Forest Inventory of Vascular Plants at Homestead National Monument of America

And

Annual Plant Community Monitoring Results, 2002

Final Report

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Cover photograph of Karola Mlekush next to a large bur oak tree at Homestead National Monument of America.

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Summary

Previously, Homestead National Monument of America (HOME) lacked a comprehensive vascular plant inventory of wooded areas. Earlier vegetation studies focused on the restored tallgrass prairie and only a partial species list for forested areas exist. Park managers are considering actions to protect and/or enhance wooded areas at HOME, and this inventory will assist them to more effectively assess management actions and adapt accordingly.

An inventory of vascular plants in forested areas at HOME was conducted throughout the growing season (i.e. April – September) in 2002. The principal objective of this inventory was to document through observation and voucher specimens 90% of the vascular plant species occurring in the forest. One hundred sixteen species of vascular plants were found representing 50 families and 98 genera. One hundred twenty-six plant voucher specimens, including duplicates for some species, were prepared for the park's museum collection. In the process of the inventory, a rare, mesic bur oak (*Quercus macrocarpa*) forest community type was found. Local experts were consulted regarding the condition and conservation value of the rare forest type, and their report is included in Appendix A.

In conjunction with the woodland inventory, Prairie Cluster ecologists and botanists made observations at two, long-term plant community monitoring sites in the forest. Diversity, evenness and other community indices were calculated from these data as well as species' frequency and relative abundance (Appendix B). Data from 2002 will serve as a baseline and compared to future observations to monitor change in the forest.

The inventory results and this final report provide a verifiable assessment of current species richness and vegetation characteristics in the woodlands at HOME; include recommendations regarding management of the site; and provide a baseline to monitoring changes in the forest resulting from management actions. This information will be valuable to park managers charged with restoring and maintaining the site to its appearance at the time of the early homesteaders.

Introduction

In 1998 the U.S. Congress passed the National Parks Omnibus Management Act in response to concerns about the conditions of natural resources within the National Parks. The Act calls for baseline inventories for parks throughout the entire National Park system. Congress envisioned these inventories providing valuable information to effectively manage and protect park resources. The National Park Service (NPS) responded to Congressional mandates with the Natural Resources Challenge program, including the establishment of biome-based inventory and monitoring (I&M) networks. The Heartland Network (HTLN) I&M program facilitates inventories of vascular plants and vertebrates within fifteen parks in eight Mid-western states including HOME.

Prior to the Natural Resource Challenge and establishment of I&M networks, NPS initiated protoype monitoring programs to begin learning how to monitor natural resources. The Prairie Cluster Protoype Long-term Ecological Monitoring Program began in 1993 and is charged with designing monitoring protocols for prairie flora, fauna and ecosystems. Although distinct, the Heartland Network and the Prairie Cluster closely coordinate efforts for monitoring in Great Plains parks.

A previous inventory of the park's flora focused on the restored tallgrass prairie community (Sutton, Stubbendieck & Traeger 1984). Incrementally, park staff has compiled a partial list of woodland species; however, there has not been a systematic search of the forest by professional botanists, nor is the forest flora represented in the park's museum collection. A knowledge of the plant species occurring in the forest is critical in the light of management alternatives being considered, including prescribed fire and hazardous fuel removal. A complete and verifiable assessment of the forest flora will allow managers to better assess the influence of their actions.

Study Area

In March 1936, Congress established HOME under the stewardship of the NPS to commemorate the hardships and lives of the early settlers in the area. HOME is located in Gage County, Nebraska, approximately 50 miles south of Lincoln. The Monument is situated 3.5 miles west of Beatrice, Nebraska in T 4N, R 5E, S 26 NW ¼, and covers 194 acres (NPS 1999). Approximately 60% of the Monument is located in the 100-year floodplain of Cub Creek and the nearby Big Blue River. The primary natural resources of HOME include the restored tallgrass prairie, Cub Creek and the riparian forest.

At the time the park was established, the forest growth was restricted to about 35 acres along Cub Creek and was described as hardwoods typical of the area dominated by relatively small oaks (Shevlin 1939). Forest growth was limited by intense logging soon before the park was established and frequent fires resulting from the common practice of 'burning off' fields. Shevlin (1939) noted the denuded nature of the forest and witnessed no regeneration due to grazing and fire; however, he also noted the presence of large stumps that "testify to the excellence of the original stand." Shortly after the park was

founded, 10,000 oak (*Quercus spp*) and hackberry (*Celtis occidentalis*) saplings were planted at the site.

Later, Dickison (1960) described the forest as uneven aged and composed of mixed species including oak, maples (*Acer spp*), elm (*Ulmus spp*), hackberry and cottonwood (*Populus deltoides*). Stands of willows (*Salix spp*) were also observed growing adjacent to the stream, a result of a massive effort in 1952 to stabilize the eroding stream bank. The willows were reported as thriving at several sites despite beaver activity. At that time, Dickison suggested that managers protect the forest from fire, insects and tree diseases. Today, the hardwood forest occupies sixty acres along Cub Creek (NPS 1999) and comprises two distinct zones based on past land use. The southern portion was intensively logged in the 1930s to the point of near total removal of the canopy, while the northern part was relatively undisturbed (Figure 1).

The topography of the area ranges from nearly level at the prairie/forest edge to steep slopes in the riparian area along Cub Creek. The unit is bordered on the west, south and north by the park boundary and on the east by the upland and lowland prairie management units (Batzer & Lacome 1999). Two types of soils are present in the unit (USDA 1964). Alluvial land (Sy) is found over the greatest portion of the site, and a small area of Hobbs silt loam (Hb) soil is located in the northwest portion.

Materials and Methods

Inventory

Fieldwork began in late April of 2002, resumed in June, and was completed in September of 2002. A field crew of three members spent about three days conducting fieldwork for the inventory during each site visit. Inventory methods followed those outlined in A Study Plan to Inventory Vascular Plants and Vertebrates: Heartland Network (Boetsch et. al. 2000). A regular grid (cell size = 50m x 50m) was randomly overlain on a digital map of the park's forest (Figure 2). A random subset of grid cells (five per sample period) was selected for the survey. Cells were stratified by soil type. One random cell per sample period was drawn from the Hobbs silt loam soil type and four random cells drawn from the alluvial soil type.

To ensure spatial dispersal of the sample sites in the alluvial soil type, two were drawn from the northern half of the area and two from the southern half. Random cells were selected without replacement into the sample pool resulting in a total of fifteen cells. Appendix C includes a list of all cells, their soil type and strata, and the UTM coordinates for the grid vertices. The fifteen cells examined in the course of the study represent approximately 18% of the forest area. A GPS unit was used to locate the corners of each cell. Once located, measuring tapes were stretched from corner to corner. In cases of large debris piles or other impediments, flags were used to demarcate the cell. Cells were exhaustively searched and a separate species list created for each.

For each cell, physical site characteristics including slope, aspect, topographic position, hydrologic regime and ground cover were collected (Figure 3). The vegetation of each cell was described by leaf phenology and physiognomic type. Furthermore, for four

strata (overstory, subcanopy, shrub, and herbaceous) dominant species were recorded, and total foliar cover was estimated (Figure 3).

Once the cells were completed, additional searches were conducted throughout the forest focusing on unique features, new species not encountered in the cells and the collection of voucher specimens. Only complete specimens with flowers and/or fruits were collected, placed into plant presses, and processed as herbarium specimens. Once the inventory was complete, voucher specimens were mounted, verified and labeled following standard herbaria procedures and NPS standard form 10-512 (June 1982). Nomenclature follows the Integrated Taxonomic Information System (http:\\www.itis.usda.gov).

Monitoring

Two long-term plant community monitoring sites were randomly located in the forest at HOME. At each site, observations of understory species were made in ten, $10m^2$ plots arranged along two, 50m transects (Figure 4). In each plot, all species were recorded and foliar cover estimated for each species using modified Daubenmeier cover classes. Data on tree species were collected in the area between the two transects (i.e. 0.1 hectare). A complete description of monitoring methods is found in Willson et. al. (2002).

