



Vegetation Classification and Mapping of Homestead National Monument of America

Project Report

Natural Resource Report NPS/HTLN/NRR—2011/345



ON THE COVER

The Homestead Heritage Center is situated next to upland restored prairie.

Photograph by: Kelly Kindscher

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This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. 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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Executive Summary

Homestead National Monument (HOME) was created at the to celebrate the significance of the Homestead Act of 1862 which granted 160 acres of free land to claimants and was one of the most significant and enduring events in the westward expansion of the United States. The National Monument encompasses 184 acres in Gage County, west of Beatrice, Nebraska. This unique site also hosts the oldest prairie restoration in the National Park system, and the second-oldest tallgrass prairie restoration known. This park unit also has a small remnant of native tallgrass prairie and remnants of bur-oak forest.

A three-year program was initiated to complete the task of mapping and classifying the vegetation at HOME. The Kansas Biological Survey in conjunction with NatureServe developed a vegetation classification using the National Vegetation Classification System and produced a digital vegetation map. To classify the vegetation, 17 representative plots located throughout the approximately 1,725 acre project area (parks + environs) were sampled during the summer of 2008. Additional data were obtained from vegetation plots sampled by the Inventory & Monitoring program in 2006. Analysis of the plot data by KBS produced six distinct plant associations and alliances and four land-use classes. Two of the communities, encompassing the upland and lowland restored tallgrass prairie area, were unique to HOME. Descriptions and a field key for all plant communities of HOME are included in this report.

Draft maps were printed, field tested, reviewed and revised. Twelve accuracy assessment (AA) data points were collected in 2009 by KBS and used to verify the map's accuracy.

Introduction

Homestead National Monument Vegetation Mapping Project

The Homestead National Monument of America (HOME) Vegetation Mapping Project was organized and coordinated by the Kansas Biological Survey (KBS) at the University of Kansas, in cooperation with NatureServe, in accordance with the standards set forth by the U.S. Geological Survey (USGS) – National Park Service (NPS) Vegetation Mapping Program.

The HOME Vegetation Mapping Project was initiated because a unified objective classification, such as outlined in the National Park Service’s Vegetative Mapping Program, can become a valuable aid to the preserve for the use in vegetation management, fire, and monitoring wetlands and wildlife. Since the National Park Service is charged with conserving, protecting, and interpreting the resources of this prairie landscape, an accurate and detailed vegetation map and data layers for a GIS will be very useful for management purposes.

Common to all Vegetation Mapping Program projects, the three major components of the HOME Vegetation Mapping Project are vegetation classification, vegetation mapping, and map accuracy assessment. In this report we discuss each of these fundamental components in detail.

USGS-NPS Vegetation Mapping Program

The National Vegetation Mapping Program is an interagency initiative established to inventory, classify, describe, and map vegetation in National Park units across the United States. It is administered by the USGS Center for Biological Informatics and the NPS Natural Resources Information Division, and provides baseline vegetation information to the NPS Inventory and Monitoring Program. Vegetation Mapping Program scientists developed procedures for classification, mapping, and accuracy assessment (The Nature Conservancy [TNC] and Environmental Systems Research Institute [ESRI] 1994a).

Use of the NVCS as the standard vegetation classification system 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;
- is appropriate for mapping at multiple scales.

The use of the NVCS and the USGS-NPS vegetation mapping protocols facilitates effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS and 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.

The NVCS has primarily been developed and implemented by The Nature Conservancy (TNC) and the network of State Natural Heritage Programs over the past 20 years (TNC and ESRI 1994a; Grossman et al. 1998). The NVCS is currently supported and endorsed by multiple federal agencies, the Federal Geographic Data Committee (FGDC), NatureServe, state natural heritage programs, and the Ecological Society of America. Refinements to the classification occur in the process of application, leading to ongoing proposed revisions that are reviewed both locally and nationally.

Vegetation Mapping Program Standards

The NPS Inventory & Monitoring 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 1994a);
- standards for field methods and mapping procedures (TNC and ESRI 1994b);
- producing rigorous and consistent accuracy assessment procedures (TNC and ESRI 1994c);
- establishing standards for using existing vegetation data (TNC 1996);

Standards

- National Vegetation Classification Standard (FGDC 1997);
- Spatial Data Transfer Standard (FGDC 1998b);
- Content Standard for Digital Geospatial Metadata (FGDC 1998a);
- 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.

These documents are available at the USGS-NPS Vegetation Program Web site (<http://biology.usgs.gov/npsveg/standards.html>).

Study Area

Homestead National Monument of America

On March 16, 1936, federal legislation was passed creating a new unit in the National Park System on the site of the Daniel Freeman homestead, recognized as the first homestead in the nation obtained through the Homestead Act of 1862. It is located on 184 acres in Gage County, west of Beatrice, NE.

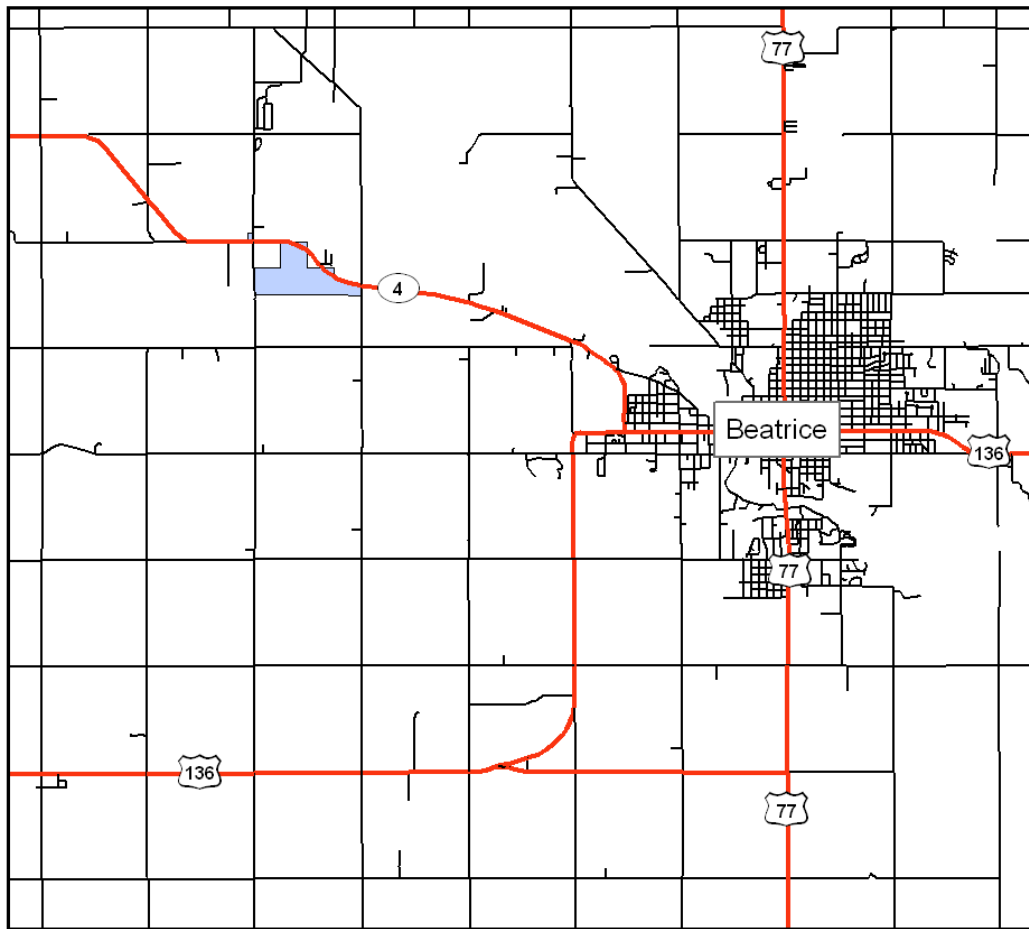
Homestead National Monument is home to the second-oldest tallgrass prairie restoration in the nation. Prior to acquisition by the NPS, the 100-acre area that is now restored prairie was heavily used for agriculture and grazing. The restoration was accomplished through a combination of seeding a mix of native grasses, installation of native plant plugs, and transplanting sod from local areas of unplowed prairie. Management for exotic species has involved mowing, selective herbicide application, and, beginning in 1970, prescribed burning on a regular basis. The restored prairie reflects the species richness and diversity of its historic source, but has more woody species in some locations (James and Debacker 2007).

Approximately 0.75 acres of tallgrass prairie, which had never been plowed, are located next to the Freeman School, which was incorporated into the park in 1970.

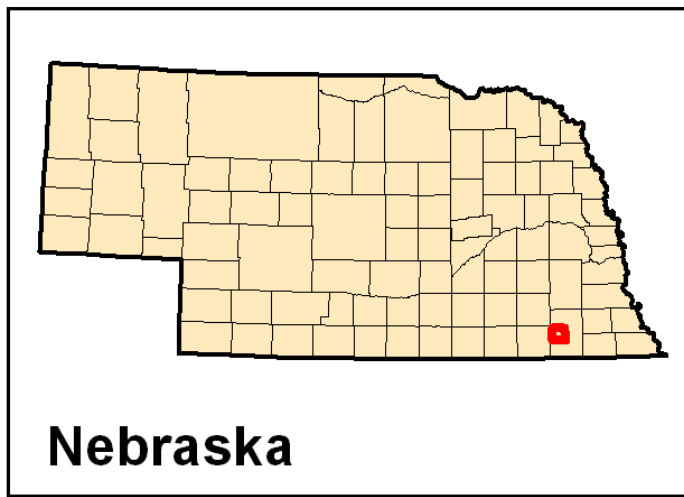
Sixty acres of lowland Bur Oak Woodland are also present at HOME along Cub Creek, remnants of a bur oak wooded community that was recorded occurring on the site in the Public Land Office survey of 1857. It reflects the pre-settlement community that occurred here with some very large characteristic bur oak trees and has been studied as a rare natural plant community (Rolfmeier 2007).

Significant facilities and cultural resources are present at Homestead National Monument. A multipurpose Heritage Center opened in May 2007, containing interactive displays on homesteading, a view of the tallgrass prairie to depict how early pioneers might have seen it, and a parking lot exactly one acre in size to give visitors a sense of scale. Another resource available to visitors is the Education Center, which includes a log cabin built in 1867 and museum displays of tools and farm machinery. The one-room Freeman School House was built in 1872 and holds a long history of use: it was a school until 1967 and was also used as a meeting place for the First Trinity Lutheran Church, the polling place for Blakely Township, and a gathering place for many debates, socials and clubs.

Location of Homestead National Monument in Nebraska



0 0.5 1 2 Miles
|-----|-----|-----|-----|



Legend

- Roads
- Highways
- Homestead National Monument

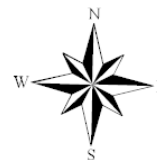


Figure 1. Location of Homestead National Monument in Beatrice, NE.

Project Statistics

Field Work Summers of 2008 and 2009:

Plot Sampling = 17 Plots:

17 Plots Sampled in July 2008 by the Kansas Biological Survey staff

Accuracy Assessment Points = 12

12 Points assessed in July 2009 by the Kansas Biological Survey staff

Classification:

4 NVC Vegetation Classes

2 Park Special Vegetation Classes

4 Non-Vegetated Land-Use Classes

GIS Database 2008-2009:

Project Size = 1,725 acres (698.08 hectares)

Homestead National Monument = 184 acres (74.46 hectares)

Base Imagery acquired from the NPS:

Spring 2001 Ikonos image

1991 USGS Digital Orthophoto Quarter Quads (DOQQs)

1971 and 1937 panchromatic imagery

Ancillary Imagery acquired by the Kansas Applied Remote Sensing Program (KARS), a program of the Kansas Biological Survey:

2003, 2006, 2007, and 2009 USDA Farm Service Administration National Agriculture
Imagery Program (NAIP)

2007 Custom CIR and RGB imagery from KARS

Minimum Mapping Unit = ½ hectare

Total Size = 60 Polygons

Average Polygon Size = 28.8 acres (11.65 hectares)

Overall Thematic Accuracy = 100%

Project Completion Date: 06/30/10

Methods

The vegetation mapping project at HOME was considered to be in the “small park” category based on the overall size of the project area (TNC and ESRI 1994b). As such, the standard methodology for sampling and mapping is to visit every vegetation polygon in the park. It is assumed that these sites will sufficiently characterize the vegetation types and explain their distribution across the park without having to survey each stand of vegetation. Based on this approach the assignment of responsibilities was divided into five major tasks, including the following:

1. Plan, gather data, and coordinate tasks;
2. Survey HOME 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;
4. Acquire current digital imagery and interpret the vegetation from these using the classification scheme and a map unit crosswalk;
5. Assess the accuracy of the final map product.

