National Park Service
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Vegetation Classification and Mapping of Wilson's Creek National Battlefield

Project Report

Natural Resource Report NPS/WICR/NRR—2013/650

ON THE COVER
Wilson's Creek National Battlefield Pic 57
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Natural Resource Report NPS/WICR/NRR—2013/650

David D. Diamond[1]*
Lee F. Elliott[1]
Michael D. DeBacker[2]
Kevin M. James[2]
Dyanna L. Pursell[1]
Alicia Struckhoff[1]

[1]Missouri Resource Assessment Partnership (MoRAP)
School of Natural Resources
University of Missouri
4200 New Haven Road
Columbia, MO 65201

[2]National Park Service
Heartland I&M Network
6424 West Farm Road 182
Republic, MO 65738

*contact diamondd@missouri.edu

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Abstract/Executive Summary

Wilson's Creek National Battlefield (WICR) is situated about five miles southwest of Springfield, Missouri, and preserves the site of the Civil War engagement called the Battle of Wilsons's Creek. The landscape is part of the James River Oak Savanna/Woodland land type association within the Springfield Plain Subsection of the Ozark Highlands ecoregion (Nigh and Schroeder 2002). Much of the area was used as cropland in the past, and the remainder was used for grazing or forest products or both, so current vegetation represents plant communities in different stages of recovery from disturbance.

A vegetation classification and mapping project was initiated in 2010 and completed in 2012. Protocols and products were produced following National Park Service Vegetation Mapping Program guidelines. Classification was based on 50 quantitative field plots, which were placed across WICR in a stratified random manner based on qualitative field observation points, consideration of biophysical setting, and viewing of air photos. Mapping was based on a combination of image object generation and heads-up digitization of air photos on-screen. Accuracy assessment points obtained during 2012 verified that the map is 81.3% accurate across all classes.

Most of WICR, including 1,836 acres (743 hectares), or 93%, is semi-natural, whereas 7% is developed or in croplands designed to enhance interpretation of the battlefield during the engagement. Grasslands, including periodically mowed or burned open areas, cover roughly half of WICR. Successional woodlands and forests cover the other half. Small glades, though they cover <1% of the area, represent significant natural communities, and support populations of the rare Missouri bladderpod (*Lesquerella filiformis*; Annis et al. 2011).

Open areas at WICR are variable across years due to periodic mowing or burning. After mowing or prescribed fire, areas show a grassland aspect for one season, and thereafter appear increasingly shrub-dominated as perennial shrubs overtop grasses. Open areas also vary across short spatial scales, which reflects past restoration activities and natural variation after recovery from rowcrop agriculture and grazing.

Introduction

Wilson's Creek National Battlefield Vegetation Mapping Project

Wilson's Creek National Battlefield (WICR) Vegetation Mapping Inventory Project was a cooperative initiative involving the Missouri Resource Assessment Partnership (MoRAP) at the University of Missouri, the Heartland Inventory and Monitoring Program (HTLN) of the National Park Service (NPS), and park managers and resource specialists. MoRAP provided the classification and mapping and HTLN provided accuracy assessment and overall project coordination. All aspects of the project conform to overall requirements set forward by the National Park Service Vegetation Inventory Program (see http://science.nature.nps.gov/im/inventory/veg/index.cfm).

The project was initiated because accurate maps of existing vegetation facilitate natural and cultural resource management and interpretation. Most of WICR has undergone a good deal of disturbance due to past cultivation, grazing, and timber management. Early successional and disturbance species are prominent throughout much of the park. Small glades represent significant natural communities, and offer opportunities for conservation of glade-associated species such as Missouri bladderpod (*Lesquerella filiformis*; Annis et al. 2011). Tallgrass prairie restorations are also important communities that resemble native prairie in aspect.

Each NPS Vegetation Mapping Inventory Project has three major components: classification, mapping, and map accuracy assessment. This report provides details on each of these fundamental elements.

USGS-NPS Vegetation Mapping Program

The National Vegetation Inventory Program is an interagency initiative established to inventory, classify, describe, and map vegetation in National Park units and other areas across the United States. It is administered by the NPS Natural Resources Information Division, and provides baseline vegetation information to the NPS Inventory and Monitoring Program (I&M).

Vegetation Inventory Program scientists have developed procedures for classification, mapping, and accuracy assessment (Lea 2011; Lea and Curtis 2010). Use of the National Vegetation Classification System (NVCS) as the standard classification is central to fulfilling the goals of this national program. This system:

- is vegetation based;
- uses a systematic approach to classify a continuum;
- emphasizes natural and existing vegetation;
- uses a combined physiognomic-floristic hierarchy;
- identifies vegetation units based on both qualitative and quantitative data; and
- is appropriate for mapping at multiple scales.

The use of the NVCS and the standardized vegetation mapping protocols facilitates effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These vegetation maps and associated information support a wide variety of resource assessment, park management, and planning needs. In addition they can be used to provide a structure for framing and answering

critical scientific questions about vegetation communities and their relationship to environmental conditions and ecological processes across the landscape.

Before 1994, NVCS development was led by The Nature Conservancy (TNC), and further development was then passed on to the newly formed NatureServe organization. A network of state and regional ecologists involving dozens of individuals worked on the classification (TNC and ESRI 1994a; Grossman et al. 1998). The NVCS is currently supported and endorsed by multiple federal agencies, the Federal Geographic Data Committee (FGDC 2008), NatureServe, state heritage programs, and the Ecological Society of America. Refinements to the classification have occurred in fits and spurts over the past decade, with funding from various federal and state agencies. A formal process for review of proposed revisions is in place (see Jennings et al. 2009), and the most accessible source for the NVCS is provided by NatureServe Explorer (http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol).

Vegetation Mapping Program Standards

The NPS I&M Program established guidance and standards for all vegetation mapping projects in a series of documents.

Protocols

- documenting a National Vegetation Classification System (TNC and ESRI 1994)
- standards for field methods and mapping procedures (Jennings et al. 2009; Lea 2011)
- producing rigorous and consistent accuracy assessment procedures (Lea and Curtis 2010)
- establishing standards for using existing vegetation data (TNC 1996)

Standards

- National Vegetation Classification Standard (FGDC 2008)
- Spatial Data Transfer Standard (FGDC 1998)
- Content Standard for Digital Geospatial Metadata (FGDC 1998)
- United States National Map Accuracy Standards (USGS 1999)
- Integrated Taxonomic Information System (http://www.itis.gov/)
- program-defined standards for map attribute accuracy and minimum mapping unit

A 12-step guidance document provides details that cover the entire process with links to information extracted or summarized from publications described above (National Parks Service 2011, available at http://science.nature.nps.gov/im/inventory/veg/docs/Veg_Inv_12step_Guidance_v1.1.pdf). Product specifications are also provided in a document (National Park Service 2011a, available at http://science.nature.nps.gov/im/inventory/veg/docs/Product_Specifications.pdf)

Wilson's Creek National Battlefield

Wilson's Creek National Battlefield is located about five miles southwest of Springfield, MO (Figure 1) and preserves approximately 1,975 acres on the site of the Battle of Wilsons's Creek. Union and Confederate forces fought on August 10, 1861, for control of Missouri during the first year of the Civil War. The National Park Service operates a visitor center and Civil War museum on site, and preserves and interprets the battlefield. Features include the Ray house, which is the only building left intact from the time of the battle, a tour loop road, and a trail. Vegetation management is largely designed to help with interpretation of the battlefield while

recognizing and enhancing natural communities such as glades and restored tallgrass prairie. Within the past decade, the National Park Service's Heartland Inventory and Monitoring Network (HTLN) has established baselines and on-going monitoring of key indicators of natural resource health (Annis et al., 2011).

The park supports open non-native grasslands, natural successional grasslands and shrublands, restored tallgrass prairie, small glades, and a variety of successional deciduous and evergreen woodlands. Initial inspection of WICR revealed native (planted) tall grasses and native oaks and hickories, plus a variety of non-native herbaceous species and vines and weedy tree and shrub species. The Natural Resource Condition Assessment, based on evaluation of data collected by the Heartland Network and from other sources, found the park in overall moderate/poor condition, and the vegetation in poor condition overall (Annis et al. 2011). Upland woodlands were in better condition than grasslands, glades, and bottomland forest. WICR has populations of 16 bird species of regional concern to Partners in Flight, most of which are associated with open areas that are periodically mowed or burned (Peitz 2006). Tall grasses such as those found in restored prairie, and 'shrubby' patches in mowed and burned openings, may be relatively rare in the regional landscape.

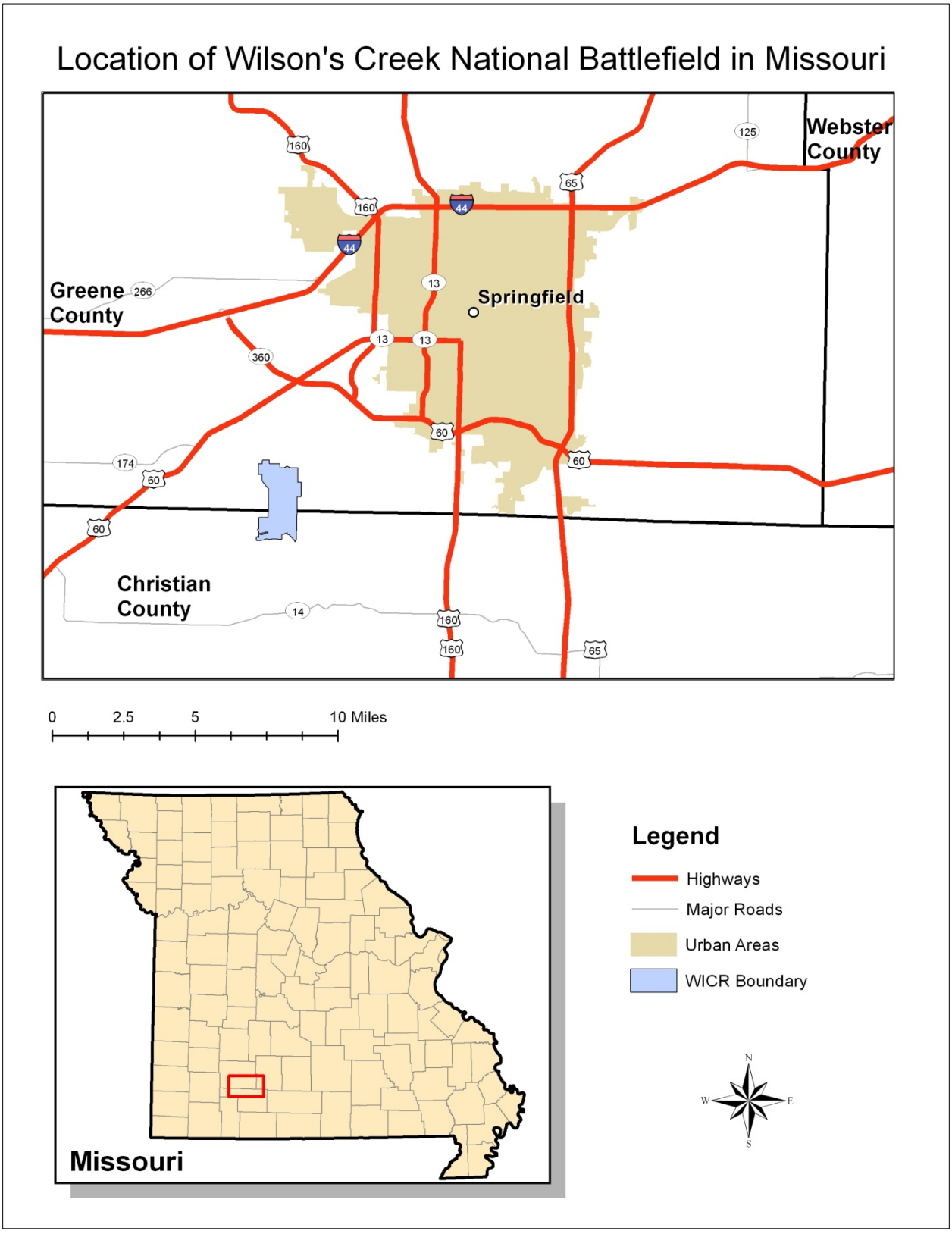

Figure 1. Location of Wilson's Creek National Battlefield in Greene and Christian Counties, Missouri.

Project Statistics

Field Work:

Observation Points = 124

Points observed between August 2009 and December 2010 by MoRAP staff. An additional 30 observation points were collected in April 2012 to clarify mapping units

Plot Sampling = 50

Plots sampled in June 2011 by MoRAP staff

Accuracy Assessment Points = 160

Collected between May and July 2012 by Heartland Inventory and Monitoring Network staff

Classification:

6 NVC Plant Associations
4 Park Special Vegetation Classes
3 Non-Vegetated Land-Use/Land Cover Classes

GIS Database 2011 - 2012:

Wilson's Creek National Battlefield = 1,975 acres (799 hectares)

Base Imagery used for mapping (acquired by MoRAP):

2007-2009, Greene County, MO, leaf-off, true color, 2 ft
2009, Greene County, MO, leaf-on, Color Infrared, 1 m
2009, Greene County, MO, leaf-on, true color, 1 m

Additional Imagery acquired and viewed by MoRAP:

1941 Panchromatic Aerial Photo
1936 Panchromatic Aerial Photo

Minimum Mapping Unit = 0.5 hectares (ha)
Total Size = 379 Polygons
Average Polygon Size = 5.21 acres (2.1 ha)
Overall Thematic Accuracy = 81.3%
Project Completion Date: 11/2012

Methods

Wilson's Creek National Battlefield, at 1,975 acres (799 ha), is a medium park as defined by sampling design protocols (TNC and ESRI 1994). Therefore, samples were stratified across the park based on biophysical setting and current vegetation cover. Since access to private lands outside of the park was not ensured, the project boundary consisted of the boundary of the park itself (Figure 2). It is assumed that these sample sites will sufficiently characterize the vegetation types and explain their distribution across the park without having to survey each stand of vegetation. Five major tasks were identified and completed, including:

1. Plan, gather data, and coordinate tasks;

2. Survey WICR to understand and sample the vegetation;

3. Classify the vegetation using the field data to NVC standard associations and alliances and crosswalk these to recognizable map units as far as possible;

4. Acquire current digital imagery and interpret the vegetation from these using the classification scheme and a map unit crosswalk; and

5. Assess the accuracy of the final map product.

All protocols for this project are outlined by NPS and important sections are summarized or linked at http://science.nature.nps.gov/im/inventory/veg/index.cfm). Drilling down to additional linked documents can be accomplished via the link to the National Park Service 12-step guidance document on that web site (National Park Service 2011). Important references include TNC and ESRI (1994), Jennings et al. (2009), Lea (2011), and Lea and Curtis (2010).

Planning, Data Gathering, and Coordination

A Natural Resource Condition Assessment (NRCA) was completed for WICR and published in 2011 (Annis et al. 2011). During the course of that project, the current vegetation mapping project was discussed with appropriate on-site staff in coordination with Heartland Network staff and MoRAP staff. A proposal for vegetation mapping was subsequently completed and approved by National Park Service National Vegetation Mapping staff. Based on that proposal, MoRAP was responsible for classification, plot sampling, mapping, and development of digital databases. The Heartland Network was responsible for oversight of MoRAP activities in concert with NPS Mapping Program staff, and accomplished Accuracy Assessment tasks. WICR staff provided logistical and technical support, and helped coordinate field activities.

Field Survey

The field methods used in sampling and classifying the vegetation followed the methodology outlined by NPS Vegetation Mapping Program team (see Jennings 2009, Lea 2011, National Park Service 2011). The application of these methods to WICR is outlined below.

A generalized land cover classification was available from the WICR NRCA (Annis et al. 2011), and this information together with NAIP air photos, digital soils information, digital elevation models, surface geology maps, and field-collected observation data were used to inform the

design of field surveys and ultimately vegetation classification and mapping (Figure 3). Observation points consisted of brief visits (less than 15 minute) by ecologists from MoRAP who collected general information on vegetation structure and composition.

Vegetation data were collected at 50 plots by MoRAP staff in June of 2011 (Figure 4). In the lab, the locations of plots were randomly placed within the following general strata based on field observation points and viewing of air photos and digital soils surveys (available at http://soils.usda.gov/survey/geography/ssurgo/): deciduous woodlands and forests on upland soils, deciduous woodlands and forests on slopes >20%, deciduous bottomland forests, upland juniper-dominated woodlands and forests, restored tallgrass prairie, successional shrubland and woodland in a wind-damaged area, disturbed grasslands and shrublands, and glade/shallow soiled juniper woodlands (Figure 4). Plots were located >30 m from an obvious land cover edge, and for each point there was at least one alternate, should the original point be determined unusable in the field (e.g. close to an un-mapped trail or road, stand too small). The stratified random plot location information was loaded into a GPS and workers navigated to the plot in the field for sampling.

Woodlands and forests were sampled with a 10 m x 40 m plot (400 sq m), shrublands and open woodlands with a 10 m x 20 m plot (200 sq m), and herbaceous vegetation with a 5 m x 20 m plot (100 sq m). Minimal flagging was used to mark the plot. Data were collected using a plot survey form (Appendix B). The survey form includes sections for plot location and description, as well as vegetation and environmental information about the plot.

Vegetation sampling included information about structure and physiognomy, with leaf phenology, leaf type and physiognomic class recorded for the dominant vegetative stratum. Cover data were collected for the following strata, where applicable.

T1 = Emergent Tree (overstory) >30 m
T2 =Tree Canopy (overstory) 20-30 m
T3 =Tree Subcanopy (midstory) 5-20 m
S1 =Tall Shrub (understory woody species, tree and shrub) 1-5 m
S2 =Short Shrub (woody species, tree and shrub) <1 m
H =Herbaceous species, does not include S2

Additionally, cover was recorded in modified Daubenmire (1959) cover classes for each species by strata (Table 1).

Table 1. Canopy cover classes used for quantitative vegetation sampling.

Cover Class Codes	Range of Cover (%)
7	95-100
6	75-95
5	50-75
4	25-50
3	5-25
2	1-5
1	0-0.99

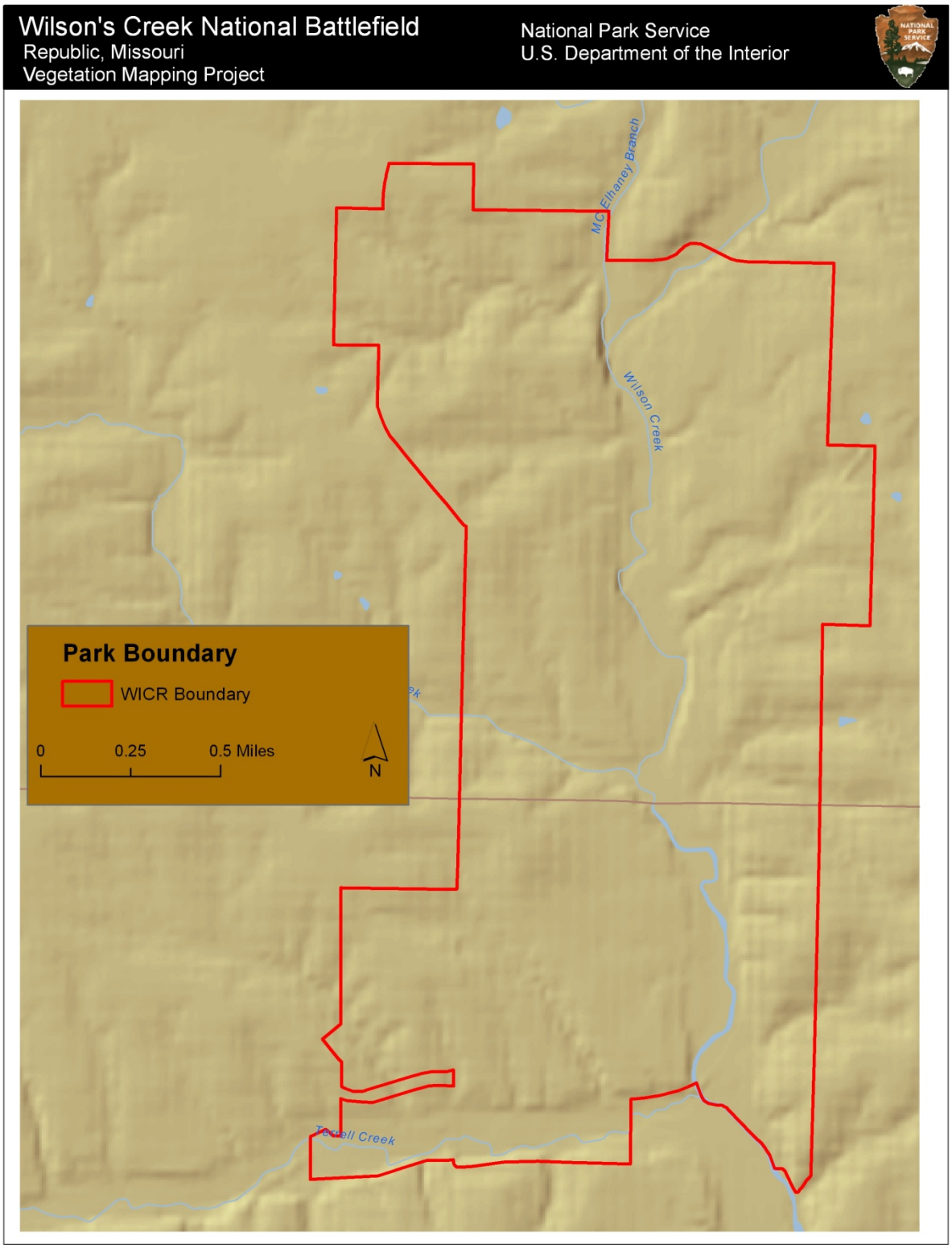

Figure 2. Map of Wilson's Creek National Battlefield showing boundary, topography, and drainages.