Results

Inventory

All field efforts at HOME yielded a total of 116 species of plants representing 50 families and 98 genera (Table 1). The sample design (i.e. searches of random grid cells) worked well. Of the total species observed, 105 were observed during searches of grid cells. Eleven additional species were observed outside the cells in focused searches.

One hundred twenty-four voucher specimens were prepared for the park's museum. Of the 116 total species, 104 (i.e. 90%) are represented by a voucher specimen and photographs document another 5 locally rare species. For seven species, neither a specimen nor an acceptable photograph could be obtained.

In the course of the inventory, several large trees were encountered and their position recorded with GPS. One individual of Eastern cottonwood measured 240 cm dbh, nearly the size of the state champion tree (Michael Stansberry, personal communication). On the north end of the forest (i.e. the area not logged) 13 large bur oaks were recorded, ranging from 61 cm dbh to 123 cm dbh (Table 2, Figure 5). GPS positions for bur oaks north of Cub Creek could not be collected due to the dense canopy.

Monitoring

Twenty-eight herbaceous species were encountered in the monitoring plots yielding a Shannon diversity value of 1.62 (App B, Table 1a). Two herbaceous species, nettle (*Laportea canadensis*) and false nettle (*Boehmeria cylindrica),* were clearly most abundant, with 24% and 16% mean foliar cover respectively (App B, Table 3a). The third most abundant species, wingstem (*Verbesina alternifolia*) had a mean cover value

of only 3%. Summer and fall forbs dominate the forest accounting for 82% of the total foliar cover (App B, Table 1c). Nine tree species were observed in the overstory plots with hackberry being the most abundant. Basal area per hectare for hackberry was nearly 10 times the basal area of the second most abundant tree, bur oak (App B, Table 4b).

Discussion

The species composition of the forest in the northern part of the park is consistent with the description of a mesic bur oak forest, a critically imperiled (S1) community in Nebraska (Steinauer & Rolfsmeier 2000). The southern portion is characterized as an eastern lowland forest and is similar to the northern part but without a bur oak component. Although beyond the scope of the original project, local experts were consulted to follow up on this significant finding. Steven Rolfsmeier (co-author of Terrestrial Natural Communities of Nebraska) was contracted to visit the site, confirm the designation of mesic bur oak forest and assess the conservation value of the area. Mr. Rolfsmeier agreed the site fit the description of a mesic bur oak forest and described it as one of relatively few sites in good condition in the state. Mr. Rolfsmeier's complete report and site description are contained in appendix A.

The bur oak forest type is lumped into a regional Bur oak / Big bluestem – Switchgrass woodland type in the Nature Conservancy's classification system for the Midwest (Association for Biodiversity Information 2001). However, there are important distinctions between the community as described in Nebraska and the more general regional description. Species indicative of oak savanna existing in states east of Nebraska do not occur at HOME. Steinauer and Rolfsmeier (2000) explain that the bur oak forest type in Nebraska has a forest understory composition characteristic of a more closed canopy forest compared to the TNC type, which is described to have a more prairie grass understory. Therefore, park managers are encouraged to resist suggestions to restore savanna. Specifically, burning and mechanical thinning are not recommended.

The inventory methods utilized extensive searches to best capture species richness, an important characteristic of a community and a general reflection of ecosystem health. The relative frequency and abundance of species are also important characteristics and are used to calculate community indices such as diversity. Intensive data collection at the two monitoring sites provides the necessary data to calculate community indices and assess a species' relative importance. Collectively, the inventory and monitoring results provide a baseline of information to be used to assess management actions and adapt accordingly.

Assessing inventory completeness

Inventory results were compared to a list of species expected to occur at the site. The expected species list was based on data for HOME in NPSpecies; although the primary data source is uncertain. The authors believe the list is based on observations made by park staff, particularly Becky Lecome in the early to mid 90s. The purpose of the comparison is to assess whether 90% of the species expected to occur at the site were documented in the inventory. Results of the inventory greatly exceed the 90% standard.

Fifty-three new species were added to the park flora, and all but four species on the expected list were observed: *Clematis virginiana* (virgin's bower), *Corydalis micrantha* (slender fumewort), *Quercus rubra* (red oak) and *Prenanthes aspera* (white lettuce). It is likely that virgin's bower and slender fumewort occur on the site. The record for white lettuce, however, is probably a false observation. *Lactuca floridana* (Florida lettuce) was recorded in the inventory and has a very similar vegetative appearance to white lettuce. The authors suggest that the list of expected species was incomplete; therefore, the comparison exaggerates the project's success and is an unreliable indicator of completeness. A more accurate assessment could be accomplished by asking local botanists to assess completeness of the species list based on their expert knowledge of the flora.

Implications and Recommendations

Undoubtedly, fire suppression, grazing cessation and changes in the hydrology of Cub Creek have produced significant changes in the woodlands since the establishment of the first homestead. Furthermore, profound changes in the forest resulted from the exploitative management practices prior to establishment of the monument. Nevertheless, the forest at HOME retains a diversity of plant species typical of the area, and contains relatively few exotic species. Management of the site should focus on monitoring and controlling invasive exotic species. The exotic species white mulberry (*Morus alba*), reed canary grass (*Phalaris arundinacea*), and garlic mustard (*Alliaria petiolata*) are of particular concern (see Appendix A). Managers should also allow prescribed fires in the prairie to burn into the forest/prairie interface in order to control the exotic grass, smooth brome (*Bromus inermis*), improve the overall diversity of the narrow ecotone, and increase oak recruitment. For additional discussion of management recommendations see Appendix A.

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Table 1. Species observed in the forest at Homestead National Monument of America. A superscript [1] indicates species documented by photographs, [2] indicates species that were observed but not documented. All other species are represented by a voucher specimen.

Family Scientific Name	Common Name	Nativity
Aceraceae		
Acer negundo L.	boxelder	Native
Acer saccharinum L.	silver maple	Native
Anacardiaceae		
Rhus aromatica var. serotina (Greene) Rehd.	fragrant sumac	Native
Rhus glabra L.	smooth sumac	Native
Toxicodendron radicans (L.) Kuntze	Eastern poison ivy	Native
Apiaceae		
Chaerophyllum procumbens (L.) Crantz	spreading chervil	Native
Cryptotaenia canadensis (L.) DC.	Canadian honewort	Native
[2]Heracleum maximum Bartr.		Native
Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe	clustered blacksnakeroot	Native
Asteraceae		
Ageratina altissima (L.) King & H.E. Robins.	tall ageratina	Native
Ambrosia artemisiifolia L.	common ragweed	Native
Ambrosia trifida L.	giant ragweed	Native
[2]Aster lanceolatus ssp. lanceolatus var. lanceolatus Willd.	white panicle aster	Native
Cirsium altissimum (L.) Hill	tall thistle	Native
Conyza canadensis (L.) Cronq.	Canada horseweed	Native
Eclipta prostrata (L.) L.	false daisy	Native
Helianthus tuberosus L.	Jerusalem artichoke	Native
Lactuca canadensis L.	Canada lettuce	Native
Lactuca floridana (L.) Gaertn.	woodland lettuce	Native
Solidago gigantea Ait.	giant goldenrod	Native
Taraxacum officinale G.H. Weber ex Wiggers	common dandelion	Non-Native
Verbesina alternifolia (L.) Britt. ex Kearney	wingstem	Native
Xanthium strumarium L.	rough cocklebur	Native
Berberidaceae		
Berberis thunbergii DC.	Japanese barberry	Non-Native
Boraginaceae		
Hackelia virginiana (L.) I.M. Johnston	beggarslice	Native
Brassicaceae		
Thlaspi arvense L.	field penny-cress	Non-Native
Campanulaceae		
Campanulastrum americanum (L.) Small	American bellflower	Native
Cannabaceae		
Cannabis sativa L.	marijuana	Non-Native

