



Bird Monitoring at George Washington Carver National Monument, Missouri

2008 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2009/193



ON THE COVER

Carver home at George Washington Carver National Monument
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Natural Resource Technical Report NPS/HTLN/NRTR—2009/193

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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 George Washington Carver National Monument, Missouri (GWCA) 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, habitat-specific, and park-wide baseline data on populations and breeding habitat of birds at GWCA. Forty-nine species of birds were recorded during site visits in May. The most common and widely distributed species was the Dickcissel (*Spiza americana*). The Brown-headed cowbird (*Molothrus ater*), Indigo bunting (*Passerina cyanea*), Carolina wren (*Thryothorus ludovicianus*), and Northern cardinal (*Cardinalis cardinalis*) 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 six species found at GWCA as species of continental importance. Species richness for birds in the grassland habitat of the monument is similar to values reported elsewhere. Three grassland obligate species were recorded, the Dickcissel, Eastern meadowlark (*Sturnella magna*), and Grasshopper sparrow (*Ammodramus savannarum*). Species richness in the woodland habitat, however, was lower than values reported elsewhere. No woodland obligates were reported. Nearly 68% of the habitat on the monument is grassland dominated by the field/prairie and brome/fescue habitat types.

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 George Washington Carver National Monument, Missouri for allowing us access to the monument during our site visit.

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.

George Washington Carver National Monument, Missouri (GWCA) is located in the transition 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 habitat of the area (Stokes and Stokes 1996). Wide spread 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 GWCA 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 GWCA. 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 habitats 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 GWCA. 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 George Washington Carver National Monument, Missouri:

- Identify significant temporal changes in the species composition and abundance of bird communities that occur at GWCA 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 100 x 100 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 70 permanent plots: 18 are located in woodland habitat and 52 are in grassland habitat. Monitoring occurred on all 70 plots (Fig. 1).

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 collected pin flags from each plot once the habitat work was completed. Monitoring plots will be re-located each year we conduct a bird survey.

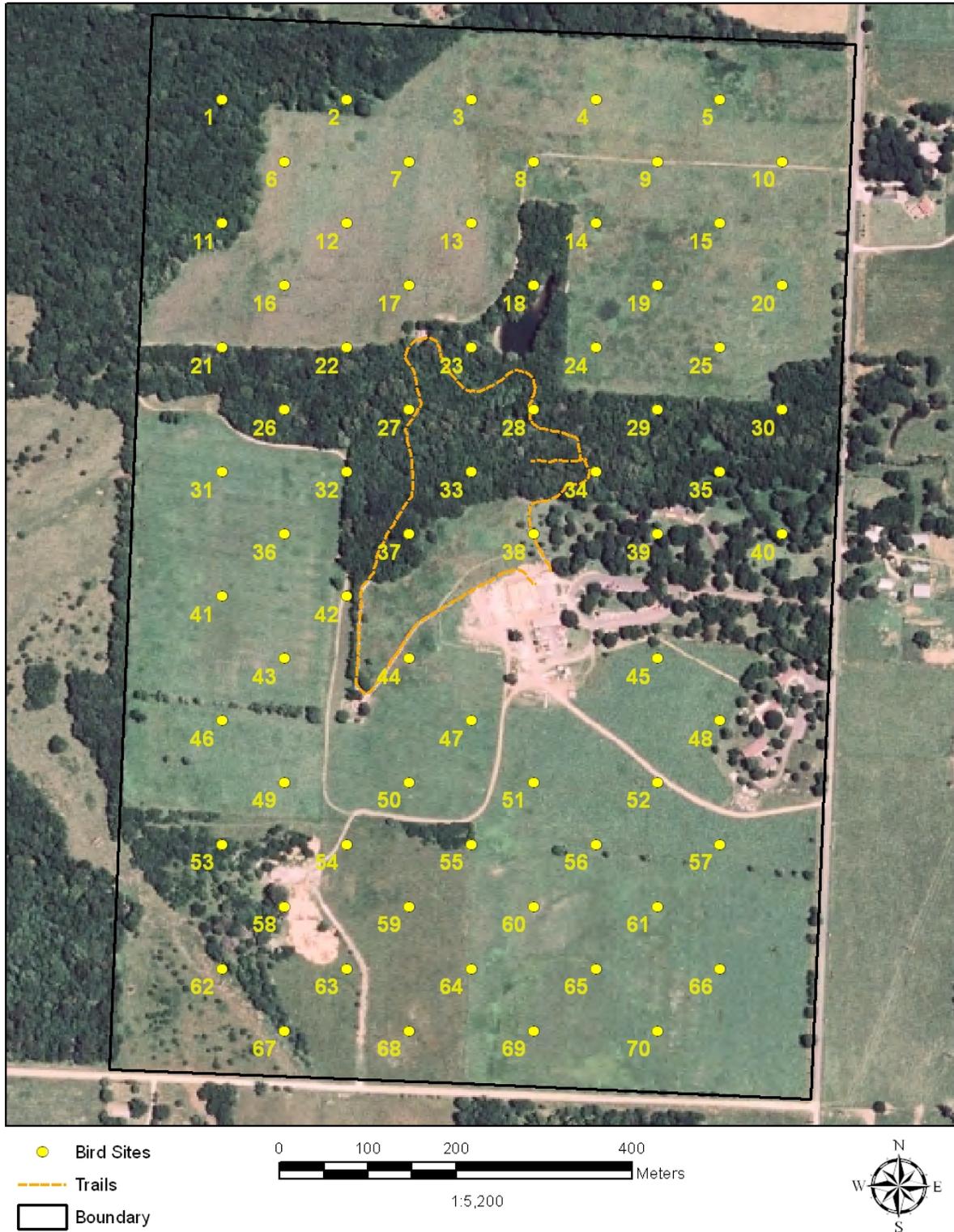


Figure 1. Bird plot locations on George Washington Carver National Monument, Missouri.

Table 1. Plot I.D. and habitat type for each breeding bird survey plot at George Washington Carver National Monument, 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)
GWCATweety1	Woodland	379070.421	4094759.924
GWCATweety2	Woodland	379211.842	4094759.924
GWCATweety3	Grassland	379353.263	4094759.924
GWCATweety4	Grassland	379494.685	4094759.924
GWCATweety5	Grassland	379636.106	4094759.924
GWCATweety6	Grassland	379141.131	4094689.214
GWCATweety7	Grassland	379282.553	4094689.214
GWCATweety8	Grassland	379423.974	4094689.214
GWCATweety9	Grassland	379565.395	4094689.214
GWCATweety10	Grassland	379706.817	4094689.214
GWCATweety11	Woodland	379070.421	4094618.503
GWCATweety12	Grassland	379211.842	4094618.503
GWCATweety13	Grassland	379353.263	4094618.503
GWCATweety14	Grassland	379494.685	4094618.503
GWCATweety15	Grassland	379636.106	4094618.503
GWCATweety16	Grassland	379141.131	4094547.792
GWCATweety17	Grassland	379282.553	4094547.792
GWCATweety18	Woodland	379423.974	4094547.792
GWCATweety19	Grassland	379565.395	4094547.792
GWCATweety20	Grassland	379706.817	4094547.792
GWCATweety21	Grassland	379070.421	4094477.082
GWCATweety22	Grassland	379211.842	4094477.082
GWCATweety23	Woodland	379353.263	4094477.082
GWCATweety24	Grassland	379494.685	4094477.082
GWCATweety25	Grassland	379636.106	4094477.082
GWCATweety26	Woodland	379141.131	4094406.371
GWCATweety27	Woodland	379282.553	4094406.371
GWCATweety28	Woodland	379423.974	4094406.371
GWCATweety29	Woodland	379565.395	4094406.371
GWCATweety30	Woodland	379706.817	4094406.371
GWCATweety31	Grassland	379070.421	4094335.660
GWCATweety32	Grassland	379211.842	4094335.660
GWCATweety33	Woodland	379353.263	4094335.660
GWCATweety34	Woodland	379494.685	4094335.660
GWCATweety35	Woodland	379636.106	4094335.660
GWCATweety36	Grassland	379141.131	4094264.949
GWCATweety37	Woodland	379282.553	4094264.949
GWCATweety38	Grassland	379423.974	4094264.949
GWCATweety39	Woodland	379565.395	4094264.949
GWCATweety40	Woodland	379706.817	4094264.949
GWCATweety41	Grassland	379070.421	4094194.239
GWCATweety42	Grassland	379211.842	4094194.239
GWCATweety43	Grassland	379141.131	4094123.528
GWCATweety44	Grassland	379282.553	4094123.528
GWCATweety45	Grassland	379565.395	4094123.528
GWCATweety46	Grassland	379070.421	4094052.817
GWCATweety47	Grassland	379353.263	4094052.817
GWCATweety48	Grassland	379636.106	4094052.817
GWCATweety49	Grassland	379141.131	4093982.107
GWCATweety50	Grassland	379282.553	4093982.107
GWCATweety51	Grassland	379423.974	4093982.107

Table 1. Plot I.D. and habitat type for each breeding bird survey plot at George Washington Carver National Monument, Missouri. Also given are x and y UTM coordinates for each plot. UTM Zone 15 North, Datum 1983 (Conus) (continued).

Plot I.D.	Habitat Type	X Coordinate (Easting)	Y Coordinate (Northing)
GWCATweety52	Grassland	379565.395	4093982.107
GWCATweety53	Woodland	379070.421	4093911.396
GWCATweety54	Grassland	379211.842	4093911.396
GWCATweety55	Grassland	379353.263	4093911.396
GWCATweety56	Grassland	379494.685	4093911.396
GWCATweety57	Grassland	379636.106	4093911.396
GWCATweety58	Woodland	379141.131	4093840.685
GWCATweety59	Grassland	379282.553	4093840.685
GWCATweety60	Grassland	379423.974	4093840.685
GWCATweety61	Grassland	379565.395	4093840.685
GWCATweety62	Grassland	379070.421	4093769.975
GWCATweety63	Grassland	379211.842	4093769.975
GWCATweety64	Grassland	379353.263	4093769.975
GWCATweety65	Grassland	379494.685	4093769.975
GWCATweety66	Grassland	379636.106	4093769.975
GWCATweety67	Grassland	379141.131	4093699.264
GWCATweety68	Grassland	379282.553	4093699.264
GWCATweety69	Grassland	379423.974	4093699.264
GWCATweety70	Grassland	379565.396	4093699.264

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 will be 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 travelling 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 all 70 plots between May 27 and May 29, 2008. 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. Birds recorded from a previous plot were noted and excluded from analysis.