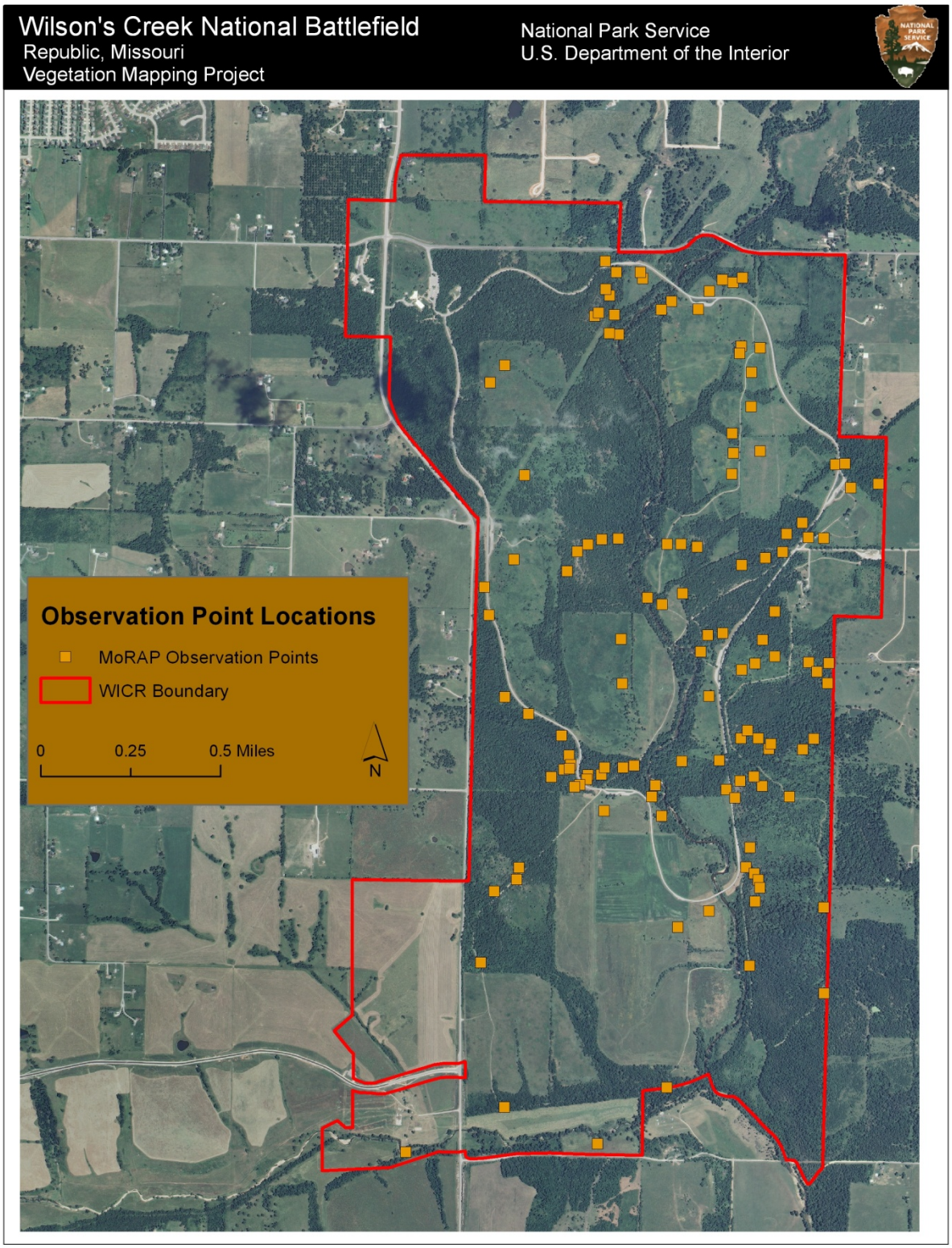

Figure 3. Location of 124 observation points in Wilson's Creek National Battlefield.

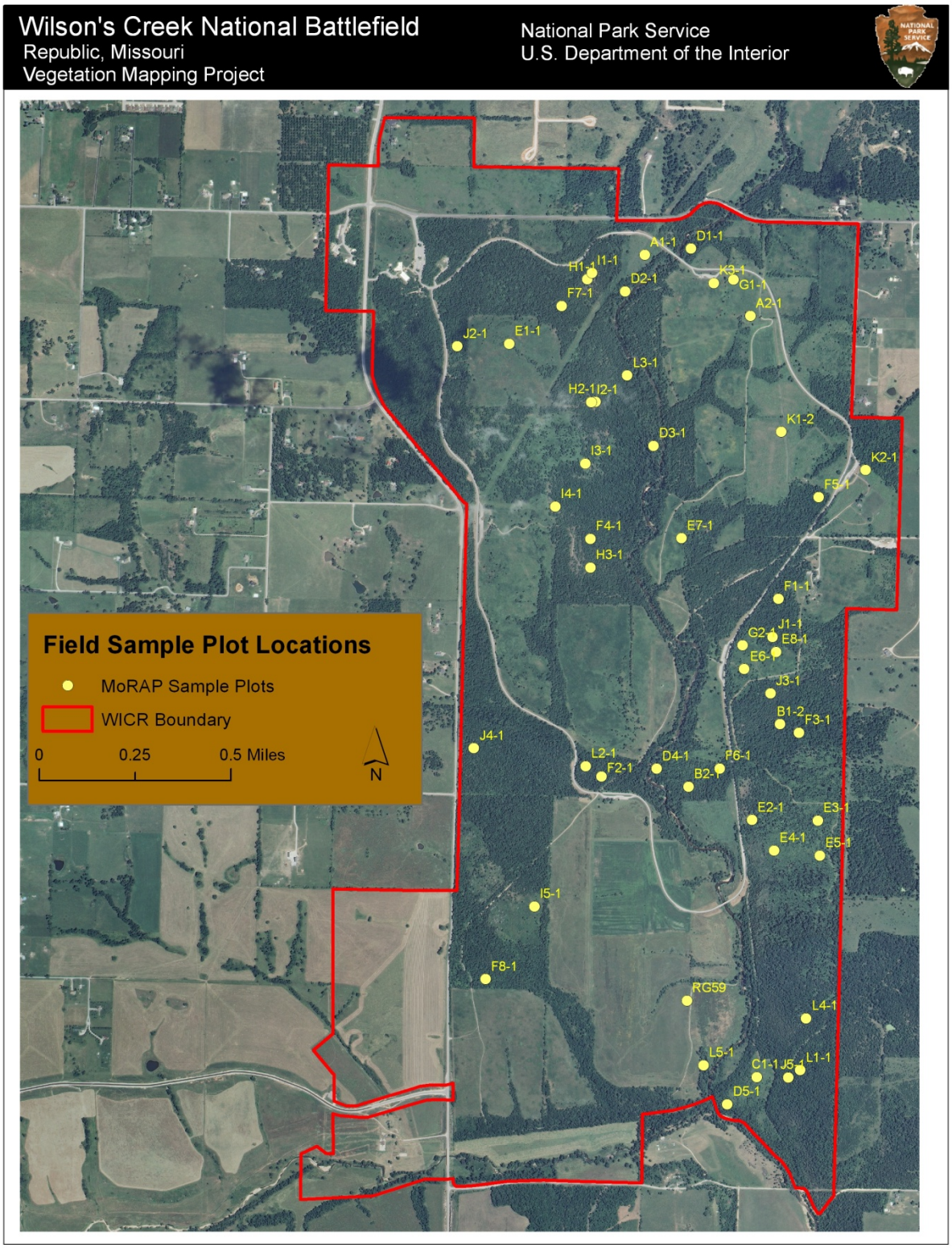

Figure 4. Location of 50 sample plots within Wilson's Creek National Battlefield.

Vegetation Classification

All recorded data were entered into the NPS PLOTS v3.2 (available at http://science.nature.nps.gov/im/inventory/veg/plots.cfm), a Microsoft Access-derived program. The PLOTS database was developed for the NPS National Vegetation Mapping Program so that data entry fields mirror the standard field form. Data entry was facilitated by assigning each plant taxon a unique, standardized code and name based on the PLANTS database developed by Natural Resources Conservation Service in cooperation with the Biota of North America Program (USDA and NRCS 2009, available at http://plants.usda.gov/java/). Data were thoroughly proofed after entry to minimize errors.

Plot data were subject to cluster analysis and ordination in order to help inform classification. Species-specific data were collected in multiple strata using cover classes, but for the purpose of analysis, the cover values for each species were combined into a single value using the midpoint of the cover class. The formula used to combine the strata cover values for each species was.

$$1 - \prod (1 - \frac{\%cover}{100})$$

Use of this formula reduces the effects of overlapping cover in various strata. We used a log transformation to standardize cover values using the formula log (cover + 1). Bray-Curtis dissimilarity was used as the distance metric for the cluster and ordination analyses (Legendre & Legendre 1998). Clustering was performed using the hierarchical clustering algorithm known as flexible Beta with a $\beta = -0.25$ (Lance & Williams 1966, Maechler et al. 2011). Non-metric multidimensional scaling was used to develop the ordination (Legendre & Legendre 1998, Roberts 2010).

Descriptive information on NVC community composition concepts and classification were obtained from the NatureServe Explorer (2012) website available at http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol . Where the observed WICR vegetation did not fit descriptions of natural associations described for Missouri, park-specific types were defined based on the quantitative data and observation points.

Once the classification was finalized, a dichotomous key was developed by MoRAP for use during the Accuracy Assessment (Appendix C). For types with an NVC assignment, the ecological systems and association descriptions served as the basis for the global description of the mapped type. For other types, descriptions are based on the quantitative plot data and on observation points. The final described types were all mapped and linked to map classes for use in the photo-interpretation and mapping portions of the project.

Digital Imagery and Interpretation

The mapping component was produced by identifying land cover in a three-step process: (1) image objects were generated at 1 m resolution using e-Cognition applied to stacked leaf-on and leaf-off air photos, (2) image objects were coded with land cover classes on-screen, and (3) image objects were cut and corrected via heads-up digitizing at a display scale of 1:1,500 against a back-drop of air photos. Imagery was the most recent available from the National Agriculture Imagery Program (NAIP; see

http://www.fsa.usda.gov/Internet/FSA_File/naip_2009_info_final.pdf). This included 2003 to 2007 true color and color infrared imagery (see Project Statistics, above) (Figure 5).

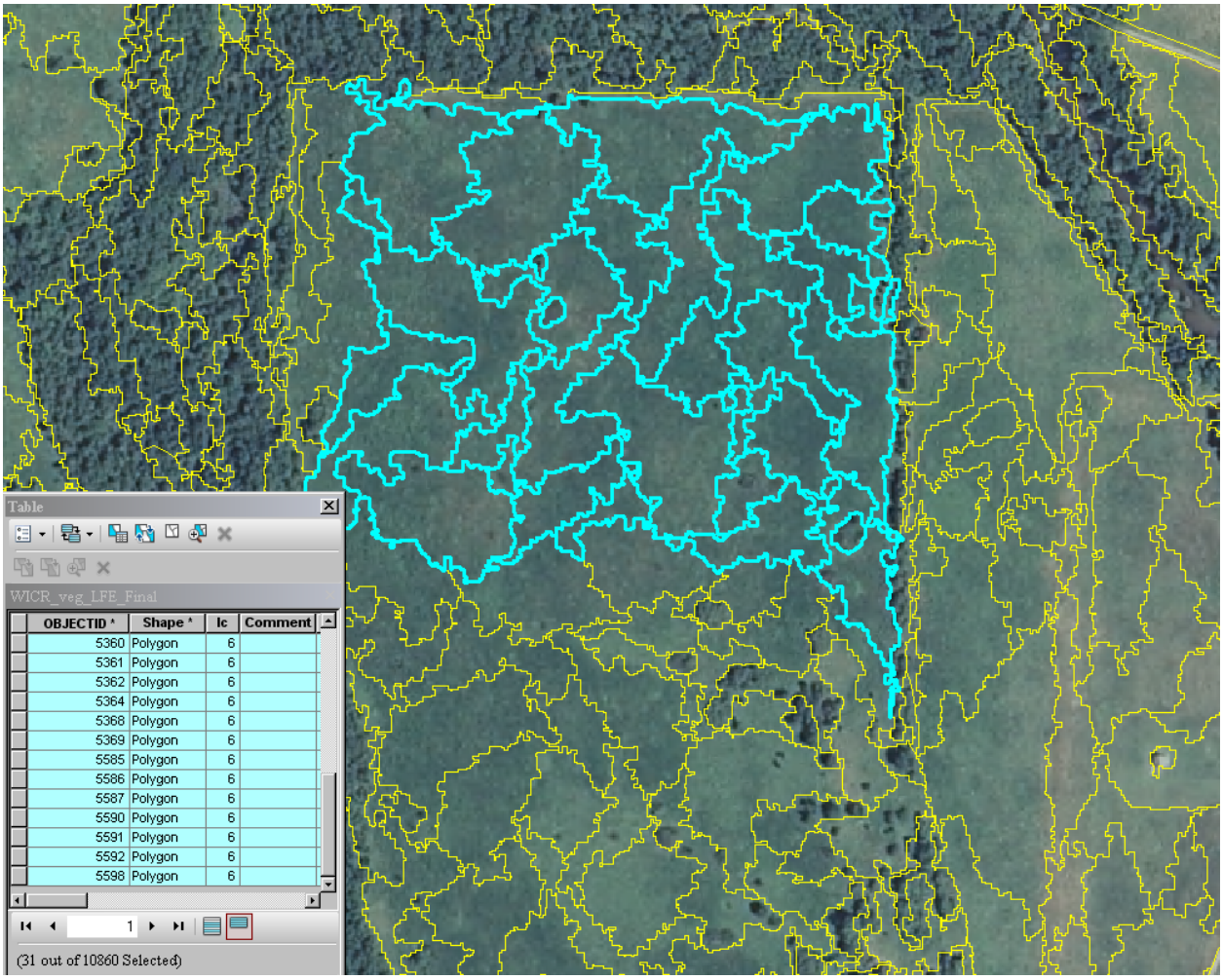

Figure 5. Image objects were generated and then corrected via heads-up digitization at a view scale of 1:1,500.

Accuracy Assessment

Thematic accuracy assessment (AA) was conducted by the Heartland Inventory and Monitoring Network (HTLN). Methods and analysis for the accuracy assessment of vegetation mapping at Wilson's Creek National Battlefield (WICR) were based on National Park Service standards (Lea and Curtis 2010). Thematic or attribute accuracy of mapped vegetation classes were assessed independently following the completion of the vegetation mapping inventory by the lead authors. Representative sites were identified and visited in the field to determine if interpreted mapped classes were correctly assigned by field observers using the dichotomous key to mapped current vegetation types (Appendix C). Identifying the degree of correspondence between field observations and mapped attributes provides a measure of the maps suitability for different applications.

Accuracy assessment consisted of first evaluating the spatial pattern (total area and number of polygons) of each mapped vegetation class. The number of samples in each class was selected from five possible scenarios (Table 2). Accuracy assessment was restricted to natural vegetation map classes, thus omitting developed areas, crop fields and standing water. Once the appropriate sampling scenario for each map class was determined, site selection was performed using a geographical information system (ArcGIS 10.0).

Table 2. Target number of Accuracy Assessment samples per map class based on number of polygons and area.

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
Scenario A:	The class is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.	>30	>50 ha	30
Scenario B:	The class is relatively abundant. It covers more than 50 hectares of the total area but consists of fewer than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.	<30	>50 ha	20
Scenario C:	The class is relatively rare. It covers less than 50 hectares of the total area but consists of more than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.	>30	<50 ha	20
Scenario D:	The class is rare. It has more than 5 but fewer than 30 polygons and covers less than 50 hectares of the area. In this case, the recommended number of samples is 5. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than 5 sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting 5 sample sites will allow an accuracy estimate to be computed, although it will not be very precise.	5 - 30	<50 ha	5

Table 2. Target number of Accuracy Assessment samples per map class based on number of polygons and area (continued).

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
Scenario E:	The class is very rare. It has fewer than 5 polygons and occupies less than 50 hectares of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than 5 sample sites (assuming 1 site per polygon) no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).	<5	<50 ha	Visit all and confirm

Random sample points were generated in ArcGIS. Points were buffered 40 meters from the park boundary and 80 meters from another point for larger polygons. The minimum mapping unit used in delineating vegetation polygons was 0.5 hectares. All random points were selected within the park boundary to avoid any private land issues.

Randomly selected site locations were loaded onto a Garmin GPS unit for field navigation. Accuracy assessment field work was completed between May and July, 2012. Field staff was provided with a GPS unit, dichotomous key for mapping vegetation map classes and vegetation class definitions (Figure 6).

Plot shape and size varied according the extent of the vegetation class patch containing the sample point. Circular 0.25 hectares (28 meter radius) plots were used for most patches. A mix of circular and rectangular 0.1 hectares plots were used for small patches and linear patch types, respectively. A circular plot size of 0.5 hectares (40 meter radius) was used to capture information for the larger homogenous patches. In all cases, the plot size selection was made to ensure the most area was considered within a homogenous map class patch.

Field staff recorded plot size and shape, positional accuracy and vegetation classification at each point (Accuracy assessment field form, Appendix D). In addition, comments regarding the plot location, plot size and vegetation were recorded on the field form. Field data from the 160 points were entered into to the PLOTS database and underwent quality assurance/quality control (QA/QC) verification. In addition, the associated project geodatabase was updated in ArcGIS to reflect any changes to the point location due to offsets made in the field. All classification and spatial field observations were compared with the vegetation map and AA point locations for any differences.

Upon completion of QA/QC, the accuracy assessment analysis was performed. All analysis and evaluation of producer and user accuracy was conducted using the AA Contingency Table Calculation Spreadsheet (http://science.nature.nps.gov/im/inventory/veg/guidance.cfm). Statistics and calculations performed in the spreadsheet are presented in Table 3.

Table 3. Summary of the Accuracy Assessment statistics used at Wilson's Creek National Battlefield.

Statisitc	**Description**
User's Accuracy	The fraction of the accuracy assessment observations in a map class that were found to have the correct vegetation class in the field.
Producer's Accuracy	The fraction of the accuracy assessment observations in a vegetation class in the field that were found to be mapped correctly.
Overall Accuracy	The fraction of accuracy assessment observations within all map classes that were correctly mapped.
Kappa Index	Another measure of overall accuracy, which takes into account the probability that mapped polygons will be correct due to random chance.