Table 1 continued

Family Scientific Name	Common Name	Nativity
Caprifoliaceae		
Sambucus canadensis L.	common elderberry	Native
Symphoricarpos orbiculatus Moench	coralberry	Native
Caryophyllaceae		
[1]Silene stellata (L.) Ait. f.	widowsfrill	Native
Stellaria media (L.) Vill.	common chickweed	Non-Native
Celastraceae		
Celastrus scandens L.	American bittersweet	Native
Euonymus atropurpurea Jacq.	Eastern wahoo	Native
Chenopodiaceae		
Chenopodium berlandieri Moq.	pitseed goosefoot	Native
Chenopodium simplex (Torr.) Raf.	mapleleaf goosefoot	Native
Commelinaceae		
Commelina communis L.	Asiatic dayflower	Non-Native
Convolvulaceae		
[2]Calystegia macounii (Greene) Brummitt	Macoun's false bindweed	Native
[2]Convolvulus arvensis L.	field-bindweed	Non-Native
Cornaceae		
Cornus drummondii C.A. Mey.	rough-leaved dogwood	Native
Cucurbitaceae		
Sicyos angulatus L.	oneseed burr cucumber	Native
Cupressaceae		
Juniperus virginiana L.	Eastern red cedar	Native
Cuscutaceae		
Cuscuta megalocarpa Rydb.	big fruit dodder	Native
Cyperaceae		
Carex aggregata Mackenzie	glomerate sedge	Native
Carex blanda Dewey	eastern woodland sedge	Native
Carex conjuncta Boott	soft fox sedge	Native
Carex sprengelii Dewey ex Spreng.	Sprengel's sedge	Native
Euphorbiaceae		
Acalypha rhomboidea Raf.	Virginia threeseed mercury	Native
Euphorbia davidii Subils	David's spurge	Non-Native

Table 1 continued

Family Scientific Name	Common Name	Nativity
Fabaceae		
Gleditsia triacanthos L.	honeylocust	Native
Medicago lupulina L.	black medick	Non-Native
[2]Melilotus officinalis (L.) Lam.	yellow sweetclover	Non-Native
Fagaceae		
Quercus macrocarpa Michx.	bur oak	Native
Grossulariaceae		
Ribes missouriense Nutt.	Missouri gooseberry	Native
Hydrophyllaceae		
Ellisia nyctelea (L.) L.	aunt Lucy	Native
Juglandaceae		
Juglans nigra L.	black walnut	Native
Lamiaceae		
Lamium amplexicaule L.	henbit deadnettle	Non-Native
Leonurus cardiaca L.	common motherwort	Non-Native
Stachys tenuifolia Willd.	smooth hedgenettle	Native
Teucrium canadense L.	Canada germander	Native
Liliaceae		
[1]Erythronium mesochoreum Knerr	midland fawnlily	Native
Maianthemum stellatum (L.) Link	starry false lily of the valley	Native
[1]Polygonatum biflorum (Walt.) Ell.	smooth Solomon's seal	Native
Smilacina stellata (L.) Desf.	false Solomon's seas	Native
Malvaceae		
Abutilon theophrasti Medik.	velvetleaf	Non-Native
Menispermaceae		
Menispermum canadense L.	common moonseed	Native
Moraceae		
Maclura pomifera (Raf.) Schneid.	osage orange	Native
Morus alba L.	white mulberry	Non-Native
Nyctaginaceae		
Mirabilis nyctaginea (Michx.) MacM.	heartleaf four o'clock	Native
Oleaceae		
Fraxinus pennsylvanica Marsh.	green ash	Native

Table 1 continued

Family Scientific Name	Common Name	Nativity
Ophioglossaceae		
[1]Botrychium virginianum (L.) Sw.	rattlesnake fern	Native
Oxalidaceae		
Oxalis stricta L.	common yellow oxalis	Native
Phytolaccaceae		
Phytolacca americana L.	American pokeweed	Native
Poaceae		
[2]Bromus inermis Leyss.	smooth brome	Non-Native
Cinna arundinacea L.	sweet woodreed	Native
Diarrhena obovata (Gleason) Brandenburg	obovate beakgrain	Native
Echinochloa muricata (Beauv.) Fern.	rough barnyardgrass	Non-Native
Elymus virginicus L.	Virginia wildrye	Native
Festuca subverticillata (Pers.) Alexeev	nodding fescue	Native
Leersia virginica Willd.	whitegrass	Native
Muhlenbergia bushii Pohl	nodding muhly	Native
Muhlenbergia racemosa (Michx.) B.S.P.	marsh muhly	Native
Phalaris arundinacea L.	reed canarygrass	Native
Poa pratensis L.	Kentucky bluegrass	Non-Native
Setaria viridis (L.) Beauv.	green bristlegrass	Non-Native
Polygonaceae		
Polygonum lapathifolium L.	curlytop knotweed	Native
Polygonum pensylvanicum L.	Pennsylvania smartweed	Native
Polygonum punctatum Ell.	dotted smartweed	Native
Polygonum scandens L.	climbing false buckwheat	Native
Polygonum virginianum L.	jumpseed	Native
Ranunculaceae		
Ranunculus abortivus L.	littleleaf buttercup	Native
[2]Thalictrum dasycarpum Fisch. & Avé-Lall.	purple meadow-rue	Native
Rosaceae		
Geum canadense Jacq.	white avens	Native
Prunus virginiana L.	chokecherry	Native
Rubus occidentalis L.	black raspberry	Native
Rubiaceae		
Galium aparine L.	stickywilly	Native
Galium circaezans Michx.	licorice bedstraw	Native
Salicaceae		
Populus deltoides Bartr. ex Marsh.	Eastern cottonwood	Native
Salix X rubens Schrank (pro sp.)	hybrid crack willow	Non-Native

Table 1 continued

Family Scientific Name	Common Name	Nativity
Scrophulariaceae		
[1]Scrophularia marilandica L.	carpenter's square	Native
Veronica peregrina var. xalapensis (Kunth)	hairy purslane speedwell	Native
Smilacaceae		
Smilax tamnoides L.	bristly greenbrier	Native
Solanaceae		
Solanum ptycanthum Dunal	West Indian nightshade	Native
Ulmaceae		
Celtis occidentalis L.	common hackberry	Native
Ulmus americana L.	American elm	Native
Ulmus rubra Muhl.	slippery elm	Native
Urticaceae		
Boehmeria cylindrica (L.) Sw.	smallspike false nettle	Native
Laportea canadensis (L.) Weddell	Canadian woodnettle	Native
Parietaria pensylvanica Muhl. ex Willd.	Pennsylvania pellitory	Native
Urtica dioica ssp. gracilis (Ait.) Seland.	California nettle	Native
Verbenaceae		
Phryma leptostachya L.	American lopseed	Native
Verbena urticifolia L.	white vervain	Native
Violaceae		
Viola missouriensis Greene	Missouri violet	Native
Viola pubescens Ait.	downy yellow violet	Native
Vitaceae		
Parthenocissus quinquefolia (L.) Planch.	Virginia creeper	Native
Vitis riparia Michx.	riverbank grape	Native

Table 2. Location of large trees encountered in the course of inventory, UTM NAD 83 CONUS, Zone 14.

Species Name	Common Name	DBH (cm)	NORTHING	EASTING
Populus deltoides	Cottonwood	240.0	4461774.391	683802.632
Populus deltoides	Cottonwood	108.0	4461801.426	683782.436
Quercus macrocarpa	Bur Oak	123.0	4462060.673	683613.009
Quercus macrocarpa	Bur Oak	74.8	4462019.709	683921.987
Quercus macrocarpa	Bur Oak	78.8	4462015.120	683909.258
Quercus macrocarpa	Bur Oak	82.0	4462021.698	683909.902
Quercus macrocarpa	Bur Oak	64.5	4462042.174	683901.401
Quercus macrocarpa	Bur Oak	85.5	4462039.006	683900.291
Quercus macrocarpa	Bur Oak	82.0	4462061.531	683894.326
Quercus macrocarpa	Bur Oak	61.0	4462060.079	683892.573
Quercus macrocarpa	Bur Oak	61.0	4462073.944	683891.630
Quercus macrocarpa	Bur Oak	63.0	4462052.612	683925.803
Quercus macrocarpa	Bur Oak	64.0	4462057.991	683911.341
Quercus macrocarpa	Bur Oak	76.5	4462016.738	683935.400
Quercus macrocarpa	Bur Oak	83.5	4462019.737	683937.861

Figure 1. Study area at the time of establishment, Homestead National Monument of America, 1937. Areas to the south that were deforested shortly before the park was established have a higher reflectance and are outlined with a dashed line in the image.

