



Vegetation Classification and Mapping of Arkansas Post National Memorial, Arkansas

Project Report

Natural Resource Report NPS/HTLN/NRR—2015/1074



ON THE COVER

Arkansas Post National Memorial

Photograph by: Lee Elliott, MoRAP

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Abstract/Executive Summary

Arkansas Post National Memorial (ARPO) is situated in southwestern Arkansas, near the confluence of the Arkansas and the White Rivers. The site was the location of a trading post established in 1686 Henri de Tontit near the Quapaw village of Osotouy.

A vegetation classification and mapping project was initiated in 2012 and completed in 2014. Protocols and products were produced following National Park Service Vegetation Inventory Program guidelines. Classification was based on 38 field plots and 75 georeferenced observation points. Mapping was based on air photo interpretation and heads-up digitizing of polygons. Accuracy assessment points obtained during 2014 verified that the map is 100% accurate.

Eleven vegetation types were classified and mapped. Most of the property is recovering from past use for rowcrops or has been otherwise disturbed. Therefore, only six of the eleven types mapped were recognizable as representative of communities described in the National Vegetation Classification. Of those, three were ruderal types, two were wetlands, and one was a rooted aquatic community. The ruderal bottomland woodland made up 60.7% of ARPO, exclusive of water and cultural areas. This type was in various stages of succession, and the majority was on moist river terrace soils. Over time, some differentiation in forest types related to differences in drainage is likely to develop within this broadly-defined community type. Two mixed herbaceous / shrubland types made up an additional 19.6% of ARPO. These areas were apparently successional old fields, and will likely become wooded over time in the absence of active management. A more natural-appearing Bald Cypress Woodland community formed a narrow gallery near perennial water, and accounted for just less than 2% of ARPO. Overall, the terrestrial communities at ARPO seem likely to recover from past disturbance through either active or passive management. However, without active management, it seems likely that almost the entire area will become wooded, except for areas of open water and rooted aquatics.

Introduction

Arkansas Post National Memorial Vegetation Inventory Project

Arkansas Post National Memorial (ARPO) Vegetation 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 NPS 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. ARPO has two units and each supports successional bottomland woodlands and forests and successional mixed herbaceous / woody communities that are dominated by a mixture of herbaceous, shrub, and young tree species (Irving and Brenholts 1977, National Park Service 2005). Each NPS Vegetation Inventory Project has three major components: classification, mapping, and map accuracy assessment. This report provides details on each of these fundamental elements.

NPS Vegetation Inventory Program

The National Vegetation Inventory Program (VIP) was established to map, classify, and describe vegetation in National Park units. It is administered by the NPS Biological Resources Management Division and provides baseline vegetation information to the NPS Natural Resource Inventory and Monitoring Program (I&M).

Vegetation Inventory Program scientists have developed procedures for classification, mapping, and accuracy assessment (Lea and Curtis 2010, Lea 2011). 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 establishment of classification and mapping standards facilitate 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).

Arkansas Post National Memorial

Arkansas Post National Memorial is located near the confluence of the Arkansas and White Rivers in southwest Arkansas (Figure 1), and consists of the 682.3 acres (276.1 ha) in two units. The main (western) unit is situated on a peninsula of land that extends from uplands to the banks of Post Bend

and Post Bayou, which are connected to the Arkansas River. The Osotouy unit is also situated on the banks of the Arkansas River. The site was established in 1686 as a trading post, near the Quapaw village of Osotouy.

The original character of the vegetation in this landscape has been modified by the advent of row crop agriculture or forest clearing, or both (Irving and Brenholts 1977, National Park Service 2005). Currently, the vegetation is a complex of communities that are recovering from past human disturbances. According to the Environmental Protection Agency, the Grand Prairie level IV ecoregion extends to the Arkansas/Ouachita River Holocene Meander Belts ecoregion in this area (see <http://www.epa.gov/wed/pages/ecoregions.htm>). Much of the area of the Osotouy unit is within the Grand Prairie ecoregion, as is more than half of the main unit. The Grand Prairie supported tallgrass prairie, upland woodlands, and narrow strips of bottomland hardwoods along streams in pre-European times. The Arkansas/Ouachita River Holocene Meander Belts supported a variety of bottomland forest types related to variation in soils and hydrology. Thus, the original vegetation at ARPO was a mix of bottomland forests and tallgrass prairies, with the Osotouy unit probably more open and grassy and the main unit more forested.

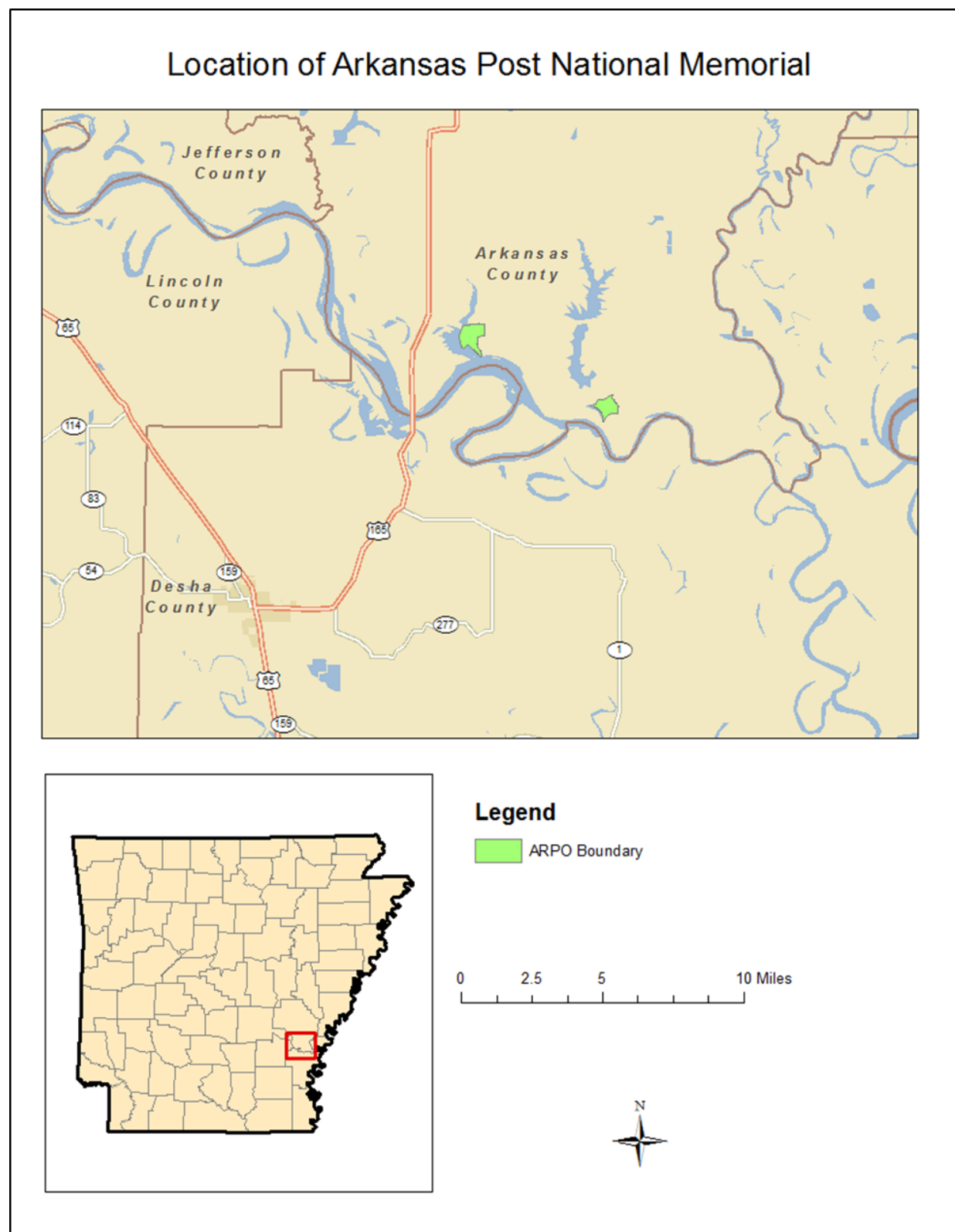


Figure 1. Location of Arkansas Post National Memorial.

Project Statistics

Field Work 2012 - 2014:

Plot Sampling = 38

Plots sampled in May 2013 by MoRAP staff

Accuracy Assessment Points = 68

All collected in September 2014 by Heartland Inventory and Monitoring Network staff

Observation Points = 75

Collected mainly in November 2012 & May 2013 by MoRAP staff

Classification:

6 NVC Plant Associations

5 Park Special Vegetation Classes

1 Non-Vegetated Land-Use Class (not including water)

GIS Database 2012 - 2014:

Arkansas Post National Memorial = 682.3 acres (276.1 hectares)

Base Imagery used for mapping (acquired by MoRAP):

2010, Arkansas County, AR, leaf-on, true color, 1m

2006, Arkansas County, AR, leaf-off, CIR, 1m

Additional Imagery acquired and viewed by MoRAP:

SPOT, leaf on

SPOT, leaf off

Minimum Mapping Unit = 0.5 hectare

Minimum Patch Size=.003 hectares

Total Size = 105 Polygons

Average Polygon Size = 6.04 acres (2.45 hectares)

Overall Thematic Accuracy = 100%

Project Completion Date: 12/2014

Methods

Arkansas Post National Memorial, at 682.3 acres, is a medium park by sampling design protocols (TNC and ESRI 1994), but at only 276 hectares, is on the small side of medium. Therefore, most of the mapped vegetation polygons were visited for this study. 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 ARPO 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

The vegetation mapping project was discussed with appropriate park staff in coordination with Heartland Network staff and MoRAP staff. A proposal for vegetation mapping was subsequently completed and approved by NPS National Vegetation Inventory Program staff. Based on that proposal, MoRAP was responsible for classification, plot sampling, mapping, and development of digital databases. The Heartland Network was responsible for oversight of MoRAP activities in concert with NPS Vegetation Inventory Program staff, and coordinated Accuracy Assessment (AA) tasks. ARPO 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 the NPS Vegetation Inventory Program team (see Jennings et al. 2009, Lea 2011, National Park Service 2011). The application of these methods to ARPO is outlined below.

Digital soil survey information, surface geology maps, and both current and historic air photos were initially reviewed, along with existing vegetation information (Irving and Brenholts 1977). A rapid field assessment, including collection of georeferenced field points, was made during the fall of 2012. Together, this body of information was used to plan quantitative field data collection (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 38 plots by MoRAP staff in May of 2013 (Figure 4). In the lab, the locations of plots were randomly placed within the following general strata based on field observation points and viewing of air photos and digital soils surveys (available at <http://sdmdataaccess.nrcs.usda.gov/>): better-drained woods and forests, more poorly drained bottomland woodlands and forests, mixed mainly herbaceous/young woody species uplands, marsh, young boxelder (*Acer negundo*) woodland, loblolly pine (*Pinus taeda*) plantation, and eastern redcedar (*Juniperus virginiana*) woodland. Plots were located >30 m from an obvious land cover edge, and for each potential plot location there was at least one alternate, should the original point be determined unusable in the field (e.g. close to an un-mapped trail or road, stand too small). The stratified random plot location information was loaded into a GPS and workers navigated to the plot in the field for field sampling.