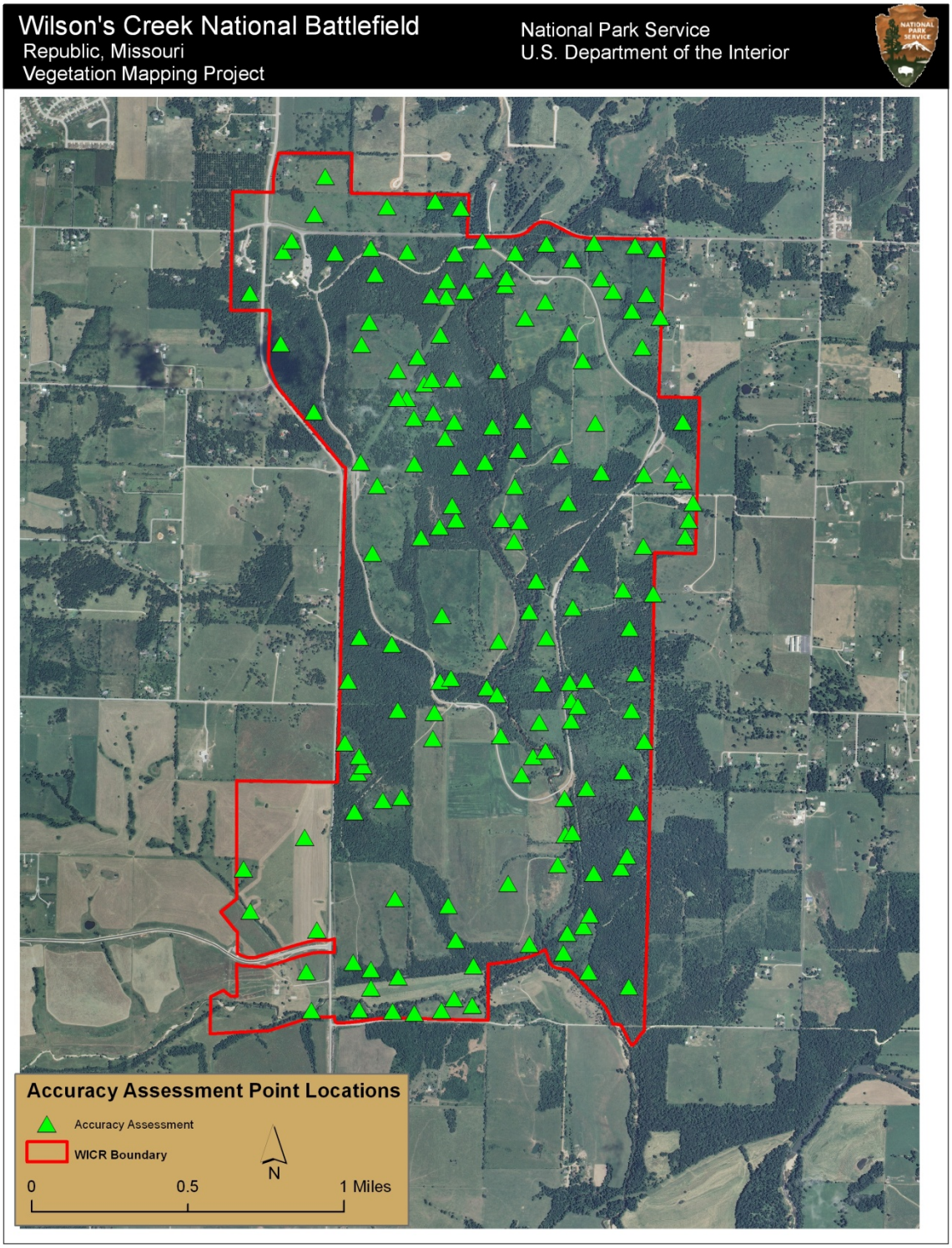

Figure 6. Accuracy Assessment points for Wilson's Creek National Battlefield.

Results

Vegetation Classification

Ten vegetation types were identified at WICR based primarily on ordination analysis results (Figure 7). Polygons in Figure 7 show the following types (common names, Table 4):

Blue solid line – Bottomland Deciduous Woodland and Forest
Blue dashed line – Upland Deciduous Woodland and Forest
Green solid line – Eastern Redcedar Woodland and Forest
Green dashed line – Thin-soiled Eastern Redcedar Woodland
Red solid line – Manley Shrubland and Woodland
Red dashed line – Non-native Ruderal Grassland
Orange dashed line – Mixed Warm- and Cool-Season Grassland and Shrubland
Black solid line – Glade
Black circle – American Plum Shrubland
Red circle – Restored Tallgrass Prairie

The landscape of WICR is patchy and disturbed, and for this reason types circumscribe a good deal of variation in composition. Representative plots for a given type are sometimes widely spread out in ordination space. Results from cluster analysis were difficult to interpret, although they generally agreed with ordination results. Mixed Warm- and Cool-Season Grassland and Shrubland showed the widest range of variation in terms of location of plots within the ordination, although most plots were low on the first axis, along with other plots that represented grassland. Forested plots are generally high on the first axis, with bottomland woodland high on the second axis as well. Upland Deciduous Woodland was high on the first axis and low on the second axis. These results identify more types than previous reports on WICR, but are generally in line with impressions of the overall landscape (see Annis et al. 2011, National Parks Service 2004). During the plot sampling efforts a total of 304 taxa of flowering plants were observed (Appendix E).

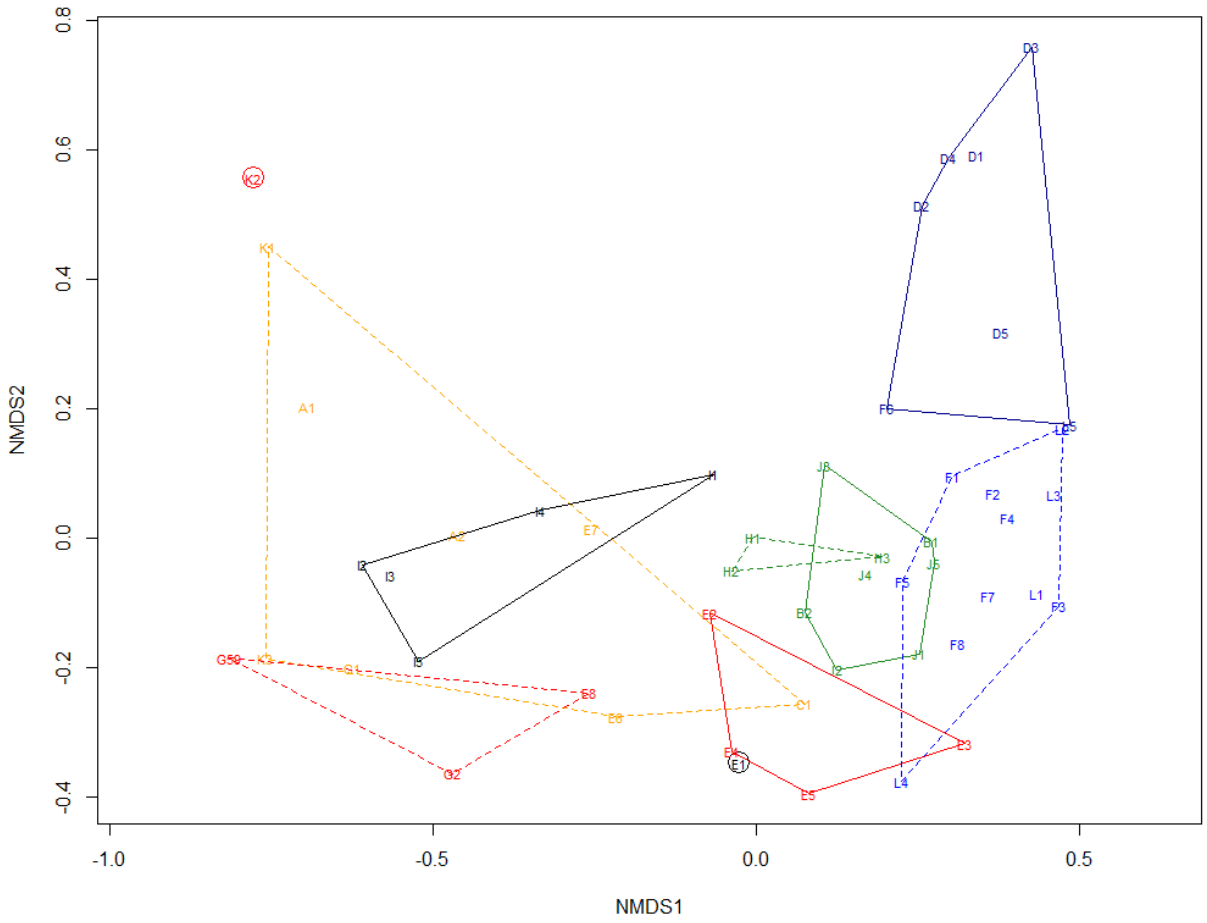

Figure 7. Results of ordination analysis of 50 plot samples for Wilson's Creek National Battlefield. Each letter/number combination represents a sampled plot. See text for interpretation of polygons.

Digital Imagery and Interpretation

Image objects created from merged imagery generally corresponded with land cover visible on the aerial photographs. Heads-up digitization resulted in 'cleaner' edges between vegetation types that were apparent on the photographs. Image objects that were less than 36 square meters in size were merged with adjacent objects. In addition, trails and roads were defined by buffering existing line files, then intersecting with the image objects.

Vegetation Map

Ten mapped types that corresponded to all identified current vegetation types, plus Developed Land, Water, and Crops were captured at WICR (Figure 8, Table 4). A total of about 1,975 acres (799 hectares) are within the accepted boundaries of WICR (Table 4). Most of the area (93%) is in semi-natural vegetation as opposed to developed. Of the semi-natural area, about half (911.7 acres, 369 ha or 46%) is open, half is woodland or forest (875 acres, 354 ha or 44.3%) and only 48 acres (19.4 ha), or 2.5%, is shrubland. Upland Deciduous Woodland and Forest covers 595 acres (240.8 ha), or 30.1% of WICR, whereas Non-native Ruderal Grassland covers 462 acres

(187 ha, or 23.3% of WICR). Open glades cover only 10.6 acres (4.3 ha) but are considered among the most important natural features of WICR. Different attempts to restore native grasses have been made over the past four or more decades, resulting in a great diversity of grassland types in the modern landscape. Only a minority, 48.7 acres (19.7 ha), or 5.3% of the herbaceous vegetation, is considered Restored Tallgrass Prairie based on current condition.

Accuracy Assessment

The 2012 accuracy assessment for WICR was limited to the 1,836 acres (743 hectares) of natural and semi-natural vegetation within the park boundary. A total of 160 points were required to accurately evaluate the ten natural vegetation map classes identified in the park (Table 4).

Navigational error (positional accuracy) of the GPS unit ranged from 1 – 5 m for the 160 accuracy assessment points. Spatial offset was required for 33 sites to ensure the entire plot was composed of a homogenous map class. The new gps coordinates for the offset were updated in both the project geodatabase as well as the tabular database.

Table 4. Mapped types identified at Wilson's Creek National Battlefield.

NVC Identifier	Mapped Type Name	Scientific Name / Description	Number of Polygons	Acres	Hectares
Forest and Woodland					
None assigned, but similar to CEGL005033	Bottomland Deciduous Woodland and Forest	*Acer negundo* Forest	32	190.77	77.2
CEGL002593	Eastern Redcedar Woodland and Forest	*Juniperus virginiana* Midwest Forest	29	69.88	28.28
None assigned, but similar to CEGL002426	Thin-soiled Eastern Redcedar Woodland	*Juniperus virginiana* Alkaline Bluff Woodland	20	19.92	8.06
None assigned, but similar to CEGL00207	Upland Deciduous Woodland and Forest	*Quercus alba* - *Quercus rubra* - *Quercus muehlenbergii* / *Cercis canadensis* Forest	69	594.91	240.76
Shrubland Vegetation					
None assigned	Manley Shrubland and Woodland	*Rhus* spp. - *Sassafras albidum* Mixed Shrubland and Woodland	4	43.66	17.67
None assigned	American Plum Shrubland	*Prunus americana* Shrubland	3	4.78	1.93
Herbaceous Vegetation					
None assigned, within Ecological System CES202.691	Glade	Central Interior Highlands Calcareous Glade and Barrens (CES202.691)	31	10.65	4.31
None assigned	Mixed Warm- and Cool-Season Grassland and Shrubland	Mixed Warm and Cool-Season Grassland and Shrubland	39	390.76	158.14

Table 4. Mapped types identified at Wilson's Creek National Battlefield (continued).

NVC Identifier	Common Name	Scientific Name / Description	Number of Polygons	Acres	Hectares
CEGL004048	Non-native Ruderal Grassland	*Schedonorus* (*phoenix*, *pratensis*) Herbaceous Vegetation	41	461.59	186.81
None assigned	Restored Tallgrass Prairie	*Andropogon gerardii* - *Sorghastrum nutans* Herbaceous Vegetation	4	48.74	19.73
Land Use/Land Cover					
Not applicable	Crop		11	64.2	25.98
Not applicable	Developed Land	buildings, parking lots, picnic areas, roads, trails	57	69.99	28.33
Not applicable	Water		39	5.81	2.35
Total Land Use/Land cover			107	140	56.66
Total Natural Vegetation			272	1,835.66	742.89
Totals			**379**	**1,975.66**	**799.55**

Overall accuracy of the final error matrix was 81.3% (the 90% confindence interval was between 75.7 and 86.9%) for the natural vegetation map classes at WICR (Appendix A). User's accuracy (commission accuracy) was below the 80% threshold for Mixed Warm and Cool-Season Grassland and Shrubland (79%), Restored Tallgrass Prairie (50%), and Upland Deciduous Woodland and Forest (79%). Conversely, five types had producer's accuracy (omission accuracy) below the 80% threshold for thematic accuracy (American Plum Shrubland, Bottomland Deciduous Woodland and Forest, Glade, Mixed Warm and Cool-Season Grassland and Ruderal Shrubland, and Restored Tallgrass Prairie, Appendix A). Of the 160 accuracy assessment points, 134 were assigned correctly. Kappa index, or the random chance polygons were assigned correctly, was 80.7%.

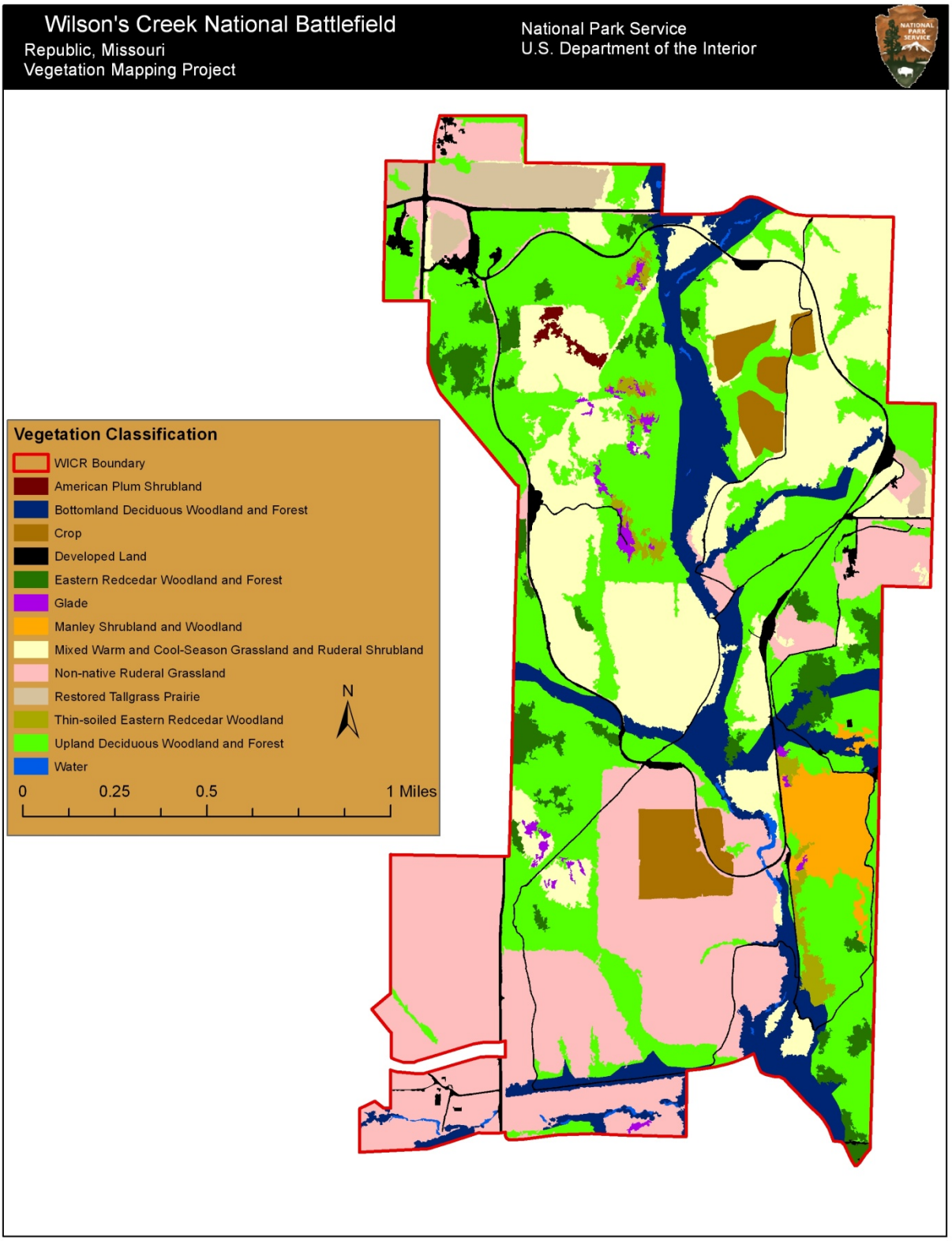

Figure 8. Vegetation map of Wilson's Creek National Battlefield.

Vegetation Associations

Mapped Type Name: American Plum Shrubland
Macrogroup: Eastern Ruderal Shrubland and Grassland (MG123)
Group: Eastern Ruderal Shrubland and Grassland (G059)
Association: None assigned
Type Common Name: American Plum Shrubland
Type Scientific Name: *Prunus americana* Shrubland

Figure 9. American Plum Shrubland at Wilson's Creek National Battlefield.

Global Summary: American plum (*Prunus americana*) is an early successional shrub or small tree that grows throughout the Midwest from North Dakota southeastward to the Carolinas (Figure 9). The species forms patches from root sprouts and thus often grows in nearly pure stands.

Environmental Description: At WICR, this type formed small patches, mainly along upland drainages within mowed grasslands.

Vegetation Description: American plum sometimes formed dense, low diversity stands sometimes >2 m tall. Other early successional shrubs such as coralberry (*Symphoricarpos orbiculatus*), Pennsylvania blackberry (*Rubus pensilvanicus*), winged sumac (*Rhus copallinum*), and the vine frost grape (*Vitis vulpina*) were often present. Common weedy species in the herbaceous layer included field brome (*Bromus arvensis*), Canadian horseweed (*Conyza canadensis*), Japanese honeysuckle (*Lonicera japonica*), and annual ragweed (*Ambrosia artemisiifolia*) (Table 5).

Most Abundant Species:

Table 5. Cover by layer and species for one plot taken within an American Plum Shrubland.

American Plum Shrubland		
Scientific Name	**Common Name**	**%Cover**
Tree		
Ulmus rubra	slippery elm	0.50
Shrub		
Prunus americana	American plum	87.25
Symphoricarpos orbiculatus	coralberry	62.50
Rubus pensilvanicus	Pennsylvania blackberry	37.50
Rhus copallinum	winged sumac	17.55
Vitis vulpina	frost grape	15.00
Toxicodendron radicans	eastern poison ivy	3.00
Rubus occidentalis	black raspberry	0.50
Herbaceous		
Bromus arvensis	field brome	15.00
Conyza canadensis	Canadian horseweed	15.00
Festuca subverticillata	nodding fescue	15.00
Lonicera japonica	Japanese honeysuckle	5.91
Ambrosia artemisiifolia	annual ragweed	0.50
Carex blanda	eastern woodland sedge	0.50
Chaerophyllum tainturieri	hairyfruit chervil	0.50
Galium aparine	stickywilly	0.50
Geum canadense	white avens	0.50

Table 5. Cover by layer and species for one plot taken within an American Plum Shrubland (continued).

Scientific Name	Common Name	%Cover
Lactuca canadensis	Canada lettuce	0.50
Lespedeza violacea .	violet lespedeza	0.50
Oxalis dillenii.	slender yellow woodsorrel	0.50
Poa sylvestris	woodland bluegrass	0.50
Scutellaria incana	hoary skullcap	0.50
Stellaria media	common chickweed	0.50
Torilis japonica	erect hedgeparsley	0.50
Triodanis perfoliata	clasping Venus' looking-glass	0.50

Mapped Type Name: Bottomland Deciduous Woodland and Forest
Macrogroup: Northern & Central Floodplain Forest & Scrub (MG039)
Group: Silver Maple – Green Ash – Sycamore – Hackberry Floodplain Forest Group(G040)
Association: None assigned, but similar to CEGL005033, *Acer negundo* Forest
Type Common Name: Box-elder Floodplain Forest
Type Scientific Name: *Acer negundo* Forest

Figure 10. Bottomland Deciduous Woodland and Forest at Wilson's Creek National Battlefield.

Global Summary: Boxelder (*Acer negundo*) is an early successional species and can be 'weedy' or can occur as a natural river-front dominant. As a natural type, it is found on floodplains in the southern, eastern, and Midwestern United States. Stands occur on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. Occurrences are mostly on higher floodplain terraces with less rocky soils which were used for agriculture or habitation. They are typically temporarily flooded in the spring. Characteristic associated species across the range may include sycamore (*Platanus occidentalis),* netleaf hackberry *(Celtis laevigata),* red maple *(Acer rubrum),* yellow poplar *(Liriodendron tulipifera),* sweetgum *(Liquidambar styraciflua*), silver maple *(Acer saccharinum),* slippery elm *(Ulmus rubra),* green ash *(Fraxinus pennsylvanica),* black walnut *(Juglans nigra),* and red mulberry *(Morus rubra)*. The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. The herb layer consists of a mixture of weedy exotics and native floodplain species (Figure 10).