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 method's follows: Habitat data collection started after the first variable circular plot count was completed. 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 (>2.50 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 (<1.50 m tall). Average parameter values were reported for grassland and woodland habitats. 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. Three plots sampled in the mowed areas (6.3 ha) were included with the larger habitat types for analysis, based on the amount of canopy cover present: < 50 % = grassland; ≥ 50 % = woodland. Bird plots were not sampled in the developed areas (2.8 ha) or pond (0.4 ha).

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 GWCA. 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 / 70). 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 ± std dev). 4) To examine local density, density was calculated as described 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 habitat-wide averages (± std dev) were determined. Flyover males were included in each calculation. Bird diversity values for each plot were calculated using the Shannon Diversity Index:

$$H' = -\sum(n_i/N)\ln(n_i/N)$$

where n_i/N is the proportion of the total number of individuals in a population consisting of the i^{th} 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):

$$J' = H' / H_{\text{max}}$$

Where H' is the Shannon Diversity Index and H_{max} is the maximum possible diversity for a given number of species if all species are present in equal numbers ($(\ln(\text{species richness}))$). 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 (\pm std dev) for semi-permanent plot data, including road and water cover were calculated from plot estimates. Using plot values, averages (\pm std dev) for horizontal vegetation cover between 0 – 0.25, 0.25-0.5, 0.5 – 0.75, 0.75-1.0, 1.0 – 1.25, 1.25-1.5, 1.5 – 1.75, and 1.75 – 2.0 meters and read at a 15-m distance were calculated. Average (\pm 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 then 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 (\pm 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 (\pm std dev). Appendix 2 lists habitat parameter values recorded for each plot.

Results

Bird Surveys

Forty-nine bird species were recorded during the breeding bird surveys at GWCA in 2008 (Table 2). Twenty-six of the 49 species recorded are classified as permanent residents (Stokes and Stokes 1996). Twenty-two species are classified as summer residents, with the remaining species classified as a winter resident. Three species, the Belted kingfisher (*Ceryle alcyon*), Great blue heron (*Ardea herodias*), and Scissor-tailed flycatcher (*Tyrannus forficatus*), were only observed outside the 5-min survey periods. Six species—the Brown thrasher (*Toxostoma rufum*), Carolina wren (*Thryothorus ludovicianus*), Dickcissel (*Spiza americana*), Indigo bunting (*Passerina cyanea*), Kentucky warbler (*Oporornis formosus*), and Red-bellied woodpecker (*Melanerpes carolinus*)—are considered species of continental importance (Rich et al. 2004). Three species—Dickcissel, Eastern meadowlark (*Sturnella magna*), and Grasshopper sparrow (*Ammodramus savannarum*)—are grassland obligates. No woodland obligate species were recorded.

The Dickcissel 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 Brown-headed cowbird (*Molothrus ater*), Indigo bunting (*Passerina cyanea*), Carolina wren (*Thryothorus ludovicianus*), and Northern cardinal (*Cardinalis cardinalis*) were moderately abundant. Eleven species—the American woodcock (*Scolopax minor*), Common nighthawk (*Chordeiles minor*), Eastern phoebe (*Sayornis phoebe*), House sparrow (*Passer domesticus*), Killdeer (*Charadrius vociferous*), Purple martin (*Progne subis*), Red-eyed vireo (*Vireo olivaceus*), Red-shouldered hawk (*Buteo lineatus*), Red-tailed hawk (*Buteo jamaicensis*), Song sparrow (*Melospiza melodia*), and Turkey vulture (*Cathartes aura*)—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 Dickcissel had the highest park-wide density of any species. The American goldfinch (*Carduelis tristis*) had the highest density for plots occupied, followed by the Carolina chickadee (*Parus carolinensis*) and Killdeer. 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 were calculated for bird communities in grassland and woodland habitats (Figure 3). Species richness and diversity were slightly higher in woodland habitat than grassland. However, species distribution evenness within diversity measures was equal between habitats.

Table 2. Bird species recorded during breeding bird surveys at George Washington Carver National Monument, 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	<i>Corvus brachyrhynchos</i>	AMCR	R
American goldfinch	<i>Carduelis tristis</i>	AMGO	R
American robin	<i>Turdus migratorius</i>	AMRO	R
American woodcock	<i>Scolopax minor</i>	AMWO	SR
Barn swallow	<i>Hirundo rustica</i>	BARS	SR
Belted kingfisher*	<i>Ceryle alcyon</i>	BEKI	R
Blue jay	<i>Cyanocitta cristata</i>	BLJA	R
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	BGGN	SR
Brown thrasher	<i>Toxostoma rufum</i>	BRTH	R
Brown-headed cowbird	<i>Molothrus ater</i>	BHCO	R
Carolina chickadee	<i>Parus carolinensis</i>	CACH	R
Carolina wren	<i>Thryothorus ludovicianus</i>	CARW	R
Chipping sparrow	<i>Spizella passerina</i>	CHSP	SR
Common nighthawk	<i>Chordeiles minor</i>	CONI	SR
Common yellowthroat	<i>Geothlypis trichas</i>	COYE	SR
Dickcissel	<i>Spiza americana</i>	DICK	SR
Downy woodpecker	<i>Picoides pubescens</i>	DOWO	R
Eastern bluebird	<i>Sialia sialis</i>	EABL	R
Eastern kingbird	<i>Tyrannus tyrannus</i>	EAKI	SR
Eastern meadowlark	<i>Sturnella magna</i>	EAME	R
Eastern phoebe	<i>Sayornis phoebe</i>	EAPH	R
Eastern wood-pewee	<i>Contopus virens</i>	EAWP	SR
Field sparrow	<i>Spizella pusilla</i>	FISP	R
Grasshopper sparrow	<i>Ammodramus savannarum</i>	GRSP	SR
Great blue heron*	<i>Ardea herodias</i>	GBHE	R
Great crested flycatcher	<i>Myiarchus crinitus</i>	GCFL	SR
House sparrow	<i>Passer domesticus</i>	HOSP	R
Indigo bunting	<i>Passerina cyanea</i>	INBU	SR
Kentucky warbler	<i>Oporornis formosus</i>	KEWA	SR
Killdeer	<i>Charadrius vociferous</i>	KILL	R
Lark sparrow	<i>Chondestes grammacus</i>	LASP	SR
Northern bobwhite	<i>Colinus virginianus</i>	NOBO	R
Northern cardinal	<i>Cardinalis cardinalis</i>	NOCA	R
Northern mockingbird	<i>Mimus polyglottos</i>	NOMO	R
Northern parula	<i>Parula americana</i>	NOPA	SR
Pileated woodpecker	<i>Dryocopus pileatus</i>	PIWO	R
Purple martin	<i>Progne subis</i>	PUMA	SR
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	RBWO	R
Red-eyed vireo	<i>Vireo olivaceus</i>	REVI	SR
Red-shouldered hawk	<i>Buteo lineatus</i>	RSHA	R
Red-tailed hawk	<i>Buteo jamaicensis</i>	RTHA	R
Ruby-throated hummingbird	<i>Archilochus colubris</i>	RTHU	SR

Table 2. Bird species recorded during breeding bird surveys at George Washington Carver National Monument, 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
Scissor-tailed flycatcher*	<i>Tyrannus forficatus</i>	STFL	SR
Song sparrow	<i>Melospiza melodia</i>	SOSP	WR
Summer tanager	<i>Piranga rubra</i>	SUTA	SR
Turkey vulture	<i>Cathartes aura</i>	TUVU	R
(Eastern) Tufted titmouse	<i>Baeolophus bicolor</i>	ETTI	R
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	YBCU	SR
Yellow-breasted chat	<i>Icteria virens</i>	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 70 plots, for bird species recorded at George Washington Carver National Monument, 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	<i>Corvus brachyrhynchos</i>	AMCR	0.06
American goldfinch	<i>Carduelis tristis</i>	AMGO	0.11
American robin	<i>Turdus migratorius</i>	AMRO	0.13
American woodcock	<i>Scolopax minor</i>	AMWO	0.01
Barn swallow	<i>Hirundo rustica</i>	BARS	0.10
Blue jay	<i>Cyanocitta cristata</i>	BLJA	0.09
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	BGGN	0.17
Brown thrasher	<i>Toxostoma rufum</i>	BRTH	0.14
Brown-headed cowbird	<i>Molothrus ater</i>	BHCO	0.41
Carolina chickadee	<i>Parus carolinensis</i>	CACH	0.06
Carolina wren	<i>Thryothorus ludovicianus</i>	CARW	0.33
Chipping sparrow	<i>Spizella passerina</i>	CHSP	0.03
Common nighthawk	<i>Chordeiles minor</i>	CONI	0.01
Common yellowthroat	<i>Geothlypis trichas</i>	COYE	0.07
Dickcissel	<i>Spiza americana</i>	DICK	0.87
Downy woodpecker	<i>Picoides pubescens</i>	DOWO	0.03
Eastern bluebird	<i>Sialia sialis</i>	EABL	0.07
Eastern kingbird	<i>Tyrannus tyrannus</i>	EAKI	0.07
Eastern meadowlark	<i>Sturnella magna</i>	EAME	0.17
Eastern phoebe	<i>Sayornis phoebe</i>	EAPH	0.01
Eastern wood-pewee	<i>Contopus virens</i>	EAWP	0.14
Field sparrow	<i>Spizella pusilla</i>	FISP	0.17
Grasshopper sparrow	<i>Ammodramus savannarum</i>	GRSP	0.20
Great crested flycatcher	<i>Myiarchus crinitus</i>	GCFL	0.03
House sparrow	<i>Passer domesticus</i>	HOSP	0.01
Indigo bunting	<i>Passerina cyanea</i>	INBU	0.36
Kentucky warbler	<i>Oporornis formosus</i>	KEWA	0.04
Killdeer	<i>Charadrius vociferous</i>	KILL	0.03
Lark sparrow	<i>Chondestes grammacus</i>	LASP	0.03
Northern bobwhite	<i>Colinus virginianus</i>	NOBO	0.21
Northern cardinal	<i>Cardinalis cardinalis</i>	NOCA	0.34
Northern mockingbird	<i>Mimus polyglottos</i>	NOMO	0.07
Northern parula	<i>Parula americana</i>	NOPA	0.13
Pileated woodpecker	<i>Dryocopus pileatus</i>	PIWO	0.06
Purple martin	<i>Progne subis</i>	PUMA	0.01
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	RBWO	0.13
Red-eyed vireo	<i>Vireo olivaceus</i>	REVI	0.01
Red-shouldered hawk	<i>Buteo lineatus</i>	RSHA	0.01
Red-tailed hawk	<i>Buteo jamaicensis</i>	RTHA	0.01
Ruby-throated hummingbird	<i>Archilochus colubris</i>	RTHU	0.03
Song sparrow	<i>Melospiza melodia</i>	SOSP	0.01

Table 3. Number of individuals encountered per plot visit, over all 70 plots, for bird species recorded at George Washington Carver National Monument, 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
Summer tanager	<i>Piranga rubra</i>	SUTA	0.04
Turkey vulture	<i>Cathartes aura</i>	TUVU	0.01
(Eastern) Tufted titmouse	<i>Baeolophus bicolor</i>	ETTI	0.06
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	YBCU	0.11
Yellow-breasted chat	<i>Icteria virens</i>	YBCH	0.03

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

Table 4. Proportion of plots (out of 70) occupied by bird species (including flyovers) at George Washington Carver National Monument, Missouri during the 2008 breeding bird surveys.