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

Vegetation sampling included information about structure and physiognomy, with leaf phenology, leaf type and physiognomic class recorded for the dominant vegetative stratum. Cover data was 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 used for quantitative 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

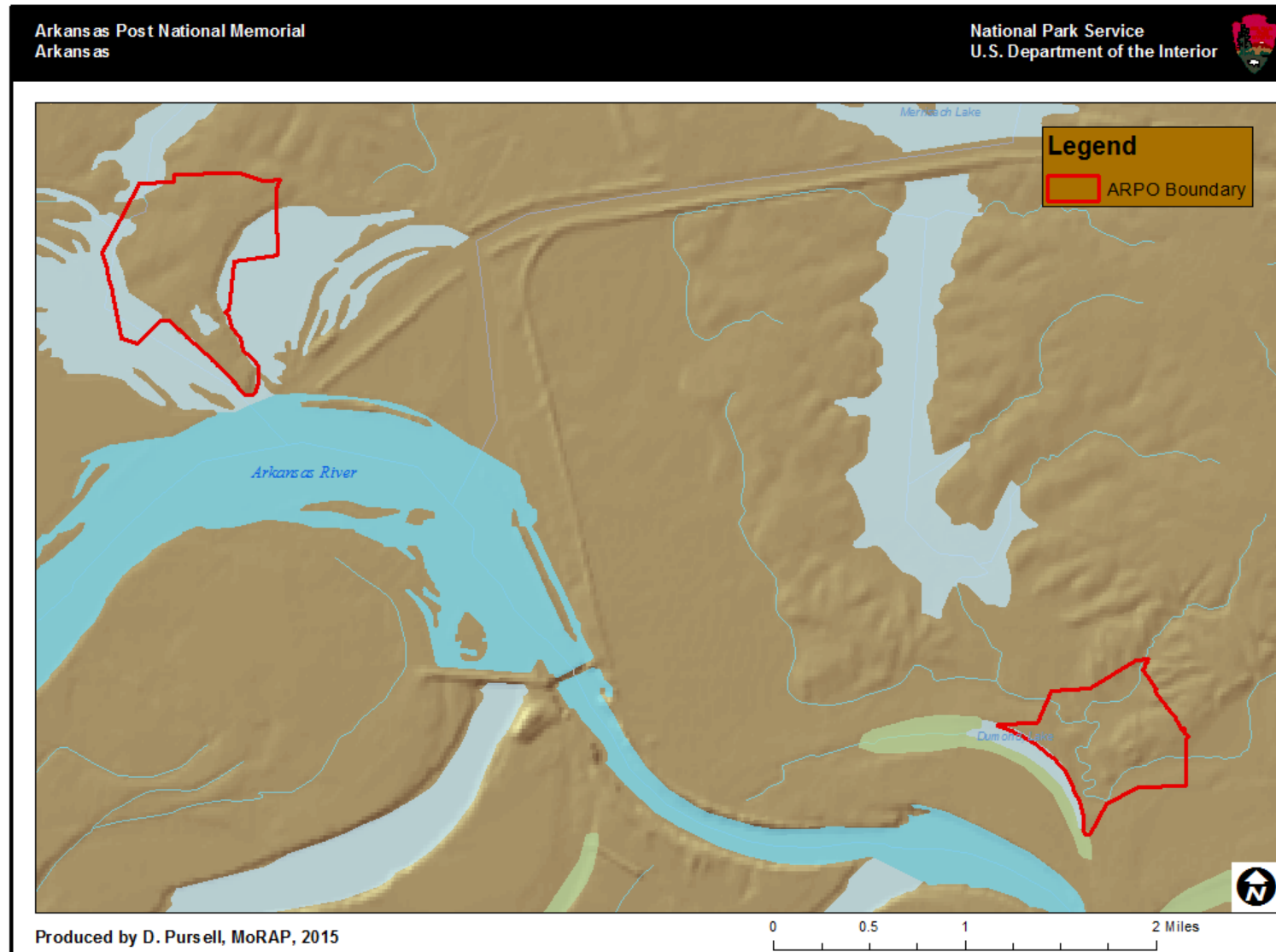


Figure 2. Map of Arkansas Post National Memorial showing the main unit to the west and the Osotouy unit to the east.

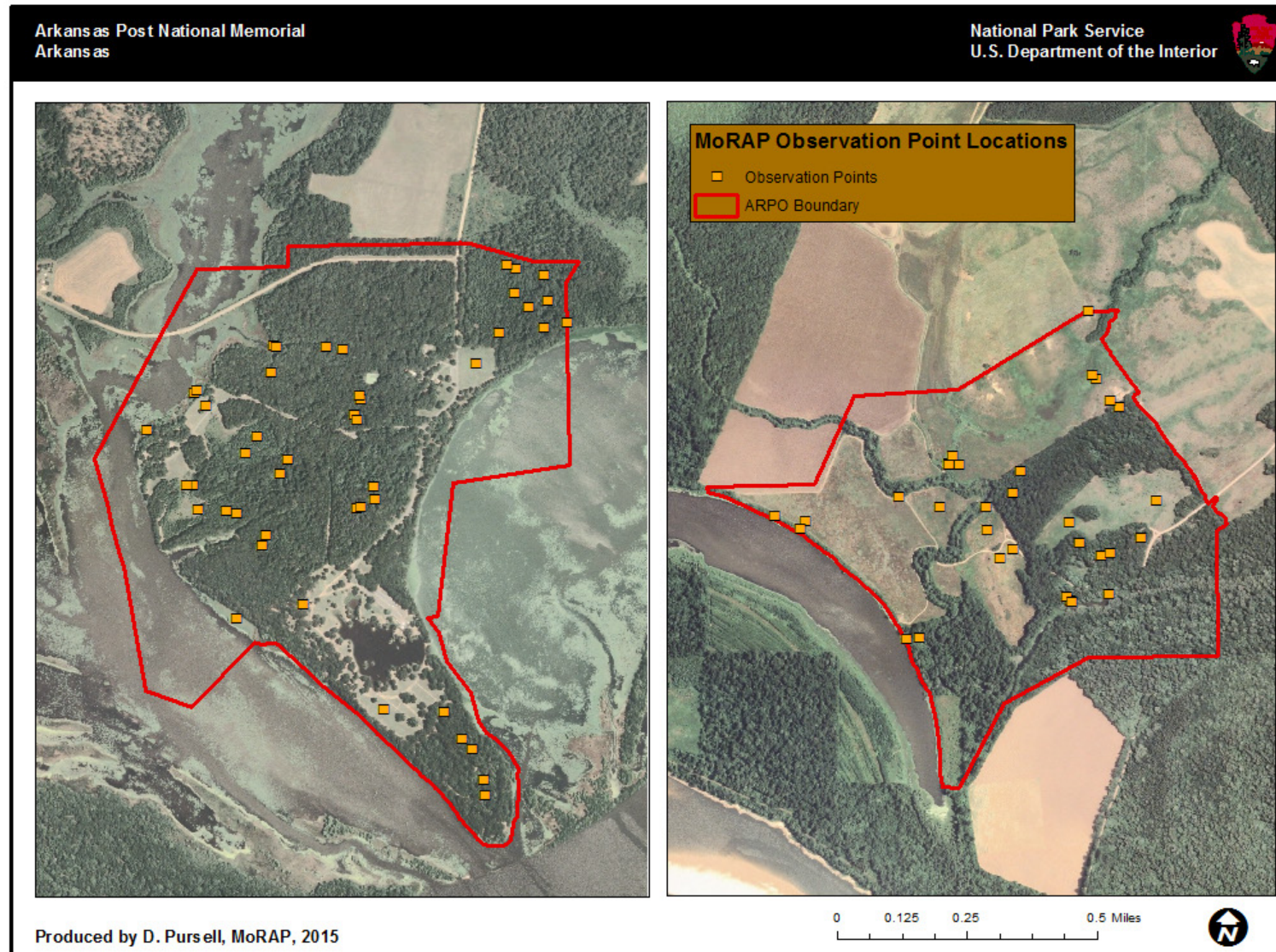


Figure 3. Map of 75 Observation Points at Arkansas Post National Memorial

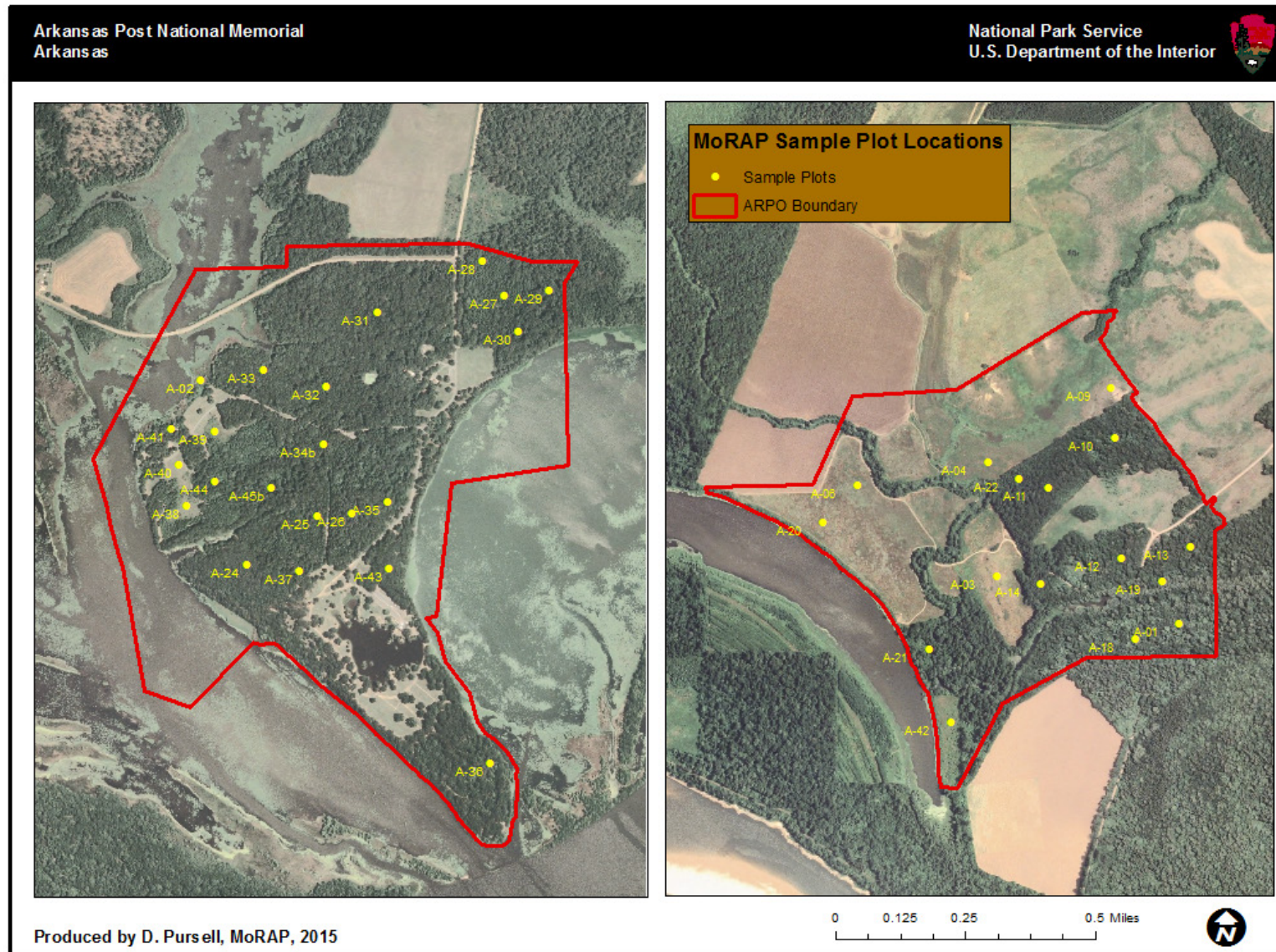


Figure 4. Map of 38 sample plots at Arkansas Post National Memorial.

Vegetation Classification

All recorded data were entered into the NPS PLOTS v3 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 Inventory 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 for percent overlap used to combine the strata cover values for each species was

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

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 $\log(\text{cover} + 1)$. Bray-Curtis dissimilarity was used as the distance metric for the cluster and ordination analyses (Legendre and Legendre 1998). Clustering was performed using the hierarchical clustering algorithm known as flexible Beta with a $\beta = -0.25$ (Lance and Williams 1967, Maechler et al. 2011). Non-metric multidimensional scaling was used to develop the ordination (Legendre and Legendre 1998, Roberts 2010).

From the initial analysis, three plots were determined to be outliers and were excluded from further analysis. One the outlier plots was strongly dominated by common rush (*Juncus effusus*) and narrowleaf cattail (*Typha angustifolia*). The other two plots were in areas heavily managed for recreational uses and had an understory dominated by turf grasses. All three of these plots were excluded from further ordination and cluster analyses.

Descriptive information on NVC community composition concepts and classification were obtained from the NatureServe Explorer (2013) website available at <http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol>. Where the observed ARPO vegetation did not fit descriptions of natural associations described for Arkansas, ruderal types were assigned.

Once the classification was finalized, a dichotomous key was developed by MoRAP for use during the AA (Appendix C). For types with an NVC assignment, the full NVC hierarchical classification and global descriptions are available in the results section. In addition, the final described types were linked to map classes for use in the photo-interpretation and mapping portions of the project.

In the future, ARPO classification plot data may be used by NatureServe to update and improve worldwide (i.e., global) descriptions of the NVC plant associations, especially for ruderal types. ARPO specific (i.e., local) descriptions were written based on ARPO plot, observation, and accuracy assessment data.

Digital Imagery and Interpretation

The mapping component was produced by identifying land cover on air photos and hand digitizing on-screen. Heads-up digitizing was accomplished at a display scale of not more than 1:1,000 against a back-drop of air photos (Figure 5). Imagery was the most recent available from the National Agriculture Imagery Program (NAIP; see http://www.fsa.usda.gov/Internet/FSA_File/naip_2009_info_final.pdf). This included 2010 leaf-on true color and 2006 leaf-off color infrared images (Figure 5).