Environmental Description: At WICR, this type occurred in moist floodplain soils along Wilson's Creek, and probably represents a disturbance/weedy expression of floodplain forest. Hydrology of Wilson's Creek may be influenced by upstream urbanization, which results in more frequent high volume flows than would have occurred in a natural landscape (Annis et al. 2011)

Vegetation Description: Boxelder together with white ash (*Fraxinus americana*), black walnut (*Juglans nigra*), common hackberry (*Celtis occidentalis*), and American elm (*Ulmus americana*) were the most frequent dominants of the overstory. Overstory cover was often rather sparse, and the shrub and herbaceous layers were well-developed. Common shrubs included Ohio buckeye (*Aesculus glabra*), coralberry (*Symphoricarpos orbiculatus*), Pennsylvania blackberry (*Rubus pensilvanicus*), and multiflora rose (*Rosa multiflora*). Vines were common, and included eastern poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), frost grape (*Vitis vulpina*), and bristly greenbrier (*Smilax tamnoides*). Virginia wildrye (*Elymus virginicus*) was an overwhelming dominant of the herbaceous layer, with a frequency in plots of 100% and average cover >55% (Table 6).

Most Abundant Species:

Table 6. Average cover (for plots where the species occurred) and frequency by layer and species for seven plots taken within Bottomland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown.

Bottomland Deciduous Woodland and Forest			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Fraxinus pennsylvanica	green ash	48.98	14.3%
Ulmus americana	American elm	15.85	57.1%
Acer negundo	boxelder	12.30	100.0%
Fraxinus americana	white ash	11.99	85.7%
Juglans nigra	black walnut	11.71	71.4%
Juniperus virginiana	eastern redcedar	7.46	42.9%
Celtis occidentalis	common hackberry	6.40	85.7%
Quercus muehlenbergii	chinkapin oak	5.64	42.9%
Gleditsia triacanthos L.	honeylocust	4.89	57.1%
Carya cordiformis	bitternut hickory	3.49	14.3%
Platanus occidentalis	American sycamore	3.49	14.3%
Quercus rubra	northern red oak	3.49	14.3%
Morus rubra	red mulberry	3.00	28.6%
Acer saccharinum	silver maple	3.00	14.3%
Ulmus pumila	Siberian elm	3.00	14.3%
Quercus macrocarpa	bur oak	1.99	28.6%
Prunus serotina	black cherry	1.33	42.9%
Ulmus rubra	slippery elm	0.50	28.6%

Table 6. Average cover (for plots where the species occurred) and frequency by layer and species for seven plots taken within Bottomland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Shrub			
Aesculus glabra	Ohio buckeye	30.27	14.3%
Rubus pensilvanicus	Pennsylvania blackberry	15.43	14.3%
Rosa multiflora	multiflora rose	12.40	57.1%
Symphoricarpos orbiculatus	coralberry	8.39	57.1%
Toxicodendron radicans	eastern poison ivy	4.99	71.4%
Cercis canadensis	eastern redbud	3.49	14.3%
Ribes missouriense	Missouri gooseberry	2.48	57.1%
Parthenocissus quinquefolia	Virginia creeper	2.33	42.9%
Smilax tamnoides	bristly greenbrier	1.25	57.1%
Vitis vulpina	frost grape	1.21	100.0%
Euonymus fortunei	winter creeper	0.50	28.6%
Lindera benzoin	northern spicebush	0.50	28.6%
Herbaceous			
Elymus virginicus	Virginia wildrye	55.71	100.0%
Laportea canadensis	Canadian woodnettle	42.50	71.4%
Verbesina alternifolia	wingstem	22.57	100.0%
Lonicera japonica	Japanese honeysuckle	16.49	28.6%
Impatiens sp.	touch-me-not	3.90	71.4%
Viola sororia Willd.	common blue violet	3.40	71.4%
Dichanthelium clandestinum	deertongue	3.00	14.3%
Hydrophyllum appendiculatum	great waterleaf	3.00	14.3%
Humulus lupulus	common hop	2.38	57.1%
Perilla frutescens	beefsteakplant	2.38	57.1%
Pilea pumila	Canadian clearweed	2.17	42.9%
Carex retroflexa	reflexed sedge	1.33	42.9%
Carex blanda	eastern woodland sedge	0.50	71.4%
Carex amphibola	eastern narrowleaf sedge	0.50	57.1%
Geum canadense	white avens	0.50	57.1%
Passiflora lutea	yellow passionflower	0.50	57.1%
Polygonum sp.	Knotweed species	0.50	57.1%
Ambrosia trifida	great ragweed	0.50	42.9%
Cryptotaenia canadensis	Canadian honewort	0.50	42.9%
Elephantopus carolinianus	Carolina elephantsfoot	0.50	42.9%
Galium aparine	stickywilly	0.50	42.9%

Table 6. Average cover (for plots where the species occurred) and frequency by layer and species for seven plots taken within Bottomland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Phytolacca americana	American pokeweed	0.50	42.9%
Rudbeckia laciniata.	cutleaf coneflower	0.50	42.9%
Asplenium platyneuron	ebony spleenwort	0.50	28.6%
Desmodium perplexum	perplexed ticktrefoil	0.50	28.6%
Festuca subverticillata	nodding fescue	0.50	28.6%
Poa sylvestris	woodland bluegrass	0.50	28.6%
Ruellia pedunculata	stalked wild petunia	0.50	28.6%
Ruellia strepens	limestone wild petunia	0.50	28.6%
Sanicula odorata	clustered blacksnakeroot	0.50	28.6%
Scutellaria incana	hoary skullcap	0.50	28.6%
Sicyos angulatus	oneseed bur cucumber	0.50	28.6%
Woodsia obtusa	bluntlobe cliff fern	0.50	28.6%
Ageratina altissima var. altissima	white snakeroot	0.50	14.3%
Alliaria petiolata	garlic mustard	0.50	14.3%
Ambrosia artemisiifolia	annual ragweed	0.50	14.3%
Arabis laevigata	smooth rockcress	0.50	14.3%
Aristolochia serpentaria	Virginia snakeroot	0.50	14.3%
Aristolochia tomentosa	woolly Dutchman's pipe	0.50	14.3%
Asarum canadense	Canadian wildginger	0.50	14.3%
Bidens aristosa	bearded beggarticks	0.50	14.3%
Botrychium virginianum	rattlesnake fern	0.50	14.3%
Bromus arvensis	field brome	0.50	14.3%
Bromus pubescens	hairy woodland brome	0.50	14.3%
Campsis radicans	trumpet creeper	0.50	14.3%
Carex scoparia	broom sedge	0.50	14.3%
Cirsium altissimum	tall thistle	0.50	14.3%
Conyza canadensis	Canadian horseweed	0.50	14.3%
Cynanchum laeve	honeyvine	0.50	14.3%
Dactylis glomerata	orchardgrass	0.50	14.3%
Daucus carota	Queen Anne's lace	0.50	14.3%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	14.3%
Erechtites hieraciifolia	American burnweed	0.50	14.3%
Erigeron annuus	eastern daisy fleabane	0.50	14.3%
Erigeron strigosus	prairie fleabane	0.50	14.3%
Lactuca canadensis	Canada lettuce	0.50	14.3%
Lactuca floridana	woodland lettuce	0.50	14.3%
Oxalis dillenii	slender yellow woodsorrel	0.50	14.3%

Table 6. Average cover (for plots where the species occurred) and frequency by layer and species for seven plots taken within Bottomland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Phlox divaricata	wild blue phlox	0.50	14.3%
Phryma leptostachya	American lopseed	0.50	14.3%
Physalis heterophylla	clammy groundcherry	0.50	14.3%
Polygonum scandens	climbing false buckwheat	0.50	14.3%
Polygonum virginianum	jumpseed	0.50	14.3%
Prenanthes altissima	tall rattlesnakeroot	0.50	14.3%
Rumex crispus	curly dock	0.50	14.3%
Solidago caesia	wreath goldenrod	0.50	14.3%
Stellaria media	common chickweed	0.50	14.3%
Torilis japonica	erect hedgeparsley	0.50	14.3%
Tridens flavus	purpletop tridens	0.50	14.3%
Trillium sessile	toadshade	0.50	14.3%
Triodanis perfoliata	clasping Venus' looking-glass	0.50	14.3%
Valerianella radiata	beaked cornsalad	0.50	14.3%
Verbesina helianthoides	gravelweed	0.50	14.3%
Vernonia baldwinii	Baldwin's ironweed	0.50	14.3%
Viola pubescens var. pubescens	downy yellow violet	0.50	14.3%
Polygonum sp.	Knotweed species	0.50	57.1%

Mapped Type Name: Eastern Redcedar Woodland and Forest
Macrogroup: Eastern North American Ruderal Forest and Plantation (MG013)
Group: North & Central Hardwood & Conifer Ruderal Forest Group (G030)
Association: CEGL002593
NVC Common Name: Eastern Redcedar Midwest Forest
NVC Scientific Name: *Juniperus viginiana* Midwest Forest

Figure 11. Eastern Redcedar Woodland and Forest at Wilson's Creek National Battlefield.

Global Summary: : Eastern redcedar (*Juniperus virginiana*) is a common native successional tree throughout the Midwest and eastern United States, ranging from South Dakota east through the Great Lakes states to the Atlantic Coast of New England, and south to northern Florida and eastern Texas. The species germinates and grows in full sun but not in the shade, and thus is a common pioneer tree in old crop fields (Figure 11). Where conditions are moist enough for taller deciduous trees to grow, stands of eastern redcedar are over-topped and replaced by more shade-tolerant species over time.

Environmental Description: At WICR, this type occured mainly as a successional type in former croplands.

Vegetation Description: Eastern redcedar often grew in dense, low-diversity stands where few other species share dominance. The shrub and herbaceous layers were often sparse. Common trees include black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), black walnut

(*Juglans nigra*), chinkapin oak (*Quercus muehlenbergii*), Osage orange (*Maclura pomifera*), and northern red oak (*Quercus rubra*). Coralberry (*Symphoricarpos orbiculatus*) was the most common shrub, and Virginia creeper (*Parthenocissus quinquefolia*) and multiflora rose (*Rosa multiflora*) the most common vines (Table 7).

Most Abundant Species:

Table 7. Average cover (for plots where the species occurred) by layer and species for seven plots taken within Eastern Redcedar Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown.

Eastern Redcedar Woodland and Forest			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Juniperus virginiana	eastern redcedar	61.72	100.0%
Quercus muehlenbergii	chinkapin oak	7.35	71.4%
Maclura pomifera	Osage orange	6.75	71.4%
Juglans nigra	black walnut	6.39	85.7%
Quercus rubra	northern red oak	5.69	71.4%
Ulmus rubra	slippery elm	4.13	57.1%
Prunus serotina	black cherry	3.43	100.0%
Quercus imbricaria	shingle oak	3.24	28.6%
Acer saccharinum	silver maple	3.00	14.3%
Sassafras albidum	sassafras	2.99	100.0%
Carya cordiformis	bitternut hickory	1.99	28.6%
Celtis occidentalis	common hackberry	1.90	85.7%
Fraxinus americana	white ash	1.66	85.7%
Ulmus americana	American elm	1.62	57.1%
Diospyros virginiana	common persimmon	0.87	57.1%
Acer negundo	boxelder	0.75	28.6%
Gleditsia triacanthos	honeylocust	0.67	42.9%
Quercus velutina	black oak	0.62	57.1%
Morus rubra	red mulberry	0.50	85.7%
Quercus stellata	post oak	0.50	71.4%
Shrub			
Symphoricarpos orbiculatus	coralberry	18.81	85.7%
Celastrus scandens	American bittersweet	15.00	14.3%
Prunus americana	American plum	6.32	42.9%
Rubus occidentalis	black raspberry	5.33	42.9%
Lindera benzoin	northern spicebush	3.49	14.3%
Rhus copallinum	winged sumac	3.21	28.6%
Parthenocissus quinquefolia	Virginia creeper	3.00	100.0%
Rosa multiflora	multiflora rose	2.99	85.7%
Vitis vulpina	frost grape	1.98	71.4%

Table 7. Average cover (for plots where the species occurred) by layer and species for seven plots taken within Eastern Redcedar Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Toxicodendron radicans	eastern poison ivy	1.60	71.4%
Ribes missouriense	Missouri gooseberry	1.00	85.7%
Viburnum rufidulum	rusty blackhaw	1.00	14.3%
Vitis aestivalis	summer grape	0.67	42.9%
Smilax tamnoides	bristly greenbrier	0.58	85.7%
Rubus pensilvanicus	Pennsylvania blackberry	0.50	42.9%
Sideroxylon lanuginosum	gum bully	0.50	42.9%
Cercis canadensis	eastern redbud	0.50	28.6%
Smilax bona-nox	saw greenbrier	0.50	28.6%
Herbaceous			
Lespedeza cuneata	sericea lespedeza	15.00	14.3%
Lonicera japonica	Japanese honeysuckle	6.45	71.4%
Carex retroflexa	reflexed sedge	1.75	85.7%
Lespedeza violacea	violet lespedeza	1.75	28.6%
Sanicula odorata	clustered blacksnakeroot	1.75	28.6%
Perilla frutescens	beefsteakplant	1.33	42.9%
Ageratina altissima var. altissima	white snakeroot	1.13	57.1%
Sanicula canadensis	Canadian blacksnakeroot	1.00	71.4%
Carex blanda	eastern woodland sedge	0.92	85.7%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	100.0%
Festuca subverticillata	nodding fescue	0.50	100.0%
Geum canadense	white avens	0.50	100.0%
Muhlenbergia sobolifera	rock muhly	0.50	100.0%
Phryma leptostachya	American lopseed	0.50	100.0%
Vernonia baldwinii	Baldwin's ironweed	0.50	100.0%
Asplenium platyneuron	ebony spleenwort	0.50	71.4%
Botrychium virginianum	rattlesnake fern	0.50	71.4%
Desmodium perplexum	perplexed ticktrefoil	0.50	71.4%
Dichanthelium malacophyllum	softleaf rosette grass	0.50	71.4%
Prunella vulgaris L.	common selfheal	0.50	71.4%
Viola sororia	common blue violet	0.50	71.4%
Ambrosia artemisiifolia L.	annual ragweed	0.50	57.1%
Carex amphibola	eastern narrowleaf sedge	0.50	57.1%
Galium aparine	stickywilly	0.50	57.1%
Galium circaezans	licorice bedstraw	0.50	57.1%
Lactuca canadensis	Canada lettuce	0.50	57.1%

Table 7. Average cover (for plots where the species occurred) by layer and species for seven plots taken within Eastern Redcedar Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Leucanthemum vulgare	oxeye daisy	0.50	57.1%
Poa sylvestris	woodland bluegrass	0.50	57.1%
Stellaria media	common chickweed	0.50	57.1%
Agrimonia pubescens	soft agrimony	0.50	42.9%
Anemone virginiana	tall thimbleweed	0.50	42.9%
Carex cephalophora	oval-leaf sedge	0.50	42.9%
Carex hirsutella	fuzzy wuzzy sedge	0.50	42.9%
Daucus carota	Queen Anne's lace	0.50	42.9%
Desmodium glutinosum	pointedleaf ticktrefoil	0.50	42.9%
Dichanthelium acuminatum var. fasciculatum	western panicgrass	0.50	42.9%
Dichanthelium clandestinum	deertongue	0.50	42.9%
Elephantopus carolinianus	Carolina elephantsfoot	0.50	42.9%
Elymus virginicus	Virginia wildrye	0.50	42.9%
Erigeron annuus.	eastern daisy fleabane	0.50	42.9%
Leersia virginica	whitegrass	0.50	42.9%
Parietaria pensylvanica	Pennsylvania pellitory	0.50	42.9%
Passiflora lutea	yellow passionflower	0.50	42.9%
Pilea pumila	Canadian clearweed	0.50	42.9%
Ranunculus recurvatus	blisterwort	0.50	42.9%
Rudbeckia hirta	blackeyed Susan	0.50	42.9%
Teucrium canadense	Canada germander	0.50	42.9%
Acalypha virginica	Virginia threeseed Mercury	0.50	28.6%
Amphicarpaea bracteata var. bracteata	American hogpeanut	0.50	28.6%
Asclepias quadrifolia	fourleaf milkweed	0.50	28.6%
Bromus pubescens	hairy woodland brome	0.50	28.6%
Cirsium altissimum (	tall thistle	0.50	28.6%
Conyza canadensis	Canadian horseweed	0.50	28.6%
Erigeron strigosus	prairie fleabane	0.50	28.6%
Hackelia virginiana	beggarslice	0.50	28.6%
Juncus tenuis	poverty rush	0.50	28.6%
Lactuca floridana	woodland lettuce	0.50	28.6%
Oxalis dillenii	slender yellow woodsorrel	0.50	28.6%
Panicum anceps	beaked panicgrass	0.50	28.6%
Polygonum virginianum	jumpseed	0.50	28.6%
Prenanthes altissima.	tall rattlesnakeroot	0.50	28.6%
Trifolium campestre	field clover	0.50	28.6%

Table 7. Average cover (for plots where the species occurred) by layer and species for seven plots taken within Eastern Redcedar Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Verbesina alternifolia	wingstem	0.50	28.6%

Mapped Type Name: Glade
Macrogroup: Northern & Central Alvar & Glade (M124)
Group: Northern & Central Alkaline Glade Group (G179)
Association: None assigned, within Ecological System CES202.691
Type Common Name: Glade
Type Scientific Name: Central Interior Highlands Calcareous Glade and Barrens (CES202.691)

Figure 12. Glade at Wilson's Creek National Battlefield.

Global Summary: This ecological system is found primarily in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions with scattered occurrences in northern

Missouri. It occurs were soils are shallow, often with exposed rock. The topography is often moderate to steeply sloping, and exposures tend to be southerly to westerly. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. These soils often dry out during the summer and autumn, and then become saturated during the winter and spring. Little bluestem (*Schizachyrium scoparium)* often dominates this system and is commonly associated with big bluestem (*Andropogon gerardii),* sideoats grama *(Bouteloua curtipendula)*, and calcium-loving plant species. Stunted woodlands primarily dominated by chinkapin oak (*Quercus muehlenbergii*) interspersed with eastern redcedar (*Juniperus virginiana)* occur on variable-depth-to-bedrock soils (Figure 12). Fire is the primary natural dynamic, and prescribed fires help manage this system by restricting woody growth and maintaining the more open glade structure.

Environmental Description: At WICR, this type formed small patches at several locations within the park. Soils were naturally shallow and of variable depth over limestone or dolomite, or in some instances, were eroded, forming glade-like, shallow-soil conditions.

Vegetation Description: Vegetation within glades was highly variable across short distances (several meters), mainly due to variation in soil depth. Recent management (e.g. juniper cutting and prescribed fire) also added to local variation. Cover was sparse overall, with exposed rock common. Common small trees included black walnut (*Juglans nigra*), common hackberry (*Celtis occidentalis*), and chinkapin oak (*Quercus muehlenbergii*). Fragrant sumac (*Rhus aromatica*) was a common shrub. The herbaceous layer was quite diverse overall, and common species included both weedy and native species, often at low cover. Species with at least 1% cover in three of five plots included sericea lespedeza (*Lespedeza cuneata*), limestone calamint (*Clinopodium arkansanum*), field clover (*Trifolium campestre*), composite dropseed (*Sporobolus compositus*), and tall thistle (*Cirsium altissimum*) (Table 8).

Most Abundant Species:

Table 8. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within the Glade vegetation type. Only species with at least 0.5% cover in at least two plots are shown.