All protocols for this project as outlined in the following sections can be found in documents produced by TNC and ESRI (1994a, 1994b, 1994c) for the USGS-NPS Vegetation Mapping Program. These documents can be found at: <http://biology.usgs.gov/npsveg>.

Planning, Data Gathering and Coordination

A scoping meeting was held in June 2007 with all project participants (Kansas Biological Survey, NatureServe, Nebraska Natural Heritage Program, NPS Heartland Network staff, Homestead National Monument staff, Kansas Park Trust, National Park Service National Vegetation Mapping staff, and the Nature Conservancy). KBS was responsible for plot sampling and reconnaissance visits of potential community types of HOME. KBS was also responsible for entering these data into a digital database, classifying the data, and providing a list and global descriptions for the HOME plant associations. KBS was responsible for the imagery interpretation and creating a digital vegetation map and spatial database. NatureServe reviewed and evaluated the draft classification and wrote vegetation descriptions for all associations. KBS created a vegetation key, and conducted accuracy assessment of the vegetation map. NatureServe and HOME staff provided logistical and technical support, and helped coordinate activities.

The project boundary included the area within HOME as well as a 0.5 mile environs (Figure 2).

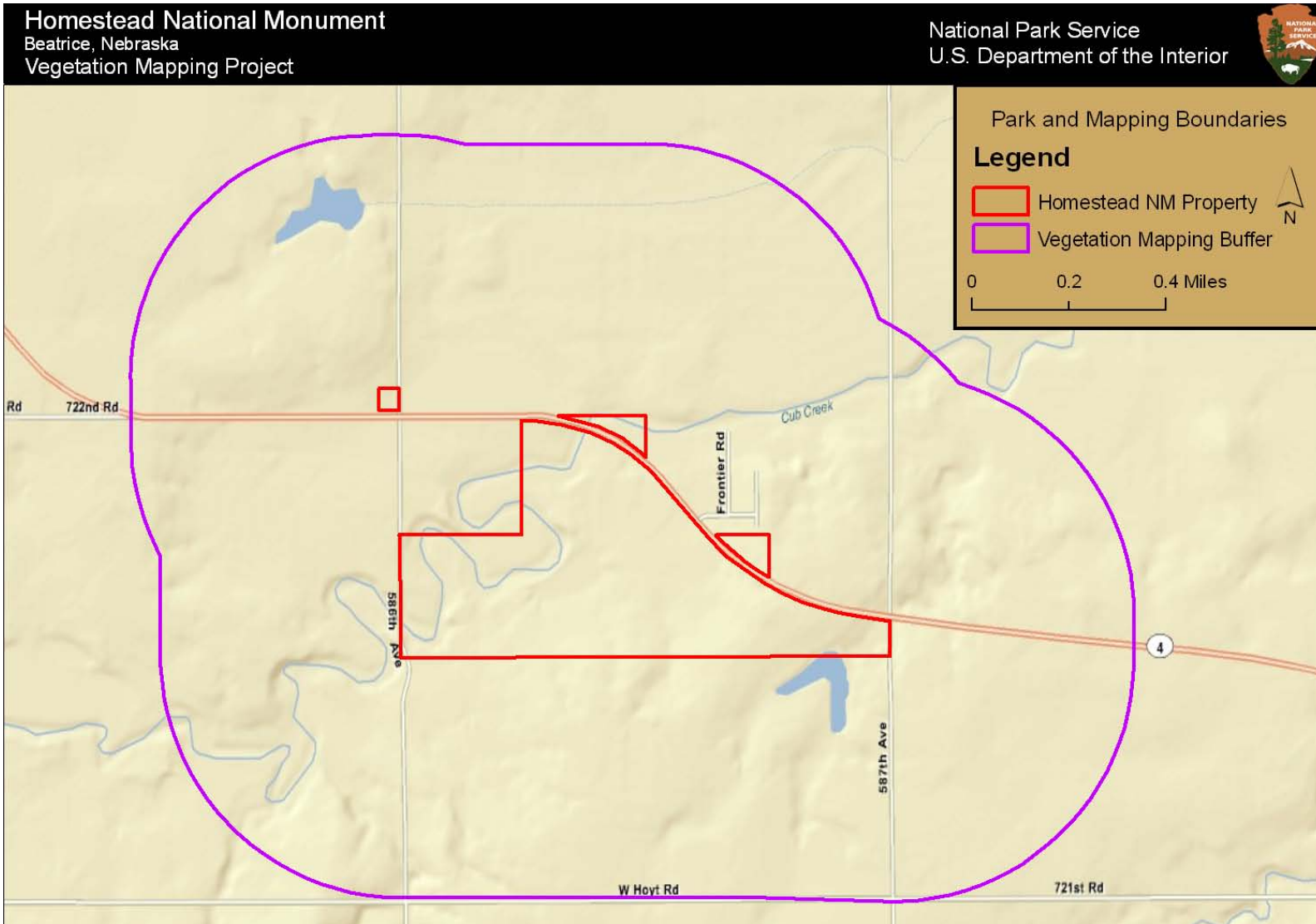


Figure 2. Map of the vegetation project boundary and park boundary.

Field Survey

Overall, the field methods used by the Kansas Natural Heritage Inventory in sampling and classifying the vegetation followed the methodology outlined by the USGS-BRD/NPS Vegetation Mapping Program and the NVC (Grossman et al. 1994, Grossman et al. 1998).

Vegetation data were collected in characteristic plots by KBS in July 2008 and additional plot information was acquired from the HTLN (Figure 3). Characteristic plots were located in areas that were visually representative of the preliminary vegetation categories. Plots were 100 m² in area, and GPS coordinates were recorded with a Garmin receiver. To maintain consistency with other projects, plots were square. The accuracy for all of the recorded points ranged from 1-7 meters in horizontal accuracy, as recorded by the GPS receiver. Thirteen plots were sampled in the preliminary vegetation type “Restored Prairie,” and three plots were sampled in the preliminary vegetation type “Central Tallgrass Prairie.”

The survey form used for characteristic plot data is located in Appendix B. All plants found within the characteristic plots were identified to species level where possible. In some cases, identification was only possible to the genus level (i.e., non-reproductive *Muhlenbergia* and *Carex* species). Visual estimates of percent cover were made for all species, including live material and the current year’s standing dead. To maintain consistency with local vegetation surveys and other work of KBS, a continuous range of possible cover estimates was used, rather than cover classes. Plants that covered less than one half of one percent of the plot were classified as a “trace” (T). Also to maintain consistency with published accounts and similar projects in the region, species were assigned names following the Flora of the Great Plains (McGregor and Barkley 1986). An updated synonymy was completed when data were entered into the PLOTS database. Noteworthy surrounding vegetation, slopes, unusual soil features, and noticeable use by animals were also noted at each plot. Most of HOME had been previously plowed for agriculture but has been restored to prairie, and many of the plots were on a gentle slope with an A horizon of silt or silty clay loam soils.

Additional plot data were obtained from the HTLN, which had sampling data from 2005 and 2006 on ten permanent plots. Each plot was comprised of two transects 50 m in length, with ten sets of nested subplots systematically arranged. Working from the smallest to the largest plot, all herbaceous, woody shrub and tree seedling and sapling species were identified. Foliar cover was estimated in the 10 m² subplot using a modified Daubenmire (1959) scale. Trees less than 5.0 cm diameter at breast height (dbh) were tallied by species in each 10 m² subplot. In woodland communities, stem density was used to estimate abundance of tree species. Seedlings and saplings were counted and assigned to one of three size classes (<0.5 m dbh, 0.5–2.5 m dbh, or 2.5–5.0 m dbh). The 0.1 ha area between the two transects was used to collect data on the woody species greater than 5.0 cm dbh in the understory and overstory canopy layers. Diameter at breast height was measured for each individual tree greater than or equal to 5.0 cm.

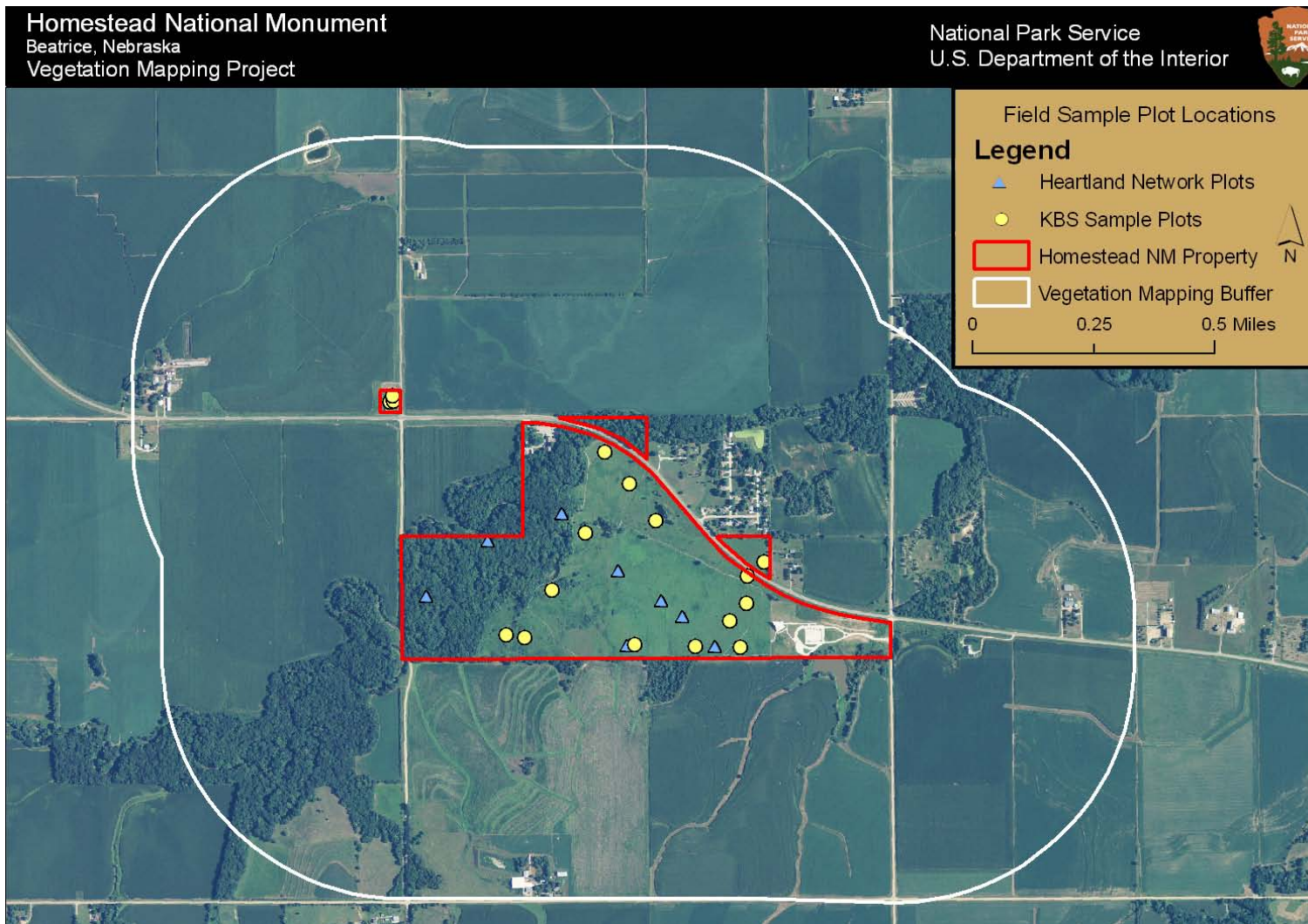


Figure 3. Locations of all vegetation plots collected at Homestead National Monument of America in 2008.

Vegetation Classification

Upon completion of field surveys, all recorded data were entered into the NPS PLOTS database (TNC 1997), a Microsoft Access-derived program. The PLOTS database was developed specifically for the NPS vegetation and mapping program so that the electronic 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). Data was thoroughly proofed after entry to minimize errors.

Plots were assigned to categories based on similarity of vegetation. These categories were assigned names following descriptions in Lauver et al. (1999) and NatureServe Explorer (NatureServe 2006). Where the observed HOME vegetation did not fit descriptions of natural associations described for Nebraska, semi-natural and disturbed associations or alliances described for other parks were considered. Most of the vegetation at HOME had been planted with native species following years of agricultural use. These areas were assigned to the alliances of the dominant native species planted, with the addition of the term “Restored.” In this manner, HOME vegetation was assigned to one of six plant associations and alliances.

Once the associations were finalized, a dichotomous key was developed by KBS for use during the Accuracy Assessment (Appendix C). The full NVC hierarchical classification and global descriptions are available in the results section. In addition, the final associations were linked to map classes for use in the photo-interpretation and mapping portions of the project.

