5	1
	Panicum capillare	–	–	–	–	3	–	–	–	–	–	–	9	3
	Panicum dichotomiflorum var. *dichotomiflorum*	2	–	–	–	–	2	2	–	–	–	–	8	2
	Panicum virgatum	4	4	–	–	–	4	–	4	–	4	–	9	4
	Paspalum floridanum	4	–	–	–	–	–	–	–	–	4	–	9	4
	Paspalum laeve	3	–	3	–	–	3	–	–	–	–	–	8	3
	Pennisetum glaucum [A,B]	0	–	0	0	–	–	–	–	–	–	–	–	0
	Phleum pratense [A,B]	–	−1	–	−1	–	–	–	–	–	–	Low	8	−1
	Poa compressa [A,B]	–	−3	–	−3	–	–	–	–	–	–	Medium	7	−3
	Poa pratensis ssp. *pratensis* [A,B]	–	–	0	0	–	–	–	–	–	–	–	7	0
	Saccharum brevibarbe var. *contortum*	4	–	–	–	–	–	–	–	–	–	–	9	4
	Saccharum sp.	–	–	X	–	–	–	–	–	–	–	–	–	–
	Schedonorus arundinaceus [A]	0	0	0	0	0	0	0	–	0	0	–	8	0
	Schizachyrium scoparium var. *scoparium*	5	5	5	5	5	5	5	5	–	–	–	8	5
	Scirpus cyperinus [B]	–	2	–	–	–	–	2	–	–	–	–	9	2
	Scleria pauciflora var. *pauciflora* [B]	–	–	–	–	–	–	6	–	–	–	–	8	6
	Setaria faberi [A]	0	0	–	–	0	0	0	–	–	0	–	8	0
	Setaria parviflora	3	3	3	3	3	3	3	–	3	3	–	8	3

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Setaria pumila* ssp. *pumila* [A]	0	–	0	0	–	–	0	–	–	–	–	8	0
	Sorghum halapense [A]	−5	−5	−5	−5	–	–	–	−5	−5	−5	–	8	−5
	Sorghastrum nutans	6	6	6	6	6	6	6	6	6	6	–	8	6
	Sphenopholis obtusata	3	3	–	–	–	–	3	–	3	–	–	6	3
	Tridens flavus	3	3	3	3	3	3	3	3	3	3	–	8	3
	Triticum aestivum [A]	–	X	–	–	X	X	–	–	–	–	–	9	–
Wildflowers	*Acalypha gracilens*	2	2	2	2	–	2	–	–	–	2	–	7	2
	Acalypha rhomboidea [B]	–	–	–	–	–	–	–	–	–	–	–	6	2
	Achillea millefolium	2	2	2	2	–	2	–	–	2	2	–	8	2
	Agalinis purpurea	5	5	5	5	5	–	5	5	–	–	–	8	5
	Agrimonia parviflora	–	–	4	4	4	–	–	4	–	–	–	6	4
	Agrimonia pubescens	–	–	6	–	–	–	–	–	–	–	–	5	6
	Aletris farinosa [B]	–	6	–	–	–	–	–	–	–	–	–	9	6
	Allium canadense var. *canadense* [B]	2	–	–	–	–	–	–	–	–	–	–	9	2
	Allium vineale [A]	0	0	0	0	–	0	0	0	0	0	–	8	0
	Ambrosia artemesiifolia	1	1	1	1	1	1	1	–	1	1	–	8	1
	Antennaria plantaginifolia [B]	5	–	–	–	–	–	–	–	–	–	–	6	5
	Apocynum cannabinum	2	2	2	2	2	2	2	2	2	2	–	8	2
	Arisaema triphyllum ssp. *triphyllum*	6	–	–	–	–	–	6	–	–	–	–	2	6
	Artemesia vulgaris [A,B]	–	0	–	–	–	–	–	–	–	–	–	8	0

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Asclepias syriaca*	–	–	–	3	–	3	–	3	–	–	–	8	3
	Bidens aristosa [A]	0	–	–	–	–	0	–	–	–	–	–	9	0
	Bidens bipinnata	1	–	1	–	–	–	–	–	–	1	–	7	1
	Bidens frondosa	2	–	–	–	–	–	2	–	–	–	–	6	2
	Bidens trichosperma [B]	–	–	–	–	–	3	–	–	–	–	–	9	3
	Boehmeria cylindrica	–	–	4	4	–	–	4	–	–	–	–	5	4
	Carduus nutans [A]	0	0	–	–	–	0	–	–	–	–	–	9	0
	Chamaecrista fasciculata var. *fasciculata*	–	2	–	–	–	2	–	2	–	–	–	8	2
	Chamaecrista nictatans var. *nictatans*	2	2	2	2	2	2	2	–	2	2	–	8	2
	Chrysopsis mariana	4	4	–	–	–	4	–	–	–	–	–	8	4
	Circaea canadensis ssp. *canadensis* [B]	6	–	–	–	–	–	–	–	–	–	–	3	6
	Cirsium discolor	–	–	3	3	–	–	–	–	–	–	–	8	3
	Commelina communis [A]	−1	−1	–	−1	–	–	–	–	–	−1	Low	7	−1
	Conoclinum coelestinum	–	4	–	–	–	–	–	–	–	–	–	7	4
	Conyza canadensis var. *canadensis*	1	1	–	1	1	1	1	1	–	1	–	8	1
	Croton glandulosus var. *septentrionalis*	0	–	–	–	–	–	–	–	–	0	–	9	0
	Cynanchum laeve	1	–	–	–	–	–	–	–	–	–	–	7	1

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Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Daucus carota* [A]	0	–	0	0	–	–	–	–	–	0	–	9	0
	Desmodium canescens [B]	–	–	4	4	–	–	–	–	–	–	–	9	4
	Desmodium ciliare	–	3	3	3	–	–	–	–	–	–	–	8	3
	Desmosdium glabellum [B]	–	–	3	3	–	–	–	–	–	–	–	7	3
	Desmodium laevigatum	–	5	–	–	–	–	–	–	–	–	–	7	5
	Desmodium nuttallii/perplexa	3	–	3	3	–	3	–	3	–	3	–	8	3
	Desmodium paniculatum var. *paniculatum*	4	4	4	4	4	4	4	4	4	4	–	8	4
	Dianthus armeria ssp. *armeria* [A]	0	–	–	–	–	0	–	–	–	–	–	9	0
	Diodia teres	1	–	–	–	1	–	–	–	–	–	–	9	1
	Diodia virginiana	–	–	–	–	3	–	–	–	–	–	–	8	3
	Dioscorea villosa	–	–	–	5	–	–	–	–	–	–	–	5	5
	Elephantopus carolinianus	3	–	3	3	–	–	–	–	–	3	–	5	3
	Elephantopus tomentosus	4	4	4	–	–	–	–	–	–	–	–	5	4
	Endodeca serpentaria	–	–	7	–	–	7	–	–	–	–	–	3	7
	Erechtites hieracifolia	2	2	–	–	2	2	–	–	2	–	–	6	2
	Erigeron anuus	2	2	2	2	–	2	–	2	2	2	–	8	2
	Erigeron pulchellus var. *pulchellus* [B]	6	–	–	–	–	–	–	–	–	–	–	5	6
	Erigeron stigosus var. *strigosus*	2	–	–	–	2	2	2	2	2	–	–	8	2
	Eryngium prostratum	4	–	–	–	–	–	–	–	4	–	–	7	4

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Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Eupatorium album* var. *album* [B]	6	–	–	–	–	–	–	–	–	–	–	8	6
	Eupatorium capillifolium	2	2	2	2	2	2	2	2	–	2	–	8	2
	Eupatorium hyssopifolium	4	4	4	–	4	4	4	–	4	4	–	8	4
	Eupatorium perfoliatum	–	–	–	6	–	–	–	–	–	–	–	7	6
	Eupatorium pilosum	6	6	–	–	–	–	6	–	6	–	–	8	6
	Eupatorium pubescens	4	4	–	–	–	4	4	–	4	–	–	7	4
	Eupatorium rotundifolium [B]	4	–	–	–	4	4	–	–	–	–	–	8	4
	Eupatorium serotinum	2	2	2	2	2	2	2	2	2	–	–	7	2
	Eupatorium torreyanum	–	4	4	–	4	–	–	–	–	–	–	8	4
	Euphorbia humistrata	–	–	–	–	0	–	–	–	–	–	–	8	0
	Euthamia caroliniana	3	3	–	–	–	3	3	3	3	–	–	8	3
	Euthamia graminifolia	4	4	4	4	4	4	4	4	4	–	–	8	4
	Galium mollugo [A,B]	–	0	–	–	–	–	–	–	–	–	–	8	0
	Galium pilosum	4	4	4	4	–	–	–	–	4	–	–	7	4
	Galium tinctorium	–	4	–	–	–	–	–	–	–	–	–	7	4
	Oenothera gaura [B]	–	–	–	3	–	–	–	–	–	–	–	8	3
	Gamochaeta purpurea/argyrinea	2	2	2	2	2	2	2	–	2	–	–	8	2
	Geum canadense	–	–	–	5	–	–	–	–	–	–	–	5	5
	Hedeoma pulegioides [B]	4	–	–	–	–	–	–	–	–	–	–	6	4
	Hemerocallus fulva [A]	–	0	–	–	–	–	–	–	–	–	–	7	0

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[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

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Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Heterotheca subaxillaris*	3	–	–	–	–	–	–	–	–	–	–	9	3
	Hieracium gronovii	4	4	–	4	–	–	–	–	–	–	–	7	4
	Hieracium paniculatum [B]	4	–	–	–	–	–	–	–	–	–	–	5	4
	Houstonia longifolia [B]	6	–	–	–	6	–	–	–	–	–	–	8	6
	Hypericum perforatum [A]	–	–	0	0	–	0	–	0	–	–	–	9	0
	Hypericum punctatum [B]	3	–	–	3	–	–	–	–	–	–	–	6	3
	Hypericum stragulum	5	5	5	5	–	–	5	5	5	–	–	6	5
	Hypochaeris radicata [A]	0	–	0	0	–	0	–	0	–	0	–	9	0
	Ipomoea hederacea	–	1	–	–	1	–	–	–	–	–	–	8	1
	Ipomoea lacunosa	–	–	–	–	3	3	–	–	–	3	–	8	3
	Krigia virginica	3	–	–	–	–	–	3	–	3	–	–	8	3
	Kummerowia stipulacea [A,B]	–	–	0	–	–	–	–	–	–	–	–	8	0
	Kummerowia striata [A]	0	0	0	0	–	0	0	–	0	0	–	8	0
	Lactuca canadensis	–	–	2	2	–	2	–	–	–	2	–	8	2
	Lathyrus pratensis [A,B]	–	–	X	–	–	–	–	–	–	–	–	–	–
	Lespedeza cuneata [A]	−5	−5	−5	−5	−5	−5	−5	−5	−5	−5	High	8	−5
	Lespedeza frutescens	–	–	–	6	–	–	–	–	–	–	–	7	6
	Lespedeza procumbens	4	4	4	4	4	4	–	–	–	–	–	7	4
	Lespedeza repens	–	–	–	–	5	5	–	–	–	–	–	7	5
	Lespedeza virginica	4	4	4	4	4	4	4	4	4	–	–	8	4