Glade			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Celtis occidentalis	common hackberry	8.00	40.0%
Juglans nigra	black walnut	6.31	60.0%
Quercus muehlenbergii	chinkapin oak	3.45	40.0%
Juniperus virginiana	eastern redcedar	0.50	40.0%
Shrub			
Rhus aromatica	fragrant sumac	6.35	60.0%
Opuntia humifusa	Devil's-tongue	1.75	40.0%
Vitis aestivalis.	summer grape	1.00	20.0%
Parthenocissus quinquefolia	Virginia creeper	0.50	60.0%
Rhus copallinum	winged sumac	0.50	40.0%

Table 8. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within the Glade vegetation type. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Rubus pensilvanicus	Pennsylvania blackberry	0.50	40.0%
Symphoricarpos orbiculatus	coralberry	0.50	80.0%
Toxicodendron radicans	eastern poison ivy	0.50	40.0%
Vitis vulpina	frost grape	0.50	40.0%
Herbaceous			
Lespedeza cuneata	sericea lespedeza	26.00	60.0%
Vulpia octoflora (Walter) Rydb.	sixweeks fescue	15.00	20.0%
Clinopodium arkansanum	limestone calamint	13.67	60.0%
Trifolium campestre	field clover	10.80	100.0%
Bromus arvensis	field brome	10.17	60.0%
Sporobolus compositus var. compositus	composite dropseed	6.17	60.0%
Cirsium altissimum	tall thistle	5.33	60.0%
Festuca subverticillata	nodding fescue	3.00	20.0%
Fragaria virginiana	Virginia strawberry	3.00	20.0%
Torilis japonica	erect hedgeparsley	3.00	20.0%
Vernonia baldwinii	Baldwin's ironweed	3.00	20.0%
Ambrosia artemisiifolia	annual ragweed	1.75	40.0%
Bromus pubescens	hairy woodland brome	1.75	40.0%
Dichanthelium malacophyllum	softleaf rosette grass	1.75	40.0%
Verbascum thapsus	common mullein	1.75	40.0%
Leucanthemum vulgare	oxeye daisy	1.33	60.0%
Daucus carota	Queen Anne's lace	1.13	80.0%
Erigeron strigosus	prairie fleabane	1.13	80.0%
Andropogon gerardii	big bluestem	0.50	80.0%
Conyza canadensis	Canadian horseweed	0.50	80.0%
Tridens flavus	purpletop tridens	0.50	80.0%
Bouteloua curtipendula	sideoats grama	0.50	60.0%
Carex blanda	eastern woodland sedge	0.50	60.0%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	60.0%
Galium virgatum	southwestern bedstraw	0.50	60.0%
Passiflora lutea	yellow passionflower	0.50	60.0%
Plantago virginica	Virginia plantain	0.50	60.0%
Chaerophyllum tainturieri	hairyfruit chervil	0.50	40.0%
Coreopsis tinctoria	golden tickseed	0.50	40.0%
Croton monanthogynus	prairie tea	0.50	40.0%
Dianthus armeria	deptford pink	0.50	40.0%

Table 8. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within the Glade vegetation type. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Elymus virginicus	Virginia wildrye	0.50	40.0%
Erigeron annuus	eastern daisy fleabane	0.50	40.0%
Geranium carolinianum	Carolina geranium	0.50	40.0%
Hypericum sphaerocarpum	roundsheed St. Johnswort	0.50	40.0%
Lonicera japonica	Japanese honeysuckle	0.50	40.0%
Ruellia humilis	fringeleaf wild petunia	0.50	40.0%
Sedum pulchellum	widowscross	0.50	40.0%
Solidago hispida	hairy goldenrod	0.50	40.0%
Sorghastrum nutans	Indiangrass	0.50	40.0%
Teucrium canadense	Canada germander	0.50	40.0%

Mapped Type Name: Manley Shrubland and Woodland
Macrogroup: Eastern Ruderal Shrubland and Grassland (MG123)
Group: Eastern Ruderal Shrubland and Grassland (G059)
Association: None assigned
Type Common Name: Sumac – Sassafras Mixed Shrubland and Woodland
Type Scientific Name: *Rhus* spp. - *Sassafras albidum* Mixed Shrubland and Woodland

Figure 13. Manley Sparse Woodland and Shrubland at Wilson's Creek National Battlefield.

Global Summary: This type is a successional shrubland or open woodland that has developed after catastrophic disturbance to an upland deciduous forest (Figure 13). Similar communities occur throughout the Ozarks wherever a mature forest canopy is removed or thinned due to wind throw or timber management practices.

Environmental Description: At WICR, this type occured where windthrow had removed or greatly thinned an upland deciduous forest canopy. A tornado was responsible for much of the disturbance to this site, and National Park Service (Heartland Inventory and Monitoring Network) staff have documented impacts (Sasseen 2003). The site was gently sloping and most soils were deep and well-drained, although some shallower-soiled areas occurred near canyon rims.

Vegetation Description: Shrubs dominated most of this site, and tree canopy tends to be low and/or sparse. Taller trees that remained standing after the tornado often had small crowns due to wind damage. Sassafras (*Sassafras albidum*) was a common and often dominant small tree and shrub. Other frequent and important trees included common hackberry (*Celtis occidentalis*), American elm (*Ulmus americana*), chinkapin oak (*Quercus muehlenbergii*), black walnut (*Juglans nigra*), and black cherry (*Prunus serotina*). Important shrubs included coralberry (*Symphoricarpos orbiculatus*), winged sumac (*Rhus copallinum*), fragrant sumac (*Rhus aromatic*), Pennsylvania blackberry (*Rubus pensilvanicus*) and black raspberry (*Rubus occidentalis*). Eastern poison ivy (*Toxicodendron radicans*) was an important vine (Table 9).

Most Abundant Species:

Table 9. Average cover (for plots where the species occurred) by layer and species for four plots taken within Manley Sparse Woodland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown.

Manley Shrubland and Woodland			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Sassafras albidum	sassafras	11.45	75.0%
Ulmus rubra	slippery elm	8.21	50.0%
Celtis occidentalis	common hackberry	4.98	100.0%
Ulmus americana	American elm	4.26	75.0%
Quercus muehlenbergii	chinkapin oak	2.49	75.0%
Juglans nigra	black walnut	2.12	100.0%
Juniperus virginiana	eastern redcedar	1.75	50.0%
Prunus serotina	black cherry	1.37	100.0%
Carya cordiformis	bitternut hickory	1.00	25.0%
Quercus rubra	northern red oak	0.83	75.0%
Carya alba	mockernut hickory	0.75	50.0%
Morus rubra	red mulberry	0.67	75.0%
Quercus alba	white oak	0.50	75.0%
Gleditsia triacanthos	honeylocust	0.50	50.0%
Maclura pomifera	Osage orange	0.50	50.0%
Quercus stellata	post oak	0.50	50.0%

Table 9. Average cover (for plots where the species occurred) by layer and species for four plots taken within Manley Sparse Woodland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Shrub			
Rhus copallinum	winged sumac	41.27	75.0%
Rubus pensilvanicus	Pennsylvania blackberry	36.25	75.0%
Rhus aromatica	Fragrant Sumac	24.18	75.0%
Symphoricarpos orbiculatus	coralberry	20.20	100.0%
Rubus occidentalis	black raspberry	18.33	100.0%
Toxicodendron radicans	eastern poison ivy	15.00	25.0%
Ribes missouriense	Missouri gooseberry	10.52	50.0%
Lindera benzoin	northern spicebush	5.91	25.0%
Vitis vulpina	frost grape	2.64	75.0%
Smilax tamnoides	bristly greenbrier	2.60	100.0%
Parthenocissus quinquefolia	Virginia creeper	2.38	100.0%
Rhus glabra	smooth sumac	2.24	50.0%
Prunus americana	American plum	1.99	50.0%
Sideroxylon lanuginosum.	gum bully	1.33	75.0%
Vitis aestivalis	summer grape	1.00	25.0%
Viburnum rufidulum	rusty blackhaw	0.50	50.0%
Herbaceous			
Lonicera japonica	Japanese honeysuckle	46.88	25.0%
Muhlenbergia sobolifera	rock muhly	6.17	75.0%
Trifolium campestre	field clover	6.17	75.0%
Andropogon virginicus	broomsedge bluestem	3.00	25.0%
Desmodium cuspidatum	largebract ticktrefoil	3.00	25.0%
Elephantopus carolinianus	Carolina elephantsfoot	3.00	25.0%
Helianthus hirsutus	hairy sunflower	3.00	25.0%
Rubus flagellaris	northern dewberry	3.00	25.0%
Verbesina alternifolia	wingstem	3.00	25.0%
Amphicarpaea bracteata	American hogpeanut	2.17	75.0%
Carex retroflexa	reflexed sedge	1.75	50.0%
Torilis japonica	erect hedgeparsley	1.75	50.0%
Viola sororia	common blue violet	1.75	50.0%
Bromus arvensis	field brome	1.33	75.0%
Desmodium perplexum	perplexed ticktrefoil	1.33	75.0%
Passiflora lutea	yellow passionflower	0.75	50.0%
Ageratina altissima var. altissima	white snakeroot	0.50	75.0%
Conyza canadensis	Canadian horseweed	0.50	75.0%

Table 9. Average cover (for plots where the species occurred) by layer and species for four plots taken within Manley Sparse Woodland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Desmodium glutinosum	pointedleaf ticktrefoil	0.50	75.0%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	75.0%
Galium aparine	stickywilly	0.50	75.0%
Lespedeza procumbens	trailing lespedeza	0.50	75.0%
Vernonia baldwinii	Baldwin's ironweed	0.50	75.0%
Anemone virginiana	tall thimbleweed	0.50	50.0%
Bromus pubescens	hairy woodland brome	0.50	50.0%
Carex blanda	eastern woodland sedge	0.50	50.0%
Cirsium altissimum	tall thistle	0.50	50.0%
Dichanthelium clandestinum	deertongue	0.50	50.0%
Festuca subverticillata	nodding fescue	0.50	50.0%
Geum canadense	white avens	0.50	50.0%
Oxalis dillenii	slender yellow woodsorrel	0.50	50.0%
Podophyllum peltatum	mayapple	0.50	50.0%
Polygonum scandens	climbing false buckwheat	0.50	50.0%
Scutellaria incana	hoary skullcap	0.50	50.0%
Tridens flavus	purpletop tridens	0.50	50.0%
Triodanis perfoliata	clasping Venus' looking-glass	0.50	50.0%

Mapped Type Name: Mixed Warm- and Cool- Season Grassland and Shrubland
Macrogroup: Eastern Ruderal Shrubland and Grassland (MG123)
Group: Eastern Ruderal Shrubland and Grassland (G059)
Association: None assigned
Type Common Name: Mixed Warm- and Cool-Season Grassland and Shrubland
Type Scientific Name: Mixed Warm- and Cool-Season Grassland and Shrubland

Figure 14. Mixed Warm- and Cool-Season Grassland and Shrubland at Wilson's Creek National Battlefield.

Global Summary: Retired croplands that have been converted to open grassland are common in the Midwest, but no good inventories or mapping of grassland composition exists. Most old croplands that are current grassy have been managed to enhance livestock grazing, including establishment of non-native grasses, mainly tall fescue (*Schedonorus phoenix*) in this region (Figure 14). At WICR, efforts have been made to introduce native tallgrasses, and grazing by domestic livestock has not occurred. Thus, this type at WICR represents an uncommon land use and management treatment in the landscape.

Environmental Description: This type occurred on old croplands, mainly on rolling uplands. Higher, steeper areas tended to have more eroded soils, whereas soils were more fertile and less eroded in lower-lying areas.

Vegetation Description: This type was variable across years due to periodic mowing and prescribed fire. Grasses predominated the general aspect after mowing or burning, and shrubs grew up to overtop grasses over time, only to be removed again by mowing of fire. In addition,

past restoration efforts resulted in patchy establishment of planted native grasses. Thus, this type circumscribed a good deal of variation. In general, dominance was shared among non-native grasses such as tall fescue (*Schedonorus phoenix*) and field brome (*Bromus arvensis*) and native tall grasses such as big bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*). Other common herbaceous species included blackeyed Susan (*Rudbeckia hirta*), Canada goldenrod (*Solidago altissima*), sericea lespedeza (*Lespedeza cuneata*), and field clover (*Trifolium campestre*). Shrubs and vines were generally present. Important species included winged sumac (*Rhus copallinum*), eastern poison ivy (*Toxicodendron radicans*), Pennsylvania blackberry (*Rubus pensilvanicus*), and coralberry (*Symphoricarpos orbiculatus*). Tree cover was sparse, and black cherry (*Prunus serotina*) was the only species that occurred in at least half of the plots (Table 10).

Most Abundant Species:

Table 10. Average cover (for plots where the species occurred) and frequency by layer and species for eight plots taken within Mixed Warm- and Cool-Season Grassland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown.

Mixed Warm- and Cool- Season Grassland and Shrubland			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Prunus serotina	black cherry	8.62	50.0%
Platanus occidentalis	American sycamore	3.49	12.5%
Quercus rubra	northern red oak	3.00	12.5%
Sassafras albidum	sassafras	2.23	25.0%
Juniperus virginiana	eastern redcedar	1.99	25.0%
Quercus muehlenbergii	chinkapin oak	1.75	25.0%
Fraxinus americana	white ash	1.33	37.5%
Juglans nigra	black walnut	0.50	25.0%
Penstemon digitalis	foxglove beardtongue	0.50	25.0%
Shrub			
Prunus americana	American plum	42.79	25.0%
Rubus pensilvanicus	Pennsylvania blackberry	26.51	50.0%
Symphoricarpos orbiculatus	coralberry	18.16	50.0%
Rhus copallinum	winged sumac	11.57	75.0%
Toxicodendron radicans	eastern poison ivy	6.30	62.5%
Ribes missouriense	Missouri gooseberry	1.99	25.0%
Vitis vulpina	frost grape	0.62	50.0%
Parthenocissus quinquefolia	Virginia creeper	0.50	25.0%
Rhus glabra	smooth sumac	0.50	25.0%
Vitis aestivalis Michx.	summer grape	0.50	25.0%
Herbaceous			
Andropogon gerardii	big bluestem	25.25	50.0%
Solidago altissima	Canada goldenrod	19.00	25.0%

Table 10. Average cover (for plots where the species occurred) and frequency by layer and species for eight plots taken within Mixed Warm- and Cool-Season Grassland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Schedonorus phoenix	tall fescue	14.20	62.5%
Lespedeza cuneata	sericea lespedeza	12.83	37.5%
Sorghastrum nutans	Indiangrass	10.17	37.5%
Bromus arvensis	field brome	9.75	50.0%
Lonicera japonica	Japanese honeysuckle	9.46	25.0%
Schizachyrium scoparium	little bluestem	7.75	25.0%
Desmodium perplexum	perplexed ticktrefoil	5.33	37.5%
Dichanthelium malacophyllum (Nash) Gould	softleaf rosette grass	5.33	37.5%
Tridens flavus	purpletop tridens	5.33	37.5%
Rudbeckia hirta.	blackeyed susan	3.40	62.5%
Fragaria virginiana	Virginia strawberry	3.00	12.5%
Solidago nemoralis	gray goldenrod	3.00	12.5%
Sporobolus compositus var. compositus	composite dropseed	3.00	12.5%
Verbesina alternifolia	wingstem	3.00	12.5%
Trifolium campestre.	field clover	2.58	75.0%
Daucus carota	Queen Anne's lace	1.33	37.5%
Leucanthemum vulgare	oxeye daisy	1.33	37.5%
Conyza canadensis	Canadian horseweed	1.13	50.0%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	75.0%
Cirsium altissimum	tall thistle	0.50	62.5%
Plantago virginica	Virginia plantain	0.50	62.5%
Potentilla recta	sulphur cinquefoil	0.50	62.5%
Ambrosia artemisiifolia.	annual ragweed	0.50	50.0%
Carex blanda	eastern woodland sedge	0.50	50.0%
Triodanis perfoliata	clasping Venus' looking-glass	0.50	50.0%
Vernonia baldwinii	Baldwin's ironweed	0.50	50.0%
Dichanthelium clandestinum	deertongue	0.50	37.5%
Erigeron annuus	eastern daisy fleabane	0.50	37.5%
Geranium carolinianum	Carolina geranium	0.50	37.5%
Oxalis dillenii	slender yellow woodsorrel	0.50	37.5%
Passiflora lutea	yellow passionflower	0.50	37.5%
Poa chapmaniana	Chapman's bluegrass	0.50	37.5%
Solanum carolinense	Carolina horsenettle	0.50	37.5%
Torilis japonica	erect hedgeparsley	0.50	37.5%
Vernonia arkansana	Arkansas ironweed	0.50	37.5%
Vulpia octoflora	sixweeks fescue	0.50	37.5%

Table 10. Average cover (for plots where the species occurred) and frequency by layer and species for eight plots taken within Mixed Warm- and Cool-Season Grassland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Agrostis hyemalis	winter bentgrass	0.50	25.0%
Asclepias viridis	green antelopehorn	0.50	25.0%
Asplenium platyneuron	ebony spleenwort	0.50	25.0%
Brickellia eupatorioides	false boneset	0.50	25.0%
Carex cephalophora	oval-leaf sedge	0.50	25.0%
Cynanchum laeve	honeyvine	0.50	25.0%
Dianthus armeria	deptford pink	0.50	25.0%
Erechtites hieraciifolia	American burnweed	0.50	25.0%
Erigeron strigosus	prairie fleabane	0.50	25.0%
Euphorbia corollata	flowering spurge	0.50	25.0%
Galium virgatum	southwestern bedstraw	0.50	25.0%
Ipomoea pandurata	man of the earth	0.50	25.0%
Rumex crispus	curly dock	0.50	25.0%
Teucrium canadense	Canada germander	0.50	25.0%
Trifolium arvense	rabbitfoot clover	0.50	25.0%

Mapped Type Name: Non-native Ruderal Grassland
Macrogroup: Eastern Ruderal Shrubland and Grassland (MG123)
Group: Eastern Ruderal Shrubland and Grassland (G059)
Association: CEGL004048
NVC Common Name: (Tall Fescue, Meadow Fescue) Herbaceous Vegetation
NVC Scientific Name: *Schedonorus* (*phoenix, pratensis*) Herbaceous Vegetation

Figure 15. Non-native Ruderal Grassland at Wilson's Creek National Battlefield.

Global Summary: This association occurs throughout the Midwest, and includes grassland pastures and hayfields, more-or-less cultural, though sometimes no longer actively maintained. The dominant species in this type are the European "tall or meadow fescues" of uncertain and controversial generic placement. Several other exotic grasses including (*Agrostis gigantea),* orchardgrass *(Dactylis glomerata),* common velvetgrass (*Holcus lanatus),* timothy (*Phleum pratense)*, and Kentucky bluegrass (*Poa pratensis),* for example are common associates. These communities are sometimes nearly monospecific but can also be very diverse and contain many native as well as exotic species of grasses, sedges, and forbs. Exotic forbs include the legumes sericea lespedeza (*Lespedeza cuneata),* field clover (*Trifolium campestre),* alsike clover (*Trifolium hybridum),* red clover (*Trifolium pratense)*, and white clover (*Trifolium repens)*, as well as common yarrow (*Achillea millefolium),* hedge false bindweed (*Calystegia sepium),* Queen Anne's lace *(Daucus carota),* oxeye daisy (*Leucanthemum vulgare),* common yellow oxalis (*Oxalis stricta)*, and narrowleaf plantain (*Plantago lanceolata)*. Common native herbs include Indianhemp (*Apocynum cannabinum),* hoary ticktrefoil (*Desmodium canescens),* deertongue (*Dichanthelium clandestinum),* eastern daisy fleabane (*Erigeron annuus),* Virginia strawberry (*Fragaria virginiana),* common cinquefoil (*Potentilla simplex),* Carolina horsenettle (*Solanum carolinense),* Canada goldenrod (*Solidago canadensis)*, and yellow crownbeard (*Verbesina occidentalis*) (Figure 15). This vegetation is currently defined for the central and southern Appalachians, Ozarks, Ouachita Mountains, and parts of the Piedmont and Interior Low Plateau, but it is possible throughout much of the eastern United States and southern Canada.

Environmental Description: At WICR, this type occurred in retired cropland that was planted to tall fescue (*Schedonorus phoenix*), where no attempts to re-establish native grasses have been made.

Vegetation Description: This type consisted of open grassland with only a few shrubs and trees. Weedy and non-native species are dominant, including tall fescue (*Schedonorus phoenix*), Canadian horseweed (*Conyza canadensis*), Queen Anne's lace (*Daucus carota*), field clover (*Trifolium campestre*), and prairie fleabane (*Erigeron strigosus*). Shrubs and vines that occurred in two of the three plots included coral berry (*Symphoricarpos orbiculatus*), Pennsylvania blackberry (*Rubus pensilvanicus*), winged sumac (*Rhus copallinum*), frost grape (*Vitis vulpina*), and smooth sumac (*Rhus glabra*) (Table 11).

Most Abundant Species:

Table 11. Average cover (for plots where the species occurred) and frequency by layer and species for three plots taken within Non-native Ruderal Grassland. Only species with at least 0.5% cover in at least two plots are shown.