In the future, HOME classification plot data will be used by NatureServe and KBS to update and improve world-wide (i.e., global) descriptions of the NVC plant associations. HOME specific (i.e., local) descriptions were written based on HOME plot and AA data. The final HOME classification contains four NVC vegetation classes and two Park Special vegetation classes.

Digital Imagery and Interpretation

The mapping component was initiated by photo interpretation and digitization of 3-band 2001 color infrared (CIR) IKONOS imagery for the vegetation and land use classes determined through the field visit and expert knowledge of project team members. The heads-up digitization was performed at a display scale of 1:1000 to 1:1500. The digitization, evaluation, and modifications were iterative and collaborative processes involving the GIS analysts and the rest of the team. Preliminary maps were checked, corrected, and rechecked for boundary delineations. Final edits were made using the 2009 NAIP imagery, which captured the changes made along the eastern end of the property with the construction of the visitor’s center.

Because vegetation phenology, and moisture conditions, and land management practices such as grazing and burning reveal or mask target map features in the imagery, multiple image sources were used during the mapping project in an attempt to extract the most accurate and comprehensive feature classifications possible. There was no one image that captured all vegetation communities and features at their peak differentiability. As noted above, a spring 2001 IKONOS image provided by the NPS served as the general basemap, with additional images used to check mapped features and make adjustments as needed. These image sources included 2003, 2006, 2007, and 2009 (3-band, R,G,B) USDA FSA NAIP, 1993 USGS DOQQs,

and 1971 and 1937 panchromatic imagery. Additionally, in the fall of 2007, custom 0.7 m and 1 m CIR and RGB imagery was acquired using the Kansas Applied Remote Sensing Program's aerial imaging system. Although the individual images were georeferenced, they were not orthorectified. Because they lacked the documented positional accuracy of the other imagery they were used to identify areas of interest but not used for digitization of polygons.

Color infrared imagery is often called false-color because the objects that are normally red appear green, green objects (except vegetation) appear blue, and "infrared" objects appear red. Because healthy green vegetation is a very strong reflector of infrared radiation, and appears bright red in color infrared imagery, it helps tremendously in vegetation mapping efforts. Through the use of color infrared imagery subtle differences between cool and warm season grasses, wetland vegetation and deciduous trees are apparent and can be accurately delineated.

Polygons were assigned map class number and name. The vegetation community polygons and other related and supporting data were then incorporated into a geodatabase format.

Accuracy Assessment

Once the vegetation layer was finalized, the accuracy assessment (AA) was conducted. Typically in mapping exercises both thematic or attribute map accuracy and the positional or polygon line accuracy are considered. In the case of the USGS-NPS National Vegetation Mapping Program, however, the positional accuracy is usually omitted since vegetation rarely splits on discrete edges that can be positively located in the field. The subjectivity involved in this effort plus the high resolution and accuracy of the NAIP basemaps usually allows for the assumption that all products derived from them are well within National Map Accuracy Standards for 1:12,000-scale maps (± 30 feet).

The thematic accuracy of the vegetation map was assessed following the standards provided by the USGS-NPS National Vegetation Mapping Program's Accuracy Assessment Procedures manual (TNC and ESRI 1994c). Assessment included a four step process consisting of a sample design, sample site selection, data collection and data analysis. The design of the AA process followed the five possible scenarios provided in the field manual with stratified random targets placed in each map class based on their respective frequency and abundance (Table 1).

These parameters were loaded into a GIS program along with the vegetation layer. Hawth's Analysis Tools for ArcGIS (Beyer 2004) was used to pick the random target locations and to buffer them 10 meters away from any polygon boundary and 50 meters from any other point. Being able to choose minimum distance to polygon boundaries helped to minimize confusion and accounted for the horizontal error typically encountered in common GPS receivers (± 5 m). The resulting target locations were restricted to the authorized boundaries of HOME due to private land access constraints.

Once the target locations were selected they were downloaded to Garmin or Trimble GPS receivers and investigators walked to the AA points to complete the assessment. During the course of the field work, the estimated position error readings on GPS receivers ranged from 1-7 meters. KBS botanists were also provided with draft field maps, map unit definitions, and a key to the associations and alliances (Appendix C). In July 2009, KBS botanists traveled to 12 AA

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target sites and determined the vegetation association using the field key. At each target they recorded vegetation data on an AA form. They also recorded height and cover of vegetative strata, environmental data, and percent canopy cover of the major species (see AA point form in Appendix D). A rationale for the choice of dominant association was noted when the decision was not clear-cut.

Table 1. Target number of AA samples per map class based on number of polygons and area.

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

During 2009 a total of 12 AA points were sampled (Figure 4). The data recorded on the field forms were subsequently entered into the PLOTS database and reviewed for data entry errors by KBS staff. The results were imported from the database into a GIS layer where they were visually compared in two stages to the vegetation map coverage. The first step was to compare the AA points to the original target locations to check for erroneous points. However, no GPS receiver or location errors were observed.

**USGS-NPS Vegetation Mapping Program
Homestead National Monument of America**

The second review step involved comparing the vegetation classification assigned by the field botanists to the vegetation classification assigned to the mapped polygon. If a mismatch was found, the mapped polygon would be corrected. However, due to the small nature of the park and the small number of AA points, there were no discrepancies between the mapped and observed vegetation classifications.

Once the data were reviewed, the accuracy analysis was conducted. In the case of HOME, the AA process was streamlined using methods developed from previous studies at Rocky Mountain National Park (Salas et al. 2004) and Wupatki National Monument (Hansen et al. 2004). All of the statistics and calculations used to analyze these data are described at length in the program manuals (TNC and ESRI 1994c) and are summarized in Table 2. Final assessments for each point were recorded using an error matrix.

Table 2. Summary of the AA statistics used at HOME.

Statistic	Description
User's Accuracy	The fraction of 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 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.

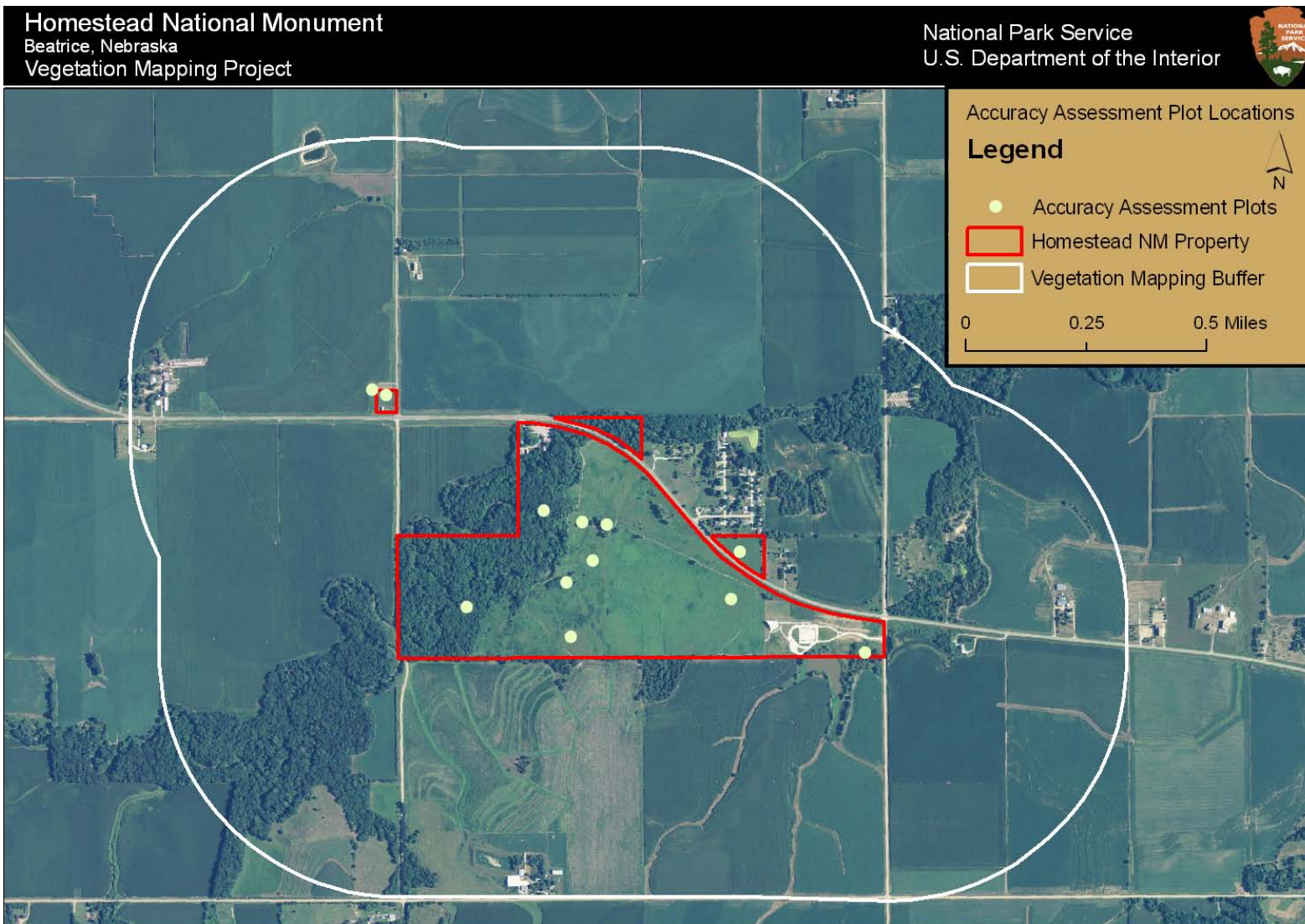


Figure 4. Locations of all accuracy assessment points collected at Homestead National Monument in 2009.

Results

Vegetation Classification

The final classification for HOME resulted in six vegetation classes, four of which had NVC descriptors. Two of the classes, upland and lowland restored prairie, were considered Park Specials. The classification results reflect both the moderate amount of diversity of vegetation in the park and a respectably high number of native species. During the sampling efforts a total of 318 species were recorded (Appendix E).

Digital Imagery and Interpretation

For HOME, ten map units were developed and directly matched to corresponding plant associations and land-use classes (Table 3). The types included six vegetation based map units and four land-use classes.

Vegetation Map

Just over 698 acres, including 214 acres in the authorized boundary of HOME and an additional 484 acres in the environs, were mapped using ten map classes (Figure 5). This included four land cover classes and six vegetation classes. Of all the map units, the most frequent was *Fraxinus pennsylvanica* / *Ulmus spp.* / *Celtis occidentalis* Forest with 21 polygons. *Fraxinus pennsylvanica* / *Ulmus spp.* / *Celtis occidentalis* Forest was also the most abundant map unit in terms of area other than cropfields in the environs, covering 219 acres (89 hectares) or about 13% of the project area. All of the frequencies for each map unit (i.e., number of polygons) along with acreage per map unit are listed in Table 3.

Normally the standard minimum mapping unit for NPS vegetation mapping projects is defined as 0.5 hectare. However this is a nominal unit and due to the small size of HOME and the resolution of the imagery it was reduced to allow for more detail in the mapping. Therefore, 13 of the total 60 polygons were under 0.5 hectare. The average area of polygons for this project was 28.8 acres (11.6 hectares).

Accuracy Assessment

The 2009 accuracy assessment effort yielded 12 points that were distributed throughout HOME; none were sampled in the environs due to access constraints.

During analysis of the AA points, a GIS point file was created from the AA point coordinates recorded in the field. These were then overlaid on the vegetation map and a comparison of the final AA field call versus the vegetation polygon label was conducted.

Examination of the final error matrix (Appendix A) shows that there was no confusion between map units, as the accuracy assessment resulted in 100% accuracy. This high level of accuracy is likely due to the small size of HOME which allowed thorough sampling during the vegetation mapping stage.

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Table 3. Map units identified at HOME, with their total frequency and acreage.

NVC Identifier	Common Name	Scientific Name / Description	Frequency	Acres	Hectares
Forest and Woodland					
CEGL002053	Bur Oak Woodland	<i>Quercus macrocarpa</i> / <i>Andropogon gerardii</i> / <i>Hesperostipa spartea</i> Woodland	1	22.8	9.2
CEGL002014	Successional Forest	<i>Fraxinus pennsylvanica</i> / <i>Ulmus</i> spp. / <i>Celtis occidentalis</i> Forest	21	219.0	88.6
Herbaceous Vegetation					
CEGL002202	Native Tallgrass Prairie	<i>Andropogon gerardii</i> / <i>Hesperostipa spartea</i> / <i>Sporobolus heterolepis</i> Herbaceous Vegetation	1	0.2	0.1
(No assigned code)	Upland Restored Prairie	Planted Semi-natural Upland Restored Tallgrass Prairie, areas of the upland that were restored to a tallgrass prairie mix of species	3	42.4	17.1
(No assigned code)	Lowland Restored Prairie	Planted Semi-natural Lowland Restored Tallgrass Prairie, areas of the lowland that were restored to a tallgrass prairie mix of species	2	55.9	22.6
CEGL005264	Smooth Brome	<i>Bromus inermis</i> - (<i>Pascopyrum smithii</i>) Semi-natural Herbaceous Vegetation	2	21.1	8.5
Land Use/Land Cover					
(No assigned code)	Cropfields	Areas planted to cropland	13	1212.8	490.8
(No assigned code)	Developed Land	Buildings and adjacent lands	13	76.4	30.9
(No assigned code)	Ponds/Water Bodies	Man-made impoundments	3	4.6	1.9
(No assigned code)	Roadways	Highways, county roads, and rights-of-way	1	69.8	28.3
Total Land Use/Land Cover			30	1363.7	551.9
Total Natural Vegetation			30	361.4	146.2
Totals			60	1725.1	698.1

Homestead National Monument
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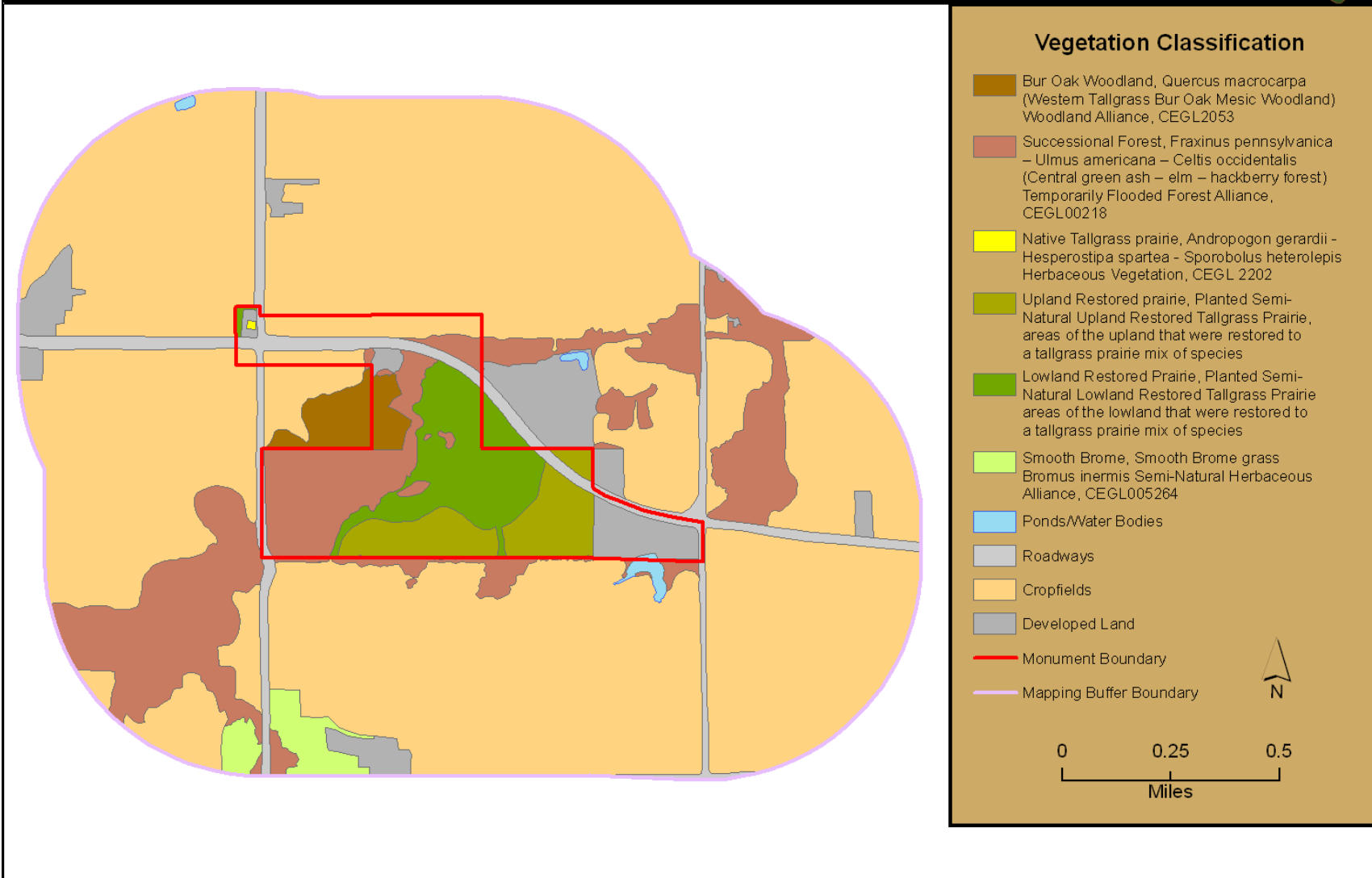


Figure 5. Vegetation map of Homestead National Monument and environs.

Vegetation Associations

Mapped Unit Name: *Bur Oak Woodland*

Common Name: Western Tallgrass Bur Oak Woodland

Scientific Name: *Quercus macrocarpa* / *Andropogon gerardii* - *Hesperostipa spartea*
Woodland

Bur Oak / Big Bluestem - Porcupine Grass Woodland

NVC Identifier: C EGL002053



Figure 6. Bur Oak Woodland at Homestead National Monument, with understory of Canadian woodnettle (*Laportea canadensis*) and Virginia wildrye (*Elymus virginicus*), July 2009.

Global Summary: This bur oak woodland community (Figure 6) is associated with the floodplains of rivers and streams in the central-western tallgrass region of the midwestern United States. Stands occur on gentle to steep slopes with silt or loam soils. Soils are well-drained to moderately well-drained, sometimes shallow (0-40 cm), and formed from loess or glacial till. The overstory of this community is open and dominated by *Quercus macrocarpa* (bur oak). *Quercus muehlenbergii* (chinkapin oak) can be a common associate. Shrubs are absent to common, and include *Cornus drummondii* (roughleaf dogwood), *Ceanothus herbaceus* (New Jersey tea), *Corylus americana* (American hazelnut), *Prunus americana* (American plum), *Rhus glabra* (smooth sumac), *Ribes missouriense* (Missouri gooseberry), *Symphoricarpos occidentalis* (western snowberry), and *Zanthoxylum americanum* (common pricklyash). The herbaceous

stratum can be similar to dry prairie. It includes the grasses *Andropogon gerardii* (big bluestem), *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prairie dropseed), and *Hesperostipa spartea* (porcupinegrass), as well as *Maianthemum stellatum* (starry false lily of the valley), *Monarda fistulosa* (wild bergamot), and *Solidago canadensis* (Canada goldenrod). In the past, periodic fires kept the canopy from closing. Where fire regimes have been disrupted, this community often begins to succeed to other, more closed oak types.

Global Environmental Description: This community occurs near floodplains and on gently sloping to steep upland mesic sites especially within 30 km of the Missouri River but possibly along other rivers. In Nebraska it may have been most abundant in the southeast because conditions are most suitable for tree growth there. The soils on which this community occurs are silt or loam, shallow to deep, with a pH range from 5.6-7.3. The soils of this community are moderately well-drained to well-drained. The parent material is loess or glacial till (Nelson 1987, Lauver et al. 1999, Steinauer and Rolfsmeier 2000).

Global Vegetation Description: The overstory of this community is open and dominated by *Quercus macrocarpa* (bur oak). *Quercus muehlenbergii* (chinkapin oak) can be a common associate. Shrubs are absent to common and include *Cornus drummondii* (roughleaf dogwood), *Ceanothus herbaceus* (New Jersey tea), *Corylus americana* (American hazelnut), *Prunus americana* (American plum), *Rhus glabra* (smooth sumac), *Ribes missouriense* (Missouri gooseberry), *Symphoricarpos occidentalis* (western snowberry), and *Zanthoxylum americanum* (common pricklyash). The herbaceous stratum can be similar to dry prairie. It includes the grasses *Andropogon gerardii* (big bluestem), *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), *Sporobolus heterolepis* (prairie dropseed), and *Hesperostipa spartea* (porcupinegrass), as well as *Maianthemum stellatum* (starry false lily of the valley), *Monarda fistulosa* (wild bergamot), and *Solidago canadensis* (Canada goldenrod). In the past, periodic fires kept the canopy from closing. Where fire regimes have been disrupted, this community often begins to succeed to other, more closed oak types (Nelson 1987, Lauver et al. 1999, Steinauer and Rolfsmeier 2000).

Most Abundant Species:

Table 4. Overstory Tree Species within Bur Oak Woodland. (Data collected by the Heartland Network, n=1 plot).

Scientific Name	Common Name	Total DBH
<i>Quercus macrocarpa</i>	bur oak	549.1
<i>Celtis occidentalis</i>	common hackberry	260.2
<i>Ulmus americana</i>	American elm	143.3
<i>Acer saccharum</i>	sugar maple	107.9
<i>Morus alba</i>	white mulberry	15.9

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Table 5. Average percent cover of the top twenty most common understory species within Bur Oak Woodland. (Data collected by the Heartland Network, n=1 plot).

Scientific Name	Common Name	% Cover
<i>Laportea canadensis</i>	Canadian woodnettle	22.7
<i>Parthenocissus quinquefolia</i>	Virginia creeper	3.7
<i>Polygonum virginianum</i>	jumpseed	2.7
<i>Carex sp.</i>	sedge	1.1
<i>Smilax tamnoides</i>	bristly greenbrier	1.0
<i>Elymus virginicus</i>	Virginia wildrye	0.8
<i>Verbesina alternifolia</i>	wingstem	0.5
<i>Toxicodendron radicans</i>	poison ivy	0.5
<i>Urtica dioica</i>	California nettle	0.5
<i>Cryptotaenia canadensis</i>	Canadian honewort	0.4
<i>Diarrhena obovata</i>	obovate beakgrain	0.4
<i>Symphoricarpos orbiculatus</i>	coralberry	0.3
<i>Ageratina altissima</i>	white snakeroot	0.3
<i>Geum canadense</i>	white avens	0.3
<i>Viola sp.</i>	violet	0.3
<i>Festuca subverticillata</i>	nodding fescue	0.2
<i>Galium aparine</i>	stickywilly	0.2
<i>Hackelia virginiana</i>	beggarslice	0.1
<i>Pilea pumila</i>	Canadian clearweed	0.1
<i>Sanicula odorata</i>	clustered blacksnakeroot	0.1

Global Conservation Status Rank & Reasons: G2G3. This community has been highly degraded in the mesic sites where it occurred historically. Bur oak woodlands and forests have recently spread upslope into drier areas in the absence of fires. Sites also occur in Missouri in association with loess hill prairies, but are not tracked for conservation purposes because of low quality (M. Leahy pers. comm. 1999). Note that the bur oak woodland community type indicated here uses the current NVCS description, which is a broader treatment than that presented in Rolfsmeier and Steinhaur (2010, p. 78), who specifically mention the HOME stand as an exemplary site for the more narrowly defined Dry-Mesic Bur Oak Forest and Woodland.

Mapped Unit Name: *Successional Forest*

Common Name: Central Green Ash - Elm - Hackberry Forest

Scientific Name: *Fraxinus pennsylvanica* - *Ulmus* spp. - *Celtis occidentalis* Forest
Green Ash - Elm species - Common Hackberry Forest

NVC Identifier: CEGL002014



Figure 7. Successional Forest at Homestead National Monument, with understory of Virginia wildrye (*Elymus virginicus*) and coralberry (*Symphoricarpos orbiculatus*), July 2009.

Global Summary: This community (Figure 7) is found in the central United States along upper floodplain terraces of rivers and streams and in upland ravine bottoms. Soils are moderately well-drained to poorly drained. Tree canopies are dominated by *Fraxinus pennsylvanica* (green ash), *Celtis occidentalis* (common hackberry), and *Ulmus americana* (American elm). Other tree species that may be present include *Juglans nigra* (black walnut), *Tilia americana* (American basswood), *Acer saccharinum* (silver maple), and *Populus deltoides* (eastern cottonwood). *Ulmus rubra* (slippery elm) can be part of the subcanopy. The shrub layer in the western part of the range includes *Cornus drummondii* (roughleaf dogwood), *Ribes missouriense* (Missouri gooseberry), *Symphoricarpos occidentalis* (western snowberry), and *Zanthoxylum americanum* (common pricklyash), as well as woody vines, such as *Parthenocissus vitacea* (woodbine), *Smilax tamnoides* (bristly greenbrier), *Toxicodendron radicans* (eastern poison-ivy), and *Vitis riparia* (riverbank grape). The herbaceous layer in the western part of its range includes *Elymus*

virginicus (Virginia wildrye), *Festuca subverticillata* (nodding fescue), *Galium aparine* (stickywilly), *Geum canadense* (white avens), and *Laportea canadensis* (Canadian woodnettle).

Global Environmental Description: Stands occur along upper floodplain terraces of rivers and streams and in upland ravine bottoms. Soils are moderately well-drained to poorly drained.

Global Vegetation Description: The vegetation has an open to closed tree canopy that is dominated by *Fraxinus pennsylvanica* (green ash), *Celtis occidentalis* (common hackberry), and *Ulmus americana* (American elm). Other tree species that may be present include *Juglans nigra* (black walnut), *Tilia americana* (American basswood), *Acer saccharinum* (silver maple), and *Populus deltoides* (eastern cottonwood). *Ulmus rubra* (slippery elm) can be part of the subcanopy. The shrub layer in the western part of the range includes *Cornus drummondii* (roughleaf dogwood), *Ribes missouriense* (Missouri gooseberry), *Symphoricarpos occidentalis* (western snowberry), and *Zanthoxylum americanum* (common pricklyash), as well as woody vines such as *Parthenocissus vitacea* (woodbine), *Smilax tamnoides* (bristly greenbrier), *Toxicodendron radicans* (eastern poison-ivy), and *Vitis riparia* (riverbank grape). The herbaceous layer in the western part of the range includes *Elymus virginicus* (Virginia wildrye), *Festuca subverticillata* (nodding fescue), *Galium aparine* (stickywilly), *Geum canadense* (white avens), and *Laportea canadensis* (Canadian woodnettle) (Steinauer and Rolfsmeier 2000).

Most Abundant Species:

Table 6. Overstory Tree Species within Successional Forest. (Data collected by the Heartland Network, n=2 plots).

Scientific Name	Common Name	Total DBH
<i>Celtis occidentalis</i>	common hackberry	1810.6
<i>Quercus macrocarpa</i>	bur oak	298.2
<i>Ulmus americana</i>	American elm	70.1
<i>Fraxinus pennsylvanica</i>	green ash	61.0
<i>Morus alba</i>	white mulberry	41.2
<i>Juglans nigra</i>	black walnut	31.9

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Table 7. Average percent cover of the top twenty-one most common understory species within Successional Forest. (Data collected by the Heartland Network, n=2 plots).

Scientific Name	Common Name	Average % Cover
<i>Laportea canadensis</i>	Canadian woodnettle	34.0
<i>Verbesina alternifolia</i>	wingstem	15.5
<i>Parthenocissus quinquefolia</i>	Virginia creeper	1.7
<i>Elymus virginicus</i>	Virginia wildrye	1.3
<i>Carex sp.</i>	sedge	1.0
<i>Festuca subverticillata</i>	nodding fescue	0.7
<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	0.7
<i>Toxicodendron radicans</i>	poison ivy	0.7
<i>Smilax tamnoides</i>	bristly greenbrier	0.6
<i>Viola missouriensis</i>	Missouri violet	0.6
<i>Urtica dioica</i>	California nettle	0.4
<i>Boehmeria cylindrica</i>	smallspike false nettle	0.4
<i>Ageratina altissima</i>	white snakeroot	0.3
<i>Hackelia virginiana</i>	beggarslice	0.2
<i>Galium aparine</i>	stickywilly	0.1
<i>Phryma leptostachya</i>	American lopseed	0.1
<i>Polygonum virginianum</i>	jumpseed	0.1
<i>Sanicula odorata</i>	clustered blacksnakeroot	0.1
<i>Chenopodium berlandieri</i>	pitseed goosefoot	0.1
<i>Ribes missouriense</i>	Missouri gooseberry	0.1
<i>Symphoricarpos orbiculatus</i>	coralberry	0.1

Global Conservation Status Rank & Reasons: G3G5.

Mapped Unit Name: *Native Tallgrass Prairie*

Common Name: Northern Mesic Tallgrass Prairie

Scientific Name: *Andropogon gerardii* - *Hesperostipa spartea* - *Sporobolus heterolepis*
Herbaceous Vegetation
Big Bluestem - Porcupine Grass - Prairie Dropseed Herbaceous
Vegetation

NVC Identifier: CEGL002202



Figure 8. Native Tallgrass Prairie at Homestead National Monument. Note abundant Canada goldenrod (*Solidago canadensis*) and dead stalks of big bluestem (*Andropogon gerardii*), and one stem of common milkweed (*Asclepias syriaca*) in bloom, July 2009.

Global Summary: This mesic big bluestem prairie community (Figure 8) is found in the northern tallgrass prairie region of the United States and Canada. Stands occur on black, friable, organic-rich soils with highly-basic surface horizons. During the warm season, soils are intermittently dry for long periods or have subsurface horizons in which salts or carbonates have accumulated. This is a grassland community with dense vegetation dominated by tall grasses. Forbs are abundant and often have high local diversity. Clumps of trees and tall brush can often be found along the boundary between wetlands and this community. Otherwise, woody vegetation is rare. *Andropogon gerardii* (big bluestem), *Sporobolus heterolepis* (prairie dropseed), *Hesperostipa spartea* (porcupinegrass), and occasionally *Sorghastrum nutans* (Indiangrass), are the most abundant species in this community. *Amorpha canescens* (leadplant),

Symphyotrichum ericoides (white heath aster), and *Solidago canadensis* (Canada goldenrod) are common forbs across this community's range.

Global Environmental Description: Soils of this community are black, friable, organic-rich soils with highly-basic surface horizons. Heidel (1984) found clay loam soils at her two study sites. During the warm season, soils are intermittently dry for long periods or have subsurface horizons in which salts or carbonates have accumulated.

Global Vegetation Description: This is a grassland community with dense vegetation dominated by tall grasses 1-2 m tall. Forbs are abundant and often have high local diversity. Clumps of trees and tall brush can often be found along the boundary between wetlands and this community. Otherwise, woody vegetation is rare. *Andropogon gerardii* (big bluestem) and *Sorghastrum nutans* (Indiangrass) are the most abundant species in this community. *Amorpha canescens* (leadplant), *Symphyotrichum ericoides* (white heath aster), and *Solidago canadensis* (Canada goldenrod) are common forbs across this community's range.

Most Abundant Species:

Table 8. Average percent cover of the top twenty-two most common species in plots within Native Tallgrass Prairie. (Plot data collected by KBS in 2008, n=3 plots.)

Scientific Name	Common Name	Average % Cover
<i>Andropogon gerardii</i>	big bluestem	91.67
<i>Solidago canadensis</i>	Canada goldenrod	28.33
<i>Sporobolus heterolepis</i>	prairie dropseed	20.00
<i>Ambrosia trifida</i>	great ragweed	3.00
<i>Rosa arkansana</i>	prairie rose	3.00
<i>Helianthus annuus</i>	common sunflower	2.00
<i>Cirsium altissimum</i>	tall thistle	1.67
<i>Asclepias syriaca</i>	common milkweed	1.33
<i>Amorpha canescens</i>	leadplant	0.68
<i>Cirsium canescens</i>	prairie thistle	0.67
<i>Teucrium canadense</i>	Canada germander	0.67
<i>Conyza canadensis</i>	Canadian horseweed	0.37
<i>Salvia azurea</i>	azure blue sage	0.35
<i>Vernonia baldwinii</i>	Baldwin's ironweed	0.35
<i>Elymus virginicus</i>	Virginia wildrye	0.33
<i>Galium aparine</i>	stickywilly	0.05
<i>Oxalis stricta</i>	common yellow oxalis	0.05
<i>Asclepias sullivantii</i>	prairie milkweed	0.03
<i>Dalea candida</i>	white prairie clover	0.03
<i>Lactuca canadensis</i>	Canada lettuce	0.03
<i>Poa pratensis</i>	Kentucky bluegrass	0.03
<i>Viola pedatifida</i>	prairie violet	0.03

Global Conservation Status Rank & Reasons: G2G3. Much of the former range of this community is now occupied by agriculture.

Mapped Unit/Name:

Common Name: *Upland Restored Prairie*

Scientific Name: Planted Semi-Natural Upland Restored Tallgrass Prairie, areas of the upland that were restored to a tallgrass prairie mix of species

NVC Identifier: N/A



Figure 9. Upland Restored Prairie at Homestead National Monument. Big bluestem (*Andropogon gerardii*) thrives after a spring burn, with leadplant (*Amorpha canescens*) interspersed, July 2009.

Global Summary: This community (Figure 9) has been defined for Homestead National Monument. At HOME, managers are attempting to restore vegetation to Northern Mesic Tallgrass Prairie through planting native grasses and forbs in formerly plowed fields. Natural vegetation of this community is found throughout the northern tallgrass prairie region of the United States and Canada.

Environmental Description: The fields that have been re-planted with native grasses at Homestead National Monument were once plowed, and have silt-loam soils.

Vegetation Description: This is a grassland community with dense vegetation dominated by tall grasses 1-2 m tall. The abundance of forbs has not reached the abundance found in native Northern Mesic Tallgrass Prairie. *Andropogon gerardii* (big bluestem) and *Sorghastrum nutans*

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(Indiangrass) are the most abundant grasses in this community. *Helianthus pauciflorus* (stiff sunflower) and *Solidago canadensis* (Canada goldenrod) are common forbs.

Most Abundant Species:

Table 9. Average percent cover of the top twenty most common species in plots within upland restored prairies. (Plot data collected by KBS in 2008, n=9 plots.)

Scientific Name	Common Name	Average % Cover
<i>Andropogon gerardii</i>	big bluestem	50.56
<i>Helianthus pauciflorus</i>	stiff sunflower	18.11
<i>Schizachyrium scoparium</i>	little bluestem	18.88
<i>Solidago canadensis</i>	Canada goldenrod	7.78
<i>Rhus glabra</i>	smooth sumac	3.89
<i>Panicum virgatum</i>	switchgrass	3.57
<i>Solidago missouriensis</i>	Missouri goldenrod	2.89
<i>Lotus unifoliolatus</i>	American bird's-foot trefoil	2.78
<i>Astragalus canadensis</i>	Canadian milkvetch	2.78
<i>Ambrosia psilostachya</i>	Cuman ragweed	2.56
<i>Symphotrichum ericoides</i>	white heath aster	2.46
<i>Amorpha canescens</i>	leadplant	1.44
<i>Sorghastrum nutans</i>	Indiangrass	1.23
<i>Psoralidium tenuiflorum</i>	slimflower scurfpea	1.23
<i>Antennaria neglecta</i>	field pussytoes	0.89
<i>Lespedeza capitata</i>	roundhead lespedeza	0.89
<i>Poa pratensis</i>	Kentucky bluegrass	0.80
<i>Dalea candida</i>	white prairie clover	0.56
<i>Achillea millefolium</i>	common yarrow	0.46
<i>Vernonia baldwinii</i>	Baldwin's ironweed	0.36

Mapped Unit/Name:

Common Name: *Lowland Restored Prairie*

Scientific Name: Planted Semi-Natural Lowland Restored Tallgrass Prairie, areas of the lowland that were restored to a tallgrass prairie mix of species

NVC Identifier: N/A



Figure 10. Lowland Restored Prairie (in the foreground) at Homestead National Monument. Tall grasses, mainly big bluestem (*Andropogon gerardii*), interspersed with Baldwin's ironweed (*Vernonia baldwinii*) and roughleaf dogwood (*Cornus drummondii*), July 2009.

Global Summary: This community (Figure 10) has been defined for Homestead National Monument. At HOME, managers are attempting to restore vegetation to Northern Mesic Tallgrass Prairie through planting native grasses and forbs in formerly plowed fields. Natural vegetation of this community is found throughout the northern tallgrass prairie region of the United States and Canada.

Environmental Description: The fields that have been re-planted with native grasses at Homestead National Monument were once plowed, and have silt-loam soils.

Vegetation Description: This is a grassland community with dense vegetation dominated by tall grasses 1-2 m tall. The abundance of forbs has not reached the abundance found in native Northern Mesic Tallgrass Prairie. *Andropogon gerardii* (big bluestem) and *Sorghastrum nutans* (Indiangrass) are the most abundant grasses in this community. *Solidago canadensis* (Canada goldenrod) and *Rudbeckia hirta* (blackeyed Susan) are common forbs. There is some encroachment by woody shrubs and tree seedlings, such as *Cornus drummondii* (roughleaf dogwood) and *Rhus glabra* (smooth sumac).

Most Abundant Species:

Table 10. Average percent cover of the top twenty-two most common species in plots within lowland restored prairie. (Plot data collected by KBS in 2008, n=5 plots.)

Scientific Name	Common Name	Average % Cover
<i>Andropogon gerardii</i>	big bluestem	56.00
<i>Solidago canadensis</i>	Canada goldenrod	16.60
<i>Cornus drummondii</i>	roughleaf dogwood	15.00
<i>Rhus glabra</i>	smooth sumac	8.00
<i>Symphoricarpos orbiculatus</i>	coralberry	8.00
<i>Chamaecrista fasciculata</i>	partridge pea	7.00
<i>Sorghastrum nutans</i>	Indiangrass	5.41
<i>Bromus inermis</i>	smooth brome	4.00
<i>Poa pratensis</i>	Kentucky bluegrass	3.21
<i>Rudbeckia hirta</i>	blackeyed Susan	3.20
<i>Solidago gigantea</i>	giant goldenrod	3.00
<i>Desmodium illinoense</i>	Illinois ticktrefoil	1.41
<i>Panicum virgatum</i>	switchgrass	1.21
<i>Silphium integrifolium</i>	wholeleaf rosinweed	1.00
<i>Rosa arkansana</i>	prairie rose	0.80
<i>Sporobolus compositus</i>	composite dropseed	0.80
<i>Vernonia baldwinii</i>	Baldwin's ironweed	0.61
<i>Polygonum amphibium</i>	water knotweed	0.40
<i>Oxalis stricta</i>	common yellow oxalis	0.23
<i>Eupatorium altissimum</i>	tall thoroughwort	0.21
<i>Symphyotrichum lanceolatum</i>	white panicle aster	0.21
<i>Ulmus rubra</i>	slippery elm	0.21

Mapped Unit Name: Smooth Brome

Common Name: Smooth Brome Semi-natural Grassland

Scientific Name: *Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation
Smooth Brome - (Western Wheatgrass) Semi-natural Herbaceous Vegetation

NVC Identifier: CEGL005264

Global Summary: This smooth brome grassland type occurs widely throughout the northern Great Plains, in disturbed montane meadows in the Rocky Mountains, on relatively mesic sites in the semi-arid interior western United States, and perhaps more widely in the midwestern U.S. and Canada. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. The type is also widely planted for revegetating disturbed land, pasture and hay fields, and has escaped into a variety of habitats, including prairie, riparian grasslands, and mesic mountain meadows. The dominant grass is *Bromus inermis* (smooth brome), a naturalized species from Eurasia that forms moderately dense to dense stands that often develop into monocultures. Other weedy species such as *Cirsium arvense* (Canada thistle) and *Poa pratensis* (Kentucky bluegrass) may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie and montane meadow grasses, such as *Pascopyrum smithii* (western wheatgrass), *Deschampsia caespitosa* (tufted hairgrass), and *Hesperostipa comata* (needle-and-thread), and sparse, scattered mesic shrubs such as *Symphoricarpos* (snowberry) spp., as well as many others. However, the native species are not conspicuous enough to identify the native plant association that could occupy the site, or the stand would be typed as such.

Global Environmental Description: This smooth brome grassland type occurs widely throughout the northern Great Plains, on relatively mesic sites in the semi-arid interior western United States, and perhaps more widely in the midwestern U.S. and Canada. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. The type is also widely planted for revegetating disturbed land, pasture and hay fields, and has escaped into a variety of habitats, including prairie, riparian grasslands, and mesic mountain meadows. This community is found at all elevational ranges with best examples occurring on mesic alluvial terraces. *Bromus inermis* (smooth brome) grows best on moist, well-drained, finer-textured loam and clay loams, not heavy clays or sand, and does not tolerate prolonged flooding, however, it does persist quite well on well-drained sandy loam derived from granitic parent material. It also occurs in foothills and plains at lower elevations on relatively mesic sites. It occurs on poorly drained sites to rapidly drained sites with fine-textured alluvial soils derived from shale formations found in Utah. This community persists because it is rhizomatous, and once seeded, with enough moisture, will persist, regardless of elevation, soil or landform.

Global Vegetation Description: This association is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Bromus inermis* (smooth brome), a naturalized species from Eurasia that forms moderately dense to dense stands that often develop into monocultures. Other weedy species, such as *Cirsium arvense* (Canada thistle), *Poa pratensis* (Kentucky bluegrass), and other introduced forage species, may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie and montane meadow grasses, such as *Juncus balticus* (Baltic rush), *Pascopyrum smithii* (western wheatgrass), *Deschampsia*

caespitosa (tufted hairgrass), and *Hesperostipa comata* (needle-and-thread), and sparse scattered mesic shrubs, such as *Artemisia tridentata ssp. wyomingensis* (Wyoming big sagebrush), *Ericameria nauseosa* (rubber rabbitbrush), and *Symphoricarpos* (snowberry) spp., and ruderal forbs, such as *Heterotheca villosa* (hairy false goldenaster), as well as many others. However, the native species are not conspicuous enough to identify the native plant association that could occupy the site, or the stand would be typed as such.

Global Conservation Status Rank & Reasons: GNA (invasive). This is a naturalized type from Europe and Asia, widely planted for cover, pasture, and hay, and has escaped into a variety of habitats.

Discussion

Homestead National Monument combines a unique mix of historically important structures, agricultural lands, remnants of native plant communities, and restored prairie. Across this fragmented landscape a wide array of native and exotic plants thrive in habitats typical of the Great Plains. Due to the small size of the park and the accessibility afforded for the sampling crews and verification efforts, a highly accurate classification and map was completed.

The restored prairie at HOME is the second oldest known tallgrass prairie restoration.

Field Survey

The vegetation data presented in this project should be used as a baseline to build upon. New survey work in a timely manner would greatly improve both the classification and mapping efforts. Also, accessing neighboring private lands would allow new plot samples to be obtained, increasing the confidence in these types, thereby strengthening the classification.

NVC Classification

Along with access onto private lands, the other main classification challenge at HOME is keeping up with the rapid changes to plant life caused by agricultural manipulation and anthropogenic disturbance. Changes include tree removal, prairie restoration, wild fires, and flooding. At all times, but especially after these events, new data should be collected to reflect these changes. For example, as the park continues to restore its tallgrass prairie, this type may later need to be classified using a more natural association such as a Big Bluestem – Indiangrass community type. Overall more specialized and targeted data collection in these areas would help to document any changes and would greatly increase our understanding of these types in general.

Digital Imagery and Interpretation

Multiple sources of imagery were used to digitize the vegetation map. Along with the small size of the park, this allowed very thorough examination of subtle vegetation characteristics and photo signatures (e.g., shadows of canopy trees). Analyzing imagery taken over multiple seasons, multiple years, and with multiple color band displays allowed us to map boundaries in fine detail and with high confidence.

Accuracy Assessment

The high level of accuracy we obtained is likely due to the small size of HOME, which allowed thorough sampling during the vegetation mapping stage. Our overall accuracy assessment is well above the 80% required by VMP (taking into account the 90% confidence interval). Individual accuracies also met the 80% requirement, although three vegetation categories (Tallgrass Prairie, Lowland Restored Prairie, and Bur Oak Woodland) had a confidence interval below 80% simply because the low occurrence of these types required only 1 or 2 sample points during accuracy assessment.

Future Recommendations

In summary, this project represents the best efforts put forth by a multi-disciplined team over a relatively short period in time. In order to create the best possible “long-term” vegetation classification for HOME and the most accurate and detailed GIS layer, this project should be

viewed as a place to start rather than an end product. Present and future NPS staff should be encouraged to scrutinize this project, building from its strengths and bolstering its weaknesses. By keeping in mind that this project was only a snapshot in time, future efforts can help complete our understanding of the vegetation in and around HOME and how it changes. It is the hope of the producers that the products presented here will help focus and direct future efforts. The following recommendations are summarized below.

1. The diversity of plant species and dynamic nature of the park with respect to the agricultural aspect warrants periodic **field surveys** by experienced ecologists. Further, the inaccessibility of the private lands in the environs should be addressed by seeking permission to sample and verify the vegetation. In this way new plant associations could be discovered and existing types could be updated.
2. Remote sensing does not replace on-the-ground knowledge provided by GPS-linked plots, observations and ground verification. Time and funding limitations curtailed the amount of map **ground-truthing** performed. As opportunities arise, maps should be examined in the field by experienced crews. Also GPS receiver data and other GIS layers should be used to improve and update the spatial data. This map product should not be viewed as static but should be updated with more current and accurate information.
3. For monitoring purposes, **change over time** could be addressed by similar remote sensing projects. New aerial photos or NAIP imagery acquired every year could be used in regular intervals to capture change. Specifically, this new imagery could be used to create up-to-date vegetation layers that could be used to compare changes in both individual vegetation stands and across the entire park.
4. In the future, resource management personnel could link the habitat for **species of concern** to specific associations and map units. These map units could then be used to help locate potential sites of endangered or threatened species in the field or identify areas for non-native plant removal or treatment.

Research Opportunities

Having an accurate and current vegetation classification and map presents many new and exciting research opportunities. Research could include expanding or linking the GIS layer to derive other information such as fire models, habitat monitoring locations, guides for rare plant surveys, and inventorying areas that likely contain exotic or invasive species. The map could also be enhanced by overlaying other existing GIS layers such as geology, hydrology, elevation, and soils. In this manner complex interactions between these layers could be examined and yield important information about growth rates, regeneration after disturbance, biomass distribution, and stream morphology. Finally, through innovative analyses the vegetation layer could possibly be used as a springboard for other ecological studies such as monitoring the tallgrass prairie restoration or examining how the vegetation interacts with soil chemistry, pollution, archeological sites, weather patterns, etc.

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Appendix A: Contingency table for vegetation mapping at HOME

		Reference Data (Accuracy Assessment Field Data)						User's Error		
Sample Data (Polygon Map Data)	Map Units	Tallgrass Prairie	Success. Forest	Lowland Restored	Upland Restored	Bur Oak	Totals	Commission Accuracy	90% Conf. Interval	
									-	+
	Tallgrass Prairie	1	0	0	0	0	1	100%	50%	150%
	Success. Forest	0	5	0	0	0	5	100%	90%	110%
	Lowland Restored	0	0	2	0	0	2	100%	75%	125%
	Upland Restored	0	0	0	3	0	3	100%	83%	117%
	Bur Oak	0	0	0	0	1	1	100%	50%	150%
	Totals	1	5	2	3	1				
Producer's Error	Omission Accuracy	100%	100%	100%	100%	100%	12 Total Correct Points			
	90% Conf. -	50%	90%	75%	83%	50%	12 Total Points			
	Level +	150%	110%	125%	117%	150%				
Overall Total Accuracy = 100% Overall Kappa Index = 100% Overall 90% Upper and Lower Confidence Interval = 95.8% and 104%										

Instructions on Using the Accuracy Assessment Contingency Table:

The contingency table or error matrix found above presents an array of numbers set out in rows and columns corresponding to a particular vegetation map unit relative to the actual vegetation type as verified on the ground. The column headings represent the vegetation classification as determined in the field and the row headings represent the vegetation classification taken from the vegetation map. The highlighted diagonal indicates the number of points assessed in the field that agree with the map label. Conversely, the inaccuracies of each map unit are described as both errors of inclusion (user's or commission errors) and errors of exclusion (producer's or omission errors). By reading across this table (i.e., rows) one can calculate the percent error of commission, or how many polygons for each map unit were incorrectly labeled when compared to the field data. By reading down the table (i.e., columns) one can calculate the percent error of omission, or how many polygons for that type were left off the map. Numbers "on the diagonal" tell the user how well the map unit was interpreted and how confident they can be in using it. Numbers "off the diagonal" yield important information about the deficiencies of the map including which types were: 1) over-mapped - commission errors on the right or 2) under-mapped - omission errors on the bottom.

Appendix B: Example of a Plot Survey Form

IDENTIFIERS/LOCATORS

Plot Code _____	
Provisional Community Name _____	
State ____	Site Name _____ Local Site Name _____
Quad Name _____	
GPS file name _____	Field UTM X _____ m E Field UTM Y _____ m N
Datum _____	Error +/- _____ m
<i>please do not complete the following information when in the field</i>	
Corrected UTM X _____ m E	Corrected UTM Y _____ m N UTM Zone _____
Project Name _____	Project Leader _____
Survey Date _____	Surveyor Lead _____ Surveyors _____
Taxonomic authority _____	
Directions to Plot _____	
Plot length _____	Plot width _____ Plot area _____
Plot Photos (y/n) _____	Roll Number _____ Frame Number _____ Plot Permanent (y/n) _____
Plot representativeness _____	

ENVIRONMENTAL DESCRIPTION

Elevation _____		Slope _____		Aspect _____	
Topographic Position _____					
Cowardin System		Non-Tidal		Tidal	
____ Upland	____ Riverine	____ Permanently Flooded	____ Saturated	____	____
____ Palustrine	____ Lacustrine	____ Semipermanently Flooded	____ Seasonally Flooded/Saturated	____	____
		____ Seasonally Flooded	____ Intermittently Flooded		
		____ Temporarily Flooded			

Environmental Comments:	Soil Drainage
	____ Rapidly drained ____ Well drained
	____ Moderately well drained ____ Somewhat poorly drained
	____ Poorly drained ____ Very poorly drained
Soil Comments	Landscape/Landform Comments

**USGS-NPS Vegetation Mapping Program
Homestead National Monument of America**

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Species	Height Scale for Strata
Trees or Shrubs	<input type="checkbox"/> Broad-leaved	<input type="checkbox"/> Forest	√ Nearby	01 <0.5 m
<input type="checkbox"/> Evergreen	<input type="checkbox"/> Needle-leaved	<input type="checkbox"/> Woodland	1 0-.01%	02 0.5-1m
<input type="checkbox"/> Cold-deciduous	<input type="checkbox"/> Microphyllous	<input type="checkbox"/> Shrubland	2 .01-1%	03 1-2 m
<input type="checkbox"/> Drought-deciduous	<input type="checkbox"/> Graminoid	<input type="checkbox"/> Dwarf-shrubland	3 1-2%	04 2-5 m
<input type="checkbox"/> Mixed evergreen - cold-deciduous	<input type="checkbox"/> Forb	<input type="checkbox"/> Herbaceous	4 2-5%	05 5-10 m
<input type="checkbox"/> Mixed evergreen - drought-deciduous	<input type="checkbox"/> Pteridophyte	<input type="checkbox"/> Nonvascular	5 5-10%	06 10-15 m
		<input type="checkbox"/> Sparsely Vegetated	6 10-25%	07 15-20 m
			7 25-50%	08 20-35 m
			8 50-75%	09 35 - 50 m
			9 75-95%	10 >50 m
			10 95-100%	
Herbs				
<input type="checkbox"/> Annual				
<input type="checkbox"/> Perennial				

Layer (sublayer-optional)	Height Class	Layer % Cover	Dominant and characteristic Species and Cover Class
T Tree			
T_ _____			
T_ _____			
S Shrub			
S_ _____			
S_ _____			
H Herbaceous			
N Nonvascular			
<i>please see above table for height and cover scales</i>			
Animal Use Evidence			
Natural and Anthropogenic Disturbance Comments			
Other Comments			

Appendix C: Homestead National Monument Dichotomous Key Plant Associations

Key to Natural and Semi-Natural Plant Communities at Homestead National Monument

- 1a. Plant community dominated by trees.....2
- 1b. Plant community dominated by herbaceous vegetation. If woody plants are present, they are scattered individuals or brush due to lack of recent fire.....3
- 2a. Woodland or forest of mixed trees of mixed heights, and mixed ages with no old growth trees.....**Central green ash – elm – hackberry forest CEG L00218**
- 2b. Forest with mix of trees, but includes old-growth bur oaks.....
Western Tallgrass Bur Oak Mesic Woodland CEG L
- 3a. Native prairie grassland with forbs.....4
- 3b. Planted non-native grasses—brome grass, green very early and late in the growing season.....
Smooth Brome grass *Bromus inermis* Semi-Natural Herbaceous Alliance
- 4a. Native prairie with forbs (located near schoolhouse).....
Big Bluestem-Yellow Indiangrass Tallgrass Prairie CEG L
- 4b. Replanted or Restored Tallgrass Prairie (may contain some patches of brush).....5
- 5a. Restored Tallgrass Prairie in the uplands.....
Planted Semi-Natural Upland Restored Tallgrass Prairie
- 5b. Restored Tallgrass Prairie in the lowlands, below 1280 ft.....
Planted Semi-Natural Lowland Restored Tallgrass Prairie

Appendix D: Example of an Accuracy Assessment Survey Form

NPS Vegetation Mapping: Accuracy Assessment Form

Plot # _____ Park Code: **HOME** Observers: _____ Date: _____
 UTM X _____ m E UTM Y _____ m N Zone: _____
 Datum: _____ PDOP _____ Elevation _____ Waypoint: _____
 Topography: _____ Slope: _____ Picture no(s): _____

	Stratum	Height (m)	% Cover of Strata	Major Species Present	% Cover of Each Species
T1	Emergent				
T2	Canopy				
T3	Subcanopy (<10 cm DBH)				
S1	Tall Shrub (2-5 m)				
S2	Short Shrub (<2m)				
H	Herbaceous				
A1	Floating Leaved Aquatic				
A2	Submerged Aquatic				
N	Nonvascular				

Comments on indicator species or rare species: _____

Mapped Vegetation Association: _____

Observed Vegetation Association: _____

Comments (note influences on vegetation, difficulties with classification, etc):

Appendix E: Homestead National Monument Species List

This is not a complete list for HOME. This list only contains the species recorded for the 2008 sample plots, the Heartland Network plots, and the 2009 accuracy assessment points (318 species). Genus-only records indicate an unknown species.

Family	Scientific Name	Common Name
Acanthaceae	<i>Justicia americana</i>	American water-willow
	<i>Ruellia caroliniensis</i>	Carolina wild petunia
Amaranthaceae	<i>Amaranthus palmeri</i>	carelessweed
	<i>Amaranthus rudis</i>	tall amaranth
	<i>Amaranthus sp.</i>	pigweed
Anacardiaceae	<i>Rhus aromatica</i>	fragrant sumac
	<i>Rhus glabra</i>	smooth sumac
	<i>Toxicodendron radicans</i>	eastern poison ivy
Apiaceae	<i>Cicuta maculata</i>	spotted water hemlock
	<i>Cryptotaenia canadensis</i>	Canadian honewort
	<i>Sanicula odorata</i>	clustered blacksnakeroot
	<i>Spermolepis inermis</i>	Red River scaleseed
	<i>Torilis arvensis</i>	spreading hedgeparsley
Apocynaceae	<i>Apocynum cannabinum</i>	Indianhemp
Asclepiadaceae	<i>Asclepias sullivantii</i>	prairie milkweed
	<i>Asclepias syriaca</i>	common milkweed
	<i>Asclepias tuberosa</i>	butterfly milkweed
	<i>Asclepias verticillata</i>	whorled milkweed
	<i>Asclepias viridiflora</i>	green comet milkweed
	<i>Asclepias viridis</i>	green antelopehorn
Asteraceae	<i>Achillea millefolium</i>	common yarrow
	<i>Ageratina altissima</i>	white snakeroot
	<i>Ambrosia artemisiifolia</i>	annual ragweed
	<i>Ambrosia psilostachya</i>	Cuman ragweed
	<i>Ambrosia trifida</i>	great ragweed
	<i>Amphiachyris dracunculoides</i>	prairie broomweed
	<i>Antennaria neglecta</i>	field pussytoes
	<i>Arnoglossum plantagineum</i>	groovestem Indian plaintain
	<i>Artemisia ludoviciana</i>	white sagebrush
	<i>Bidens frondosa</i>	devil's beggartick
	<i>Brickellia eupatorioides</i>	false boneset
	<i>Cirsium sp.</i>	thistle
	<i>Cirsium altissimum</i>	tall thistle
	<i>Cirsium canescens</i>	prairie thistle
Asteraceae cont.	<i>Cirsium undulatum</i>	wavyleaf thistle

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Family	Scientific Name	Common Name
	<i>Conyza canadensis</i>	Canadian horseweed
	<i>Eclipta prostrata</i>	false daisy
	<i>Erechtites hieracifolia</i>	burnweed
	<i>Erigeron annuus</i>	eastern daisy fleabane
	<i>Erigeron philadelphicus</i>	Philadelphia fleabane
	<i>Erigeron strigosus</i>	prairie fleabane
	<i>Eupatorium altissimum</i>	tall thoroughwort
	<i>Euthamia gymnospermoides</i>	Texas goldentop
	<i>Helianthus annuus</i>	common sunflower
	<i>Helianthus grosseserratus</i>	sawtooth sunflower
	<i>Helianthus laetiflorus</i>	cheerful sunflower
	<i>Helianthus maximiliani</i>	Maximilian sunflower
	<i>Helianthus pauciflorus</i>	stiff sunflower
	<i>Hieracium longipilum</i>	hairy hawkweed
	<i>Hymenopappus scabiosaeus</i>	Carolina woollywhite
	<i>Iva annua</i>	annual marshelder
	<i>Lactuca canadensis</i>	Canada lettuce
	<i>Lactuca floridana</i>	woodland lettuce
	<i>Lactuca saligna</i>	willowleaf lettuce
	<i>Lactuca serriola</i>	prickly lettuce
	<i>Liatris punctata</i>	dotted blazing star
	<i>Liatris pycnostachya</i>	prairie blazing star
	<i>Oligoneuron rigidum</i>	stiff goldenrod
	<i>Packera plattensis</i>	prairie groundsel
	<i>Ratibida columnifera</i>	upright prairie coneflower
	<i>Ratibida pinnata</i>	pinnate prairie coneflower
	<i>Rudbeckia hirta</i>	blackeyed Susan
	<i>Senecio plattensis</i>	prairie groundsel
	<i>Silphium integrifolium</i>	wholeleaf rosinweed
	<i>Solidago canadensis</i>	Canada goldenrod
	<i>Solidago gigantea</i>	giant goldenrod
	<i>Solidago missouriensis</i>	Missouri goldenrod
	<i>Solidago speciosa</i>	showy goldenrod
	<i>Symphyotrichum ericoides</i>	white heath aster
	<i>Symphyotrichum lanceolatum</i>	white panicle aster
	<i>Symphyotrichum oblongifolium</i>	aromatic aster
	<i>Symphyotrichum praealtum</i>	willowleaf aster
	<i>Taraxacum officinale</i>	common dandelion
	<i>Verbesina alternifolia</i>	wingstem
	<i>Vernonia baldwinii</i>	Baldwin's ironweed

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Homestead National Monument of America

Family	Scientific Name	Common Name
Asteraceae cont.	<i>Xanthium strumarium</i>	rough cockleburr
Boraginaceae	<i>Lithospermum canescens</i>	hoary puccoon
	<i>Lithospermum incisum</i>	narrowleaf stoneseed
	<i>Onosmodium molle</i>	softhair marbleseed
Brassicaceae	<i>Alliaria petiolata</i>	garlic mustard
	<i>Lepidium densiflorum</i>	common pepperweed
	<i>Rorippa nasturtium-aquaticum</i>	watercress
	<i>Thlaspi arvense</i>	field pennycress
Cactaceae	<i>Escobaria missouriensis</i>	Missouri foxtail cactus
	<i>Opuntia macrorhiza</i>	twistspine pricklypear
Campanulaceae	<i>Lobelia siphilitica</i>	great blue lobelia
	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass
Caprifoliaceae	<i>Sambucus nigra</i>	European black elderberry
	<i>Symphoricarpos occidentalis</i>	western snowberry
	<i>Symphoricarpos orbiculatus</i>	coralberry
Caryophyllaceae	<i>Dianthus armeria</i>	Deptford pink
	<i>Silene antirrhina</i>	sleepy silene
	<i>Stellaria media</i>	common chickweed
Chenopodiaceae	<i>Chenopodium sp.</i>	goosefoot
	<i>Chenopodium album</i>	lambquarters
	<i>Chenopodium berlandieri</i>	pitseed goosefoot
	<i>Chenopodium simplex</i>	mapleleaf goosefoot
	<i>Kochia scoparia</i>	Mexican-fireweed
Convolvulaceae	<i>Calystegia sepium</i>	hedge false bindweed
	<i>Convolvulus arvensis</i>	field bindweed
	<i>Evolvulus nuttallianus</i>	shaggy dwarf morning-glory
Cornaceae	<i>Cornus drummondii</i>	roughleaf dogwood
	<i>Cornus foemina</i>	stiff dogwood
Cucurbitaceae	<i>Cucurbita foetidissima</i>	Missouri gourd
Cupressaceae	<i>Juniperus virginiana</i>	eastern redcedar
Cuscutaceae	<i>Cuscuta megalocarpa</i>	bigfruit dodder
Cyperaceae	<i>Carex sp.</i>	sedge
	<i>Carex amphibola</i>	eastern narrowleaf sedge
	<i>Carex annectens</i>	yellowfruit sedge
	<i>Carex austrina</i>	southern sedge
	<i>Carex bicknellii</i>	Bicknell's sedge
	<i>Carex brevior</i>	shortbeak sedge
	<i>Carex frankii</i>	Frank's sedge
	<i>Carex gravida</i>	heavy sedge
<i>Carex molesta</i>	troublesome sedge	

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Family	Scientific Name	Common Name
	<i>Carex muehlenbergii</i>	Muhlenberg's sedge
Cyperaceae cont.	<i>Carex vulpinoidea</i>	fox sedge
	<i>Cyperus sp.</i>	flatsedge
	<i>Cyperus acuminatus</i>	tapertip flatsedge
	<i>Cyperus lupulinus</i>	Great Plains flatsedge
	<i>Cyperus odoratus</i>	fragrant flatsedge
	<i>Cyperus setigerus</i>	lean flatsedge
	<i>Cyperus strigosus</i>	strawcolored flatsedge
	<i>Eleocharis sp.</i>	spikerush
	<i>Eleocharis compressa</i>	flatstem spikerush
	<i>Schoenoplectus tabernaemontani</i>	softstem bulrush
	<i>Scirpus atrovirens</i>	green bulrush
<i>Scirpus pendulus</i>	rufous bulrush	
Euphorbiaceae	<i>Acalypha ostryifolia</i>	pineland threeseed mercury
	<i>Acalypha rhomboidea</i>	Virginia threeseed mercury
	<i>Acalypha virginica</i>	Virginia threeseed mercury
	<i>Chamaesyce sp.</i>	sandmat
	<i>Chamaesyce maculata</i>	spotted sandmat
	<i>Chamaesyce nutans</i>	eyebane
	<i>Croton monanthogynus</i>	prairie tea
	<i>Euphorbia corollata</i>	flowering spurge
	<i>Euphorbia dentata</i>	toothed spurge
	<i>Euphorbia marginata</i>	snow on the mountain
	<i>Tragia betonicifolia</i>	betonyleaf noseburn
Fabaceae	<i>Amorpha canescens</i>	leadplant
	<i>Amorpha fruticosa</i>	desert false indigo
	<i>Astragalus canadensis</i>	Canadian milkvetch
	<i>Baptisia alba</i>	white wild indigo
	<i>Baptisia australis</i>	blue wild indigo
	<i>Baptisia bracteata</i>	longbract wild indigo
	<i>Cercis canadensis</i>	eastern redbud
	<i>Chamaecrista fasciculata</i>	sleepingplant
	<i>Dalea candida</i>	white prairie clover
	<i>Dalea purpurea</i>	violet prairie clover
	<i>Desmanthus illinoensis</i>	prairie bundleflower
	<i>Desmodium glutinosum</i>	pointedleaf ticktrefoil
	<i>Desmodium illinoense</i>	Illinois ticktrefoil
	<i>Desmodium sessilifolium</i>	sessileleaf ticktrefoil
	<i>Gleditsia triacanthos</i>	honeylocust
<i>Glycine max</i>	soybean	

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Family	Scientific Name	Common Name
	<i>Glycyrrhiza lepidota</i>	American licorice
	<i>Gymnocladus dioicus</i>	Kentucky coffeetree
Fabaceae cont.	<i>Lespedeza capitata</i>	roundhead lespedeza
	<i>Lespedeza frutescens</i>	shrubby lespedeza
	<i>Lotus unifoliolatus</i> var. <i>unifoliolatus</i>	American bird's-foot trefoil
	<i>Medicago lupulina</i>	black medick
	<i>Melilotus officinalis</i>	yellow sweetclover
	<i>Mimosa nuttallii</i>	Nuttall's sensitive-briar
	<i>Psoralea tenuiflora</i>	slimflower scurfpea
	<i>Strophostyles leiosperma</i>	slickseed fuzzybean
Fagaceae	<i>Quercus macrocarpa</i>	bur oak
Gentianaceae	<i>Gentiana puberulenta</i>	downy gentian
Grossulariaceae	<i>Ribes missouriense</i>	Missouri gooseberry
Iridaceae	<i>Sisyrinchium campestre</i>	prairie blue-eyed grass
Juglandaceae	<i>Juglans nigra</i>	black walnut
Juncaceae	<i>Juncus</i> sp.	rush
	<i>Juncus dudleyi</i>	Dudley's rush
	<i>Juncus interior</i>	inland rush
	<i>Juncus torreyi</i>	Torrey's rush
Lamiaceae	<i>Hedeoma hispida</i>	rough false pennyroyal
	<i>Lycopus americanus</i>	American water horehound
	<i>Monarda fistulosa</i>	wild bergamot
	<i>Prunella vulgaris</i>	common selfheal
	<i>Salvia azurea</i>	azure blue sage
	<i>Scutellaria parvula</i>	small skullcap
	<i>Teucrium canadense</i>	Canada germander
Lemnaceae	<i>Lemna minor</i>	common duckweed
Liliaceae	<i>Maianthemum stellatum</i>	starry false lily of the valley
Linaceae	<i>Linum sulcatum</i>	grooved flax
Loasaceae	<i>Mentzelia oligosperma</i>	chickenthiel
Lythraceae	<i>Ammannia coccinea</i>	valley redstem
	<i>Lythrum alatum</i>	winged lythrum
Malvaceae	<i>Abutilon theophrasti</i>	velvetleaf
	<i>Callirhoe alcaeoides</i>	light poppymallow
	<i>Sida spinosa</i>	prickly fanpetals
Menispermaceae	<i>Menispermum canadense</i>	common moonseed
Molluginaceae	<i>Mollugo verticillata</i>	green carpetweed
Moraceae	<i>Maclura pomifera</i>	osage orange
	<i>Morus alba</i>	white mulberry
	<i>Morus rubra</i>	red mulberry

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Family	Scientific Name	Common Name
Nyctaginaceae	<i>Mirabilis albida</i>	white four o'clock
	<i>Mirabilis nyctaginea</i>	heartleaf four o'clock
Oleaceae	<i>Fraxinus nigra</i>	black ash
Oleaceae cont.	<i>Fraxinus pennsylvanica</i>	green ash
Onagraceae	<i>Calylophus serrulatus</i>	yellow sundrops
	<i>Gaura mollis</i>	velvetweed
	<i>Ludwigia alternifolia</i>	seedbox
	<i>Ludwigia peploides</i>	floating primrose-willow
	<i>Oenothera biennis</i>	common evening-primrose
	<i>Oenothera macrocarpa</i>	bigfruit evening-primrose
	<i>Oenothera speciosa</i>	pinkladies
Oxalidaceae	<i>Oxalis stricta</i>	common yellow oxalis
	<i>Oxalis violacea</i>	violet woodsorrel
Phytolaccaceae	<i>Phytolacca americana</i>	American pokeweed
Plantaginaceae	<i>Plantago rugelii</i>	blackseed plantain
	<i>Plantago virginica</i>	Virginia plantain
Platanaceae	<i>Platanus occidentalis</i>	American sycamore
Poaceae	<i>Andropogon gerardii</i>	big bluestem
	<i>Bouteloua curtipendula</i>	sideoats grama
	<i>Bouteloua gracilis</i>	blue grama
	<i>Bouteloua hirsuta</i>	hairy grama
	<i>Bromus arvensis</i>	field brome
	<i>Bromus inermis</i>	smooth brome
	<i>Buchloe dactyloides</i>	buffalograss
	<i>Diarrhena obovata</i>	obovate beakgrain
	<i>Dichanthelium acuminatum</i>	tapered rosette grass
	<i>Dichanthelium oligosanthes</i>	Heller's rosette grass
	<i>Dichanthelium wilcoxianum</i>	fall rosette grass
	<i>Digitaria cognata</i>	Carolina crabgrass
	<i>Digitaria sanguinalis</i>	hairy crabgrass
	<i>Echinochloa muricata</i>	rough barnyardgrass
	<i>Elymus sp.</i>	wildrye
	<i>Elymus canadensis</i>	Canada wildrye
	<i>Elymus virginicus</i>	Virginia wildrye
	<i>Elymus vulpinus</i>	Rydberg's wildrye
	<i>Festuca subverticillata</i>	nodding fescue
	<i>Glyceria striata</i>	fowl mannagrass
<i>Hesperostipa spartea</i>	porcupinegrass	
<i>Koeleria macrantha</i>	prairie Junegrass	
<i>Leersia oryzoides</i>	rice cutgrass	

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Family	Scientific Name	Common Name
	<i>Leersia virginica</i>	whitegrass
	<i>Leptochloa panicea</i>	mucronate sprangletop
	<i>Lolium arundinaceum</i>	tall fescue
	<i>Muhlenbergia sp.</i>	muhly
Poaceae cont.	<i>Muhlenbergia cuspidata</i>	plains muhly
	<i>Muhlenbergia frondosa</i>	wirestem muhly
	<i>Muhlenbergia mexicana</i>	Mexican muhly
	<i>Muhlenbergia racemosa</i>	marsh muhly
	<i>Panicum capillare</i>	witchgrass
	<i>Panicum virgatum</i>	switchgrass
	<i>Paspalum pubiflorum</i>	hairyseed paspalum
	<i>Poa sp.</i>	bluegrass
	<i>Poa pratensis</i>	Kentucky bluegrass
	<i>Schizachyrium scoparium</i>	little bluestem
	<i>Setaria sp.</i>	bristlegrass
	<i>Setaria faberi</i>	Japanese bristlegrass
	<i>Setaria pumila</i>	yellow bristlegrass
	<i>Setaria pumila ssp. pallidifusca</i>	yellow bristlegrass
	<i>Setaria viridis</i>	green bristlegrass
	<i>Sorghastrum nutans</i>	Indiangrass
	<i>Sorghum halepense</i>	Johnsongrass
	<i>Spartina pectinata</i>	prairie cordgrass
	<i>Sphenopholis obtusata</i>	prairie wedgescale
	<i>Sporobolus compositus</i>	composite dropseed
	<i>Sporobolus heterolepis</i>	prairie dropseed
<i>Tridens flavus</i>	purpletop tridens	
<i>Tripsacum dactyloides</i>	eastern gamagrass	
<i>Vulpia octoflora</i>	sixweeks fescue	
Polygalaceae	<i>Polygala verticillata</i>	whorled milkwort
Polygonaceae	<i>Polygonum sp.</i>	knotweed
	<i>Polygonum amphibium</i>	water knotweed
	<i>Polygonum pennsylvanicum</i>	Pennsylvania smartweed
	<i>Polygonum persicaria</i>	spotted ladythumb
	<i>Polygonum scandens</i>	climbing false buckwheat
	<i>Polygonum virginianum</i>	jumpseed
	<i>Rumex altissimus</i>	pale dock
	<i>Rumex crispus</i>	curly dock
Portulacaceae	<i>Portulaca oleracea</i>	little hogweed
Pteridaceae	<i>Pellaea glabella</i>	smooth cliffbrake
Rhamnaceae	<i>Ceanothus americanus</i>	New Jersey tea

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Family	Scientific Name	Common Name
	<i>Ceanothus herbaceus</i>	Jersey tea
Rosaceae	<i>Agrimonia parviflora</i>	harvestlice
	<i>Geum canadense</i>	white avens
	<i>Prunus americana</i>	American plum
	<i>Rosa arkansana</i>	prairie rose
Rubiaceae	<i>Galium aparine</i>	stickywilly
Salicaceae	<i>Populus deltoides</i>	eastern cottonwood
	<i>Populus fremontii</i>	Fremont cottonwood
	<i>Salix exigua</i>	narrowleaf willow
	<i>Salix gooddingii</i>	Goodding's willow
	<i>Salix nigra</i>	black willow
Scrophulariaceae	<i>Agalinis tenuifolia</i>	slenderleaf false foxglove
	<i>Leucospora multifida</i>	narrowleaf paleseed
	<i>Mimulus ringens</i>	Allegheny monkeyflower
	<i>Veronica anagallis-aquatica</i>	water speedwell
	<i>Veronica peregrina</i>	neckweed
Smilacaceae	<i>Smilax tamnoides</i>	bristly greenbrier
Solanaceae	<i>Physalis heterophylla</i>	clammy groundcherry
	<i>Physalis longifolia</i>	longleaf groundcherry
	<i>Physalis pubescens</i>	husk tomato
	<i>Physalis pumila</i>	dwarf groundcherry
	<i>Physalis virginiana</i>	Virginia groundcherry
	<i>Solanum carolinense</i>	Carolina horsenettle
	<i>Solanum rostratum</i>	buffalobur nightshade
Ulmaceae	<i>Celtis occidentalis</i>	common hackberry
	<i>Ulmus americana</i>	American elm
	<i>Ulmus rubra</i>	slippery elm
Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle
	<i>Laportea canadensis</i>	Canadian woodnettle
	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory
	<i>Pilea pumila</i>	Canadian clearweed
	<i>Urtica dioica</i>	stinging nettle
Verbenaceae	<i>Glandularia bipinnatifida</i>	Dakota mock vervain
	<i>Phryma leptostachya</i>	American lopseed
	<i>Verbena hastata</i>	swamp verbena
	<i>Verbena simplex</i>	narrowleaf vervain
	<i>Verbena stricta</i>	hoary verbena
	<i>Verbena urticifolia</i>	white vervain
Violaceae	<i>Hybanthus verticillatus</i>	babyslippers
	<i>Viola missouriensis</i>	Missouri violet

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Family	Scientific Name	Common Name
	<i>Viola nephrophylla</i>	northern bog violet
	<i>Viola pedatifida</i>	prairie violet
Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper

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National Park Service
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