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Wildflowers (continued)	*Leucanthemum vulgare* [A]	0	0	0	0	0	0	0	0	0	0	–	8	0
	Lobelia inflata	2	–	2	2	–	2	–	–	–	–	–	6	2
	Lobelia puberula	–	4	4	–	–	–	–	–	–	–	–	8	4
	Ludwigia alternifolia	3	–	–	–	–	3	–	–	3	–	–	8	3
	Lycopus virginicus	–	–	–	4	–	–	–	–	–	–	–	5	4
	Mecardonia acuminata var. *acuminata*	–	–	–	5	–	–	–	–	–	–	–	7	5
	Melothria pendula	–	–	–	–	–	–	–	–	–	4	–	6	4
	Mikania scandens	–	–	–	3	–	–	–	–	–	–	–	6	3
	Mimulus ringens var. *ringens* [B]	–	5	–	–	–	–	–	–	–	–	–	7	5
	Mollugo verticillata [A,B]	0	–	–	–	–	–	–	–	–	–	–	9	0
	Monarda punctata [B]	–	–	–	5	–	–	–	–	–	–	–	8	5
	Nuttalanthus canadensis	2	2	–	–	–	–	–	–	2	–	–	9	2
	Oenothera biennis	–	1	1	–	–	1	–	–	–	–	–	8	1
	Oxalis dillenii	2	2	2	2	2	2	2	2	2	2	–	7	2
	Oxalis stricta [B]	–	–	2	–	–	–	–	2	–	–	–	7	2
	Packera anonyma	–	–	–	–	–	4	–	–	4	4	–	8	4
	Passiflora incarnata	2	2	2	2	2	2	–	–	–	2	–	8	2
	Persicaria extremiorientalis [A]	–	−3	–	–	–	–	–	–	–	–	–	–	−3
	Persicaria longiseta [A]	−3	–	–	–	–	−3	–	–	–	–	Medium	6	−3

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Wildflowers (continued)	*Persicaria maculosa* [A,B]	–	–	–	–	–	0	–	–	–	–	–	7	0
	Persicaria virginiana	–	–	–	5	–	–	–	–	–	–	–	4	5
	Phyllanthus caroliniensis	–	–	–	–	2	–	–	–	–	–	–	6	2
	Physalis angulata var. *angulata*	–	2	–	–	2	–	–	–	–	–	–	9	2
	Physalis heterophylla	4	–	–	–	–	–	–	–	–	–	–	8	4
	Physalis pubescens	–	–	–	–	–	3	–	–	–	–	–	9	3
	Phytolacca americana var. *americana*	–	1	1	–	1	1	–	–	–	1	–	7	1
	Plantago lanceolata [A]	–	0	0	0	–	–	–	0	–	0	–	7	0
	Plantago virginica	2	2	–	–	–	2	–	–	–	–	–	7	2
	Polypremum procumbens [B]	–	2	–	–	–	–	–	–	–	–	–	8	2
	Potentilla canadensis var. *canadensis* [B]	–	4	4	–	–	–	–	–	–	–	–	5	4
	Potentilla simplex [B]	–	4	4	–	–	4	–	–	–	–	–	6	4
	Prunella vulgaris	–	–	2	2	–	–	–	–	–	–	–	8	2
	Psueodognaphalium obtusifolium	2	2	2	2	2	2	2	2	2	2	–	8	2
	Pycnanthemum tenuifolium	5	5	–	–	–	–	5	–	5	–	–	7	5
	Pyrrhopappus carolinianus	2	–	2	–	–	–	–	–	–	–	–	8	2
	Rhexia mariana	4	4	–	4	–	–	4	4	–	–	–	8	4
	Rudbeckia hirta	3	–	–	3	–	3	–	3	–	3	–	8	3
	Ruellia caroliniensis	4	–	–	4	–	–	–	4	–	–	–	7	4

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Wildflowers (continued)	*Rumex acetosella* [A]	−3	−3	−3	−3	–	−3	−3	–	–	−3	Medium	–	−3
	Rumex conglomeratus [A]	–	–	–	0	–	–	–	–	–	–	–	7	0
	Rumex crispus [A]	–	−1	−1	−1	−1	−1	–	−1	–	−1	Low	8	−1
	Sabatia angularis [B]	–	–	–	–	–	5	–	–	–	–	–	7	5
	Salvia lyrata	–	–	–	2	–	–	–	–	–	2	–	7	2
	Sanicula sp	–	–	–	–	–	X	–	–	–	–	–	–	–
	Scleranthus annuus [A]	0	–	–	–	–	–	–	–	–	–	–	9	0
	Scutellaria integrifolia	5	5	–	–	5	5	–	5	–	–	–	7	5
	Securigera varia [A]	–	–	–	–	–	−1	–	–	–	–	–	8	−1
	Senna marilandica	5	–	–	–	–	–	–	–	–	–	–	7	5
	Sida spinosa [A]	–	–	–	–	0	–	–	–	–	–	–	8	0
	Sisyrinchium angustifolium	4	–	–	4	–	–	4	–	4	–	–	7	4
	Solanum carolliniense var. *caroliniense*	2	2	2	2	2	2	2	–	2	–	–	8	2
	Solanum ptychanthum	–	2	–	–	–	–	–	–	–	–	–	7	2
	Solidago altissima ssp. *altissima*	3	3	3	3	–	3	3	–	3	3	–	8	3
	Solidago canadensis	3	3	–	–	3	3	3	3	3	–	–	8	3
	Solidago gigantea	4	4	–	–	–	4	–	4	–	–	–	8	4
	Solidago odora	–	5	–	–	–	–	–	–	–	–	–	7	5
	Solidago pinetorum	4	–	–	4	–	–	–	–	–	–	–	8	4

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Wildflowers (continued)	*Solidago rugosa/ulmifolia*	4	4	–	4	4	4	4	–	4	–	–	6	4
	Stylosanthes biflora	–	4	–	–	4	–	–	–	–	–	–	7	4
	Symphyotrichum laeve var. *laeve* [B]	–	–	–	6	–	6	–	–	–	–	–	7	6
	Symphyotrichum lateriflorum [B]	–	–	–	6	–	–	–	–	–	–	–	5	6
	Symphyotrichum pilosum var. *pilosum* [B]	–	–	–	2	2	–	–	–	–	–	–	8	2
	Taraxacum officinale [A,B]	–	0	0	–	–	–	–	–	–	–	–	9	0
	Thyranthella difforme	5	–	5	–	–	–	–	–	–	–	–	5	5
	Tragopogon pratensis [A,B]	0	–	–	–	–	0	–	–	–	–	–	9	0
	Trifolium arvense [A]	0	0	–	–	–	–	–	–	–	–	–	8	0
	Trifolium dubium [A]	–	–	–	–	–	–	–	–	–	0	–	8	0
	Trifolium pratense [A]	–	0	–	0	–	0	–	–	–	0	–	8	0
	Trifolium repens [A]	–	–	0	–	–	0	–	–	–	0	–	8	0
	Trichostema dichotomum	4	–	–	–	–	–	4	–	–	–	–	8	4
	Triodanis perfoliata	1	1	–	1	1	1	1	–	1	1	–	8	1
	Verbascum blattaria [A]	–	–	–	0	–	–	–	–	–	–	–	8	0
	Verbascum thapsus [A]	0	0	0	–	0	0	–	–	0	0	–	8	0
	Verbena urticifolia [B]	–	–	–	–	–	–	–	–	–	–	–	6	3
	Verbesina occidentalis	2	2	2	2	2	2	2	–	2	2	–	7	2

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Vernonia noveboracensis*	–	–	–	–	6	–	–	6	–	–	–	8	6
	Veronica arvensis [A]	0	0	–	–	0	–	–	–	–	–	–	7	0
Woody plants	*Acer rubrum*	–	–	–	–	–	–	–	–	2	2	–	4	2
	Ailanthus altissima [A]	−5	−5	−5	–	–	−5	–	–	–	−5	High	6	−5
	Arailia spinosa	3	–	–	3	–	–	3	–	–	3	–	5	3
	Campsis radicans	2	2	2	2	–	2	2	–	2	2	–	5	2
	Celastrus orbiculatus [A]	–	–	–	–	–	–	–	–	–	−5	–	6	−5
	Carya sp.	X	X	X	X	–	X	–	–	X	–	–	–	–
	Diospyros virginiana	–	5	5	5	–	5	5	5	5	5	–	6	5
	Elaeagnus umbellata [A]	–	–	–	−5	–	–	–	–	–	–	High	6	−5
	Fraxinus americana [B]	–	–	–	–	–	7	–	–	–	–	–	5	7
	Fraxinus pensylvanica [B]	–	–	–	–	–	6	–	–	–	–	–	5	6
	Hypericum hypericoides	4	4	4	–	–	–	4	–	–	–	–	5	4
	Ilex opaca var. *opaca*	–	–	5	–	–	–	–	–	–	5	–	4	5
	Juglans nigra	–	–	–	5	–	5	–	–	–	5	–	5	5
	Juniperus virginiana	–	–	–	–	–	–	–	–	–	3	–	7	3
	Ligustrum sinense [A]	–	–	−5	−5	–	–	–	–	–	–	High	5	−5
	Liquidambar styraciflua	3	3	3	3	3	3	3	3	–	3	–	5	3
	Liriodendron tulipifera	–	–	4	4	–	4	4	–	–	4	–	5	4
	Lonicera japonica [A]	−5	−5	−5	−5	–	−5	−5	–	−5	−5	High	6	−5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	*Lonicera morrowii* [A,B]	–	–	–	−5	–	–	–	–	–	–	High	5	−5
	Morus alba [A]	–	–	–	–	–	–	–	–	–	−1	Low	5	−1
	Parthenocissus quinquefolia	3	3	–	–	–	3	–	–	–	3	–	5	3
	Pinus taeda	3	–	–	–	–	3	3	–	–	3	–	6	3
	Pinus virginiana	–	–	–	–	–	–	2	–	–	–	–	8	2
	Prunus serotina var. *serotina*	3	3	3	3	–	–	–	–	3	3	–	5	3
	Quercus falcata	5	5	5	–	–	5	5	–	5	5	–	5	5
	Quercus phellos	4	4	4	4	–	4	4	–	–	4	–	5	4
	Quercus stellata	–	–	4	–	–	–	–	–	–	–	–	8	4
	Rhus copallinum var. *latifolia*	3	–	3	–	–	3	–	–	3	3	–	7	3
	Robinia pseudoacacia	–	–	–	–	–	–	–	–	–	2	–	7	2
	Rubus allegheniensis [B]	3	–	–	–	–	–	–	–	–	–	–	7	3
	Rubus cuneifolius [B]	3	–	–	–	3	3	3	3	–	–	–	7	3
	Rubus flagellaris	3	–	–	–	–	3	–	–	–	–	–	8	3
	Rubus pascuus [A]	X	X	–	–	–	–	X	–	–	–	–	8	–
	Rubus pensylvanicus	2	2	2	2	2	2	2	2	2	2	–	8	2
	Sambucus canadensis	–	–	–	–	–	–	–	–	–	4	–	6	4
	Sassafras albidum	–	4	–	–	–	4	–	–	–	4	–	5	4
	Smilax bona-nox	4	4	–	–	–	–	4	–	4	–	–	5	4
	Smilax glauca	5	5	5	–	–	–	–	–	5	–	–	6	5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 8 (continued). Plant species documented at each plot in Richmond National Battlefield Park. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a C Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	*Smilax rotundifolia*	3	–	–	3	–	3	3	–	–	3	–	5	3
	Toxicodendron radicans	2	2	2	2	–	2	–	2	–	2	–	5	2
	Ulmus alata	4	–	4	–	–	4	–	–	–	–	–	5	4
	Vaccinium stamineum	–	–	–	–	–	–	–	–	–	6	–	5	6
	Vitis cinerea var. *baileyana*	–	4	–	–	–	–	–	–	–	–	–	4	4
	Vitis rotundifolia var. *rotundifolia*	4	4	4	4	4	4	4	–	4	4	–	5	4
	Vitis vulpina	–	–	–	–	–	–	–	–	–	4	–	5	4
	Sum of GFI	483	316	257	268	183	284	268	133	179	164	2535	–	–
	Total taxa	175	134	110	119	75	122	93	56	67	87	1038	–	–
	MEAN CC	**2.76**	**2.36**	**2.34**	**2.25**	**2.44**	**2.33**	**2.88**	**2.38**	**2.67**	**1.89**	**2.44**	**–**	–

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Appendix C. Mean Grassland Fidelity Index (GFI) Values for Flora of Field Units at Richmond National Battlefield Park.

Table 9 lists vascular plant species found in each plot with the grassland fidelity index (GFI) for each species and the mean GFI for each plot.

Table 9. Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Ferns	*Asplenium platyneuron*	4	–	4	–	–	–	–	–	–	–	–	4	4
	Athyrium asplenioides	–	–	–	3	–	–	–	–	–	–	–	3	4
	Onoclea sensibilis	–	5	–	5	–	–	–	–	–	–	–	5	4
	Polystichum acrostichoides	–	3	–	–	–	–	–	–	–	–	–	3	4
	Pteridium aquilinum	6	–	–	–	–	–	–	–	–	6	–	6	3
Graminoids	*Agrostis perennans*	5	–	–	5	5	–	5	5	–	–	–	5	4
	Agrostis gigantea [A,B]	8	–	–	8	–	–	–	–	–	–	–	8	0
	Andropogon gerardii	9	–	–	–	–	9	–	9	–	9	–	9	7
	Andropogon ternarius	9	9	–	–	–	–	9	–	–	–	–	9	5
	Andropogon virginicus	9	9	9	9	9	9	9	9	9	9	–	9	3
	Anthoxanthum odoratum [A]	8	8	8	8	8	8	8	8	8	8	–	8	0
	Arthraxon hispidus var. *hispidus* [A]	–	–	–	–	–	–	–	7	–	–	Medium	7	−3
	Arrhenatherum elatius var. *elatius* [A]	–	–	–	–	–	–	–	–	–	8	–	8	0

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Brachyelytrum erectum* [B]	2	–	–	–	–	–	–	–	–	–	–	2	6
	Bromus arvensis [B]	9	9	–	–	–	–	–	–	–	–	–	9	0
	Bromus japonicus/secalinus [A]	–	8	8	8	8	8	–	8	–	–	–	8	0
	Bromus racemosus	–	–	–	–	–	–	–	–	–	–	–	–	0
	Carex albolutescens	–	5	5	–	–	5	5	–	5	–	–	5	5
	Carex annectens	–	–	–	7	–	–	7	–	–	–	–	7	5
	Carex blanda	5	–	–	–	–	–	–	–	–	–	–	5	4
	Carex cephalophora	5	–	5	–	–	–	–	–	–	–	–	5	5
	Carex complanata	–	–	–	–	–	–	6	–	–	–	–	6	4
	Carex lurida	–	6	–	–	–	–	–	–	–	–	–	6	4
	Carex mesochorea	–	–	–	–	–	–	–	6	–	–	–	6	6
	Carex radiata	–	–	–	3	–	–	–	–	–	–	–	3	5
	Carex squarosa	5	–	–	–	–	–	5	–	–	–	–	5	6
	Carex swanii/hirsutella	5	5	5	–	–	5	5	–	5	–	–	5	5
	Carex umbellata	5	–	–	–	–	–	–	–	–	–	–	5	5
	Chasmanthium laxum	5	5	–	–	–	–	5	–	–	–	–	5	4
	Cinna arundinacea	–	–	–	–	5	–	–	–	–	–	–	5	5
	Coleataenia anceps ssp. *anceps*	7	7	7	7	7	–	–	7	–	7	–	7	4
	Coleataenia rigidula ssp. *rigidula* [B]	8	8	8	8	–	–	–	–	–	–	–	8	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Cynodon dactylon* [A]	–	9	–	9	9	9	–	–	–	–	–	9	0
	Cyperus echinatus	7	–	7	–	–	7	7	–	7	7	–	7	4
	Cyperus erythrorhizos	–	–	–	–	9	–	–	–	–	–	–	9	4
	Cyperus ca. hystricinus	7	–	–	7	–	–	–	7	–	–	–	7	7
	Cyperus iria [A]	7	–	–	–	–	–	–	–	–	–	–	7	0
	Cyperus odoratus var. *odoratus*	–	–	–	–	–	8	–	–	–	–	–	8	3
	Cyperus retrorsus [B]	–	–	9	–	–	–	–	–	–	–	–	9	5
	Dactylis glomerata [A]	7	–	7	7	–	–	–	–	–	7	–	7	0
	Danthonia sericea	–	7	–	–	–	–	7	–	7	–	–	7	5
	Danthonia spicata	6	–	–	–	–	–	–	–	–	–	–	6	4
	Dichanthelium acuminatum var. *acuminatum*	8	8	8	–	8	–	8	–	–	–	–	8	4
	Dichanthelium acuminaturm var. *lindheimeri*	8	8	–	–	–	–	8	–	–	–	–	8	5
	Dichanthelium boscii	4	–	–	–	–	–	–	–	–	–	–	4	5
	Dichanthelium clandestinum	5	5	5	–	5	5	5	–	–	5	–	5	3
	Dichanthelium commutatum var. *commutatum*	5	–	5	–	–	–	5	–	–	–	–	5	5
	Dichanthelium depauperatum [B]	–	–	–	–	–	8	–	–	–	–	–	8	5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Dichanthelium dichotomum* var. *dichotomum* [B]	5	5	5	–	–	–	5	–	–	–	–	5	4
	Dichanthelium latifolium	–	–	–	–	–	–	–	–	–	–	–	4	7
	Dichanthelium laxiflorum	5	5	–	–	–	5	5	–	–	–	–	5	4
	Dichanthelium meridionale	6	–	–	–	–	–	–	–	–	–	–	6	5
	Dichanthelium oligosanthes var. *oligosanthes* [B]	8	–	–	8	–	–	–	–	–	–	–	8	6
	Dichanthelium polyanthes	7	–	–	–	–	–	–	–	–	–	–	7	5
	Dichanthelium scoparium	8	8	8	8	8	8	8	–	8	–	–	8	4
	Dichanthelium sphaerocarpon [B]	7	–	–	–	–	7	–	–	–	–	–	7	4
	Dichanthelium villosissimum var. *villosissimum* [B]	8	8	–	–	–	–	–	–	–	–	–	8	6
	Digitaria ciliaris/sanguinalis [A]	8	8	–	–	8	8	8	8	–	–	–	8	0
	Echinochloa crusgalli var. *crusgalli* [A]	–	8	–	–	–	8	–	–	–	–	–	8	0
	Elymus virginicus	–	–	–	–	–	5	–	–	–	–	–	5	4
	Eragrostis capillaris	9	9	–	–	–	–	–	–	9	–	–	9	4
	Eragrostis spectabilis	9	9	9	–	9	9	9	–	9	9	–	9	4
	Erianthus contortus	8	–	–	8	8	–	8	–	8	–	–	8	4
	Festuca trachyphylla [A,B]	–	–	–	–	8	–	8	–	–	–	–	8	0
	Festuca rubra [A]	9	–	9	9	9	9	9	–	–	–	–	9	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Graminoids (continued)	*Juncus coriaceus*	7	–	–	–	–	–	7	–	7	–	–	7	5
	Juncus effusus	7	–	–	7	–	–	7	7	–	7	–	7	3
	Juncus tenuis	6	6	6	6	6	6	6	6	6	–	–	6	2
	Leersia virginica	5	–	–	–	–	–	–	–	–	–	–	5	4
	Microstegium vimineum [A]	5	5	5	5	–	5	5	5	–	–	High	5	−5
	Muhlenbergia schreberi	5	5	5	5	–	5	–	–	–	–	–	5	1
	Panicum capillare	–	–	–	–	9	–	–	–	–	–	–	9	3
	Panicum dichotomiflorum var. *dichotomiflorum*	8	–	–	–	–	8	8	–	–	–	–	8	2
	Panicum virgatum	9	9	–	–	–	9	–	9	–	9	–	9	4
	Paspalum floridanum	9	–	–	–	–	–	–	–	–	9	–	9	4
	Paspalum laeve	8	–	8	–	–	8	–	–	–	–	–	8	3
	Pennisetum glaucum [A,B]	X	–	X	X	–	–	–	–	–	–	–	–	0
	Phleum pratense [A,B]	–	8	–	8	–	–	–	–	–	–	Low	8	−1
	Poa compressa [A,B]	–	7	–	7	–	–	–	–	–	–	Medium	7	−3
	Poa pratensis ssp. *pratensis* [A,B]	–	–	7	7	–	–	–	–	–	–	–	7	0
	Saccharum brevibarbe var. *contortum*	9	–	–	–	–	–	–	–	–	–	–	9	4
	Saccharum sp.	–	–	X	–	–	–	–	–	–	–	–	–	–
	Schedonorus arundinaceus [A]	8	8	8	8	8	8	8	–	8	8	–	8	0

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers	*Schizachyrium scoparium* var. *scoparium*	8	8	8	8	8	8	8	8	–	–	–	8	5
	Scirpus cyperinus [B]	–	9	–	–	–	–	9	–	–	–	–	9	2
	Scleria pauciflora var. *pauciflora* [B]	–	–	–	–	–	–	8	–	–	–	–	8	6
	Setaria faberi [A]	8	8	–	–	8	8	8	–	–	8	–	8	0
	Setaria parviflora	8	8	8	8	8	8	8	–	8	8	–	8	3
	Setaria pumila ssp. *pumila* [A]	8	–	8	8	–	–	8	–	–	–	–	8	0
	Sorghum halapense [A]	8	–	8	8	–	–	–	8	8	8	–	8	−5
	Sorghastrum nutans	8	8	8	8	8	8	8	8	8	8	–	8	6
	Sphenopholis obtusata	6	6	–	–	–	–	6	–	6	–	–	6	3
	Tridens flavus	8	8	8	8	8	8	8	8	8	8	–	8	3
	Triticum aestivum [A]	–	9	–	–	9	9	–	–	–	–	–	9	–
	Acalypha gracilens	7	7	7	7	–	7	–	–	–	7	–	7	2
	Acalypha rhomboidea [B]	–	–	–	–	–	–	–	–	–	–	–	6	2
	Achillea millefolium	8	8	8	8	–	8	–	–	8	8	–	8	2
	Agalinis purpurea	8	8	8	8	8	–	8	8	–	–	–	8	5
	Agrimonia parviflora	–	–	6	6	6	–	–	6	–	–	–	6	4
	Agrimonia pubescens	–	–	5	–	–	–	–	–	–	–	–	5	6
	Aletris farinosa [B]	–	9	–	–	–	–	–	–	–	–	–	9	6
	Allium canadense var. *canadense* [B]	9	–	–	–	–	–	–	–	–	–	–	9	2

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Allium vineale* [A]	8	8	8	8	–	8	8	8	8	8	–	8	0
	Ambrosia artemesiifolia	8	8	8	8	8	8	8	–	8	8	–	8	1
	Antennaria plantaginifolia [B]	6	–	–	–	–	–	–	–	–	–	–	6	5
	Apocynum cannabinum	8	8	8	8	8	8	8	8	8	8	–	8	2
	Arisaema triphyllum ssp. *triphyllum*	2	–	–	–	–	–	2	–	–	–	–	2	6
	Artemesia vulgaris [A,B]	–	8	–	–	–	–	–	–	–	–	–	8	0
	Asclepias syriaca	–	–	–	8	–	8	–	8	–	–	–	8	3
	Bidens aristosa [A]	9	–	–	–	–	9	–	–	–	–	–	9	0
	Bidens bipinnata	7	–	7	–	–	–	–	–	–	7	–	7	1
	Bidens frondosa	6	–	–	–	–	–	6	–	–	–	–	6	2
	Bidens trichosperma [B]	–	–	–	–	–	9	–	–	–	–	–	9	3
	Boehmeria cylindrica	–	–	5	5	–	–	5	–	–	–	–	5	4
	Carduus nutans [A]	9	9	–	–	–	9	–	–	–	–	–	9	0
	Chamaecrista fasciculata var. *fasciculata*	–	8	–	–	–	8	–	8	–	–	–	8	2
	Chamaecrista nictatans var. *nictatans*	8	8	8	8	8	8	8	–	8	8	–	8	2
	Chrysopsis mariana	8	8	–	–	–	8	–	–	–	–	–	8	4
	Circaea canadensis ssp. *canadensis* [B]	3	–	–	–	–	–	–	–	–	–	–	3	6

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[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

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Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Cirsium discolor*	–	–	8	8	–	–	–	–	–	–	–	8	3
	Commelina communis [A]	7	7	–	7	–	–	–	–	–	7	Low	7	−1
	Conoclinum coelestinum	–	7	–	–	–	–	–	–	–	–	–	7	4
	Conyza canadensis var. *canadensis*	8	8	–	8	8	8	8	8	–	8	–	8	1
	Croton glandulosus var. *septentrionalis*	9	–	–	–	–	–	–	–	–	9	–	9	0
	Cynanchum laeve	7	–	–	–	–	–	–	–	–	–	–	7	1
	Daucus carota [A]	9	–	9	9	–	–	–	–	–	9	–	9	0
	Desmodium canescens [B]	–	–	9	9	–	–	–	–	–	–	–	9	4
	Desmodium ciliare	–	8	8	8	–	–	–	–	–	–	–	8	3
	Desmosdium glabellum [B]	–	–	7	7	–	–	–	–	–	–	–	7	3
	Desmodium laevigatum	–	7	–	–	–	–	–	–	–	–	–	7	5
	Desmodium nuttallii/perplexa	8	–	8	8	–	8	–	8	–	8	–	8	3
	Desmodium paniculatum var. *paniculatum*	8	8	8	8	8	8	8	8	8	8	–	8	4
	Dianthus armeria ssp. *armeria* [A]	9	–	–	–	–	9	–	–	–	–	–	9	0
	Diodia teres	9	–	–	–	9	–	–	–	–	–	–	9	1
	Diodia virginiana	–	–	–	–	8	–	–	–	–	–	–	8	3
	Dioscorea villosa	–	–	–	5	–	–	–	–	–	–	–	5	5
	Elephantopus carolinianus	5	–	5	5	–	–	–	–	–	5	–	5	3

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Wildflowers (continued)	*Elephantopus tomentosus*	5	5	5	–	–	–	–	–	–	–	–	5	4
	Endodeca serpentaria	–	–	3	–	–	3	–	–	–	–	–	3	7
	Erechtites hieracifolia	6	6	–	–	6	6	–	–	6	–	–	6	2
	Erigeron anuus	8	8	8	8	–	8	–	8	8	8	–	8	2
	Erigeron pulchellus var. *pulchellus* [B]	5	–	–	–	–	–	–	–	–	–	–	5	6
	Erigeron stigosus var. *strigosus*	8	–	–	–	8	8	8	8	8	–	–	8	2
	Eryngium prostratum	7	–	–	–	–	–	–	–	7	–	–	7	4
	Eupatorium album var. *album* [B]	8	–	–	–	–	–	–	–	–	–	–	8	6
	Eupatorium capillifolium	8	8	8	8	8	8	8	8	–	8	–	8	2
	Eupatorium hyssopifolium	8	8	8	–	8	8	8	–	8	8	–	8	4
	Eupatorium perfoliatum	–	–	–	7	–	–	–	–	–	–	–	7	6
	Eupatorium pilosum	8	8	–	–	–	–	8	–	8	–	–	8	6
	Eupatorium pubescens	7	7	–	–	–	7	7	–	7	–	–	7	4
	Eupatorium rotundifolium [B]	8	–	–	–	8	8	–	–	–	–	–	8	4
	Eupatorium serotinum	7	7	7	7	7	7	7	7	7	–	–	7	2
	Eupatorium torreyanum	–	8	8	–	8	–	–	–	–	–	–	8	4
	Euphorbia humistrata	–	–	–	–	8	–	–	–	–	–	–	8	0
	Euthamia caroliniana	8	8	–	–	–	8	8	8	8	–	–	8	3
	Euthamia graminifolia	8	8	8	8	8	8	8	8	8	–	–	8	4

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Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Wildflowers (continued)	*Galium mollugo* [A,B]	–	8	–	–	–	–	–	–	–	–	–	8	0
	Galium pilosum	7	7	7	7	–	–	–	–	7	–	–	7	4
	Galium tinctorium	–	7	–	–	–	–	–	–	–	–	–	7	4
	Oenothera gaura [B]	–	–	–	8	–	–	–	–	–	–	–	8	3
	Gamochaeta purpurea/argyrinea	8	8	8	8	8	8	8	–	8	–	–	8	2
	Geum canadense	–	–	–	5	–	–	–	–	–	–	–	5	5
	Hedeoma pulegioides [B]	6	–	–	–	–	–	–	–	–	–	–	6	4
	Hemerocallus fulva [A]	–	7	–	–	–	–	–	–	–	–	–	7	0
	Heterotheca subaxillaris	9	–	–	–	–	–	–	–	–	–	–	9	3
	Hieracium gronovii	7	7	–	7	–	–	–	–	–	–	–	7	4
	Hieracium paniculatum [B]	5	–	–	–	–	–	–	–	–	–	–	5	4
	Houstonia longifolia [B]	8	–	–	–	8	–	–	–	–	–	–	8	6
	Hypericum perforatum [A]	–	–	9	9	–	9	–	9	–	–	–	9	0
	Hypericum punctatum [B]	6	–	–	6	–	–	–	–	–	–	–	6	3
	Hypericum stragulum	6	6	6	6	–	–	6	6	6	–	–	6	5
	Hypochaeris radicata [A]	9	–	9	9	–	9	–	9	–	9	–	9	0
	Ipomoea hederacea	–	8	–	–	8	–	–	–	–	–	–	8	1
	Ipomoea lacunosa	–	–	–	–	8	8	–	–	–	8	–	8	3
	Krigia virginica	8	–	–	–	–	–	8	–	8	–	–	8	3

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Wildflowers (continued)	*Kummerowia stipulacea* [A,B]	–	–	8	–	–	–	–	–	–	–	–	8	0
	Kummerowia striata [A]	8	8	8	8	–	8	8	–	8	8	–	8	0
	Lactuca canadensis	–	–	8	8	–	8	–	–	–	8	–	8	2
	Lathyrus pratensis [A,B]	–	–	X	–	–	–	–	–	–	–	–	–	–
	Lespedeza cuneata [A]	8	8	8	8	8	8	8	8	8	8	High	8	−5
	Lespedeza frutescens	–	–	–	7	–	–	–	–	–	–	–	7	6
	Lespedeza procumbens	7	7	7	7	7	7	–	–	–	–	–	7	4
	Lespedeza repens	–	–	–	–	7	7	–	–	–	–	–	7	5
	Lespedeza virginica	8	8	8	8	8	8	8	8	8	–	–	8	4
	Leucanthemum vulgare [A]	8	8	8	8	8	8	8	8	8	8	–	8	0
	Lobelia inflata	6	–	6	6	–	6	–	–	–	–	–	6	2
	Lobelia puberula	–	8	8	–	–	–	–	–	–	–	–	8	4
	Ludwigia alternifolia	8	–	–	–	–	8	–	–	8	–	–	8	3
	Lycopus virginicus	–	–	–	5	–	–	–	–	–	–	–	5	4
	Mecardonia acuminata var. *acuminata*	–	–	–	7	–	–	–	–	–	–	–	7	5
	Melothria pendula	–	–	–	–	–	–	–	–	–	6	–	6	4
	Mikania scandens	–	–	–	6	–	–	–	–	–	–	–	6	3
	Mimulus ringens var. *ringens* [B]	–	7	–	–	–	–	–	–	–	–	–	7	5
	Mollugo verticillata [A,B]	9	–	–	–	–	–	–	–	–	–	–	9	0

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Wildflowers (continued)	*Monarda punctata* [B]	–	–	–	8	–	–	–	–	–	–	–	8	5
	Nuttalanthus canadensis	9	9	–	–	–	–	–	–	9	–	–	9	2
	Oenothera biennis	–	8	8	–	–	8	–	–	–	–	–	8	1
	Oxalis dillenii	7	7	7	7	7	7	7	7	7	7	–	7	2
	Oxalis stricta [B]	–	–	7	–	–	–	–	7	–	–	–	7	2
	Packera anonyma	–	–	–	–	–	8	–	–	8	8	–	8	4
	Passiflora incarnata	8	8	8	8	8	8	–	–	–	8	–	8	2
	Persicaria extremiorientalis [A]	–	X	–	–	–	–	–	–	–	–	–	–	−3
	Persicaria longiseta [A]	6	–	–	–	–	6	–	–	–	–	Medium	6	−3
	Persicaria maculosa [A,B]	–	–	–	–	–	7	–	–	–	–	–	7	0
	Persicaria virginiana	–	–	–	4	–	–	–	–	–	–	–	4	5
	Phyllanthus caroliniensis	–	–	–	–	6	–	–	–	–	–	–	6	2
	Physalis angulata var. *angulata*	–	9	–	–	9	–	–	–	–	–	–	9	2
	Physalis heterophylla	8	–	–	–	–	–	–	–	–	–	–	8	4
	Physalis pubescens	–	–	–	–	–	9	–	–	–	–	–	9	3
	Phytolacca americana var. *americana*	–	7	7	–	7	7	–	–	–	7	–	7	1
	Plantago lanceolata [A]	–	7	7	7	–	–	–	7	–	7	–	7	0
	Plantago virginica	7	7	–	–	–	7	–	–	–	–	–	7	2
	Polypremum procumbens [B]	–	8	–	–	–	–	–	–	–	–	–	8	2

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Wildflowers (continued)	*Potentilla canadensis* var. *canadensis* [B]	–	5	5	–	–	–	–	–	–	–	–	5	4
	Potentilla simplex [B]	–	6	6	–	–	6	–	–	–	–	–	6	4
	Prunella vulgaris	–	–	8	8	–	–	–	–	–	–	–	8	2
	Psueodognaphalium obtusifolium	8	8	8	8	8	8	8	8	8	8	–	8	2
	Pycnanthemum tenuifolium	7	7	–	–	–	–	7	–	7	–	–	7	5
	Pyrrhopappus carolinianus	8	–	8	–	–	–	–	–	–	–	–	8	2
	Rhexia mariana	8	8	–	8	–	–	8	8	–	–	–	8	4
	Rudbeckia hirta	8	–	–	8	–	8	–	8	–	8	–	8	3
	Ruellia caroliniensis	7	–	–	7	–	–	–	7	–	–	–	7	4
	Rumex acetosella [A]	X	X	X	X	–	X	X	–	–	X	Medium	–	−3
	Rumex conglomeratus [A]	–	–	–	7	–	–	–	–	–	–	–	7	0
	Rumex crispus [A]	–	8	8	8	8	8	–	8	–	8	Low	8	−1
	Sabatia angularis [B]	–	–	–	–	–	7	–	–	–	–	–	7	5
	Salvia lyrata	–	–	–	7	–	–	–	–	–	7	–	7	2
	Sanicula sp	–	–	–	–	–	X	–	–	–	–	–	–	–
	Scleranthus annuus [A]	9	–	–	–	–	–	–	–	–	–	–	9	0
	Scutellaria integrifolia	7	7	–	–	7	7	–	7	–	–	–	7	5
	Securigera varia [A]	–	–	–	–	–	8	–	–	–	–	–	8	−1
	Senna marilandica	7	–	–	–	–	–	–	–	–	–	–	7	5

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Wildflowers (continued)	*Sida spinosa* [A]	–	–	–	–	8	–	–	–	–	–	–	8	0
	Sisyrinchium angustifolium	7	–	–	7	–	–	7	–	7	–	–	7	4
	Solanum carolliniense var. *caroliniense*	8	8	8	8	8	8	8	–	8	–	–	8	2
	Solanum ptychanthum	–	7	–	–	–	–	–	–	–	–	–	7	2
	Solidago altissima ssp. *altissima*	8	8	8	8	–	8	8	–	8	8	–	8	3
	Solidago canadensis	8	8	–	–	8	8	8	8	8	–	–	8	3
	Solidago gigantea	8	8	–	–	–	8	–	8	–	–	–	8	4
	Solidago odora	–	7	–	–	–	–	–	–	–	–	–	7	5
	Solidago pinetorum	8	–	–	8	–	–	–	–	–	–	–	8	4
	Solidago rugosa/ulmifolia	6	6	–	6	6	6	6	–	6	–	–	6	4
	Stylosanthes biflora	–	7	–	–	7	–	–	–	–	–	–	7	4
	Symphyotrichum laeve var. *laeve* [B]	–	–	–	7	–	7	–	–	–	–	–	7	6
	Symphyotrichum lateriflorum [B]	–	–	–	5	–	–	–	–	–	–	–	5	6
	Symphyotrichum pilosum var. *pilosum* [B]	–	–	–	8	8	–	–	–	–	–	–	8	2
	Taraxacum officinale [A,B]	–	9	9	–	–	–	–	–	–	–	–	9	0
	Thyranthella difforme	5	–	5	–	–	–	–	–	–	–	–	5	5
	Tragopogon pratensis [A,B]	9	–	–	–	–	9	–	–	–	–	–	9	0
	Trifolium arvense [A]	8	8	–	–	–	–	–	–	–	–	–	8	0

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Wildflowers (continued)	*Trifolium dubium* [A]	–	–	–	–	–	–	–	–	–	8	–	8	0
	Trifolium pratense [A]	–	8	–	8	–	8	–	–	–	8	–	8	0
	Trifolium repens [A]	–	–	8	–	–	8	–	–	–	8	–	8	0
	Trichostema dichotomum	8	–	–	–	–	–	8	–	–	–	–	8	4
	Triodanis perfoliata	8	8	–	8	8	8	8	–	8	8	–	8	1
	Verbascum blattaria [A]	–	–	–	8	–	–	–	–	–	–	–	8	0
	Verbascum thapsus [A]	8	8	8	–	8	8	–	–	8	8	–	8	0
	Verbena urticifolia [B]	–	–	–	–	–	–	–	–	–	–	–	6	3
	Verbesina occidentalis	7	7	7	7	7	7	7	–	7	7	–	7	2
	Vernonia noveboracensis	–	–	–	–	8	–	–	8	–	–	–	8	6
	Veronica arvensis [A]	7	7	–	–	7	–	–	–	–	–	–	7	0
Woody plants	*Acer rubrum*	–	–	–	–	–	–	–	–	4	4	–	4	2
	Ailanthus altissima [A]	6	6	6	–	–	6	–	–	–	6	High	6	−5
	Arailia spinosa	5	–	–	5	–	–	5	–	–	5	–	5	3
	Campsis radicans	5	5	5	5	–	5	5	–	5	5	–	5	2
	Celastrus orbiculatus [A]	–	–	–	–	–	–	–	–	–	6	–	6	−5
	Carya sp.	X	X	X	X	–	X	–	–	X	–	–	–	–
	Diospyros virginiana	–	6	6	6	–	6	6	6	6	6	–	6	5
	Elaeagnus umbellata [A]	–	–	–	6	–	–	–	–	–	–	High	6	−5

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	*Fraxinus americana* [B]	–	–	–	–	–	5	–	–	–	–	–	5	7
	Fraxinus pensylvanica [B]	–	–	–	–	–	5	–	–	–	–	–	5	6
	Hypericum hypericoides	5	5	5	–	–	–	5	–	–	–	–	5	4
	Ilex opaca var. *opaca*	–	–	4	–	–	–	–	–	–	4	–	4	5
	Juglans nigra	–	–	–	5	–	5	–	–	–	5	–	5	5
	Juniperus virginiana	–	–	–	–	–	–	–	–	–	7	–	7	3
	Ligustrum sinense [A]	–	–	5	5	–	–	–	–	–	–	High	5	−5
	Liquidambar styraciflua	5	5	5	5	5	5	5	5	–	5	–	5	3
	Liriodendron tulipifera	–	–	5	5	–	5	5	–	–	5	–	5	4
	Lonicera japonica [A]	6	6	6	6	–	6	6	–	6	6	High	6	−5
	Lonicera morrowii [A,B]	–	–	–	5	–	–	–	–	–	–	High	5	−5
	Morus alba [A]	–	–	–	–	–	–	–	–	–	5	Low	5	−1
	Parthenocissus quinquefolia	5	5	–	–	–	5	–	–	–	5	–	5	3
	Pinus taeda	6	–	–	–	–	6	6	–	–	6	–	6	3
	Pinus virginiana	–	–	–	–	–	–	8	–	–	–	–	8	2
	Prunus serotina var. *serotina*	5	5	5	5	–	–	–	–	5	5	–	5	3
	Quercus falcata	5	5	5	–	–	5	5	–	5	5	–	5	5
	Quercus phellos	5	5	5	5	–	5	5	–	–	5	–	5	4
	Quercus stellata	–	–	8	–	–	–	–	–	–	–	–	8	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	*Rhus copallinum* var. *latifolia*	7	–	7	–	–	7	–	–	7	7	–	7	3
	Robinia pseudoacacia	–	–	–	–	–	–	–	–	–	7	–	7	2
	Rubus allegheniensis [B]	7	–	–	–	–	–	–	–	–	–	–	7	3
	Rubus cuneifolius [B]	7	–	–	–	7	7	7	7	–	–	–	7	3
	Rubus flagellaris	8	–	–	–	–	8	–	–	–	–	–	8	3
	Rubus pascuus [A]	8	8	–	–	–	–	8	–	–	–	–	8	–
	Rubus pensylvanicus	8	8	8	8	8	8	8	8	8	8	–	8	2
	Sambucus canadensis	–	–	–	–	–	–	–	–	–	6	–	6	4
	Sassafras albidum	–	5	–	–	–	5	–	–	–	5	–	5	4
	Smilax bona-nox	5	5	–	–	–	–	5	–	5	–	–	5	4
	Smilax glauca	6	6	6	–	–	–	–	–	6	–	–	6	5
	Smilax rotundifolia	5	–	–	5	–	5	5	–	–	5	–	5	3
	Toxicodendron radicans	5	5	5	5	–	5	–	5	–	5	–	5	2
	Ulmus alata	5	–	5	–	–	5	–	–	–	–	–	5	4
	Vaccinium stamineum	–	–	–	–	–	–	–	–	–	5	–	5	6
	Vitis cinerea var. *baileyana*	–	4	–	–	–	–	–	–	–	–	–	4	4
	Vitis rotundifolia var. *rotundifolia*	5	5	5	5	5	5	5	–	5	5	–	5	4
	Vitis vulpina	–	–	–	–	–	–	–	–	–	5	–	5	4

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Table 9 (continued). Plant species documented at each plot in Richmond National Battlefield Park with the Grassland Fidelity Index (GFI) shown if present. Also shown for each species are the Virginia Natural Heritage Program/Native Plant Society Invasive Rank, the mean Grassland Fidelity Index, and the Coefficient of Conservatism (C value). Species nomenclature is from Flora of Virgina (2012), and an "X" indicates presence for species without a GFI Value assigned for Virginia.

Group	Species	M7	M8	M9	M10	M13	M15	M16	M17	M18	GM	Heritage/ VNPS invasive rank	Grassland Fidelity Index	Coefficient of Conservatism
Woody plants (continued)	Sum of GFI	1227	963	767	834	573	886	650	420	487	611	7418	–	–
	Total taxa	175	134	110	119	75	122	93	56	67	87	1038	–	–
	MEAN GFI	**7.01**	**7.19**	**6.97**	**7.01**	**7.64**	**7.26**	**6.99**	**7.50**	**7.27**	**7.02**	**7.15**	–	–

[A] Species not thought to be native to Virginia.

[B] Species from fire effects transects pre-2022; also shown with blue cell shading.

Appendix D. Richmond National Battlefield Park Apoidea (Bee) Species Totals and Sampling Methods by Study Plot, 2023–2024 .

Table 10 lists Apoidea (bee) species found in each plot and sampling method for each observation.

Table 10. Apoidea (bee) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH-A1	14-Jun-23	Bee Bowl N	*Lasioglossum callidum*	Unranked	Native	1
RICH-A1	14-Jun-23	Bee Bowl S	*Lasioglossum versatum*	G5: Secure	Native	2
RICH-A1	14-Jun-23	Bee Bowl E	*Bombus bimaculatus*	G5: Secure	Native	1
RICH-A1	14-Jun-23	Bee Bowl W	*Lasioglossum weemsi*	Unranked	Native	1
RICH-A1	14-Jun-23	Bee Net	*Bombus bimaculatus*	G5: Secure	Native	2
RICH-A1	14-Jun-23	Bee Net	*Bombus impatiens*	G5: Secure	Native	3
RICH-A1	12-Aug-23	Bee Bowl W	*Lasioglossum weemsi*	Unranked	Native	1
RICH-A1	12-Aug-23	Bee Net	*Halictus ligatus/poeyi*	G5: Secure	Native	2
RICH-A1	12-Aug-23	Bee Net	*Lasioglossum zephyrus*	G5: Secure	Native	1
RICH-A1	12-Aug-23	Bee Net	*Lasioglossum versatum*	G5: Secure	Native	1
RICH-A1	9-Apr-24	Bee Net	*Bombus bimaculatus*	G5: Secure	Native	1
RICH-A1	9-Apr-24	Bee Net	*Ceratina calcarata*	G5: Secure	Native	1
RICH-A1	9-Apr-24	Bee Net	*Halictus rubicundus*	G5: Secure	Native	1
RICH-A1	9-Apr-24	Bee Net	*Andrena perplexa*	Unranked	Native	1
RICH-A1	9-Apr-24	Bee Net	*Osmia albiventris*	G4: Apparently Secure	Native	1
RICH-A1	10-Apr-24	Bee Bowl C	*Osmia cornifrons*	G5: Secure	Native	1
RICH-A1	10-Apr-24	Bee Bowl C	*Protandrena abdominalis*	Unranked	Native	1
RICH-A1	10-Apr-24	Bee Bowl S	*Augochlora pura*	G5: Secure	Native	1
RICH-A2	14-Jun-23	Bee Bowl N	*Lasioglossum bruneri*	G5: Secure	Native	1
RICH-A2	14-Jun-23	Bee Bowl C	*Bombus impatiens*	G5: Secure	Native	1