Non-native Ruderal Grassland			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Gleditsia triacanthos	honeylocust	15.00	33.3%
Maclura pomifera	Osage orange	15.00	33.3%
Diospyros virginiana	common persimmon	0.50	33.3%
Juniperus virginiana	eastern redcedar	0.50	33.3%
Prunus serotina	black cherry	0.50	33.3%
Shrub			
Symphoricarpos orbiculatus	coralberry	9.00	66.7%
Rosa multiflora	multiflora rose	3.49	33.3%
Rubus pensilvanicus	Pennsylvania blackberry	3.00	66.7%
Toxicodendron radicans	eastern poison ivy	3.00	33.3%
Rhus copallinum	winged sumac	1.99	66.7%
Vitis vulpina	frost grape	0.75	66.7%
Rhus glabra	smooth sumac	0.50	66.7%
Rubus occidentalis	black raspberry	0.50	33.3%
Herbaceous			
Conyza canadensis	Canadian horseweed	31.50	66.7%
Daucus carota	Queen Anne's lace	22.83	100.0%
Schedonorus phoenix	tall fescue	12.83	100.0%
Trifolium campestre	field clover	11.00	100.0%
Erigeron strigosus	prairie fleabane	9.00	66.7%
Brickellia eupatorioides	false boneset	3.00	33.3%
Bromus arvensis	field brome	3.00	66.7%
Erigeron annuus	eastern daisy fleabane	3.00	33.3%

Table 11. Average cover (for plots where the species occurred) and frequency by layer and species for three plots taken within Non-native Ruderal Grassland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Leucanthemum vulgare	oxeye daisy	3.00	66.7%
Vulpia octoflora	Sixweeks fescue	3.00	33.3%
Desmodium perplexum	perplexed ticktrefoil	2.17	100.0%
Lespedeza cuneata	Sericea lespedeza	1.75	66.7%
Achillea millefolium	Common Yarrow	0.50	33.3%
Ageratina altissima var. altissima	white snakeroot	0.50	33.3%
Andropogon virginicus	broomsedge bluestem	0.50	100.0%
Asclepias quadrifolia	fourleaf milkweed	0.50	33.3%
Carex blanda	eastern woodland sedge	0.50	33.3%
Carex bushii	Bush's Sedge	0.50	33.3%
Cirsium altissimum	tall thistle	0.50	66.7%
Desmodium marilandicum	smooth small-leaf ticktrefoil	0.50	33.3%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	33.3%
Dianthus armeria	deptford pink	0.50	33.3%
Dichanthelium acuminatum var. fasciculatum	western panicgrass	0.50	33.3%
Dichanthelium malacophyllum	softleaf rosette grass	0.50	100.0%
Elephantopus carolinianus	Carolina elephantsfoot	0.50	33.3%
Galium virgatum	southwestern bedstraw	0.50	66.7%
Lonicera japonica	Japanese honeysuckle	0.50	33.3%
Monarda fistulosa	wild bergamot	0.50	33.3%
Plantago virginica	Virginia plantain	0.50	66.7%
Poa annua	annual bluegrass	0.50	33.3%
Rudbeckia hirta	blackeyed susan	0.50	66.7%
Scutellaria incana	hoary skullcap	0.50	33.3%
Solanum carolinense	Carolina horsenettle	0.50	33.3%
Solidago caesia	wreath goldenrod	0.50	33.3%
Teucrium canadense	Canada germander	0.50	66.7%
Torilis japonica	erect hedgeparsley	0.50	33.3%
Tragopogon dubius	yellow salsify	0.50	33.3%
Tridens flavus	purpletop tridens	0.50	33.3%
Vernonia baldwinii	Baldwin's ironweed	0.50	66.7%

Mapped Type Name: Restored Tallgrass Prairie
Macrogroup: Planted to replicate – Great Plains Tallgrass Prairie, Savanna & Shrubland (MG054)
Group: Planted to replicate – Central Great Plains Tallgrass Prairie Group (G333)
Association: None assigned
Type Common Name: Big Bluestem – Indiangrass Herbaceous Vegetation
Type Scientific Name: *Andropogon gerardii – Sorghastrum nutans* Herbaceous Vegetation

Figure 16. Restored Tallgrass Prairie at Wilson's Creek National Battlefield.

Global Summary: Efforts to restore tallgrass prairie have been made throughout the range of this type in the Midwest. Native tall grasses are planted from seed, and some native forbs may also be present in seed mixes. Both native and non-native grasses and forbs may volunteer in.

Efforts are often on-going and uneven, with managers adding native forbs or grasses in an ad hoc fashion. The general aspect of restorations is of a tallgrass prairie with the flowering culms of visual dominants often reaching 2 m tall, but prairie forbs are often lacking or may be present in novel proportions (Figure 16). Weedy shrubs and vines such as blackberry (*Rubus* spp.) and sumac (*Rhus* spp.) are nearly always present in prairie restorations.

Environmental Description: At WICR, prairie restorations with good results (e.g. a predominance of native tall grasses dominant) occurred in a few fairly well-defined areas.

Vegetation Description: This type was often patchy and variable, but big bluestem (*Andropogon gerardii*) was the most common dominant, and sometimes occurred in low diversity stands. Little bluestem (*Schizachyrium scoparium*) and Indiangrass (*Sorghastrum nutans*) were important. Canada goldenrod (*Solidago altissima*) was dominant in some patches. Visually prominent prairie forbs included pale purple coneflower (*Echinacea pallida*), compassplant (*Silphium laciniatum*), and prairie rosinweed (*Silphium terebinthinaceum*). Shrubs and trees occurred sparingly in this type (Table 12).

Most Abundant Species:

Table 12. Percent cover for species found in one plot sampled for Restored Tallgrass Prairie.

Restored Tallgrass Prairie		
Scientific Name	**Common Name**	**%Cover**
Herbaceous		
Solidago altissima	Canada goldenrod	85.00
Andropogon gerardii	big bluestem	15.00
Rudbeckia triloba	browneyed susan	3.00
Allium vineale	wild garlic	0.50
Conyza canadensis	Canadian horseweed	0.50
Echinacea pallida	pale purple coneflower	0.50
Elymus virginicus	Virginia wildrye	0.50
Erigeron annuus	eastern daisy fleabane	0.50
Geranium carolinianum	Carolina geranium	0.50
Melilotus officinalis	sweetclover	0.50
Monarda fistulosa	wild bergamot	0.50
Parthenium integrifolium	wild quinine	0.50
Penstemon digitalis	foxglove beardtongue	0.50
Rumex crispus	curly dock	0.50
Silphium laciniatum	compassplant	0.50
Silphium terebinthinaceum	prairie rosinweed	0.50
Solanum carolinense	Carolina horsenettle	0.50
Trifolium campestre	field clover	0.50
Triodanis perfoliata	clasping Venus' looking-glass	0.50

Mapped Type Name: Thin-Soiled Eastern Redcedar Woodland
Macrogroup: South-Central Oak – Hardwood & Pine Forest (MG016)
Group: *Quercus muehlenbergii – Quercus shumardii – Fraxinus quadrangulata* Forest Group (G601)
Association: None assigned but similar to CEGL002426 *Juniperus virginiana* Alkaline Bluff Woodland
Type Common Name: Eastern Redcedar Alkaline Bluff Woodland
Type Scientific Name: *Juniperus virginiana* Alkaline Bluff Woodland

Figure 17. Thin-Soiled Eastern Redcedar Woodland at Wilson's Creek National Battlefield.

Global Summary: This type occurs as small patches on bluff tops in the Ozarks. Composition may also be similar in communities that occur over thin soils associated with glades that have not undergone regular burning. Associated species along bluffs include chinkapin oak (*Quercus muehlenbergii*) and ash (*Fraxinus* spp.). Ground vegetation dominants include little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), and sideoats grama (*Bouteloua curtipendula*). Dry oak woodlands may be invaded by eastern redcedar (*Juniperus virginiana*) and for communities of similar composition on deeper soils (Figure 17).

Environmental Description: At WICR, this type occurred as a narrow strip along a bluff top in the southeastern portion of the park, and was also associated with thin soils near open glades. The glade expression of this type may be the result of invasion of eastern redcedar into former openings, but eastern redcedar is a natural component of glade complexes.

Vegetation Description: Eastern redcedar may form low-diversity, nearly closed-canopy stands, or may occur together with deciduous trees and shrubs. The ground layer was generally sparse. Trees that occurred in all three of the plots representing this type included black walnut (*Juglans nigra*), chinkapin oak (*Quercus muehlenbergii*), northern red oak (*Quercus rubra*), and common hackberry (*Celtis occidentalis*). Shrubs and vines that occurred in all plots included Virginia creeper (*Parthenocissus quinquefolia*), coralberry (*Symphoricarpos orbiculatus*), fragrant sumac (*Rhus aromatic*), Missouri gooseberry (*Ribes missouriensis*), frost grape (V*itis vulpina*), and gum bully (*Sideroxylon lanuginosum*). Field brome (*Bromus arvensis*), field clover (*Trifolium campestre*), broomsedge (*Andropogon virginicus*), and Queen Anne's lace (*Daucus carota*) were common herbaceous components (Table 13).

Most Abundant Species:

Table 13. Average cover (for plots where the species occurred) and frequency by layer and species for three plots within the Thin-Soiled Eastern Redcedar Woodland. Only species with at least 0.5% cover in at least two plots are shown.

Thin-soiled Eastern Redcedar Woodland			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Juniperus virginiana	eastern redcedar	78.57	100.0%
Juglans nigra	black walnut	18.76	100.0%
Quercus muehlenbergii	chinkapin oak	9.09	100.0%
Quercus rubra	northern red oak	6.35	100.0%
Fraxinus americana	white ash	3.49	33.3%
Ulmus americana	American elm	3.45	66.7%
Celtis occidentalis	common hackberry	2.47	100.0%
Maclura pomifera	Osage orange	1.75	66.7%
Celtis tenuifolia	dwarf hackberry	1.00	33.3%
Gleditsia triacanthos	honeylocust	1.00	33.3%
Quercus stellata	post oak	0.50	66.7%
Ulmus rubra	slippery elm	0.50	66.7%
Carya texana	black hickory	0.50	33.3%
Diospyros virginiana	common persimmon	0.50	33.3%
Elaeagnus umbellata	autumn olive	0.50	33.3%
Prunus serotina.	black cherry	0.50	33.3%
Quercus velutina	black oak	0.50	33.3%
Shrub			
Viburnum rufidulum	rusty blackhaw	3.49	33.3%
Parthenocissus quinquefolia	Virginia creeper	2.49	100.0%
Symphoricarpos orbiculatus	coralberry	2.33	100.0%
Smilax tamnoides	bristly greenbrier	2.24	66.7%
Rhus aromatica	fragrant sumac	1.66	100.0%
Ribes missouriense	Missouri gooseberry	1.50	100.0%

Table 13. Average cover (for plots where the species occurred) and frequency by layer and species for three plots within the Thin-Soiled Eastern Redcedar Woodland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Vitis vulpina.	frost grape	1.33	100.0%
Sideroxylon lanuginosum	gum bully	0.50	100.0%
Rubus occidentalis	black raspberry	0.50	66.7%
Celastrus scandens	American bittersweet	0.50	33.3%
Euonymus atropurpureus	burningbush	0.50	33.3%
Frangula caroliniana	Carolina buckthorn	0.50	33.3%
Opuntia humifusa	Devil's-tongue	0.50	33.3%
Prunus americana	American plum	0.50	33.3%
Rosa multiflora.	multiflora rose	0.50	33.3%
Smilax bona-nox.	saw greenbrier	0.50	33.3%
Toxicodendron radicans	eastern poison ivy	0.50	33.3%
Ulmus alata	winged elm	0.50	33.3%
Vitis aestivalis	summer grape	0.50	33.3%
Herbaceous			
Bromus arvensis	field brome	3.00	66.7%
Trifolium campestre	field clover	3.00	66.7%
Muhlenbergia sobolifera	rock muhly	3.00	33.3%
Verbesina alternifolia	wingstem	3.00	33.3%
Andropogon virginicus	broomsedge bluestem	1.75	66.7%
Daucus carota	Queen Anne's lace	1.75	66.7%
Lespedeza violacea	violet lespedeza	1.75	66.7%
Desmodium perplexum.	perplexed ticktrefoil	1.33	100.0%
Bromus pubescens	hairy woodland brome	0.50	100.0%
Cirsium altissimum	tall thistle	0.50	100.0%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	100.0%
Dichanthelium malacophyllum	softleaf rosette grass	0.50	100.0%
Elymus virginicus	Virginia wildrye	0.50	100.0%
Erythronium albidum	white fawnlily	0.50	100.0%
Glandularia canadensis	rose mock vervain	0.50	100.0%
Sanicula canadensis	Canadian blacksnakeroot	0.50	100.0%
Tridens flavus.	purpletop tridens	0.50	100.0%
Vernonia baldwinii Torr.	Baldwin's ironweed	0.50	100.0%
Ageratina altissima	white snakeroot	0.50	66.7%
Ambrosia artemisiifolia	annual ragweed	0.50	66.7%
Aristolochia serpentaria	Virginia snakeroot	0.50	66.7%
Asplenium platyneuron	ebony spleenwort	0.50	66.7%

Table 13. Average cover (for plots where the species occurred) and frequency by layer and species for three plots within the Thin-Soiled Eastern Redcedar Woodland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Carex amphibola	eastern narrowleaf sedge	0.50	66.7%
Carex blanda	eastern woodland sedge	0.50	66.7%
Elephantopus carolinianus	Carolina elephantsfoot	0.50	66.7%
Erigeron strigosus	prairie fleabane	0.50	66.7%
Festuca subverticillata	nodding fescue	0.50	66.7%
Galium circaezans	licorice bedstraw	0.50	66.7%
Lespedeza cuneata	sericea lespedeza	0.50	66.7%
Plantago virginica	Virginia plantain	0.50	66.7%
Potentilla recta	sulphur cinquefoil	0.50	66.7%
Prenanthes altissima	tall rattlesnakeroot	0.50	66.7%
Rudbeckia hirta	blackeyed susan	0.50	66.7%
Sedum pulchellum.	widowscross	0.50	66.7%
Stellaria media	common chickweed	0.50	66.7%
Viola sororia	common blue violet	0.50	66.7%
Ambrosia trifida.	great ragweed	0.50	33.3%
Andropogon gerardii	big bluestem	0.50	33.3%
Anemone virginiana	tall thimbleweed	0.50	33.3%
Aristolochia tomentosa	woolly Dutchman's pipe	0.50	33.3%
Bidens bipinnata	spanish needles	0.50	33.3%
Botrychium virginianum	rattlesnake fern	0.50	33.3%
Bouteloua curtipendula	sideoats grama	0.50	33.3%
Bromus tectorum	cheatgrass	0.50	33.3%
Campanulastrum americanum	American bellflower	0.50	33.3%
Carex cephalophora	oval-leaf sedge	0.50	33.3%
Carex retroflexa	reflexed sedge	0.50	33.3%
Dianthus armeria	deptford pink	0.50	33.3%
Dichanthelium commutatum	variable panicgrass	0.50	33.3%
Erigeron annuus	eastern daisy fleabane	0.50	33.3%
Gamochaeta purpurea	spoonleaf purple everlasting	0.50	33.3%
Geum canadense	white avens	0.50	33.3%
Hedeoma pulegioides	American false pennyroyal	0.50	33.3%
Helianthus hirsutus	hairy sunflower	0.50	33.3%
Hieracium gronovii	Queen Devil	0.50	33.3%
Hypericum hypericoides ssp. hypericoides	St. Andrew's cross	0.50	33.3%
Lactuca floridana	woodland lettuce	0.50	33.3%
Lespedeza procumbens	trailing lespedeza	0.50	33.3%
Lesquerella filiformis	limestoneglade bladderpod	0.50	33.3%

Table 13. Average cover (for plots where the species occurred) and frequency by layer and species for three plots within the Thin-Soiled Eastern Redcedar Woodland. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Leucanthemum vulgare	oxeye daisy	0.50	33.3%
Lonicera japonica	Japanese honeysuckle	0.50	33.3%
Oxalis dillenii	slender yellow woodsorrel	0.50	33.3%
Passiflora lutea	yellow passionflower	0.50	33.3%
Pellaea atropurpurea	purple cliffbrake	0.50	33.3%
Phryma leptostachya	American lopseed	0.50	33.3%
Podophyllum peltatum	mayapple	0.50	33.3%
Rubus flagellaris	northern dewberry	0.50	33.3%
Ruellia humilis	fringeleaf wild petunia	0.50	33.3%
Ruellia pedunculata	stalked wild petunia	0.50	33.3%
Scutellaria parvula	small skullcap	0.50	33.3%
Sisyrinchium angustifolium	narrowleaf blue-eyed grass	0.50	33.3%
Solidago ulmifolia	elmleaf goldenrod	0.50	33.3%
Teucrium canadense	Canada germander	0.50	33.3%
Torilis japonica	erect hedgeparsley	0.50	33.3%
Tragia betonicifolia	betonyleaf noseburn	0.50	33.3%
Triodanis perfoliata	clasping Venus' looking-glass	0.50	33.3%
Triosteum perfoliatum.	feverwort	0.50	33.3%

Mapped Type Name: Upland Deciduous Woodland and Forest
Macrogroup: South-Central Oak – Hardwood & Pine Forest (MG016)
Group: South-Central Interior Oak Forest Group (G159)
Association: None assigned but similar to CEGL002070 *Quercus alba – Quercus rubra – Quercus muehlenbergii / Cercis canadensis* Forest
Type Common Name: White Oak – Red Oak – Chinkapin Oak / Eastern Redbud Forest
Type Scientific Name: *Quercus alba* - *Quercus rubra* - *Quercus muehlenbergii* / *Cercis canadensis* Forest

Figure 18. Upland Deciduous Woodland and Forest at Wilson's Creek National Battlefield.

Global Summary: This dry-mesic white oak - mixed oak alkaline forest community is found in unglaciated areas of the Interior Highlands of the east-central United States. Stands occur on gentle to steep slopes with moderately to well-drained moist loamy/sandy, relatively neutral to basic soils, which are underlain by bedrock of limestone and less commonly sandstone, siltstone, or shale. Soils may be shallow to somewhat deep (20-100 cm), with rock fragments present. The canopy is dense, yet enough scattered light penetrates to encourage a rich and diverse herbaceous layer, especially in the spring. Typical tree dominants include white oak (*Quercus alba),* northern red oak (*Quercus rubra),* black oak (*Quercus velutina)*, and chinkapin oak (*Quercus muehlenbergii)*. Typical associates include shagbark hickory (*Carya ovata),* mockernut hickory (*Carya alba)*, and tuliptree (*Liriodendron tulipifera)*. Other shade-tolerant tree associates that may dominate the subcanopy include sugar maple (*Acer saccharum)* (or possibly southern sugar maple (*Acer barbatum)* to the south), slippery elm (*Ulmus rubra),* black walnut (*Juglans nigra),* white ash (*Fraxinus americana),* hophornbeam (*Ostrya virginiana),* American hornbeam (*Carpinus caroliniana)*, and American serviceberry (*Amelanchier arborea)*.

Chinkapin oak (*Quercus muehlenbergii)* is a key, but perhaps uncommon, indicator of the more neutral to alkaline soil characteristics of this type. Typical shrubs include Ohio buckeye (*Aesculus glabra),* pawpaw (*Asimina triloba),* eastern redbud (*Cercis canadensis),* flowering dogwood (*Cornus florida),* bursting-heart *(Euonymus americanus),* Carolina buckthorn (*Frangula caroliniana)*, and rusty haw (*Viburnum rufidulum)*. Woody vines include Virginia creeper (*Parthenocissus quinquefolia)* and poison ivy (*Toxicodendron radicans)*. Herbaceous species include tall thimbleweed (*Anemone virginiana),* Jack-in-the-pulpit (*Arisaema triphyllum),* rattlesnake fern *(Botrychium virginianum),* James' sedge (*Carex jamesii),* black bugbane (*Actaea racemosa= Cimicifuga racemosa),* pointedleaf ticktrefoil (*Desmodium glutinosum),* prostrate ticktrefoil (*Desmodium rotundifolium),* fourleaf yam (*Dioscorea quaternata),* downy rattlesnake plantain (*Goodyera pubescens),* eastern greenviolet (*Hybanthus concolor),* dwarf crested iris (*Iris cristata),* feathery false lily of the valley (*Maianthemum racemosum),* yellow passionflower (*Passiflora lutea)*, and Canadian blacksnakeroot (*Sanicula canadensis)*. These forests occur in habitats transitional between mesic to wet riparian and floodplain communities and the drier ridgetop ecosystems (Figure 18).

Environmental Description: At WICR, this type occurred in uplands on flats, rolling hills, and occasionally steep slopes. Abiotic sites ranged from fairly dry to fairly moist, but essentially all areas of this type were disturbed, and the communities were variable across short distances.

Vegetation Description: Northern red oak (*Quercus rubra*), common hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), and chinkapin oak (*Quercus muehlenbergii*) were the most common dominant canopy trees of this type. A common early successional, and possibly introduced species, Osage orange (*Maclura pomifera*), was among the dominants in more than half of the plots representing this type. Two hickories, shagbark and bitternut (*Carya ovata* and *C. cordiformis*), were important in many stands. Coralberry (*Symphoricarpos orbiculatus*) and Missouri gooseberry (*Ribes missouriense*) occurred in all plots. Virginia creeper (*Parthenocissus quinquefolia*), frost grape (*Vitis vulpina*), and bristly greenbrier (*Smilax tamnoides*) were common vines. The herbaceous layer was typically sparse, and Virginia wildrye (*Elymus virginicus*) was the most common dominant grass (Table 14).

