Vegetation Classification and Mapping of Pea Ridge National Military Park

Project Report

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Abstract/Executive Summary

Pea Ridge National Military Park (PERI) is situated in northwestern Arkansas, about five miles northeast of Rogers, AR. The site commemorates the critical March 1862 Civil War Battle of Pea Ridge. The border between the flatter Springfield Plains and the more hilly Dissected Springfield Plateau-Elk River Hills ecoregions bisects the park from east to west. Plant communities are therefore relatively diverse, reflecting the variety of landforms and abiotic habitats as well as past and current human use.

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 47 quantitative field plots and an additional 96 observation points. Plots were placed across PERI in a stratified random manner based on qualitative field observation points and viewing of air photos. Mapping was based on photo-interpretation of both leaf-on and leaf-off air photos. Accuracy assessment points obtained during 2012 verified that the map is 93.9% accurate.

Natural and semi-natural vegetation covers 4,209.6 acres (1,703.6 ha), or >98% of the park. Of that area, 76% is in woodland or forest and 23% is herbaceous vegetation. Two-thirds of the grasslands are mowed more than once annually and are dominated primarily by the non-native tall fescue (*Schedonorus phoenix*). Dry and typic upland oak-hickory woodland and forest together comprise 2,481 acres (1,004 ha), or 59% of the natural and semi-natural vegetation of the park. A total of nine non-developed types were mapped, with an overall accuracy across all types of 93.1%.

Introduction

Pea Ridge National Military Park Vegetation Mapping Project

Pea Ridge National Military Park (PERI) 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. PERI contains examples of oak-hickory forest in relatively large patches, including communities over sandstone and limestone substrates. In addition, large patches of semi-natural grassland and some areas of restored tallgrass prairie are contained within the park. These communities offer good opportunities for conservation of regional flora and fauna that are compatible with interpretation of the Civil War battlefield.

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 1994; 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)

Pea Ridge National Military Park
Pea Ridge National Military Park comprises approximately 4,267 acres (1,727 hectares) near Pea Ridge, Arkansas, about five miles northeast of Rogers, AR (Figure 1). A series of Civil War engagements that occurred in March, 1862, are commemorated and interpreted on site. The park was created by an act of Congress in 1956. Management of areas not associated with the battlefields, mainly woodlands and forests, have largely been passive. Efforts have been made to restore tallgrass prairie within limited areas. More recent (and on-going) active management has been initiated to increase visibility, reduce eastern redcedar (*Juniperus virginiana*) dominance,

and generally restore important portions of the park to conditions similar to those present at the time of the battle. Within the past decade, the HTLN has established baselines and on-going monitoring of key indicators of natural resource health (Annis et al. 2011).

The park contains oak-hickory woodlands that are in moderate overall condition and provide nesting habitat for Acadian Flycatchers (*Empidomax virescens*) and Yellow-throated Vireos (*Vireo flavifrons*), both forest interior birds of special concern (Peitz 2009). Relatively few invasive species occur, although patches of eastern redcedar are apparent in places and lower overall quality by reducing landscape condition scores (Annis et al. 2011). Bottomland forests and woodlands are only found along Lee Creek in the southeastern part of the park and are of relatively low quality (Annis et al. 2011). Mowed grasslands are part of the interpretive landscape, and some areas of shrubland and sparse woodland have grown up after abandonment of agricultural production. These shrubby areas provide nesting habitat for Indigo Buntings (*Passerina cyanea*) and Eastern Towhees (*Pipilo erythrophthalmus*), two shrubland birds of special concern (Peitz 2009).
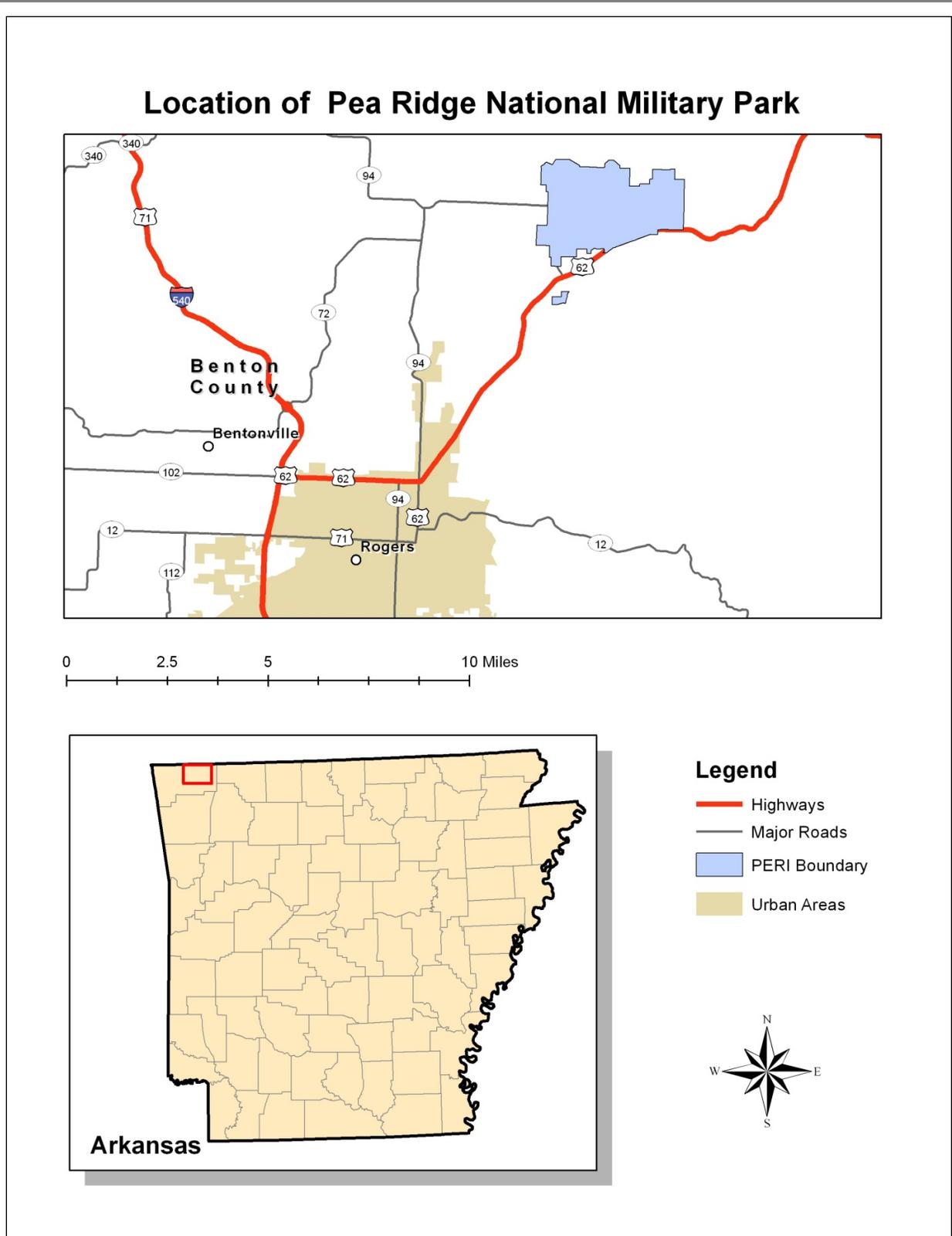
Figure 1. Location of Pea Ridge National Military Park in Benton County, Arkansas.

Project Statistics

Field Work Summer 2011:

        Observation Points = 97

                Collected between May 2010 and May 2012 by MoRAP staff

        Plot Sampling = 47

                Plots sampled in May 2011 by MoRAP staff

        Accuracy Assessment Points = 155

                All collected in July 2012 by Heartland Inventory and Monitoring Network staff

Classification:

        7 NVC Plant Associations
        2 Park Special Vegetation Classes
        1 Developed Land-Use Class

GIS Database 2011 - 2012:

        Pea Ridge National Military Park = 4,267 acres (1,727 hectares)
        Base Imagery used for mapping (acquired by MoRAP):
                2009, Benton County, AR, leaf-on, true color, 0.61 m (2 feet)
                2009, Benton County, AR, leaf-off, 4-band CIR, 1 m

        Minimum Mapping Unit = 0.5 hectares (ha)
        Minimum Patch Size = .005 hectares (ha)
        Total Size = 300 Polygons
        Average Polygon Size = 14.22 acres (5.75 ha)
        Overall Thematic Accuracy = 93.1%
        Project Completion Date: 11/2012

Methods

Pea Ridge National Military Park, at 4,267 acres (1,726.8 ha), is a medium sized park as defined by sampling design protocols (TNC and ESRI 1994). Standard methodology for sampling and mapping therefore called for stratification of samples based on biophysical setting and current vegetation cover. These sites should sufficiently characterize the vegetation types and explain distributions across the landscape. 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). Five major tasks were identified and completed, including:

1. Plan, gather data, and coordinate tasks;

2. Survey PERI 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 PERI and published in 2011 (Annis et al. 2011). During the course of that project, the current vegetation mapping project was discussed with appropriate park staff in coordination with HTLN and MoRAP staff. A proposal for vegetation mapping was subsequently completed and approved by NPS National Vegetation Mapping staff. Based on that proposal, MoRAP was responsible for classification, plot sampling, mapping, and development of digital databases. The HTLN was responsible for oversight of MoRAP activities in concert with NPS Mapping Program staff, and coordinated accuracy assessment tasks. PERI 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 PERI is outlined below.

A generalized land cover classification was available from the PERI NRCA (Annis et al. 2011), and this information together with National Agriculture Imagery Program (NAIP) air photos, digital soils information, digital surface geology maps, digital elevation models, 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 (fewer than 15 minutes) by ecologists from MoRAP where general information on vegetation structure and composition was noted.

Vegetation data were collected at 47 plots by MoRAP staff in May of 2011 (Figure 4). In the lab, the locations of plots were randomly placed within the following general strata: deciduous woodlands and forests on moist upland soils, deciduous woodlands and forests on dry upland soils, deciduous woodlands and forests on slopes >20%, deciduous bottomland forests, upland juniper-dominated woodlands and forests, bottomland juniper dominated woodlands and forests, restored tallgrass prairie, disturbed grasslands and shrublands, mowed grasslands, and marsh (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). Workers navigated to the stratified random plot sampling locations by GPS.

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 vegetation 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
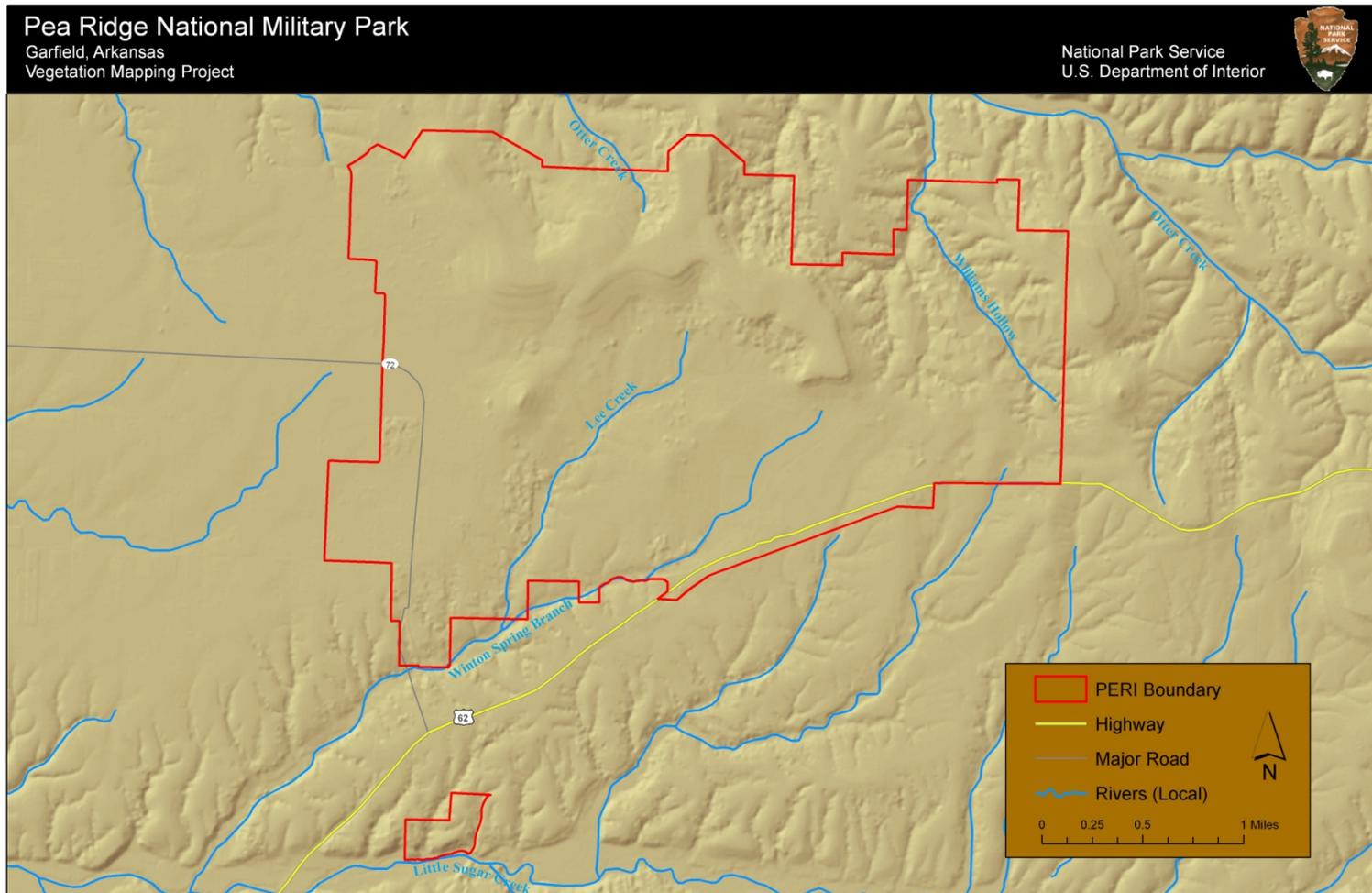
Figure 2. Map of Pea Ridge National Military Park.
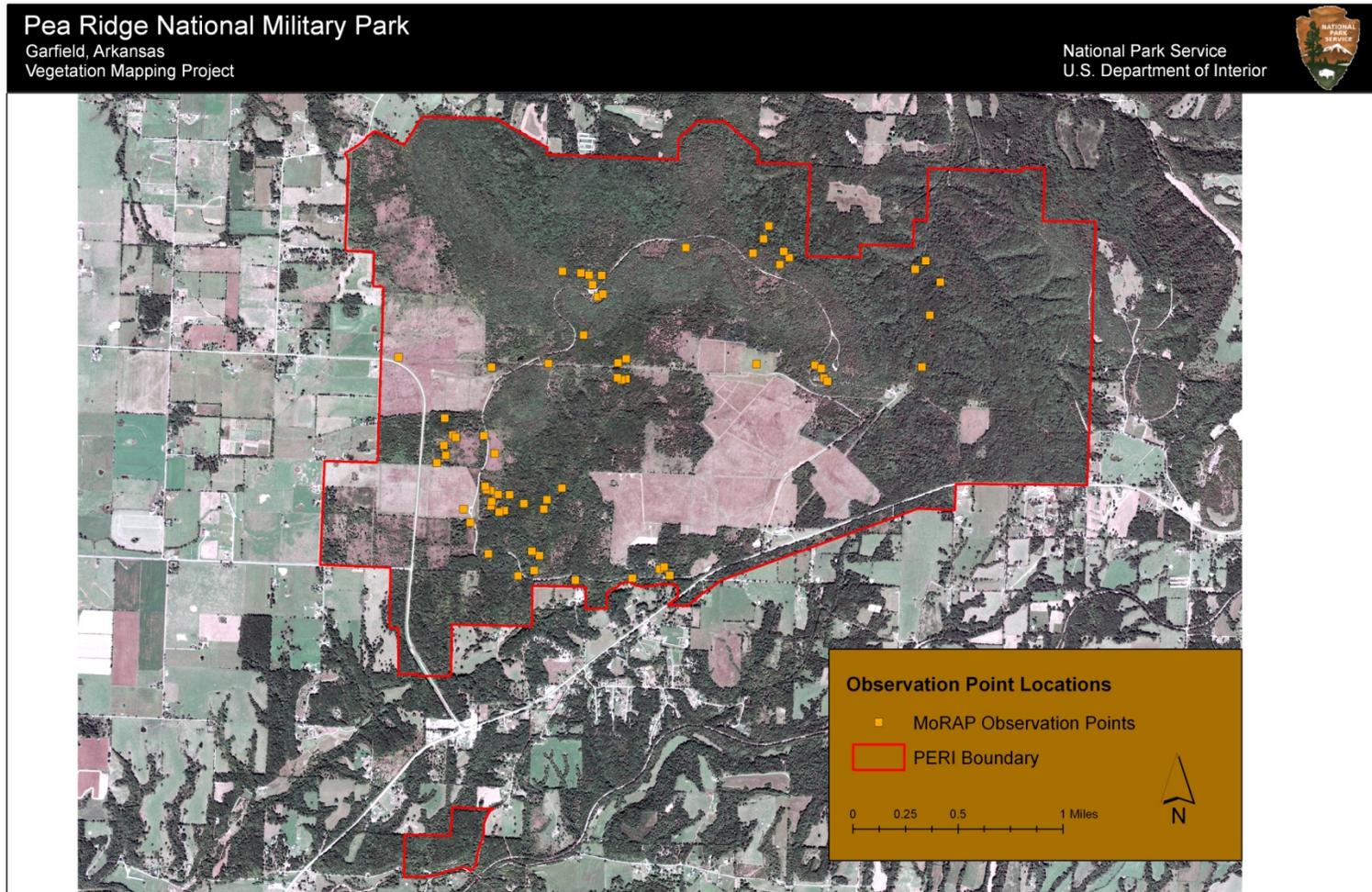
Figure 3. Location of 96 observation points collected in Pea Ridge National Military Park.
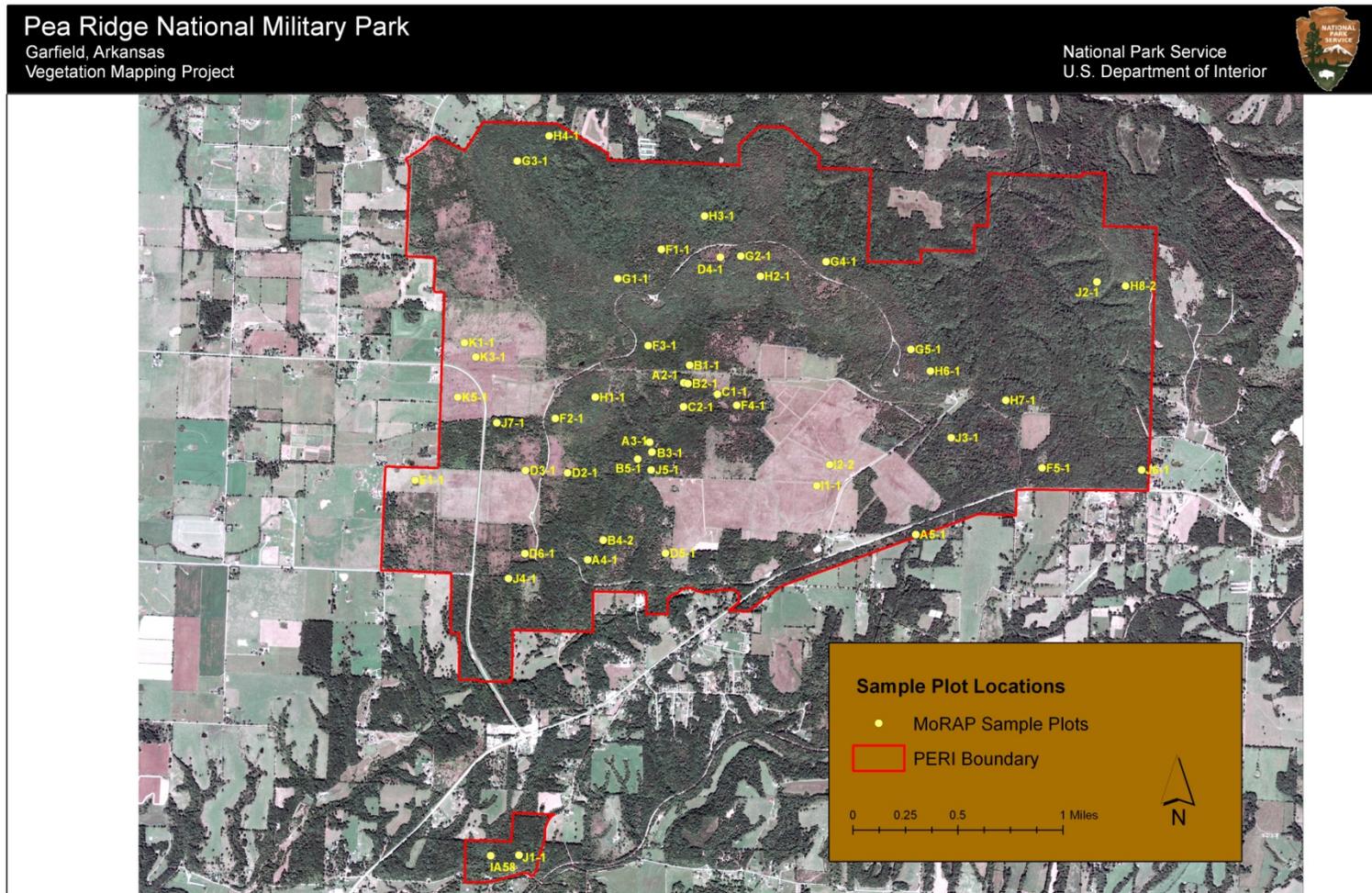
Figure 4. Location of 47 sampled plots within Pea Ridge National Military Park.