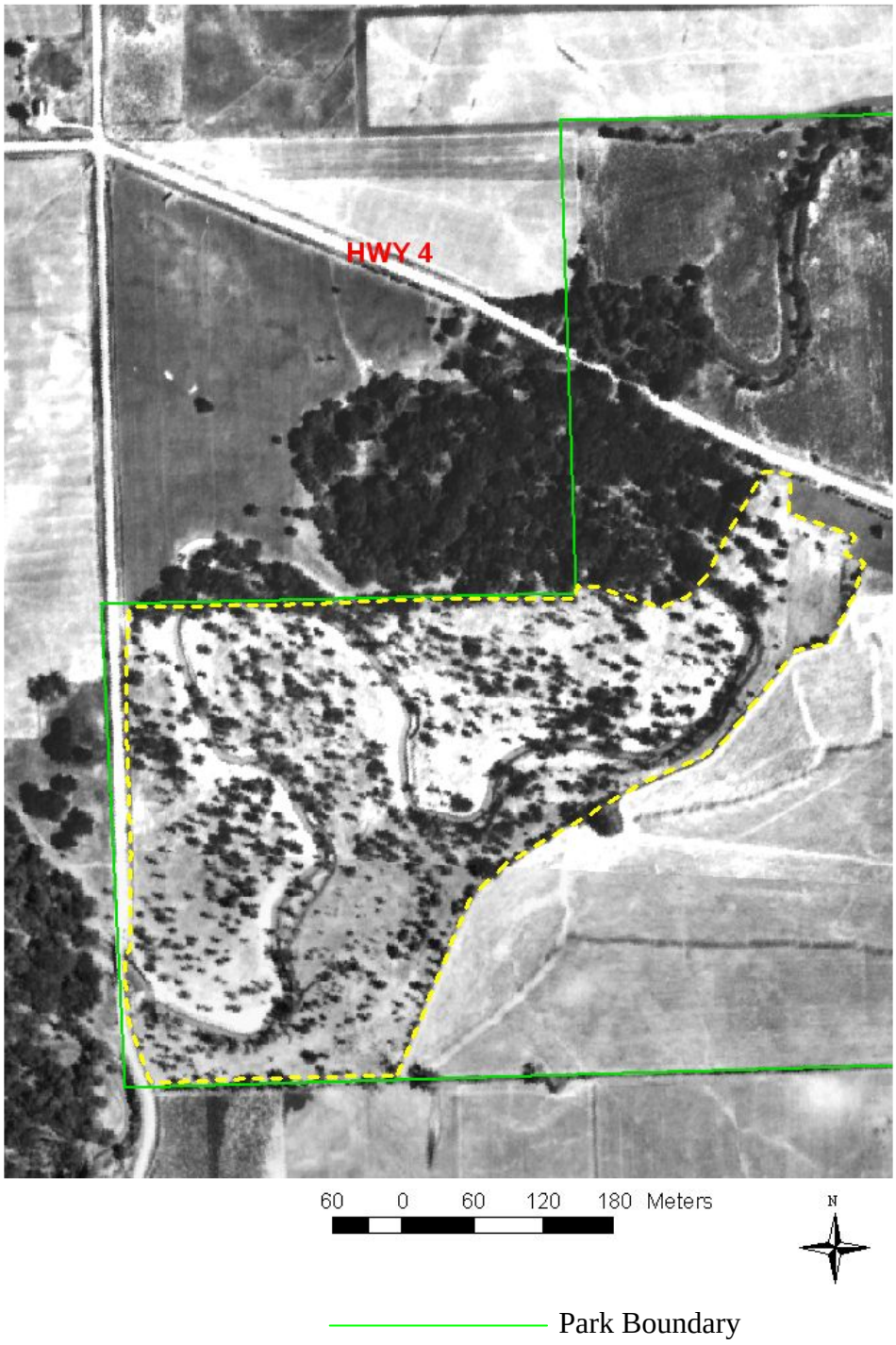


Figure 2. Sample grid (cell size = 50m x 50m) used to select random search areas. Cell ID number is in the center of each cell. Grid vertex numbers are labeled above each vertex.

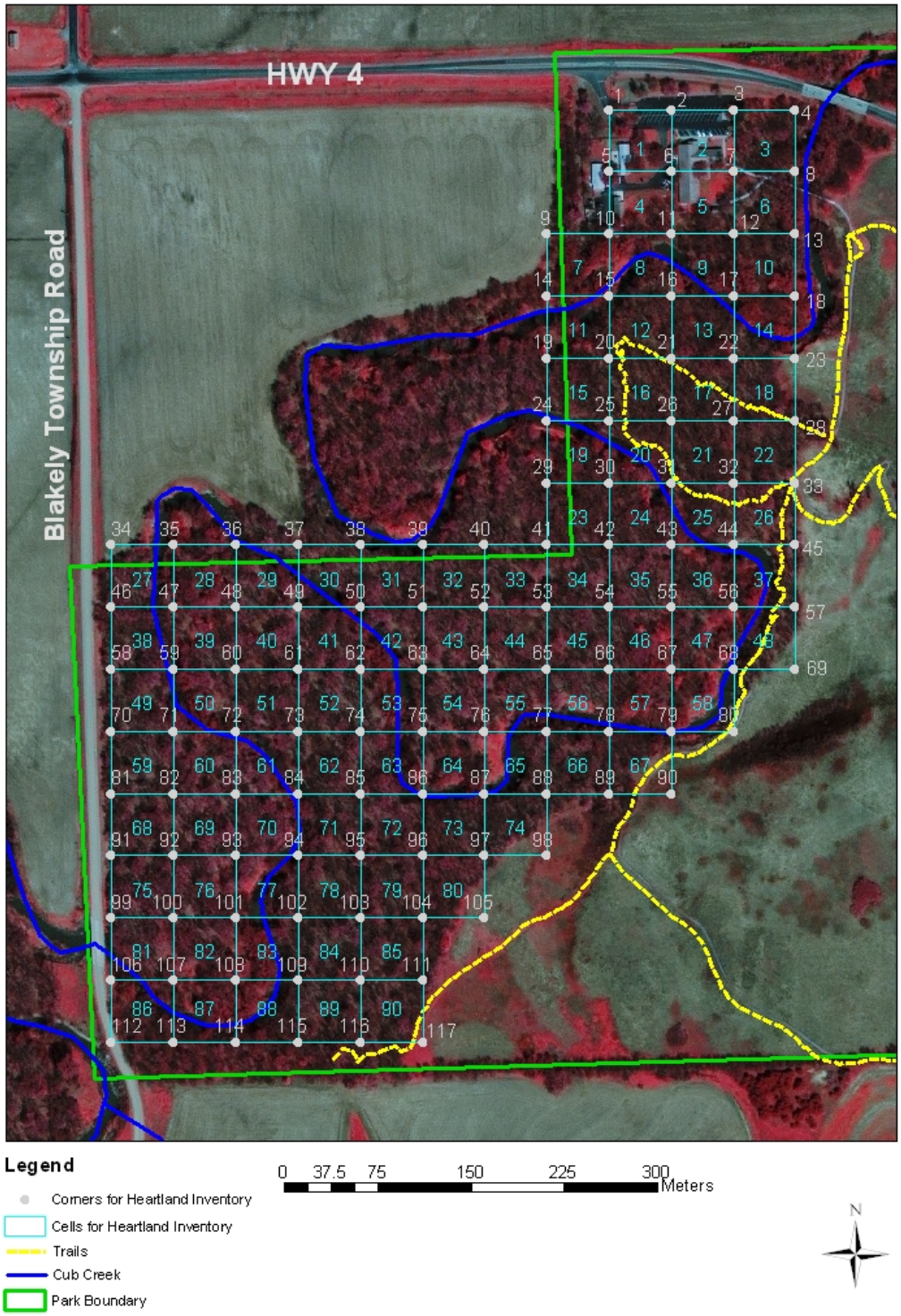


Figure 3. Habitat and site assessment data sheet.