Most Abundant Species:

Table 14. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within Upland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown.

Upland Deciduous Woodland and Forest			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Quercus rubra	northern red oak	16.10	90.9%
Maclura pomifera	Osage orange	14.53	54.5%
Carya ovata	shagbark hickory	14.16	36.4%
Celtis occidentalis	common hackberry	11.17	100.0%
Juglans nigra	black walnut	10.95	100.0%
Quercus alba	white alba	9.00	36.4%
Fraxinus americana	white ash	7.31	54.5%

Table 14. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within Upland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Carya cordiformis	bitternut hickory	7.13	63.6%
Quercus muehlenbergii	chinkapin oak	6.93	100.0%
Ulmus americana	American elm	4.77	63.6%
Carya texana	black hickory	4.69	18.2%
Sassafras albidum	sassafras	4.59	45.5%
Ulmus rubra	slippery elm	3.29	54.5%
Morus rubra	red mulberry	3.05	72.7%
Quercus macrocarpa	bur oak	3.00	9.1%
Carya alba	mockernut hickory	2.86	36.4%
Diospyros virginiana.	common persimmon	1.99	18.2%
Juniperus virginiana	eastern redcedar	1.99	63.6%
Gleditsia triacanthos.	honeylocust	1.37	36.4%
Prunus serotina	black cherry	0.75	54.5%
Quercus velutina	black oak	0.67	27.3%
Quercus stellata	post oak	0.50	27.3%
Acer negundo	boxelder	0.50	18.2%
Shrub			
Symphoricarpos orbiculatus	coralberry	41.08	100.0%
Lindera benzoin	northern spicebush	23.69	18.2%
Ribes missouriense	Missouri gooseberry	20.19	100.0%
Rubus pensilvanicus	Pennsylvania blackberry	16.79	27.3%
Aesculus glabra	Ohio buckeye	11.75	18.2%
Ostrya virginiana	hophornbeam	9.91	18.2%
Rhus aromatica	fragrant sumac	6.88	63.6%
Rubus occidentalis	black raspberry	6.30	45.5%
Parthenocissus quinquefolia	Virginia creeper	5.17	81.8%
Toxicodendron radicans	eastern poison ivy	3.80	45.5%
Sideroxylon lanuginosum.	gum bully	3.58	45.5%
Rosa multiflora	multiflora rose	3.31	72.7%
Vitis aestivalis	summer grape	3.00	9.1%
Vitis vulpina	frost grape	1.43	81.8%
Smilax tamnoides	bristly greenbrier	1.16	81.8%
Viburnum rufidulum	rusty blackhaw	1.00	72.7%
Rhus glabra	smooth sumac	1.00	9.1%
Cercis canadensis	eastern redbud	0.67	27.3%
Cornus florida	flowering dogwood	0.50	27.3%

Table 14. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within Upland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Prunus americana	American plum	0.50	18.2%
Ulmus alata	winged elm	0.50	18.2%
Herbaceous			
Desmodium glutinosum	pointedleaf ticktrefoil	10.80	45.5%
Elymus virginicus	Virginia wildrye	9.19	72.7%
Lonicera japonica	Japanese honeysuckle	8.31	54.5%
Helianthus hirsutus	hairy sunflower	7.75	18.2%
Sanicula odorata	clustered blacksnakeroot	7.50	54.5%
Clematis virginiana	Devil's darning needles	6.17	27.3%
Staphylea trifolia	American bladdernut	3.49	9.1%
Fragaria virginiana	Virginia strawberry	3.00	9.1%
Hydrophyllum appendiculatum.	great waterleaf	3.00	9.1%
Danthonia spicata	poverty oatgrass	1.75	18.2%
Verbesina alternifolia	wingstem	1.57	63.6%
Carex jamesii	James' sedge	1.50	45.5%
Amphicarpaea bracteata var. bracteata	American hogpeanut	1.21	63.6%
Sanicula canadensis	Canadian blacksnakeroot	1.00	45.5%
Podophyllum peltatum.	mayapple	1.00	45.5%
Carex retroflexa	reflexed sedge	0.92	54.5%
Elephantopus carolinianus	Carolina elephantsfoot	0.86	63.6%
Carex blanda	eastern woodland sedge	0.78	81.8%
Phryma leptostachya	American lopseed	0.50	100.0%
Poa sylvestris	woodland bluegrass	0.50	81.8%
Desmodium perplexum	perplexed ticktrefoil	0.50	72.7%
Galium aparine	stickywilly	0.50	72.7%
Ageratina altissima var. altissima	white snakeroot	0.50	63.6%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	63.6%
Geum canadense	white avens	0.50	63.6%
Viola sororia	common blue violet	0.50	63.6%
Asplenium platyneuron	ebony spleenwort	0.50	54.5%
Bromus pubescens	hairy woodland brome	0.50	54.5%
Festuca subverticillata	nodding fescue	0.50	54.5%
Carex amphibola	eastern narrowleaf sedge	0.50	45.5%
Cirsium altissimum	tall thistle	0.50	45.5%
Dichanthelium clandestinum	deertongue	0.50	45.5%
Galium circaezans	licorice bedstraw	0.50	45.5%

Table 14. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within Upland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Vernonia baldwinii	Baldwin's ironweed	0.50	45.5%
Agrimonia pubescens	soft agrimony	0.50	36.4%
Muhlenbergia sobolifera	rock muhly	0.50	36.4%
Passiflora lutea	yellow passionflower	0.50	36.4%
Pilea pumila	Canadian clearweed	0.50	36.4%
Polygonum virginianum	jumpseed	0.50	36.4%
Ruellia pedunculata	stalked wild petunia	0.50	36.4%
Scutellaria incana	hoary skullcap	0.50	36.4%
Solidago ulmifolia	elmleaf goldenrod	0.50	36.4%
Stellaria media	common chickweed	0.50	36.4%
Ambrosia trifida	great ragweed	0.50	27.3%
Botrychium virginianum	rattlesnake fern	0.50	27.3%
Chaerophyllum tainturieri	hairyfruit chervil	0.50	27.3%
Cryptotaenia canadensis (	Canadian honewort	0.50	27.3%
Erigeron strigosus	prairie fleabane	0.50	27.3%
Lactuca floridana	woodland lettuce	0.50	27.3%
Ranunculus recurvatus	blisterwort	0.50	27.3%
Viola pubescens var. pubescens	downy yellow violet	0.50	27.3%
Agrimonia rostellata	beaked agrimony	0.50	18.2%
Carex cephalophora	oval-leaf sedge	0.50	18.2%
Conyza canadensis	Canadian horseweed	0.50	18.2%
Dichanthelium acuminatum var. fasciculatum	western panicgrass	0.50	18.2%
Dichanthelium malacophyllum	softleaf rosette grass	0.50	18.2%
Galium concinnum	shining bedstraw	0.50	18.2%
Galium triflorum	fragrant bedstraw	0.50	18.2%
Geum vernum	spring avens	0.50	18.2%
Leersia virginica	whitegrass	0.50	18.2%
Lespedeza procumbens	trailing lespedeza	0.50	18.2%
Oxalis stricta	common yellow oxalis	0.50	18.2%
Parietaria pensylvanica.	Pennsylvania pellitory	0.50	18.2%
Phlox divaricata	wild blue phlox	0.50	18.2%
Phytolacca americana	American pokeweed	0.50	18.2%
Plantago rugelii	blackseed plantain	0.50	18.2%
Silene stellata	widowsfrill	0.50	18.2%
Thalictrum thalictroides	rue anemone	0.50	18.2%
Tridens flavus	purpletop tridens	0.50	18.2%

Table 14. Average cover (for plots where the species occurred) and frequency by layer and species for five plots taken within Upland Deciduous Woodland and Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Trillium sessile	toadshade	0.50	18.2%
Triosteum perfoliatum	feverwort	0.50	18.2%
Valerianella radiata	beaked cornsalad	0.50	18.2%

Discussion

The vegetation of WICR is about half open grassland and shrubland and half woodland and forest, about 90% of which is deciduous. Communities are predominantly disturbed, and grasslands are mostly dominated or co-dominated by non-native or weedy grasses and early successional vines and shrubs. Likewise, woodlands and forests generally contain early successional trees among the dominants. Small, open glades support unique plant communities, and prairie restoration efforts have helped establish native warm-season grasses in some areas.

Field Survey

This classification and mapping effort provides a baseline against which to measure change over time. Grassland types range from restored tallgrass, to mixed warm- and cool-season, to non-native, and each has different management needs and dynamics. The grasslands are periodically mowed or burned, and contain many rooted perennial shrubs and vines, especially within the Mixed Warm- and Cool-Season Grassland and Shrubland type. In the absence of clearing, these will likely grow up into shrublands, and then woodlands. Documentation of the dynamics within grasslands via field survey is therefore an on-going need. The current extent of the three types also affords an index to the range of management needs at WICR. Efforts have been made to clear woody species from thin soils and expand open glade areas for the benefit of Missouri bladderpod (*Lesquerella filiformis*) and other glade species. Therefore, the documentation of the current extent of openings versus Thin-Soiled Eastern Redcedar (*Juniperus virginiana*) Woodland via repeated surveys is important.

NVC Classification

Only six of ten types defined and mapped have matches in the NVC. Only two are good matches to defined types, and both of those are broadly-defined successional types. Thus, quantitative data from the park may help improve the description of all types sampled, and may help define new types for those without matches in the NVC. Restored Tallgrass Prairie may remain outside of the NVC as a cultural type. The lack of close matches for types found at WICR reflects the disturbed nature of communities in the study area, and the fact that many disturbance types have not yet been described and classified within the NVC.

Digital Imagery and Interpreation

Multiple years of both leaf-on and leaf-off imagery were available for the park and were used to develop map polygons. The use of leaf-on and leaf-off data helped ensure high quality results. Because the park was small, heads-up corrections to initial image objects were made at fine resolution. Small mapped polygons were retained in the final results, again due to the small size of the park.

Accuracy Assessment

Overall thematic accuracy of the vegetation mapping inventory met the required threshold. However, not all individual map classes had the same degree of accuracy. The differences between mapped classes and field desgination can be attributed to small accuracy assessment sample size, small patches of low abundance vegetation classes (Scenario C and D), inherent variability within types at fine grain (10's of square meters), and/or park management activities that occurred between the period of initial field observations and accuracy assessment. Mowing

and prescribed fire altered the amount of woody cover in many places which was reflected in the accuracy assessment field observations. These differences do not impact the dichotomous key for vegetation map classes or the use of map products for future projects.

Future Recommendations

The current results help document the composition of plant communities at this point in time. They can be built upon in several ways. First, permanent plot locations could be modified or established based on the classification and mapping completed by this project. In particular, stratification of randomly located permanent plots across all mapped types may be advisable. Second, the grassy and shrubby areas of the park will tend to succeed to woodlands without active management, and current active management to remove junipers from some areas is on-going. Given the dynamic nature of these communities, a new, carefully constructed, easy to interpret, easy to populate, spatially specific database to track management activities and their results would be advisable.

Research Opportunities

Given the dynamic nature of communities at WICR, periodically re-sampled permanent plots may provide valuable information in the future. Grassland management to enhance interpretation of the battlefield will likely continue, and opportunities to reduce costs and enhance natural communities while still offering open vistas to visitors might be explored. Management work designed to increase populations of Missouri bladderpod (*Lesquerella filiformis*) also offers research opportunities in terms of documentation of impacts on that species and at the community level. Recovery of Manely Woodland and Shrubland from past disturbances also offers a good opportunity for study of forest dynamics. Finally, ways to link Heartland Network Inventory and Monitoring activities with the results of this mapping project might be explored.

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Appendix A: Contingency Table for Vegetation Mapping at Wilson's Creek National Battlefield

		Reference Data (Accuracy Assessment Field Data)										User's Error			
Sample Data (Polygon Map Data)	Map Units	American Plum Shrubland	Bottomland Deciduous Woodland and Forest	Eastern Redcedar Woodland and Forest	Glade	Manley Shrubland and Woodland	Mixed Warm and Cool-Season Grassland and Ruderal Shrubland	Non-native Ruderal Grassland	Restored Tallgrass Prairie	Thin-soiled Eastern Redcedar Woodland	Upland Deciduous Woodland and Forest	Totals	Commission Accuracy	90% Conf. Interval	
	American Plum Shrubland	**1**										1	100%	50%	100%
	Bottomland Deciduous Woodland and Forest		**26**								2	28	93%	83%	100%
	Eastern Redcedar Woodland and Forest			**4**								4	100%	88%	100%
	Glade				**16**							16	100%	97%	100%
	Manley Shrubland and Woodland					**4**	1					5	80%	41%	100%
	Mixed Warm and Cool-Season Grassland and Ruderal Shrubland	1			1		**19**	1	1		1	24	79%	63%	95%
	Non-native Ruderal Grassland		1		1		5	**29**				36	81%	68%	93%
	Restored Tallgrass Prairie				1		2		**3**			6	50%	8%	92%
	Thin-soiled Eastern Redcedar Woodland				1					**5**		6	83%	50%	100%
	Upland Deciduous Woodland and Forest	1	3	1			2				**27**	34	79%	67%	92%
	Totals	3	30	5	20	4	29	30	4	5	30				
Producer's Error	Omission Accuracy	12%	73%	80%	21%	100%	71%	96%	60%	100%	94%	**134 Total Correct Points**			
	90% Conf. -	12%	72%	80%	21%	99%	68%	94%	58%	100%	91%	**160 Total Points**			
	Level +	13%	74%	80%	21%	100%	75%	98%	61%	100%	97%				
Overall Total Accuracy = 81.3% Overall Kappa Index = 80.7% Overall 90% Upper and Lower Confidence Interval =75.7% and 86.9%															

Accuracy Assessment Contingency Table:

The contingency table combines the sample contingency and population contingency tables in which rows represent the map classes from the vegetation map and columns are the map classes determined in the field. The shaded areas display the number of accuracy assessment points where the field determination of the map class agrees with the vegetation map. Disagreement between field data (columns) and map data result in producer's error (omission error). Conversely, disagreement between map data (rows) and field data reflect user's error (errors of commission). Both types of error are reported in terms of accuracy (100% indicates no errors) and a corresponding 90% confidence interval. The total number of correct points out of the total number of accuracy assessment points (shaded diagonal values) provides the degree to which map classes were interpreted correctly. The Kappa Index is an index that accounts for chance agreement in the contingency table.

Appendix B: Example of Plot Survey Form

NPS VEGETATION MAPPING PROGRAM – PLOT SURVEY FORM
PLOT LOCATION AND DESCRIPTION

Plot Code _____ Surveyors _____
Date _____

Plot Directions

_____

Plot Dimensions _____ by _____ m Photos (y/n) _____
Provisional Community Name

_____
Relative Stand Size extensive (>100x plot), large (>10-100x plot), small (3-10x plot), very small (1-3x plot), unknown
Representativeness

_____
_____
_____

Landform (circle) interfluve, gap/saddle, side slope, terrace/bench flat plain

Topographic Position (circle) crest, upper slope, middle slope, lower slope, toe slope, plain/level/bottom, basin/depression

Hydrologic Regime ___Upland ___Permanently flooded ___Semipermanently flooded ___Seasonally/Temporarily flooded ___Unknown

Plot Shape (circle) concave convex flat irregular
General Comments

_____
_____
_____

Plot Code _____

NPS VEGETATION MAPPING PROGRAM – PLOT SURVEY FORM
VEGETATION SAMPLING

Leaf Phenology	Leaf type	Physiognomic Class
____Deciduous (<25% evergreen)	____Broadleaf	____Forest
____Evergreen (<25% deciduous)	____Needleleaf	____Woodland
____Mixed deciduous/evergreen	____Mixed	____Sparse woodland
____Perennial graminoid	____Graminoid	____Shrubland
____Perennial forb	____Forb	____Sparse shrubland
____Perennial mixed	____Pteridophyte	____Herbaceous
____Annual herbaceous	____Non-vascular	____Sparse vegetation

Strata	%Cover (1=<1%, 2=1-5%, 3=5-25%, 4=25-50%, 5=50-75%, 6=75-95%, 7=95-100%)
T1 Emergent >30m	_____
T2 Tree Canopy 20-30m	_____
T3 Tree Subcanopy 5-20m	_____
S1 Tall Shrub 1-5m	_____
S2 Short Shrub <1m	_____
H Herbaceous	_____

SPECIES COMPOSITION AND COVER CLASS BY STRATUM
%Cover (1=<1%, 2=1-5%, 3=5-25%, 4=25-50%, 5=50-75%, 6=75-95%, 7=95-100%)

T1	T2	T3	S1	S2	H	Species	Comments

Plot Code ___________

T1	T2	T3	S1	S2	H	Species	Comments

Appendix C: Wilson's Creek National Battlefield Dichotomous Key to Mapped Current Vegetation Types

1a. Eastern redcedar (*Juniperus virginiana*) is the visual dominant, with relative canopy cover more than 50%……..…….……..2

2a. Soils thin to bedrock, with massive bedrock often exposed at the surface .... Thin-soiled Eastern Redcedar Woodland

2b. Soils not thin and massive bedrock not exposed at the surface .... ……..Eastern Redcedar Woodland and Forest

1b. Eastern redcedar (*Juniperus virginiana*) is not the visual dominant ..……..... 3

3a. . Vegetation dominated by deciduous trees >5m tall with absolute tree cover >50%; trees without obvious signs of wind damage to crowns 4

4a. A combination of bottomland tree species such as boxelder (*Acer negundo*), American elm (*Ulmus americana*), and white ash (*Fraxinus americana*) among the dominants; soils low and moist …….……Bottomland Deciduous Woodland and Forest

4b. A combination of upland trees species such as red oak (*Quercus rubra*), chinkapin oak (*Quercus muehlenbergii*) and hickories (*Carya* spp.), or early successional species such as osage orange (*Maclura pomifera*) and honeylocust (*Gleditsia triacanthos*) among the dominants; soils not low and moist ……Upland Deciduous Woodland and Forest

3b. Vegetation dominated by herbaceous species or shrubs; if trees form a canopy >50% at 5 m, the crowns with obvious signs of damage ……..……..…..5

5a. Vegetation sparse with >20% bare soil or bedrock exposed at the surface… …...Glade

5b. Vegetation not sparse and without significant exposed bedrock or exposed soil…….6

6a. Vegetation dominated by shrubs or trees with total woody cover at 1.5 m and above >50%..... ……7

7a. American plum (*Prunus americana*) dominant with low diversity of other species ……...American Plum Shrubland

7b. Vegetation dominated by a diversity of shrubs and trees; if dominated by plum, the matrix shrubland mixed.....Manley Shrubland and Woodland

6b. Vegetation dominated by herbaceous species, vines, or low shrubs, with total shrub and tree cover at 1.5 m<50%……...……8

8a. Vegetation dominated by non-native, cool-season grasses such as tall fescue (*Schedonorus phoenix*) and field brome (*Bromus arvensis*) together with early successional forbs; total shrub cover <20%; warm-season grasses, if present, are minor components…….....Non-native Ruderal Grassland

8b. Vegetation not strongly dominated by non-native, cool-season grasses; when present, cool-season grasses share dominance with native warm-season grasses, vines, and shrubs …….....9

9a. Native grasses such as big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and little bluestem (*Schizachyrium scoparium*), together with mainly native forbs, dominant; few non-native cool-season grasses or shrubs present ……...….Restored Tallgrass Prairie

9b. Native grasses may be present but, if so, share dominance with cool-season grasses, forbs, vines, or shrubs ……...……
.....Mixed Warm- and Cool-Season Grassland and Shrubland