Vegetation Classification

All recorded data were entered into the NPS PLOTS v3.2 database (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 β = -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 website available at
http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol. PERI park-specific types
were defined based on the quantitative data and observation points when the observed vegetation
did not fit descriptions of associations described for Arkansas.

Once the classification was finalized, a dichotomous key was developed by MoRAP for use
during the accuracy assessment (Appendix C). For mapped vegetation types (mapped types)
with an NVC assignment, the ecological systems and association descriptions served as the basis
for the global descripton of the mapped type. For other mapped types, descriptions are based on
the quantitative plot data and on observation points. The final described mapped 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. The best available imagery was from the NAIP (see
http://www.fsa.usda.gov/Internet/FSA_File/naip_2009_info_final.pdf).   This included 2009
leaf-on true color and 4-band color infrared (CIR) 1 m resolution photos, and 2007-2009 leaf-off
true color 2 foot resolution photos (Figure 5).
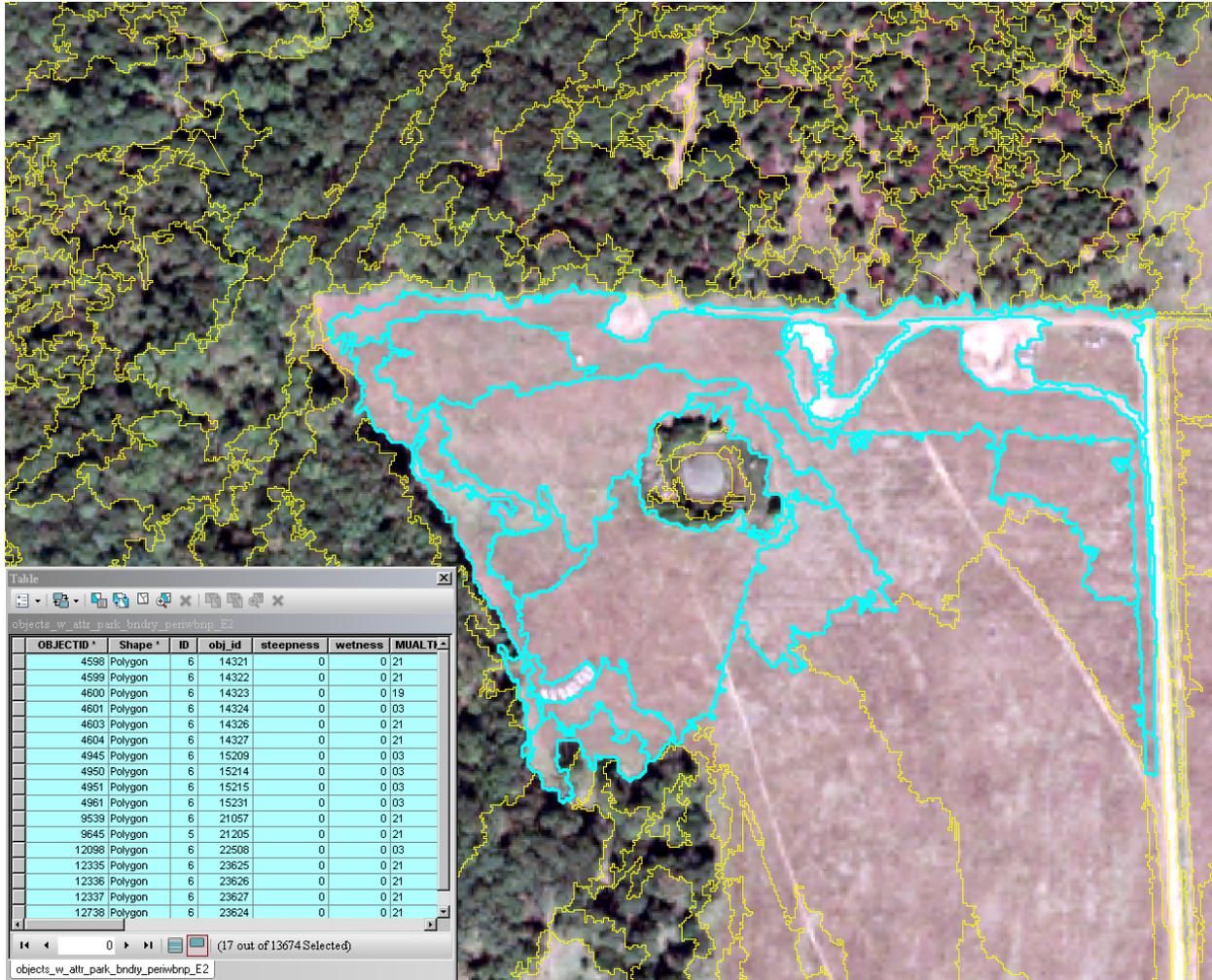
Figure 5. Image objects were generated and then corrected via heads-up digitization at a view scale of
1:1,500.

Accuracy Assessment

Thematic accuracy assessment (AA) was conducted by the HTLN. Methods and analysis for the accuracy assessment of vegetation mapping at PERI were based on NPS standards (Lea and Curtis 2010). Thematic or attribute accuracy of mapped vegetation types were assessed independently following the completion of the vegetation mapping inventory by the lead authors. Representative sites were identified and visited to determine if interpreted mapped types 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 type. The number of samples in each mapped type was selected from five possible scenarios (Table 2). Accuracy assessment was restricted to natural and semi-natural vegetation mapped types, thus omitting developed areas and standing water. Once the appropriate sampling scenario for each mapped type was determined, site selection was performed using a geographical information system (ArcGIS 10.0).

Table 2. Target number of Accuracy Assessment samples per mapped type based on number of polygons and area.

Scenario	Description	Polygons in type	Area occupied by type	Recommended number of samples in type
Scenario A:	The mapped type 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 mapped type 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 scenario is that sample sites are more difficult to find because of the lower frequency of the type.	<30	>50 ha	20
Scenario C:	The mapped type 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 type occupies a small area. At the same time, however, the type 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

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

Scenario	Description	Polygons in type	Area occupied by type	Recommended number of samples in type
Scenario D:	The mapped type 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 type 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
Scenario E:	The mapped type 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 type 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 m from the park boundary and 80 m from another point for larger polygons. The minimum mapping unit used in delineating vegetation polygons was 0.5 hectare. 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 during August 2012. Field staff was provided with a GPS unit, dichotomous key for mapped types and vegetation definitions for each mapped type (Figure 6).

Plot shape and size varied according to the patch extent of the mapped vegetation type containing the sample point. Circular 0.25 hectare (28 m radius) plots were used for most patches. A mix of circular and rectangular 0.1 hectare plots were used for small patches and linear patch types, respectively. A circular plot size of 0.5 hectare (40 m 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 mapped type patch.

Field staff recorded plot size and shape, positional accuracy and vegetation classification at each point (Accuracy Assessment Field Form, Appendix D). Field data from the 155 points were entered into 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 Pea Ridge National Military Park.

Statistic	Description
User's Accuracy	The fraction of the accuracy assessment observations in a mapped type that were found to have the correct vegetation type 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.

USGS-NPS Vegetation Mapping Program
Pea Ridge National Military Park
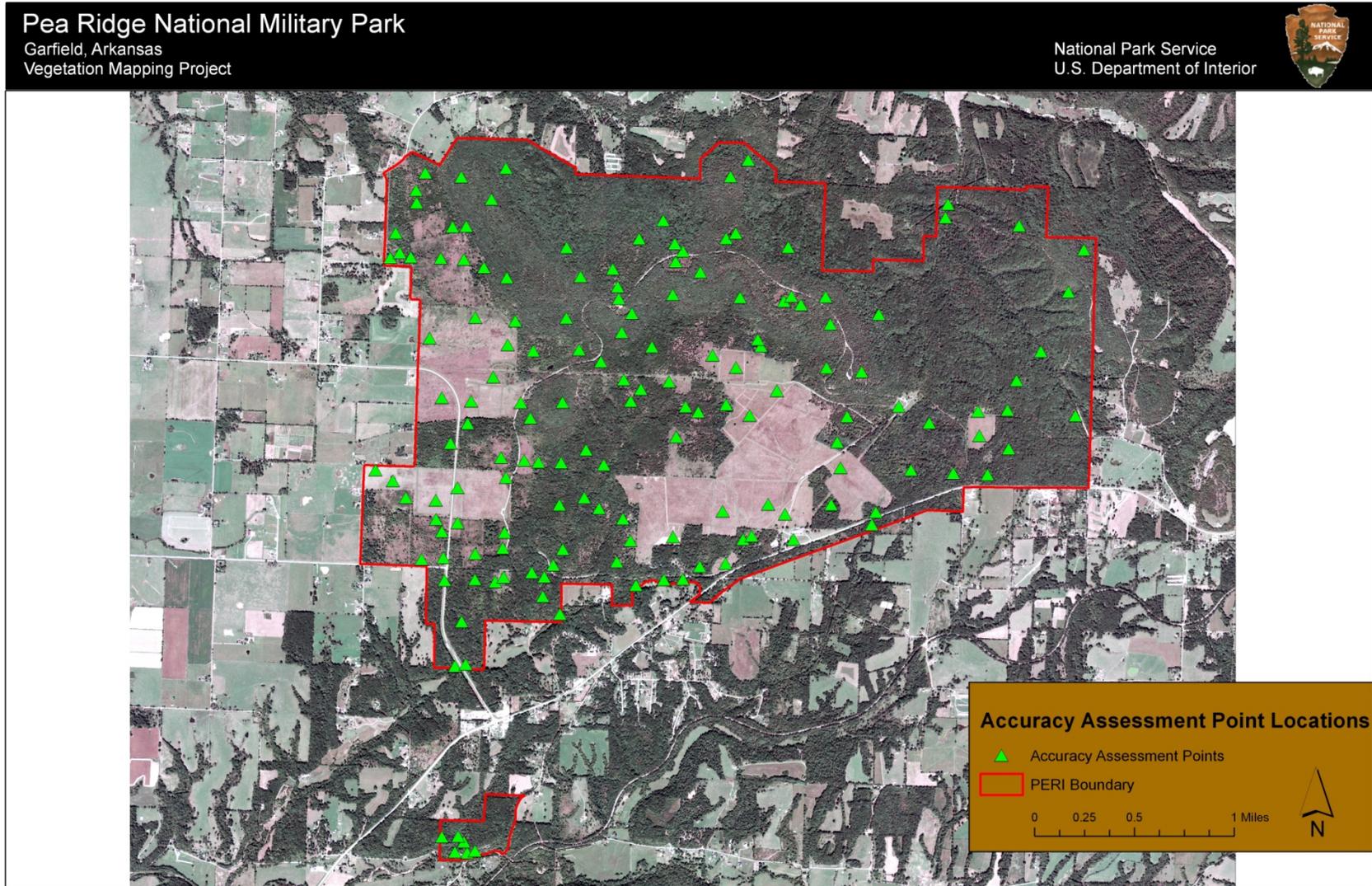
Figure 6. Accuracy Assessment points for Pea Ridge National Military Park.

Results

Vegetation Classification

We identified nine natural and semi-natural community types within the park. The Mowed Grassland type was considered semi-natural vegetation, but is part of the cultural landscape, and is managed mainly to enhance interpretation of the park's battlefield setting (Table 4). These types were identified based on a combination of quantitative analysis of plots and field observation. Of the 47 plots, we eliminated six from cluster analysis and ordination because they were collected from easily recognizable community types, and their composition was unlike other plots. These included plots from Mowed Grassland (3), Restored Tallgrass Prairie (2), and Marsh (1).

The remaining 41 plots were analyzed via cluster analysis and ordination (Figure 7). Deciduous forest plots over dry soils clustered away from those over more moist soils on the right side of the ordination, and those two types were identified as Dry Deciduous and Typic Upland Deciduous Woodland and Forest Communities (Figure 7). Deciduous forest plots on bottomland soils also formed a cluster on the left side of the ordination, and were identified as Bottomland Deciduous Woodland and Forest. Plots taken within non-forested areas, exclusive of mowed grasslands and restored prairie, formed a cluster on the lower center part of the ordination and were identified as Ruderal Grassland and Shrubland. Finally, all plots dominated by eastern redcedar, whether on bottomlands, dry uplands, or moist uplands, formed one group in the central part of the ordination and were identified as Eastern Redcedar Woodland and Forest.

One final type, Silver Maple Forest, occurred in only one small area of the park (6.4 acres or 2.6 ha), and was identified based on field observation. This type was discovered after field plots had been collected, and is a relatively low diversity, non-natural or at best successional forest.

During the plot sampling efforts a total of 327 taxa of flowering plants were observed (Appendix E). Hinterthuer (2003) found 520 taxa on a grid of 496 plots, 70 of which were visited three times over a 15-month period.

Cluster Dendrogram
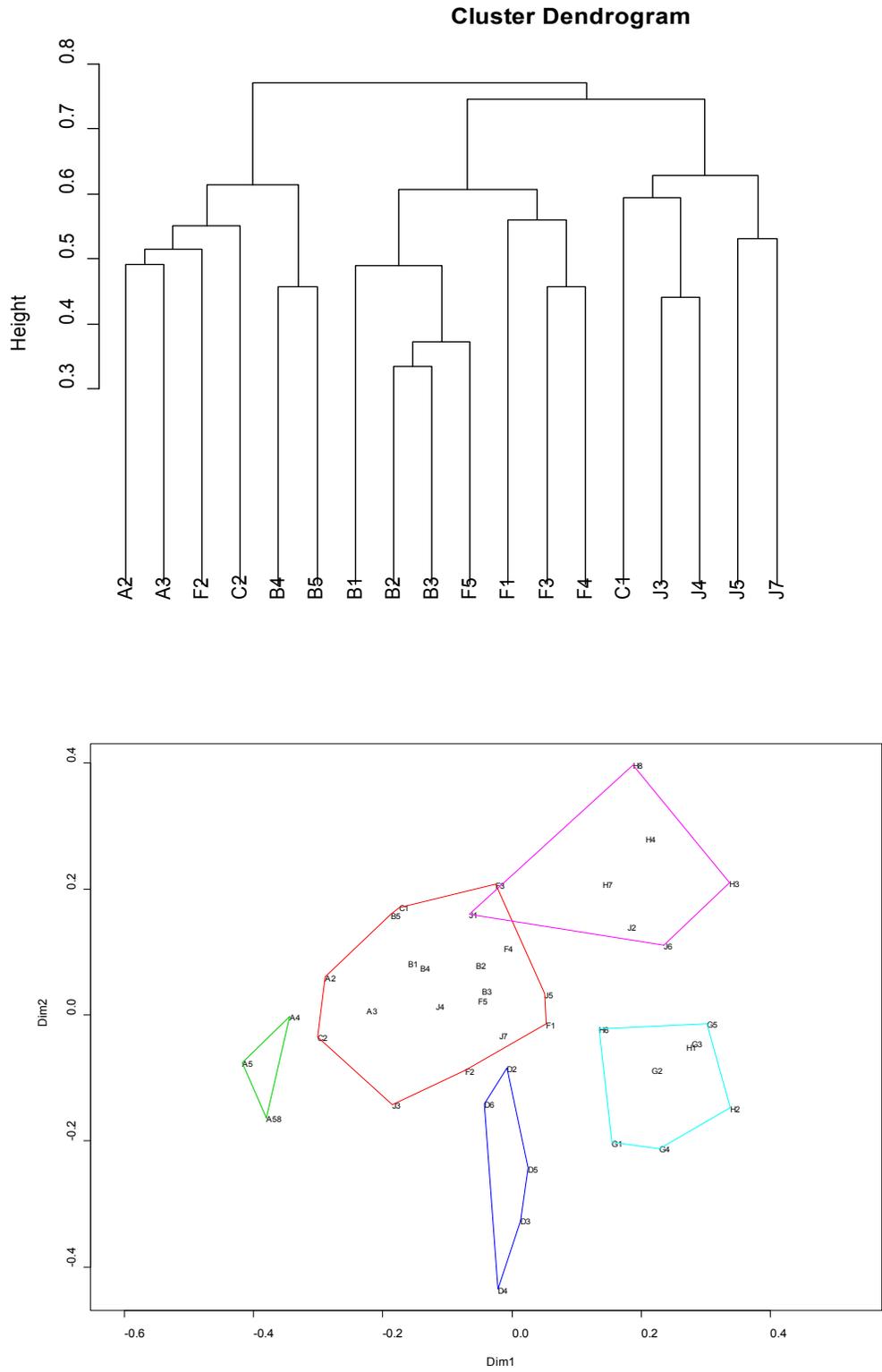
Figure 7. Ordination analysis and cluster dendogram for 47 plots sampled in Pea Ridge. Groups of Mapped Types are, from left to right on the ordination, Bottomland Deciduous Woodland and Forest (green), Eastern Redcedar Woodland and Forest (red), Ruderal Grassland and Shrubland (blue), Typic Upland Deciduous Woodland and Forest (purple) and Dry Deciduous Woodland and Forest (cyan).

Digital Imaging and Interpretation

Image objects created from merged imagery generally corresponded with land cover visable 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.

Eleven mapped types that corresponded directly with the classified vegetation plus developed land and water were created (Table 4). The developed land map class was a catch-all that included all areas without semi-natural vegetation.

Vegetation Map

The total of approximately 4,267 acres (1,727 ha) are within the accepted boundaries of PERI (Figure 8). The standard minimum mapping unit for NPS vegetation mapping projects is defined as 0.5 hectare, although several mapped polygons were smaller for PERI. Typic Upland Deciduous Woodland and Forest covers 2,001.4 acres (810 ha or 46.8%), of the park, and Dry Deciduous Woodland and Forest 480.0 acres (194.2 ha or 11.2%). Eastern Redcedar Woodland and Forest covers 673.9 acres (272.7 ha or 15.8% of the park). Thus, these three typic, dry, and successional woodlands and forests account for almost three-quarters of the total area of the park. Regularly mowed grassland covers 568.9 acres (230.2 ha or 13.3%) and Ruderal Grassland and Shrubland 362.9 acres (146.9 ha or 8.5%). Other types each account for less than 1.5% of the area.

Accuracy Assessment

The 2012 accuracy assessment for PERI was limited to the 4,210 acres (1,704 hectares) of natural and semi-natural vegetation within the park boundary. A total of 155 points were required to accurately evaluate the nine natural and semi-natural mapped vegetation types identified in the park (Table 4).

Navigational error (positional accuracy) of the GPS unit ranged from 1 – 5 meters for the 155 accuracy assessment points. Spatial offset was required for 7 sites to ensure the entire plot was composed of a homogenous mapped type. 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 Pea Ridge National Battlefied.

NVC Identifier	Mapped Type	Scientific Name / Description	Number of Polygons	Acres	Hectares
		Forest and Woodlands			
similar to CEGL002410	Bottomland Deciduous Woodland and Forest	*Juglans nigra - Morus rubra - Ulmus americana* Bottomland Forest	18	54.77	22.17
CEGL002149	Dry Deciduous Woodland and Forest	*Quercus stellata - Quercus marilandica - Quercus velutina - Carya texana / Schizachyrium scoparium* Woodland	8	480.04	194.27

Table 4. Mapped types Identified at Pea Ridge National Battlefield (continued).

NVC Identifier	Mapped Type	Scientific Name / Description	Number of Polygons	Acres	Hectares
CEGL002593	Eastern Redcedar Woodland and Forest	*Juniperus virginiana* Midwest Forest	99	673.96	272.75
similar to CEGL002586	Silver Maple Forest	*Acer saccharinum - Ulmus americana* Forest	2	6.35	2.57
CEGL002076	Typic Upland Deciduous Woodland and Forest	*Quercus velutina - Quercus alba - Carya* (*glabra, ovata*) Forest	75	2,001.43	809.98
Herbaceous and Shrubland Vegetation					
CEGL002233	Marsh	*Typha spp.* Midwest Herbaceous Vegetation	2	.53	.21
CEGL004048	Mowed Grassland	*Schedonorus* (*phoenix, pratensis*) Herbaceous Vegetation	16	568.88	230.22
None assigned	Restored Tallgrass Prairie	*Schizachyrium scoparium - Andropogon gerardii / Symphoricarpos orbiculatus* Grassland	2	60.79	24.6
None assigned	Ruderal Grassland and Shrubland	*Symphoricarpos orbiculatus - Ulmus alata - Rubus pensilvanicus / Schedonorus phoenix* Grassland and Shrubland	35	362.86	146.85
Developed Land and Water					
Not applicable	Developed Land	buildings, parking lots, picnic areas, roads, cemetery, garden, sewage application field	38	57.28	23.18
None assigned	Water	man-made, spring-fed pond	5	.59	.24
Total Developed Land and Water			43	57.87	23.42
Total Natural and Semi-natural Vegetation			257	4,209.61	1,703.62
Totals			**300**	**4,267.48**	**1,727.04**

Overall accuracy of the final error matrix was 93.1% (the 90% confidence interval was between 88.6 and 97.6%) for the natural and semi-natural mapped vegetation types at PERI (Appendix A). All nine natural and semi-natural mapped vegetation types exceeded the 80% threshold for both producer's and user's accuracy. Of the 155 accuracy assessment points, 147 were assigned correctly. Kappa Index, or the random chance polygons were assigned correctly, was 93.9%.
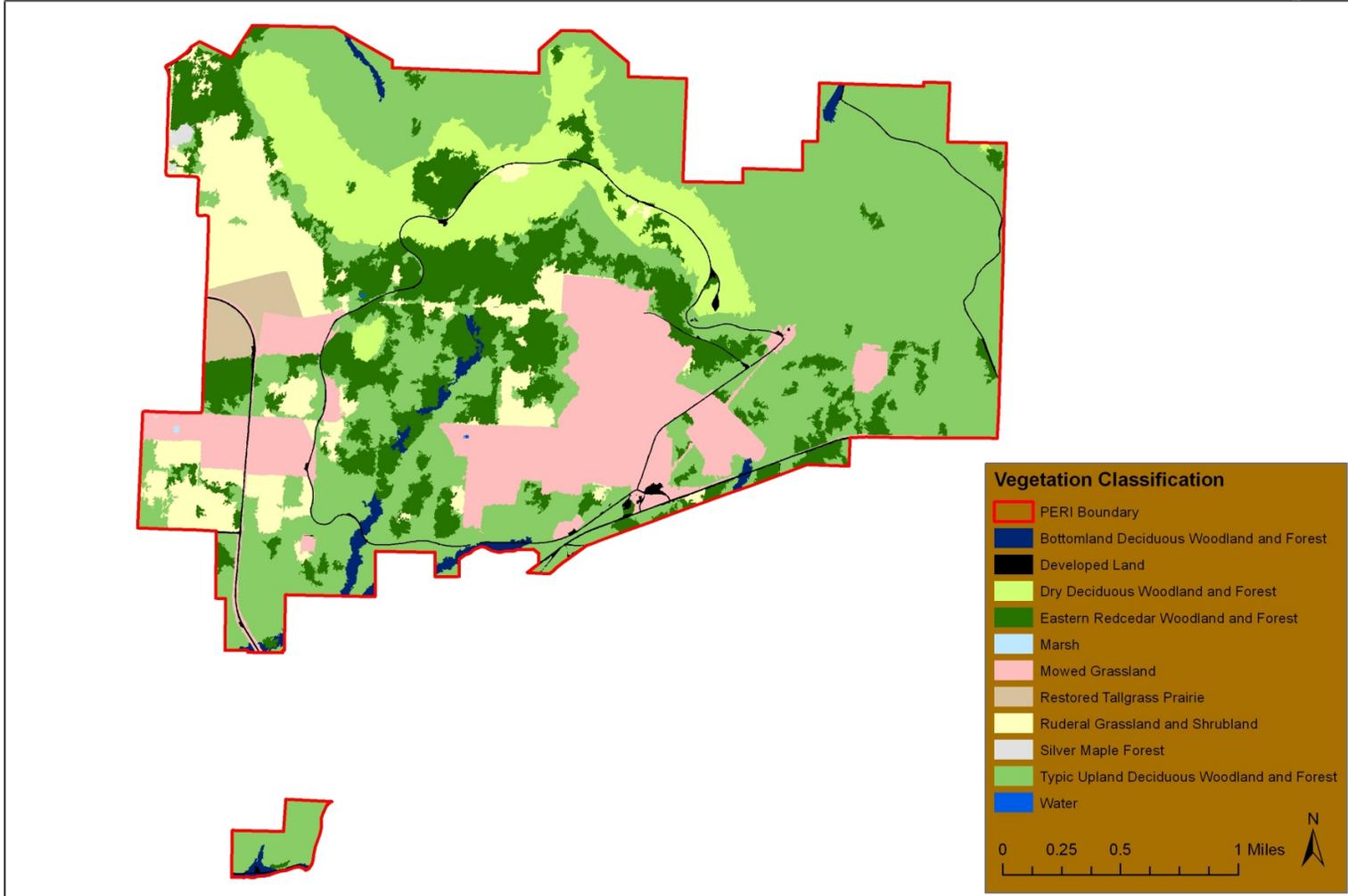
Figure 8. Vegetation map of Pea Ridge National Military Park.

Vegetation Associations

Mapped Type Name: Bottomland Deciduous Woodland and Forest

Macrogroup: Northern & Central Floodplain Forest & Scrub (MG029)

Group: Silver Maple – Green Ash – Sycamore – Hackberry Floodplain Forest (G040)

Association: No association assigned, but similar to CEGL002410 *Fraxinus pennsylvanica – Celtis* spp. *– Quercus* spp. *– Platanus occidentalis* Bottomland Forest

Type Common Name: Black Walnut – Red Mulberry – American Elm Bottomland Forest

Type Scientific Name: *Juglans nigra - Morus rubra - Ulmus americana* Bottomland Forest

Figure 9. Bottomland Deciduous Woodland and Forest at Pea Ridge National Military Park.

Global Summary: The similar association is part of the broadly-defined North-Central Interior Floodplain ecological system that is found along rivers and streams in the Midwest. The system occurs from river's edge across the floodplain or to where it meets a wet meadow or upland system. The ash - oak - sycamore mesic bottomland forest association is found in Arkansas, Missouri and possibly other parts of the southeastern United States. Stands occur on level to gently sloping terraces and levees of stream and river floodplains, typically on larger streams. Soils are moderately well-drained and moist throughout the year, but only wet in spring. Ponding is typically absent. The species in the dominant tree layer include common hackberry (*Celtis occidentalis),* green ash (*Fraxinus pennsylvanica),* American sycamore (*Platanus occidentalis),* bur oak (*Quercus macrocarpa*) (or more rarely white oak (*Quercus alba)*). Canadian woodnettle (*Laportea canadensis)* is common in the ground layer (Figure 9).

Environmental Description: At PERI, this type was restricted to well-watered soils of narrow floodplains along small streams, especially Lee Creek.

Vegetation Description: Relatively early successional bottomland species dominated this type at PERI. Important overstory species included black walnut (*Juglans nigra*), American elm (*Ulmus americana*), red mulberry (*Morus rubra*), common hackberry (*Celtis occidentalis*), boxelder (*Acer negundo*), and chinkapin oak (*Quercus muehlenbergii*). Coralberry (*Symphoricarpos orbiculatus*) and northern spicebush (*Lindera benzoin*) were present within all plots and dominated the shrub layer. The non-native invasive multiflora rose (*Rosa multiflora*) also occurred in all plots. Virginia wildrye (*Elymus virginicus*) was the most dominant herbaceous species, although several others occurred in all plots (Table 5).

Most Abundant Species:

Table 5. Average cover (for plots where the species occurred) and frequency for four 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			
Ulmus rubra	slippery elm	30.3	25.0%
Juglans nigra	black walnut	29.8	100.0%
Nyssa sylvatica	black gum	17.6	25.0%
Morus rubra	red mulberry	16.0	75.0%
Acer negundo	boxelder	15.8	50.0%
Platanus occidentalis	American sycamore	15.0	25.0%
Ulmus americana	American elm	12.0	100.0%
Celtis occidentalis	common hackberry	6.7	100.0%
Quercus muehlenbergii	chinkapin oak	5.6	75.0%
Fraxinus pennsylvanica	green ash	4.0	25.0%
Maclura pomifera	Osage orange	3.5	25.0%
Gleditsia triacanthos	honey locust	3.0	25.0%
Quercus rubra	northern red oak	2.5	75.0%

Table 5. Average cover (for plots where the species occurred) and frequency for four 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
Quercus velutina	black oak	2.2	50.0%
Fraxinus americana	white ash	2.0	50.0%
Aesculus glabra.	Ohio buckeye	1.0	25.0%
Asimina triloba	pawpaw	1.0	25.0%
Juniperus virginiana	eastern redcedar	1.0	25.0%
Cornus florida	flowering dogwood	0.8	75.0%
Carya cordiformis	bitternut hickory	0.5	50.0%
Prunus serotina	black cherry	0.5	50.0%
Shrub			
Symphoricarpos orbiculatus	coralberry	41.2	100.0%
Lindera benzoin	northern spicebush	24.2	100.0%
Lonicera japonica.	Japanese honeysuckle	8.0	50.0%
Rosa multiflora.	multiflora rose	6.8	100.0%
Toxicodendron radicans	eastern poison ivy	6.3	75.0%
Parthenocissus quinquefolia	Virginia creeper	6.2	75.0%
Vitis vulpina	frost grape	3.5	75.0%
Frangula caroliniana	Carolina buckthorn	3.0	25.0%
Ribes missouriense	Missouri gooseberry	3.0	25.0%
Rosa carolina	Carolina rose	3.0	25.0%
Smilax bona-nox	saw greenbrier	2.0	50.0%
Sambucus nigra ssp. *canadensis*	American black elderberry	2.0	50.0%
Euonymus fortunei	winter creeper	1.0	25.0%
Viburnum rufidulum	rusty blackhaw	0.7	50.0%
Smilax tamnoides	bristly greenbrier	0.5	75.0%
Rubus pensilvanicus	Pennsylvania blackberry	0.5	50.0%
Herbaceous			
Glechoma hederacea	ground ivy	37.5	25.0%
Laportea canadensis	Canadian woodnettle	37.5	25.0%
Elymus virginicus	Virginia wildrye	28.3	100.0%
Chasmanthium latifolium	Indian woodoats	26.0	75.0%
Carex amphibola	eastern narrowleaf sedge	5.3	75.0%
Microstegium vimineum	Nepalese browntop	5.3	75.0%

Table 5. Average cover (for plots where the species occurred) and frequency for four 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
Carex blanda	eastern woodland sedge	4.8	100.0%
Verbesina alternifolia	wingstem	2.2	75.0%
Chaerophyllum tainturieri.	hairyfruit chervil	1.8	50.0%
Dichanthelium clandestinum	deertongue	1.8	50.0%
Festuca subverticillata	nodding fescue	1.8	50.0%
Valerianella radiata	beaked cornsalad	1.8	50.0%
Ageratina altissima var. *altissima*	white snakeroot	1.3	75.0%
Galium aparine	stickywilly	1.3	75.0%
Sanicula odorata	clustered blacksnakeroot	1.1	100.0%
Geum canadense.	white avens	0.5	100.0%
Phryma leptostachya	American lopseed	0.5	100.0%
Viola sororia	common blue violet	0.5	100.0%
Agrimonia pubescens	soft agrimony	0.5	75.0%
Allium canadense	meadow garlic	0.5	75.0%
Amphicarpaea bracteata var. *bracteata*	American hogpeanut	0.5	75.0%
Elephantopus carolinianus.	Carolina elephantsfoot	0.5	75.0%
Arisaema dracontium	green dragon	0.5	50.0%
Botrychium virginianum	rattlesnake fern	0.5	50.0%
Geum vernum	spring avens	0.5	50.0%
Oxalis dillenii.	slender yelloww Woodsorrel	0.5	50.0%
Pilea pumila	Canadian clearweed	0.5	50.0%
Poa sylvestris	woodland bluegrass	0.5	50.0%
Polygonum virginianum	jumpseed	0.5	50.0%
Ranunculus recurvatus	blisterwort	0.5	50.0%
Triodanis perfoliata	clasping Venus' looking-glass	0.5	50.0%
Verbesina virginica	white crownbeard	0.5	50.0%
Veronica arvensis	corn speedwell	0.5	50.0%
Woodsia obtusa	bluntlobe cliff fern	0.5	50.0%

Mapped Type Name: Dry Deciduous Woodland and Forest
Macrogroup: South-Central Oak – Hardwood & Pine Forest (MG016)
Group: *Quercus alba – Quercus falcata – Quercus rubra* Forest and Woodland
                    Group (G159)
Association: CEGL002149
NVC Common Name: Ozark/Ouachita Post Oak – Blackjack Oak – Black Oak / Little
                    Bluestem Woodland
NVC Scientific Name: *Quercus stellata - Quercus marilandica - Quercus velutina - Carya
texana / Schizachyrium scoparium* Woodland

Figure 10. Dry Deciduous Woodland and Forest at Pea Ridge National Military Park.

Global Summary: This type is part of the Ozark-Ouachita Dry Oak Woodland ecological system (Figure 10), which is common throughout the Ozarks and Ouachita's and into the Interior Low Plateau regions on dry site types. The post oak - blackjack oak woodland type occurs on gentle to steep hills and plains, bluff escarpments, and broad ridges and flats with any aspect, but primarily south- and west-facing slopes. Soils are rapidly to very rapidly drained, shallow, and strewn with boulders, cobbles, gravel, and sand. Soil pH is neutral to slightly acidic. Bedrock can be sandstone, chert, or igneous rock and is often exposed. The tree canopy is short to medium (7-20 m), spreading, open, and limby. Dominant species include post oak (*Quercus stellata)* and/or blackjack oak (*Quercus marilandica)*. Other species may form a minor canopy component, scattered in the canopy, and include (e.g., *Quercus velutina, Quercus rubra, Quercus alba*, and *Carya alba*). The understory is very poorly developed, consisting of a few widely scattered shrubs and small trees, including, in addition to the dominant trees, winged elm (*Ulmus*

alata) and *Vaccinium* spp. (*Vaccinium arboreum, Vaccinium stamineum*, or *Vaccinium pallidum*). Coverage of the herbaceous stratum can vary from quite sparse to moderately dense, consisting of mixed grasses and forbs. Typical species include woodland sunflower (*Helianthus divaricatus),* American ipecac (*Porteranthus stipulatus),* poverty oatgrass (*Danthonia spicata),* little bluestem (*Schizachyrium scoparium),* common dittany *(Cunila origanoides),* big bluestem (*Andropogon gerardii)*, and tall blazing star (*Liatris aspera)*, but others may occur. Lichens and mosses can be abundant.

Environmental Description: At PERI, this type occurred on well-drained, elevated sandstone and shale hills and plateaus and down gentle slopes associated with the sandstone and shale. The largest expanse was on Elkhorn Mountain, a linear mountain that trends east to west across the north central portion of the park.

Vegetation Description: The most elevated portions of this type formed open woodlands with a grassy understory, and areas downslope were more closed with fewer herbaceous species in the understory. Post oak (*Quercus stellata*) was the prevailing dominant tree, with blackjack oak (*Quercus marilandica*), black hickory (*Carya texana*), and black oak (*Quercus velutina*) often important components. Coralberry (*Symphoricarpos orbiculatus*) was among the most important shrubs on every plot, and deerberry (*Vaccinium stamineum*), winged elm (*Ulmus alata*), common service berry (*Amelanchier arborea*), and rusty blackhaw (*Viburnum rufidulum*) were often important. Virginia creeper (*Parthenocissus quinquefolia*) and Pennsylvania blackberry (*Rubus pensilvanicus*) were important vines. Important herbaceous species included Virginia wildrye (*Elymus virginicus*), poverty oatgrass (*Danthonia spicata*), Muhlenberg's sedge (*Carex muehlenbergii*), and rock muhly (*Muhlenbergia sobolifera*) (Table 6).

Most Abundant Species:

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

Dry Deciduous Woodland and Forest			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Quercus stellata	post oak	40.99	87.5%
Quercus rubra	northern red oak	17.77	37.5%
Carya ovata	shagbark hickory	15.85	12.5%
Carya glabra	pignut hickory	15.00	12.5%
Quercus velutina.	black oak	12.83	87.5%
Quercus marilandica	blackjack oak	10.94	62.5%
Carya texana	black hickory	10.18	100.0%
Ulmus americana	American elm	7.96	25.0%
Quercus alba	white oak	5.70	50.0%
Juglans nigra	black walnut	3.73	25.0%
Carya alba	mockernut hickory	3.00	12.5%
Tilia americana	American basswood	1.75	25.0%

Table 6. Average cover (for plots where the species occurred) and frequency for eight plots taken within Dry 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
Morus rubra	red mulberry	1.25	50.0%
Nyssa sylvatica	blackgum	1.00	25.0%
Diospyros virginiana	common persimmon	0.67	75.0%
Juniperus virginiana	eastern redcedar	0.58	75.0%
Celtis occidentalis	common hackberry	0.50	87.5%
Fraxinus americana	white ash	0.50	50.0%
Sassafras albidum	sassafras	0.50	37.5%
Gleditsia triacanthos	honeylocust	0.50	25.0%
Shrub			
Vaccinium stamineum	deerberry	9.75	50.0%
Cornus florida	flowering dogwood	6.33	37.5%
Symphoricarpos orbiculatus	Coralberry	3.07	100.0%
Amelanchier arborea	common serviceberry	1.41	75.0%
Ulmus alata	winged elm	0.87	87.5%
Parthenocissus quinquefolia	Virginia creeper	0.75	100.0%
Rubus pensilvanicus	Pennsylvania blackberry	0.50	75.0%
Vitis vulpina	frost grape	0.50	75.0%
Viburnum rufidulum	rusty blackhaw	0.50	62.5%
Smilax bona-nox	saw greenbrier	0.50	50.0%
Frangula caroliniana	Carolina buckthorn	0.50	25.0%
Lonicera flava	yellow honeysuckle	0.50	25.0%
Rosa carolina.	Carolina rose	0.50	25.0%
Toxicodendron radicans	eastern poison ivy	0.50	25.0%
Herbaceous			
Elymus virginicus	Virginia wildrye	6.06	100.0%
Danthonia spicata	poverty oatgrass	4.00	87.5%
Muhlenbergia sobolifera	rock muhly	3.33	75.0%
Carex muehlenbergii	Muhlenberg's sedge	3.29	87.5%
Stellaria media	common chickweed	3.00	12.5%
Cardamine parviflora	sand bittercress	2.92	75.0%
Cunila origanoides	common dittany	1.75	25.0%
Dichanthelium laxiflorum	openflower rosette grass	1.75	25.0%
Lespedeza violacea	violet lespedeza	1.75	25.0%
Woodsia obtusa	bluntlobe cliff fern	1.75	25.0%
Carex hirsutella.	fuzzy wuzzy sedge	1.75	100.0%
Carex albicans var. *albicans*	whitetinge sedge	1.75	75.0%

Table 6. Average cover (for plots where the species occurred) and frequency for eight plots taken within Dry 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
Krigia dandelion	potato dwarfdandelion	1.33	37.5%
Scutellaria parvula.	small skullcap	1.33	37.5%
Carex cephalophora	oval-leaf sedge	1.33	75.0%
Triodanis perfoliata	clasping Venus' looking-glass	1.21	87.5%
Parietaria pensylvanica	Pennsylvania pellitory	1.13	50.0%
Schizachyrium scoparium	little bluestem	1.13	50.0%
Scutellaria ovata	heartleaf skullcap	1.00	62.5%
Solidago ulmifolia	elmleaf goldenrod	1.00	62.5%
Rubus flagellaris	northern dewberry	0.67	37.5%
Carex retroflexa	reflexed sedge	0.50	100.0%
Lespedeza procumbens	trailing lespedeza	0.50	100.0%
Asclepias quadrifolia	fourleaf milkweed	0.50	87.5%
Dichanthelium boscii	Bosc's panicgrass	0.50	87.5%
Antennaria plantaginifolia	woman's tobacco	0.50	75.0%
Desmodium perplexum	perplexed ticktrefoil	0.50	75.0%
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	0.50	75.0%
Dichanthelium linearifolium	slimleaf panicgrass	0.50	75.0%
Galium circaezans.	licorice bedstraw	0.50	75.0%
Lespedeza virginica	slender lespedeza	0.50	75.0%
Aristolochia serpentaria	Virginia snakeroot	0.50	62.5%
Asplenium platyneuron	ebony spleenwort	0.50	62.5%
Carex nigromarginata	black edge sedge	0.50	62.5%
Carex umbellata	parasol sedge	0.50	62.5%
Hypericum hypericoides spp. *hypericoides*	St. Andrew's cross	0.50	62.5%
Acalypha virginica	Virginia threeseed mercury	0.50	50.0%
Amphicarpaea bracteata var. *bracteata*	American hogpeanut	0.50	50.0%
Bidens bipinnata	Spanish needles	0.50	50.0%
Festuca subverticillata	nodding fescue	0.50	50.0%
Galium aparine	stickywilly	0.50	50.0%
Lobelia spicata	palespike lobelia	0.50	50.0%
Oxalis violacea	violet woodsorrel	0.50	50.0%
Physalis virginiana	Virginia groundcherry	0.50	50.0%
Sanicula canadensis	Canadian blacksnakeroot	0.50	50.0%
Symphyotrichum patens var. *patens*	late purple aster	0.50	50.0%
Tridens flavus	purpletop tridens	0.50	50.0%
Andropogon virginicus	broomsedge bluestem	0.50	37.5%

Table 6. Average cover (for plots where the species occurred) and frequency for eight plots taken within Dry 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
Desmodium nuttallii	Nuttall's ticktrefoil	0.50	37.5%
Dichanthelium malacophyllum	softleaf rosette grass	0.50	37.5%
Galium pilosum	hairy bedstraw	0.50	37.5%
Hypoxis hirsuta	common goldstar	0.50	37.5%
Lespedeza repens	creeping lespedeza	0.50	37.5%
Mimosa nuttallii	Nuttall's sensitive-briar	0.50	37.5%
Panicum anceps.	beaked panicgrass	0.50	37.5%
Viola triloba.	three-lobe violet	0.50	37.5%
Ageratina altissima var. *altissima*	white snakeroot	0.50	25.0%
Botrychium virginianum	rattlesnake fern	0.50	25.0%
Bromus pubescens	hairy woodland brome	0.50	25.0%
Carex glaucodea	blue sedge	0.50	25.0%
Chaerophyllum tainturieri.	hairyfruit chervil	0.50	25.0%
Conyza canadensis	Canadian horseweed	0.50	25.0%
Desmodium marilandicum	smooth small-leaf ticktrefoil	0.50	25.0%
Desmodium rotundifolium	prostrate ticktrefoil	0.50	25.0%
Dichanthelium commutatum	variable panicgrass	0.50	25.0%
Dichanthelium dichotomum	cypress panicgrass	0.50	25.0%
Erigeron annuus.	eastern daisy fleabane	0.50	25.0%
Euphorbia corollata	flowering spurge	0.50	25.0%
Geum canadense	white avens	0.50	25.0%
Hieracium gronovii	queendevil	0.50	25.0%
Oxalis dillenii	slender yellow woodsorrel	0.50	25.0%
Penstemon digitalis	talus slope penstemon	0.50	25.0%
Poa sylvestris	woodland bluegrass	0.50	25.0%
Polygonum scandens	climbing false buckwheat	0.50	25.0%
Solanum carolinense	Carolina horsenettle	0.50	25.0%
Solidago buckleyi	Buckley's goldenrod	0.50	25.0%
Sphenopholis obtusata	prairie wedgescale	0.50	25.0%
Stylosanthes biflora	sidebeak pencilflower	0.50	25.0%
Thalictrum thalictroides	rue anemone	0.50	25.0%
Verbesina alternifolia	wingstem	0.50	25.0%
Vernonia baldwinii.	Baldwin's ironweed	0.50	25.0%
Viola bicolor	field pansy	0.50	25.0%
Viola sororia	common blue violet	0.50	25.0%

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 (G0303)
Association: CEGL002593
NVC Common Name: Eastern Redcedar Midwest Forest
NVC Scientific Name: *Juniperus virginiana* Midwest Forest

Figure 11. Eastern Redcedar Woodland and Forest at Pea Ridge National Military Park.

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. 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 (Figure 11).

Environmental Description: At PERI, this type occurred in old crop fields over all soils and in all landscape positions.

Vegetation Description: Eastern redcedar was the prevailing dominant of this type, often in low-diversity stands. Other trees found in all or almost all plots included American elm (*Ulmus americana*), common hackberry (*Celtis occidentalis*), black oak (*Quercus velutina*), and red mulberry (*Morus rubra*). These deciduous trees may overtop and replace eastern redcedar over

time, and hence stands that represent this type may become more different from each other through succession (e.g. stands in bottomlands versus stands in uplands will be dominated by different deciduous species). Other common small trees and shrubs included flowering dogwood (*Cornus florida*), common persimmon (*Diospyros virginiana*), and coral berry (*Symphoricarpos orbiculatus*). Common vines included Virginia creeper (*Parthenocissus quinquefolia*), saw greenbrier (*Smilax bona-nox*), eastern poison ivy (*Toxicodendron radicans*), and frost grape (*Vitis vulpina*). Common herbaceous species included ebony spleenwort (*Asplenium platyneuron*), eastern woodland sedge (*Carex blanda*), reflexed sedge (*Carex retroflexa*), and Virginia wildrye (*Elymus virginicus*) (Table 7).

Most Abundant Species:

Table 7. Average cover (for plots where the species occurred) and frequency for thirteen 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	54.9	100.0%
Quercus alba	white oak	28.1	7.7%
Platanus occidentalis	American sycamore	15.0	7.7%
Quercus velutina	black oak	10.4	76.9%
Cornus florida	flowering dogwood	10.0	92.3%
Juglans nigra	black walnut	9.8	38.5%
Ulmus americana	American elm	8.6	100.0%
Maclura pomifera	Osage orange	5.5	23.1%
Quercus stellata.	post oak	5.0	69.2%
Quercus muehlenbergii	chinkapin oak	4.9	30.8%
Sassafras albidum	sassafras	4.5	69.2%
Carya cordiformis	bitternut hickory	3.5	15.4%
Fraxinus americana	white ash	3.3	84.6%
Quercus marilandica.	blackjack oak	3.0	53.8%
Morus rubra	red mulberry	2.5	69.2%
Diospyros virginiana	common persimmon	1.6	61.5%
Celtis occidentalis	common hackberry	1.4	100.0%
Prunus serotina	black cherry	1.0	46.2%
Carya texana	black hickory	0.6	53.8%
Gleditsia triacanthos	honeylocust	0.5	38.5%
Quercus rubra	northern red oak	0.5	23.1%
Acer rubrum	red maple	0.5	15.4%
Carya alba	mockernut hickory	0.5	15.4%
Salix nigra	black willow	0.5	15.4%

Table 7. Average cover (for plots where the species occurred) and frequency for thirteen 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
Shrub			
Lindera benzoin	northern spicebush	10.5	61.5%
Symphoricarpos orbiculatus	coralberry	10.1	100.0%
Vitis vulpina	frost grape	7.6	92.3%
Frangula caroliniana	Carolina buckthorn	5.5	1.0%
Parthenocissus quinquefolia	Virginia creeper	1.3	100.0%
Rosa multiflora	multiflora rose	1.2	69.2%
Viburnum rufidulum	rusty blackhaw	1.1	38.5%
Smilax bona-nox	saw greenbrier	0.8	100.0%
Ulmus alata	winged elm	0.7	30.8%
Toxicodendron radicans	eastern poison ivy	0.5	76.9%
Rubus pensilvanicus	Pennsylvania blackberry	0.5	61.5%
Smilax tamnoides	bristly greenbrier	0.5	53.8%
Ribes missouriense	Missouri gooseberry	0.5	30.8%
Sideroxylon lanuginosum	gum bully	0.5	30.8%
Ilex opaca	American holly	0.5	23.1%
Prunus americana	American plum	0.5	15.4%
Rosa carolina	Carolina rose	0.5	15.4%
Herbaceous			
Bromus arvensis	field brome	37.5	7.7%
Chasmanthium latifolium	Indian woodoats	17.8	61.5%
Trifolium campestre	field clover	5.3	23.1%
Elymus virginicus	Virginia wildrye	3.4	84.6%
Lonicera japonica	Japanese honeysuckle	3.0	46.0%
Antennaria plantaginifolia	woman's tobacco	3.0	7.7%
Leersia oryzoides	rice cutgrass	3.0	7.7%
Carex retroflexa	reflexed sedge	2.5	76.9%
Carex blanda	eastern woodland sedge	2.3	92.3%
Danthonia spicata	poverty oatgrass	1.4	61.5%
Poa sylvestris	woodland bluegrass	1.3	23.1%
Amphicarpaea bracteata var. *bracteata*	American hogpeanut	1.2	53.8%
Carex cephalophora	oval-leaf sedge	1.1	30.8%
Carex amphibola	eastern narrowleaf sedge	1.0	38.5%
Sanicula odorata	clustered blacksnakeroot	1.0	38.5%
Asplenium platyneuron	ebony spleenwort	0.9	100.0%
Chaerophyllum tainturieri	hairyfruit chervil	0.9	53.8%

Table 7. Average cover (for plots where the species occurred) and frequency for thirteen 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
Panicum anceps.	beaked panicgrass	0.9	53.8%
Festuca subverticillata	nodding fescue	0.8	69.2%
Carex hirsutella	fuzzy wuzzy sedge	0.8	76.9%
Galium aparine	stickywilly	0.8	76.9%
Muhlenbergia sobolifera	rock muhly	0.8	76.9%
Sanicula canadensis	Canadian blacksnakeroot	0.5	69.2%
Woodsia obtusa	bluntlobe cliff fern	0.5	69.2%
Dichanthelium malacophyllum	softleaf rosette grass	0.5	61.5%
Galium circaezans	licorice bedstraw	0.5	61.5%
Lespedeza procumbens.	trailing lespedeza	0.5	61.5%
Phryma leptostachya.	American lopseed	0.5	61.5%
Ranunculus abortivus.	littleleaf buttercup	0.5	61.5%
Desmodium perplexum	perplexed ticktrefoil	0.5	53.8%
Hackelia virginiana	beggarslice	0.5	53.8%
Ambrosia artemisiifolia	annual ragweed	0.5	46.2%
Cirsium altissimum	tall thistle	0.5	46.2%
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	0.5	46.2%
Lactuca floridana	woodland lettuce	0.5	46.2%
Rubus flagellaris.	northern dewberry	0.5	46.2%
Teucrium canadense	Canada germander	0.5	46.2%
Anemone virginiana	tall thimbleweed	0.5	38.5%
Carex nigromarginata	black edge sedge	0.5	38.5%
Elephantopus carolinianus.	Carolina elephantsfoot	0.5	38.5%
Parietaria pensylvanica	Pennsylvania pellitory	0.5	38.5%
Scutellaria ovata	heartleaf skullcap	0.5	38.5%
Triodanis perfoliata	clasping Venus' looking-glass	0.5	38.5%
Valerianella radiata	beaked cornsalad	0.5	38.5%
Vernonia baldwinii	Baldwin's ironweed	0.5	38.5%
Acalypha virginica	Virginia threeseed mercury	0.5	30.8%
Botrychium dissectum	cutleaf grapefern	0.5	30.8%
Erigeron annuus	eastern daisy fleabane	0.5	30.8%
Ipomoea pandurata	man of the earth	0.5	30.8%
Lactuca canadensis	Canada lettuce	0.5	30.8%
Lespedeza cuneata	sericea lespedeza	0.5	30.8%
Liparis liliifolia	brown widelip orchid	0.5	30.8%
Passiflora lutea	yellow passionflower	0.5	30.8%

Table 7. Average cover (for plots where the species occurred) and frequency for thirteen 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
Penstemon digitalis	talus slope penstemon	0.5	30.8%
Perilla frutescens	beefsteakplant	0.5	30.8%
Potentilla simplex.	common cinquefoil	0.5	30.8%
Prunella vulgaris	common selfheal	0.5	30.8%
Ranunculus recurvatus	blisterwort	0.5	30.8%
Rudbeckia hirta	blackeyed Susan	0.5	30.8%
Taraxacum officinale	common dandelion	0.5	30.8%
Viola sororia	common blue violet	0.5	30.8%
Agrimonia pubescens.	soft agrimony	0.5	23.1%
Agrimonia rostellata	beaked agrimony	0.5	23.1%
Arisaema dracontium	green dragon	0.5	23.1%
Dichanthelium laxiflorum	openflower rosette grass	0.5	23.1%
Galium pilosum	hairy bedstraw	0.5	23.1%
Houstonia purpurea	Venus' pride	0.5	23.1%
Hypericum hypericoides	St. Andrew's cross	0.5	23.1%
Menispermum canadense	common moonseed	0.5	23.1%
Physalis virginiana	Virginia groundcherry	0.5	23.1%
Ranunculus hispidus	bristly buttercup	0.5	23.1%
Smilax ecirrhata	upright carrionflower	0.5	23.1%
Tridens flavus	purpletop tridens	0.5	23.1%
Verbesina virginica	white crownbread	0.5	23.1%
Allium canadense	meadow garlic	0.5	15.4%
Andropogon virginicus	broomsedge bluestem	0.5	15.4%
Barbarea vulgaris	garden yellowrocket	0.5	15.4%
Brachyelytrum erectum	bearded shorthusk	0.5	15.4%
Carex glaucodea	blue sedge	0.5	15.4%
Carex muehlenbergii	Muhlenberg's sedge	0.5	15.4%
Desmodium nudiflorum	nakedflower ticktrefoil	0.5	15.4%
Desmodium paniculatum	panicledleaf ticktrefoil	0.5	15.4%
Dichanthelium boscii	Bosc's panicgrass	0.5	15.4%
Dichanthelium clandestinum	deertongue	0.5	15.4%
Erigeron strigosus	prairie fleabane	0.5	15.4%
Geranium carolinianum	Carolina geranium	0.5	15.4%
Hypericum punctatum	spotted St. Johnswort	0.5	15.4%
Juncus tenuis	poverty rush	0.5	15.4%
Leersia virginica	whitegrass	0.5	15.4%

Table 7. Average cover (for plots where the species occurred) and frequency for thirteen 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
Lespedeza repens	creeping lespedeza	0.5	15.4%
Lespedeza violacea	violet lespedeza	0.5	15.4%
Muhlenbergia schreberi	nimblewill	0.5	15.4%
Oxalis stricta	common yellow oxalis	0.5	15.4%
Oxalis violacea	violet woodsorrel	0.5	15.4%
Physalis heterophylla	clammy groundcherry	0.5	15.4%
Polystichum acrostichoides	Christmas fern	0.5	15.4%
Ruellia humilis	fringeleaf wild petunia	0.5	15.4%
Salvia lyrata	lyreleaf sage	0.5	15.4%
Solidago ulmifolia	elmleaf goldenrod	0.5	15.4%
Viola triloba	three-lobe violet	0.5	15.4%

Mapped Type Name: Marsh
Macrogroup: Eastern North American Wet Meadow & Marsh (MG069)
Group: *Schoenoplectus* spp. – *Typha* spp. Freshwater Marsh Group (G125)
Association: CEGL002233
NVC Common Name: Midwest Cattail Deep Marsh
NVC Scientific Name: *Typha* spp. Midwest Herbaceous Vegetation

Figure 12. Marsh at Pea Ridge National Military Park.

Global Summary: This type is within the North – Central Interior Freshwater Marsh ecological system, which is found throughout the Midwest north to southern Canada (Figure 12). Soils are hydric and representative stands include shallow, emergent herbaceous vegetation and submerged rooted vegetation. Many sources of water are included in the concept, from local depressions to streamsides and lakesides. The system occurs as small patches in the landscape.

Environmental Description: At PERI, this type was restricted to a single small area that retained water in the southeastern part of the park. The marsh was surrounded by grassland and includes small areas of open water in most years and seasons.

Vegetation Description: The marsh was dominated by broadleaf cattail (*Typha latifolia*) together with sedges (*Carex lurida*, *C. molesta*). Yellow pond-lily (*Nuphar lutea*) was also found in the often-flooded areas. A few small trees and shrubs, including common persimmon

(*Diospyros virginiana*), American sycamore (*Platanus occidentalis*), and silver maple (*Acer saccharinum*) were scattered in the marsh (Table 8).

Most Abundant Species:

Table 8. Cover by layer and species for one plot taken within Marsh.

Marsh		
Scientific Name	**Common Name**	**%Cover**
Tree		
Diospyros virginiana	common persimmon	3
Platanus occidentalis	American sycamore	3
Acer saccharinum	silver maple	0.5
Juniperus virginiana	eastern redcedar	0.5
Herbaceous		
Typha latifolia	broadleaf cattail	62.5
Carex lurida	shallow sedge	15
Carex molesta	troublesome sedge	15
Nuphar lutea	yellow pond-lily	15
Polygonum sp.	knotweed	15
Leersia oryzoides	rice cutgrass	3
Ageratina altissima var. *altissima*	white snakeroot	0.5
Andropogon virginicus	broomsedge bluestem	0.5
Carex annectens	yellowfruit sedge	0.5
Eleocharis sp.	spikerush	0.5
Juncus tenuis	poverty rush	0.5
Lycopus americanus	American water horehound	0.5
Phleum pratense	timothy	0.5
Scirpus sp.	bulrush	0.5
Vicia sativa	garden vetch	0.5

Mapped Type Name: Mowed 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 13. Mowed Grassland at Pea Ridge National Military Park.

Global Summary: This association 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 redtop (*Agrostis gigantea),* orchardgrass *(Dactylis glomerata),* common velvetgrass *(Holcus lanatus),* timothy *(Phleum pratense)*, and Kentucky bluegrass (*Poa pratensis)* 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),* Gould 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)*. 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 (Figure 13).

Environmental Description: At PERI, this type occurred as mowed fields in the central and southern part of the park. The condition of the fields, especially the views afforded visitors, is designed to enhance interpretation of the historic battlefield.

Vegetation Description: Tall fescue (*Schedonorus phoenix)* was the prevailing dominant of this type, and broomsedge bluestem (*Andropogon virginicus*) was present in all plots. Chapman's bluegrass (*Poa chapmaniana*) was often important (Table 9). No species of woody plant or vine was present in more than one plot, and overall cover values were always low.

Most Abundant Species:

Table 9. Average cover (for plots where the species occurred) and frequency for three plots taken within Mowed Grassland. Only species with at least 0.5% cover in at least two plots are shown.

Mowed Grassland			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Acer negundo	boxelder	0.5	33.0%
Diospyros virginiana	common persimmon	0.5	33.0%
Fraxinus americana	white ash	0.5	33.0%
Shrub			
Parthenocissus quinquefolia	Virginia creeper	0.5	33.0%
Prunus americana	American plum	0.5	33.0%
Rubus pensilvanicus	Pennsylvania blackberry	0.5	33.0%
Symphoricarpos orbiculatus	coralberry	0.5	33.0%
Ulmus alata	winged elm	0.5	33.0%
Vitis vulpina.	frost grape	0.5	33.0%
Herbaceous			
Pycnanthemum tenuifolium	narrowleaf mountainmint	62.5	33.3%
Schedonorus phoenix	tall fescue	61.7	100.0%
Poa chapmaniana	Chapman's bluegrass	26.3	66.7%
Carex annectens	yellowfruit sedge	15.0	33.3%
Carex molesta	troublesome sedge	15.0	33.3%
Andropogon virginicus	broomsedge bluestem	6.2	100.0%
Lolium perenne ssp. *multiflorum*	Italian ryegrass	3.0	33.3%
Poa pratensis	Kentucky bluegrass	3.0	33.3%
Vernonia baldwinii	Baldwin's ironweed	3.0	33.3%
Dactylis glomerata	orchardgrass	0.5	66.7%
Oxalis dillenii	slender yellow woodsorrel	0.5	66.7%
Pseudognaphalium obtusifolium ssp. *obtusifolium*	rabbit-tobacco	0.5	66.7%
Vicia sativa	garden vetch	0.5	66.7%

Table 9. Average cover (for plots where the species occurred) and frequency for three plots taken within Mowed Grassland. Only species with at least 0.5% cover in at least two plots are shown. (continued).

Scientific Name	Common Name	%Cover	Frequency
Ageratina altissima var. *altissima*	white snakeroot	0.5	33.3%
Carex bushii	Bush's sedge	0.5	33.3%
Carex cephalophora	oval-leaf sedge	0.5	33.3%
Carex retroflexa	reflexed sedge	0.5	33.3%
Desmodium paniculatum	panicledleaf ticktrefoil	0.5	33.3%
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	0.5	33.3%
Dichanthelium oligosanthes	Heller's rosette grass	0.5	33.3%
Dichanthelium ravenelii	Ravenel's rosette grass	0.5	33.3%
Eleocharis sp.	spikerush	0.5	33.3%
Elymus virginicus	Virginia wildrye	0.5	33.3%
Erigeron annuus	eastern daisy fleabane	0.5	33.3%
Eupatorium serotinum	lateflowering thoroughwort	0.5	33.3%
Galium virgatum	southwestern bedstraw	0.5	33.3%
Geranium carolinianum	Carolina geranium	0.5	33.3%
Hordeum pusillum	little barley	0.5	33.3%
Juncus tenuis	poverty rush	0.5	33.3%
Lobelia spicata	palespike lobelia	0.5	33.3%
Panicum anceps	beaked panicgrass	0.5	33.3%
Poa annua	annual bluegrass	0.5	33.3%
Potentilla simplex	common cinquefoil	0.5	33.3%
Rubus flagellaris	northern dewberry	0.5	33.3%
Scirpus sp.	bulrush	0.5	33.3%
Sisyrinchium campestre	prairie blue-eyed grass	0.5	33.3%
Solidago ulmifolia	elmleaf goldenrod	0.5	33.3%
Tridens flavus	purpletop tridens	0.5	33.3%
Trifolium campestre	field clover	0.5	33.3%
Valerianella radiata	beaked cornsalad	0.5	33.3%
Vernonia arkansana	Arkansas ironweed	0.5	33.3%
Veronica arvensis	corn speedwell	0.5	33.3%

Mapped Type Name: Restored Tallgrass Prairie

Macrogroup: Planted to replicate – Great Plains Tallgrass Prairie, Savannah &
                              Shrubland (MG054)

Group: Planted to replicate – Central Great Plains Tallgrass Prairie Group (G333)

Association: None assigned

Type Common Name: Little Bluestem – Big Bluestem / Coralberry Herbaceous Vegetation

Type Scientific Name: *Schizachyrium scoparium* - *Andropogon gerardii* / *Symphoricarpos orbiculatus* Herbaceous Vegetation

Figure 14. Restored Tallgrass Prairie at Pea Ridge National Military Park.

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. Restoration efforts are often on-going and uneven, with managers adding native forbs or grasses in an ad hoc fashion. Restored sites are often visually dominated by tall grasses with flowering culms over 2 m tall, but prairie forbs are often lacking or may be present in novel proportions. Weedy shrubs and vines such as blackberry (*Rubus* spp.) and sumac (*Rhus* spp.) are nearly always present in prairie restorations (Figure 14).

Environmental Description: At PERI, restored prairie occurred in a defined block on the far eastern side of the park. Soils were relatively moist and fertile, and the flower culms of dominate grasses reach over 2 m tall.

Vegetation Description: A combination of little bluestem (*Schizachyrium scoparium*) and big bluestem (*Andropogon gerardii*) dominated the restored prairie. Other important species included yellowfruit sedge (*Carex annectens*), Indiangrass (*Sorghastrum nutans*), and broomsedge bluestem (*Andropogon virginicus*). Cool season grasses, including non-native Kentucky bluegrass (*Poa pratensis*) and tall fescue (*Schedonorus phoenix*), were important components under the warm-season grass canopy. Coralberry (*Symphoricarpos orbiculatus*) was found in every plot, and small trees or shrubs, including common persimmon (*Diospyros virginiana*), boxelder (*Acer negundo*), and American elm (*Ulmus americana*), and winged elm (*Ulmus alata*) were minor components (Table 10).

Most Abundant Species:

Table 10. Average cover (for plots where the species occurred) and frequency for two plots taken within Restored Tallgrass Prairie. Only species with at least 0.5% cover in at least two plots are shown.

Restored Tallgrass Prairie			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Diospyros virginiana	common persimmon	3	50.0%
Acer negundo	boxelder	0.5	50.0%
Ulmus americana	American elm	0.5	50.0%
Shrub			
Symphoricarpos orbiculatus	coralberry	7.75	100.0%
Rubus pensilvanicus	Pennsylvania blackberry	3	100.0%
Dioscorea quaternata	fourleaf yam	0.5	50.0%
Ulmus alata	winged elm	0.5	50.0%
Herbaceous			
Andropogon gerardii	big bluestem	62.5	50.0%
Schizachyrium scoparium	little bluestem	38.75	100.0%
Carex annectens	yellowfruit sedge	15	50.0%
Carex molesta	troublesome sedge	7.75	100.0%
Poa pratensis	Kentucky bluegrass	3	100.0%
Sorghastrum nutans	Indiangrass	3	100.0%
Andropogon virginicus	broomsedge bluestem	3	50.0%
Carex blanda	eastern woodland sedge	3	50.0%
Carex bushii	Bush's sedge	3	50.0%
Polygonum	knotweed	3	50.0%
Schedonorus phoenix	tall fescue	1.75	100.0%

Table 10. Average cover (for plots where the species occurred) and frequency for two plots taken within Restored Tallgrass Prairie. 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	0.5	100.0%
Barbarea vulgaris	garden yellowrocket	0.5	100.0%
Galium virgatum	southwestern bedstraw	0.5	100.0%
Lespedeza capitata	roundhead lespedeza	0.5	100.0%
Oxalis dillenii	slender yellow woodsorrel	0.5	100.0%
Plantago virginica	Virginia plantain	0.5	100.0%
Valerianella radiata	beaked cornsalad	0.5	100.0%
Vicia sativa	garden vetch	0.5	100.0%
Acalypha virginica	Virginia threeseed mercury	0.5	50.0%
Achillea millefolium	common yarrow	0.5	50.0%
Ageratina altissima var. *altissima*	white snakeroot	0.5	50.0%
Bidens bipinnata	Spanish needles	0.5	50.0%
Bromus pubescens	hairy woodland brome	0.5	50.0%
Cardamine parviflora	sand bittercress	0.5	50.0%
Cirsium altissimum	tall thistle	0.5	50.0%
Conyza canadensis	Canadian horseweed	0.5	50.0%
Desmodium paniculatum	panicledleaf ticktrefoil	0.5	50.0%
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	0.5	50.0%
Dichanthelium commutatum	variable panicgrass	0.5	50.0%
Eleocharis sp.	spikerush	0.5	50.0%
Erigeron annuus	eastern daisy fleabane	0.5	50.0%
Galium aparine	stickywilly	0.5	50.0%
Geranium carolinianum	Carolina geranium	0.5	50.0%
Juncus tenuis	poverty rush	0.5	50.0%
Lactuca floridana	woodland lettuce	0.5	50.0%
Lespedeza cuneata	sericea lespedeza	0.5	50.0%
Lobelia spicata	palespike lobelia	0.5	50.0%
Panicum anceps	beaked panicgrass	0.5	50.0%
Phytolacca americana	American pokeweed	0.5	50.0%
Plantago rugelii	blackseed plantain	0.5	50.0%
Potentilla recta	sulphur cinquefoil	0.5	50.0%
Rumex acetosella	common sheep sorrel	0.5	50.0%
Rumex crispus	curly dock	0.5	50.0%
Salvia lyrata	lyreleaf sage	0.5	50.0%

Table 10. Average cover (for plots where the species occurred) and frequency for two plots taken within Restored Tallgrass Prairie. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Sisyrinchium campestre	prairie blue-eyed grass	0.5	50.0%
Solanum carolinense	Carolina horsenettle	0.5	50.0%
Solidago altissima	Canada goldenrod	0.5	50.0%
Trifolium campestre	field clover	0.5	50.0%
Triodanis perfoliata	clasping Venus' looking-glass	0.5	50.0%
Veronica arvensis	corn speedwell	0.5	50.0%

Mapped Type Name: Ruderal Grassland and Shrubland
Macrogroup: Eastern Ruderal Shrubland and Grassland (MG123)
Group: Eastern Ruderal Shrubland and Grassland (G059)
Association: None assigned
Type Common Name: Coralberry – Winged Elm – Pennsylvania Blackberry / Tall Fescue
                             Grassland and Shrubland
Type Scientific Name: *Symphoricarpos orbiculatus - Ulmus alata - Rubus pensilvanicus /*
                       Schedonorus phoenix Grassland and Shrubland

Figure 15. Ruderal Grassland and Shrubland at Pea Ridge National Military Park.

Global Summary: This type represents retired crop fields that have not been mowed or burned frequently enough to suppress a significant woody component, but have been managed in a way that has generally suppressed eastern redcedar (*Juniperus virginiana*). The abundance of this type in the region is not clear, but similar communities, dominated by weedy shrubs, vines, and herbaceous species, are found throughout the Midwestern United States (Figure 15).

Environmental Description: At PERI, this type was found mainly on former croplands on the eastern side of the park. Soils were relatively moist and the topography was very gently rolling to nearly flat.

Vegetation Description: A mix of shrubs, vines, small trees, and herbaceous species were characteristic of this fairly broadly-defined type. Common small woody species included Pennsylvania blackberry (*Rubus pensilvanicus*), coralberry (*Symphoricarpos orbiculatus*) winged elm (*Ulmus alata*), winged sumac (*Rhus copallinum*), saw greenbrier (*Smilax bona-nox*), eastern poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), and frost grape (*Vitis vulpina*). Common herbaceous species included Japanese honeysuckle (*Lonicera japonica*), fuzzy wuzzy sedge (*Carex hirsutella*), Virginia wildrye (*Elymus virginicus*), softleaf rosette grass (*Dichanthelium malacophyllum*), tall fescue (*Schedonorus phoenix*), and sericea lespedeza (*Lespedeza cuneata*). Small trees were often present, including common persimmon (*Diospyros virginiana*), sassafras (*Sassafras albidum*), black cherry (*Prunus serotina*), post oak (*Quercus stellata*), and black oak (*Quercus velutina*) (Table 11).

Most Abundant Species:

Table 11. Average cover (for plots where the species occurred) and frequency for four plots taken within Ruderal Grassland and Shrubland. Only species with at least 0.5% cover in at least two plots are shown.

Ruderal Grassland and Shrubland			
Scientific Name	**Common Name**	**%Cover**	**Frequency**
Tree			
Sassafras albidum	sassafras	23.43	75.0%
Quercus stellata	post oak	15.56	50.0%
Acer negundo	boxelder	15.00	25.0%
Diospyros virginiana	common persimmon	6.12	100.0%
Prunus serotina	black cherry	5.33	75.0%
Quercus velutina	black oak	2.33	75.0%
Quercus marilandica	blackjack oak	1.99	50.0%
Carya texana	black hickory	0.50	50.0%
Celtis occidentalis	common hackberry	0.50	50.0%
Juniperus virginiana	eastern redcedar	0.50	50.0%
Shrub			
Cornus florida	flowering dogwood	37.81	25.0%
Symphoricarpos orbiculatus	coralberry	33.89	75.0%
Ulmus alata	winged elm	13.46	75.0%
Toxicodendron radicans	eastern poison ivy	10.46	50.0%
Smilax bona-nox	saw greenbrier	10.26	50.0%
Rubus pensilvanicus	Pennsylvania blackberry	9.01	100.0%
Rhus copallinum	winged sumac	6.33	75.0%
Lindera benzoin	northern spicebush	3.00	25.0%

Table 11. Average cover (for plots where the species occurred) and frequency for four plots taken within Ruderal 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
Viburnum rufidulum	rusty blackhaw	3.00	25.0%
Rosa setigera	climbing rose	1.99	50.0%
Vitis aestivalis	summer grape	1.99	50.0%
Rosa multiflora	multiflora rose	1.75	50.0%
Parthenocissus quinquefolia	Virginia creeper	1.33	75.0%
Cercis canadensis	eastern redbud	1.00	25.0%
Vitis vulpina	frost grape	0.50	75.0%
Herbaceous			
Schedonorus phoenix	tall fescue	26.25	50.0%
Lespedeza cuneata	sericea lespedeza	19.00	50.0%
Agalinis tenuifolia	slenderleaf false foxglove	15.00	25.0%
Lonicera japonica	Japanese honeysuckle	9.83	100.0%
Carex hirsutella	fuzzy wuzzy sedge	5.38	100.0%
Poa sylvestris	woodland bluegrass	3.00	25.0%
Desmodium marilandicum	smooth small-leaf ticktrefoil	2.17	75.0%
Muhlenbergia sobolifera	rock muhly	2.17	75.0%
Penstemon digitalis	talus slope penstemon	2.17	75.0%
Plantago rugelii	blackseed plantain	1.75	50.0%
Teucrium canadense	Canada germander	1.75	50.0%
Elymus virginicus	Virginia wildrye	1.75	100.0%
Dichanthelium malacophyllum	softleaf rosette grass	1.13	100.0%
Cirsium altissimum	tall thistle	0.50	100.0%
Mimosa nuttallii	Nuttall's sensitive-briar	0.50	100.0%
Oxalis dillenii	slender yellow woodsorrel	0.50	100.0%
Panicum anceps	beaked panicgrass	0.50	100.0%
Achillea millefolium	common yarrow	0.50	75.0%
Amphicarpaea bracteata	American hogpeanut	0.50	75.0%
Andropogon virginicus	broomsedge bluestem	0.50	75.0%
Carex retroflexa	reflexed sedge	0.50	75.0%
Danthonia spicata	poverty oatgrass	0.50	75.0%
Desmodium nuttallii	Nuttall's ticktrefoil	0.50	75.0%
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	75.0%
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	0.50	75.0%
Houstonia purpurea	Venus' pride	0.50	75.0%
Lespedeza virginica	slender lespedeza	0.50	75.0%
Orbexilum pedunculatum var. *pedunculatum*	Sampson's snakeroot	0.50	75.0%

Table 11. Average cover (for plots where the species occurred) and frequency for four plots taken within Ruderal 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
Potentilla simplex	common cinquefoil	0.50	75.0%
Rudbeckia hirta	blackeyed Susan	0.50	75.0%
Tridens flavus	purpletop tridens	0.50	75.0%
Valerianella radiata	beaked cornsalad	0.50	75.0%
Acalypha virginica	Virginia threeseed mercury	0.50	50.0%
Ageratina altissima var. *altissima*	white snakeroot	0.50	50.0%
Apocynum cannabinum	Indianhemp	0.50	50.0%
Asplenium platyneuron	ebony spleenwort	0.50	50.0%
Botrychium virginianum	rattlesnake fern	0.50	50.0%
Desmodium laevigatum	smooth ticktrefoil	0.50	50.0%
Desmodium perplexum	perplexed ticktrefoil	0.50	50.0%
Elephantopus carolinianus.	Carolina elephantsfoot	0.50	50.0%
Euphorbia corollata	flowering spurge	0.50	50.0%
Fragaria virginiana	Virginia strawberry	0.50	50.0%
Galium circaezans	licorice bedstraw	0.50	50.0%
Galium pilosum	hairy bedstraw	0.50	50.0%
Geranium carolinianum	Carolina geranium	0.50	50.0%
Geum canadense	white avens	0.50	50.0%
Leucanthemum vulgare	oxeye daisy	0.50	50.0%
Lobelia spicata	palespike lobelia	0.50	50.0%
Prenanthes altissima	tall rattlesnakeroot	0.50	50.0%
Rubus flagellaris	northern dewberry	0.50	50.0%
Solanum carolinense	Carolina horsenettle	0.50	50.0%
Vernonia baldwinii	Baldwin's ironweed	0.50	50.0%

Mapped Type Name: Silver Maple Forest
Macrogroup:　　　　Northern & Cenrtal Flooded & Swamp Forest (MG029)
Group:　　　　Silver Maple – Green Ash – Sycamore Floodplain Group (G040)
Association:　　　　No association assigned, but similar to CEGL002586 *Acer saccharinum –*
　　　　　　Ulmus americana Forest
Type Common Name: Silver Maple – American Elm Forest
Type Scientific Name: *Acer saccharinum - Ulmus americana* Forest

Figure 16. Silver Maple Forest at Pea Ridge National Military Park.

Global Summary: Communities dominated or co-dominated by silver maple (*Acer saccharinum*) often are components of floodplain complexes in the Midwest, and are part of the North-Central Interior Floodplain ecological system (Figure 16). Silver maple also grows on disturbed, moist soils in a variety to circumstances thoughout the range of the species. The naturally occurring silver maple – American elm forest is found throughout the midwestern United States and parts of the eastern United States. Stands occur on large, regularly flooded floodplains. The canopy cover is more-or-less closed and dominated by silver maple (*Acer saccharinum*). Codominants may include American sycamore (*Platanus occidentalis),* river birch (*Betula nigra*), and rarely sugar maple (*Acer saccharum).* Associated species may include American elm (*Ulmus americana),* slippery elm (*Ulmus rubra),* boxelder (*Acer negundo),* black

willow (*Salix nigra*), common hackberry *(Celtis occidentalis)*, bitternut hickory (*Carya cordiformis)*, black walnut (*Juglans nigra*), and green ash (*Fraxinus pennsylvanica)*. The shrub and sapling layer is often open (<25% cover). Species that may be present include American black elderberry (*Sambucus nigra* ssp. *canadensis)*, black raspberry (*Rubus occidentalis)*, or northern spicebush (*Lindera benzoin)*. Woody and herbaceous vines can be prominent, including among the woody vines Virginia creeper (*Parthenocissus quinquefolia),* eastern poison ivy (*Toxicodendron radicans)*, and riverbank grape (*Vitis riparia)*. Herbaceous vine species include groundnut (*Apios americana),* American hogpeanut *(Amphicarpaea bracteata)*, and wild cucumber (*Echinocystis lobata)*. Herbaceous grasses, forbs, and ferns dominate the ground layer, including calico aster (*Symphyotrichum lateriflorum = Aster lateriflorus),* smallspike false nettle *(Boehmeria cylindrica),* dogtooth violet (*Erythronium americanum),* giant goldenrod *(Solidago gigantea),* sweet woodreed (*Cinna arundinacea),* whitegrass (*Leersia virginica),* Virginia wildrye *(Elymus virginicus),* pale touch-me-not *(Impatiens pallida),* Canadian woodnettle (*Laportea canadensis),* ostrich fern (*Matteuccia struthiopteris),* sensitive fern (*Onoclea sensibilis),* Canadian clearweed (*Pilea pumila),*stinging nettle *(Urtica dioica)*, and others. A variety of exotics may be present, including yellow loosestrife (*Lysimachia* spp.), Nepalese browntop (*Microstegium vimineum),* Japanese knotweed (*Polygonum cuspidatum),* multiflora rose (*Rosa multiflora)*, and Japanese honeysuckle (*Lonicera japonica)*.

Environmental Description: At PERI, this type was limited to a location on the northwestern boundary of the park over poorly-drained, nearly flat soils adjacent to a road. The adjacent road may impede drainage of the site, and hence it is probably a response to human disturbance.

Vegetation Description: Young silver maples were the prevailing dominant of this forest. Other tree species, including American elm (*Ulmus americana*), common hackberry (*Celtis occidentalis*), black cherry (*Prunus serotina*), and green ash (*Fraxinus pennsylvanica*) made up little of the overstory canopy cover. Shrubs and small trees included redbud (*Cercis canadensis*), coralberry (*Symphoricarpos orbiculatus*), multiflora rose (*Rosa multiflora*), eastern redcedar (*Juniperus virginiana*), and common persimmon (*Diospyros virginiana*). Herbaceous species included Indian woodoats (*Chasmanthium latifolium*), Japanese honeysuckle (*Lonicera japonica*, and stickywilly (*Galium aparine*).

Most Abundant Species:
No plot was taken within this stand. Species present were as described above based on notes taken during a site visit.

Mapped Unit Name: Typic Upland Deciduous Woodland and Forest
Macrogroup: Central Oak – Hardwood & Pine Forest (M012)
Group: Northeastern & North-Central Oak – Hickory Forest Group (G158)
Association: CEGL002076
NVC Common Name: Black Oak – White Oak – Hickory Forest
NVC Scientific Name: *Quercus velutina - Quercus alba – Carya (glabra, ovata)* Forest

Figure 17. Typic Upland Deciduous Woodland and Forest at Pea Ridge National Military Park.

Global Summary: This type is an association within the Ozark-Ouachita Dry-Mesic Oak Forest ecological system (Figure 17). This system is found throughout the Ozark and Ouachita Highlands ranging to the western edge of the Interior Low Plateau. The black oak - white oak – hickory forest community is found throughout the range of the ecological system. Stands occur on dry to dry-mesic mid- to upper slopes and terraces where soils are more well-drained. Bedrock is sandstone, siltstone, limestone, chert, or shale, and may be covered by thin loess. Trees in this community often have moderate to short trunks and spreading crowns, and the canopy can vary from open to closed (50-100%). Black oak (*Quercus velutina),* white oak (*Quercus alba),* pignut hickory (*Carya glabra*), and shagbark hickory (*Carya ovata)* are typical tree dominants. Associated oaks can include chinkapin oak (*Quercus muehlenbergii)*, scarlet oak (*Quercus coccinea),* chestnut oak (*Quercus prinus*), and post oak (*Quercus stellata)*. Typical shrubs and small trees include flowering dogwood (*Cornus florida)*(southward), stiff dogwood (*Cornus foemina),* hophornbeam (*Ostrya virginiana*), and sassafras (*Sassafras albidum)*. Vines include eastern poison ivy (*Toxicodendron radicans),* Virginia creeper *(Parthenocissus quinquefolia)*, and grape (*Vitis* spp.). The herbaceous layer can include tall hairy agrimony

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(*Agrimonia gryposepala),* beaked agrimony *(Agrimonia rostellata),* American hogpeanut
(*Amphicarpaea bracteata),* rattlesnake fern *(Botrychium virginianum),* eastern woodland sedge
(*Carex blanda),* Pennsylvania sedge (*Carex pensylvanica),* pointedleaf ticktrefoil (*Desmodium glutinosum),* nakedflower ticktrefoil (*Desmodium nudiflorum),* fourleaf yam (*Dioscorea quaternata),* licorice bedstraw (*Galium circaezans),* spotted geranium (*Geranium maculatum),*
Christmas fern (*Polystichum acrostichoides),* feathery false lily of the valley (*Maianthemum racemosum)*, and starry false lily of the valley (*Maianthemum stellatum)*, among others. More
southern stands may contain poverty oatgrass (*Danthonia spicata)*.

Environmental Description: This was the primary forest association at PERI, and comprised
almost twice as much area as all other types combined. The black oak (*Quercus velutina*)
dominated and co-dominated variants of this ecological system are most common in Missouri
and adjacent Arkansas than elsewhere in the range of the type. At PERI, the type occurred on all
landscape positions and slopes over well-drained or moderately well-drained upland soils.

Vegetation Description: Black oak *(Quercus velutina)* was among the most important canopy
species of all 12 plots sampled that represented this type. Other important canopy dominants
included white oak (*Quercus alba*), northern red oak (*Quercus rubra*), mockernut hickory
(*Carya alba*), and post oak (*Quercus stellata*). Important shrubs included coralberry
(*Symphoricarpos orbiculatus*), flowering dogwood (*Cornus florida*), and northern spicebush
(*Lindera benzoin*). Frost grape (*Vitis vulpia*), saw greenbrier (*Smilax bona-nox*), Virginia
creeper (*Parthenocissus quinquefolia*), and Pennsylvania blackberry (*Rubus pensilvanicus*) were
common vines. The herbaceous layer was often sparse and varied from plot to plot, with only
rock muhly (*Muhlenbergia sobolifera*), reflexed sedge (*Carex retroflexa*), white snakeroot
(*Ageratina altissima*), and American lopseed (*Phryma leptostachya*), and ebony spleenwort
(*Asplenium platyneuron*) occurring in 8 of 12 samples (Table 12).

Most Abundant Species:

Table 12. Average cover (for plots where the species occurred) and frequency for twelve plots taken
within Typic Upland Deciduous Woodland & Forest. Only species with at least 0.5% cover in at least two
plots are shown.

Typic Upland Woodland			
Scientific Name	Common Name	%Cover	Frequency
Tree			
Acer saccharinum	silver maple	64.89	8.3%
Quercus alba	white oak	38.10	58.3%
Quercus velutina	black oak	21.82	100.0%
Quercus rubra	northern red oak	15.74	41.7%
Gleditsia triacanthos	honeylocust	13.56	33.3%
Carya alba	mockernut hickory	13.47	41.7%
Sassafras albidum	sassafras	9.89	83.3%
Quercus stellata.	post oak	7.94	66.7%
Acer rubrum	red maple	7.40	33.3%
Carya texana	black hickory	6.33	66.7%

Table 12. Average cover (for plots where the species occurred) and frequency for twelve plots taken within Typic Upland Deciduous Woodland & Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Nyssa sylvatica	blackgum	4.87	33.3%
Diospyros virginiana	common persimmon	4.51	83.3%
Juniperus virginiana	eastern redcedar	3.98	50.0%
Ulmus americana	American elm	3.33	83.3%
Celtis occidentalis	common hackberry	3.20	75.0%
Quercus marilandica	blackjack oak	2.08	41.7%
Prunus serotina	black cherry	1.00	58.3%
Fraxinus americana	white ash	0.94	66.7%
Juglans nigra	black walnut	0.83	25.0%
Acer negundo	boxelder	0.67	25.0%
Morus rubra	red mulberry	0.50	75.0%
Platanus occidentalis	American sycamore	0.50	16.7%
Shrub			
Symphoricarpos orbiculatus	coralberry	20.98	91.7%
Cornus florida	flowering dogwood	10.90	91.7%
Lindera benzoin	northern spicebush	10.37	41.7%
Rosa multiflora.	multiflora rose	7.85	25.0%
Ulmus alata.	winged elm	6.05	41.7%
Ostrya virginiana	hophornbeam	3.49	8.3%
Rubus pensilvanicus	Pennsylvania blackberry	3.44	100.0%
Toxicodendron radicans	eastern poison ivy	3.40	41.7%
Vaccinium stamineum	deerberry	2.92	50.0%
Parthenocissus quinquefolia	Virginia creeper	2.70	83.3%
Asimina triloba	pawpaw	2.24	16.7%
Lonicera flava	yellow honeysuckle	1.75	16.7%
Cercis canadensis	eastern redbud	1.66	25.0%
Smilax bona-nox	saw greenbrier	1.10	75.0%
Frangula caroliniana	Carolina buckthorn	1.07	58.3%
Vitis aestivalis	summer grape	1.00	50.0%
Castanea pumila var. *ozarkensis*	Ozark chinkapin	1.00	8.3%
Corylus americana	American hazelnut	1.00	8.3%
Rubus occidentalis	black raspberry	1.00	8.3%
Amelanchier arborea	common serviceberry	0.62	33.3%
Vitis vulpina	frost grape	0.50	83.3%
Smilax tamnoides	bristly greenbrier	0.50	58.3%

Table 12. Average cover (for plots where the species occurred) and frequency for twelve plots taken within Typic Upland Deciduous Woodland & Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Viburnum rufidulum	rusty blackhaw	0.50	50.0%
Prunus americana	American plum	0.50	33.3%
Dioscorea quaternata	fourleaf yam	0.50	16.7%
Rosa carolina	Carolina rose	0.50	16.7%
Vaccinium pallidum	blue ridge blueberry	0.50	16.7%
Herbaceous			
Lonicera japonica	Japanese honeysuckle	8.49	33.3%
Bromus pubescens	hairy woodland brome	7.75	16.7%
Desmodium nudiflorum	nakedflower ticktrefoil	6.71	58.3%
Microstegium vimineum	Nepalese browntop	5.33	25.0%
Perilla frutescens	beefsteakplant	3.00	8.3%
Pycnanthemum tenuifolium.	narrowleaf mountainmint	3.00	8.3%
Amphicarpaea bracteata var. *bracteata*	American hogpeanut	2.93	58.3%
Muhlenbergia sobolifera	rock muhly	2.31	66.7%
Stellaria media	common chickweed	2.17	25.0%
Galium aparine	stickywilly	1.33	25.0%
Elymus virginicus	Virginia wildrye	0.92	50.0%
Carex retroflexa	reflexed sedge	0.75	83.3%
Ageratina altissima var. *altissima*	white snakeroot	0.50	75.0%
Asplenium platyneuron	ebony spleenwort	0.50	66.7%
Phryma leptostachya	American lopseed	0.50	66.7%
Aristolochia serpentaria	Virginia snakeroot	0.50	58.3%
Carex hirsutella	fuzzy wuzzy sedge	0.50	58.3%
Dichanthelium boscii	Bosc's panicgrass	0.50	58.3%
Geum canadense	white avens	0.50	58.3%
Hypericum hypericoides ssp. *hypercoides*	St. Andrew's cross	0.50	58.3%
Viola triloba	three-lobe violet	0.50	58.3%
Carex muehlenbergii	Muhlenberg's sedge	0.50	50.0%
Galium circaezans	licorice bedstraw	0.50	50.0%
Sanicula canadensis	Canadian blacksnakeroot	0.50	50.0%
Botrychium virginianum	rattlesnake fern	0.50	41.7%
Carex umbellata	parasol sedge	0.50	41.7%
Danthonia spicata	poverty oatgrass	0.50	41.7%
Dichanthelium dichotomum	cypress panicgrass	0.50	41.7%
Festuca subverticillata	nodding fescue	0.50	41.7%
Rubus flagellaris	northern dewberry	0.50	41.7%

Table 12. Average cover (for plots where the species occurred) and frequency for twelve plots taken within Typic Upland Deciduous Woodland & Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Brachyelytrum erectum	bearded shorthusk	0.50	33.3%
Carex albicans var. *albicans*	whitetinge sedge	0.50	33.3%
Carex blanda	eastern woodland sedge	0.50	33.3%
Carex cephalophora	oval-leaf sedge	0.50	33.3%
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	0.50	33.3%
Hackelia virginiana	beggarslice	0.50	33.3%
Lespedeza procumbens.	trailing lespedeza	0.50	33.3%
Podophyllum peltatum	mayapple	0.50	33.3%
Scutellaria ovata	heartleaf skullcap	0.50	33.3%
Acalypha virginica	Virginia threeseed mercury	0.50	25.0%
Andropogon virginicus	broomsedge bluestem	0.50	25.0%
Carex jamesii	James' sedge	0.50	25.0%
Carex nigromarginata	black edge sedge	0.50	25.0%
Desmodium perplexum	perplexed ticktrefoil	0.50	25.0%
Desmodium glutinosum	pointedleaf ticktrefoil	0.50	25.0%
Galium arkansanum	Arkansas bedstraw	0.50	25.0%
Geranium carolinianum	Carolina geranium	0.50	25.0%
Juncus tenuis	poverty rush	0.50	25.0%
Lespedeza virginica	slender lespedeza	0.50	25.0%
Oxalis dillenii	slender yellow woodsorrel	0.50	25.0%
Panicum anceps	beaked panicgrass	0.50	25.0%
Passiflora lutea	yellow passionflower	0.50	25.0%
Physalis virginiana	Virginia groundcherry	0.50	25.0%
Sanicula odorata	clustered blacksnakeroot	0.50	25.0%
Solidago ulmifolia	elmleaf goldenrod	0.50	25.0%
Symphyotrichum anomalum	manyray aster	0.50	25.0%
Symphyotrichum patens var. *patens*	late purple aster	0.50	25.0%
Thalictrum thalictroides	rue anemone	0.50	25.0%
Tridens flavus	purpletop tridens	0.50	25.0%
Viola sororia	common blue violet	0.50	25.0%
Agrimonia rostellata	beaked agrimony	0.50	16.7%
Allium canadense	meadow garlic	0.50	16.7%
Ambrosia artemisiifolia	annual ragweed	0.50	16.7%
Chasmanthium latifolium	Indian woodoats	0.50	16.7%
Cirsium altissimum	tall thistle	0.50	16.7%
Cunila origanoides	common dittany	0.50	16.7%
Desmodium laevigatum	smooth ticktrefoil	0.50	16.7%

Table 12. Average cover (for plots where the species occurred) and frequency for twelve plots taken within Typic Upland Deciduous Woodland & Forest. Only species with at least 0.5% cover in at least two plots are shown (continued).

Scientific Name	Common Name	%Cover	Frequency
Desmodium paniculatum	panicledleaf ticktrefoil	0.50	16.7%
Desmodium rotundifolium	prostrate ticktrefoil	0.50	16.7%
Dichanthelium malacophyllum	softleaf rosette grass	0.50	16.7%
Euphorbia corollata	flowering spurge	0.50	16.7%
Houstonia purpurea	Venus' pride	0.50	16.7%
Leersia virginica	whitegrass	0.50	16.7%
Lespedeza frutescens	shrubby lespedeza	0.50	16.7%
Lespedeza violacea	violet lespedeza	0.50	16.7%
Maianthemum racemosum ssp. *racemosum*	feathery false lily of the valley	0.50	16.7%
Monarda russeliana	redpurple beebalm	0.50	16.7%
Oxalis violacea	violet woodsorrel	0.50	16.7%
Packera aurea	golden ragwort	0.50	16.7%
Parietaria pensylvanica	Pennsylvania pellitory	0.50	16.7%
Phytolacca americana	American pokeweed	0.50	16.7%
Poa sylvestris	woodland bluegrass	0.50	16.7%
Polygonum sp.	Knotweed	0.50	16.7%
Polystichum acrostichoides	Christmas fern	0.50	16.7%
Prenanthes altissima	tall rattlesnakeroot	0.50	16.7%
Pseudognaphalium obtusifolium ssp. *obtusifolium*	rabbit-tobacco	0.50	16.7%
Rudbeckia hirta	blackeyed Susan	0.50	16.7%
Schedonorus phoenix	tall fescue	0.50	16.7%
Solanum carolinense L.	Carolina horsenettle	0.50	16.7%
Symphyotrichum turbinellum	smooth violet prairie aster	0.50	16.7%
Taraxacum officinale	common dandelion	0.50	16.7%
Teucrium canadense	Canada germander	0.50	16.7%
Verbesina virginica	white crownbeard	0.50	16.7%
Viola bicolor	field pansy	0.50	16.7%
Woodsia obtusa	bluntlobe cliff fern	0.50	16.7%

Discussion

Pea Ridge National Military Park supports 2,490 acres (1,007.7 ha) of oak woodland and forest, which cover 58% of the park, in relatively natural condition (Annis et al. 2011). This result is similar to an earlier map provided by Wright et al. (1970), although they mapped fewer and different types based on fewer quantitative data samples. The top and slopes of Elkhorn Mountain support a Dry Deciduous Woodland and Forest whereas most of the rest of the park supports a Typic (wetter) Upland Deciduous Woodland and Forest type. These oak forests together with successional and bottomland types form a large block of essentially uninterrupted woodland and forest landscape that surrounds mowed grassland, which in turn forms the core of the cultural portion of the park.

Field Survey
The classification and mapping completed for this project should help provide a baseline. Eastern Redcedar Woodland and Forest will be dynamic over time in the absence of management, but active management of some portions of this type is on-going at the date of publication of this report. Documentation of change via repeated sampling will be highly desirable, especially in the juniper treatment areas. Sampling of the general landscape around the park (e.g. interpretation of general vegetation types such as urban, grassland, and woodland/forest) will help to document context and provide early signs of urban encroachment on the boundaries. The proximity of expanding urban areas (e.g. Bentonville, Rogers) makes urban encroachment on the park's boundaries highly likely.

NVC Classification
Only four of nine types defined and mapped have good matches in the NVC, and two others have similar associations defined. Quantitative data from the park may help in the description of three other types, including Eastern Redcedar Woodland and Forest, Restored Tallgrass Prairie, and Ruderal Grassland and Shrubland. Among these, Restored Tallgrass Prairie may remain outside of the NVC as a cultural type. However, eastern redcedar and ruderal shrublands and grasslands are common components of the landscape and descriptions within the NVC may be appropriate.

Digital Imagery and Interpretation
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. The combination of fewer natural and semi-natural vegetation types distributed among larger polygons added to the overall high degree of thematic accuracy. Of those rare map classes (Scenario E), they were easy to identify in the field using the dichotomous key and vegetation descriptions. For all vegetation map classes, the dichotomous key allowed for clear identification at the majority of points.

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

On-going eastern redcedar control efforts at PERI provide a significant opportunity for research. Clearing has resulted in canopy gaps, and documentation of the fate of these sites over time is highly desirable. A second avenue of research may involve linking of HTLN inventory and monitoring activities with the results of this mapping project.

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Appendix A: Contingency Table for Vegetation Mapping at Pea Ridge National Military Park

| | Reference Data (Accuracy Assessment Field Data) | | | | | | | | | | User's Error | | |
Map Units	Bottomland Deciduous Woodland and Forest	Dry Deciduous Woodland and Forest	Eastern Redcedar Woodland and Forest	Marsh	Mowed Grassland	Restored Tallgrass Prairie	Ruderal Grassland and Shrubland	Silver Maple Forest	Typic Upland and Deciduous Woodland and Forest	Totals	Commission Accuracy	90% Conf. Interval -	+
Bottomland Deciduous Woodland and Forest	20	0	0	0	0	0	0	0	0	20	100%	97.5%	100%
Dry Deciduous Woodland and Forest	0	19	0	0	0	0	0	0	2	21	90.5%	77.6%	100%
Eastern Redcedar Woodland and Forest	0	0	27	0	0	0	0	0	0	27	100%	98.1%	100%
Marsh	0	0	0	2	0	0	0	0	0	2	100%	75%	100%
Mowed Grassland	0	0	0	0	19	0	1	0	0	20	95%	84.5%	100%
Restored Tallgrass Prairie	0	0	0	0	0	2	0	0	0	2	100%	75%	100%
Ruderal Grassland and Shrubland	0	0	0	0	1	0	29	0	1	31	93.5%	84.7%	100%
Silver Maple Forest	0	0	0	0	0	0	0	2	0	2	100%	75%	100%
Typic Upland Deciduous Woodland and Forest	0	1	2	0	0	0	0	0	27	30	90%	79.3%	100%
Totals	20	20	29	2	20	2	30	2	30				
Omission Accuracy	100%	86.7%	83.5%	100%	97.9%	100%	92.3%	100%	96.9%		147 Total Correct Points		
90% Conf. Level -	100%	85.4%	82.7%	100%	96.9%	100%	91.7%	100%	94.4%		155 Total Points		
Level +	100%	87.9%	84.3%	100%	98.8%	100%	92.9%	100%	99.4%				

Sample Data (Polygon Map Data) — row labels; *Producer's Error* — omission rows.

Overall Total Accuracy = 93.1%   Overall Kappa Index = 93.9%   Overall Upper and Lower Confidence Interval = 97.6% and 88.6%

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%)

Strata	%Cover
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: Pea Ridge National Military Park Dichotomous Key to Mapped Current Vegetation Types

1a. Area with overstory canopy (at a height > 4m) greater than 50% 2

    2a. Eastern redcedar (*Juniperus virginiana)* with a canopy cover (including overstory and understory canopies) > 20%…………………………….Eastern Redcedar Woodland and Forest

    2b. Eastern redcedar (*Juniperus virginiana*) with a canopy cover < 20% 3

        3a. Woodland dominated by silver maple (*Acer saccharinum*) and associated with clearing along powerline.. Silver Maple Forest

        3b. Woodland dominated by species other than silver maple (*Acer saccharinum*)..........4

            4a. Combined absolute canopy cover of post oak (*Quercus stellata*), black hickory (*Carya texana*), and blackjack oak (*Quercus marilandica*) in the overstory (at a height > 4m) greater than 15%………………...Dry Deciduous Woodland and Forest

            4b. Combined absolute canopy cover of these three species in the overstory < 15%. 5

                5a. Combined absolute canopy cover of black walnut (*Juglans nigra*), American elm (*Ulmus americana*), red mulberry (*Morus rubra*), boxelder (*Acer negundo*), American sycamore (*Platanus occidentalis*), and slippery elm (*Ulmus rubra*) in the overstory (at a height > 4m) greater than 20%..Bottomland Deciduous Woodland and Forest

                5b. Combined absolute canopy cover of those 6 species in the overstory less than 20%...Typic Upland Deciduous Woodland and Forest

1b. Area lacking an overstory canopy (at a height > 4m), or with overstory canopy < 50% 6

    6a. Herbaceous wetlands surrounding ponds with species such as cattail (*Typha latifolia*), yellow pond-lily (*Nuphar lutea*), rice cutgrass (*Leersia oryzoides*), and/or bulrush (*Scirpus* spp.) present ....Marsh

    6b. Areas dominated by herbaceous species or shrubs, but not a herbaceous wetland characterized by the above species. 7

        7a. Grasslands with greater than 50% of the herbaceous cover by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and/or Indian grass (*Sorghastrum nutans*) and with woody cover <15% .... Restored Tallgrass Prairie

        7b. Grasslands or shrublands with lesser amounts of the above tallgrass species............8

8a. Grasslands frequently mowed and dominated by non-native species such as tall fescue (*Schedonorus phoenix*), Italian ryegrass (*Lolium perenne* ssp. *multiflorum*), and/or orchardgrass (*Dactylis glomerata*) ....Mowed Grassland

8b. Grasslands and shrublands in various stages of regrowth ....
....Ruderal 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 Pea Ridge National Military Park

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 rubrum L.	red maple
	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
Annonaceae	*Asimina triloba* (L.) Dunal	pawpaw
Apiaceae	*Chaerophyllum tainturieri* Hook.	hairyfruit chervil
	Osmorhiza claytonii (Michx.) C.B. Clarke	Clayton's sweetroot
	Sanicula canadensis L.	Canadian blacksnakeroot
	Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe	clustered blacksnakeroot
Apocynaceae	*Apocynum cannabinum* L.	Indianhemp
Aquifoliaceae	*Ilex opaca* Aiton	American holly
Araceae	*Arisaema dracontium* (L.) Schott	green dragon
Aristolochiaceae	*Aristolochia serpentaria* L.	Virginia snakeroot
	Asarum canadense L.	Canadian wildginger
Asclepiadaceae	*Asclepias quadrifolia* Jacq.	fourleaf milkweed
	Asclepias tuberosa L.	butterfly milkweed
	Asclepias viridis Walter	green antelopehorn
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
	Antennaria plantaginifolia (L.) Richardson	woman's tobacco
	Arnoglossum atriplicifolium (L.) H. Rob.	pale Indian plantain
	Bidens bipinnata L.	Spanish needles
	Cirsium altissimum (L.) Hill	tall thistle
	Conyza canadensis (L.) Cronquist	Canadian horseweed
	Elephantopus carolinianus Raeusch.	Carolina elephantsfoot
	Erechtites hieraciifolia (L.) Raf. ex DC.	American burnweed
	Erigeron annuus (L.) Pers.	eastern daisy fleabane
	Erigeron strigosus Muhl. ex Willd.	prairie fleabane
	Eupatorium serotinum Michx.	lateflowering thoroughwort
	Helianthus hirsutus Raf.	hairy sunflower
	Heliopsis helianthoides (L.) Sweet	smooth oxeye
	Hieracium gronovii L.	queendevil
	Krigia biflora (Walter) S.F. Blake	twoflower dwarfdandelion

Appendix E: Species List for Pea Ridge National Military Park

Family	Scientific Name	Common Name
Asteraceae	*Krigia dandelion* (L.) Nutt.	potato dwarfdandelion
	Lactuca canadensis L.	Canada lettuce
	Lactuca floridana (L.) Gaertn.	woodland lettuce
	Leucanthemum vulgare Lam.	oxeye daisy
	Machaeranthera canescens (Pursh) A. Gray ssp. *glabra* (A. Gray) B.L. Turner *var. glabra* A. Gray	hoary tansyaster
	Packera aurea (L.) A. Löve & D. Löve	golden ragwort
	Packera obovata (Muhl. ex Willd.) W.A. Weber & A. Löve	roundleaf ragwort
	Polymnia canadensis L.	whiteflower leafcup
	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
	Solidago altissima L.	Canada goldenrod
	Solidago buckleyi Torr. & A. Gray	Buckley's goldenrod
	Solidago caesia L.	wreath goldenrod
	Solidago gigantea Aiton	giant goldenrod
	Solidago nemoralis Aiton	gray goldenrod
	Solidago ulmifolia Muhl. ex Willd.	elmleaf goldenrod
	Symphyotrichum anomalum (Engelm.) G.L. Nesom	manyray aster
	Symphyotrichum patens (Aiton) G.L. Nesom var. patens	late purple aster
	Symphyotrichum turbinellum (Lindl.) G.L. Nesom	smooth violet prairie aster
	Taraxacum officinale F.H. Wigg.	common dandelion
	Verbesina alternifolia (L.) Britton ex Kearney	wingstem
	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	*Carpinus caroliniana* Walter	American hornbeam
	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
	Myosotis verna Nutt.	spring forget-me-not
Brassicaceae	*Barbarea vulgaris* W.T. Aiton	garden yellowrocket
	Cardamine parviflora L.	sand bittercress

Appendix E: Species List for Pea Ridge National Military Park

Family	Scientific Name	Common Name
Campanulaceae	*Lobelia inflata* L.	Indian-tobacco
	Lobelia spicata Lam.	palespike lobelia
	Triodanis perfoliata (L.) Nieuwl.	clasping Venus' looking-glass
Caprifoliaceae	*Lonicera flava* Sims	yellow honeysuckle
	Lonicera japonica Thunb.	Japanese honeysuckle
	Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli	American black elderberry
	Symphoricarpos orbiculatus Moench	coralberry
	Viburnum rufidulum Raf.	rusty blackhaw
Caryophyllaceae	*Cerastium fontanum* Baumg. ssp. *vulgare* (Hartm.) Greuter & Burdet	big chickweed
	Stellaria media (L.) Vill.	common chickweed
Celastraceae	*Euonymus alatus* (Thunb.) Siebold	burningbush
	Euonymus fortunei (Turcz.) Hand.-Maz.	winter creeper
Cistaceae	*Lechea tenuifolia* Michx.	narrowleaf pinweed
Clusiaceae	*Hypericum hypericoides* (L.) Crantz ssp. hypericoides	St. Andrew's cross
	Hypericum punctatum Lam.	spotted St. Johnswort
Commelinaceae	*Commelina communis* L.	Asiatic dayflower
	Tradescantia ohiensis Raf.	bluejacket
Convolvulaceae	*Ipomoea pandurata* (L.) G. Mey.	man of the earth
Cornaceae	*Cornus florida* L.	flowering dogwood
	Nyssa sylvatica Marsh.	blackgum
Cupressaceae	*Juniperus virginiana* L.	eastern redcedar
Cyperaceae	*Carex albicans* Willd. ex Spreng. var. *albicans*	whitetinge sedge
	Carex amphibola Steud.	eastern narrowleaf sedge
	Carex annectens (E.P. Bicknell) E.P. Bicknell	yellowfruit sedge
	Carex blanda Dewey	eastern woodland sedge
	Carex bushii Mack.	Bush's sedge
	Carex cephalophora Muhl. ex Willd.	oval-leaf sedge
	Carex glaucodea Tuck. ex Olney	blue sedge
	Carex hirsutella Mack.	fuzzy wuzzy sedge
	Carex jamesii Schwein.	James' sedge
	Carex lurida Wahlenb.	shallow sedge
	Carex molesta Mack. ex Bright	troublesome sedge
	Carex muehlenbergii Schkuhr ex Willd.	Muhlenberg's sedge
	Carex nigromarginata Schwein.	black edge sedge
	Carex retroflexa Muhl. ex Willd.	reflexed sedge
	Carex rosea Schkuhr ex Willd.	rosy sedge
	Carex umbellata Schkuhr ex Willd.	parasol sedge
	Eleocharis sp.	spikerush
	Scirpus sp.	bulrush
	Scleria oligantha Michx.	littlehead nutrush
Dioscoreaceae	*Dioscorea quaternata* J.F. Gmel.	fourleaf yam

Appendix E: Species List for Pea Ridge National Military Park

Family	Scientific Name	Common Name
Dryopteridaceae	*Polystichum acrostichoides* (Michx.) Schott	Christmas fern
	Woodsia obtusa (Spreng.) Torr.	bluntlobe cliff fern
Ebenaceae	*Diospyros virginiana* L.	common persimmon
Ericaceae	*Vaccinium pallidum* Aiton	Blue Ridge blueberry
	Vaccinium stamineum L.	deerberry
Euphorbiaceae	*Acalypha gracilens* A. Gray	slender threeseed mercury
	Acalypha virginica L.	Virginia threeseed mercury
	Euphorbia corollata L.	flowering spurge
Fabaceae	*Amphicarpaea bracteata (*L.) Fernald var. *bracteata*	American hogpeanut
	Amphicarpaea bracteata (L.) Fernald var. *comosa* (L.) Fernald	American hogpeanut
	Cercis canadensis L.	eastern redbud
	Chamaecrista nictitans (L.) Moench ssp. *nictitans* var. *nictitans*	sensitive partridge pea
	*Desmodium glutinosum (*Muhl. ex Willd.) Alph. Wood	pointedleaf ticktrefoil
	Desmodium laevigatum (Nutt.) DC.	smooth ticktrefoil
	Desmodium marilandicum (L.) DC.	smooth small-leaf ticktrefoil
	Desmodium nudiflorum (L.) DC.	nakedflower ticktrefoil
	Desmodium nuttallii (Schindl.) B.G. Schub.	Nuttall's ticktrefoil
	Desmodium paniculatum (L.) DC.	panicledleaf ticktrefoil
	Desmodium perplexum B.G. Schub.	perplexed ticktrefoil
	Desmodium rotundifolium DC.	prostrate ticktrefoil
	Gleditsia triacanthos L.	honeylocust
	Lespedeza capitata Michx.	roundhead lespedeza
	Lespedeza cuneata (Dum. Cours.) G. Don	sericea lespedeza
	Lespedeza frutescens (L.) Hornem.	shrubby lespedeza
	Lespedeza procumbens Michx.	trailing lespedeza
	Lespedeza repens (L.) W. Bartram	creeping lespedeza
	Lespedeza violacea (L.) Pers.	violet lespedeza
	Lespedeza virginica (L.) Britton	slender lespedeza
	Mimosa nuttallii (DC. ex Britton & Rose) B.L. Turner	Nuttall's sensitive-briar
	Orbexilum pedunculatum (Mill.) Rydb. var. *pedunculatum*	Sampson's snakeroot
	Strophostyles helvola (L.) Elliott	amberique-bean
	Stylosanthes biflora (L.) Britton, Sterns & Poggenb.	sidebeak pencilflower
	Trifolium campestre Schreb.	field clover
	Vicia sativa L.	garden vetch
Fagaceae	*Castanea pumila* (L.) Mill. var. *ozarkensis* (Ashe) Tucker	Ozark chinkapin
	Quercus alba L.	white oak
	Quercus marilandica Münchh.	blackjack oak

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Family	Scientific Name	Common Name
Fagaceae	*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
Hippocastanaceae	*Aesculus glabra* Willd.	Ohio buckeye
Hydrangeaceae	*Hydrangea arborescens* L.	wild hydrangea
Iridaceae	*Iris cristata* Aiton	dwarf crested iris
	Iris virginica L.	Virginia iris
	Sisyrinchium campestre E.P. Bicknell	prairie blue-eyed grass
Juglandaceae	*Carya alba* (L.) Nutt.	mockernut hickory
	Carya cordiformis (Wangenh.) K. Koch	bitternut hickory
	Carya glabra (Mill.) Sweet	pignut hickory
	Carya ovata (Mill.) K. Koch	shagbark hickory
	Carya texana Buckley	black hickory
	Juglans nigra L.	black walnut
Juncaceae	*Juncus tenuis* Willd.	poverty rush
	Luzula bulbosa (Alph. Wood) Smyth & Smyth	bulbous woodrush
Lamiaceae	*Cunila origanoides* (L.) Britton	common dittany
	Glechoma hederacea L.	ground ivy
	Lamium purpureum L.	purple deadnettle
	Lycopus americanus Muhl. ex W. Bartram	American water horehound
	Monarda russeliana Nutt. ex Sims	redpurple beebalm
	Perilla frutescens (L.) Britton	beefsteakplant
	Prunella vulgaris L.	common selfheal
	Pycnanthemum albescens Torr. & A. Gray	whiteleaf mountainmint
	Pycnanthemum tenuifolium Schrad.	narrowleaf mountainmint
	Salvia lyrata L.	lyreleaf sage
	Scutellaria incana Biehler	hoary skullcap
	Scutellaria ovata Hill	heartleaf 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
	Hypoxis hirsuta (L.) Coville	common goldstar
	Maianthemum racemosum (L.) Link ssp. *racemosum*	feathery false lily of the valley
	Uvularia grandiflora Sm.	largeflower bellwort
Menispermaceae	*Menispermum canadense* L.	common moonseed
Moraceae	*Maclura pomifera* (Raf.) C.K. Schneid.	osage orange
	Morus rubra L.	red mulberry

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Family	Scientific Name	Common Name
Nymphaeaceae	*Nuphar lutea* (L.) Sm.	yellow pond-lily
Oleaceae	*Fraxinus americana* L.	white ash
	Fraxinus pennsylvanica Marsh.	green ash
	Ligustrum vulgare L.	European privet
Ophioglossaceae	*Botrychium dissectum* Spreng.	cutleaf grapefern
	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
Passifloraceae	*Passiflora lutea* L.	yellow passionflower
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
	Brachyelytrum erectum (Schreb. ex Spreng.) P. Beauv.	bearded shorthusk
	Bromus arvensis L.	field brome
	Bromus pubescens Muhl. ex Willd.	hairy woodland brome
	Chasmanthium latifolium (Michx.) Yates	Indian woodoats
	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 boscii (Poir.) Gould & C.A. Clark	Bosc's panicgrass
	Dichanthelium clandestinum (L.) Gould	deertongue
	Dichanthelium commutatum (Schult.) Gould	variable panicgrass
	Dichanthelium dichotomum (L.) Gould	cypress panicgrass
	Dichanthelium latifolium (L.) Gould & C.A. Clark	broadleaf rosette grass
	Dichanthelium laxiflorum (Lam.) Gould	openflower rosette grass
	Dichanthelium linearifolium (Scribn. ex Nash) Gould	slimleaf panicgrass
	Dichanthelium malacophyllum (Nash) Gould	softleaf rosette grass
	Dichanthelium oligosanthes (Schult.) Gould	Heller's rosette grass
	Dichanthelium ravenelii (Scribn. & Merr.) Gould	Ravenel's rosette grass

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Family	Scientific Name	Common Name
Poaceae	*Elymus virginicus* L.	Virginia wildrye
	Elymus virginicus L. var. *virginicus*	Virginia wildrye
	Festuca subverticillata (Pers.) Alexeev	nodding fescue
	Hordeum pusillum Nutt.	little barley
	Leersia oryzoides (L.) Sw.	rice cutgrass
	Leersia virginica Willd.	whitegrass
	Lolium perenne L. ssp. *multiflorum* (Lam.) Husnot	Italian ryegrass
	Microstegium vimineum (Trin.) A. Camus	Nepalese browntop
	Muhlenbergia schreberi J.F. Gmel.	nimblewill
	Muhlenbergia sobolifera (Muhl. ex Willd.) Trin.	rock muhly
	Panicum anceps Michx.	beaked panicgrass
	Phleum pratense L.	timothy
	Poa annua L.	annual bluegrass
	Poa chapmaniana Scribn.	Chapman's bluegrass
	Poa compressa L.	Canada bluegrass
	Poa pratensis L.	Kentucky bluegrass
	Poa sylvestris A. Gray	woodland bluegrass
	Schedonorus phoenix (Scop.) Holub	tall fescue
	Schizachyrium scoparium (Michx.) Nash	little bluestem
	Sorghastrum nutans (L.) Nash	Indiangrass
	Sphenopholis obtusata (Michx.) Scribn.	prairie wedgescale
	Sporobolus compositus (Poir.) Merr. var. *compositus*	composite dropseed
	Tridens flavus (L.) Hitchc.	purpletop tridens
Polemoniaceae	*Phlox divaricata* L.	wild blue phlox
	Polemonium reptans L.	Greek valerian
Polygonaceae	*Polygonum* sp.	knotweed
	Polygonum scandens L.	climbing false buckwheat
	Polygonum virginianum L.	jumpseed
	Rumex acetosella L.	common sheep sorrel
	Rumex crispus L.	curly dock
Primulaceae	*Lysimachia lanceolata* Walter	lanceleaf loosestrife
Ranunculaceae	*Anemone virginiana* L.	tall thimbleweed
	Ranunculus abortivus L.	littleleaf buttercup
	Ranunculus fascicularis Muhl. ex Bigelow	early buttercup
	Ranunculus hispidus Michx.	bristly buttercup
	Ranunculus micranthus Nutt.	rock buttercup
	Ranunculus recurvatus Poir.	blisterwort
	Thalictrum thalictroides (L.) Eames & B. Boivin	rue anemone
Rhamnaceae	*Frangula caroliniana* (Walter) A. Gray	Carolina buckthorn

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Family	Scientific Name	Common Name
Rosaceae	*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
	Potentilla recta L.	sulphur cinquefoil
	Potentilla simplex Michx.	common cinquefoil
	Prunus americana Marsh.	American plum
	Prunus mexicana S. Watson	Mexican 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 Poir.	Pennsylvania blackberry
Rubiaceae	*Galium aparine* L.	stickywilly
	Galium arkansanum A. Gray	Arkansas bedstraw
	Galium circaezans Michx.	licorice bedstraw
	Galium pilosum Aiton	hairy bedstraw
	Galium virgatum Nutt.	southwestern bedstraw
	Houstonia purpurea L.	Venus' pride
Salicaceae	*Salix nigra* Marsh.	black willow
Sapotaceae	*Sideroxylon lanuginosum* Michx.	gum bully
Scrophulariaceae	*Agalinis tenuifolia* (Vahl) Raf.	slenderleaf false foxglove
	Penstemon digitalis Nutt. ex Sims	talus slope penstemon
	Verbascum thapsus L.	common mullein
	Veronica arvensis L.	corn speedwell
Smilacaceae	*Smilax bona-nox* L.	saw greenbrier
	Smilax ecirrhata (Engelm. ex Kunth) S. Watson	upright carrionflower
	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
Tiliaceae	*Tilia americana* L.	American basswood
Typhaceae	*Typha latifolia* L.	broadleaf cattail
Ulmaceae	*Celtis occidentalis* L.	common hackberry
	Ulmus alata Michx.	winged elm
	Ulmus americana L.	American elm
	Ulmus rubra Muhl.	slippery elm

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Family	Scientific Name	Common Name
Urticaceae	*Boehmeria cylindrica* (L.) Sw.	smallspike false nettle
	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	*Phryma leptostachya* L.	American lopseed
Violaceae	*Hybanthus concolor* (T.F. Forst.) Spreng.	eastern greenviolet
	Viola bicolor Pursh	field pansy
	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

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