Habitat and Plant Species Inventory Data Sheet, Homestead NM of America

Date: _____ **Park**: _____ **Cell ID #**: _____ **Observers**: _____

UTM Zone:____ **Datum**:_____ **Easting**: _____ **Northing**: _____ **Project File**: _____ **WP#**:_____

Location Description: Floodplain Woodland, Homestead National Monument of America, Beatrice NE

Quad: **Beatrice West** T: **4N** R: **5E** S: **26 NW1/4** Plot size, length (m): **50** width (m): **50**

Site Characteristics:

Elevation (ft): _____ **Slope**: _____ Var: high med low **Aspect**: _____ Var: high med low

Topographic position: level lower-slope mid-slope upper-slope escarpment/face ledge crest depression draw

Slope-shape, Horizontal (30m): concave straight convex Vertical (30m): concave straight convex **Surface water**: in plot <50m >50m

Hydrologic regime: permanently flooded semi-permanently flooded seasonally/temporarily flooded intermittently flooded seep upland

Ground Cover: bryophyte/lichen 1 2 3 4 5 woody debris 1 2 3 4 5 grass litter 1 2 3 4 5 tree leaf litter 1 2 3 4 5
bedrock/boulder 1 2 3 4 5 gravel/cobble 1 2 3 4 5 sand/soil 1 2 3 4 5
(cover classes 1: <1%, 2: 1-5% 3: 5-25% 4: 25-50% 5: 50-100%)

Vegetation Description:

Leaf phenology (of uppermost stratum having > 10% cover):

Trees and shrubs
___Evergreen
___Deciduous
___Mixed (evergreen, deciduous)
Herbs
___Annual
___Perennial

Physiognomic class (see definitions):

___Forest
___Woodland
___Sparse Woodland
___Shrubland
___Sparse Shrubland
___Herbaceous
___Sparse Vegetation

Strata	Stratum Height[1]	Stratum Cover Class[2]	Dominant Species (list top 3-5 species in order; use = sign to indicate equal importance)
Canopy	1 2 3 4 5 6	A B C D	_____ _____ _____ _____ _____
Sub-canopy	1 2 3 4 5 6	A B C D	_____ _____ _____ _____ _____
Shrub	1 2 3 4 5 6	A B C D	_____ _____ _____ _____ _____
Herbaceous	1 2 3 4 5 6	A B C D	_____ _____ _____ _____ _____

[1] Stratum Height Classes: 1: <0.5m 2: 0.5-5m 3: 5-10m 4: 10-20m 5: 20-30m 6: >30m

[2] Stratum Cover Classes: A: <10% B: 10-25% C: 25-60% D: >60%

Figure 4. Plot layout for long-term plant community monitoring. Nested in each large, $10m^2$ plot are smaller plots for measuring the frequency of dominant herbaceous species. Tree species data is collected in the 0.1 hectare area between the two transects.

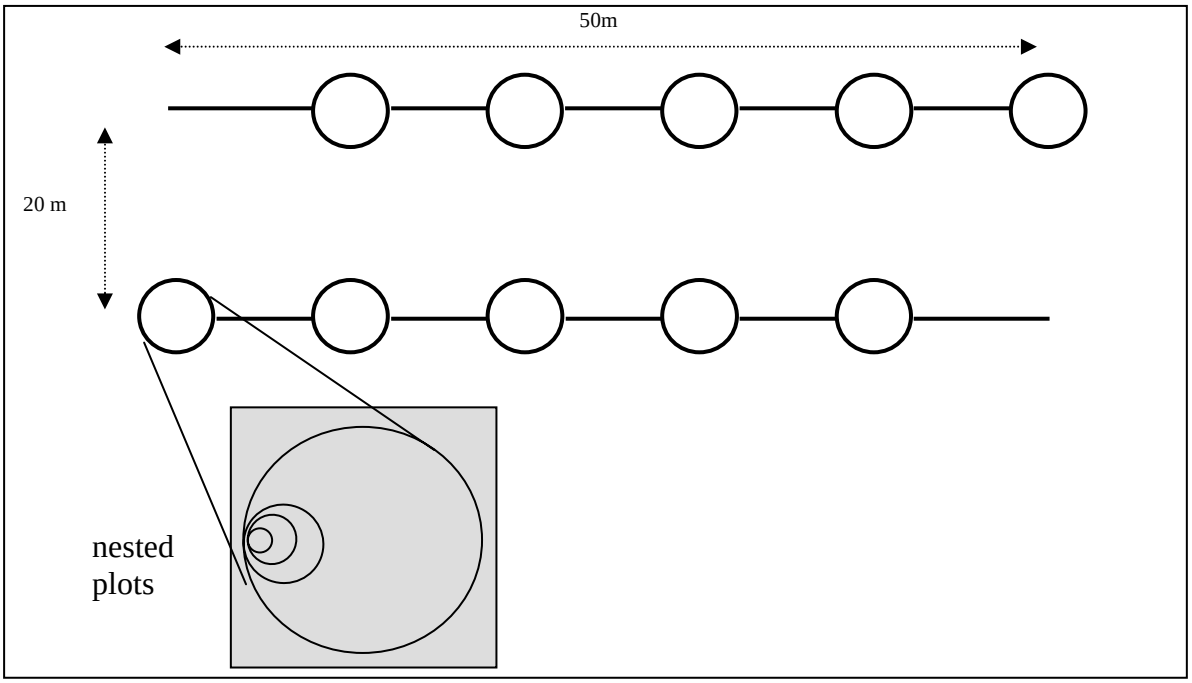
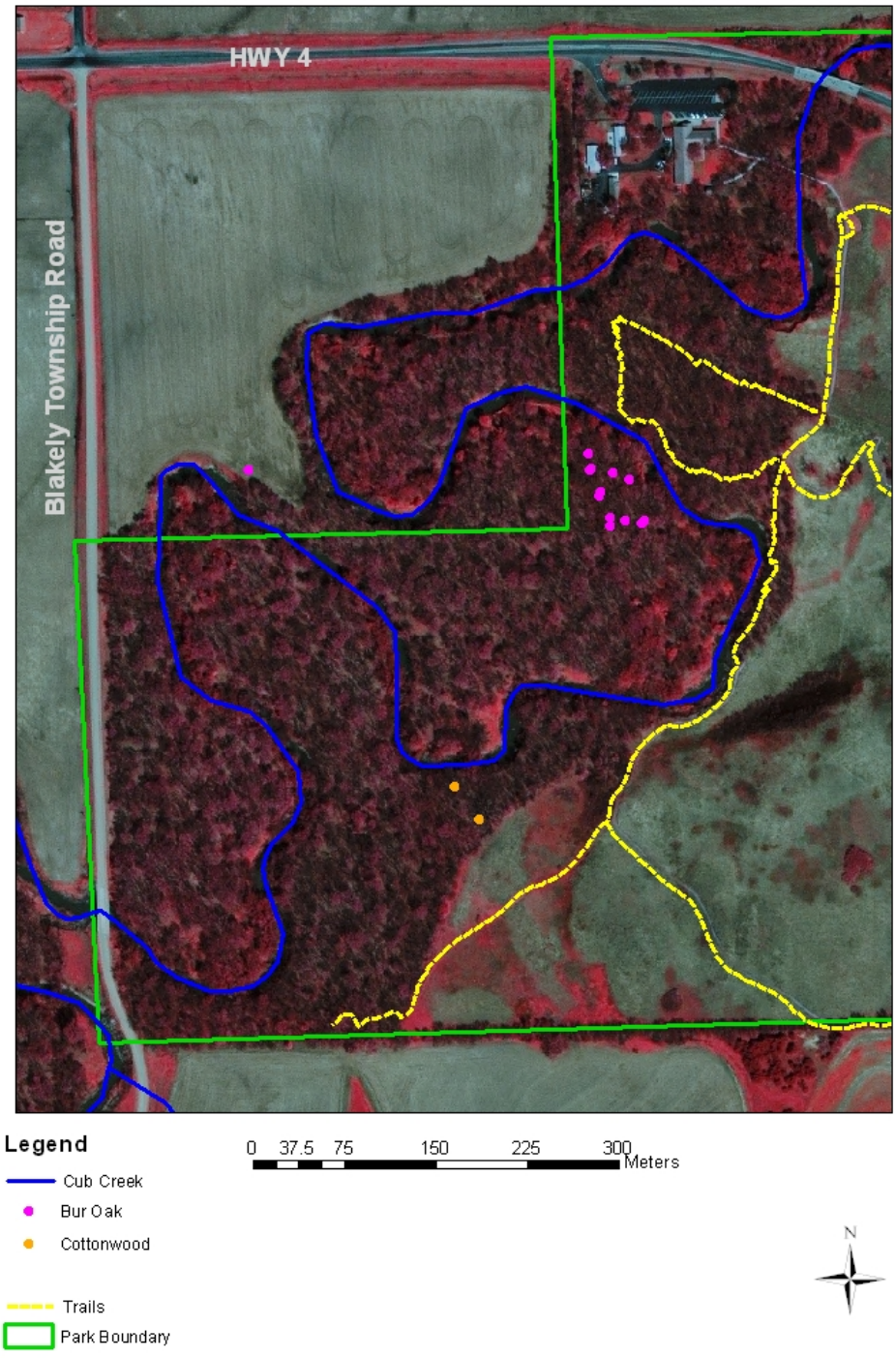


Figure 5. Locations of large bur oak and cottonwood trees encountered during the inventory. GPS positions for other large bur oak trees in areas to the north of Cub Creek and encircled by the woodland trail could not be obtained due to the dense overstory.



Appendix A

CUB CREEK WOODLANDS, HOMESTEAD NATIONAL MONUMENT

A report to the National Park Service

Steven B. Rolfsmeier

5 September 2002

The woodlands along Cub Creek at Homestead National Monument were visited on 30 August and 5 September 2002 to provide a detailed description of the site and its place in the Nebraska Natural Heritage community classification, to evaluate its quality and to generate management recommendations for the site. The forest can be divided into two distinct zones corresponding to past history. The south portion of the site was heavily logged in the early 1930's to the point of almost total removal of the canopy. The north half was comparatively undisturbed.

VEGETATION DESCRIPTION

Large, spreading-crowned bur oaks (*Quercus macrocarpa*) about 60 ft. tall dominate the canopy in the north half of the site, with scattered large cottonwoods (*Populus deltoides*) and some large honey locusts (*Gleditsia triacanthos*) filling gaps among the oaks. The subcanopy contains mostly hackberries (*Celtis occidentalis*) and slippery elms (*Ulmus rubra*) 30-40 ft. tall, with silver maples (*Acer saccharinum*) conspicuous in lower places, especially along the stream banks. Understory shrubs are nearly absent from the woods except along the margins, but a layer of hackberry saplings under 10 ft. tall simulates a tall shrub layer in places. In slightly lower places near the stream banks, oaks are not a conspicuous part of the canopy, which is dominated by hackberry and black walnut (*Juglans nigra*) 40-50 ft. tall, with scattered larger cottonwoods. Hackberries 20-30 ft. tall dominate the subcanopy along with occasional young bur oaks and silver maple. Oaks are also not important canopy trees along the margins of the woods, which are dominated by small to medium sized trees of hackberry, green ash (*Fraxinus pennsylvanica*), honey locust, American elm (*Ulmus americana*), and the exotic white mulberry (*Morus alba*). Young oaks, elms, and black walnut are often present in the subcanopy along the margins, and a short shrub layer of coralberry (*Symphoricarpos orbiculatus*) is frequently present.

Herbaceous understory in the mesic woods in the north half is dominated primarily by wood nettle (*Laportea canadensis*) with sedges (*Carex* spp.), wingstem (*Verbesina alternifolia*) and *Elymus macgregorii* abundant in places. Other conspicuous fall-flowering components include jumpseed (*Polygonum virginianum*), *Diarrhena obovata,* and *Muhlenbergia bushii.* Open areas near the stream and along the margins may also contain conspicuous patches of stinging nettle (*Urtica dioica*) and Jerusalem artichoke (*Helianthus tuberosus*). Slightly higher areas closer to the woodland margins are often dominated by Virginia wildrye (*Elymus virginicus*), wingstem, and wood nettle, the latter not as dense as in the rest of the woods. The exotic smooth brome (*Bromus inermis*) often dominates in the herbaceous layer within about 30 ft. of the forest-prairie margin. Other common constituents of the understory at the margins include Virginia wildrye, poison ivy (*Toxicodendron radicans*) and white snakeroot (*Ageratina altissima*).

The woods of the south half have a shorter canopy 40-50 ft. tall dominated by honey locust and hackberry with scattered larger cottonwoods. Hackberry, slippery elm and black walnut are scattered in the understory and a shrub layer is nearly absent, except along the margins. Among the dominants are white snakeroot, Virginia wildrye, *Muhlenbergia bushii,* sedges, and wingstem. Wood nettle is locally common in lower areas, but is never as dense as in the north half of the site. Occasional small bur oaks are found scattered in the south half.

SITE CLASSIFICATION AND QUALITY

The north half of the site closely fits the description of mesic bur oak forest by Steinauer and Rolfsmeier, 2000, a woodland type for which a satisfactory TNC equivalent has not yet been found. Bur oaks, hackberry and black walnut are all part of the canopy or tall subcanopy and many of the herbaceous understory dominants such as wood nettle and wingstem are typical of this community. The south half of the site, which is similar except for the absence of an oak canopy, fits the broadly-defined eastern lowland forest of Nebraska Heritage (*Fraxinus pennsylvanica – Ulmus* spp. *– Celtis occidentalis* Forest of TNC), though it differs from the north half primarily in the absence of the bur oak canopy and some minor differences in the understory vegetation.

Mesic bur oak forest in known from fewer than four sites in Nebraska, and may have been more common than currently represented, since removal of oaks appears to convert this community to one resembling the much more common eastern lowland forest. This community apparently is found along small permanent streams and was probably subject to periodic flooding which may have prevented the woody vegetation from being removed by fires. Usually some species diagnostic for upland bur oak forest are present in these sites such as bitternut hickory, though few are reported for the site except for *Erythronium* sp. and *Botrychium virginianum*, which are evidently uncommon. Despite the relatively low species diversity, the Cub Creek woods are noteworthy in that they are not extensively invaded by exotic woody species such as Eurasian buckthorn (*Rhamnus cathartica*) and multiflora rose (*Rosa multiflora*) that frequently invade this community. The only exotic woody species observed at the site were white mulberry and Osage orange (*Maclura pomifera*), neither of which is abundant. Given the scarcity of this community in Nebraska (it is listed as an S1 community by Nebraska Heritage), it represents one of relatively few sites in good condition in the state.

MANAGEMENT CONCERNS AND RECOMMENDATIONS

The woods along Cub Creek have undoubtedly undergone significant changes since the first homestead was established there. The suppression of fire and change in hydrology due to downcutting of the stream channel have allowed the woody vegetation to expand beyond its pre-settlement extent. A management plan for the site must first address factors that may contribute to degradation of the site, and secondly should strive to restore the area to pre-settlement condition if possible.

Two invasive grasses present in the woods are cause for concern. Smooth brome is present along the margins of the woods and can probably be controlled by allowing spring burns to spread into the woods. The native grasses in the adjacent restored prairie will hopefully replace this band of smooth brome over time. Reed canarygrass (*Phalaris arundinacea*) is also established in a few places along the stream banks and could quickly become problematic, especially following silt deposition after a flood. The extent of reed canarygrass should be determined and attempts to control it should be made as soon as possible. Another species that might soon pose a threat is garlic mustard (*Alliaria petiolata*), which was collected from along the Blue River in Beatrice in 1992. The woods should be monitored for this species and any populations found should be immediately destroyed.

Outside of removal of exotic species, it is difficult to approach how the woods along Cub Creek should be restored. There has been a trend in recent years to recognize

any densely wooded area that contains spreading crowned oaks as “degraded presettlement savanna” and recommend destructive management practices to restore its supposed natural condition. The woods at Cub Creek contain no species that are diagnostic of former oak savanna in states to our east where such a community likely existed. Even if savanna species were once present, there is no trace of them now and it would be entirely speculative to attempt to restore a community to a condition that may never have existed at the site. It is reasonable to assume that woody vegetation was present, especially near the stream and that most of what may appear to have been savanna probably at the very least represented a broad, dynamic ecotone between prairie and woodland. Allowing fire to spread into the margins of the current woodland is likely to increase oak recruitment and improve the overall diversity of the very narrow current ecotone, but opening up densely wooded areas by removal of the overstory is more likely to provide habitat for unwanted invaders than produce a savanna-like community.

Recommended management priorities for the woods at Cub Creek include monitoring for the presence of exotic invaders not yet found at the site, such as garlic mustard, Eurasian buckthorn and multiflora rose; removal of reed canarygrass; and allowing controlled burns to spread into the woodlands to the extent they are able. It may be necessary to control white mulberry at some point in the future to prevent it from overpopulating the newly-opened prairie-woodland ecotone.

Appendix B

Annual plant community monitoring results for woodland monitoring sites at Homestead National Monument of America – 2002

Karola E. Mlekush and Michael D. DeBacker

National Park Service
The Prairie Cluster Prototype Long-term Ecological Monitoring Program
Wilson's Creek National Battlefied
6424 West Farm Road 182
Republic, MO 65738

January, 2003

Table 1a. Plant Community Composition: Species Richness and Shannon Diversity.

All Species:

Species Richness:	**28**		
Total Shannon Diversity:	**1.62**	Total Shannon Evenness:	**0.48**
Mean Diversity (st dev):	**1.46 (0.03)**	Mean Evenness (st dev):	**0.47 (0.02)**

Native Species Only:

Native Species Richness:	**28**		
Total Shannon Diversity:	**1.62**	Total Shannon Evenness:	**0.48**
Mean Diversity (st dev):	**1.46 (0.03)**	Mean Eveness (st dev):	**0.47 (0.02)**

Table 1b. Plant Community Summary: Relative Frequency and Cover of Exotic Species.

Number of Exotic Species: **0**
Number of Native Species: **28**
Exotic Ratio:

	Mean Relative Frequency	Mean Relative Cover
Native	**100.00%**	**100.00%**

Table 1c. Plant Community Composition: Relative Frequency and Cover of Plant Guilds.

Plant Guild	Mean Relative Cover (st dev.)	Mean Relative Frequency (st dev.)
Annuals and Biennials	**5.48% (0.048)**	**14.72% (0.009)**
Cool-Season Grasses	**2.14% (0.004)**	**9.10% (0.007)**
Ephemeral Spring Forbs	**1.02% (0.010)**	**5.83% (0.028)**
Grass-Like	**4.79% (0.005)**	**8.71% (0.013)**
Spring Forbs	**0.29% (0.001)**	**2.61% (0.004)**
Summer/Fall Forbs	**82.30% (0.012)**	**32.81% (0.066)**
Woody Species	**2.70% (0.011)**	**20.85% (0.037)**

Table 2a. Plant Community Structure: Ground Cover.

Structural Component	Mean Percent Cover
BARE SOIL	**18.85**
BARE ROCK	**0.03**
GRASS LITTER	**1.35**
WOODY DEBRIS	**9.75**
LEAF LITTER	**85.00**
UNVEGETATED	**97.50**

Table 2b. Plant Community Structure: Vegetation Type Cover.

Vegetation Type	Mean Percent Cover
Grasses/Grass-Like	**3.63**
Herbs	**46.90**
Shrubs	**0.15**
Woody Vines	**1.20**

Table 3a. Plant Community Composition: Herbaceous and Shrub Species.

Species	Common Name	Frequency - recorded at four scales				Mean Cover	Importance Value
		$0.01m^2$	$0.1m^2$	$1m^2$	$10m^2$		
LAPORTEA CANADENSIS	Nettle	40%	65%	95%	100%	24	0.2867
BOEHMERIA CYLINDRICA	False nettle	35%	60%	90%	100%	15.85	0.1782
VERBESINA ALTERNIFOLIA	Wingstem	5%	50%	70%	95%	2.97	0.0712
CAREX SPP	Sedge	30%	50%	65%	100%	2.48	0.0675
GALIUM APARINE	Cleavers	[1]	20%	50%	80%	3.41	0.0585
ELYMUS VIRGINICUS	Virginia wild rye	10%	40%	60%	85%	1.09	0.0458
PARTHENOCISSUS QUINQUEFOLIA	Virginia-creeper, woodbine	10%	[1]	40%	85%	0.65	0.0417
SMILAX TAMNOIDES	Catbrier	[1]	[1]	10%	80%	0.5	0.038
VIOLA SPP	Violet	[1]	20%	45%	70%	0.68	0.0343
TOXICODENDRON RADICANS	Common poison-ivy	[1]	[1]	15%	50%	0.5	0.0239
PARIETARIA PENSYLVANICA	Pennsylvania pellitory	5%	10%	30%	40%	1.13	0.0212
POLYGONUM VIRGINIANUM	Jumpseed	[1]	[1]	5%	40%	0.5	0.0205
HACKELIA VIRGINIANA	Stickseed, beggar's lice	[1]	[1]	5%	30%	0.5	0.0149
GEUM CANADENSE	White avens	[1]	[1]	[1]	30%	0.5	0.0145
CHENOPODIUM BERLANDIERI	Pitseed goosefoot	[1]	[1]	10%	30%	0.5	0.0134
ELLISIA NYCTELEA	Water-pod	[1]	5%	15%	20%	0.5	0.0093
AGERATINA ALTISSIMA	Tall ageratina	[1]	[1]	5%	20%	0.5	0.009
SYMPHORICARPOS ORBICULATUS	Coralberry	[1]	[1]	5%	20%	0.5	0.009
FESTUCA SUBVERTICILLATA	Nodding fescue	[1]	5%	15%	15%	1.33	0.0082
CUSCUTA MEGALOCARPA	bigfruit dodder	5%	5%	5%	15%	0.5	0.0075
SANICULA ODORATA	Clustered blacksnakeroot	[1]	5%	5%	15%	0.5	0.0071
RIBES MISSOURIENSE	Missouri gooseberry	[1]	[1]	5%	10%	0.5	0.0052
PHYTOLACCA AMERICANA	Pokeweed, pokeberry	[1]	[1]	[1]	5%	0.5	0.0026
VIOLA MISSOURIENSIS	Missouri violet	[1]	[1]	[1]	5%	0.5	0.0026
AMBROSIA TRIFIDA	Giant ragweed	[1]	[1]	[1]	5%	0.5	0.0026
DIARRHENA OBOVATA	Obovate beakgrain	[1]	5%	5%	5%	0.5	0.0022
CAMPANULASTRUM AMERICANUM	Tall bellflower	[1]	[1]	[1]	5%	0.5	0.0022
GALIUM SPP		[1]	[1]	[1]	5%	0.5	0.0022

[1] species not recorded at that scale

Table 4a. Density (stems per m^2) for seedlings, saplings and large saplings.

Species	Common Name	Individuals per m^2		
		Seedlings (<0.5m tall)	Saplings (<2.5 cm dbh)	Lrg. Saplings (>2.5 & <5.0 cm dbh)
CELTIS OCCIDENTALIS	Northern hackberry	0.51	0	0.015
GLEDITSIA TRIACANTHOS	Honey-locust	0.005	0	0
JUNIPERUS VIRGINIANA	Eastern red cedar	0.005	0	0
QUERCUS MACROCARPA	Bur oak	0.03	0	0
ULMUS SPP	Elm	0.095	0	0

Table 4b. Total basal area (cm^2) at breast height per hectare for tree species.

Species	Common Name	Basal area (cm^2) per hectare
CELTIS OCCIDENTALIS	Northern hackberry	9148
QUERCUS MACROCARPA	Bur oak	916.5
QUERCUS SPP	Oak	553.5
FRAXINUS PENNSYLVANICA	Ash	297
MORUS ALBA	White mulberry	255.5
ULMUS RUBRA	Slippery or red elm	132.5
JUGLANS NIGRA	Black walnut	64

Appendix C

Location of sample grid cells (UTM), their soil type and strata, and grid cells randomly selected for inventory of vascular plants at Homestead National Monument of America

Table 1. Cell ID, soil type and strata for 90, 50m x 50m grid cells composing the sample area. Fifteen cells were chosen at random for survey.

Cell ID	Soil Type	Strata	Selected for Survey
1	None[1]		No
2	None[1]		No
3	None[1]		No
4	None[1]		No
5	None[1]		No
6	None[1]		No
7	alluvial soil	North	No
8	alluvial soil	North	Yes
9	alluvial soil	North	No
10	alluvial soil	North	No
11	alluvial soil	North	Yes
12	alluvial soil	North	No
13	alluvial soil	North	No
14	alluvial soil	North	No
15	alluvial soil	North	No
16	alluvial soil	North	Yes
17	alluvial soil	North	No
18	alluvial soil	North	No
19	alluvial soil	North	No
20	alluvial soil	North	No
21	alluvial soil	North	Yes
22	alluvial soil	North	No
23	alluvial soil	North	No
24	alluvial soil	North	No
25	alluvial soil	North	No
26	alluvial soil	North	Yes
27	alluvial soil	North	No
28	alluvial soil	North	No
29	alluvial soil	North	No
30	Hobbs silt loam	Hobbs	No
31	Hobbs silt loam	Hobbs	Yes
32	Hobbs silt loam	Hobbs	No
33	Hobbs silt loam	Hobbs	No
34	alluvial soil	North	No
35	alluvial soil	North	No
36	alluvial soil	North	No
37	alluvial soil	North	No
38	alluvial soil	North	No
39	alluvial soil	North	No
40	alluvial soil	North	Yes
41	alluvial soil	North	No
42	alluvial soil	North	No
43	Hobbs silt loam	Hobbs	Yes
44	Hobbs silt loam	Hobbs	No
45	Hobbs silt loam	Hobbs	Yes
46	alluvial soil	South	No
47	alluvial soil	South	No
48	alluvial soil	South	No
49	alluvial soil	South	No
50	alluvial soil	South	Yes
51	alluvial soil	South	No
52	alluvial soil	South	No
53	alluvial soil	South	No
54	alluvial soil	South	No
55	alluvial soil	South	No
56	alluvial soil	South	No
57	alluvial soil	South	No
58	alluvial soil	South	No
59	alluvial soil	South	No
60	alluvial soil	South	No
61	alluvial soil	South	No
62	alluvial soil	South	No
63	alluvial soil	South	Yes
64	alluvial soil	South	No
65	alluvial soil	South	No
66	alluvial soil	South	No
67	alluvial soil	South	No
68	alluvial soil	South	Yes
69	alluvial soil	South	No
70	alluvial soil	South	No
71	alluvial soil	South	No
72	alluvial soil	South	No
73	alluvial soil	South	No
74	alluvial soil	South	No
75	alluvial soil	South	Yes
76	alluvial soil	South	Yes
77	alluvial soil	South	No
78	alluvial soil	South	No
79	alluvial soil	South	No
80	alluvial soil	South	No
81	alluvial soil	South	No
82	alluvial soil	South	No
83	alluvial soil	South	No
84	alluvial soil	South	No
85	alluvial soil	South	No
86	alluvial soil	South	No
87	alluvial soil	South	Yes
88	alluvial soil	South	No
89	alluvial soil	South	No
90	alluvial soil	South	No

[1] Visitors center and interpretive zone occupy these cells; therefore, they were removed from the study area.

Table 2. UTM coordinates for grid vertices. UTM NAD 83 CONUS, Zone 14.

Corner ID	NORTHING	EASTING
1	4462370.000	683905.000
2	4462370.000	683955.000
3	4462370.000	684005.000
4	4462370.000	684055.000
5	4462320.000	683905.000
6	4462320.000	683955.000
7	4462320.000	684005.000
8	4462320.000	684055.000
9	4462270.000	683855.000
10	4462270.000	683905.000
11	4462270.000	683955.000
12	4462270.000	684005.000
13	4462270.000	684055.000
14	4462220.000	683855.000
15	4462220.000	683905.000
16	4462220.000	683955.000
17	4462220.000	684005.000
18	4462220.000	684055.000
19	4462170.000	683855.000
20	4462170.000	683905.000
21	4462170.000	683955.000
22	4462170.000	684005.000
23	4462170.000	684055.000
24	4462120.000	683855.000
25	4462120.000	683905.000
26	4462120.000	683955.000
27	4462120.000	684005.000
28	4462120.000	684055.000
29	4462070.000	683855.000
30	4462070.000	683905.000
31	4462070.000	683955.000
32	4462070.000	684005.000
33	4462070.000	684055.000
34	4462020.000	683505.000
35	4462020.000	683555.000
36	4462020.000	683605.000
37	4462020.000	683655.000
38	4462020.000	683705.000
39	4462020.000	683755.000
40	4462020.000	683805.000
41	4462020.000	683855.000
42	4462020.000	683905.000
43	4462020.000	683955.000
44	4462020.000	684005.000
45	4462020.000	684055.000
46	4461970.000	683505.000

Corner ID	NORTHING	EASTING
47	4461970.000	683555.000
48	4461970.000	683605.000
49	4461970.000	683655.000
50	4461970.000	683705.000
51	4461970.000	683755.000
52	4461970.000	683805.000
53	4461970.000	683855.000
54	4461970.000	683905.000
55	4461970.000	683955.000
56	4461970.000	684005.000
57	4461970.000	684055.000
58	4461920.000	683505.000
59	4461920.000	683555.000
60	4461920.000	683605.000
61	4461920.000	683655.000
62	4461920.000	683705.000
63	4461920.000	683755.000
64	4461920.000	683805.000
65	4461920.000	683855.000
66	4461920.000	683905.000
67	4461920.000	683955.000
68	4461920.000	684005.000
69	4461920.000	684055.000
70	4461870.000	683505.000
71	4461870.000	683555.000
72	4461870.000	683605.000
73	4461870.000	683655.000
74	4461870.000	683705.000
75	4461870.000	683755.000
76	4461870.000	683805.000
77	4461870.000	683855.000
78	4461870.000	683905.000
79	4461870.000	683955.000
80	4461870.000	684005.000
81	4461820.000	683505.000
82	4461820.000	683555.000
83	4461820.000	683605.000
84	4461820.000	683655.000
85	4461820.000	683705.000
86	4461820.000	683755.000
87	4461820.000	683805.000
88	4461820.000	683855.000
89	4461820.000	683905.000
90	4461820.000	683955.000
91	4461770.000	683505.000
92	4461770.000	683555.000

Table 2. Conintued

Corner ID	NORTHING	EASTING
93	4461770.000	683605.000
94	4461770.000	683655.000
95	4461770.000	683705.000
96	4461770.000	683755.000
97	4461770.000	683805.000
98	4461770.000	683855.000
99	4461720.000	683505.000
100	4461720.000	683555.000
101	4461720.000	683605.000
102	4461720.000	683655.000
103	4461720.000	683705.000
104	4461720.000	683755.000
105	4461720.000	683805.000
106	4461670.000	683505.000
107	4461670.000	683555.000
108	4461670.000	683605.000
109	4461670.000	683655.000
110	4461670.000	683705.000
111	4461670.000	683755.000
112	4461620.000	683505.000
113	4461620.000	683555.000
114	4461620.000	683605.000
115	4461620.000	683655.000
116	4461620.000	683705.000
117	4461620.000	683755.000