Appendix D: Example of Accuracy Assessment Form

Accuracy Assessment Form

NPS Vegetation Inventory

1. PLOT (WAYPOINT) #:_____ 2. DATE:_____

3. OBSERVER (DETERMING ASSOCIATION) _____

4. Observer (assisting) _____

5. ACCURACY OF NAVIGATION (METERS) _____

6. How Determined: _____

7. UTM EASTING: _____ 8. UTM: _____

9. UTM Zone: _____ 10. Datum: _____

11. If GPS Position is an intentional offset from the waypoint, circle the explanation:

a.) Mosaicing scenario (too heterogeneous to key because of two or more clearly distinct types within observation area)

b.) Physical constraints in reaching waypoint

c.) Other (explain as needed):_____

_____

_____

12. VEGETATION ASSOCIATION (Primary call): _____

_____

13. Other possible associations (complexing scenario) (if applicable): _____

_____

14. Explanation for # 13 (if applicable): _____

_____

Appendix E: Species List for Wilson's Creek National Battlefield

Family	Scientific Name	Common Name
Acanthaceae	*Ruellia humilis* Nutt.	fringeleaf wild petunia
	Ruellia pedunculata Torr. ex A. Gray	stalked wild petunia
	Ruellia strepens L.	limestone wild petunia
Aceraceae	*Acer negundo* L.	boxelder
	Acer saccharinum L.	silver maple
Anacardiaceae	*Rhus aromatica* Aiton	fragrant sumac
	Rhus copallinum L.	winged sumac
	Rhus glabra L.	smooth sumac
	Toxicodendron radicans (L.) Kuntze	eastern poison ivy
Apiaceae	*Chaerophyllum tainturieri* Hook.	hairyfruit chervil
	Cryptotaenia canadensis (L.) DC.	Canadian honewort
	Daucus carota L.	Queen Anne's lace
	Sanicula canadensis L.	Canadian blacksnakeroot
	Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe	clustered blacksnakeroot
	Taenidia integerrima (L.) Drude	yellow pimpernel
	Torilis japonica (Houtt.) DC.	erect hedgeparsley
Apocynaceae	*Apocynum cannabinum* L.	Indianhemp
Aristolochiaceae	*Aristolochia serpentaria* L.	Virginia snakeroot
	Aristolochia tomentosa Sims	woolly dutchman's pipe
	Asarum canadense L.	Canadian wildginger
Asclepiadaceae	*Asclepias purpurascens* L.	purple milkweed
	Asclepias quadrifolia Jacq.	fourleaf milkweed
	Asclepias tuberosa L.	butterfly milkweed
	Asclepias viridis Walter	green antelopehorn
	Cynanchum laeve (Michx.) Pers.	honeyvine
Aspleniaceae	*Asplenium platyneuron* (L.) Britton, Sterns & Poggenb.	ebony spleenwort
Asteraceae	*Achillea millefolium* L.	common yarrow
	Ageratina altissima (L.) King & H. Rob. var. altissima	white snakeroot
	Ambrosia artemisiifolia L.	annual ragweed
	Ambrosia trifida L.	great ragweed
	Bidens aristosa (Michx.) Britton	bearded beggarticks
	Bidens bipinnata L.	Spanish needles
	Brickellia eupatorioides (L.) Shinners	false boneset
	Cirsium altissimum (L.) Hill	tall thistle
	Conyza canadensis (L.) Cronquist	Canadian horseweed
	Coreopsis tinctoria Nutt.	golden tickseed
	Echinacea pallida (Nutt.) Nutt.	pale purple coneflower
	Elephantopus carolinianus Raeusch.	Carolina elephantsfoot
	Erechtites hieraciifolia (L.) Raf. ex DC.	American burnweed
	Erigeron annuus (L.) Pers.	eastern daisy fleabane

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Family	Scientific Name	Common Name
Asteraceae	*Erigeron strigosus* Muhl. ex Willd.	prairie fleabane
	Gamochaeta purpurea (L.) Cabrera	spoonleaf purple everlasting
	Helianthus hirsutus Raf.	hairy sunflower
	Hieracium gronovii L.	queendevil
	Krigia biflora (Walter) S.F. Blake	twoflower dwarfdandelion
	Lactuca canadensis L.	Canada lettuce
	Lactuca floridana (L.) Gaertn.	woodland lettuce
	Leucanthemum vulgare Lam.	oxeye daisy
	Parthenium integrifolium L.	wild quinine
	Prenanthes altissima L.	tall rattlesnakeroot
	Pseudognaphalium obtusifolium (L.) Hilliard & B.L. Burtt ssp. obtusifolium	rabbit-tobacco
	Rudbeckia hirta L.	blackeyed Susan
	Rudbeckia laciniata L.	cutleaf coneflower
	Rudbeckia triloba L.	browneyed Susan
	Silphium laciniatum L.	compassplant
	Silphium terebinthinaceum Jacq.	prairie rosinweed
	Solidago altissima L.	Canada goldenrod
	Solidago caesia L.	wreath goldenrod
	Solidago gigantea Aiton	giant goldenrod
	Solidago hispida Muhl. ex Willd.	hairy goldenrod
	Solidago nemoralis Aiton	gray goldenrod
	Solidago ulmifolia Muhl. ex Willd.	elmleaf goldenrod
	Symphyotrichum cordifolium (L.) G.L. Nesom	common blue wood aster
	Taraxacum officinale F.H. Wigg.	common dandelion
	Tragopogon dubius Scop.	yellow salsify
	Verbesina alternifolia (L.) Britton ex Kearney	wingstem
	Verbesina helianthoides Michx.	gravelweed
	Verbesina virginica L.	white crownbeard
	Vernonia arkansana DC.	Arkansas ironweed
	Vernonia baldwinii Torr.	Baldwin's ironweed
Balsaminaceae	*Impatiens* sp.	touch-me-not
Berberidaceae	*Podophyllum peltatum* L.	mayapple
Betulaceae	*Corylus americana* Walter	American hazelnut
	Ostrya virginiana (Mill.) K. Koch	hophornbeam
Bignoniaceae	*Campsis radicans* (L.) Seem. ex Bureau	trumpet creeper
Boraginaceae	*Hackelia virginiana* (L.) I.M. Johnst.	beggarslice
	Heliotropium tenellum (Nutt.) Torr.	pasture heliotrope
Brassicaceae	*Alliaria petiolata* (M. Bieb.) Cavara & Grande	garlic mustard
	Arabis laevigata (Muhl. ex Willd.) Poir.	smooth rockcress

Appendix E: Species List for Wilson's Creek National Battlefield

Family	Scientific Name	Common Name
Brassicaceae	*Barbarea vulgaris* W.T. Aiton	garden yellowrocket
	Lepidium campestre (L.) W.T. Aiton	field pepperweed
	Lepidium virginicum L.	Virginia pepperweed
	Lesquerella filiformis Rollins	limestoneglade bladderpod
Cactaceae	*Opuntia humifusa* (Raf.) Raf.	Devil's-tongue
Campanulaceae	*Campanulastrum americanum* (L.) Small	American bellflower
	Triodanis perfoliata (L.) Nieuwl.	clasping Venus' looking-glass
Cannabaceae	*Humulus lupulus* L.	common hop
Caprifoliaceae	*Lonicera flava* Sims	yellow honeysuckle
	Lonicera japonica Thunb.	Japanese honeysuckle
	Symphoricarpos orbiculatus Moench	coralberry
	Triosteum angustifolium L.	yellowfruit horse-gentian
	Triosteum perfoliatum L.	feverwort
	Viburnum prunifolium L.	blackhaw
	Viburnum rufidulum Raf.	rusty blackhaw
Caryophyllaceae	*Arenaria serpyllifolia* L.	thymeleaf sandwort
	Dianthus armeria L.	Deptford pink
	Silene stellata (L.) W.T. Aiton	widowsfrill
	Stellaria media (L.) Vill.	common chickweed
Celastraceae	*Celastrus scandens* L.	American bittersweet
	Euonymus atropurpureus Jacq.	burningbush
	Euonymus fortunei (Turcz.) Hand.-Maz.	winter creeper
Clusiaceae	*Hypericum hypericoides* (L.) Crantz ssp. hypericoides	St. Andrew's cross
	Hypericum sphaerocarpum Michx.	roundseed St. Johnswort
Commelinaceae	*Tradescantia ohiensis* Raf.	bluejacket
Convolvulaceae	*Ipomoea pandurata* (L.) G. Mey.	man of the earth
Cornaceae	*Cornus florida* L.	flowering dogwood
	Nyssa sylvatica Marsh.	blackgum
Crassulaceae	*Sedum pulchellum* Michx.	widowscross
Cucurbitaceae	*Sicyos angulatus* L.	oneseed bur cucumber
Cupressaceae	*Juniperus virginiana* L.	eastern redcedar
Cyperaceae	*Carex albicans* Willd. ex Spreng. var. albicans	whitetinge sedge
	Carex amphibola Steud.	eastern narrowleaf sedge
	Carex blanda Dewey	eastern woodland sedge
	Carex bushii Mack.	Bush's sedge
	Carex cephalophora Muhl. ex Willd.	oval-leaf sedge
	Carex hirsutella Mack.	fuzzy wuzzy sedge
	Carex jamesii Schwein.	James' sedge
	Carex muehlenbergii Schkuhr ex Willd.	Muhlenberg's sedge

Appendix E: Species List for Wilson's Creek National Battlefield

Family	Scientific Name	Common Name
Cyperaceae	*Carex nigromarginata* Schwein.	black edge sedge
	Carex retroflexa Muhl. ex Willd.	reflexed sedge
	Carex scoparia Schkuhr ex Willd.	broom sedge
	Eleocharis sp.	spikerush
Dioscoreaceae	*Dioscorea quaternata* J.F. Gmel.	fourleaf yam
Dryopteridaceae	*Woodsia obtusa* (Spreng.) Torr.	bluntlobe cliff fern
Ebenaceae	*Diospyros virginiana* L.	common persimmon
Elaeagnaceae	*Elaeagnus umbellata* Thunb.	autumn olive
Euphorbiaceae	*Acalypha virginica* L.	Virginia threeseed mercury
	Croton monanthogynus Michx.	prairie tea
	Euphorbia corollata L.	flowering spurge
	Tragia betonicifolia Nutt.	betonyleaf noseburn
Fabaceae	*Amphicarpaea bracteata* (L.) Fernald var. bracteata	American hogpeanut
	Cercis canadensis L.	eastern redbud
	Desmodium cuspidatum (Muhl. ex Willd.) DC. ex D. Don	largebract ticktrefoil
	Desmodium glutinosum (Muhl. ex Willd.) Alph. Wood	pointedleaf ticktrefoil
	Desmodium marilandicum (L.) DC.	smooth small-leaf ticktrefoil
	Desmodium paniculatum (L.) DC.	panicledleaf ticktrefoil
	Desmodium perplexum B.G. Schub.	perplexed ticktrefoil
	Gleditsia triacanthos L.	honeylocust
	Lespedeza cuneata (Dum. Cours.) G. Don	sericea lespedeza
	Lespedeza procumbens Michx.	trailing lespedeza
	Lespedeza violacea (L.) Pers.	violet lespedeza
	Melilotus officinalis (L.) Lam.	yellow sweetclover
	Orbexilum pedunculatum (Mill.) Rydb. var. pedunculatum	Sampson's snakeroot
	Trifolium arvense L.	rabbitfoot clover
	Trifolium campestre Schreb.	field clover
	Trifolium pratense L.	red clover
	Vicia sativa L.	garden vetch
Fagaceae	*Quercus alba* L.	white oak
	Quercus imbricaria Michx.	shingle oak
	Quercus macrocarpa Michx.	bur oak
	Quercus muehlenbergii Engelm.	chinkapin oak
	Quercus rubra L.	northern red oak
	Quercus stellata Wangenh.	post oak
	Quercus velutina Lam.	black oak
Geraniaceae	*Geranium carolinianum* L.	Carolina geranium
Grossulariaceae	*Ribes missouriense* Nutt.	Missouri gooseberry

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Family	Scientific Name	Common Name
Hippocastanaceae	*Aesculus glabra* Willd.	Ohio buckeye
Hydrophyllaceae	*Hydrophyllum appendiculatum* Michx.	great waterleaf
Iridaceae	*Sisyrinchium angustifolium* Mill.	narrowleaf blue-eyed grass
	Sisyrinchium campestre E.P. Bicknell	prairie blue-eyed grass
Juglandaceae	*Carya alba* (L.) Nutt.	mockernut hickory
	Carya cordiformis (Wangenh.) K. Koch	bitternut hickory
	Carya ovata (Mill.) K. Koch	shagbark hickory
	Carya texana Buckley	black hickory
	Juglans nigra L.	black walnut
Juncaceae	*Juncus tenuis* Willd.	poverty rush
Lamiaceae	*Agastache nepetoides* (L.) Kuntze	yellow giant hyssop
	Clinopodium arkansanum (Nutt.) House	limestone calamint
	Hedeoma pulegioides (L.) Pers.	American false pennyroyal
	Monarda fistulosa L.	wild bergamot
	Perilla frutescens (L.) Britton	beefsteakplant
	Prunella vulgaris L.	common selfheal
	Scutellaria incana Biehler	hoary skullcap
	Scutellaria parvula Michx.	small skullcap
	Teucrium canadense L.	Canada germander
Lauraceae	*Lindera benzoin* (L.) Blume	northern spicebush
	Sassafras albidum (Nutt.) Nees	sassafras
Liliaceae	*Allium canadense* L.	meadow garlic
	Allium vineale L.	wild garlic
	Erythronium albidum Nutt.	white fawnlily
	Polygonatum biflorum (Walter) Elliot	smooth Solomon's seal
	Trillium sessile L.	toadshade
Menispermaceae	*Menispermum canadense* L.	common moonseed
Moraceae	*Maclura pomifera* (Raf.) C.K. Schneid.	osage orange
	Morus rubra L.	red mulberry
Oleaceae	*Fraxinus americana* L.	white ash
	Fraxinus pennsylvanica Marsh.	green ash
	Ligustrum vulgare L.	European privet
Ophioglossaceae	*Botrychium virginianum* (L.) Sw.	rattlesnake fern
Orchidaceae	*Liparis liliifolia* (L.) Rich. ex Ker Gawl.	brown widelip orchid
Oxalidaceae	*Oxalis dillenii* Jacq.	slender yellow woodsorrel
	Oxalis stricta L.	common yellow oxalis
	Oxalis violacea L.	violet woodsorrel
Papaveraceae	*Sanguinaria canadensis* L.	bloodroot
Passifloraceae	*Passiflora lutea* L.	yellow passionflower

Appendix E: Species List for Wilson's Creek National Battlefield

Family	Scientific Name	Common Name
Phytolaccaceae	*Phytolacca americana* L.	American pokeweed
Plantaginaceae	*Plantago rugelii* Decne.	blackseed plantain
	Plantago virginica L.	Virginia plantain
Platanaceae	*Platanus occidentalis* L.	American sycamore
Poaceae	*Agrostis hyemalis* (Walter) Britton, Sterns & Poggenb.	winter bentgrass
	Andropogon gerardii Vitman	big bluestem
	Andropogon virginicus L.	broomsedge bluestem
	Bouteloua curtipendula (Michx.) Torr.	sideoats grama
	Bromus arvensis L.	field brome
	Bromus pubescens Muhl. ex Willd.	hairy woodland brome
	Bromus tectorum L.	cheatgrass
	Dactylis glomerata L.	orchardgrass
	Danthonia spicata (L.) P. Beauv. ex Roem. & Schult.	poverty oatgrass
	*Dichanthelium acuminatum (*Sw.) Gould & C.A. Clark var. fasciculatum (Torr.) Freckmann	western panicgrass
	Dichanthelium clandestinum (L.) Gould	deertongue
	Dichanthelium commutatum (Schult.) Gould	variable panicgrass
	Dichanthelium linearifolium (Scribn. ex Nash) Gould	slimleaf panicgrass
	*Dichanthelium malacophyllum (*Nash) Gould	softleaf rosette grass
	Elymus virginicus L.	Virginia wildrye
	Festuca subverticillata (Pers.) Alexeev	nodding fescue
	Leersia virginica Willd.	whitegrass
	Muhlenbergia schreberi J.F. Gmel.	nimblewill
	Muhlenbergia sobolifera (Muhl. ex Willd.) Trin.	rock muhly
	Panicum anceps Michx.	beaked panicgrass
	Panicum virgatum L.	switchgrass
	Phleum pratense L.	timothy
	Poa annua L.	annual bluegrass
	Poa chapmaniana Scribn.	Chapman's bluegrass
	Poa compressa L.	Canada bluegrass
	Poa sylvestris A. Gray	woodland bluegrass
	Schedonorus phoenix (Scop.) Holub	tall fescue
	Schedonorus pratensis (Huds.) P. Beauv.	meadow fescue
	Schizachyrium scoparium (Michx.) Nash	little bluestem

Appendix E: Species List for Wilson's Creek National Battlefield

Family	Scientific Name	Common Name
Poaceae	*Sphenopholis obtusata* (Michx.) Scribn.	prairie wedgescale
	Sporobolus compositus (Poir.) Merr. var. compositus	composite dropseed
	Tridens flavus (L.) Hitchc.	purpletop tridens
	Vulpia octoflora (Walter) Rydb.	sixweeks fescue
Polemoniaceae	*Phlox divaricata* L.	wild blue phlox
Polygonaceae	*Polygonum* sp.	knotweed
	Polygonum scandens L.	climbing false buckwheat
	Polygonum virginianum L.	jumpseed
	Rumex crispus L.	curly dock
Pteridaceae	*Pellaea atropurpurea* (L.) Link	purple cliffbrake
Ranunculaceae	*Actaea racemosa* L. var. *racemosa*	black bugbane
	Anemone virginiana L.	tall thimbleweed
	Aquilegia canadensis L.	red columbine
	Clematis virginiana L.	devil's darning needles
	Hepatica nobilis Schreb.	hepatica
	Ranunculus abortivus L.	littleleaf buttercup
	Ranunculus hispidus Michx.	bristly buttercup
	Ranunculus recurvatus Poir.	blisterwort
	Thalictrum thalictroides (L.) Eames & B. Boivin	rue anemone
Rhamnaceae	*Frangula caroliniana* (Walter) A. Gray	Carolina buckthorn
Rosaceae	*Rubus pensilvanicus* Poir.	Pennsylvania blackberry
	Agrimonia pubescens Wallr.	soft agrimony
	Agrimonia rostellata Wallr.	beaked agrimony
	Amelanchier arborea (Michx. f.) Fernald	common serviceberry
	Fragaria virginiana Duchesne	Virginia strawberry
	Geum canadense Jacq.	white avens
	Geum vernum (Raf.) Torr. & A. Gray	spring avens
	Physocarpus opulifolius (L.) Maxim., orth. cons.	common ninebark
	Potentilla recta L.	sulphur cinquefoil
	Prunus americana Marsh.	American plum
	Prunus serotina Ehrh.	black cherry
	Rosa carolina L.	Carolina rose
	Rosa multiflora Thunb.	multiflora rose
	Rosa setigera Michx.	climbing rose
	Rubus flagellaris Willd.	northern dewberry
	Rubus occidentalis L.	black raspberry
	Rubus pensilvanicus Poiret	Pennsylvania blackberry
Rubiaceae	*Galium aparine* L.	stickywilly
	Galium circaezans Michx.	licorice bedstraw

Appendix E: Species List for Wilson's Creek National Battlefield

Family	Scientific Name	Common Name
Rubiaceae	*Galium concinnum* Torr. & A. Gray	shining bedstraw
	Galium triflorum Michx.	fragrant bedstraw
	Galium virgatum Nutt.	southwestern bedstraw
	Houstonia purpurea L.	Venus' pride
Sapotaceae	*Sideroxylon lanuginosum* Michx.	gum bully
Scrophulariaceae	*Penstemon digitalis* Nutt. ex Sims	talus slope penstemon
	Verbascum thapsus L.	common mullein
	Veronica arvensis L.	corn speedwell
	Veronicastrum virginicum (L.) Farw.	Culver's root
Simaroubaceae	*Ailanthus altissima* (Mill.) Swingle	tree of heaven
Smilacaceae	*Smilax bona-nox* L.	saw greenbrier
	Smilax pulverulenta Michx.	downy carrionflower
	Smilax tamnoides L.	bristly greenbrier
Solanaceae	*Physalis heterophylla* Nees	clammy groundcherry
	Physalis virginiana Mill.	Virginia groundcherry
	Solanum carolinense L.	Carolina horsenettle
Staphyleaceae	*Staphylea trifolia* L.	American bladdernut
Tiliaceae	*Tilia americana* L.	American basswood
Ulmaceae	*Celtis occidentalis* L.	common hackberry
	Celtis tenuifolia Nutt.	dwarf hackberry
	Ulmus alata Michx.	winged elm
	Ulmus americana L.	American elm
	Ulmus pumila L.	Siberian elm
	Ulmus rubra Muhl.	slippery elm
Urticaceae	*Laportea canadensis* (L.) Weddell	Canadian woodnettle
	Parietaria pensylvanica Muhl. ex Willd.	Pennsylvania pellitory
	Pilea pumila (L.) A. Gray	Canadian clearweed
Valerianaceae	*Valerianella radiata* (L.) Dufr.	beaked cornsalad
Verbenaceae	*Glandularia canadensis* (L.) Nutt.	rose mock vervain
	Phryma leptostachya L.	American lopseed
Violaceae	*Viola pubescens* Aiton *var. pubescens*	downy yellow violet
	Viola sororia Willd.	common blue violet
	Viola triloba Schwein.	three-lobe violet
Vitaceae	*Parthenocissus* quinquefolia (L.) Planch.	Virginia creeper
	Vitis aestivalis Michx.	summer grape
	Vitis rupestris Scheele	sand grape
	Vitis vulpina L.	frost grape

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 410/120415, April 2013

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov