National Park Service
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Natural Resource Program Center

Bird Monitoring at Wilson's Creek National Battlefield, Missouri

2008 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2009/195

ON THE COVER
Cannon at Wilson's Creek National Battlefield
Photo from Heartland Network Files

Bird Monitoring at Wilson's Creek National Battlefield, Missouri
2008 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2009/195

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April 2009

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Please cite this publication as:

Peitz, D.G. 2009. Bird monitoring at Wilson's Creek National Battlefield, Missouri *2008 status report*. Natural Resource Technical Report NPS/HTLN/NRTR—2009/195. National Park Service, Fort Collins, Colorado.

NPS D-86, April 2009

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Executive Summary

During 2008, the Heartland I&M Network and Prairie Cluster Prototype Monitoring Program (HTLN) initiated breeding bird surveys on Wilson's Creek National Battlefield, Missouri (WICR) to address two objectives. The first is to monitor changes in bird community composition and abundance. The second is to monitor the responses of bird communities to changes in habitat structure and other habitat variables related to management activities. This report provides plot specific and park-wide baseline data on populations and breeding habitat of birds at WICR. Forty-seven species of birds were recorded during site visits in May. The most common and widely distributed species was the Indigo bunting (*Passerina cyanea*). The Northern cardinal (*Cardinalis cardinalis*) and Blue-gray gnatcatcher (*Polioptila caerulea*) occurred frequently as well. Partners in Flight, a coalition of agencies and individuals whose mission is to conserve North America's declining bird populations, classify ten species found at WICR as species of continental importance. Species richness of birds is similar to the species richness observed in similar habitats elsewhere. Two grassland obligate species were recorded, the Dickcissel (*Spiza Americana*) and the Eastern meadowlark (*Sturnella magna*). No woodland obligates were reported. Grasslands, deciduous woodlands, and shrub habitat dominate at WICR; other habitats are less prevalent.

Plot-specific population information and habitat conditions during the breeding season of 2008 will aid natural resource staff in planning management actions that may affect various bird populations. With this report, park staff will be able to better plan management objectives, and future monitoring will aid in assessing their effectiveness. Monitoring data also provides park staff with additional information useful for interpreting natural resources.

Acknowledgements

We would like to thank the staff of Wilson's Creek National Battlefield, Missouri for allowing us access to the battlefield during our breeding bird surveys.

Introduction

Birds are an important component of park ecosystems, as their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems. It has been suggested that management activities aimed at preserving habitat for bird populations, such as neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer 1993). Moreover, birds have a tremendous following among the public and many parks provide information on the status and trends of birds through their interpretive programs.

Wilson's Creek National Battlefield, Missouri (WICR) is located in the transition zone between the tallgrass prairie of the Osage Plains and the Ozark hardwood forests. The rolling topography of the area is less dissected than other portions of the Ozarks, but more dissected than areas of the Osage Plains further north and west (Fitzgerald and Pashley 2000). This landscape contains a rich mix of forested plant communities and tallgrass prairie. Approximately 122 species of breeding birds can be found in the habitats of the area (Stokes and Stokes 1996). Widespread habitat loss to agriculture, as well as urban and industrial development, threaten the integrity of this physiographic area for birds.

Data collected during the U.S. Geological Survey's annual North American Breeding Bird Surveys (BBS) between 1966 and 2007 indicate that a number of bird species with potential to occur at WICR show evidence of population declines (Sauer et al. 2008). In fact, 52% of the species have populations reported to be in decline, with species such as the American redstart (*Setophaga ruticilla*), Bell's vireo (*Vireo bellii*), Black-crowned night heron (*Nycticorax nycticorax*), Common nighthawk (*Chordeiles minor*), Loggerhead Shrike (*Lanius ludovicianus*), Rose-breasted grosbeak (*Pheucticus ludovicianus*), and Yellow warbler (*Dendroica petechia*) declining at alarming rates.

We will use trends in the composition and abundance of bird populations as long-term indicators of ecosystem integrity in their habitat found at WICR. Ecosystem integrity is defined as the system's capability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region (Karr and Dudley 1981). Research has demonstrated that birds serve as good indicators of changes in ecosystems (Cairns et al. 2004, Mallory et al. 2006, Wood et al. 2006). Therefore, changes in the numbers and composition of bird communities may reflect the effectiveness of management in restoring and maintaining bird habitat at WICR. Bird monitoring, initiated in 2008, will aid in assessing the success of management efforts. Long-term trends in community composition and abundance of breeding bird populations provide one measure for assessing the ecological integrity and sustainability of this system.

Objectives

There are two primary objectives for monitoring breeding birds at Wilson's Creek National Battlefield:

- Identify significant temporal changes in the species composition and abundance of bird communities that occur at WICR during the breeding season.
- Improve our understanding of breeding bird – habitat relationships and the effects of management actions such as stand thinning or prescribed fire on bird populations, by correlating changes in bird community composition and abundance with changes in specific habitat variables (e.g., vegetation structure, ground cover).

This report summarizes survey results for the first year of monitoring.

Methods

Site Selection

Permanent monitoring locations or 'plots' were selected by overlaying a systematic grid of 400 x 400 meter cells (originating from a random start point). The orientation of the grid was rotated 45 degrees to prevent monitoring sites from being influenced by man-made features (roads, fences, etc.) located along cardinal directions. We established 38 permanent plots (Fig. 1). However, due to flooding and the location of two plots, one in the Terrell Creek floodplain and one in the Wilson's Creek floodplain, monitoring only occurred on 36 of the plots. Future monitoring will occur on all 38 plots, weather permitting.

During bird surveys, monitoring plots were located using navigation waypoints (Table 1) in a GPS unit and temporarily marked with 36-inch pin flags to aid in re-locating the plots for habitat assessment, eliminating the need for permanent plot markers. We collect pin flags from each plot once the habitat work is completed. Monitoring plots will be re-located each year we conduct a bird survey.

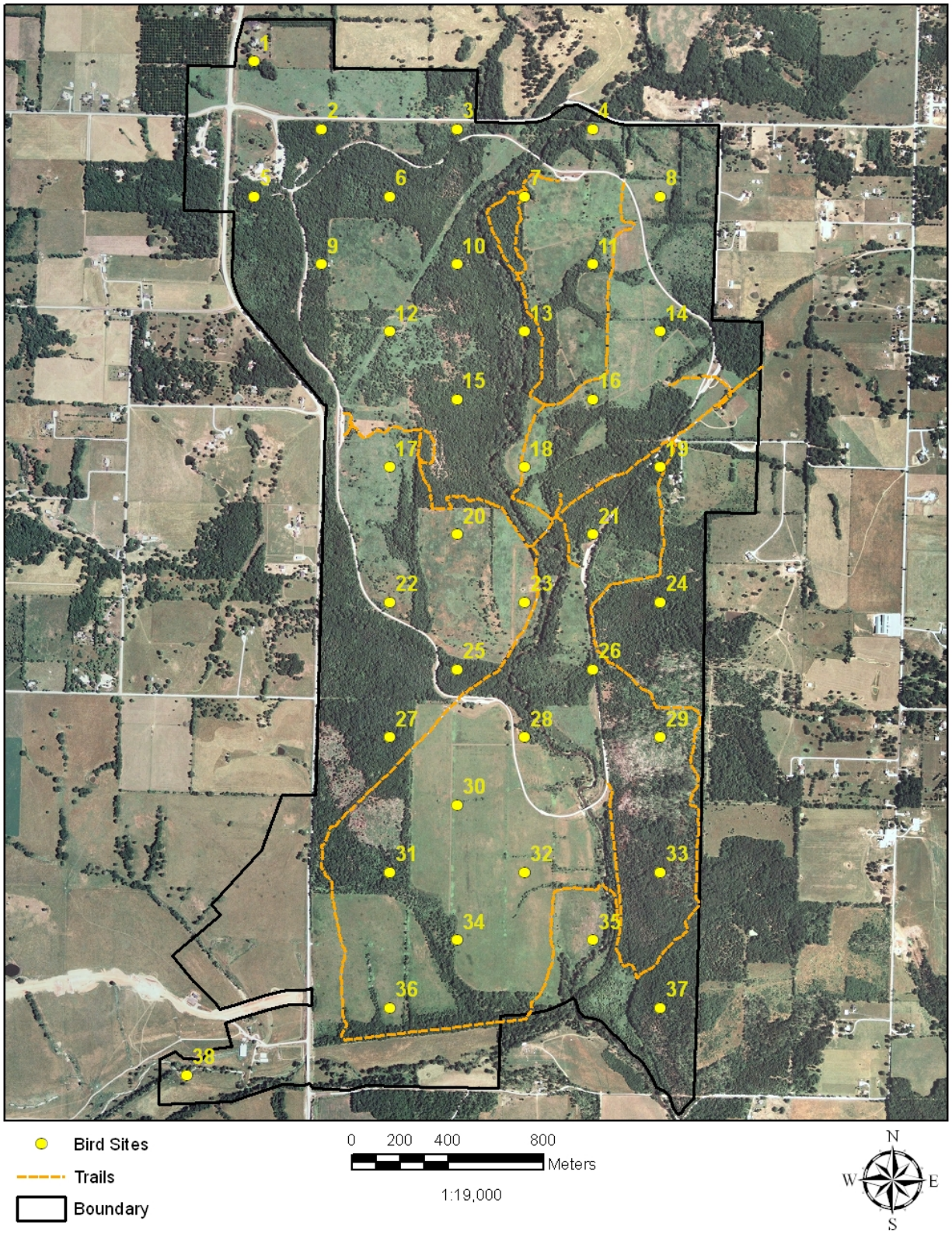

Figure 1. Bird plot locations on Wilson's Creek National Battlefield, Missouri.

Table 1. Plot I.D. and habitat type for each breeding bird survey plot at Wilson's Creek National Battlefield, Missouri. Also given are x and y UTM coordinates for each plot. UTM Zone 15 North, Datum 1983 (Conus).

Plot I.D.	Habitat Type	X Coordinate (Easting)	Y Coordinate (Northing)
WICRTweety1	Grassland	462677.994	4108243.010
WICRTweety2	Woodland	462960.837	4107960.167
WICRTweety3	Woodland	463526.522	4107960.167
WICRTweety4	Grassland	464092.207	4107960.167
WICRTweety5	Woodland	462677.994	4107677.325
WICRTweety6	Woodland	463243.679	4107677.325
WICRTweety7	Woodland	463809.365	4107677.325
WICRTweety8	Grassland	464375.050	4107677.325
WICRTweety9	Woodland	462960.837	4107394.482
WICRTweety10	Woodland	463526.522	4107394.482
WICRTweety11	Woodland	464092.207	4107394.482
WICRTweety12	Shrub	463243.679	4107111.639
WICRTweety13	Woodland	463809.365	4107111.639
WICRTweety14	Grassland	464375.050	4107111.639
WICRTweety15	Woodland	463526.522	4106828.796
WICRTweety16	Grassland	464092.207	4106828.796
WICRTweety17	Grassland	463243.679	4106545.954
WICRTweety18	Grassland	463809.365	4106545.954
WICRTweety19	Woodland	464375.050	4106545.954
WICRTweety20	Grassland	463526.522	4106263.111
WICRTweety21	Woodland	464092.207	4106263.111
WICRTweety22	Grassland	463243.679	4105980.268
WICRTweety23	Grassland	463809.365	4105980.268
WICRTweety24	Woodland	464375.050	4105980.268
WICRTweety25	Woodland	463526.522	4105697.426
WICRTweety26	Woodland	464092.207	4105697.426
WICRTweety27	Woodland	463243.679	4105414.583
WICRTweety28	Grassland	463809.365	4105414.583
WICRTweety29	Shrub	464375.050	4105414.583
WICRTweety30	Grassland	463526.522	4105131.740
WICRTweety31	Woodland	463243.679	4104848.897
WICRTweety32	Grassland	463809.365	4104848.897
WICRTweety33	Woodland	464375.050	4104848.897
WICRTweety34	Grassland	463526.522	4104566.055
WICRTweety35	Grassland	464092.207	4104566.055
WICRTweety36	Grassland	463243.679	4104283.212
WICRTweety37	Woodland	464375.050	4104283.212
WICRTweety38	Grassland	462395.151	4104000.369

Bird Surveys

Bird surveys followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized below. Variable circular plot counts, a point count methodology that incorporates a measure of detectability into population estimates, were used to survey birds present (Fancy 1997). All birds seen or heard at plots during 5-min sampling periods were recorded along with their corresponding distance from observer. Bird observations were separated into two time segments: those detected during the first three minutes of the count (to allow future comparisons with the national Breeding Bird Survey data), and any new birds detected during the final two minutes of the count. For most species, we recorded each individual bird as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size, and not the individual bird. During analysis, each individual in a cluster or flock is treated as a separate observation. After completing a count at a plot and filling out the data sheet, the observer navigated to the next plot using a GPS unit. While traveling between plots, the observer was vigilant for the presence of species not recorded during timed surveys. These species help formulate a more complete species list for the park by identifying species missed during timed surveys. We sampled 36 of the 38 survey plots between May 20 and May 22, 2008. Flooding at the time of surveys prohibited us from sampling all 38 plots. We sampled birds during a period when it was light enough to observe birds to four hours after sunrise, approximately 12 hours over the three days of surveys.

Variable circular plot counts were conducted in an attempt to get an "instantaneous count" of all birds present. The observer recorded birds flushed from a plot when approached and the counts were started as soon as the observer reached plot center. Our method took into account the fact that birds close to the observer have a higher probability of being detected (if they were not flushed) than birds far from the observer and that different species have different detection functions (i.e., the probability of detecting a bird at different distances from the observer). An important assumption of the method is that birds exactly at the center of the plot have a 100% probability of being detected, and that there is a high probability of detecting birds within the first 5-10 meters of the plot center. The most important birds to detect are those very close to the observer (within the first 5-10 meters), and it is highly desirable that estimated distances, or those taken with a rangefinder, be within 1-2 meters of actual distances for any bird within 20 meters of the observer. However, we recorded all birds seen or heard, including flyovers, along with distance from the observer when possible. For this report, all birds seen or heard during the full 5-min are included.

Bird Habitat

The collection of habitat data followed methods outlined in the bird monitoring protocol by Peitz et al. (2008). A summary of the sampling methods follows: Habitat data collection started after the first variable circular plot count was completed each day. Observers visited plots for habitat measures in the same order they were surveyed (for birds) to avoid disturbing birds on a plot prior to the survey. Once the habitat crew arrived at a plot, they set up the center subplot and completed all habitat measures for this subplot and the 50-m radius plot.

We characterized habitat available for each bird species on a number of different scales. Slope, slope variability, aspect, aspect variability, and topographic position of each 50-m radius plot were determined and recorded first. Measurements were recorded during the first year of

monitoring, and will not be re-measured in subsequent years. The amount of various vegetation types and the amount of road and water cover on each plot were recorded. As plots were sampled, horizontal vegetation cover was estimated in 0.25-m intervals from 0.0 to 2.0 meters above ground surface using a 15-cm wide cover board. Area of the cover board obscured by vegetation was estimated at a 15-m distances from plot center. Using a graduated measuring rod, vertical vegetation structure was measured in 1-m increments up to 7.5 meters in height at four locations around the perimeter of the subplot. Locations were in the four cardinal directions. Vertical structure was recorded for deciduous, coniferous, and herbaceous vegetation. Trees were tallied by species and size class (<1.0 cm, 1.1 – 2.5 cm, 2.6 – 8.0 cm, 8.1 – 15.0 cm, 15.1 – 23.0 cm, 23.1 – 38.0 or >38.0 cm) on the subplot. Lastly, at the subplot, ground and foliar cover were recorded in a 1.78-m radius nested sample plot. Ground cover included deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm DBH), and un-vegetated. Foliar cover was estimated for six plant guilds, including warm- and cool-season grasses, forbs, moss and lichens, shrubs and vines, tree seedlings, and total foliar cover (<1.5 m tall). Heads-up digitizing of habitat types in a geographic information system (GIS) was used to determine the amounts of these various habitats present on the park. Bird plots were not sampled in, nor habitat characterized for, the crop (27.1 ha), developed (30.6 ha), or stream (10.7 ha) areas.

Data Analysis

Prior to summary analysis, the residency status (permanent resident, summer resident, migrant) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants from analysis of breeding birds within WICR. The frequency and abundance of bird species were reported in four ways. 1) For each species, the number of individuals encountered per plot visit (individuals / plot visit) was averaged over all plots. 2) The proportion of plots occupied by each species was determined (total number of plots occupied by a species / 36 plots). 3) Restricting the area of inference to a 100-m radius (3.14 ha) around each plot center, we determined each species density (individuals / 3.14 ha) and averaged these values across all plots (average density $\pm$ std dev). 4) To examine local density, density was calculated as in (3) above, but only from plots where a species was encountered. Distance software, which accounts for un-detected individuals, will be used in future species density estimates once there are enough observations (~60) to do so accurately (Buckland et al. 1993, Buckland et al. 2001). A map was created showing species richness and the richness of species of continental importance, as determined by Partners in Flight (Rich et al. 2004), by plot.

Annual bird diversity, richness, and distribution evenness were calculated for permanent and summer resident males, by plot, and park-wide averages ($\pm$ std dev) were determined. Flyover males were included in each calculation. Bird diversity values for each plot were calculated using the Shannon Diversity Index:

$$H' = -\Sigma(n_1/N)\ln(n_1/N)$$

where n_1/N is the proportion of the total number of individuals in a population consisting of the ith species (Shannon, 1949). Species richness is the total number of bird taxa recorded per plot. Species distribution evenness is calculated for each plot using Pielou (J):

$$J' = H' / Hmax$$

where H' is the Shannon Diversity Index and Hmax is the maximum possible diversity for a given number of species if all species are present in equal numbers ((ln(species richness)). J' is a measure of how evenly individuals are distributed within a community when compared to the equal distribution and maximum diversity a community can have (Pielou, 1969).

Location and permanent abiotic measures on each plot and habitat subplot were reported. Annual averages (± std dev) for semi-permanent plot data, including road and water cover were calculated from plot estimates. Using plot values, averages (± std dev) for horizontal vegetation cover between 0 – 0.25, 0.25-0.50, 0.50 – 0.75, 0.75-1.00, 1.00 – 1.25, 1.25-1.50, 1.50 – 1.75, and 1.75 – 2.00 meters were calculated for measures taken at 15-m distances. Average (± std dev) annual vertical structure diversity was estimated and reported. Vertical structure diversity values were determined for each plot by summing the percents of possible touches (12) from vegetation within each 1-m height increment actually touched; dividing this value by the number of height increments measured (8); adding the resulting value to the percent of increments occupied; multiplying this value by 100; and than dividing it by two. Vertical structure diversity values are weighted equally to represent both the vertical height of vegetation and how dense the vegetation is within each height increment.

Within each plot, ground cover, including deciduous and grass litter, bare soil, rock, woody debris (>2.50 cm DBH), and unvegetated, were averaged (± std dev) across plots. Foliar cover, by guild of warm- and cool-season grasses, forbs, mosses and lichens, shrubs and vines, tree seedlings, and total foliar cover (<1.50 m tall) were averaged across plots (± std dev). Appendix 2 lists habitat parameter values recorded for each plot.

Results

Bird Surveys

Forty-seven bird species were recorded during the breeding bird surveys at WICR in 2008 (Table 2). Twenty-seven of the 47 species recorded are classified as permanent residents (Stokes and Stokes 1996). Nineteen species are classified as summer residents, with the remaining species classified as a winter resident. Four species, the Cliff swallow (*Hirundo pyrrhonota*), Cedar waxwing (*Bombycilla cedrorum*), Eastern bluebird (*Sialia sialis*), and Eastern kingbird (*Tyrannus tyrannus*), were only observed outside the 5-min survey periods. Ten species—the Blue-winged warbler (*Vermivora pinus*), Brown thrasher (*Toxostoma rufum*), Carolina wren (*Thryothorus ludovicianus*), Dickcissel (*Spiza americana*), Eastern towhee (*Pipilo erythrophthalmus*), Indigo bunting (*Passerina cyanea*), Kentucky warbler (*Oporornis formosus*), Prairie warbler (*Dendroica discolor*), Red-bellied woodpecker (*Melanerpes carolinus*), and White-eyed vireo (*Vireo griseus*)—are considered species of continental importance (Rich et al. 2004). Two species—the Dickcissel and Eastern meadowlark (*Sturnella magna*)—are grassland obligate species. No interior woodland obligate species (those requiring more than 1200 ha of continuous woodlands) were recorded.

The Indigo bunting was the most commonly occurring species during the breeding season based on the mean number of individuals per plot and the proportion of plots occupied (Tables 3 and 4, also see Appendix 1). The Northern cardinal (*Cardinalis cardinalis*), Blue-gray gnatcatcher (*Polioptila caerulea*), Brown-headed cowbird (*Molothrus ater*), Dickcissel, Eastern towhee, Field sparrow (*Spizella pusilla*), and Wild turkey (*Meleagris gallopavo*) were moderately abundant. Fifteen species—the American goldfinch (*Carduelis tristis*), Bank swallow (*Riparia riparia*), Bewick's wren (*Thryomanes bewickii*), Blue-winged warbler, Canada goose (*Branta canadensis*), Common grackle (*Quiscalus quiscula*), Downy woodpecker (*Picoides pubescens*), Eastern phoebe (*Sayornis phoebe*), Gray catbird (*Dumetella carolinensis*), Great blue heron (*Ardea herodias*), Ovenbird (*Seiurus aurocapillus*), Pileated woodpecker (*Dryocopus pileatus*), Prairie warbler, Red-tailed hawk (*Buteo jamaicensis*), and Song sparrow (*Melospiza melodia*)—were represented by observation(s) on single plots. Average park-wide density of each bird species during the breeding season of 2008 is listed in Table 5. Average density of each species for plots occupied is listed in Table 6. The Indigo bunting had the highest park-wide density of any species. The Blue jay (*Cyanocitta cristata*) and Downy woodpecker, however, had the highest densities for plots occupied. Species richness and the richness of species of continental importance by plot are illustrated in Figure 2. Average ($\pm$ std dev) species richness, diversity, and species distribution evenness values for the bird community are given in Figure 3.

Table 2. Bird species recorded during breeding bird surveys at Wilson's Creek National Battlefield, Missouri in 2008. The American Ornithologists' Union Code (AOU code) and residency status of each species is given.

Common name	Species name	AOU code	Residency[1]
American crow	*Corvus brachyrhynchos*	AMCR	R
American goldfinch	*Carduelis tristis*	AMGO	R
Bank swallow	*Riparia riparia*	BANS	SR
Bewick's wren	*Thryomanes bewickii*	BEWR	R
Blue jay	*Cyanocitta cristata*	BLJA	R
Blue-gray gnatcatcher	*Polioptila caerulea*	BGGN	SR
Blue-winged warbler	***Vermivora pinus***	**BWWA**	**SR**
Brown thrasher	***Toxostoma rufum***	**BRTH**	**R**
Brown-headed cowbird	*Molothrus ater*	BHCO	R
Canada goose	*Branta canadensis*	CAGO	R
Carolina chickadee	*Parus carolinensis*	CACH	R
Carolina wren	***Thryothorus ludovicianus***	**CARW**	**R**
Cliff swallow*	*Hirundo pyrrhonota*	CLSW	SR
Cedar waxwing*	*Bombycilla cedrorum*	CEDW	WR
Common grackle	*Quiscalus quiscula*	COGR	R
Common yellowthroat	*Geothlypis trichas*	COYE	SR
Dickcissel	***Spiza americana***	**DICK**	**SR**
Downy woodpecker	*Picoides pubescens*	DOWO	R
Eastern (Rufous-side) towhee	***Pipilo erythrophthalmus***	**EATO**	**R**
Eastern bluebird*	*Sialia sialis*	EABL	R
Eastern kingbird*	*Tyrannus tyrannus*	EAKI	SR
Eastern meadowlark	*Sturnella magna*	EAME	R
Eastern phoebe	*Sayornis phoebe*	EAPH	R
Eastern wood-pewee	*Contopus virens*	EAWP	SR
Field sparrow	*Spizella pusilla*	FISP	R
Gray catbird	*Dumetella carolinensis*	GRCA	SR
Great blue heron	*Ardea herodias*	GBHE	R
Great crested flycatcher	*Myiarchus crinitus*	GCFL	SR
Indigo bunting	***Passerina cyanea***	**INBU**	**SR**
Kentucky warbler	***Oporornis formosus***	**KEWA**	**SR**
Northern bobwhite	*Colinus virginianus*	NOBO	R
Northern cardinal	*Cardinalis cardinalis*	NOCA	R
Northern mockingbird	*Minus polyglottos*	NOMO	R
Northern parula	*Parula americana*	NOPA	SR
Ovenbird	*Seirus aurocapillus*	OVEN	SR
Pileated woodpecker	*Dryocopus pileatus*	PIWO	R
Prairie warbler	***Dendroica discolor***	**PRAW**	**SR**
Red-bellied woodpecker	***Melanerpes carolinus***	**RBWO**	**R**
Red-eyed vireo	*Vireo olivaceus*	REVI	SR
Red-tailed hawk	*Buteo jamaicensis*	RTHA	R
Song sparrow	*Melospiza melodia*	SOSP	R

Table 2. Bird species recorded during breeding bird surveys at Wilson's Creek National Battlefield, Missouri in 2008. The American Ornithologists' Union Code (AOU code) and residency status of each species is given (continued).

Common name	Species name	AOU code	Residency[1]
Summer tanager	*Piranga rubra*	SUTA	SR
Turkey vulture	*Cathartes aura*	TUVU	R
(Eastern) Tufted titmouse	*Baeolophus bicolor*	ETTI	R
White-eyed vireo	***Vireo griseus***	**WEVI**	**SR**
Wild turkey	*Meleagris gallopavo*	WITU	R
Yellow-breasted chat	*Icteria virens*	YBCH	SR

[*] Species recorded only while traveling between point transects or at other times outside of 5-min survey periods.

[1] Residency: SR = summer resident; R = year around resident; WR = winter resident; According to Stokes and Stokes (1996).

Species names are valid and verified names taken from ITIS (Integrated Taxonomic Information System). http://www.itis.usda.gov/.

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Table 3. Number of individuals encountered per plot visit, over all 36 plots, for bird species recorded at Wilson's Creek National Battlefield, Missouri during the 2008 breeding bird surveys. Number of individuals per plot includes all individuals recorded on plots during a 5-min survey, including flyovers.

Common name	Species name	AOU code	Individual / plot visit
American crow	*Corvus brachyrhynchos*	AMCR	0.17
American goldfinch	*Carduelis tristis*	AMGO	0.03
Bank swallow	*Riparia riparia*	BANS	0.03
Bewick's wren	*Thryomanes bewickii*	BEWR	0.03
Blue jay	*Cyanocitta cristata*	BLJA	0.11
Blue-gray gnatcatcher	*Polioptila caerulea*	BGGN	0.36
Blue-winged warbler	***Vermivora pinus***	**BWWA**	**0.03**
Brown thrasher	***Toxostoma rufum***	**BRTH**	**0.06**
Brown-headed cowbird	*Molothrus ater*	BHCO	0.28
Canada goose	*Branta canadensis*	CAGO	0.06
Carolina chickadee	*Parus carolinensis*	CACH	0.11
Carolina wren	***Thryothorus ludovicianus***	**CARW**	**0.22**
Common grackle	*Quiscalus quiscula*	COGR	0.06
Common yellowthroat	*Geothlypis trichas*	COYE	0.14
Dickcissel	***Spiza americana***	**DICK**	**0.28**
Downy woodpecker	*Picoides pubescens*	DOWO	0.06
Eastern (Rufous-side) towhee	***Pipilo erythrophthalmus***	**EATO**	**0.25**
Eastern meadowlark	*Sturnella magna*	EAME	0.06
Eastern phoebe	*Sayornis phoebe*	EAPH	0.03
Eastern wood-pewee	*Contopus virens*	EAWP	0.17
Field sparrow	*Spizella pusilla*	FISP	0.25
Gray catbird	*Dumetella carolinensis*	GRCA	0.03
Great blue heron	*Ardea herodias*	GBHE	0.03
Great crested flycatcher	*Myiarchus crinitus*	GCFL	0.14
Indigo bunting	***Passerina cyanea***	**INBU**	**0.98**
Kentucky warbler	***Oporornis formosus***	**KEWA**	**0.22**
Northern bobwhite	*Colinus virginianus*	NOBO	0.11
Northern cardinal	*Cardinalis cardinalis*	NOCA	0.44
Northern mockingbird	*Minus polyglottos*	NOMO	0.19
Northern parula	*Parula americana*	NOPA	0.11
Ovenbird	*Seirus aurocapillus*	OVEN	0.03
Pileated woodpecker	*Dryocopus pileatus*	PIWO	0.03
Prairie warbler	***Dendroica discolor***	**PRAW**	**0.06**
Red-bellied woodpecker	***Melanerpes carolinus***	**RBWO**	**0.08**
Red-eyed vireo	*Vireo olivaceus*	REVI	0.11
Red-tailed hawk	*Buteo jamaicensis*	RTHA	0.06
Song sparrow	*Melospiza melodia*	SOSP	0.03
Summer tanager	*Piranga rubra*	SUTA	0.08
Turkey vulture	*Cathartes aura*	TUVU	0.06
(Eastern) Tufted titmouse	*Baeolophus bicolor*	ETTI	0.17

Table 3. Number of individuals encountered per plot visit, over all 36 plots, for bird species recorded at Wilson's Creek National Battlefield, Missouri during the 2008 breeding bird surveys. Number of individuals per plot includes all individuals recorded on plots during a 5-min survey, including flyovers (continued).

Common name	Species name	AOU code	Individual / plot visit
White-eyed vireo	***Vireo griseus***	**WEVI**	**0.14**
Wild turkey	*Meleagris gallopavo*	WITU	0.25
Yellow-breasted chat	*Icteria virens*	YBCH	0.19

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Table 4. Proportion of plots (out of 36) occupied by bird species (including flyovers) at Wilson's Creek National Battlefield, Missouri during the 2008 breeding bird surveys.

Common name	Species name	AOU code	Proportion of plots occupied
American crow	*Corvus brachyrhynchos*	AMCR	0.14
American goldfinch	*Carduelis tristis*	AMGO	0.03
Bank swallow	*Riparia riparia*	BANS	0.03
Bewick's wren	*Thryomanes bewickii*	BEWR	0.03
Blue jay	*Cyanocitta cristata*	BLJA	0.08
Blue-gray gnatcatcher	*Polioptila caerulea*	BGGN	0.33
Blue-winged warbler	***Vermivora pinus***	**BWWA**	**0.03**
Brown thrasher	***Toxostoma rufum***	**BRTH**	**0.06**
Brown-headed cowbird	*Molothrus ater*	BHCO	0.22
Canada goose	*Branta canadensis*	CAGO	0.03
Carolina chickadee	*Parus carolinensis*	CACH	0.11
Carolina wren	***Thryothorus ludovicianus***	**CARW**	**0.22**
Common grackle	*Quiscalus quiscula*	COGR	0.03
Common yellowthroat	*Geothlypis trichas*	COYE	0.14
Dickcissel	***Spiza americana***	**DICK**	**0.17**
Downy woodpecker	*Picoides pubescens*	DOWO	0.03
Eastern (Rufous-side) towhee	***Pipilo erythrophthalmus***	**EATO**	**0.25**
Eastern meadowlark	*Sturnella magna*	EAME	0.06
Eastern phoebe	*Sayornis phoebe*	EAPH	0.03
Eastern wood-pewee	*Contopus virens*	EAWP	0.14
Field sparrow	*Spizella pusilla*	FISP	0.22
Gray catbird	*Dumetella carolinensis*	GRCA	0.03
Great blue heron	*Ardea herodias*	GBHE	0.03
Great crested flycatcher	*Myiarchus crinitus*	GCFL	0.14
Indigo bunting	***Passerina cyanea***	**INBU**	**0.67**
Kentucky warbler	***Oporornis formosus***	**KEWA**	**0.20**
Northern bobwhite	*Colinus virginianus*	NOBO	0.08
Northern cardinal	*Cardinalis cardinalis*	NOCA	0.33
Northern mockingbird	*Minus polyglottos*	NOMO	0.20
Northern parula	*Parula americana*	NOPA	0.11
Ovenbird	*Seirus aurocapillus*	OVEN	0.03
Pileated woodpecker	*Dryocopus pileatus*	PIWO	0.03
Prairie warbler	***Dendroica discolor***	**PRAW**	**0.06**
Red-bellied woodpecker	***Melanerpes carolinus***	**RBWO**	**0.08**
Prairie warbler	*Dendroica discolor*	PRAW	0.03
Red-eyed vireo	*Vireo olivaceus*	REVI	0.11
Red-tailed hawk	*Buteo jamaicensis*	RTHA	0.03
Song sparrow	*Melospiza melodia*	SOSP	0.03
Summer tanager	*Piranga rubra*	SUTA	0.08
Turkey vulture	*Cathartes aura*	TUVU	0.06
(Eastern) Tufted titmouse	*Baeolophus bicolor*	ETTI	0.14
White-eyed vireo	***Vireo griseus***	**WEVI**	**0.11**

Table 4. Proportion of plots (out of 36) occupied by bird species (including flyovers) at Wilson's Creek National Battlefield, Missouri during the 2008 breeding bird surveys (continued).

Common name	Species name	AOU code	Proportion of plots occupied
Wild turkey	*Meleagris gallopavo*	WITU	0.19
Yellow-breasted chat	*Icteria virens*	YBCH	0.19

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Table 5. Average density (± std. dev.) of bird species at Wilson's Creek National Battlefield, Missouri during the 2008 breeding bird surveys. Species densities are for individuals recorded within 100-m of plot center during a 5-min survey, excluding flyovers.

Common name	Species name	AOU code	Individuals / ha
American crow	*Corvus brachyrhynchos*	AMCR	0.01 (0.05)
Bewick's wren	*Thryomanes bewickii*	BEWR	0.01 (0.05)
Blue jay	*Cyanocitta cristata*	BLJA	0.02 (0.11)
Blue-gray gnatcatcher	*Polioptila caerulea*	BGGN	0.11 (0.17)
Blue-winged warbler	***Vermivora pinus***	**BWWA**	**0.01 (0.05)**
Brown thrasher	***Toxostoma rufum***	**BRTH**	**0.01 (0.05)**
Brown-headed cowbird	*Molothrus ater*	BHCO	0.06 (0.13)
Carolina chickadee	*Parus carolinensis*	CACH	0.04 (0.10)
Carolina wren	***Thryothorus ludovicianus***	**CARW**	**0.06 (0.13)**
Common yellowthroat	*Geothlypis trichas*	COYE	0.04 (0.11)
Dickcissel	***Spiza americana***	**DICK**	**0.07 (0.20)**
Downy woodpecker	*Picoides pubescens*	DOWO	0.02 (0.11)
Eastern (Rufous-side) towhee	***Pipilo erythrophthalmus***	**EATO**	**0.07 (0.13)**
Eastern phoebe	*Sayornis phoebe*	EAPH	0.01 (0.05)
Eastern wood-pewee	*Contopus virens*	EAWP	0.04 (0.14)
Field sparrow	*Spizella pusilla*	FISP	0.04 (0.11)
Gray catbird	*Dumetella carolinensis*	GRCA	0.01 (0.05)
Great crested flycatcher	*Myiarchus crinitus*	GCFL	0.03 (0.09)
Indigo bunting	***Passerina cyanea***	**INBU**	**0.30 (0.28)**
Kentucky warbler	***Oporornis formosus***	**KEWA**	**0.07 (0.15)**
Northern bobwhite	*Colinus virginianus*	NOBO	0.03 (0.12)
Northern cardinal	*Cardinalis cardinalis*	NOCA	0.10 (0.22)
Northern mockingbird	*Minus polyglottos*	NOMO	0.03 (0.09)
Northern parula	*Parula americana*	NOPA	0.03 (0.09)
Ovenbird	*Seirus aurocapillus*	OVEN	0.01 (0.05)
Prairie warbler	***Dendroica discolor***	**PRAW**	**0.02 (0.07)**
Red-bellied woodpecker	***Melanerpes carolinus***	**RBWO**	**0.02 (0.07)**
Red-eyed vireo	*Vireo olivaceus*	REVI	0.04 (0.10)
Song sparrow	*Melospiza melodia*	SOSP	0.01 (0.05)
Summer tanager	*Piranga rubra*	SUTA	0.03 (0.09)
(Eastern) Tufted titmouse	*Baeolophus bicolor*	ETTI	0.04 (0.13)
White-eyed vireo	***Vireo griseus***	**WEVI**	**0.05 (0.14)**
Wild turkey	*Meleagris gallopavo*	WITU	0.05 (0.16)
Yellow-breasted chat	*Icteria virens*	YBCH	0.05 (0.11)

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Table 6. Average bird density (± std. dev.) for plots occupied by species at Wilson's Creek National Battlefield, Missouri during the 2008 breeding bird surveys. Species densities are for individuals recorded within 100-m of plot center during a 5-min survey, excluding flyovers. A standard deviation of 0.00 indicates the species occurred on two or more plots with equal density. When a species occurred on only one plot, the standard deviation could not be calculated.

Common name	Species name	AOU code	Individuals / ha
American crow	*Corvus brachyrhynchos*	AMCR	0.32
Bewick's wren	*Thryomanes bewickii*	BEWR	0.32
Blue jay	*Cyanocitta cristata*	BLJA	0.64
Blue-gray gnatcatcher	*Polioptila caerulea*	BGGN	0.35 (0.10)
Blue-winged warbler	***Vermivora pinus***	**BWWA**	**0.32**
Brown thrasher	***Toxostoma rufum***	**BRTH**	**0.32**
Brown-headed cowbird	*Molothrus ater*	BHCO	0.32 (0.00)
Carolina chickadee	*Parus carolinensis*	CACH	0.32 (0.00)
Carolina wren	***Thryothorus ludovicianus***	**CARW**	**0.32 (0.00)**
Common yellowthroat	*Geothlypis trichas*	COYE	0.32 (0.00)
Dickcissel	***Spiza americana***	**DICK**	**0.51 (0.28)**
Downy woodpecker	*Picoides pubescens*	DOWO	0.64
Eastern (Rufous-side) towhee	***Pipilo erythrophthalmus***	**EATO**	**0.32 (0.00)**
Eastern phoebe	*Sayornis phoebe*	EAPH	0.32
Eastern wood-pewee	*Contopus virens*	EAWP	0.40 (0.16)
Field sparrow	*Spizella pusilla*	FISP	0.32 (0.00)
Gray catbird	*Dumetella carolinensis*	GRCA	0.32
Great crested flycatcher	*Myiarchus crinitus*	GCFL	0.32 (0.00)
Indigo bunting	***Passerina cyanea***	**INBU**	**0.47 (0.21)**
Kentucky warbler	***Oporornis formosus***	**KEWA**	**0.36 (0.12)**
Northern bobwhite	*Colinus virginianus*	NOBO	0.48 (0.23)
Northern cardinal	*Cardinalis cardinalis*	NOCA	0.44 (0.24)
Northern mockingbird	*Minus polyglottos*	NOMO	0.32 (0.00)
Northern parula	*Parula americana*	NOPA	0.32 (0.00)
Ovenbird	*Seirus aurocapillus*	OVEN	0.32
Prairie warbler	***Dendroica discolor***	**PRAW**	**0.32 (0.00)**
Red-bellied woodpecker	***Melanerpes carolinus***	**RBWO**	**0.32 (0.00)**
Red-eyed vireo	*Vireo olivaceus*	REVI	0.32 (0.00)
Song sparrow	*Melospiza melodia*	SOSP	0.32
Summer tanager	*Piranga rubra*	SUTA	0.32 (0.00)
(Eastern) Tufted titmouse	*Baeolophus bicolor*	ETTI	0.43 (0.18)
White-eyed vireo	***Vireo griseus***	**WEVI**	**0.40 (0.16)**
Wild turkey	*Meleagris gallopavo*	WITU	0.53 (0.18)
Yellow-breasted chat	*Icteria virens*	YBCH	0.32 (0.00)

Bolded species names are those species considered of continental importance (Rich et al. 2004).

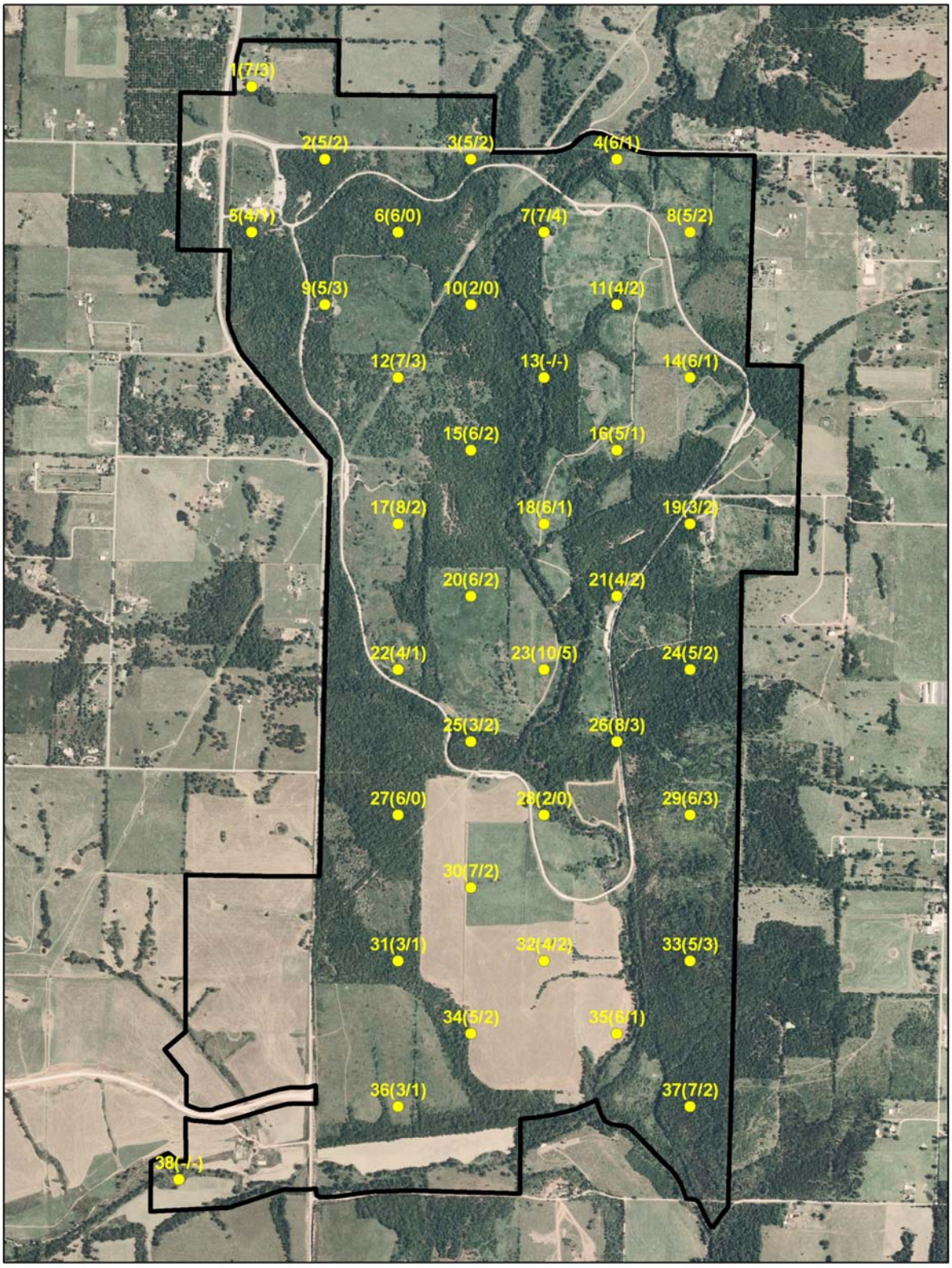

Figure 2. Bird species richness and the richness of species of continental importance for each plot on Wilson's Creek National Battlefield, Missouri, in 2008.

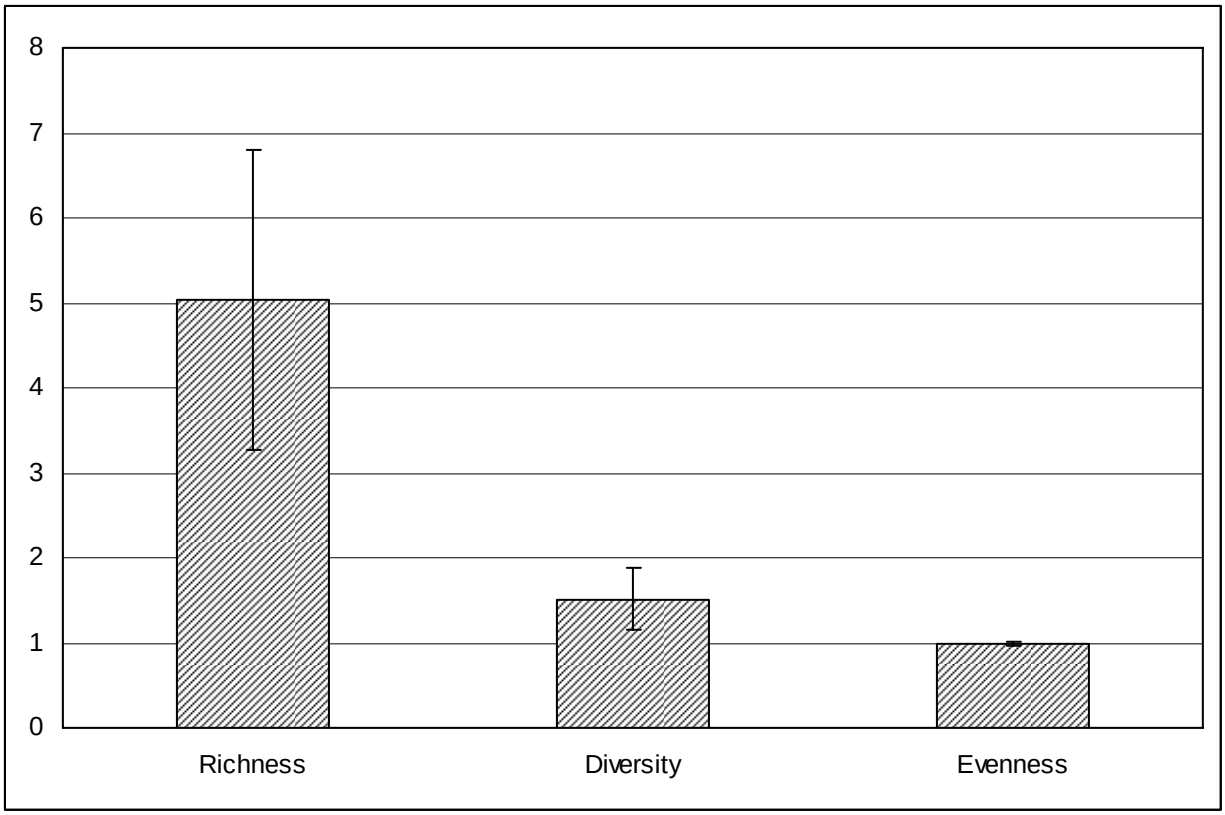

Figure 3. Average (± std dev) species richness, diversity, and species distribution evenness values for the bird community at Wilson's Creek National Battlefield, Missouri during the breeding seasons of 2008.

Bird Habitat

Abiotic features of plots sampled for breeding birds and habitat composition are given in Table 7. Slope and aspect variability were mostly low. The slopes of all but two plots were ≤10.

Bird habitat on WICR consist primarily of the grassland (358.1 ha), woodland (307.2), and shrub (65.8 ha) types. However, lesser amounts of other types are present (e.g. developed areas (30.6 ha), mowed areas (3.4 ha), and stream (10.7 ha)). Fifty percent of our bird plots where in mixed grassland habitat, 45% in woodland habitat, and 5% in shrub habitat (Table 7). Vegetation cover on bird plots averaged 44% mixed woodlands, 33% mixed grasslands, and 10% shrub, with smaller amounts of other habitat types present (Table 8). Canopy cover averaged almost 46%, with most being from hardwood trees. Basal area from hardwood trees averaged over 3.0 m^2/ha; conifer basal area was 0.3 m^2/ha. Hardwood tree species from nine different families contributed to the canopy cover and basal area (Table 9). Tree species from the *Cupressaceae* family accounted for the limited amount of conifer canopy cover and basal area.

The highest horizontal vegetation covers observed occurred in profile classes below 1.25 meter when read from a 15-m distance (Table 8, also see Appendix 2). However, vegetation cover was recorded for all height classes. In spite of good horizontal vegetation cover, the average vertical structure diversity estimate, 25%, appears to be low.

Deciduous and grass litter were almost equally prevalent across plots (Table 8). Ground cover was mostly unvegetated and bare soil. Cool-season grass, forbs, and woody shrubs and vines contributed equally to the total amount of live foliar cover. Total foliar coverage averaged 56% across plots.

Table 7. Abiotic features of 50-m radius plots sampled for breeding birds at Wilson's Creek National Battlefield, Missouri.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
WICRTweety1	5	medium	203	low	upper-slope	Grassland
WICRTweety2	4	low	194	low	upper-slope	Woodland
WICRTweety3	4	low	163	low	mid-slope	Woodland
WICRTweety4	2	medium	287	low	lower-slope	Grassland
WICRTweety5	9	low	179	low	upper-slope	Woodland
WICRTweety6	8	low	16	low	mid-slope	Woodland
WICRTweety7	1	medium	314	low	mid-slope	Woodland
WICRTweety8	4	low	317	low	mid-slope	Grassland
WICRTweety9	2	low	327	low	crest	Woodland
WICRTweety10	6	low	54	low	mid-slope	Woodland
WICRTweety11	2	low	239	low	mid-slope	Woodland
WICRTweety12	8	low	10	low	mid-slope	Shrub
WICRTweety13			no data			Woodland
WICRTweety14	3	low	226	low	mid-slope	Grassland
WICRTweety15	5	low	45	low	mid-slope	Woodland
WICRTweety16	3	low	290	low	mid-slope	Grassland
WICRTweety17	5	low	102	low	mid-slope	Grassland
WICRTweety18	2	low	216	medium	lower-slope	Grassland
WICRTweety19	6	low	305	low	mid-slope	Woodland
WICRTweety20	5	low	112	low	upper-slope	Grassland
WICRTweety21	5	medium	294	medium	mid-slope	Woodland
WICRTweety22	9	low	212	low	mid-slope	Grassland
WICRTweety23	2	low	88	low	lower-slope	Grassland
WICRTweety24	6	low	174	low	upper-slope	Woodland
WICRTweety25	31	high	9	high	lower-slope	Woodland
WICRTweety26	23	high	268	low	mid-slope	Woodland
WICRTweety27	4	low	19	low	mid-slope	Woodland
WICRTweety28	7	low	65	medium	draw	Grassland
WICRTweety29	3	low	12	low	upper-slope	Shrub
WICRTweety30	3	low	74	low	mid-slope	Grassland
WICRTweety31			no data			Woodland
WICRTweety32	4	low	100	low	mid-slope	Grassland
WICRTweety33	7	low	230	low	upper-slope	Woodland
WICRTweety34	4	low	228	low	upper-slope	Grassland
WICRTweety35	2	low	110	low	lower-slope	Grassland
WICRTweety36	5	low	241	low	mid-slope	Grassland

Table 7. Abiotic features of 50-m radius plots sampled for breeding birds at Wilson's Creek National Battlefield, Missouri (continued).

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
WICRTweety37	10	low	270	low	mid-slope	Woodland
WICRTweety38			no data			Grassland

Table 8. Averages (± std dev) for habitat parameters at Wilson's Creek National Battlefield, Missouri during the bird breeding season, 2008. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%).

Habitat Parameter	Mean	std dev
50 meter plot coverage		
Woodland (%)	36.59	(41.27)
Riparian Woodland (%)	3.29	(12.32)
Open Woodland (%)	3.94	(17.47)
Shrub (%)	10.0	(24.50)
Tree Line (%)	0.60	(2.60)
Field / Prairie (%)	19.60	(34.47)
Restored Prairie (%)	0.43	(2.54)
Fescue / Orchard Grass (%)	9.86	(26.95)
Brome (%)	3.21	(16.6)
Lawn (%)	0.26	(0.85)
Road / Parking Lot (%)	0.67	(4.18)
Path / Trail/ Sidewalk (%)	0.51	(2.57)
Highway Right of Way (%)	0.09	(0.51)
Pond / Stream (%)	2.01	(7.12)
Corn Field (%)	2.86	(14.52)
5 meter subplot		
Canopy cover		
Hardwood (%)	42.93	(39.53)
Conifer (%)	4.05	(13.87)
Total cover (%)	46.07	(41.42)
Canopy Height		
Hardwood (m)	8.66	(8.07)
Conifer (m)	1.41	(3.70)
Basal Area		
Hardwood (m^2/ha)	3.24	(3.61)
Conifer (m^2/ha)	0.30	(0.74)
Horizontal vegetation profile at 15-m		
0.00 – 0.25 m (%)	97.14	(2.11)
0.25 – 0.50 m (%)	92.73	(18.70)
0.50 – 0.75 m (%)	69.81	(36.27)
0.75 – 1.00 m (%)	57.11	(40.74)
1.00 – 1.25 m (%)	46.09	(40.60)
1.25 – 1.50 m (%)	33.97	(39.88)
1.50 – 1.75 m (%)	36.41	(42.11)
1.75 – 2.00 m (%)	35.23	(43.38)
Vertical structure diversity (%)	25.10	(16.61)

Tables 8. Averages (± std dev) for habitat parameters at Wilson's Creek National Battlefield, Missouri during the bird breeding season, 2008. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%) (continued).

Habitat Parameter	Mean	std dev
1.78 meter sample plot coverage		
Deciduous litter (%)	24.63	(31.00)
Conifer litter (%)	1.07	(3.55)
Grass litter (%)	23.34	(26.98)
Bare soil (%)	36.83	(27.87)
Rock (%)	1.24	(2.69)
Woody debris (%)	4.13	(7.37)
Unvegetated (%)	81.64	(13.83)
Warm-season grass (%)	1.39	(3.55)
Cool-season grass (%)	15.41	(16.42)
Forb (%)	15.40	(10.49)
Moss and lichen (%)	2.67	(6.98)
Woody shrub and vine (%)	15.60	(20.19)
Tree seedling (%)	0.67	(1.19)
Total foliar (%)	55.86	(20.21)

Table 9. Stems per hectare of trees by size class found on Wilson's Creek National Battlefield, Missouri during the 2008 bird-breeding season. Stems per hectare of trees are reported by family.

Family	<1.0 cm	1.1 – 2.5 cm	2.6 – 8.0 cm	8.1 – 15.0 cm	15.1 – 23.0 cm	23.1 – 38.0 cm	>38.0 cm
Aceraceae	0.0	0.0	0.0	7.3	0.0	0.0	0.0
Cupressaceae	3.6	10.9	18.2	10.9	7.3	0.0	3.6
Fagaceae	10.9	7.3	18.2	10.9	3.6	3.6	0.0
Hippocastanaceae	3.6	0.0	10.9	0.0	0.0	0.0	0.0
Juglandaceae	0.0	3.6	21.8	21.8	7.3	10.9	3.6
Lauraceae	3.6	0.0	7.3	0.0	0.0	0.0	0.0
Moraceae	3.6	3.6	3.6	0.0	3.6	0.0	0.0
Oleacea	0.0	7.3	21.8	0.0	0.0	0.0	0.0
Rosaceae	0.0	10.9	7.3	10.9	3.6	0.0	0.0
Ulmaceae	10.9	3.6	138.2	47.3	3.6	10.9	3.6
Total stems	**36.2**	**47.2**	**247.3**	**109.1**	**29.0**	**25.4**	**10.8**
Snags	0.0	32.7	116.4	69.1	7.3	14.6	0.0

Discussion

Bird surveys and habitat assessment work were initiated at Wilson's Creek National Battlefield, Missouri in 2008, to assist the park in assessing the integrity of their bird community and bird habitat through time. Forty-six of the 47 bird species recorded during the breeding bird surveys are permanent or summer residents to the area (Stokes and Stokes 1996). Therefore, they have some value in characterizing the breeding bird community. Changes in the number of the most common and widely distributed species in the park—Indigo bunting, Northern cardinal, and Blue-gray gnatcatcher—will serve as better measures for assessing changing habitat conditions.

For example, species like the Northern cardinal and Indigo bunting have improved reproductive success when shrub cover is dense and mid-canopy trees are present (Stokes and Stokes 1996). Therefore, a decline in either species' numbers could very well indicate changes in the understory and mid-story of the woodlands found at WICR. Less common and widely distributed species will likely occur so infrequently that strong species-habitat relationships may not be established. Dickcissel, abundant in the grassland habitat of the battlefield, will serve as a good species for assessing changes in this habitat type.

Grasslands and woodlands dominate the bird habitat at WICR. However, other habitat provides critical habitat for a number of birds and the rich mix of habitat types positively influenced the number of bird species observed. The only habitat obligate species recorded were the grassland obligates; Dickcissel and Eastern Meadowlark. The remaining 44 resident species are habitat generalist, mixed woodland species, shrub species, or edge specialist; favored by the mix and positioning of habitats on the park. Habitat diversity (structural composition) is especially important to high priority species, as their microhabitat requirements can vary (Pashley and Barrow 1993). For example, Red-bellied woodpecker prefers woodlands and urban/suburban forest, and Kentucky warbler prefer moist deciduous bottomlands and ravines, but most other species of continental importance observed require thick shrubby or old field habitat (Stokes and Stokes 1996). The ten species of continental importance deserve extra scrutiny each time a survey is completed. Although the diverse mix of habitats provides potentially satisfactory habitat for all the birds of continental importance as well as most other bird species, this habitat is easily altered if trees are thinned, insect infestations occur, or brushy fields are mowed. Our baseline data suggests that three of the ten species of continental importance (i.e., Indigo bunting, Dickcissel, and Eastern towhee) occur frequently enough at WICR to aid significantly in assessing the influence of habitat management actions on their numbers. Similar to the habitat requirements listed above for the Red-bellied woodpecker and Kentucky warbler, the habitat requirement of these three species can be identified: Indigo bunting, brush and low trees of overgrown fields; Dickcissel, prairie and weedy fields; and Eastern towhee, shrubby edges and open woodlands with shrubby understory (Stokes and Stokes 1996).

The Northern cardinal, the second most common species, has remained relatively stable throughout the Ozark-Ouachita Plateau and the Osage Plain, but declined in other areas of North America (Sauer et al. 2008). Therefore, the importance of the park to conservation of even its more common species cannot be underestimated. Management decisions aimed at influencing bird populations should center on those identified as species of local or continental importance. Species common to the park, however, such as the Northern cardinal, need consideration in a broader context of bird conservation when making management decisions. An interesting finding from this initial bird survey is that even moderately widespread species, such as the Indigo Bunting, Dickcissel, and Eastern towhee, are species of continental importance.

In planning management actions that aim to improve habitat for birds, one should refer to Figure 2 and Appendix 1. Figure 2 identifies areas where species richness and the richness of species of continental importance are greatest, allowing managers to prioritize areas for habitat improvement. Appendix 2 describes in detail each habitat parameter found on a plot. Managers may choose to manipulate a particular habitat element to benefit a particular species. Management actions aimed at improving habitat for a single species, however, may come at a

price to other species, unless that species is a keystone species for the desired habitat conditions (e.g.., Ovenbird in mature woodlands).

Species richness, diversity, and evenness values are generally greater for bird communities in woodland and mixed habitats (Kelsey 2001) than grasslands (Cody 1966, Knopf 1997, Wiens 1973, Wiens 1974, Zimmerman 1992). Kelsey (2001) reported species richness for breeding birds on 271 transects (0.5 ha) to be between 5.3 and 6.5 individuals in woodland habitats. Using spot mapping techniques on 4.0 – 10.6 ha plots, Cody (1966) reported species richness across seasons in grasslands as generally less than 10 and Wiens (1973) reported breeding species richness much less than this, 2 - 6. Therefore, species richness, diversity, and distribution evenness values for the breeding bird community in the mixed habitat types at WICR appear to be quite normal. Average species richness on plots surveyed is just over 5.0 individuals. Our distribution evenness values suggest that a number of breeding species contributed significantly to diversity measures. The utility of richness, diversity, and evenness values will increase when we examine changes in the bird community through time—20, 30 or more years—and these changes may be linked to management activity rather than innate variability of the habitats present.

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Appendix

Appendix 1. Bird species counts by plot for Wilson's Creek National Battlefield, Missouri in 2008. Data include all species recorded from a plot during a 5 min. survey. A species may have been recorded as a flyover only. No species recorded outside a 5 min. survey were included.

	Species Code																																			
PLOT	AMCR	AMGO	BANS	BEWR	BGGN	BHCO	BLJA	**BRTH**	**BWWA**	CACH	CAGO	**CARW**	COGR	COYE	**DICK**	DOWO	EAME	EAPH	**EATO**	EAWP	ETTI	FISP	GBHE	GCFL	GRCA	**INBU**	**KEWA**	NOBO	NOCA	NOMO	NOPA	OVEN	PIWO	**PRAW**	**RBWO**	REVI
1	0	0	0	0	0	0	2	**1**	**0**	1	0	**1**	0	0	**0**	0	1	0	**0**	0	0	0	0	0	0	**1**	**0**	1	0	0	0	0	0	**0**	**0**	0
2	0	0	0	0	0	1	0	**0**	**0**	1	0	**1**	0	0	**0**	0	0	0	**0**	1	0	0	0	0	0	**1**	**0**	0	0	0	0	0	0	**0**	**0**	0
3	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	**0**	**2**	0	1	0	1	0	0	**0**	**0**	0
4	0	0	0	0	0	0	0	**0**	**0**	1	2	**0**	2	0	**0**	0	0	0	**0**	0	0	1	0	0	0	**1**	**0**	0	0	0	0	0	0	**0**	**0**	0
5	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	1	0	0	0	0	**1**	**0**	0	1	0	0	0	0	**0**	**0**	0
6	0	0	0	0	1	1	1	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	1	0	0	0	0	**0**	**0**	0	1	0	0	0	0	**0**	**0**	1
7	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**1**	0	0	0	**1**	0	0	0	0	0	0	**3**	**1**	0	1	0	0	0	0	**0**	**0**	0
8	0	0	0	0	0	3	1	**0**	**0**	0	0	**0**	0	0	**2**	0	0	0	**0**	0	0	1	0	0	0	**3**	**0**	0	0	0	0	0	0	**0**	**0**	0
9	0	0	0	0	1	0	0	**0**	**0**	0	0	**1**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	**1**	**0**	0	2	0	0	0	0	**0**	**1**	0
10	0	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	**0**	**0**	1
11	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	1	**2**	**0**	0	0	0	0	0	0	**0**	**0**	0
12	0	0	0	0	0	1	0	**0**	**0**	0	0	**1**	0	0	**0**	0	0	0	**1**	0	0	1	0	0	0	**0**	**0**	0	0	0	0	0	0	**0**	**0**	0
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	0	0	1	0	1	0	0	**1**	**0**	0	0	**0**	0	1	**0**	0	0	0	**0**	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	**0**	**0**	0
15	0	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	**2**	**0**	0	0	0	1	0	0	**0**	**0**	0
16	0	0	0	1	0	0	0	**0**	**0**	0	0	**0**	0	1	**0**	0	0	0	**0**	0	0	0	0	0	0	**0**	**0**	0	1	0	0	0	0	**0**	**0**	0
17	0	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	1	**0**	0	0	0	**0**	0	0	2	0	1	0	**1**	**0**	0	1	1	0	0	0	**1**	**0**	0
18	0	0	0	0	0	0	0	**0**	**0**	1	0	**0**	0	1	**0**	0	0	0	**1**	0	1	0	0	0	0	**0**	**0**	0	0	1	0	1	0	**0**	**0**	0
19	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	**1**	**0**	0	2	0	0	0	0	**0**	**0**	0
20	0	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	0	**3**	0	0	0	**0**	0	0	0	0	1	0	**1**	**0**	0	0	0	0	0	0	**0**	**0**	0
21	0	0	0	0	2	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	**2**	**1**	0	0	0	0	0	0	**0**	**0**	0
22	0	0	0	0	0	1	0	**0**	**0**	0	0	**0**	0	1	**0**	0	0	0	**0**	0	0	0	0	0	0	**2**	**0**	0	0	0	0	0	0	**0**	**0**	0
23	0	0	0	0	0	0	0	**0**	**0**	0	0	**1**	0	0	**1**	0	0	1	**1**	0	0	1	1	1	0	**1**	**0**	0	0	0	1	0	0	**0**	**1**	0
24	2	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	**0**	**1**	0	1	0	0	0	0	**0**	**0**	0
25	0	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	**1**	**0**	0	0	0	0	0	0	**1**	**0**	0
26	0	0	0	0	1	0	0	**0**	**0**	0	0	**1**	0	0	**0**	0	0	0	**1**	1	2	1	0	0	0	**1**	**0**	0	0	0	0	0	0	**0**	**0**	1
27	2	0	0	0	1	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	1	0	0	0	0	0	**0**	**0**	1	0	0	0	0	0	**0**	**0**	1
28	0	0	0	0	0	1	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	**0**	**0**	0	0	1	0	0	0	**0**	**0**	0

Appendix 1. Bird species counts by plot for Wilson's Creek National Battlefield, Missouri in 2008. Data include all species recorded from a plot during a 5 min. survey. A species may have been recorded as a flyover only. No species recorded outside a 5 min. survey were included (continued).

	Species Code																																			
PLOT	AMCR	AMGO	BANS	BEWR	BGGN	BHCO	BLJA	**BRTH**	**BWWA**	CACH	CAGO	**CARW**	COGR	COYE	**DICK**	DOWO	EAME	EAPH	**EATO**	EAWP	ETTI	FISP	GBHE	GCFL	GRCA	**INBU**	**KEWA**	NOBO	NOCA	NOMO	NOPA	OVEN	PIWO	**PRAW**	**RBWO**	REVI
29	1	0	0	0	0	0	0	**0**	**1**	0	0	**0**	0	0	**0**	2	0	0	**0**	0	0	0	0	0	0	**2**	**1**	0	0	1	0	0	0	**0**	**0**	0
30	1	1	0	0	0	1	0	**0**	**0**	0	0	**0**	0	0	**1**	0	0	0	**0**	0	0	1	0	0	0	**1**	**0**	2	0	0	0	0	0	**0**	**0**	0
31	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	1	0	0	0	0	0	**0**	**0**	0	0	1	0	0	0	**0**	**0**	0
32	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**2**	0	1	0	**0**	0	0	0	0	0	0	**1**	**0**	0	0	1	0	0	0	**0**	**0**	0
34	2	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	**1**	**0**	0	1	1	0	0	0	**0**	**1**	0
35	0	0	0	0	0	1	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	1	1	0	0	0	**1**	**0**	0	0	0	0	0	0	**0**	**0**	0
36	0	0	0	0	0	0	0	**0**	**0**	0	0	**0**	0	0	**0**	0	0	0	**0**	0	0	0	0	1	0	**2**	**0**	0	1	0	0	0	0	**0**	**0**	0
37	0	0	0	0	0	0	0	**0**	**0**	0	0	**1**	0	0	**0**	0	0	0	**0**	0	0	0	0	1	0	**0**	**1**	0	3	0	1	0	1	**0**	**0**	0
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 1. Bird species counts by plot for Wilson's Creek National Battlefield, Missouri in 2008. Data include all species recorded from a plot during a 5 min. survey. A species may have been recorded as a flyover only. No species recorded outside a 5 min. survey were included (continued).

	Species Code								
PLOT	RTHA	SOSP	SUTA	TUVU	**WEVI**	WITU	YBCH	**SPP**	**SCI**
1	0	0	0	0	**0**	0	0	**7**	**3**
2	0	0	0	0	**0**	0	0	**5**	**2**
3	0	0	0	0	**0**	0	1	**5**	**2**
4	0	0	0	0	**0**	0	1	**6**	**1**
5	0	0	0	0	**0**	1	0	**4**	**1**
6	0	0	0	0	**0**	0	0	**6**	**0**
7	0	0	1	1	**0**	0	0	**7**	**4**
8	0	0	0	0	**0**	0	0	**5**	**2**
9	0	0	0	0	**0**	0	0	**5**	**3**
10	0	0	0	0	**0**	0	0	**2**	**0**
11	0	0	1	0	**1**	0	0	**4**	**2**
12	0	0	0	0	**1**	2	1	**7**	**3**
13	-	-	-	-	**-**	-	-	**-**	**-**
14	0	0	0	0	**0**	8	1	**6**	**1**
15	0	0	0	0	**0**	1	1	**6**	**2**
16	0	0	0	0	**1**	0	1	**5**	**1**
17	0	0	0	0	**0**	0	0	**8**	**2**
18	0	0	0	0	**0**	0	0	**6**	**1**
19	0	0	0	0	**0**	0	0	**3**	**2**
20	0	1	0	0	**0**	0	1	**6**	**2**
21	0	0	0	0	**0**	2	0	**4**	**2**
22	0	0	0	1	**0**	0	0	**4**	**1**
23	0	0	0	0	**0**	0	0	**10**	**5**
24	0	0	0	0	**0**	0	0	**5**	**2**
25	0	0	0	0	**0**	0	0	**3**	**2**
26	0	0	0	0	**0**	0	0	**8**	**3**
27	0	0	0	0	**0**	1	0	**6**	**0**
28	0	0	0	0	**0**	0	0	**2**	**0**

Appendix 1. Bird species counts by plot for Wilson's Creek National Battlefield, Missouri in 2008. Data include all species recorded from a plot during a 5 min. survey. A species may have been recorded as a flyover only. No species recorded outside a 5 min. survey were included (continued).

	Species Code								
PLOT	RTHA	SOSP	SUTA	TUVU	**WEVI**	WITU	YBCH	**SPP**	**SCI**
29	0	0	0	0	**0**	0	0	**6**	**3**
30	0	0	0	0	**0**	0	0	**7**	**2**
31	0	0	0	0	**2**	0	0	**3**	**1**
32	0	0	0	0	**0**	0	0	**4**	**2**
33	0	0	0	0	**0**	0	0	**5**	**3**
34	0	0	0	0	**0**	0	0	**5**	**2**
35	2	0	0	0	**0**	1	0	**6**	**1**
36	0	0	0	0	**0**	0	0	**3**	**1**
37	0	0	1	0	**0**	0	0	**7**	**2**
38	-	-	-	-	**-**	-	-	**-**	**-**

SPP = Species Richness

SCI = The Species Richness for a plot of "Species of Continental Importance"

Appendix 2. Listed are measured habitat parameters at Wilson's Creek National Battlefield, Missouri during the 2008 bird breeding season. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%).

	Plot														
Habitat Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50 meter plot coverage															
Woodland (%)	0.0	97.5	37.5	0.0	97.5	97.5	0.0	0.5	62.5	97.5	62.5	15.0	-	37.5	0.0
Riparian Woodland (%)	0.0	0.0	0.0	37.5	0.0	0.0	62.5	0.0	0.0	0.0	0.0	0.0	-	0.0.	0.0
Open Woodland (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	97.5
Shrub (%)	0.0	0.0	62.5	0.0	0.0	0.0	0.0	15.0	15.0	0.0	0.0	15.0	-	37.5	0.0
Tree Line (%)	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Field / Prairie (%)	62.5	0.0	0.0	37.5	0.0	0.0	37.5	85.0	15.0	0.0	0.0	37.5	-	0.0	0.0
Restored Prairie (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	15.0	0.0
Fescue / Orchard Grass (%)	0.0	0.0	0.0	0.0	0.0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Brome (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Lawn (%)	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Road / Parking Lot (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Path/ Trail/ Sidewalk (%)	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	15.0	0.0	0.0	0.0	-	0.0	0.0
Highway Right of Way (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Pond / Stream (%)	0.0	0.0	3.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Corn Field (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	-	0.0	0.0
5 meter subplot															
Canopy cover															
Hardwood (%)	0.0	83.98	99.06	19.5	62.4	70.46	51.74	0.0	23.14	48.88	91.52	8.84	-	0.0	79.3
Conifer (%)	0.0	0.0	4.68	0.0	46.54	0.0	0.0	0.0	0.0	67.6	0.0	18.2	-	0.0	0.0
Total cover (%)	0.0	83.98	99.58	19.5	99.84	70.46	51.74	0.0	23.14	99.84	91.52	26.0	-	0.0	79.3
Canopy Height															
Hardwood (m)	0.0	0.0	5.3	21.6	22.2	11.5	21.1	0.0	6.8	11.4	20.2	13.5	-	0.0	15.1
Conifer (m)	0.0	0.0	7.0	0.0	8.9	0.0	0.0	0.0	0.0	7.3	0.0	10.6	-	0.0	0.0
Basal Area															
Hardwood (m^2/ha)	0.0	8.0	1.0	2.0	5.0	4.0	6.0	0.0	3.0	4.0	8.0	1.0	-	0.0	5.0
Conifer (m^2/ha)	0.0	0.0	2.0	0.0	3.0	0.0	0.0	0.0	0.0	2.0	0.0	1.0	-	0.0	0.0
Horizontal vegetation profile at 15-m															
0.0 – 0.25 m (%)	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	-	97.5	97.5
0.25 – 0.5 m (%)	3.0	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	-	97.5	97.5
0.5 – 0.75 m (%)	0.0	97.5	97.5	97.5	97.5	97.5	62.5	97.5	97.5	97.5	97.5	15.0	-	97.5	85.0
0.75 – 1.0 m (%)	0.0	85.0	97.5	97.5	62.5	97.5	37.5	85.0	97.5	97.5	97.5	3.0	-	97.5	85.0

Appendix 2. Listed are measured habitat parameters at Wilson's Creek National Battlefield, Missouri during the 2008 bird breeding season. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%) (continued).

	Plot														
Habitat Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.0 – 1.25 m (%)	0.0	62.5	97.5	97.5	37.5	85.0	3.0	15.0	97.5	85.0	97.5	3.0	-	97.5	37.5
1.25 – 1.5 m (%)	0.0	15.0	97.5	97.5	15.0	62.5	0.0	0.0	97.5	37.5	0.0	37.5	-	37.5	62.5
1.5 – 1.75 m (%)	0.0	85.0	97.5	97.5	3.0	62.5	0.0	0.0	97.5	37.5	0.0	15.0	-	3.0	62.5
1.75 – 2.0 m (%)	0.0	85.0	97.5	97.5	85.0	97.5	0.0	0.0	97.5	15.0	0.0	0.0	-	0.0	37.5
Vertical Profile: Deciduous															
0.0 – 1.0 m (%)	0.0	0.0	50.0	25.0	25.0	50.0	0.0	0.0	0.0	100.0	50.0	75.0	-	50.0	100.0
1.0 – 2.0 m (%)	0.0	0.0	75.0	25.0	25.0	50.0	0.0	0.0	0.0	0.0	0.0	25.0	-	25.0	25.0
2.0 – 3.0 m (%)	0.0	0.0	50.0	25.0	25.0	25.0	0.0	0.0	0.0	25.0	25.0	25.0	-	0.0	25.0
3.0 – 4.0 m (%)	0.0	0.0	50.0	0.0	25.0	0.0	0.0	0.0	0.0	50.0	25.0	0.0	-	0.0	25.0
4.0 – 5.0 m (%)	0.0	25.0	0.0	0.0	25.0	0.0	0.0	0.0	25.0	50.0	25.0	0.0	-	0.0	25.0
5.0 – 6.0 m (%)	0.0	25.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	75.0	50.0	0.0	-	0.0	0.0
6.0 – 7.0 m (%)	0.0	50.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	50.0	75.0	0.0	-	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	50.0	0.0	-	0.0	0.0
Vertical Profile: Conifer															
0.0 – 1.0 m (%)	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	-	0.0	0.0
1.0 – 2.0 m (%)	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	-	0.0	0.0
2.0 – 3.0 m (%)	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	25.0	-	0.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	25.0	-	0.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	25.0	-	0.0	0.0
5.0 – 6.0 m (%)	0.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
6.0 – 7.0 m (%)	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
Vertical Profile: Herbaceous															
0.0 – 1.0 m (%)	100.0	100.0	75.0	100.0	100.0	75.0	100.0	100.0	100.0	75.0	100.0	100.0	-	100.0	100.0
1.0 – 2.0 m (%)	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
2.0 – 3.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
5.0 – 6.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
6.0 – 7.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0

Appendix 2. Listed are measured habitat parameters at Wilson's Creek National Battlefield, Missouri during the 2008 bird breeding season. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%) (continued).

	Plot														
Habitat Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.78 meter sample plot coverage															
Deciduous litter (%)	3.0	15.0	3.0	3.0	85.0	85.0	15.0	0.0	3.0	62.5	15.0	15.0	-	3.0	15.0
Conifer litter (%)	0.0	0.0	15.0	0.0	3.0	0.0	0.0	0.0	0.0	15.0	0.0	3.0	-	0.0	0.5
Grass litter (%)	62.5	15.0	0.5	62.5	0.5	0.0	0.5	62.5	15.0	0.5	3.0	37.5	-	3.0	3.0
Bare soil (%)	15.0	62.5	37.5	37.5	0.5	0.5	62.5	37.5	62.5	15.0	62.5	37.5	-	85.0	62.5
Rock (%)	0.0	0.5	0.5	0.0	3.0	0.0	0.5	0.0	3.0	3.0	0.0	0.0	-	0.5	0.5
Woody debris (%)	0.0	3.0	0.5	3.0	3.0	15.0	15.0	0.0	3.0	3.0	0.5	15.0	-	3.0	3.0
Unvegetated (%)	85.0	85.0	37.5	62.5	85.0	97.5	85.0	85.0	85.0	97.5	85.0	85.0	-	85.0	62.5
Warm-season grass (%)	0.5	0.0	0.0	0.5	0.0	0.0	0.5	3.0	0.5	0.0	0.0	0.0	-	0.0	15.0
Cool-season grass (%)	37.5	3.0	15.0	15.0	3.0	0.0	15.0	15.0	37.5	0.5	37.5	15.0	-	3.0	3.0
Forb (%)	3.0	15.0	3.0	37.5	37.5	15.0	15.0	15.0	15.0	3.0	15.0	15.0	-	15.0	37.5
Moss and lichen (%)	0.0	15.0	37.5	0.5	0.5	0.5	0.5	0.5	0.5	3.0	0.5	0.5	-	0.5	0.5
Woody shrub and vine (%)	0.0	37.5	15.0	3.0	15.0	62.5	15.0	0.0	3.0	15.0	15.0	37.5	-	62.5	15.0
Tree seedling (%)	0.0	3.0	0.0	0.0	0.5	3.0	0.0	0.0	0.5	0.5	0.0	0.5	-	0.0	0.0
Total foliar (%)	37.5	85.0	85.0	62.5	62.5	62.5	62.5	37.5	37.5	15.0	62.5	62.5	-	85.0	85.0

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	Plot														
Habitat Parameter	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
50 meter plot coverage															
Woodland (%)	0.0	0.0	0.0	85.0	0.0	0.0	0.0	0.0	97.5	37.5	62.5	97.5	62.5	0.0	0.0
Riparian Woodland (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0
Open Woodland (%)	0.0	0.0	0.0	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0
Shrub (%)	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.5	0.0
Tree Line (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Field / Prairie (%)	3.0	97.5	97.5	3.0	97.5	15.0	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Restored Prairie (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fescue / Orchard Grass (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0
Brome (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
Lawn (%)	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road / Parking Lot (%)	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0
Path/ Trail/ Sidewalk (%)	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highway Right of Way (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
Pond / Stream (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.5	15.0	0.0	0.0	0.0	0.0
Corn Field (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.0
5 meter subplot															
Canopy cover															
Hardwood (%)	84.0	0.0	0.0	92.6	0.0	58.8	0.0	0.0	83.0	93.0	72.0	97.0	78.0	34.0	0.0
Conifer (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total cover (%)	84.0	0.0	0.0	92.6	0.0	58.8	0.0	0.0	83.0	93.0	72.0	97.0	78.0	34.0	0.0
Canopy Height															
Hardwood (m)	4.4	0.0	0.0	7.7	0.0	5.6	0.0	0.0	17.6	13.1	18.2	16.7	10.6	9.7	0.0
Conifer (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Basal Area															
Hardwood (m^2/ha)	3.0	0.0	0.0	14.0	0.0	4.0	0.0	0.0	8.0	5.0	7.0	7.0	3.0	4.0	0.0
Conifer (m^2/ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
Horizontal vegetation profile at 15-m															
0.0 – 0.25 m (%)	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	85.0
0.25 – 0.5 m (%)	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	37.5
0.5 – 0.75 m (%)	97.5	15.0	37.5	97.5	97.5	37.5	85.0	37.5	62.5	97.5	97.5	85.0	37.5	97.5	0.0
0.75 – 1.0 m (%)	97.5	15.0	15.0	97.5	97.5	37.5	15.0	15.0	15.0	85.0	62.5	97.5	37.5	97.5	0.0

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	Plot														
Habitat Parameter	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.0 – 1.25 m (%)	97.5	3.0	0.5	62.5	97.5	62.5	0.5	3.0	15.0	62.5	37.5	37.5	37.5	97.5	0.0
1.25 – 1.5 m (%)	97.5	0.0	0.0	0.5	0.5	62.5	0.0	0.0	15.0	15.0	0.0	97.5	62.5	97.5	0.0
1.5 – 1.75 m (%)	97.5	0.5	0.0	37.5	0.0	97.5	0.0	0.0	37.5	97.5	0.0	97.5	3.0	97.5	0.0
1.75 – 2.0 m (%)	97.5	0.0	0.0	15.0	0.0	37.5	0.0	0.0	97.5	97.5	0.0	97.5	3.0	97.5	0.0
Vertical Profile: Deciduous															
0.0 – 1.0 m (%)	100.0	50.0	0.0	75.0	0.0	0.0	0.0	0.0	50.0	25.0	50.0	75.0	0.0	75.0	0.0
1.0 – 2.0 m (%)	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	25.0	50.0	25.0	0.0
2.0 – 3.0 m (%)	25.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	25.0	25.0	0.0	0.0	0.0	0.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	50.0	25.0	0.0	50.0	0.0	0.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	50.0	0.0	0.0	25.0	0.0	0.0
5.0 – 6.0 m (%)	0.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	25.0	0.0	0.0	25.0	0.0	0.0
6.0 – 7.0 m (%)	0.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	25.0	25.0	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	25.0	0.0	0.0	0.0
Vertical Profile: Conifer															
0.0 – 1.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0 – 2.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0 – 3.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0 – 6.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0 – 7.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical Profile: Herbaceous															
0.0 – 1.0 m (%)	100.0	100.0	100.0	50.0	100.0	100.0	100.0	100.0	100.0	75.0	50.0	50.0	100.0	100.0	75.0
1.0 – 2.0 m (%)	0.0	0.0	0.0	0.0	25.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0 – 3.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0 – 6.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0 – 7.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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	Plot														
Habitat Parameter	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.78 meter sample plot coverage															
Deciduous litter (%)	15.0	62.5	0.0	62.5	0.5	37.5	0.0	0.5	37.5	37.5	15.0	85.0	0.5	15.0	0.0
Conifer litter (%)	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grass litter (%)	15.0	15.0	37.5	3.0	85.0	37.5	62.5	62.5	3.0	0.5	0.5	0.5	15.0	0.5	15.0
Bare soil (%)	62.5	15.0	62.5	15.0	3.0	3.0	37.5	15.0	0.5	15.0	62.5	3.0	85.0	62.5	62.5
Rock (%)	0.0	0.0	0.0	0.0	0.0	3.0	0.5	0.0	0.0	15.0	0.5	0.5	3.0	3.0	0.5
Woody debris (%)	0.5	0.5	0.0	15.0	0.0	3.0	0.0	0.0	37.5	3.0	3.0	3.0	3.0	3.0	0.0
Unvegetated (%)	62.5	97.5	85.0	85.0	85.0	85.0	85.0	85.0	62.5	62.5	85.0	97.5	85.0	97.5	97.5
Warm-season grass (%)	0.5	3.0	0.0	0.0	3.0	0.0	15.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Cool-season grass (%)	15.0	0.5	15.0	0.5	37.5	15.0	3.0	15.0	15.0	3.0	3.0	0.5	37.5	0.5	0.5
Forb (%)	15.0	15.0	15.0	3.0	15.0	37.5	37.5	15.0	15.0	15.0	15.0	3.0	15.0	15.0	3.0
Moss and lichen (%)	3.0	0.0	0.0	3.0	0.0	0.5	0.5	0.5	3.0	15.0	0.5	0.5	0.5	0.5	0.5
Woody shrub and vine (%)	15.0	37.5	0.0	62.5	0.5	3.0	0.0	3.0	15.0	15.0	3.0	3.0	0.0	62.5	0.0
Tree seedling (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.5	3.0	0.0	3.0	0.0
Total foliar (%)	62.5	62.5	62.5	62.5	62.5	37.5	62.5	37.5	37.5	62.5	37.5	15.0	62.5	85.0	15.0

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	Plot							
Habitat Parameter	31	32	33	34	35	36	37	38
50 meter plot coverage								
Woodland (%)	-	0.0	97.5	37.5	0.0	0.0	97.5	-
Riparian Woodland (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Open Woodland (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Shrub (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Tree Line (%)	-	0.0	0.0	0.0	0.0	3.0	0.0	-
Field / Prairie (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Restored Prairie (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Fescue / Orchard Grass (%)	-	97.5	0.0	62.5	0.0	85.0	0.0	-
Brome (%)	-	0.0	0.0	0.0	97.5	0.0	0.0	-
Lawn (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Road / Parking Lot (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Path/ Trail/ Sidewalk (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Highway Right of Way (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Pond / Stream (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Corn Field (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
5 meter subplot								
Canopy cover								
Hardwood (%)	-	0.0	79.0	0.0	0.0	0.0	92.3	-
Conifer (%)	-	0.0	4.68	0.0	0.0	0.0	0.0	-
Total cover (%)	-	0.0	83.0	0.0	0.0	0.0	92.3	-
Canopy Height								
Hardwood (m)	-	0.0	18.9	0.0	0.0	0.0	14.9	-
Conifer (m)	-	0.0	15.5	0.0	0.0	0.0	0.0	-
Basal Area								
Hardwood (m^2/ha)	-	0.0	10.0	0.0	0.0	0.0	8.0	-
Conifer (m^2/ha)	-	0.0	2.0	0.0	0.0	0.0	0.0	-
Horizontal vegetation profile at 15-m								
0.0 – 0.25 m (%)	-	97.5	97.5	97.5	97.5	97.5	97.5	-
0.25 – 0.5 m (%)	-	97.5	97.5	85.0	97.5	97.5	97.5	-
0.5 – 0.75 m (%)	-	37.5	97.5	3.0	85.0	3.0	97.5	-
0.75 – 1.0 m (%)	-	3.0	85.0	0.0	0.0	0.5	85.0	-

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	Plot							
Habitat Parameter	31	32	33	34	35	36	37	
1.0 – 1.25 m (%)	-	0.0	97.5	0.0	0.0	0.0	85.0	-
1.25 – 1.5 m (%)	-	0.0	85.0	0.0	0.0	0.0	97.5	-
1.5 – 1.75 m (%)	-	0.0	85.0	0.0	0.0	0.0	62.5	-
1.75 – 2.0 m (%)	-	0.0	62.5	0.0	0.0	0.0	15.0	-
Vertical Profile: Deciduous								
0.0 – 1.0 m (%)	-	0.0	75.0	0.0	0.0	0.0	75.0	-
1.0 – 2.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
2.0 – 3.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
3.0 – 4.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
4.0 – 5.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	50.0	-
5.0 – 6.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
6.0 – 7.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	25.0	-
7.0 – 7.5 m (%)	-	0.0	0.0	0.0	0.0	0.0	25.0	-
Vertical Profile: Conifer								
0.0 – 1.0 m (%)	-	0.0	25.0	0.0	0.0	0.0	0.0	-
1.0 – 2.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
2.0 – 3.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
3.0 – 4.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
4.0 – 5.0 m (%)	-	0.0	25.0	0.0	0.0	0.0	0.0	-
5.0 – 6.0 m (%)	-	0.0	25.0	0.0	0.0	0.0	0.0	-
6.0 – 7.0 m (%)	-	0.0	25.0	0.0	0.0	0.0	0.0	-
7.0 – 7.5 m (%)	-	0.0	25.0	0.0	0.0	0.0	0.0	-
Vertical Profile: Herbaceous								
0.0 – 1.0 m (%)	-	100.0	25.0	100.0	100.0	100.0	75.0	-
1.0 – 2.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
2.0 – 3.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
3.0 – 4.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
4.0 – 5.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
5.0 – 6.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
6.0 – 7.0 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-
7.0 – 7.5 m (%)	-	0.0	0.0	0.0	0.0	0.0	0.0	-

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	Plot							
Habitat Parameter	31	32	33	34	35	36	37	38
1.78 meter sample plot coverage								
Deciduous litter (%)	-	0.0	85.0	0.5	0.0	0.0	85.0	-
Conifer litter (%)	-	0.0	0.5	0.0	0.0	0.0	0.0	-
Grass litter (%)	-	37.5	0.0	37.5	37.5	85.0	0.5	-
Bare soil (%)	-	62.5	3.0	62.5	62.5	15.0	0.5	-
Rock (%)	-	0.0	3.0	0.0	0.0	0.0	3.0	-
Woody debris (%)	-	0.0	3.0	0.0	0.0	0.0	3.0	-
Unvegetated (%)	-	85.0	97.5	62.5	62.5	85.0	85.0	-
Warm-season grass (%)	-	0.5	0.0	0.0	0.0	0.5	0.0	-
Cool-season grass (%)	-	37.5	0.0	37.5	62.5	37.5	3.0	-
Forb (%)	-	15.0	3.0	15.0	15.0	0.5	15.0	-
Moss and lichen (%)	-	0.5	0.5	0.0	0.5	0.5	3.0	-
Woody shrub and vine (%)	-	0.0	15.0	0.0	0.0	0.0	15.0	-
Tree seedling (%)	-	0.0	3.0	0.0	0.0	0.0	3.0	-
Total foliar (%)	-	62.5	37.5	62.5	85.0	37.5	62.5	-

The NPS has organized its parks with significant natural resources into 32 networks linked by geography and shared natural resource characteristics. HTLN is composed of 15 National Park Service (NPS) units in eight Midwestern states. These parks contain a wide variety of natural and cultural resources including sites focused on commemorating civil war battlefields, Native American heritage, westward expansion, and our U.S. Presidents. The Network is charged with creating inventories of its species and natural features as well as monitoring trends and issues in order to make sound management decisions. Critical inventories help park managers understand the natural resources in their care while monitoring programs help them understand meaningful change in natural systems and to respond accordingly. The Heartland Network helps to link natural and cultural resources by protecting the habitat of our history.

The I&M program bridges the gap between science and management with a third of its efforts aimed at making information accessible. Each network of parks, such as Heartland, has its own multi-disciplinary team of scientists, support personnel, and seasonal field technicians whose system of online databases and reports make information and research results available to all. Greater efficiency is achieved through shared staff and funding as these core groups of professionals augment work done by individual park staff. Through this type of integration and partnership, network parks are able to accomplish more than a single park could on its own.

The mission of the Heartland Network is to collaboratively develop and conduct scientifically credible inventories and long-term monitoring of park "vital signs" and to distribute this information for use by park staff, partners, and the public, thus enhancing understanding which leads to sound decision making in the preservation of natural resources and cultural history held in trust by the National Park Service.

www.nature.nps.gov/im/units/htln/

Heartland Network

Natural Resource Monitoring

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

NPS D-86, April 2009

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