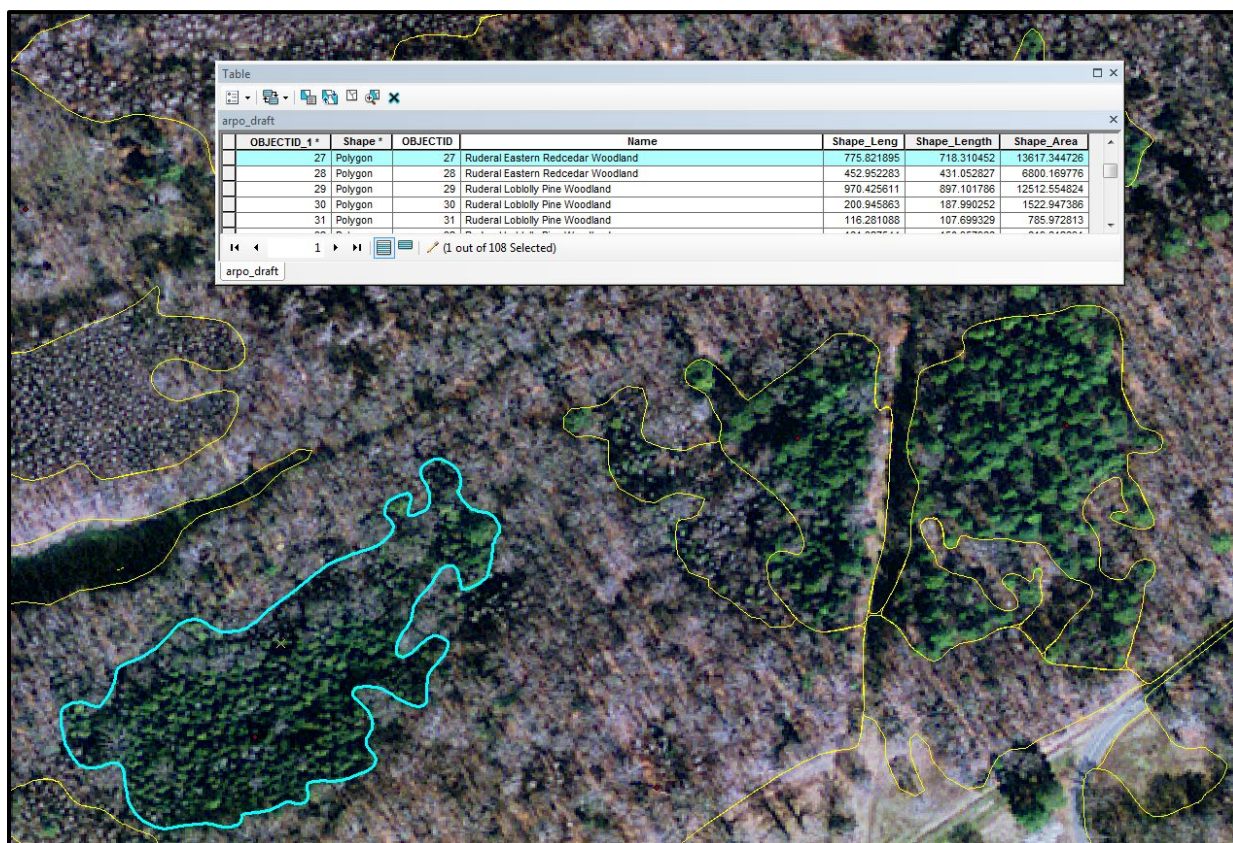


Figure 5. Representation of hand-digitized polygons.

Accuracy Assessment

Thematic accuracy assessment was conducted by HTLN. Methods and analysis for the accuracy assessment of vegetation mapping at ARPO were based on NPS standards (Lea and Curtis 2010). Thematic accuracy assessment of mapped vegetation classes were assessed independently following the completion of the vegetation mapping inventory by the lead authors.

Representative sites were identified and visited in the field to determine if interpreted mapped classes were correctly assigned by field observers using the dichotomous key to mapped current vegetation types (Appendix C). Identifying the degree of correspondence between field observations and mapped attributes provides a measure of the map's suitability for different applications.

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

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

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
Scenario A:	The class is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.	>30	>50 ha	30
Scenario B:	The class is relatively abundant. It covers more than 50 hectares of the total area but consists of fewer than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.	<30	>50 ha	20
Scenario C:	The class is relatively rare. It covers less than 50 hectares of the total area but consists of more than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.	>30	<50 ha	20

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

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
Scenario D:	The class is rare. It has more than 5 but fewer than 30 polygons and covers less than 50 hectares of the area. In this case, the recommended number of samples is 5. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than 5 sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting 5 sample sites will allow an accuracy estimate to be computed, although it will not be very precise.	5 - 30	<50 ha	5
Scenario E:	The class is very rare. It has fewer than 5 polygons and occupies less than 50 hectares of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than 5 sample sites (assuming 1 site per polygon) no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).	<5	<50 ha	Visit all and confirm

Random sample points were generated in ArcGIS. Points were buffered 40 meters from the park boundary and 80 meters from another point. 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 (Figure 6). All accuracy assessment field work was completed on the 15th and 16th of September, 2014. Field staff was provided with a GPS unit, dichotomous key for mapping vegetation map classes and vegetation class definitions.

Plot shape and size varied according to the extent of the vegetation class patch containing the sample point. Circular 0.25 hectare (28 m radius) plots were used for larger patches while rectangular 0.1 hectare (20 x 50 m) plots were used for small patches approaching the minimum mapping unit and for linear patches such as along waterways. A circular plot size of 0.5 hectare (40 m radius) was used to capture information for a single large homogenous patch. In all cases, plot size exceeded the minimum patch size for ARPO.

Field staff recorded plot size and shape, positional accuracy and vegetation classification at each point (Accuracy assessment field form, Appendix D). In addition, comments regarding the plot location, plot size and vegetation were recorded on the field form. Field data from the 68 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 Arkansas Post National Memorial.

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

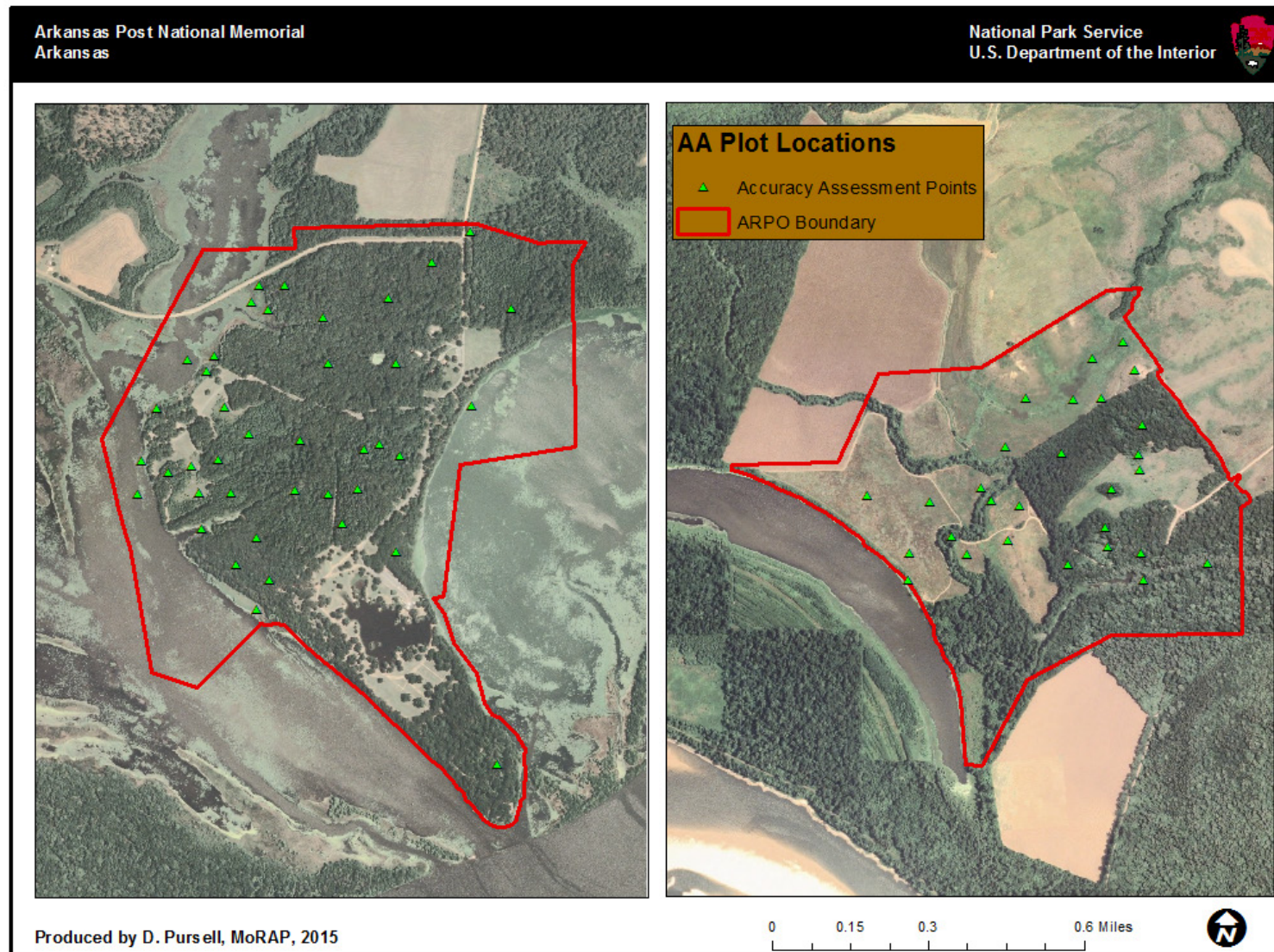


Figure 6. Accuracy assessment points for Arkansas Post National Memorial.

Results

Vegetation Classification

Eleven vegetation types were identified at ARPO based on evaluation of plot and observation point data. Most plots (23; green, see Figure 7) represented the Ruderal Bottomland Woodland type, and the Ruderal Mixed Herbaceous / Shrubland type was represented by an additional six plots (red, see Figure 7). The Ruderal Young Boxelder / Blackberry Woodland type had three plots (blue, see Figure 7) the Ruderal Eastern Redcedar Woodland two (orange), and the Ruderal Loblolly Pine Woodland (black) and Cattail – Rush Herbaceous Vegetation (not included in ordination or cluster results) one each. Five types were distinctive based on observation points but of low diversity, and those were described and classified from observation points (**Table 4**). Six of the eleven types were recognized communities within the National Vegetation classification, but five were only similar to described types, and represent park-specific types.

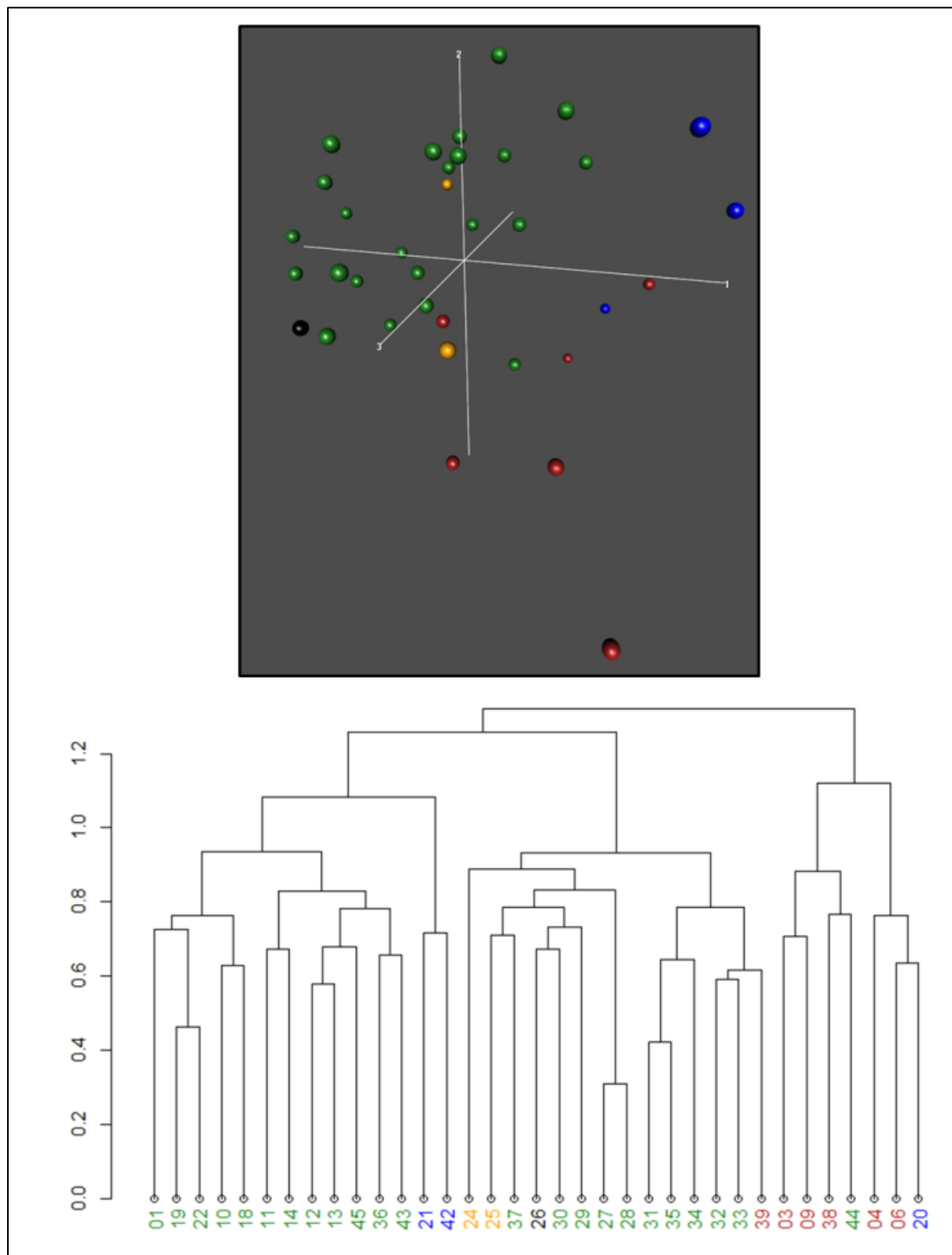


Figure 7. Three-dimensional ordination results and cluster dendrogram.