Table 10 (continued). Apoidea (bee) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH-A2	14-Jun-23	Bee Net	*Halictus parallelus*	Unranked	Native	1
RICH-A2	14-Jun-23	Bee Net	*Lasioglossum weemsi*	Unranked	Native	1
RICH-A2	14-Jun-23	Bee Net	*Megachile mendica*	G5: Secure	Native	1
RICH-A2	12-Aug-23	Bee Bowl E	*Agapostemon virescens*	G5: Secure	Native	2
RICH-A2	12-Aug-23	Bee Bowl W	*Melissodes tinctus*	Unranked	Native	1
RICH-A2	12-Aug-23	Bee Net	*Augochloropsis metallica*	Unranked	Native	1
RICH-A2	12-Aug-23	Bee Net	*Bombus impatiens*	G5: Secure	Native	1
RICH-A2	12-Aug-23	Bee Net	*Xylocopa virginica*	G5: Secure	Native	1
RICH-A2	13-Oct-23	Bee Net	*Bombus impatiens*	G5: Secure	Native	4
RICH-A2	9-Apr-24	Bee Net	*Bombus bimaculatus*	G5: Secure	Native	1
RICH-A2	9-Apr-24	Bee Net	*Lasioglossum fuscipenne*	Unranked	Native	1
RICH-A2	10-Apr-24	Bee Bowl E	*Andrena perplexa*	Unranked	Native	1
RICH-A2	10-Apr-24	Bee Bowl C	*Andrena perplexa*	Unranked	Native	1
RICH-A3	14-Jun-23	Bee Bowl C	*Lasioglossum weemsi*	Unranked	Native	1
RICH-A3	14-Jun-23	Bee Net	*Bombus pensylvanicus*	G3: Vulnerable	Native	1
RICH-A3	14-Jun-23	Bee Net	*Xylocopa virginica*	G5: Secure	Native	1
RICH-A3	12-Aug-23	Bee Bowl C	*Lasioglossum* sp.	Unranked	Unknown	1
RICH-A3	12-Aug-23	Bee Bowl N	*Agapostemon virescens*	G5: Secure	Native	1
RICH-A3	12-Aug-23	Bee Bowl W	*Lasioglossum versatum*	G5: Secure	Native	1
RICH-A3	9-Apr-24	Bee Net	*Bombus bimaculatus*	G5: Secure	Native	1
RICH-A3	9-Apr-24	Bee Net	*Osmia collinsiae*	G5: Secure	Native	1
RICH-A3	10-Apr-24	Bee Bowl C	*Nomada denticulata*	Unranked	Native	1
RICH-A3	10-Apr-24	Bee Bowl E	*Andrena perplexa*	Unranked	Native	1
RICH-B1	14-Jun-23	Bee Bowl C	*Agapostemon virescens*	G5: Secure	Native	1
RICH-B1	14-Jun-23	Bee Net	*Bombus bimaculatus*	G5: Secure	Native	1

Table 10 (continued). Apoidea (bee) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH-B1	14-Jun-23	Bee Net	*Bombus griseocollis*	G5: Secure	Native	1
RICH-B1	12-Aug-23	Bee Bowl E	*Melissodes bimaculatus*	Unranked	Native	1
RICH-B1	12-Aug-23	Bee Bowl N	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B1	12-Aug-23	Bee Bowl S	*Augochlora pura*	G5: Secure	Native	1
RICH-B1	12-Aug-23	Bee Bowl S	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B1	12-Aug-23	Bee Bowl S	*Lasioglossum bruneri*	G5: Secure	Native	1
RICH-B1	12-Aug-23	Bee Net	*Apis mellifera*	Unranked	Exotic	2
RICH-B1	12-Aug-23	Bee Net	*Augochloropsis metallica*	Unranked	Native	1
RICH-B1	10-Apr-24	Bee Bowl C	*Osmia cornifrons*	G5: Secure	Native	1
RICH-B2	14-Jun-23	Bee Bowl E	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B2	14-Jun-23	Bee Bowl W	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B2	14-Jun-23	Bee Bowl C	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B2	12-Aug-23	Bee Bowl C	*Augochlorella aurata*	G5: Secure	Native	2
RICH-B2	12-Aug-23	Bee Bowl E	*Ceratina calcarata*	G5: Secure	Native	1
RICH-B2	12-Aug-23	Bee Bowl N	*Augochlora pura*	G5: Secure	Native	1
RICH-B2	12-Aug-23	Bee Bowl W	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B2	12-Aug-23	Bee Net	*Apis mellifera*	Unranked	Exotic	1
RICH-B2	12-Aug-23	Bee Net	*Augochlorella aurata*	G5: Secure	Native	1
RICH-B2	10-Apr-24	Bee Bowl S	*Andrena rudbeckiae*	Unranked	Native	1
RICH-B2	10-Apr-24	Bee Bowl N	*Osmia taurus*	G5: Secure	Native	1
RICH BV 1	14-Jun-23	Bee Vane 1	*Bombus impatiens*	G5: Secure	Native	1
RICH BV 1	12-Aug-23	Blue Vane 1	*Lasioglossum bruneri*	G5: Secure	Native	2
RICH BV 2	14-Jun-23	Bee Vane 2	*Lasioglossum callidum*	Unranked	Native	1
RICH BV 2	12-Aug-23	Blue Vane 2	*Lasioglossum cressonii*	G5: Secure	Native	1
RICH BV 2	12-Aug-23	Blue Vane 2	*Melissodes bimaculatus*	Unranked	Native	3

Table 10 (continued). Apoidea (bee) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH BV 2	13-Oct-23	Blue Vane 2	*Ceratina dupla*	G5: Secure	Native	1
RICH-C1	14-Jun-23	Bee Bowl N	*Bombus impatiens*	G5: Secure	Native	1
RICH-C1	14-Jun-23	Bee Bowl W	*Bombus impatiens*	G5: Secure	Native	1
RICH-C1	14-Jun-23	Bee Bowl C	*Agapostemon virescens*	G5: Secure	Native	1
RICH-C1	14-Jun-23	Bee Net	*Bombus impatiens*	G5: Secure	Native	1
RICH-C1	12-Aug-23	Bee Bowl N	*Lasioglossum bruneri*	G5: Secure	Native	2
RICH-C1	12-Aug-23	Bee Net	*Colletes nudus*	Unranked	Native	5
RICH-C1	12-Aug-23	Bee Net	*Megachile mendica*	G5: Secure	Native	1
RICH-C1	12-Aug-23	Bee Net	*Melissodes bimaculatus*	Unranked	Native	1
RICH-C1	12-Aug-23	Bee Net	*Melissodes comptoides*	Unranked	Native	1
RICH-C1	9-Apr-24	Bee Net	*Bombus bimaculatus*	G5: Secure	Native	1
RICH-C1	9-Apr-24	Bee Net	*Andrena perplexa*	Unranked	Native	1
RICH-C1	10-Apr-24	Bee Bowl S	*Andrena perplexa*	Unranked	Native	1
RICH-C1	10-Apr-24	Bee Bowl C	*Apis mellifera*	Unranked	Exotic	1
RICH-C2	14-Jun-23	Bee Bowl E	*Lasioglossum admirandum*	G5: Secure	Native	1
RICH-C2	14-Jun-23	Bee Net	*Bombus griseocollis*	G5: Secure	Native	4
RICH-C2	12-Aug-23	Bee Bowl C	*Augochlorella aurata*	G5: Secure	Native	2
RICH-C2	12-Aug-23	Bee Bowl C	*Melissodes bimaculatus*	Unranked	Native	1
RICH-C2	12-Aug-23	Bee Bowl E	*Augochlorella aurata*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Bee Bowl N	*Augochlorella aurata*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Bee Bowl W	*Lasioglossum versatum*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Bee Net	*Halictus ligatus/poeyi*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Bee Net	*Megachile parallela*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Bee Net	*Svastra atripes*	Unranked	Native	1
RICH-C2	12-Aug-23	Bee Net	*Svastra obliqua*	Unranked	Native	1

Table 10 (continued). Apoidea (bee) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH-C2	12-Aug-23	Bee Net	*Xylocopa virginica*	G5: Secure	Native	3
RICH-C2	13-Oct-23	Bee Bowl C	*Augochlorella aurata*	G5: Secure	Native	1
RICH-C2	13-Oct-23	Bee Net	*Apis mellifera*	Unranked	Exotic	4
RICH-C2	13-Oct-23	Bee Net	*Xylocopa virginica*	G5: Secure	Native	1
RICH-C2	10-Apr-24	Bee Bowl S	*Andrena sigmundi*	Unranked	Native	1
RICH-C2	10-Apr-24	Bee Bowl W	*Andrena geranii*	Unranked	Native	1
RICH-C2	10-Apr-24	Bee Bowl W	*Ceratina dupla*	G5: Secure	Native	2
RICH-C2	10-Apr-24	Bee Bowl N	*Lasioglossum rozeni*	Unranked	Native	1
RICH-C2	10-Apr-24	Bee Bowl C	*Andrena erythronii*	Unranked	Native	2
RICH-C3	14-Jun-23	Bee Bowl N	*Lasioglossum callidum*	Unranked	Native	2
RICH-C3	14-Jun-23	Bee Bowl N	*Lasioglossum laevissimum*	G5: Secure	Native	1
RICH-C3	14-Jun-23	Bee Bowl W	*Augochlorella aurata*	G5: Secure	Native	2
RICH-C3	14-Jun-23	Bee Bowl W	*Augochlorella gratiosa*	Unranked	Native	1
RICH-C3	14-Jun-23	Bee Bowl C	*Lasioglossum weemsi*	Unranked	Native	1
RICH-C3	14-Jun-23	Bee Net	*Calliopsis andreniformis*	G5: Secure	Native	1
RICH-C3	12-Aug-23	Bee Net	*Bombus impatiens*	G5: Secure	Native	1
RICH-C3	13-Oct-23	Bee Bowl E	*Lasioglossum callidum*	Unranked	Native	1
RICH-C3	13-Oct-23	Bee Net	*Apis mellifera*	Unranked	Exotic	1
RICH-C3	13-Oct-23	Bee Net	*Xylocopa virginica*	G5: Secure	Native	1
RICH-C3	10-Apr-24	Bee Bowl C	*Halictus ligatus/poeyi*	G5: Secure	Native	1
RICH-C3	10-Apr-24	Bee Bowl C	*Hoplitis pilosifrons*	G5: Secure	Native	1
RICH Malaise	14-Jun-23	Malaise	*Lasioglossum callidum*	Unranked	Native	1
RICH Malaise	12-Aug-23	Malaise	*Lasioglossum weemsi*	Unranked	Native	1
RICH Malaise	12-Aug-23	Malaise	*Lasioglossum callidum*	Unranked	Native	2
RICH Malaise	10-Apr-24	Malaise	*Osmia taurus*	G5: Secure	Native	1

Appendix E. Richmond National Battlefield Park Formicidae (Ant) Species Totals and Sampling Methods by Study Plot, 2023–2024.

Table 11 lists Formicidae (ant) species found in each plot and sampling method for each observation.

Table 11. Formicidae (ant) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH-A3	14-Jun-23	pecan sandie bait station	*Lasius americanus*	Unranked	Native	1
RICH-A2	9-Apr-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1
RICH-C3	9-Apr-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1
RICH-C3	9-Apr-23	pecan sandie bait station	*Tapinoma sessile*	G5: Secure	Native	8
RICH-C3	14-Jun-23	pecan sandie bait station	*Pheidole dentata*	Unranked	Unknown	24
RICH-C2	12-Aug-23	pecan sandie bait station	*Nylanderia faisonensis*	Unranked	Native	9
RICH-C2	12-Aug-23	pecan sandie bait station	*Aphaenogaster carolinensis*	Unranked	Native	4
RICH-A1	12-Aug-23	pecan sandie bait station	*Pheidole tysoni*	Unranked	Native	6
RICH-A1	12-Aug-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1
RICH-C1	12-Aug-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	26
RICH-B1	9-Apr-24	pecan sandie bait station	*Prenolepis imparis*	G5: Secure	Native	1
RICH-B2	9-Apr-24	pecan sandie bait station	*Camponotus nearcticus*	G5: Secure	Native	1
RICH-A1	14-Jun-23	pecan sandie bait station	*Aphaenogaster treatae*	Unranked	Native	1
RICH-A1	14-Jun-23	pecan sandie bait station	*Prenolepis imparis*	G5: Secure	Native	1
RICH-A2	14-Jun-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	5
RICH-A3	14-Jun-23	pecan sandie bait station	*Myrmica punctiventris*	Unranked	Native	7
RICH-A1	12-Aug-23	pecan sandie bait station	*Aphaenogaster treatae*	Unranked	Native	24
RICH-A1	12-Aug-23	pecan sandie bait station	*Aphaenogaster carolinensis*	Unranked	Native	1
RICH-A3	12-Aug-23	pecan sandie bait station	*Lasius neoniger*	G5: Secure	Native	1
RICH-A3	12-Aug-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1

Table 11 (continued). Formicidae (ant) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap Type	Species	Conservation Rank	Native Status	Total
RICH-C1	14-Jun-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	3
RICH-C3	14-Jun-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1
RICH-C1	14-Jun-23	pecan sandie bait station	*Pheidole dentata*	Unranked	Unknown	3
RICH-C2	14-Jun-23	pecan sandie bait station	*Pheidole dentata*	Unranked	Unknown	1
RICH-C2	12-Aug-23	pecan sandie bait station	*Pheidole dentata*	Unranked	Unknown	90
RICH-C1	12-Aug-23	pecan sandie bait station	*Pheidole dentata*	Unranked	Unknown	90
RICH-C1	12-Aug-23	pecan sandie bait station	*Myrmica punctiventris*	Unranked	Native	2
RICH-C2	12-Aug-23	pecan sandie bait station	*Tapinoma sessile*	G5: Secure	Native	3
RICH-C2	12-Aug-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1
RICH-B2	14-Jun-23	pecan sandie bait station	*Pheidole dentata*	Unranked	Unknown	2
RICH-B2	12-Aug-23	pecan sandie bait station	*Aphaenogaster carolinensis*	Unranked	Native	3
RICH-A1	10-Oct-23	pecan sandie bait station	*Prenolepis imparis*	G5: Secure	Native	1
RICH-B1	13-Oct-23	pecan sandie bait station	*Prenolepis imparis*	G5: Secure	Native	7
RICH-C3	13-Oct-23	pecan sandie bait station	*Nylanderia vividula*	Unranked	Native	1
RICH-C2	13-Oct-23	pecan sandie bait station	*Monomorium minimum*	G5: Secure	Native	1
RICH-B2	13-Oct-23	pecan sandie bait station	*Formica subsericea*	G5: Secure	Native	1
RICH	10-Apr-24	Blue Vane 2	*Camponotus castaneus*	Unranked	Native	1
RICH	10-Apr-24	Malaise	*Camponotus castaneus*	Unranked	Native	1

Appendix F. Richmond National Battlefield Park Orthoptera Species Totals and Sampling Methods by Study Plot, 2023–2024.

Table 12 lists Orthoptera species found in each plot and sampling method for each observation.

Table 12. Orthoptera (grasshoppers, crickets and katydids) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Collection Method	Species	Conservation Rank	Native Status	Total
RICH-A1	12-Aug-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A2	12-Aug-23	Sweep Net	*Schistocerca americana*	G5: Secure	Native	1
RICH-A3	12-Aug-23	Sweep Net	*Schistocerca americana*	G5: Secure	Native	1
RICH-A3	12-Aug-23	Sweep Net	*Melanoplus differentialis*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Sweep Net	*Melanoplus femurrubrum*	G5: Secure	Native	4
RICH-C3	12-Aug-23	Sweep Net	*Schistocerca americana*	G5: Secure	Native	1
RICH-C3	12-Aug-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-C3	12-Aug-23	Sweep Net	*Melanoplus femurrubrum*	G5: Secure	Native	2
RICH-A2	13-Oct-23	Sweep Net	*Melanoplus scudderi*	G5: Secure	Native	8
RICH-A3	13-Oct-23	Sweep Net	*Schistocerca americana*	G5: Secure	Native	4
RICH-A3	13-Oct-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A3	13-Oct-23	Sweep Net	*Melanoplus scudderi*	G5: Secure	Native	1
RICH-C2	13-Oct-23	Sweep Net	*Melanoplus femurrubrum*	G5: Secure	Native	1
RICH-C3	13-Oct-23	Sweep Net	*Syrbula admirabilis*	G5: Secure	Native	1
RICH-C1	14-Jun-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A1	14-Jun-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A1	14-Jun-23	Sweep Net	*Melanoplus differentialis*	G5: Secure	Native	1
RICH-A3	14-Jun-23	Sweep Net	*Schistocerca americana*	G5: Secure	Native	1
RICH-A3	14-Jun-23	Sweep Net	*Melanoplus* sp.	Unranked	Unknown	1

Table 12 (continued). Orthoptera (grasshoppers, crickets and katydids) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Collection Method	Species	Conservation Rank	Native Status	Total
RICH-A3	9-Apr-24	Sweep Net	*Melanoplus* sp.	Unranked	Unknown	1
RICH-A2	9-Apr-24	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A2	9-Apr-24	Sweep Net	*Gryllus* sp.	Unranked	Unknown	1
RICH-A3	9-Apr-24	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A3	9-Apr-24	Sweep Net	Tetrigidae	Unranked	Unknown	1
RICH-C1	12-Aug-23	Sweep Net	*Schistocerca americana*	G5: Secure	Native	1
RICH-C3	12-Aug-23	Sweep Net	*Scudderia* sp.	Unranked	Unknown	1
RICH-C2	13-Oct-23	Sweep Net	*Oceanthus* sp.	Unranked	Unknown	1
RICH-A1	13-Oct-23	Sweep Net	Tettigoniidae	Unranked	Unknown	1
RICH-A1	13-Oct-23	Sweep Net	*Melanoplus* sp.	Unranked	Unknown	1
RICH-A3	12-Aug-23	Sweep Net	*Melanoplus femurrubrum*	G5: Secure	Native	1
RICH-A3	12-Aug-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	1
RICH-A2	13-Oct-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	7
RICH-A2	12-Aug-23	Sweep Net	*Chortophaga viridifasciata*	G5: Secure	Native	2
RICH-A2	9-Apr-24	Sweep Net	Acridae	Unranked	Unknown	1
RICH-A2	14-Jun-23	Sweep Net	Acridae	Unranked	Unknown	5
RICH	10-Apr-24	Malaise	*Neoconocephalus triops*	Unranked	Native	1
RICH	10-Apr-24	Black Light	*Neoconocephalus triops*	Unranked	Native	1

Appendix G. Richmond National Battlefield Park Lepidoptera Species Totals and Sampling Methods by Study Plot, 2023–2024.

Table 13 lists Lepidoptera species found in each plot and sampling method for each observation.

Table 13. Lepidoptera (butterflies and moths) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap	ID	Conservation Rank	Native Status	Total
RICH	15-Jun-23	Black Light	*Nadata gibbosa*	G5: Secure	Native	2
RICH	15-Jun-23	Black Light	*Cosmia calami*	G5: Secure	Native	3
RICH	15-Jun-23	Black Light	*Automeris io*	G5: Secure	Native	1
RICH	15-Jun-23	Black Light	*Prionoxystus robiniae*	G5: Secure	Native	1
RICH	15-Jun-23	Black Light	*Callopistria cordata*	G5: Secure	Native	1
RICH	15-Jun-23	Black Light	*Scopula limboundata*	G5: Secure	Native	11
RICH	15-Jun-23	Black Light	*Hypomecis umbrosaria*	G4: Apparently Secure	Native	4
RICH	15-Jun-23	Black Light	*Halysidota harrisii*	G5: Secure	Native	3
RICH	15-Jun-23	Black Light	*Hypoprepia fucosa*	G5: Secure	Native	3
RICH	15-Jun-23	Black Light	*Megalopyge crispata*	G5: Secure	Native	3
RICH	15-Jun-23	Black Light	*Atteva aurea*	G5: Secure	Native	1
RICH	15-Jun-23	Black Light	*Lithacodes fasciola*	G5: Secure	Native	3
RICH	15-Jun-23	Black Light	*Hypsopygia olinalis*	G5: Secure	Native	28
RICH	15-Jun-23	Black Light	*Virbia opella*	G5: Secure	Native	5
RICH	15-Jun-23	Black Light	*Urola nivalis*	G5: Secure	Native	8
RICH	15-Jun-23	Black Light	*Nomophila nearctica*	G5: Secure	Native	1
RICH	15-Jun-23	Black Light	*Hyperstrotia flaviguttata*	G4: Apparently Secure	Native	2
RICH	15-Jun-23	Black Light	*Pyralidae*	Unranked	Unknown	1
RICH	12-Aug-23	Malaise	*Schizura ipomaeae*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Lapara coniferarum*	G5: Secure	Native	3

Table 13 (continued). Lepidoptera (butterflies and moths) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap	ID	Conservation Rank	Native Status	Total
RICH	13-Aug-23	Black Light	*Marimatha nigrofimbria*	G5: Secure	Native	2
RICH	13-Aug-23	Black Light	*Cycnia tenera*	G5: Secure	Native	4
RICH	13-Aug-23	Black Light	*Heterocampa obliqua*	G5: Secure	Native	3
RICH	13-Aug-23	Black Light	*Nadata gibbosa*	G5: Secure	Native	2
RICH	13-Aug-23	Black Light	*Parasa chloris*	G4: Apparently Secure	Native	1
RICH	13-Aug-23	Black Light	*Pyrrharctia isabella*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Papaipema furcata*	G4: Apparently Secure	Native	1
RICH	13-Aug-23	Black Light	*Symmerista albifrons*	G5: Secure	Native	3
RICH	13-Aug-23	Black Light	*Polygrammate hebraeicum*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Desmia funeralis*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Eacles imperialis*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Catocala ilia*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Zale helata*	G5: Secure	Native	2
RICH	13-Aug-23	Black Light	*Caenurgia chloropha*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Hypagyrtis unipunctata*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Pangrapta decoralis*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Orthodes detracta*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Nedra ramosula*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Chytonix palliatricula*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Parapediasia decorellus*	Unranked	Native	1
RICH	13-Aug-23	Black Light	*Idia americalis*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Hyphantria cunea*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Atteva aurea*	G5: Secure	Native	4
RICH	13-Aug-23	Black Light	*Spodoptera ornithogalli*	G5: Secure	Native	2

Table 13 (continued). Lepidoptera (butterflies and moths) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap	ID	Conservation Rank	Native Status	Total
RICH	13-Aug-23	Black Light	*Melanolophia canadaria*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Ectropis crepuscularia*	G5: Secure	Native	3
RICH	13-Aug-23	Black Light	*Apantesis vittata*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Acronicta increta*	G5: Secure	Native	5
RICH	13-Aug-23	Black Light	*Acronicta impleta*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Acronicta interrupta*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Cecrita guttivitta*	G5: Secure	Native	5
RICH	13-Aug-23	Black Light	*Melanolophia signataria*	G5: Secure	Native	3
RICH	13-Aug-23	Black Light	*Epimecis hortaria*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Diastictis ventralis*	Unranked	Native	1
RICH	13-Aug-23	Black Light	*Choristoneura parallela*	Unranked	Native	2
RICH	13-Aug-23	Black Light	*Hypagyrtis esther*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Panopoda rufimargo*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Euchlaena obtusaria*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Dasychira tephra*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Macaria bicolorata*	G5: Secure	Native	1
RICH	13-Aug-23	Black Light	*Pococera robustella*	Unranked	Native	2
RICH	13-Aug-23	Black Light	*Zale lunata*	G5: Secure	Native	1
RICH	12-Oct-23	Black Light	*Caenurgia chloropha*	G5: Secure	Native	2
RICH	12-Oct-23	Black Light	*Condica videns*	G5: Secure	Native	1
RICH	12-Oct-23	Black Light	*Glenoides texanaria*	G5: Secure	Native	2
RICH	12-Oct-23	Black Light	*Agrotis gladiaria*	G5: Secure	Native	9
RICH	12-Oct-23	Black Light	*Noctuini*	Unranked	Unknown	1
RICH	12-Oct-23	Black Light	*Agriphila vulgivagellus*	Unranked	Native	6

Table 13 (continued). Lepidoptera (butterflies and moths) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap	ID	Conservation Rank	Native Status	Total
RICH	12-Oct-23	Black Light	*Xestia elimata*	G5: Secure	Native	6
RICH	12-Oct-23	Black Light	*Xestia dilucida*	G5: Secure	Native	1
RICH-C1	14-Jun-23	Net	*Cupido comyntas*	G5: Secure	Native	2
RICH-A2	14-Jun-23	Net	*Pterourus glaucus*	G5: Secure	Native	2
RICH-A3	14-Jun-23	Net	*Pterourus troilus*	G5: Secure	Native	1
RICH-B1	14-Jun-23	Net	*Tetracis crocallata*	G5: Secure	Native	1
RICH-B1	14-Jun-23	Net	*Caenurgia chloropha*	G5: Secure	Native	1
RICH-C2	14-Jun-23	Net	*Cupido comyntas*	G5: Secure	Native	1
RICH-C2	14-Jun-23	Net	*Cycnia tenera*	G5: Secure	Native	1
RICH-C2	14-Jun-23	Net	*Scopula limboundata*	G5: Secure	Native	1
RICH-C2	14-Jun-23	Net	*Herpetogramma theseusalis*	Unranked	Native	1
RICH-C3	14-Jun-23	Net	*Eusarca confusaria*	G5: Secure	Native	1
RICH-C3	14-Jun-23	Net	*Cycnia oregonensis*	G5: Secure	Native	4
RICH-A1	14-Jun-23	Net	*Caenurgia chloropha*	G5: Secure	Native	1
RICH-A1	14-Jun-23	Net	*Pyralidae*	Unranked	Unknown	1
RICH-C1	12-Aug-23	Net	*Pterourus glaucus*	G5: Secure	Native	1
RICH-C1	12-Aug-23	Net	*Cupido comyntas*	G5: Secure	Native	1
RICH-C1	12-Aug-23	Net	*Atteva aurea*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Net	*Pterourus troilus*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Net	*Polites egeremet*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Net	*Lon zabulon*	G5: Secure	Native	1
RICH-C2	12-Aug-23	Net	*Epargyreus clarus*	G5: Secure	Native	1
RICH-C3	12-Aug-23	Net	*Euptoieta claudia*	G5: Secure	Native	2
RICH-C3	12-Aug-23	Net	*Cycnia tenera*	G5: Secure	Native	1

Table 13 (continued). Lepidoptera (butterflies and moths) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap	ID	Conservation Rank	Native Status	Total
RICH-A1	12-Aug-23	Net	*Pyralidae*	Unranked	Unknown	1
RICH-A1	12-Aug-23	Net	*Marimatha nigrofimbria*	G5: Secure	Native	1
RICH-A2	12-Aug-23	Net	*Danaus plexippus*	G4: Apparently Secure	Native	1
RICH-A2	12-Aug-23	Net	*Euptoieta claudia*	G5: Secure	Native	2
RICH-A2	12-Aug-23	Net	*Helicoverpa zea*	G5: Secure	Native	1
RICH-A2	12-Aug-23	Net	*Crambidae*	Unranked	Unknown	1
RICH-A3	12-Aug-23	Net	*Euptoieta claudia*	G5: Secure	Native	1
RICH-B1	12-Aug-23	Net	*Cupido comyntas*	G5: Secure	Native	1
RICH-A2	13-Oct-23	Net	*Crambidae*	Unranked	Unknown	3
RICH-A3	13-Oct-23	Net	*Phyciodes tharos*	G4: Apparently Secure	Native	2
RICH-A3	13-Oct-23	Net	*Burnsius communis*	G5: Secure	Native	1
RICH-A3	13-Oct-23	Net	*Blepharomastix ranalis*	Unranked	Native	2
RICH-A1	13-Oct-23	Net	*Crambidae*	Unranked	Unknown	3
RICH-C1	13-Oct-23	Net	*Crambidae*	Unranked	Unknown	2
RICH-C2	13-Oct-23	Net	*Danaus plexippus*	G4: Apparently Secure	Native	1
RICH-C2	13-Oct-23	Net	*Crambinae*	Unranked	Unknown	1
RICH-C3	13-Oct-23	Net	*Crambinae*	Unranked	Unknown	1
RICH-A1	9-Apr-24	Net	*Colias eurytheme*	G4: Apparently Secure	Native	1
RICH-A1	9-Apr-24	Net	*Cupido comyntas*	G5: Secure	Native	1
RICH-A1	9-Apr-24	Net	*Crambinae*	Unranked	Unknown	1
RICH-A2	9-Apr-24	Net	*Cupido comyntas*	G5: Secure	Native	1
RICH-A3	9-Apr-24	Net	*Cupido comyntas*	G5: Secure	Native	1
RICH-A3	9-Apr-24	Net	*Crambidae*	Unranked	Unknown	1
RICH-C1	9-Apr-24	Net	*Cupido comyntas*	G5: Secure	Native	4

Table 13 (continued). Lepidoptera (butterflies and moths) species found by site at Richmond National Battlefield Park. Also shown for each bee species are the observation date, the trap type used, the species' conservation rank and native status, and the total number of individuals observed.

Site	Date	Trap	ID	Conservation Rank	Native Status	Total
RICH-C1	9-Apr-24	Net	*Euptoieta claudia*	G5: Secure	Native	1
–	–	–	–	–	–	**247**

Appendix H. eBird Comparison of Gaines' Mill and Malvern Hill Hotspots.

Table 14 lists bird species and breeding statuses documented on eBird for Gaines' Mill and Malvern Hills sites.

Table 14. eBird comparison of Gaines' Mill and Malvern Hill sites. B = breeding in the area. Nomenclature follows eBird.

Species Habitat and Location	Species	Breeding Status
Non-forest species found only at Malvern Hill (17 species)	Cooper's Hawk	B
	Broad-winged Hawk	–
	Merlin	–
	Horned Lark	B
	Purple Martin	B
	Northern Rough-winged Swallow	B
	Cliff Swallow	B
	American Pipit	–
	Purple Finch	–
	Grasshopper Sparrow	B
	Fox Sparrow	–
	White-crowned Sparrow	–
	Savannah Sparrow	–
	Yellow-breasted Chat	B
	Orchard Oriole	B
	Rusty Blackbird	–
	Yellow Warbler	B
Non-forest species found at both sites (57 species)	Northern Bobwhite	B
	Wild Turkey	B
	Rock Pigeon	B
	Mourning Dove	B
	Chimney Swift	B
	Ruby-throated Hummingbird	B
	Killdeer	B
	American Woodcock	B
	Black Vulture	B
	Turkey Vulture	B
	Northern Harrier	–
	Sharp-shinned Hawk	–

Table 14 (continued). eBird comparison of Gaines' Mill and Malvern Hill sites. B = breeding in the area. Nomenclature follows eBird. Non-forest species found only at Malvern Hill (17 species).

Species Habitat and Location	Species	Breeding Status
Non-forest species found at both sites (57 species) (continued)	Bald Eagle	B
	Red-shouldered Hawk	B
	Red-tailed Hawk	B
	Northern Flicker	B
	American Kestrel	B
	Great Crested Flycatcher	B
	Eastern Kingbird	B
	White-eyed Vireo	B
	Blue Jay	B
	American Crow	B
	Fish Crow	B
	Common Raven	–
	Tree Swallow	B
	Barn Swallow	B
	House Wren	B
	Carolina Wren	B
	European Starling	B
	Gray Catbird	B
	Brown Thrasher	B
	Northern Mockingbird	B
	Eastern Bluebird	B
	American Robin	B
	Cedar Waxwing	–
	House Sparrow	B
	House Finch	B
	American Goldfinch	B
	Chipping Sparrow	B
	Field Sparrow	B
	Dark-eyed Junco	–
	White-throated Sparrow	–
	Song Sparrow	B
	Swamp Sparrow	–
	Eastern Towhee	B
	Bobolink	–
	Eastern Meadowlark	B

Table 14 (continued). eBird comparison of Gaines' Mill and Malvern Hill sites. B = breeding in the area. Nomenclature follows eBird. Non-forest species found only at Malvern Hill (17 species).

Species Habitat and Location	Species	Breeding Status
Non-forest species found at both sites (57 species) (continued)	Red-winged Blackbird	B
	Brown-headed Cowbird	B
	Common Grackle	B
	Common Yellowthroat	B
	Palm Warbler	–
	Yellow-rumped Warbler	–
	Prairie Warbler	B
	Northern Cardinal	B
	Blue Grosbeak	B
	Indigo Bunting	B
Forest species found only at Malvern Hill (4 species)	Eastern Screech-Owl	B
	Great Horned Owl	B
	Kentucky Warbler	B
	Blackpoll Warbler	–
Forest species found at both sites (38 species)	Yellow-billed Cuckoo	B
	Barred Owl	B
	Yellow-bellied Sapsucker	–
	Red-headed Woodpecker	B
	Red-bellied Woodpecker	B
	Downy Woodpecker	B
	Hairy Woodpecker	B
	Pileated Woodpecker	B
	Eastern Wood-Pewee	B
	Acadian Flycatcher	B
	Eastern Phoebe	B
	Yellow-throated Vireo	B
	Red-eyed Vireo	B
	Carolina Chickadee	B
	Tufted Titmouse	B
	Ruby-crowned Kinglet	–
	Golden-crowned Kinglet	–
	White-breasted Nuthatch	B
	Brown Creeper	B
	Blue-gray Gnatcatcher	B
	Winter Wren	–

Table 14 (continued). eBird comparison of Gaines' Mill and Malvern Hill sites. B = breeding in the area. Nomenclature follows eBird. Non-forest species found only at Malvern Hill (17 species).

Species Habitat and Location	Species	Breeding Status
Forest species found at both sites (38 species) (continued)	Veery	–
	Swainson's Thrush	–
	Hermit Thrush	–
	Wood Thrush	B
	Ovenbird	B
	Louisiana Waterthrush	B
	Northern Waterthrush	–
	Black-and-white Warbler	B
	Prothonotary Warbler	B
	Hooded Warbler	B
	American Redstart	–
	Northern Parula	B
	Black-throated Blue Warbler	–
	Pine Warbler	B
	Yellow-throated Warbler	B
	Summer Tanager	B
	Scarlet Tanager	B

National Park Service
U.S. Department of the Interior

Science Report NPS/SR—2026/374
https://doi.org/10.36967/2315976



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NPS 367/198636, January 2026