Digital Imagery and Interpretation

Thirteen terrestrial map units were identified at ARPO, including open water and cultural lands (**Table 4**). Plot data were taken in six of the natural and semi-natural types, and the remaining five were identified from observation points. All types were visible from air photos, although several covered 10 hectares or less area. The cultural land cover circumscribed all developed land, including buildings and maintained lawns.

Vegetation Map

A total of 682.3 acres (276.1 hectares) are within the accepted boundaries of ARPO (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 ARPO. Ruderal Bottomland Woodland covered 60.7% of the non-cultural, non-water area within the park units. Ruderal Mixed Herbaceous / Shrubland Vegetation covered an additional 17.6%, with the largest area in the Osotouy unit. The largest non-ruderal type, rooted aquatics within the American Lotus – Water Hyacinth Herbaceous Wetland type, covered 7.4% of ARPO, and was confined to nearly permanently flooded areas of Post Bayou and Post Bend bordering the main unit. The second largest non-ruderal type was Bald Cypress Woodland, which formed narrow borders along perennial water at the Osotouy unit. Another non-ruderal wetland, the Cattail – Rush Herbaceous Vegetation type, covered 1.5% of the area, and was found bordering Post Bayou on the main unit. Other types were a mix of ruderal herbaceous, shrubland, young woodland, and planted pine types. The largest was Ruderal Young Boxelder / Blackberry Woodland, which covered 4.4% of the area and was found entirely on the Osotouy unit.

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Table 4. Mapped types identified at Arkansas Post National Memorial.

NVC Identifier	Mapped Type Name	Scientific Name / Description	Number of Polygons	Acres	Hectares
Forest and Woodlands					
CEGL002420	Bald Cypress Woodland	<i>Taxodium distichum</i> / <i>Lemna minor</i> Forest	7	10.4	4.2
similar to CEGL007952	Ruderal Bottomland Woodland	<i>Quercus pagoda</i> / <i>Ulmus crassifolia</i> - <i>Celtis laevigata</i> / <i>Carex cherokeensis</i> Forest	14	319.3	129.2
similar to CEGL007124	Ruderal Eastern Redcedar Woodland	<i>Juniperus virginiana</i> – (<i>Quercus</i> spp.) Ruderal Forest	2	5.1	2.0
CEGL008462	Ruderal Loblolly Pine Woodland	<i>Pinus taeda</i> - <i>Liquidambar styraciflua</i> Ruderal Forest	4	3.9	1.6
CEGL005033	Ruderal Young Boxelder / Blackberry Woodland	<i>Acer negundo</i> Ruderal Floodplain Forest	3	23.3	9.4
CEGL002427	Ruderal Young Green Ash Woodland	<i>Fraxinus pennsylvanica</i> - <i>Ulmus americana</i> - <i>Celtis laevigata</i> / <i>Ilex decidua</i> Forest	2	4.7	1.9
similar to CEGL007216	Ruderal Young Sweetgum Woodland	<i>Liquidambar styraciflua</i> Ruderal Forest	6	9.0	3.6
Mixed Herbaceous / Shrubland Vegetation					
similar to CEGL004044	Ruderal Mixed Herbaceous / Shrubland Vegetation	<i>Andropogon virginicus</i> var. <i>virginicus</i> Ruderal Herbaceous Vegetation	34	92.4	37.4
similar to CEGL002191	Ruderal Wetland Mixed Herbaceous / Shrubland Vegetation	<i>Cephalanthus occidentalis</i> / <i>Carex</i> spp. - <i>Lemna</i> spp. Southern Shrubland	1	10.7	4.3
Herbaceous Vegetation					
CEGL004323	American Lotus - Water Hyacinth Herbaceous Wetland	<i>Nelumbo lutea</i> Herbaceous Wetland	7	39.0	15.8
CEGL002026	Cattail - Rush Herbaceous Vegetation	<i>Schoenoplectus tabernaemontani</i> - <i>Typha</i> spp. - <i>Sparganium</i> spp., <i>Juncus</i> spp. Herbaceous Vegetation	7	8.1	3.3
Land Use/Land Cover					
	Cultural		5	74.4	30.1
	Open Water		13	82.1	33.2
Total Land Use/Land Cover			18	156.4	63.3
Total Natural Vegetation			91	525.9	212.8
Totals			109	682	276

Accuracy Assessment

The 2014 accuracy assessment for ARPO was limited to the 525.9 acres (218.8 hectares) of natural and semi-natural vegetation within the park boundary. A total of 68 points were required to accurately evaluate the eleven natural and semi-natural vegetation map classes identified in the park. Navigational error (positional accuracy) of the GPS unit ranged from 2 – 7 meters for the 68 accuracy assessment points.

All types mapped were assessed to be 100% accurate, with no errors of omission or commission, and the Kappa index was therefore 100% (Appendix A).

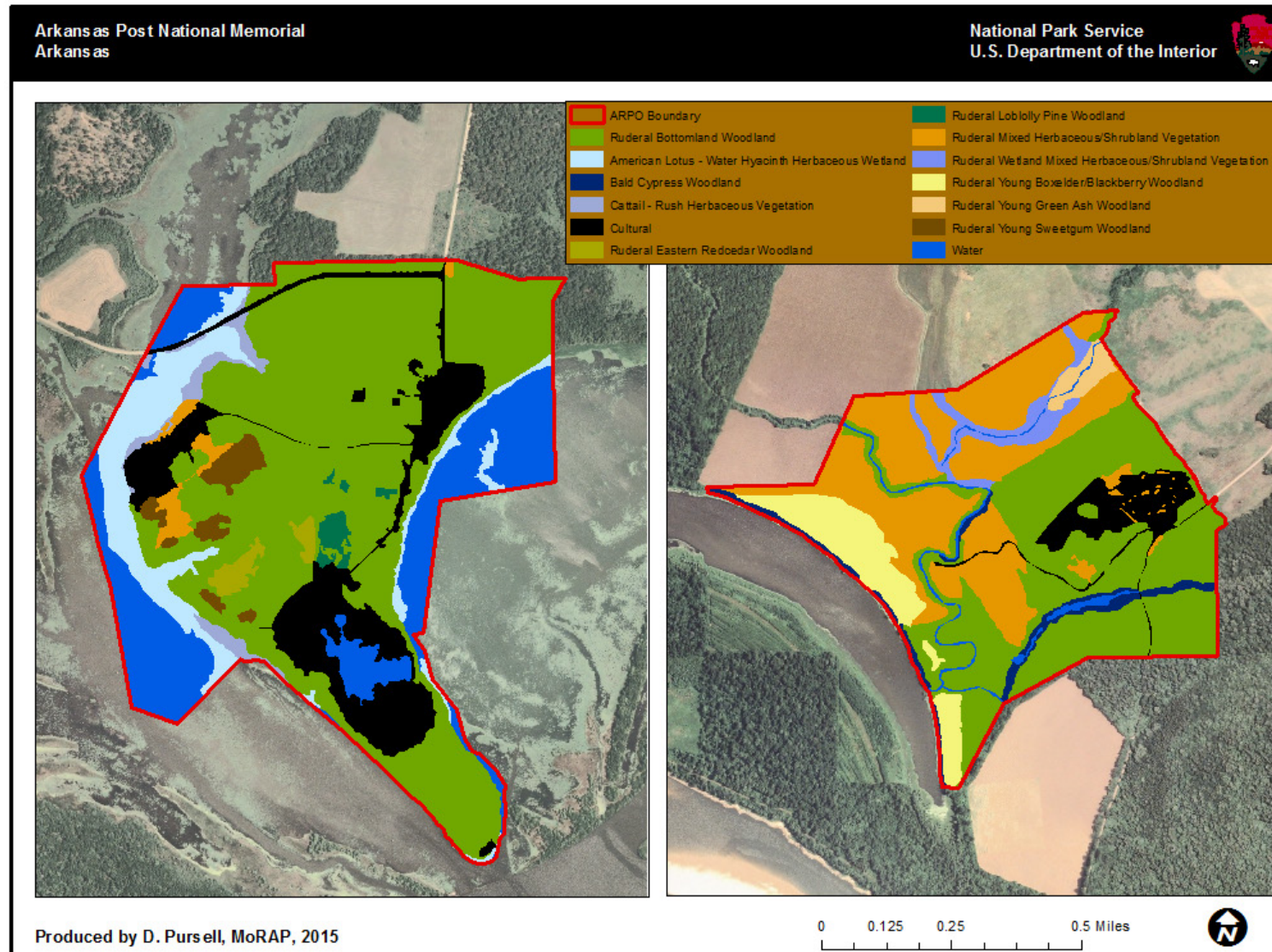


Figure 8. Vegetation classification for Arkansas Post National Memorial.

Vegetation Associations

Mapped Type Name: *American Lotus-Water Hyacinth Herbaceous Wetland*

Macrogroup: Eastern North American Freshwater Aquatic Vegetation

Group: Eastern North American Freshwater Aquatic Vegetation

Association: *Nelumbo lutea* Herbaceous Vegetation

Type Common Name: American Lotus Aquatic Wetland

Type Scientific Name: *Nelumbo lutea* Herbaceous Vegetation



Figure 9. American lotus was monodominant across much of the area of the American Lotus – Water Hyacinth Herbaceous Wetland type, with common water hyacinth abundant at some sites.

Global Summary: This type occurs in natural wetlands or artificial impoundments across the eastern United States. Often, *Nelumbo lutea* is monodominant. Other species may be present, such as *Cephalanthus occidentalis* may be present where water depths vary, and floating aquatics are often present. The hydrology is highly variable, and hydrologic placement is uncertain.

Environmental Description: At ARPO, this type was mainly in areas that are flooded to variable depths for most of the year along the inland margins and extending into Post Bayou and Post Bend (Figure 9). The location and extent of this type probably depends to a large extent on water depths that are controlled by structures on the Arkansas River.

Vegetation Description:

Most Abundant Species: American lotus (*Nelumbo lutea*) was monodominant across most of the area, and duckweed (*Lemna minor*) was present. In some areas, water hyacinth (*Eichhornia crassipes*) shared dominance.

Mapped Type Name: *Bald Cypress Woodland*

Macrogroup: Southern Coastal Plain Floodplain Forest

Group: Bald Cypress – Tupelo Floodplain Forest

Association: *Taxodium distichum* / *Lemna minor*

Type Common Name: Bald Cypress Swamp

Type Scientific Name: *Taxodium distichum* / *Lemna minor* Forest



Figure 10. Bald cypress gallery woodland occurred along the margins of a flooded stream and an ox-bow lake at Arkansas Post National Memorial.

Global Summary: This bald cypress swamp is found in the Atlantic and Gulf coastal plains of the United States in a variety of ecological settings. Examples may occur in oxbow lakes and ponds, and along the banks of rivers and lakes in saturated or flooded soils. It often has tall individuals of *Taxodium distichum* above shallow to deep water (depths ranging from soil saturation to approximately 6 m) during all or most of the year. Flooding is often seasonal, occurring during winter and spring. Stands have a sparse to moderate subcanopy and depauperate shrub and herb layers. The trunks of the canopy trees typically form swelled buttresses. Canopy cover is variable, from at or near 100% to less than 60% in some examples. More open examples of this type tend to occur in deeper water. In the deepest water situations scattered trees grow over an open water surface covered by floating and submersed aquatic plants. Bald cypress regeneration is absent in areas of

permanent inundation, as seed germination does not occur in standing water. The subcanopy and herbaceous layers are dependent upon timing, duration, and depth of flooding. *Cephalanthus occidentalis* and *Rosa palustris* may be common shrubs in some examples of this community, while *Fraxinus* spp. and *Acer rubrum* var. *drummondii* are common in the subcanopy. Shallow water emergent and floating aquatics may be present. This community is differentiated from other swamp forests by lacking gums (*Nyssa* spp.) as other than occasional individuals. This is the only community type currently defined outside Florida with bald cypress as the sole dominant.

Environmental Description: At ARPO, this type occurred as narrow gallery woodland or forest along a small, almost perennially flooded stream, and along the margin of an un-named bayou or oxbow lake which is connected to the Arkansas River by a small drainage (Figure 10). These narrow bands were generally 20 to no more than 50 meters wide, including open water in the stream.

Vegetation Description:

Most Abundant Species: The community was often only one or two trees wide at water's edge, and bald cypress (*Taxodium distichum*) was the only tree in the canopy. Buttonbush (*Cephalanthus occidentalis*) was often present as an understory shrub. Moving toward drier ground upslope, water oak (*Quercus nigra*), possum haw (*Ilex decidua*), pecan (*Carya illinoensis*), and winged elm (*Ulmus alata*) were common woody species, but these species were immediately adjacent to, not part of, the Bald Cypress Woodland community. No quantitative plots were collected within this type.

Mapped Type Name: *Cattail – Rush Herbaceous Vegetation*

Macrogroup: Eastern North America Wet Meadow & Marsh

Group: Bulrush species – Cattail species Freshwater Marsh

Association: *Schoenoplectus tabernaemontani* – *Typha* spp. - *Sparganium* spp., *Juncus* spp.
Herbaceous Vegetation

Type Common Name: Softstem Bulrush – Cattail – Bur-reed species, Rush species Herbaceous Vegetation

Type Scientific Name: *Schoenoplectus tabernaemontani* - *Typha* spp. - *Sparganium* spp., *Juncus* spp. Herbaceous Vegetation



Figure 11. Herbaceous wetlands were formed on inland margins of Post Bayou and Post Bend at Arkansas Post National Memorial.

Global Summary: This shallow marsh mixed emergent community ranges broadly over the Midwestern United States and adjacent Canada. It is found in basin-like depressions, backwater areas of floodplains, and shallow margins of lakes or ponds. Soils are shallow to deep, very poorly drained, consisting of peats, mucks, or mineral materials, often found in alluvium. Vegetation varies from zones dominated by tall emergents 1-2 m tall to those with hydrophytic annual and perennial forbs <1 m tall. In the tall emergent zone, *Schoenoplectus tabernaemontani* (= *Scirpus tabernaemontani*), *Schoenoplectus fluviatilis* (= *Scirpus fluviatilis*), *Schoenoplectus acutus* (= *Scirpus acutus*), *Typha*

angustifolia, and *Typha latifolia* may dominate, mixed with a variety of other herbaceous species, such as *Leersia oryzoides*, *Eleocharis palustris*, *Juncus* spp., and *Sparganium* spp. A hydrophytic annual and perennial forb zone may be present, as well as floating-leaved aquatics.

Environmental Description: This type was found along the inland margins of Post Bayou and Post Bend at ARPO. These areas were likely flooded for most of each year in the recent past, but water is not so deep as to prevent emergent wetland species from dominating the community.

Vegetation Description:

Most Abundant Species: This type was dominated by common rush (*Juncus effusus*) and narrowleaf cattail (*Typha angustifolia*) at ARPO (Figure 11). Watershield (*Brasenia schreberi*), alligatorweed (*Alternanthera philoxeroides*), and black willow (*Salix nigra*) were the only other species present in one plot sampled within this type. Two observation points within this type were overwhelmingly dominated by narrowleaf cattail.

Mapped Type Name: *Ruderal Bottomland Woodland*

Macrogroup: Southern Floodplain Hardwood Forest

Group: *Quercus michauxii* – *Quercus laurifolia* – *Liquidambar styraciflua* Bottomland Forest Group

Association: *Quercus pagoda* / *Ulmus crassifolia* - *Celtis laevigata* / *Carex cherokeensis* Forest

Type Common Name: Cherrybark Oak / Cedar elm – Sugarberry / Cherokee Sedge Forest

Type Scientific Name: *Quercus pagoda* / *Ulmus crassifolia* - *Celtis laevigata* / *Carex cherokeensis* Forest



Figure 12. The Ruderal Bottomland Woodland type at Arkansas Post National Memorial was fairly diverse in successional stage and soil moisture regime.

Global Summary: This riparian forest occurs along the periphery of the West Gulf Coastal Plain on rich, often calcareous alluvium. The canopy of typical stands contains *Quercus pagoda* and *Liquidambar styraciflua*, with *Ulmus crassifolia* and *Celtis laevigata* in the understory. *Carex cherokeensis* is a characteristic herb. The midstory is dominated by *Celtis laevigata*, followed by *Ulmus crassifolia* and *Ulmus alata*. Other dominant or frequently encountered species include *Sabal minor*, *Ulmus alata*, *Crataegus spathulata*, *Crataegus viridis*, *Ilex decidua*, *Ilex vomitoria*, *Fraxinus americana*, *Rubus trivialis*, *Smilax bona-nox*, *Toxicodendron radicans*, *Chasmanthium latifolium*, *Campsis radicans*, *Elymus virginicus*, *Geum canadense*, and seedlings

of *Quercus pagoda*, *Celtis laevigata*, and *Quercus nigra*. Shrubs include *Symphoricarpos orbiculatus*, *Forestiera ligustrina*, and *Sanicula odorata* (= *Sanicula gregaria*).

Environmental Description: This type is represented by young woodlands and forests at ARPO. Some areas are better drained than others, and the woodlands appear to be of different ages. Past disturbances mask differences that are related to site type, and make mapping of different bottomland forest types related to drainage impossible.

Vegetation Description: The overall dominants of the Ruderal Bottomland Woodland type at ARPO were cherrybark oak (*Quercus pagoda*), sugarberry (*Celtis laevigata*), pecan (*Carya illinoensis*), sweetgum (*Liquidambar styraciflua*), and water oak (*Quercus nigra*) (Figure 12). Most plots had water oak and sweetgum in the tree layer, and these species are indicative of moist bottomland forests, and are often relatively early successional species. However, slightly drier or older sites were also represented, and these had cherrybark oak as the main dominant. Some younger woodland patches were dominated by sugarberry, winged elm (*Ulmus alata*), and water oak. A few better-drained woodlands on the northeast side of the main unit had white oak (*Quercus alba*) and post oak (*Quercus stellata*) among the dominants (Table 5).

Most Abundant Species:

Table 5. Species in at least 6 of 23 plots within the Ruderal Bottomland Woodland with relative cover at least 5%, or in 10 or more plots.

Scientific Name	Common Name	%Frequency	% Relative Cover
Tree Layer			
<i>Carya illinoensis</i>	pecan	26.1	13.7
<i>Celtis laevigata</i>	sugarberry	52.2	16.9
<i>Liquidambar styraciflua</i>	sweetgum	60.9	13.3
<i>Quercus nigra</i>	water oak	78.3	11.1
<i>Quercus pagoda</i>	cherrybark oak	39.1	26.4
<i>Quercus phellos</i>	willow oak	43.5	12.0
<i>Quercus stellata</i>	post oak	56.5	3.0
<i>Ulmus americana</i>	American elm	43.5	10.9
Shrub Layer			
<i>Diospyros virginiana</i>	common persimmon	52.2	1.2
<i>Ilex decidua</i>	possumhaw	65.2	5.2
<i>Ulmus alata</i>	winged elm	100.0	12.3
Herbaceous Layer & Vines			
<i>Berchemia scandens</i>	Alabama supplejack	69.6	0.8
<i>Carex cherokeensis</i>	Cherokee sedge	56.5	9.5
<i>Carex glaucoidea</i>	blue sedge	69.6	0.7
<i>Carex oxylepis</i>	sharp scale sedge	43.5	2.7
<i>Chaerophyllum tainturieri</i>	hairyfruit chervil	43.5	0.8

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Scientific Name	Common Name	%Frequency	% Relative Cover
<i>Galium aparine</i>	stickywilly	47.8	1.2
<i>Lonicera japonica</i>	Japanese honeysuckle	60.9	4.0
<i>Myosotis verna</i>	spring forget-me-not	60.9	3.5
<i>Parthenocissus quinquefolia</i>	Virginia creeper	69.6	1.0
<i>Rubus trivialis</i>	southern dewberry	34.8	5.4
<i>Sanicula canadensis</i>	Canadian blacksnakeroot	56.5	0.7
<i>Smilax bona-nox</i>	saw greenbriar	91.3	0.6
<i>Toxicodendron radicans</i>	eastern poison ivy	91.3	7.6
<i>Viola sororia</i>	common blue violet	47.8	0.7
<i>Vitis rotundifolia</i> var. <i>rotundifolia</i>	muscadine	56.5	12.1

Mapped Type Name: *Ruderal Eastern Redcedar Woodland*

Macrogroup: Eastern North American Semi-natural Forest

Group: Northern & Central *Juniperus virginiana* – *Liriodendron tulipifera* / *Lonicera tatarica*
Semi-natural Forest Group

Association: *Juniperus virginiana* – (*Quercus* spp.) Ruderal Forest

Type Common Name: Eastern Redcedar Successional Forest

Type Scientific Name: *Juniperus virginiana* – (*Quercus* spp.) Ruderal Forest



Figure 13. Ruderal Eastern Redcedar Woodland was present on formerly disturbed soils, probably former croplands, at Arkansas Post National Memorial.

Global Summary: This is a successional community dominated by a nearly monospecific *Juniperus virginiana* var. *virginiana* canopy. Species composition and cover are variable depending upon geographic location and disturbance history. Some examples are densely forested (75-100% total cover) with *Juniperus virginiana* var. *virginiana* and sparse subcanopy, shrub and herb strata. Other examples, especially those that are somewhat more open-canopied, are more species-rich, and other tree species may enter the canopy in low levels of abundance. Species that may occur in the canopy include *Carya alba*, *Carya carolinae-septentrionalis*, *Carya ovata*, *Cercis canadensis*, and *Pinus virginiana*. Various oaks (including *Quercus coccinea*, *Quercus falcata*, *Quercus stellata*, and *Quercus phellos*) may also be present, seeding in from adjacent oak-hardwood forests. The

midstory is typically sparse, with canopy species as well as *Cornus florida*, *Ilex opaca*, *Liquidambar styraciflua*, and *Prunus serotina* var. *serotina*. In addition, *Frangula caroliniana* occurs in various strata. Herbs are patchy.

Environmental Description: This type occurred mainly in two well-defined disturbance patches, presumably old cropland, at ARPO (Figure 13). These patches were surrounded by the Ruderal Bottomland Woodland type.

Vegetation Description: Eastern redcedar (*Juniperus virginiana*) was the overwhelming canopy dominant of this type, with sweetgum (*Liquidambar styraciflua*) also important in the canopy. Other woody components included sugarberry (*Celtis laevigata*), winged elm (*Ulmus alata*), and American elm (*Ulmus americana*). Cherokee sedge (*Carex cherokeensis*) was the most important herbaceous component (Table 6).

Most Abundant Species:

Table 6. Species in at least one of two plots within the Ruderal Eastern Redcedar Woodland with relative cover of at least 1.0%.

Scientific Name	Common Name	%Frequency	% Relative Cover
Tree Layer			
<i>Celtis laevigata</i>	sugarberry	100	0.5
<i>Juniperus virginiana</i>	eastern redcedar	100	74.3
<i>Liquidambar styraciflua</i>	sweetgum	100	19.9
<i>Pinus taeda</i>	loblolly pine	50	3.5
<i>Ulmus alata</i>	winged elm	50	4.4
<i>Ulmus americana</i>	American elm	50	3.0
Shrub Layer			
<i>Callicarpa americana</i>	American beautyberry	100	0.5
<i>Diospyros virginiana</i>	common persimmon	50	1.0
Herbaceous Layer & Vines			
<i>Carex cherokeensis</i>	Cherokee sedge	100	7.8
<i>Carex oxylepis</i>	sharpscale sedge	50	3.0
<i>Diarrhena americana</i>	American beakgrain	50	3.0
<i>Oxalis stricta</i>	common yellow oxalis	100	0.5
<i>Parthenocissus quinquefolia</i>	Virginia creeper	100	1.8
<i>Toxicodendron radicans</i>	eastern poison ivy	100	3.0
<i>Vitis rotundifolia</i> var. <i>rotundifolia</i>	muscadine	50	3.0

Mapped Type Name: *Ruderal Loblolly Pine Woodland*

Macrogroup: Southeastern North American Ruderal Forest

Group: Southeastern Native Ruderal Forest

Association: *Pinus taeda* - *Liquidambar styraciflua* Ruderal Forest

Type Common Name: Loblolly Pine – Sweetgum Ruderal Forest

Type Scientific Name: *Pinus taeda* - *Liquidambar styraciflua* Ruderal Forest



Figure 14. Ruderal loblolly pine forest, probably from old plantings, were present at Arkansas Post National Memorial.

Global Summary: This community type is broadly defined to accommodate mid- to late-successional upland forests strongly codominated by *Pinus taeda* and *Liquidambar styraciflua*, resulting from past disturbance (such as agricultural or other land clearing). Understory composition differs based on edaphic site and on age and history. This broadly defined type occupies a variety of edaphic sites, ranging from mesic through dry-mesic sites on a wide variety of (generally acidic) soils. If left unmanaged or undisturbed, this can be a short-lived forest type, which is likely to succeed with greater age into various oak- and oak-pine-dominated forests.

Environmental Description: This type at ARPO was represented by one larger patch of (apparently) planted loblolly pines (*Pinus taeda*), and by a few small patches near this planting (Figure 14).

Vegetation Description:

Most Abundant Species: Loblolly pine was the overwhelming overstory dominant of these pine patches at ARPO. Understory species included common persimmon (*Diospyros virginiana*) and American beautyberry (*Callicarpa americana*). Species common in the Ruderal Bottomland Forest were found on stand edges.

Mapped Type Name: *Ruderal Mixed Herbaceous / Shrubland Vegetation*

Macrogroup: Southeastern Ruderal Grassland & Shrubland

Group: Southeastern Ruderal Grassland & Shrubland Vegetation

Association: *Andropogon virginicus* var. *virginicus* Ruderal Herbaceous Vegetation

Type Common Name: Broomsedge Bluestem Vegetation

Type Scientific Name: *Andropogon virginicus* var. *virginicus* Ruderal Herbaceous Vegetation



Figure 15. Ruderal Mixed Herbaceous / Shrubland Vegetation was common on former agricultural fields at Arkansas Post National Memorial.

Global Summary: This association includes herbaceous-dominated vegetation that has been anthropogenically altered and/or maintained, especially on old fields and pastures. Examples support predominately native species or a mixture of native and exotic species, one of the most dominant or characteristic species being *Andropogon virginicus* var. *virginicus*. *Lolium pratense* (= *Festuca pratensis*) can dominate fields early in the season. This is a very common and wide-ranging association that can be quite variable in terms of species composition. Additional components are other perennial grasses and herbaceous species, most with pioneer or weedy tendencies, the exact composition of which will vary with geography, management history, and habitat.

Environmental Description: This type at ARPO occupies former agricultural fields, and is hence the result of past management rather than variation in site-level abiotic conditions (Figure 15).

Vegetation Description: Broomsedge bluestem (*Andropogon virginicus*), sawtooth blackberry (*Rubus argutus*), great ragweed (*Ambrosia trifida*), and Carolina geranium (*Geranium carolinianum*) were among the early-successional species that dominated this community. Early successional trees and shrubs, including sweetgum (*Liquidambar styraciflua*), winged elm (*Ulmus alata*), common persimmon (*Diospyros virginiana*), sugarberry (*Celtis laevigata*), and honeylocust (*Gleditsia triacanthos*), were also important (**Table 7**). This type will likely become more wooded through time without management intervention.

Most Abundant Species:

Table 7. Species in at least two of six plots within the Ruderal Mixed Herbaceous / Shrubland with relative cover at least 5%, or in three or more plots.

Scientific Name	Common Name	%Frequency	% Relative Cover
Tree Layer			
<i>Albizia julibrissin</i>	silktree	33.3	7.8
<i>Celtis laevigata</i>	sugarberry	33.3	9.0
<i>Gleditsia triacanthos</i>	honeylocust	66.7	4.1
<i>Liquidambar styraciflua</i>	sweetgum	83.3	13.4
Shrub Layer			
<i>Cornus drummondii</i>	roughleaf dogwood	33.3	8.0
<i>Diospyros virginiana</i>	common persimmon	83.3	2.8
<i>Ulmus alata</i>	winged elm	83.3	7.6
Herbaceous Layer & Vines			
<i>Agrostis hyemalis</i>	winter bentgrass	50.0	1.3
<i>Ambrosia trifida</i>	great ragweed	50.0	13.7
<i>Andropogon virginicus</i>	broomsedge bluestem	66.7	19.6
<i>Campsis radicans</i>	trumpet creeper	83.3	3.4
<i>Erigeron philadelphicus</i>	Philadelphia fleabane	50.0	0.5
<i>Erigeron strigosus</i>	prairie fleabane	66.7	0.5
<i>Geranium carolinianum</i>	Carolina geranium	50.0	13.7
<i>Lonicera japonica</i>	Japanese brome	33.3	7.8
<i>Rubus argutus</i>	sawtooth blackberry	50.0	22.0
<i>Rubus trivialis</i>	southern dewberry	83.3	3.9
<i>Solidago altissima</i>	Canada goldenrod	50.0	0.5
<i>Sorghum halepense</i>	Johnsongrass	33.3	7.8
<i>Toxicodendron radicans</i>	eastern poison ivy	66.7	5.4
<i>Vicia caroliniana</i>	Carolina vetch	50.0	0.5

Mapped Type Name: *Ruderal Wetland Mixed Herbaceous / Shrubland Vegetation*

Macrogroup: Eastern North American Wet Meadow & Marsh

Group: Northern & Central Shrub Swamp

Association: *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland

Type Common Name: Common Buttonbush / Sedge species – Duckweed species Southern Shrubland

Type Scientific Name: *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland



Figure 16. The Ruderal Wetland Mixed Herbaceous / Shrubland Vegetation type occupies bottoms near upland drainages at Arkansas Post National Memorial.

Global Summary: This buttonbush shrubland occurs widely throughout the southeastern United States. Stands occupy shallow water depressions, oxbow ponds, beaver ponds, and backwater sloughs of stream and river floodplains. It also occurs in upland pond depressions. Inundation is usually continuous throughout the year, but these sites can become dry in mid or late summer or during periods of prolonged drought. In floodplain situations, soils are deep (1 m or more) consisting of peat or muck over alluvial parent material. *Cephalanthus occidentalis* comprises nearly 90% of the shrub layer in waters 1-2 m deep. Other shrubs commonly encountered may include *Cornus* sp. (*Cornus foemina* (= *Cornus stricta*) or *Cornus amomum* to the south and *Cornus sericea* (= *Cornus stolonifera*) to the north) and *Salix* spp. Sedges, including *Carex stipata*, *Carex stricta*, *Carex lurida*,

and *Carex intumescens*, are the dominant herbaceous species present, although *Hibiscus* spp. can also form dense stands in shallower water. *Lemna* spp. and *Leersia oryzoides* are also common plants in this natural community. *Populus heterophylla* and *Nyssa biflora* or *Nyssa aquatica* may also occur within their range. Floristic characteristics that distinguish this type from more northern types are needed. This may occur as a long-persistent successional stage. This community can result from natural or artificial disturbance of hydrology.

Environmental Description: This type occurs on bottoms on both sides of headwaters streams at ARPO. Bottomland strips range from 10 m to about 85 meters wide (Figure 16). These areas appear to be recovering from past disturbance, probably row crop agriculture.

Vegetation Description:

Most Abundant Species: This type was dominated by a mix of wetland herbaceous species, shrubs, and small trees. Spike rushes (*Eleocharis* spp.), flat sedges (*Carex* spp.), smartweed species (*Polygonum* spp.), cattail species (*Typha* spp.), rush species (*Juncus* spp.), common buttonbush (*Cephalanthus occidentalis*), green ash (*Fraxinus pennsylvanica*), honeylocust (*Gleditsia triacanthos*), and mallow species (*Hibiscus* spp.) were present.

Mapped Type Name: *Ruderal Young Boxelder / Blackberry Woodland*

Macrogroup: Eastern North American Ruderal Flooded & Swamp Forest

Group: Northern & Central Native Ruderal Flooded & Swamp Forest

Association: *Acer negundo* Ruderal Floodplain Forest

Type Common Name: Boxelder Ruderal Floodplain Forest

Type Scientific Name: *Acer negundo* Ruderal Floodplain Forest



Figure 17. Young boxelder stands occupied a poorly-drained area inland from an ox-bow lake at Arkansas Post National Memorial.

Global Summary: This semi-open to closed-canopy ruderal forest is found on disturbed sites in floodplains in the southern, eastern, and midwestern United States. Stands occur on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. Occurrences are mostly on higher floodplain terraces with less rocky soils which were used for agriculture or habitation. They are typically temporarily flooded in the spring. These ruderal forests are dominated by *Acer negundo*. Other characteristic species include *Platanus occidentalis*, *Celtis laevigata*, *Acer rubrum*, *Liriodendron tulipifera*, *Robinia pseudoacacia*, *Liquidambar styraciflua*, *Acer saccharinum*, *Ulmus alata*, *Ulmus rubra*, *Carya cordiformis*, *Fraxinus pennsylvanica*, *Juglans nigra*, *Carpinus caroliniana*, *Morus rubra*, and *Populus deltoides*. The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. The herb layer consists of a

mixture of weedy exotics and native floodplain species, including *Rhamnus cathartica* and various invasive *Lonicera* species.

Environmental Description: This type occurs primarily in two well-defined patches that extend 50 to 150 meters inland from an ox-bow at ARPO (Figure 17). These areas may represent poorly-drained old crop fields.

Vegetation Description: This is a fairly diverse vegetation type where boxelder (*Acer negundo*) is generally the prevailing dominant, occurring as a small tree. Other woody components include pawpaw (*Asimina triloba*), sugarberry (*Celtis laevigata*), and green ash (*Fraxinus pennsylvanica*). Herbaceous species dominated more open patches, with vine species such as eastern poison ivy (*Toxicodendron radicans*), saw greenbriar (*Smilax bona-nox*), Japanese honeysuckle (*Lonicera japonica*), and American buckwheat vine (*Brunnichia ovata*) common (**Table 8**).

Most Abundant Species:

Table 8. Species in at least one of three plots within the Ruderal Young Boxelder / Blackberry Woodland with at least 3% relative cover, or in two plots.

Scientific Name	Common Name	%Frequency	% Relative Cover
Shrub and Small Tree Layer			
<i>Acer negundo</i>	boxelder	33.3	63.25
<i>Asimina triloba</i>	pawpaw	33.3	54.84
<i>Celtis laevigata</i>	sugarberry	33.3	3.49
<i>Fraxinus pennsylvanica</i>	green ash	33.3	3.00
Herbaceous Layer & Vines			
<i>Ambrosia trifida</i>	great ragweed	66.7	19.00
<i>Bignonia capreolata</i>	crossvine	33.3	3.00
<i>Brunnichia ovata</i>	American buckwheat vine	33.3	3.00
<i>Lonicera japonica</i>	Japanese honeysuckle	33.3	3.00
<i>Myosotis verna</i>	spring forget-me-not	33.3	3.00
<i>Rubus trivialis</i>	southern dewberry	66.7	0.50
<i>Smilax bona-nox</i>	saw greenbriar	33.3	3.00
<i>Stellaria media</i>	common chickweed	33.3	3.00
<i>Torilis japonica</i>	erect hedgeparsley	66.7	0.50
<i>Toxicodendron radicans</i>	eastern poison ivy	33.3	62.50
<i>Viola sororia</i>	common blue violet	33.3	3.00
<i>Vitis riparia</i>	riverbank grape	33.3	3.00

Mapped Type Name: *Ruderal Young Green Ash Woodland*

Macrogroup: Central & Appalachian Floodplain Forest

Group: Silver Maple – Sugarberry – Sweetgum Floodplain Forest

Association: *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Forest

Type Common Name: Green Ash – American Elm – Sugarberry / Possumhaw Forest

Type Scientific Name: *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Forest



Figure 18. Young green ash forest was found on bottoms along a headwaters stream at Arkansas Post National Memorial.

Global Summary: This green ash - American elm - sugarberry community is found throughout the central and southern United States. Stands occur in floodplains of major rivers where water is absent for most of the growing season. Soils are moist alluvial clay or silt loams. *Ulmus americana* was once the most prominent member of this forest, but Dutch elm disease (*Ceratostomella ulmi*) and logging have eliminated many of the largest mature *Ulmus* spp. from most of the species' natural range. *Fraxinus pennsylvanica* dominates on moist flats and shallow sloughs, while *Celtis laevigata* is most prevalent on new land or front sites. Other species commonly encountered include *Carya aquatica*, *Quercus lyrata*, *Liquidambar styraciflua*, and *Acer negundo*. The subcanopy

is often dense and dominated by *Fraxinus pennsylvanica* which sprouts prolifically. Shrubs typical of this forest include *Cornus drummondii*, *Ilex decidua*, and *Crataegus* spp. The herbaceous layer is dense and diverse, dominated by *Galium* spp., *Viola* spp., *Carex* spp., *Leersia* spp., *Boehmeria cylindrica*, *Laportea canadensis*, *Pilea pumila*, *Impatiens capensis* (= *Impatiens biflora*), and *Impatiens pallida*. Vines most often encountered include *Toxicodendron radicans*, *Campsis radicans*, and *Parthenocissus quinquefolia*.

Environmental Description: At ARPO, this type occupied low landscape positions on both sides of a headwater drainage, and ranged up to about 85 meters wide (Figure 18). Adjacent private lands were cropped, and this area probably is former cropland.

Vegetation Description:

Most Abundant Species: This type was dominated by young green ash (*Fraxinus pennsylvanica*) or, in some small patches, honeylocust (*Gleditsia triacanthos*) trees, and wetland herbaceous plants and vines occurred in openings. Trees were apparently not more than 20 years old, and the future composition of this area is uncertain.

Mapped Type Name: *Ruderal Young Sweetgum Woodland*

Macrogroup: Southeastern North American Ruderal Forest

Group: Southeastern Native Ruderal Forest

Association: *Liquidambar styraciflua* Ruderal Forest

Type Common Name: Sweetgum Ruderal Forest

Type Scientific Name: *Liquidambar styraciflua* Ruderal Forest



Figure 19. Ruderal Young Sweetgum Woodland formed patches of nearly monodominant, closed canopy woodland at Arkansas Post National Memorial.

Global Summary: This early-successional upland forest of the southeastern U.S. occurs on a variety of environmental settings, resulting from succession following human activities such as logging and clearing or agriculture. Stands are dominated by *Liquidambar styraciflua*, sometimes to the exclusion of other species. *Pinus taeda* is a common associate. Other associated species are highly variable and depend on location and stand history.

Environmental Description: At ARPO, this type occurred in patches generally surrounded by older, but still not mature, ruderal bottomland forest (Figure 19). These patches do not appear to correspond with any abiotic variable, but rather appear to be the result of past disturbance.

Vegetation Description:

Most Abundant Species: Dense, fairly closed-canopy stands of sweetgum (*Liquidambar styraciflua*) characterized this type at ARPO. Winged elm (*Ulmus alata*) sometimes occurred as a dense understory layer, and American elm (*Ulmus americana*), pecan (*Carya illinoensis*), cherrybark oak (*Quercus pagoda*), water oak (*Quercus nigra*), and common persimmon (*Diospyros virginiana*) were other woody components.

Discussion

Both units of ARPO have been highly disturbed by past use for row crops and/or timber harvesting. Overall, the main unit was more wooded with young ruderal forests and the Osotouy unit more open, with earlier successional herbaceous / shrub dominated vegetation. The overall impression at both units was that of a highly human-modified landscape. Water levels at both units were currently manipulated via the Arkansas River Navigation Project.

Irving and Brenholts (1977) evaluated forest communities on the main unit, and also recognized that all communities at ARPO were recovering from past disturbance. They recognized three types associated with drainage patterns, including a limited better-drained upland type with white oak (*Quercus alba*), an intermediate type (the largest) with cherrybark oak (*Quercus pagoda*), and a wet type with water oak (*Quercus nigra*) and willow oak (*Quercus phellos*). They also recognized types dominated by pine (*Pinus taeda*) and eastern redcedar (*Juniperus virginiana*).

Plot data showed variation that apparently corresponded with both drainage patterns and past disturbances. Some younger and or better-drained plots were dominated by winged elm (*Ulmus alata*), sugarberry (*Celtis laevigata*), and water oak (*Quercus nigra*). The ability to map the variation observed in plots was confounded by past disturbances and the resulting mixing of communities that was unrelated to drainage patterns. Indeed, the map Irving and Brenholts (1977) provided did not attempt to draw lines between types, and indicated that some sampled areas were transitional or mixed types. We recognized a young sweetgum (*Liquidambar styraciflua*) forest that Irving and Brenholts (1977) did not, and this type may have grown up in the 35 years between their data collection and ours.

The mixed herbaceous / shrubland communities at ARPO were mainly on the Osotouy unit, and apparently represented recently abandoned croplands. Woodlands at the Osotouy unit appear mainly similar in age to those at the main unit, although some trees within the narrow Bald Cypress Woodland type appear to be more mature

Field Survey

Even though ARPO is a relatively small park, access to some areas on the Osotouy unit was limited due to drainages that fill with water after rains throughout the year. No quantitative plots were placed within the Ruderal Wetland Mixed Herbaceous / Shrubland Vegetation type because it was flooded during field visits. However, observation points were taken and were used to identify and describe the type. This was the only type at ARPO that was initially targeted for sampling where no plots were taken. Other types without quantitative plots were quite distinct, mainly ruderal, and of low species diversity.

NVC Classification

Six types at ARPO fit within National Vegetation Classification (NVC) concepts, and quantitative data from ARPO will add to the knowledge of variation within these types. Five types do not fit the descriptions of types within the NVC, but were somewhat similar to described types. Among these,

the Ruderal Bottomland Woodland type was probably too variable to provide useful input to the NVC because it circumscribed variation due to both past human disturbance history and drainage patterns. However, data from other ruderal types might be useful to broaden the definition of existing types. The degree of variation within ruderal types seems so large that providing a definition that fits every occurrence would be problematic.

Digital Imagery and Interpretation

Both 2010 leaf-on, true color imagery and 2006 leaf-off, color infrared imagery, both at 1 meter resolution, were available for ARPO. These were sufficient to distinguish differences between grassland / shrubland and forest, between very young and older deciduous forest types, and between evergreen and deciduous forests. Because the park was fairly small, heads up digitizing of polygons that represented the classified types was possible.

Accuracy Assessment

Overall thematic accuracy of the vegetation mapping at ARPO was 100%. Several of the mapped types were small. Four of eleven required only one or two AA sample points, and five more required six or fewer points. The most extensive types required 17 and 20 points each, and all were mapped accurately.

Future Recommendations

Successional communities characterized the vegetation at ARPO. The main unit had more forests and wetlands, whereas the Osotouy unit had more early successional herbaceous and shrub dominated communities. Historically, some of the better-drained uplands of both units may have been tallgrass prairie with wetland inclusions along drainages. Terrace and floodplains soils along the Arkansas River and bayous were likely forested. Even in the absence of much active management, areas that are currently deciduous woodland and forest will become more mature over time, and different types may become more evident as the composition of communities come to more nearly reflect abiotic potential. For example, cherrybark oak (*Quercus pagoda*) may become the prevailing dominant on most soils, whereas willow oak (*Quercus phellos*) and water oak (*Quercus nigra*) may come to prevail in the most poorly drained areas. A small area on the northwest side of the main unit appears better-drained, and may come to support white oak (*Quercus alba*) dominated forest. Evergreen pine and juniper woodlands on the main unit will likely lose ground to deciduous woodlands and forests through succession, as deciduous tree species overtop and recruit at a higher rate than the evergreens. More open areas on the Osotouy unit offer the opportunity for prairie restoration. A fairly extensive area of both upland and wetland herbaceous and shrub dominated communities occurred on the northwest side of the unit. Some woody vegetation is already present in this area, and in the absence of active management such as mowing or prescribed fire, the area will likely become forested over a fairly short period of time.

Research Opportunities

If restoration of tallgrass prairie on former croplands on the Osotouy unit becomes a priority, workers may find research opportunities related to restoration efforts. Much of the woodland and forest vegetation at ARPO can be expected to change over time, and this offers the opportunity to track

changes. Invasive plant species are a concern at ARPO, and the evaluation of any control efforts offers an avenue for research (Young et al. 2012)

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Appendix A: Contingency Table for Vegetation Mapping of Arkansas Post National Memorial

	Reference Data (Accuracy Assessment Field Data)												User's Error			
Sample Data (Polygon Map Data)	Map Units	American Lotus - Water Hyacinth Herbaceous Wetland	Bald Cypress Woodland	Cattail - Rush Herbaceous Vegetation	Ruderal Eastern Redcedar Woodland	Ruderal Loblolly Pine Woodland	Ruderal Mixed Herbaceous/Shrubland Vegetation	Ruderal Wetland Mixed Herbaceous/Shrubland Vegetation	Ruderal Bottomland Woodland	Ruderal Young Boxelder/Blackberry Woodland	Ruderal Young Green Ash Woodland	Ruderal Young Sweetgum Woodland	Totals	Commission Accuracy	90% Conf. Interval	
															-	+
	American Lotus - Water Hyacinth Herbaceous Wetland	6											6	100.0%	100.0%	100.0%
	Bald Cypress Woodland		4										4	100.0%	100.0%	100.0%
	Cattail - Rush Herbaceous Vegetation			5									5	100.0%	100.0%	100.0%
	Ruderal Eastern Redcedar Woodland				2								2	100.0%	100.0%	100.0%
	Ruderal Loblolly Pine Woodland					4							4	100.0%	100.0%	100.0%
	Ruderal Mixed Herbaceous/Shrubland Vegetation						17						17	100.0%	100.0%	100.0%
	Ruderal Wetland Mixed Herbaceous/Shrubland Vegetation							1					1	100.0%	100.0%	100.0%
	Ruderal Bottomland Woodland								20				20	100.0%	100.0%	100.0%
	Ruderal Young Boxelder/Blackberry Woodland									2			2	100.0%	100.0%	100.0%
	Ruderal Young Green Ash Woodland										2		2	100.0%	100.0%	100.0%
	Ruderal Young Sweetgum Woodland											5	5	100.0%	100.0%	100.0%
	Totals	6	4	5	2	4	17	1	20	2	2	5				
Producer's Error	Omission Accuracy	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	68 Total Correct Points			
	90% Conf. -	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	68 Total Points			
	Level +	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%				
Overall Total Accuracy = 100% Overall Kappa Index = 100% Overall 90% Upper and Lower Confidence Interval = 100% and 100%																

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	<u>Photos (y/n)</u> _____
Provisional Community Name _____	
Relative Stand Size extensive (>100x plot), <u>large</u> (>10-100x plot), small (3-10x plot), <u>very small</u> (1-3x plot), unknown	
Representativeness _____ _____ _____	
Landform (circle) <u>interfluvial</u> , gap/saddle, side slope, terrace/bench flat plain	
Topographic Position (circle) crest, upper slope, middle slope, lower slope, toe slope, <u>plain/level/bottom</u> , basin/depression	
Hydrologic Regime <u>Upland</u> Permanently flooded <u>Semipermanently</u> flooded <u>Seasonally/Temporarily</u> flooded Unknown	
Plot Shape (circle) <u>concave</u> convex flat irregular	
<u>General Comments</u> _____ _____ _____	

Plot Code _____

NPS VEGETATION MAPPING PROGRAM – PLOT SURVEY FORM
VEGETATION SAMPLING

NPS Vegetation Inventory Program
Arkansas Post National Memorial

[illegible]

NPS Vegetation Inventory Program
Arkansas Post National Memorial

Plot Code _____

[illegible]

Appendix C: Arkansas Post National Memorial Dichotomous Key to Mapped Current Vegetation Types

- 1a. Eastern redcedar or loblolly pine the prevailing dominant trees **2**
 - 2a. Eastern redcedar the prevailing dominant **Ruderal Eastern Redcedar Woodland**
 - 2b. Loblolly pine the prevailing dominant **Ruderal Loblolly Pine Woodland**
- 1b. Eastern redcedar or loblolly pine absent or if present, not dominant **3**
 - 3a. Woodland or forest dominated by trees >10 m tall and not strongly dominated by sweetgum **4**
 - 4a. Linear patches of forest or woodland along drainage-ways dominated by bald cypress
..... **Bald Cypress Woodland**
 - 4b. More extensive forest and woodland dominated by deciduous trees
..... **Ruderal Bottomland Woodland**
 - 3b. Trees >10 m tall not present, or if present, not dominant **5**
 - 5a. Wetlands in low landscape positions dominated by rooted aquatics or mainly wetland
herbaceous or shrub species such as buttonbush, cattails, and rushes **6**
 - 6a. Dominated by rooted aquatics including American locus or common water hyacinth
..... **American Lotus - Water Hyacinth Herbaceous Wetland**
 - 6b. Not dominated by rooted aquatics **7**
 - 7a. Dominated by cattails and rushes, and occurring at the edge of open water or
areas dominated by rooted aquatics **Rush - Cattail Herbaceous Wetland**
 - 7b. Wetland shrub and herbaceous species such as buttonbush, spikerushes,
sedges, and knotweed (smartweed) among the dominants; oblong or linear
patches along first-order drainage
..... **Ruderal Wetland Mixed Herbaceous/Shrubland Vegetation**

- 5b. Upland flats or slight slopes; not dominated by mainly wetland species, or if so,
strongly dominated by young stands of bottomland tree species..... **8**
- 8a. Tree layer strongly dominated by one of three species: sweetgum, green ash, or
boxelder **9**
- 9a. Dominated by green ash **Ruderal Young Green Ash Woodland**
- 9b. Dominated by sweetgum or boxelder **10**
- 10a. Dominated by boxelder or a combination of boxelder and blackberry
..... **Ruderal Young Boxelder/Blackberry Woodland**
- 10b. Dominated by sweetgum **Ruderal Young Sweetgum Woodland**
- 8b. Dominated by a variety of herbaceous species or young trees and shrubs; if green
ash, sweetgum, or boxelder dominant, then occurring within a diverse matrix of
shrubs and herbaceous species
..... **Ruderal Mixed Herbaceous/Shrubland Vegetation**

Appendix D: Example of Accuracy Assessment Form

Accuracy Assessment Form

NPS Vegetation Inventory

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

3. OBSERVER (DETERMINING 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 Arkansas Post National Memorial

Family	Scientific Name	Common Name
Acanthaceae	<i>Ruellia pedunculata</i>	stalked wild petunia
Aceraceae	<i>Acer negundo</i>	boxelder
	<i>Acer rubrum</i>	red maple
Amaranthaceae	<i>Alternanthera philoxeroides</i>	alligatorweed
Anacardiaceae	<i>Toxicodendron pubescens</i>	Atlantic poison oak
	<i>Toxicodendron radicans</i>	eastern poison ivy
Annonaceae	<i>Asimina triloba</i>	pawpaw
Apiaceae	<i>Chaerophyllum tainturieri</i>	hairyfruit chervil
	<i>Chaerophyllum tainturieri</i> var. <i>tainturieri</i>	hairyfruit chervil
	<i>Cryptotaenia canadensis</i>	Canadian honewort
	<i>Sanicula canadensis</i>	Canadian blacksnakeroot
	<i>Sanicula odorata</i>	clustered blacksnakeroot
	<i>Spermolepis echinata</i>	bristly scaleseed
	<i>Torilis japonica</i>	erect hedgeparsley
Apocynaceae	<i>Trachelospermum difforme</i>	climbing dogbane
	<i>Vinca minor</i>	common periwinkle
Aquifoliaceae	<i>Ilex decidua</i>	possumhaw
Araceae	<i>Arisaema dracontium</i>	green dragon
	<i>Peltandra virginica</i>	green arrow arum
Arecaceae	<i>Sabal minor</i>	dwarf palmetto
Aristolochiaceae	<i>Aristolochia serpentaria</i>	Virginia snakeroot
Asclepiadaceae	<i>Matelea decipiens</i>	oldfield milkvine
Aspleniaceae	<i>Asplenium platyneuron</i>	ebony spleenwort
Asteraceae	<i>Ambrosia artemisiifolia</i>	annual ragweed
	<i>Ambrosia trifida</i>	great ragweed
	<i>Aster</i> spp.	Aster
	<i>Baccharis halimifolia</i>	eastern baccharis
	<i>Cirsium</i> spp.	thistle
	<i>Coreopsis grandiflora</i>	largeflower tickseed
	<i>Elephantopus carolinianus</i>	Carolina elephantsfoot
	<i>Erigeron philadelphicus</i>	Philadelphia fleabane
	<i>Erigeron strigosus</i>	prairie fleabane
	<i>Gamochaeta purpurea</i>	spoonleaf purple everlasting
	<i>Ionactis linariifolius</i>	flaxleaf whitetop aster
	<i>Krigia biflora</i>	twoflower dwarfdandelion
	<i>Rudbeckia hirta</i>	blackeyed Susan
	<i>Solidago altissima</i>	Canada goldenrod

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Family	Scientific Name	Common Name
	<i>Symphotrichum pilosum</i> var. <i>pilosum</i>	hairy white oldfield aster
	<i>Symphotrichum turbinellum</i>	smooth violet prairie aster
	<i>Verbesina alternifolia</i>	wingstem
	<i>Vernonia baldwinii</i>	Baldwin's ironweed
Balsaminaceae	<i>Impatiens</i> spp.	touch-me-not
Berberidaceae	<i>Podophyllum peltatum</i>	mayapple
Bignoniaceae	<i>Bignonia capreolata</i>	crossvine
	<i>Campsis radicans</i>	trumpet creeper
Boraginaceae	<i>Myosotis verna</i>	spring forget-me-not
Cabombaceae	<i>Brasenia schreberi</i>	watershield
Campanulaceae	<i>Lobelia spicata</i>	palespike lobelia
	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass
Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle
	<i>Sambucus nigra</i> ssp. <i>canadensis</i>	American black elderberry
Caryophyllaceae	<i>Agrostemma githago</i>	common corncockle
	<i>Silene antirrhina</i>	sleepy silene
	<i>Stellaria media</i>	common chickweed
	<i>Chenopodium album</i>	lambsquarters
Clusiaceae	<i>Hypericum hypericoides</i>	St. Andrew's cross
	<i>Hypericum punctatum</i>	spotted St. Johnswort
Cornaceae	<i>Cornus drummondii</i>	roughleaf dogwood
	<i>Cornus florida</i>	flowering dogwood
	<i>Nyssa sylvatica</i>	blackgum
Cupressaceae	<i>Juniperus virginiana</i>	eastern redcedar
	<i>Taxodium distichum</i>	bald cypress
Cyperaceae	<i>Carex amphibola</i>	eastern narrowleaf sedge
	<i>Carex cephalophora</i>	oval-leaf sedge
	<i>Carex cherokeensis</i>	Cherokee sedge
	<i>Carex glaucoidea</i>	blue sedge
	<i>Carex normalis</i>	greater straw sedge
	<i>Carex oxylepis</i>	sharp-scale sedge
	<i>Carex retroflexa</i>	reflexed sedge
	<i>Carex</i> spp.	sedge
Ebenaceae	<i>Diospyros virginiana</i>	common persimmon
Ericaceae	<i>Vaccinium arboreum</i>	farkleberry
Euphorbiaceae	<i>Croton monanthogynus</i>	prairie tea
Fabaceae	<i>Albizia julibrissin</i>	silk tree
	<i>Desmanthus illinoensis</i>	Illinois bundleflower
	<i>Desmodium paniculatum</i>	panicled leaf ticktrefoil
	<i>Desmodium perplexum</i>	perplexed ticktrefoil

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	<i>Gleditsia triacanthos</i>	honeylocust
	<i>Lathyrus venosus</i>	veiny pea
	<i>Orbexilum pedunculatum</i> var. <i>pedunculatum</i>	Sampson's snakeroot
	<i>Robinia pseudoacacia</i>	black locust
	<i>Trifolium arvense</i>	rabbitfoot clover
	<i>Trifolium campestre</i>	field clover
	<i>Vicia caroliniana</i>	Carolina vetch
	<i>Quercus alba</i>	white oak
	<i>Quercus nigra</i>	water oak
	<i>Quercus pagoda</i>	cherrybark oak
	<i>Quercus palustris</i>	pin oak
	<i>Quercus phellos</i>	willow oak
	<i>Quercus similis</i>	bottomland post oak
	<i>Quercus stellata</i>	post oak
	<i>Quercus texana</i>	Nuttall oak
Fumariaceae	<i>Corydalis flavula</i>	yellow fumewort
Geraniaceae	<i>Geranium carolinianum</i>	Carolina geranium
Hamamelidaceae	<i>Liquidambar styraciflua</i>	sweetgum
Hippocastanaceae	<i>Aesculus pavia</i>	red buckeye
Hydrangeaceae	<i>Hydrangea arborescens</i>	wild hydrangea
Hydrophyllaceae	<i>Phacelia gilioides</i>	Brand's phacelia
Juglandaceae	<i>Carya alba</i>	mockernut hickory
	<i>Carya aquatica</i>	water hickory
	<i>Carya illinoensis</i>	pecan
Juncaceae	<i>Juncus effusus</i>	common rush
	<i>Juncus</i> spp.	rush
Lamiaceae	<i>Blephilia ciliata</i>	downy pagoda-plant
	<i>Lycopus virginicus</i>	Virginia water horehound
	<i>Perilla frutescens</i>	beefsteakplant
	<i>Prunella vulgaris</i>	common selfheal
	<i>Salvia lyrata</i>	lyreleaf sage
	<i>Trichostema brachiatum</i>	fluxweed
Liliaceae	<i>Allium</i> spp.	Onion
	<i>Narcissus</i>	daffodil
Menispermaceae	<i>Cocculus carolinus</i>	Carolina coralbead
Moraceae	<i>Morus rubra</i>	red mulberry
Oleaceae	<i>Forestiera acuminata</i>	eastern swampprivet
	<i>Fraxinus pennsylvanica</i>	green ash
	<i>Ligustrum sinense</i>	Chinese privet
Ophioglossaceae	<i>Ophioglossum vulgatum</i>	southern adderstongue

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Oxalidaceae	<i>Oxalis dillenii</i>	slender yellow woodsorrel
	<i>Oxalis stricta</i>	common yellow oxalis
Passifloraceae	<i>Passiflora lutea</i>	yellow passionflower
Pinaceae	<i>Pinus taeda</i>	loblolly pine
Plantaginaceae	<i>Plantago patagonica</i>	woolly plantain
	<i>Plantago rugelii</i>	blackseed plantain
Platanaceae	<i>Platanus occidentalis</i>	American sycamore
Poaceae	<i>Agrostis gigantea</i>	redtop
	<i>Agrostis hyemalis</i>	winter bentgrass
	<i>Aira elegans</i>	annual silver hairgrass
	<i>Alopecurus carolinianus</i>	Carolina foxtail
	<i>Andropogon gerardii</i>	big bluestem
	<i>Andropogon virginicus</i>	broomsedge bluestem
	<i>Bromus racemosus</i>	bald brome
	<i>Cynodon dactylon</i>	Bermudagrass
	<i>Diarrhena americana</i>	American beakgrain
	<i>Dichanthelium acuminatum</i> var. <i>acuminatum</i>	tapered rosette grass
	<i>Dichanthelium boscii</i>	Bosc's panicgrass
	<i>Dichanthelium dichotomum</i>	cypress panicgrass
	<i>Digitaria ciliaris</i>	southern crabgrass
	<i>Eleusine indica</i>	Indian goosegrass
	<i>Elymus virginicus</i>	Virginia wildrye
	<i>Hordeum pusillum</i>	little barley
	<i>Leersia virginica</i>	whitegrass
	<i>Lolium perenne</i>	perennial ryegrass
	<i>Panicum capillare</i>	witchgrass
	<i>Panicum virgatum</i>	switchgrass
	<i>Phalaris arundinacea</i>	reed canarygrass
	<i>Poa annua</i>	annual bluegrass
	<i>Poa pratensis</i>	Kentucky bluegrass
	<i>Schedonorus arundinaceus</i>	tall fescue
	<i>Schizachyrium scoparium</i>	little bluestem
	<i>Sorghum halepense</i>	Johnsongrass
Polemoniaceae	<i>Phlox divaricata</i>	wild blue phlox
Polygonaceae	<i>Brunnichia ovata</i>	American buckwheat vine
	<i>Polygonum</i> spp.	smartweed
	<i>Polygonum virginianum</i>	jumpseed
	<i>Rumex hastatulus</i>	heartwing sorrel
Primulaceae	<i>Lysimachia lanceolata</i>	lanceleaf loosestrife
Ranunculaceae	<i>Clematis virginiana</i>	devil's darning needles

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	<i>Ranunculus parviflorus</i>	smallflower buttercup
	<i>Ranunculus sardous</i>	hairy buttercup
Rhamnaceae	<i>Berchemia scandens</i>	Alabama supplejack
Rosaceae	<i>Agrimonia pubescens</i>	soft agrimony
	<i>Crataegus</i>	hawthorn
	<i>Geum canadense</i>	white avens
	<i>Prunus mexicana</i>	Mexican plum
	<i>Prunus serotina</i>	black cherry
	<i>Rosa arkansana</i>	prairie rose
	<i>Rubus argutus</i>	sawtooth blackberry
	<i>Rubus trivialis</i>	southern dewberry
	<i>Spiraea prunifolia</i>	bridalwreath spirea
Rubiaceae	<i>Galium aparine</i>	stickywilly
	<i>Galium arkansanum</i>	Arkansas bedstraw
	<i>Galium circaezans</i>	licorice bedstraw
	<i>Mitchella repens</i>	partridgeberry
Rutaceae	<i>Poncirus trifoliata</i>	hardy orange
Salicaceae	<i>Populus deltoides</i>	eastern cottonwood
	<i>Salix nigra</i>	black willow
Sapotaceae	<i>Sideroxylon lanuginosum</i>	gum bully
Scrophulariaceae	<i>Veronica arvensis</i>	corn speedwell
Smilacaceae	<i>Smilax bona-nox</i>	saw greenbrier
Solanaceae	<i>Solanum carolinense</i>	Carolina horsenettle
Tiliaceae	<i>Tilia americana</i>	American basswood
Typhaceae	<i>Typha angustifolia</i>	narrowleaf cattail
Ulmaceae	<i>Celtis laevigata</i>	sugarberry
	<i>Ulmus alata</i>	winged elm
	<i>Ulmus americana</i>	American elm
	<i>Ulmus crassifolia</i>	cedar elm
Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle
	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory
	<i>Urtica chamaedryoides</i>	heartleaf nettle
Valerianaceae	<i>Valerianella radiata</i>	beaked cornsalad
	<i>Callicarpa americana</i>	American beautyberry
Violaceae	<i>Viola pedata</i>	birdfoot violet
	<i>Viola sororia</i>	common blue violet
	<i>Parthenocissus quinquefolia</i>	Virginia creeper
	<i>Vitis aestivalis</i>	summer grape
	<i>Vitis riparia</i>	riverbank grape
	<i>Vitis rotundifolia</i> var. <i>rotundifolia</i>	muscadine

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

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