Common name	Species name	AOU code	Proportion of plots occupied
American crow	<i>Corvus brachyrhynchos</i>	AMCR	0.06
American goldfinch	<i>Carduelis tristis</i>	AMGO	0.06
American robin	<i>Turdus migratorius</i>	AMRO	0.11
American woodcock	<i>Scolopax minor</i>	AMWO	0.01
Barn swallow	<i>Hirundo rustica</i>	BARS	0.10
Blue jay	<i>Cyanocitta cristata</i>	BLJA	0.07
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	BGGN	0.11
Brown thrasher	<i>Toxostoma rufum</i>	BRTH	0.09
Brown-headed cowbird	<i>Molothrus ater</i>	BHCO	0.30
Carolina chickadee	<i>Parus carolinensis</i>	CACH	0.03
Carolina wren	<i>Thryothorus ludovicianus</i>	CARW	0.27
Chipping sparrow	<i>Spizella passerina</i>	CHSP	0.03
Common nighthawk	<i>Chordeiles minor</i>	CONI	0.01
Common yellowthroat	<i>Geothlypis trichas</i>	COYE	0.07
Dickcissel	<i>Spiza americana</i>	DICK	0.46
Downy woodpecker	<i>Picoides pubescens</i>	DOWO	0.03
Eastern bluebird	<i>Sialia sialis</i>	EABL	0.04
Eastern kingbird	<i>Tyrannus tyrannus</i>	EAKI	0.06
Eastern meadowlark	<i>Sturnella magna</i>	EAME	0.14
Eastern phoebe	<i>Sayornis phoebe</i>	EAPH	0.01
Eastern wood-pewee	<i>Contopus virens</i>	EAWP	0.11
Field sparrow	<i>Spizella pusilla</i>	FISP	0.16
Grasshopper sparrow	<i>Ammodramus savannarum</i>	GRSP	0.20
Great crested flycatcher	<i>Myiarchus crinitus</i>	GCFL	0.03
House sparrow	<i>Passer domesticus</i>	HOSP	0.01
Indigo bunting	<i>Passerina cyanea</i>	INBU	0.29
Kentucky warbler	<i>Oporornis formosus</i>	KEWA	0.04
Killdeer	<i>Charadrius vociferous</i>	KILL	0.01
Lark sparrow	<i>Chondestes grammacus</i>	LASP	0.03
Northern bobwhite	<i>Colinus virginianus</i>	NOBO	0.17
Northern cardinal	<i>Cardinalis cardinalis</i>	NOCA	0.24
Northern mockingbird	<i>Mimus polyglottos</i>	NOMO	0.04
Northern parula	<i>Parula americana</i>	NOPA	0.11
Pileated woodpecker	<i>Dryocopus pileatus</i>	PIWO	0.06
Purple martin	<i>Progne subis</i>	PUMA	0.01
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	RBWO	0.11
Red-eyed vireo	<i>Vireo olivaceus</i>	REVI	0.01
Red-shouldered hawk	<i>Buteo lineatus</i>	RSHA	0.01
Red-tailed hawk	<i>Buteo jamaicensis</i>	RTHA	0.01
Ruby-throated hummingbird	<i>Archilochus colubris</i>	RTHU	0.03
Song sparrow	<i>Melospiza melodia</i>	SOSP	0.01
Summer tanager	<i>Piranga rubra</i>	SUTA	0.04

Table 4. Proportion of plots (out of 70) occupied by bird species (including flyovers) at George Washington Carver National Monument, Missouri during the 2008 breeding bird surveys (continued).

Common name	Species name	AOU code	Proportion of plots occupied
Turkey vulture	<i>Cathartes aura</i>	TUVU	0.01
(Eastern) Tufted titmouse	<i>Baeolophus bicolor</i>	ETTI	0.06
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	YBCU	0.11
Yellow-breasted chat	<i>Icteria virens</i>	YBCH	0.03

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

Table 5. Average density (\pm std. dev.) of bird species at George Washington Carver National Monument, Missouri during the 2008 breeding bird surveys. Species densities are only for individuals recorded within 100-m of plot center during a 5-min survey, excluding flyovers.

Common name	Species name	AOU code	2008 Individuals / ha
American goldfinch	<i>Carduelis tristis</i>	AMGO	0.03 (0.15)
American robin	<i>Turdus migratorius</i>	AMRO	0.02 (0.08)
American woodcock	<i>Scolopax minor</i>	AMWO	0.01 (0.04)
Blue jay	<i>Cyanocitta cristata</i>	BLJA	0.01 (0.08)
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	BGGN	0.06 (0.17)
Brown thrasher	<i>Toxostoma rufum</i>	BRTH	0.04 (0.15)
Brown-headed cowbird	<i>Molothrus ater</i>	BHCO	0.10 (0.28)
Carolina chickadee	<i>Parus carolinensis</i>	CACH	0.01 (0.08)
Carolina wren	<i>Thryothorus ludovicianus</i>	CARW	0.09 (0.18)
Chipping sparrow	<i>Spizella passerina</i>	CHSP	0.01 (0.05)
Common yellowthroat	<i>Geothlypis trichas</i>	COYE	0.01 (0.05)
Dickcissel	<i>Spiza americana</i>	DICK	0.25 (0.34)
Downy woodpecker	<i>Picoides pubescens</i>	DOWO	0.01 (0.05)
Eastern bluebird	<i>Sialia sialis</i>	EABL	0.02 (0.11)
Eastern kingbird	<i>Tyrannus tyrannus</i>	EAKI	0.01 (0.08)
Eastern meadowlark	<i>Sturnella magna</i>	EAME	0.04 (0.12)
Eastern wood-pewee	<i>Contopus virens</i>	EAWP	0.03 (0.11)
Field sparrow	<i>Spizella pusilla</i>	FISP	0.03 (0.10)
Grasshopper sparrow	<i>Ammodramus savannarum</i>	GRSP	0.06 (0.13)
Great crested flycatcher	<i>Myiarchus crinitus</i>	GCFL	0.01 (0.05)
House sparrow	<i>Passer domesticus</i>	HOSP	0.01 (0.04)
Indigo bunting	<i>Passerina cyanea</i>	INBU	0.11 (0.20)
Kentucky warbler	<i>Oporornis formosus</i>	KEWA	0.01 (0.07)
Killdeer	<i>Charadrius vociferous</i>	KILL	0.01 (0.08)
Lark sparrow	<i>Chondestes grammacus</i>	LASP	0.01 (0.04)
Northern bobwhite	<i>Colinus virginianus</i>	NOBO	0.04 (0.10)
Northern cardinal	<i>Cardinalis cardinalis</i>	NOCA	0.10 (0.21)
Northern mockingbird	<i>Mimus polyglottos</i>	NOMO	0.02 (0.09)
Northern parula	<i>Parula americana</i>	NOPA	0.04 (0.12)
Pileated woodpecker	<i>Dryocopus pileatus</i>	PIWO	0.01 (0.05)
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	RBWO	0.03 (0.09)
Red-eyed vireo	<i>Vireo olivaceus</i>	REVI	0.01 (0.04)
Ruby-throated hummingbird	<i>Archilochus colubris</i>	RTHU	0.01 (0.04)
Song sparrow	<i>Melospiza melodia</i>	SOSP	0.01 (0.04)
Summer tanager	<i>Piranga rubra</i>	SUTA	0.01 (0.05)
(Eastern) Tufted titmouse	<i>Baeolophus bicolor</i>	ETTI	0.01 (0.07)
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	YBCU	0.02 (0.08)
Yellow-breasted chat	<i>Icteria virens</i>	YBCH	0.01 (0.05)

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

Table 6. Average bird density (\pm std. dev.) for plots occupied by species at George Washington Carver National Monument, Missouri during the 2008 breeding bird surveys. Species densities are only 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 goldfinch	<i>Carduelis tristis</i>	AMGO	0.74 (0.18)
American robin	<i>Turdus migratorius</i>	AMRO	0.32 (0.00)
American woodcock	<i>Scolopax minor</i>	AMWO	0.32
Blue jay	<i>Cyanocitta cristata</i>	BLJA	0.48 (0.23)
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	BGGN	0.48 (0.24)
Brown thrasher	<i>Toxostoma rufum</i>	BRTH	0.51 (0.28)
Brown-headed cowbird	<i>Molothrus ater</i>	BHCO	0.56 (0.45)
Carolina chickadee	<i>Parus carolinensis</i>	CACH	0.64
Carolina wren	<i>Thryothorus ludovicianus</i>	CARW	0.40 (0.15)
Chipping sparrow	<i>Spizella passerina</i>	CHSP	0.32 (0.00)
Common yellowthroat	<i>Geothlypis trichas</i>	COYE	0.32 (0.00)
Dickcissel	<i>Spiza americana</i>	DICK	0.56 (0.28)
Downy woodpecker	<i>Picoides pubescens</i>	DOWO	0.32 (0.00)
Eastern bluebird	<i>Sialia sialis</i>	EABL	0.53 (0.18)
Eastern kingbird	<i>Tyrannus tyrannus</i>	EAKI	0.48 (0.26)
Eastern meadowlark	<i>Sturnella magna</i>	EAME	0.36 (0.12)
Eastern wood-pewee	<i>Contopus virens</i>	EAWP	0.37 (0.13)
Field sparrow	<i>Spizella pusilla</i>	FISP	0.32 (0.00)
Grasshopper sparrow	<i>Ammodramus savannarum</i>	GRSP	0.32 (0.00)
Great crested flycatcher	<i>Myiarchus crinitus</i>	GCFL	0.32 (0.00)
House sparrow	<i>Passer domesticus</i>	HOSP	0.32
Indigo bunting	<i>Passerina cyanea</i>	INBU	0.41 (0.18)
Kentucky warbler	<i>Oporornis formosus</i>	KEWA	0.32 (0.00)
Killdeer	<i>Charadrius vociferous</i>	KILL	0.64
Lark sparrow	<i>Chondestes grammacus</i>	LASP	0.32
Northern bobwhite	<i>Colinus virginianus</i>	NOBO	0.32 (0.00)
Northern cardinal	<i>Cardinalis cardinalis</i>	NOCA	0.48 (0.17)
Northern mockingbird	<i>Minus polyglottos</i>	NOMO	0.43 (0.18)
Northern parula	<i>Parula americana</i>	NOPA	0.36 (0.12)
Pileated woodpecker	<i>Dryocopus pileatus</i>	PIWO	0.32 (0.00)
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	RBWO	0.32 (0.00)
Red-eyed vireo	<i>Vireo olivaceus</i>	REVI	0.32
Ruby-throated hummingbird	<i>Archilochus colubris</i>	RTHU	0.32
Song sparrow	<i>Melospiza melodia</i>	SOSP	0.32
Summer tanager	<i>Piranga rubra</i>	SUTA	0.32 (0.00)
(Eastern) Tufted titmouse	<i>Baeolophus bicolor</i>	ETTI	0.32 (0.00)
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	YBCU	0.32 (0.00)
Yellow-breasted chat	<i>Icteria virens</i>	YBCH	0.32 (0.00)

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

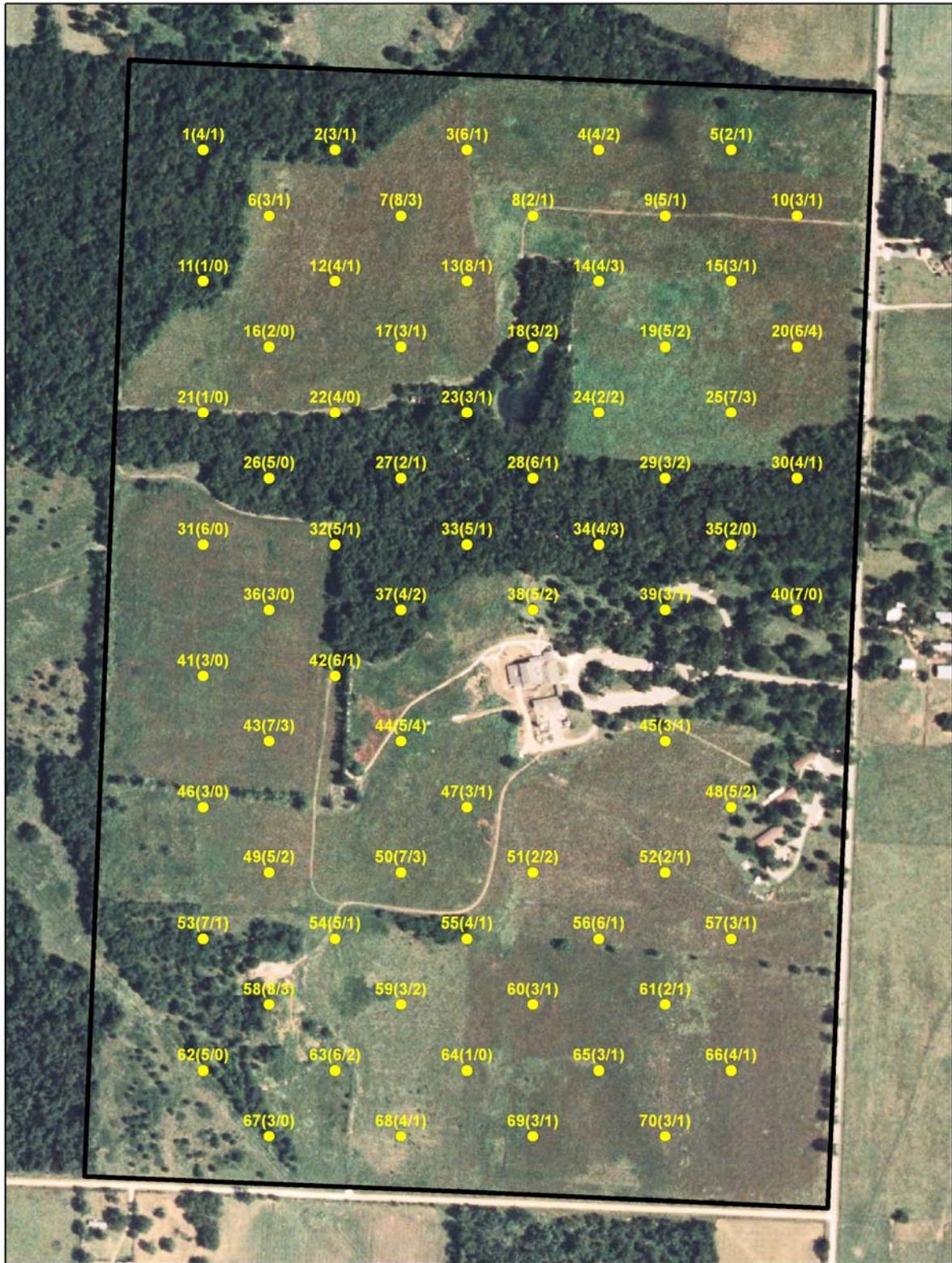


Figure 2. Bird species richness and the richness of species of continental importance for each plot on George Washington Carver National Monument, Missouri, in 2008

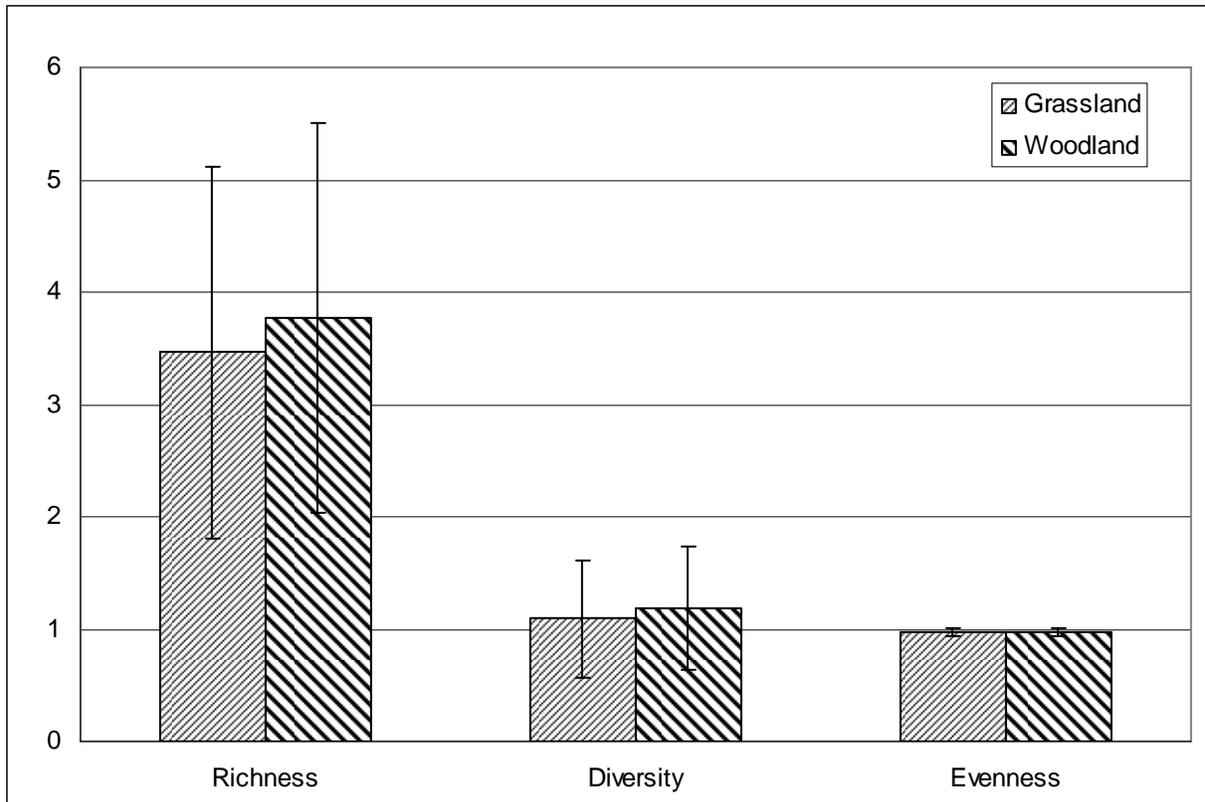


Figure 3. Average (\pm std dev) species richness, diversity, and species distribution evenness values for the bird communities at George Washington Carver National Monument, Missouri during the breeding seasons of 2008.

Bird Habitat

Abiotic features of plots sampled for breeding birds and habitat composition are given in Table 7. Slope and aspect variability were low to medium for plots sampled, except for high slope variability on plot one. All plots were located on level to mid-slope topographic positions, except for plots 23, 25, and 26 which were located in a shallow draws. Slope across all survey plots was $\leq 7^\circ$.

Bird habitat sampled consisted of the grassland (67.7 ha) and woodland (25.0 ha) types. Bird survey plots in the grassland habitat average over 75% field/prairie and 13% brome/fescue, with smaller amounts of other habitat types present (Table 8). Survey plots in the woodland habitat average over 47% upland woodland and 21% riparian woodland, with smaller amounts of other habitat types present. Canopy cover averaged over 85% in the woodland habitat, but only 5% in the grassland habitat. All canopy cover was from hardwood trees. Basal area from hardwood trees averaged 7.5 m²/ha in the woodland habitat, but only 0.3 m²/ha in the grassland habitat. Hardwood tree species from nine different families contributed to the canopy cover and basal area (Table 9). Tree species from the family *Cupressaceae* accounted for the limited amount of conifer litter observed.

In the grassland habitat, the highest horizontal vegetation covers observed occurred in profile classes below 0.75 meter when read from a 15-m distance (Table 8, also see Appendix 2). In the

woodland habitat, the highest horizontal vegetation covers observed occurred in profile classes below 1.25 meter. However, vegetation cover was recorded for all height classes in both habitat types. In spite of good horizontal vegetation cover, the average vertical structure diversity estimate in grassland habitat, 11%, appears to be low. In the woodland habitat the vertical structure diversity estimate is 36%.

Deciduous litter was the most prominent litter type recorded in the woodland habitat, followed closely by grass litter (Table 8). Grass litter dominated the litter type recorded in the grassland habitat. Ground cover was mostly unvegetated and bare soil in both habitat types. Forbs, cool season grasses, and warm season grasses contributed the greatest amount to live foliar cover in the grassland habitat. Woody shrubs and vines, forbs, and cool season grasses contributed the greatest amount to live foliar cover in the woodland habitat. Total foliar coverage averaged 36% across plots in the grassland habitat, and 53% in the woodland habitat.

Table 7. Abiotic features of 50-m radius plots sampled for breeding birds at George Washington Carver National Monument, Missouri.

Plot number	Slope (^o)	Slope variability	Aspect (^o)	Aspect variability	Topographic position	Habitat type
GWCATweety1	2	high	132	medium	mid-slope	Woodland
GWCATweety2	1	low	311	low	lower-slope	Woodland
GWCATweety3	2	low	249	low	lower-slope	Grassland
GWCATweety4	1	low	294	low	lower-slope	Grassland
GWCATweety5	2	low	201	low	lower-slope	Grassland
GWCATweety6	2	low	283	low	lower-slope	Grassland
GWCATweety7	1	low	229	low	lower-slope	Grassland
GWCATweety8	1	low	270	low	lower-slope	Grassland
GWCATweety9	2	low	136	low	lower-slope	Grassland
GWCATweety10	1	low	235	low	lower-slope	Grassland
GWCATweety11	1	medium	149	low	lower-slope	Woodland
GWCATweety12	1	low	240	low	level	Grassland
GWCATweety13	2	low	210	low	lower-slope	Grassland
GWCATweety14	2	low	173	low	lower-slope	Grassland
GWCATweety15	1	low	229	low	lower-slope	Grassland
GWCATweety16	1	low	235	low	level	Grassland
GWCATweety17	1	low	236	low	level	Grassland
GWCATweety18	3	low	105	low	level	Woodland
GWCATweety19	1	low	220	low	lower-slope	Grassland
GWCATweety20	1	low	190	low	lower-slope	Grassland
GWCATweety21	1	low	230	low	level	Grassland
GWCATweety22	1	low	228	low	level	Grassland
GWCATweety23	1	low	254	low	draw	Woodland
GWCATweety24	1	low	239	low	lower-slope	Grassland
GWCATweety25	1	low	225	low	lower-slope	Grassland
GWCATweety26	1	low	347	low	draw	Woodland
GWCATweety27	4	low	276	low	draw	Woodland
GWCATweety28	2	low	184	low	level	Woodland
GWCATweety29	1	low	194	low	level	Woodland
GWCATweety30	1	low	178	low	level	Woodland
GWCATweety31	1	low	335	low	lower-slope	Grassland
GWCATweety32	1	low	344	low	lower-slope	Grassland
GWCATweety33	3	medium	314	low	lower-slope	Woodland
GWCATweety34	7	low	1	low	lower-slope	Woodland
GWCATweety35	2	low	349	low	lower-slope	Woodland

Table 7. Abiotic features of 50-m radius plots sampled for breeding birds at George Washington Carver National Monument, Missouri (continued).

Plot number	Slope (^o)	Slope variability	Aspect (^o)	Aspect variability	Topographic position	Habitat type
GWCATweety36	1	low	309	low	level	Grassland
GWCATweety37	4	low	334	low	lower-slope	Woodland
GWCATweety38	1	low	359	low	mid-slope	Grassland
GWCATweety39	2	low	4	low	mid-slope	Woodland
GWCATweety40	3	low	281	low	mid-slope	Woodland
GWCATweety41	1	low	304	low	lower-slope	Grassland
GWCATweety42	2	low	304	low	lower-slope	Grassland
GWCATweety43	2	low	316	low	lower-slope	Grassland
GWCATweety44	3	low	313	low	mid-slope	Grassland
GWCATweety45	2	low	298	low	mid-slope	Grassland
GWCATweety46	1	low	277	low	lower-slope	Grassland
GWCATweety47	2	low	24	low	mid-slope	Grassland
GWCATweety48	1	low	295	low	lower-slope	Grassland
GWCATweety49	2	low	244	low	lower-slope	Grassland
GWCATweety50	4	low	235	low	mid-slope	Grassland
GWCATweety51	1	low	169	low	lower-slope	Grassland
GWCATweety52	1	low	224	low	lower-slope	Grassland
GWCATweety53	0	low	281	low	level	Woodland
GWCATweety54	2	low	233	low	lower-slope	Grassland
GWCATweety55	4	low	180	low	lower-slope	Grassland
GWCATweety56	2	low	230	low	lower-slope	Grassland
GWCATweety57	1	low	226	low	lower-slope	Grassland
GWCATweety58	1	low	181	low	lower-slope	Woodland
GWCATweety59	1	low	208	low	lower-slope	Grassland
GWCATweety60	1	low	198	low	lower-slope	Grassland
GWCATweety61	1	low	234	low	lower-slope	Grassland
GWCATweety62	2	low	332	low	level	Grassland
GWCATweety63	1	low	242	low	lower-slope	Grassland
GWCATweety64	1	low	218	low	lower-slope	Grassland
GWCATweety65	1	low	234	low	lower-slope	Grassland
GWCATweety66	2	low	254	low	lower-slope	Grassland
GWCATweety67	3	low	344	low	level	Grassland
GWCATweety68	1	low	211	low	lower-slope	Grassland
GWCATweety69	1	low	229	low	lower-slope	Grassland
GWCATweety70	1	low	238	low	lower-slope	Grassland

Table 8. Averages (\pm std dev) for habitat parameters at George Washington Carver National Monument, 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	Grassland		Woodland	
	Mean	Std dev	Mean	Std dev
50 meter plot coverage				
Woodland (%)	1.84	(9.06)	47.50	(36.56)
Riparian Woodland (%)	1.30	(5.89)	21.39	(35.43)
Shrubland / Tree Line (%)	0.40	(2.14)	1.00	(3.56)
Field / Prairie (%)	75.19	(36.93)	5.11	(9.82)
Brome / Fescue (%)	13.27	(30.34)	4.17	(12.13)
Lawn (%)	2.5	(10.32)	9.22	(24.05)
Road / Parking Lot (%)	2.21	(5.14)	1.03	(3.56)
Path / Trail / Sidewalk (%)	0.35	(2.11)	3.69	(6.29)
Pond (%)	0.00	(0.00)	2.11	(8.83)
Stream (%)	0.40	(2.14)	4.50	(6.77)
Seep (%)	0.35	(2.11)	0.83	(3.54)
5 meter subplot				
Canopy cover				
Hardwood (%)	5.57	(17.72)	85.31	(21.79)
Conifer (%)	0.00	(0.00)	0.00	(0.00)
Total cover (%)	5.57	(17.72)	85.31	(21.79)
Canopy Height				
Hardwood (m)	1.73	(4.60)	18.63	(6.17)
Conifer (m)	0.00	(0.00)	0.00	(0.00)
Basal Area				
Hardwood (m ² /ha)	0.25	(0.79)	7.50	(3.88)
Conifer (m ² /ha)	0.00	(0.00)	0.00	(0.00)
Horizontal vegetation profile at 15-m				
0.00 – 0.25 m (%)	93.13	(14.86)	87.67	(28.69)
0.25 – 0.50 m (%)	62.89	(36.47)	84.72	(31.90)
0.50 – 0.75 m (%)	13.16	(27.43)	62.14	(42.17)
0.75 – 1.00 m (%)	8.58	(24.86)	59.67	(42.81)
1.00 – 1.25 m (%)	3.96	(16.58)	45.67	(42.42)
1.25 – 1.5 m (%)	4.95	(20.60)	43.56	(45.19)
1.50 – 1.75 m (%)	4.47	(19.49)	42.42	(45.33)
1.75 – 2.00 m (%)	5.38	(22.02)	38.50	(45.81)
Vertical structure diversity (%)	11.41	(10.00)	35.59	(17.16)
1.78 meter sample plot coverage				
Deciduous litter (%)	1.47	(5.53)	18.14	(26.06)
Conifer litter (%)	0.00	(0.00)	0.03	(0.12)
Grass litter (%)	31.49	(31.03)	15.39	(20.73)
Bare soil (%)	54.07	(30.94)	49.92	(32.40)
Rock (%)	0.62	(2.15)	6.47	(22.99)
Woody debris (%)	0.16	(0.59)	3.86	(5.27)
Unvegetated (%)	87.88	(5.32)	82.64	(10.09)
Warm-season grass (%)	6.44	(10.34)	0.03	(0.12)
Cool-season grass (%)	8.86	(12.49)	12.93	(15.67)
Forb (%)	13.25	(14.56)	17.94	(19.49)

Tables 8. Averages (\pm std dev) for habitat parameters at George Washington Carver National Monument, 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	Mean	Std dev
Moss and lichen (%)	0.28	(0.46)	3.67	(5.36)
Woody shrub and vine (%)	3.68	(7.88)	19.83	(21.00)
Tree seedling (%)	0.06	(0.42)	0.58	(1.13)
Total foliar (%)	36.40	(15.54)	53.36	(22.93)

Table 9. Stems per hectare of trees by size class found on George Washington Carver National Monument, 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
Cornaceae	1.88	0.00	0.00	0.00	0.00	0.00	0.00
Cupressaceae	0.00	1.82	0.00	0.00	0.00	0.00	0.00
Fabaceae	7.28	5.46	9.09	14.55	0.00	3.64	0.00
Fagaceae	0.00	0.00	1.82	0.00	0.00	1.82	0.00
Juglandaceae	0.00	7.28	10.91	3.64	14.55	9.09	0.00
Moraceae	0.00	0.00	0.00	1.82	0.00	0.00	0.00
Oleaceae	0.00	7.28	14.55	0.00	7.28	0.00	0.00
Platanaceae	0.00	0.00	0.00	0.00	0.00	0.00	1.82
Rosaceae	0.00	5.46	3.64	0.00	0.00	0.00	0.00
Ulmaceae	10.91	36.38	112.77	40.02	5.46	3.64	3.64
Total stems	20.01	63.66	152.79	60.02	27.28	18.19	5.46
Snags	0.00	3.64	20.01	3.64	0.00	0.00	0.00

Discussion

Bird surveys and habitat assessment work were initiated at George Washington Carver National Monument, Missouri in 2008, to assist the park in assessing the integrity of their grasslands and woodlands through time. Forty-eight of the 49 bird species recorded during the breeding bird surveys are permanent or summer residents to the area (Stokes and Stokes 1996). Therefore, these 48 species have some value in characterizing the breeding bird community of GWCA. Changes in the number of the most common and widely distributed species in the park—the Dickcissel, Brown-headed cowbird, Indigo bunting, Carolina wren, and Northern cardinal—will serve as better species 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. Less common and widely distributed species will likely occur so infrequently that strong species-habitat relationships may not be established.

Grassland dominates the bird habitat at GWCA by nearly three to one. However, the woodland habitat provides critical habitat for a number of birds and the rich mix of woodland and grassland

habitat types, along with the other habitat types present, positively influenced the number of bird species observed. The only habitat obligate species recorded were the grassland obligates, Dickcissel, Eastern Meadowlark, and Grasshopper sparrow. The remaining 45 resident species are habitat generalist or edge species, favored by the mix and positioning of habitats on the park. Habitat diversity (structural composition) is especially important for the high priority species, as their microhabitat requirements vary (Pashley and Barrow 1993). For example, Red-bellied woodpeckers prefer woodlands and urban/suburban forest, and Kentucky warblers 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 six species of continental importance deserve extra scrutiny each time a survey is completed. Although the 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 burned. Our baseline data suggests that three of the six species of continental importance (i.e. Dickcissel, Indigo bunting, and Carolina wren) occur frequently enough at GWCA 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: Dickcissel, prairie and weedy fields; Indigo buntings, brush and low trees of overgrown fields; and Carolina wrens, woodland understory (Stokes and Stokes 1996).

The Northern cardinal, one of the most common species not of continental importance, 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 Dickcissel, Indigo bunting, and Carolina wren, 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. In Figure 2, areas of grassland and woodland habitat are readily distinguished. 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 (i.e., Dickcissel in tallgrass prairie).

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 GWCA appear to be slightly low to normal. Similar species richness, diversity, and distribution evenness values between habitats are the result of the many bird species occupying both habitat types. Average species richness on plots surveyed in the grassland habitat is just over 4.0 individuals, and 4.3 individuals in the woodland habitat. Our distribution evenness values suggest that a number of breeding species contributed significantly to diversity measures in both habitat types. 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 George Washington Carver National Monument, 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.

P L O T	Species Code																																		
	A M C R O	A M G R O	A M R O	A M W O	B A R S N	B G G O	B H C O	B L J A H	B R T H	C A C H W	C H S P	C O N I E	C O Y C K	D O W L O	E A B L I	E A K M E	E A P H	E A W P I	E T S P	F I S P	G C F L	G R S P	H O S P	I N B U A	K E W L A	L A S P O	N O B C M A O	N O C M A O	N O P A O	P I W O A	P U M A				
1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		
2	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		
3	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0		
4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0		
5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0		
6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0		
7	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0		
8	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
9	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	1	0	0	0	0	3	0	0	0	0	0		
10	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
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	0	0	0	2	0	0	0	0	0		
12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2		
13	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0		
14	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
15	0	0	0	0	1	0	1	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	
16	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	0	0	1	0	0	0	
17	0	0	1	0	0	0	2	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	
18	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	
19	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	
20	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
21	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	0	0	0	0	0	
22	0	0	0	0	0	2	1	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	
23	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	2	0	0	
24	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	0	0	0	0	
25	1	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	
26	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
28	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	
29	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0

Appendix 1. Bird species counts by plot for George Washington Carver National Monument, 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).

P L O T	Species Code																																							
	A M C R	A M G O	A M R O	A M W O	B A R S	B G N	B H C	B L J	B R T H	C A C	C A R	C H S	C O N	C O Y	C O E	D I C	D O W	E A B	E A K	E A M	E A P	E A W	E T I	F I S	G C F	G R S	H O S	I N B U	K E W A	K I L	L A S	N O B	N O C	N O M	N O P	P I W	P U M			
30	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	0	0	0	2	0	1	1	0		
31	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	
32	0	2	0	0	0	0	1	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	2	0	0	0	0		
33	0	0	0	0	0	1	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	1	0	1	0	0			
34	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	0	2	1	0	0	0	0	0	0	0	0		
35	0	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	0	0	0	0	0	0	0	0	0	0	0	0		
36	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		
37	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0		
38	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
40	0	0	1	0	0	0	0	2	0	2	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	2	0	0	0	0	0		
41	0	0	0	0	0	0	3	0	0	2	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		
42	0	3	0	0	0	0	0	1	0	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	0	0	0	0		
43	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
44	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
45	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
46	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0		
47	0	0	0	0	1	0	0	0	0	0	0	0	0	1	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	
48	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0	0	0		
49	0	0	0	0	0	0	6	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0		
50	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0		
51	0	0	0	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	0	0	0	0	0	0	0	
52	1	0	0	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	0	0	0	0	0	0	0	
53	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0		
54	0	0	0	0	0	0	5	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	
55	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0		
56	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
57	0	0	0	0	0	0	0	0	0	0	0	0	0	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	
58	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	
59	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	
60	0	0	0	0	0	0	2	0	0	0	0	0	0	1	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

Appendix 1. Bird species counts by plot for George Washington Carver National Monument, 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).

P L O T	Species Code																																					
	A M C R	A M G O	A M R O	A M W O	B A R S	B G N	B H O	B L A	B R T H	C A C H	C A R W	C H S P	C O N I	C O Y E	D I C K	D O W N	E A B L	E A K I	E A M P	E A P W	E A T I	E P S F	G C F L	G R S P	H O S P	I N B U	K E W A	K I L P	L A S P	N O B A	N O C A	N O M A	N O P A	P I W O	P U M A			
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	1	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	0	0	2	0	0	0	0	0	0
63	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
64	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	0	0	0	0	0	0	0	0	0
65	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	
67	0	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	0	0	0	1	1	0	0	0	0	0	0	
68	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	0	1	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	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	1	0	0	0	0	0	0	
70	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 1. Bird species counts by plot for George Washington Carver National Monument, 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).

P L O T	Species Code											
	R B W O	R E V I	R S H A	R T H A	R T H U	S O S P	S U T A	T U U	Y B C H	Y B C U	S P P	S C I
1	0	0	0	0	0	0	0	0	0	0	4	1
2	0	0	0	0	0	0	0	0	0	0	3	1
3	0	0	0	0	0	0	0	1	0	0	6	1
4	0	0	0	0	0	0	0	0	0	0	4	2
5	0	0	0	0	0	0	0	0	0	0	2	1
6	1	0	0	0	0	0	0	0	0	0	3	1
7	0	0	0	0	0	0	0	0	0	0	8	3
8	0	0	0	0	0	0	0	0	0	0	2	1
9	0	0	0	0	0	0	0	0	0	0	5	1
10	0	0	0	0	0	0	0	0	0	0	3	1
11	0	0	0	0	0	0	0	0	0	0	1	0
12	0	0	0	0	0	0	0	0	0	0	4	1
13	0	0	0	0	0	0	0	0	0	0	8	1
14	1	0	0	0	0	0	0	0	0	0	4	3
15	0	0	0	0	0	0	0	0	0	0	3	1
16	0	0	0	0	0	0	0	0	0	0	2	0
17	0	0	0	0	0	0	0	0	0	0	3	1
18	0	0	0	0	0	0	0	0	0	1	3	2
19	0	0	0	0	0	0	0	0	0	0	5	2
20	1	0	0	0	0	0	1	0	0	1	6	4
21	0	0	0	0	0	0	0	0	0	0	1	0
22	0	0	0	0	1	0	0	0	0	0	4	0
23	0	0	0	0	0	0	0	0	0	0	3	1
24	0	0	0	0	0	0	0	0	0	0	2	2
25	0	0	0	0	0	0	0	0	0	0	7	3
26	0	0	0	0	0	0	0	0	0	0	5	0
27	0	0	0	0	0	0	0	0	0	0	2	1
28	0	1	0	0	0	0	0	0	0	0	6	1
29	1	0	0	0	0	0	0	0	0	0	3	2

Appendix 1. Bird species counts by plot for George Washington Carver National Monument, 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).

PLOT	Species Code											
	R	R	R	R	R	S	S	T	Y	Y	S	S
	B	E	S	T	T	O	U	U	B	B	P	P
	W	V	H	H	H	S	T	V	C	C	P	C
	O	I	A	A	U	P	A	U	H	U	P	I
30	0	0	0	0	0	0	0	0	0	0	4	1
31	0	0	0	0	0	0	0	0	0	0	6	0
32	0	0	0	0	0	0	0	0	0	1	5	1
33	0	0	0	0	0	0	0	0	0	0	5	1
34	0	0	0	0	0	0	0	0	0	0	4	3
35	0	0	0	0	0	0	1	0	0	0	2	0
36	0	0	0	0	0	0	0	0	0	0	3	0
37	0	0	0	0	0	0	0	0	0	1	4	2
38	0	0	0	0	0	0	1	0	0	0	5	2
39	0	0	0	0	0	0	0	0	0	0	3	1
40	0	0	0	0	0	0	0	0	0	0	7	0
41	0	0	0	0	0	0	0	0	0	0	3	0
42	0	0	0	0	0	1	0	0	0	1	6	1
43	2	0	0	1	0	0	0	0	0	0	7	3
44	1	0	0	0	0	0	0	0	0	0	5	4
45	0	0	0	0	0	0	0	0	0	0	3	1
46	0	0	0	0	0	0	0	0	0	0	3	0
47	0	0	0	0	0	0	0	0	0	0	3	1
48	0	0	0	0	0	0	0	0	0	0	5	2
49	0	0	0	0	0	0	0	0	0	0	5	2
50	0	0	0	0	0	0	0	0	0	1	7	3
51	1	0	0	0	0	0	0	0	0	0	2	2
52	0	0	0	0	0	0	0	0	0	0	2	1
53	0	0	0	0	0	0	0	0	1	1	7	1
54	0	0	0	0	0	0	0	0	0	0	5	1
55	0	0	0	0	0	0	0	0	0	0	4	1
56	0	0	0	0	0	0	0	0	0	0	6	1
57	0	0	0	0	0	0	0	0	0	0	3	1
58	1	0	0	0	1	0	0	0	0	1	8	3
59	0	0	0	0	0	0	0	0	0	0	3	2
60	0	0	0	0	0	0	0	0	0	0	3	1

Appendix 1. Bird species counts by plot for George Washington Carver National Monument, 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).

P L O T	Species Code											
	R B W O	R E V I	R S H A	R T H A	R T H U	S O S P	S U T A	T U U	Y B C H	Y B C U	S P P	S C I
61	0	0	0	0	0	0	0	0	0	0	2	1
62	0	0	0	0	0	0	0	0	1	0	5	0
63	0	0	0	0	0	0	0	0	0	0	6	2
64	0	0	0	0	0	0	0	0	0	0	1	0
65	0	0	0	0	0	0	0	0	0	0	3	1
66	0	0	0	0	0	0	0	0	0	0	4	1
67	0	0	0	0	0	0	0	0	0	0	3	0
68	0	0	1	0	0	0	0	0	0	0	4	1
69	0	0	0	0	0	0	0	0	0	0	3	1
70	0	0	0	0	0	0	0	0	0	0	3	1

SPP = Species Richness

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

Appendix 2. Listed are the measured habitat parameters at George Washington Carver National Monument, Missouri during the 2008 bird breeding season, by plot. 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	Plot														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50 meter plot coverage															
Woodland (%)	62.5	62.5	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	62.5	0.0	0.0	0.0	0.0
Riparian Woodland (%)	15.0	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	0.0
Shrubland / 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	0.0
Field / Prairie (%)	0.0	37.5	97.5	97.5	97.5	97.5	97.5	85.0	97.5	97.5	0.0	97.5	97.5	97.5	97.5
Brome / Fescue (%)	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
Lawn (%)	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
Road / Parking Lot (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	15.0	15.0	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond (%)	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
Stream (%)	3.0	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	0.0
Seep (%)	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 meter subplot															
Canopy cover															
Hardwood (%)	97.5	49.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.8	0.0	0.0	0.0	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 (%)	97.5	49.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.8	0.0	0.0	0.0	0.0
Canopy Height															
Hardwood (m)	11.9	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	0.0	0.0	0.0	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)	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	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	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	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
0.25 – 0.5 m (%)	97.5	97.5	85.0	37.5	97.5	37.5	37.5	85.0	62.5	85.0	97.5	37.5	37.5	85.0	85
0.5 – 0.75 m (%)	3.0	97.5	0.5	0.5	0.5	0.0	0.0	0.5	0.0	0.0	62.5	0.0	0.0	0.5	0.5
0.75 – 1.0 m (%)	15.0	97.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
1.0 – 1.25 m (%)	62.5	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
1.25 – 1.5 m (%)	62.5	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.0	0.0	0.0	0.0	0.0
1.5 – 1.75 m (%)	62.5	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.0	0.0	0.0	0.0	0.0
1.75 – 2.0 m (%)	37.5	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0

Appendix 2. Listed are the measured habitat parameters at George Washington Carver National Monument, Missouri during the 2008 bird breeding season, by plot. 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	Plot														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vertical Profile: Deciduous															
0.0 – 1.0 m (%)	75.0	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0	0.0
1.0 – 2.0 m (%)	50.0	75.0	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
2.0 – 3.0 m (%)	50.0	25.0	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
3.0 – 4.0 m (%)	75.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
4.0 – 5.0 m (%)	75.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0	0.0
5.0 – 6.0 m (%)	75.0	0.0	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
6.0 – 7.0 m (%)	25.0	0.0	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
7.0 – 7.5 m (%)	25.0	0.0	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
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	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
Vertical Profile: Herbaceous															
0.0 – 1.0 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1.0 – 2.0 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
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
1.78 meter sample plot coverage															
Deciduous litter (%)	15.0	15.0	3.0	0.5	0.0	0.5	0.0	0.5	0.5	0.0	15.0	0.5	0.5	0.5	0.5
Conifer litter (%)	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
Grass litter (%)	62.5	37.5	37.5	85.0	85.0	37.5	37.5	85.0	62.5	37.5	37.5	85.0	15.0	62.5	37.5
Bare soil (%)	37.5	37.5	37.5	15.0	15.0	62.5	62.5	15.0	15.0	37.5	15.0	15.0	62.5	37.5	62.5

Appendix 2. Listed are the measured habitat parameters at George Washington Carver National Monument, Missouri during the 2008 bird breeding season, by plot. 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	Plot														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rock (%)	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.5	0.5	3.0	0.0
Woody debris (%)	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.5	0.0	0.0	0.0	0.0
Unvegetated (%)	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	62.5	97.5	85.0	85.0	85.0
Warm-season grass (%)	0.0	0.0	0.5	15.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	3.0	3.0	0.5	3.0
Cool-season grass (%)	15.0	15.0	3.0	0.5	3.0	0.5	0.5	3.0	0.5	0.5	15.0	0.5	3.0	15.0	0.5
Forb (%)	3.0	3.0	37.5	15.0	37.5	37.5	15.0	37.5	62.5	37.5	0.0	3.0	37.5	15.0	15.0
Moss and lichen (%)	0.5	0.5	0.5	0.5	0.0	0.5	3.0	0.0	0.0	0.0	15.0	0.5	0.5	0.5	0.5
Woody shrub and vine (%)	15.0	62.5	15.0	3.0	0.5	0.0	0.0	0.5	3.0	0.0	0.0	0.5	3.0	3.0	3.0
Tree seedling (%)	0.0	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
Total foliar (%)	62.5	85.0	62.5	37.5	37.5	37.5	37.5	62.5	62.5	37.5	3.0	15.0	62.5	37.5	37.5

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Habitat Parameter	Plot														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
50 meter plot coverage															
Woodland (%)	0.0	0.0	37.5	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	97.5	85.0	85.0
Riparian Woodland (%)	0.0	0.0	0.0	0.0	0.0	37.5	0.0	85.0	0.0	0.0	85.0	85.0	0.0	0.0	0.0
Shrubland / 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	0.0
Field / Prairie (%)	97.5	97.5	0.5	97.5	97.5	37.5	62.5	15.0	97.5	97.5	3.0	0.0	0.0	15.0	15.0
Brome / Fescue (%)	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
Lawn (%)	0.0	0.0	15.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road / Parking Lot (%)	0.0	0.0	0.0	0.0	0.0	15.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
Path / Trail / Sidewalk (%)	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	15.0	15.0	0.0	0.0
Pond (%)	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stream (%)	0.0	0.0	0.0	0.0	0.0	3.0	0.0	15.0	0.0	0.0	15.0	15.0	0.0	0.0	0.0
Seep (%)	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	0.0	15.0
5 meter subplot															
Canopy cover															
Hardwood (%)	0.0	0.0	99.32	0.0	0.0	48.36	25.48	83.72	0.0	0.0	94.12	98.54	99.84	95.42	97.5
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 (%)	0.0	0.0	99.32	0.0	0.0	48.36	25.48	83.72	0.0	0.0	94.12	98.54	99.84	95.42	97.5
Canopy Height															
Hardwood (m)	0.0	0.0	17.2	0.0	0.0	13.0	14.8	24.4	0.0	0.0	18.3	22.2	25.9	12.2	18.8
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)	0.0	0.0	5.0	0.0	0.0	2.0	0.0	10.0	0.0	0.0	14.0	7.0	8.0	3.0	7.0
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	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	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
0.25 – 0.5 m (%)	15.0	85.0	62.5	97.5	97.5	62.5	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	0.0	37.5	37.5	3.0	15.0	15.0	62.5	3.0	0.0	97.5	3.0	85.0	97.5	85.0
0.75 – 1.0 m (%)	0.0	0.0	0.5	3.0	0.0	3.0	15.0	62.5	0.0	0.0	97.5	3.0	62.5	97.5	62.5
1.0 – 1.25 m (%)	0.0	0.0	0.0	0.0	0.0	0.5	3.0	62.5	0.0	0.0	37.5	3.0	3.0	97.5	62.5
1.25 – 1.5 m (%)	0.0	0.0	15.0	0.0	0.0	0.0	0.0	97.5	0.0	0.0	15.0	0.0	0.5	97.5	3.0
1.5 – 1.75 m (%)	0.0	0.0	37.5	0.0	0.0	0.0	0.0	97.5	0.0	0.0	0.0	0.0	0.0	97.5	3.0
1.75 – 2.0 m (%)	0.0	0.0	97.5	0.0	0.0	0.0	0.0	97.5	0.0	0.0	0.0	0.5	0.5	97.5	0.0

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Habitat Parameter	Plot														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Vertical Profile: Deciduous															
0.0 – 1.0 m (%)	0.0	0.0	50.0	0.0	0.0	50.0	0.0	100.0	0.0	0.0	100.0	25.0	75.0	50.0	50.0
1.0 – 2.0 m (%)	0.0	0.0	50.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	25.0	0.0	25.0
2.0 – 3.0 m (%)	0.0	0.0	50.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	25.0	25.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	75.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	25.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	50.0	0.0	0.0	25.0	0.0	75.0	0.0	0.0	25.0	0.0	0.0	25.0	25.0
5.0 – 6.0 m (%)	0.0	0.0	50.0	0.0	0.0	25.0	0.0	50.0	0.0	0.0	0.0	25.0	25.0	50.0	50.0
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	50.0	0.0	0.0	25.0
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	25.0	0.0	0.0	50.0
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	0.0	0.0	0.0	0.0	0.0	25.0	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
Vertical Profile: Herbaceous															
0.0 – 1.0 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	75.0	50.0	100.0	75.0
1.0 – 2.0 m (%)	0.0	0.0	0.0	0.0	0.0	25.0	50.0	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	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
1.78 meter sample plot coverage															
Deciduous litter (%)	0.5	0.0	15.0	3.0	0.0	37.5	3.0	85.0	0.0	0.5	85.0	0.5	3.0	15.0	15.0
Conifer litter (%)	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	0.0
Grass litter (%)	62.5	62.5	3.0	37.5	15.0	15.0	15.0	0.5	37.5	15.0	0.5	0.5	15.0	0.0	3.0
Bare soil (%)	37.5	15.0	62.5	62.5	85.0	15.0	62.5	3.0	62.5	62.5	15.0	0.5	85.0	0.0	85.0

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

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Habitat Parameter	Plot														
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
50 meter plot coverage															
Woodland (%)	0.0	62.5	85.0	0.0	85.0	0.0	85.0	0.0	15.0	15.0	0.0	15.0	0.0	0.0	0.0
Riparian Woodland (%)	0.0	0.0	0.0	85.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shrubland / Tree Line (%)	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	15.0	0.0	3.0	0.0	0.0	0.0
Field / Prairie (%)	97.5	15.0	3.0	0.0	0.0	85.0	3.0	0.0	0.0	0.0	97.5	85.0	97.5	0.0	62.5
Brome / Fescue (%)	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	62.5	0.0
Lawn (%)	0.0	0.0	0.0	0.0	0.5	0.0	0.0	62.5	85.0	62.5	0.0	0.0	0.0	15.0	15.0
Road / Parking Lot (%)	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	15.0	0.0	0.0	0.5
Path / Trail / Sidewalk (%)	0.0	0.0	0.0	15.0	0.0	0.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0
Pond (%)	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
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	0.0
Seep (%)	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 meter subplot															
Canopy cover															
Hardwood (%)	0.0	23.92	94.38	98.54	92.82	0.0	94.12	0.78	28.86	47.32	0.0	16.12	0.0	0.0	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 (%)	0.0	23.92	94.38	98.54	92.82	0.0	94.12	0.78	28.86	47.32	0.0	16.12	0.0	0.0	0.0
Canopy Height															
Hardwood (m)	0.0	8.7	19.8	25.2	23.9	0.0	25.5	0.0	25.8	14.5	0.0	14.8	0.0	0.0	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)	0.0	0.0	13.0	9.0	2.0	0.0	11.0	0.0	7.0	3.0	0.0	1.0	0.0	0.0	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	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	97.5	97.5	15.0	3.0	15.0	85.0	97.5	37.5	97.5
0.25 – 0.5 m (%)	85.0	97.5	97.5	97.5	97.5	15.0	97.5	0.0	0.0	0.0	0.5	97.5	0.5	97.5	85.0
0.5 – 0.75 m (%)	0.5	37.5	97.5	0.0	97.5	0.0	97.5	0.0	0.0	0.0	0.0	37.5	0.0	0.0	0.0
0.75 – 1.0 m (%)	0.0	3.0	85.0	97.5	97.5	0.0	97.5	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0
1.0 – 1.25 m (%)	0.0	0.0	15.0	97.5	85.0	0.0	97.5	0.5	0.0	0.0	0.0	3.0	0.0	0.0	0.0
1.25 – 1.5 m (%)	0.0	0.0	15.0	97.5	3.0	0.0	97.5	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.5 – 1.75 m (%)	0.0	0.0	3.0	97.5	0.0	0.0	85.0	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.75 – 2.0 m (%)	0.0	0.0	62.5	97.5	0.5	0.0	3.0	97.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 2. Listed are the measured habitat parameters at George Washington Carver National Monument, Missouri during the 2008 bird breeding season, by plot. 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	Plot														
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Vertical Profile: Deciduous															
0.0 – 1.0 m (%)	0.0	25.0	100.0	75.0	50.0	0.0	50.0	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	25.0	0.0	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	50.0	25.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0 – 4.0 m (%)	0.0	25.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0 – 5.0 m (%)	0.0	25.0	25.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0 – 6.0 m (%)	0.0	25.0	75.0	25.0	0.0	0.0	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0 – 7.0 m (%)	0.0	25.0	50.0	0.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	50.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	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	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
Vertical Profile: Herbaceous															
0.0 – 1.0 m (%)	100.0	100.0	100.0	100.0	100.0	75.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1.0 – 2.0 m (%)	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	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
1.78 meter sample plot coverage															
Deciduous litter (%)	0.5	0.5	3.0	3.0	3.0	0.5	15.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0	0.0
Conifer litter (%)	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
Grass litter (%)	3.0	37.5	3.0	15.0	3.0	0.5	15.0	3.0	15.0	62.5	0.5	62.5	0.5	37.5	0.5
Bare soil (%)	85.0	37.5	62.5	62.5	85.0	85.0	62.5	37.5	85.0	15.0	85.0	15.0	85.0	15.0	85.0

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Habitat Parameter	Plot														
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Rock (%)	0.0	3.0	0.0	3.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.5	3.0
Woody debris (%)	0.0	0.0	3.0	15.0	15.0	3.0	3.0	0.0	0.0	0.5	3.0	0.5	0.0	0.0	0.0
Unvegetated (%)	97.5	85.0	62.5	85.0	85.0	97.5	85.0	85.0	85.0	85.0	97.5	85.0	85.0	97.5	85.0
Warm-season grass (%)	0.5	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	3.0	3.0	0.0	37.5
Cool-season grass (%)	3.0	15.0	15.0	15.0	3.0	0.5	3.0	3.0	15.0	62.5	0.5	15.0	3.0	3.0	0.5
Forb (%)	3.0	37.5	15.0	15.0	37.5	3.0	15.0	37.5	62.5	3.0	3.0	15.0	15.0	3.0	3.0
Moss and lichen (%)	0.5	0.5	15.0	3.0	0.0	0.5	3.0	0.0	0.5	3.0	0.5	0.5	0.5	0.0	0.0
Woody shrub and vine (%)	3.0	0.0	37.5	15.0	15.0	3.0	37.5	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.5
Tree seedling (%)	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total foliar (%)	15.0	62.5	62.5	37.5	62.5	3.0	62.5	37.5	62.5	62.5	15.0	37.5	37.5	15.0	37.5

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Habitat Parameter	Plot														
	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
50 meter plot coverage															
Woodland (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	0.0	0.0	0.0	0.0	15.0	0.0	0.0
Riparian 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	0.0	0.0
Shrubland / Tree Line (%)	3.0	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
Field / Prairie (%)	97.5	97.5	62.5	97.5	97.5	97.5	97.5	0.0	0.0	37.5	97.5	97.5	0.0	0.0	97.5
Brome / Fescue (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.5	97.5	37.5	0.0	0.0	37.5	97.5	0.0
Lawn (%)	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road / Parking Lot (%)	0.0	3.0	0.0	0.0	3.0	0.0	0.0	0.0	15.0	0.5	0.0	0.0	0.5	0.0	0.0
Path / Trail / Sidewalk (%)	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
Pond (%)	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
Stream (%)	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
Seep (%)	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 meter subplot															
Canopy cover															
Hardwood (%)	0.0	0.0	0.78	0.0	0.0	0.0	0.0	98.54	0.0	98.28	0.0	0.0	66.82	0.0	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 (%)	0.0	0.0	0.78	0.0	0.0	0.0	0.0	98.54	0.0	98.28	0.0	0.0	66.82	0.0	0.0
Canopy Height															
Hardwood (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.0	9.2	0.0	0.0	21.6	0.0	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)	0.0	0.0	1.0	0.0	0.0	0.0	0.0	8.0	0.0	4.0	0.0	0.0	10.0	0.0	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	0.0	0.0	0.0	0.0
Horizontal vegetation profile at 15-m															
0.0 – 0.25 m (%)	85.0	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	97.5
0.25 – 0.5 m (%)	3.0	15.0	97.5	37.5	37.5	97.5	37.5	97.5	97.5	97.5	97.5	85.0	97.5	97.5	37.5
0.5 – 0.75 m (%)	0.0	0.0	37.5	0.0	0.0	0.5	0.5	97.5	97.5	97.5	0.5	0.5	97.5	62.5	0.0
0.75 – 1.0 m (%)	0.0	0.0	0.5	0.0	0.0	0.0	0.0	97.5	85.0	97.5	0.0	0.0	97.5	37.5	0.0
1.0 – 1.25 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.5	97.5	0.0	0.0	97.5	0.5	0.0
1.25 – 1.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.5	0.0	0.0	97.5	0.0	0.0
1.5 – 1.75 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.5	0.0	0.0	97.5	0.0	0.0
1.75 – 2.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	97.5	0.0	0.0	97.5	0.0	0.0

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Habitat Parameter	Plot														
	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Vertical Profile: Deciduous															
0.0 – 1.0 m (%)	0.0	50.0	0.0	25.0	0.0	0.0	0.0	50.0	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	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	25.0	0.0	25.0	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	75.0	0.0	50.0	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	75.0	0.0	25.0	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	75.0	0.0	25.0	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	25.0	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	25.0	0.0	0.0	0.0	0.0	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	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
Vertical Profile: Herbaceous															
0.0 – 1.0 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.0	100.0	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	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	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
1.78 meter sample plot coverage															
Deciduous litter (%)	0.5	0.5	0.0	0.5	0.5	0.0	0.0	0.5	0.0	15.0	0.0	0.0	37.5	0.5	0.0
Conifer litter (%)	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
Grass litter (%)	37.5	37.5	0.5	0.5	62.5	0.5	0.5	0.5	85.0	37.5	0.5	0.5	3.0	85.0	0.5
Bare soil (%)	62.5	62.5	85.0	85.0	15.0	85.0	85.0	85.0	15.0	37.5	85.0	85.0	15.0	0.5	97.5

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Habitat Parameter	Plot														
	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Rock (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	15.0	0.0	0.5
Woody debris (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	15.0	0.0	0.0
Unvegetated (%)	85.0	85.0	85.0	97.5	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	97.5
Warm-season grass (%)	3.0	15.0	37.5	3.0	15.0	37.5	3.0	0.0	0.0	0.5	15.0	37.5	0.0	0.0	15.0
Cool-season grass (%)	15.0	0.5	3.0	0.5	3.0	3.0	15.0	0.5	37.0	3.0	3.0	3.0	15.0	37.5	0.5
Forb (%)	3.0	3.0	3.0	15.0	3.0	3.0	15.0	37.5	3.0	3.0	15.0	3.0	15.0	3.0	3.0
Moss and lichen (%)	0.0	0.0	0.0	0.5	0.0	0.0	0.0	3.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0
Woody shrub and vine (%)	3.0	3.0	0.0	15.0	3.0	3.0	0.5	3.0	0.0	37.5	0.0	3.0	0.5	0.5	0.0
Tree seedling (%)	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 foliar (%)	37.5	15	37.5	37.5	37.5	37.5	37.5	37.5	37.5	62.5	37.5	62.5	37.5	37.5	15.0

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Habitat Parameter	Plot									
	61	62	63	64	65	66	67	68	69	70
50 meter plot coverage										
Woodland (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Riparian Woodland (%)	0.0	15.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0
Shrubland / Tree Line (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Field / Prairie (%)	97.5	0.0	0.0	62.5	97.5	97.5	0.0	0.0	97.5	97.5
Brome / Fescue (%)	0.0	85.0	97.5	37.5	0.0	0.0	62.5	97.5	0.0	0.0
Lawn (%)	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
Path / Trail / Sidewalk (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stream (%)	0.0	3.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0
Seep (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 meter subplot										
Canopy cover										
Hardwood (%)	0.0	12.48	0.0	0.0	0.0	0.0	63.18	0.0	0.0	0.0
Conifer (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total cover (%)	0.0	12.48	0.0	0.0	0.0	0.0	63.18	0.0	0.0	0.0
Canopy Height										
Hardwood (m)	0.0	18.9	0.0	0.0	0.0	0.0	10.5	0.0	0.0	0.0
Conifer (m)	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)	0.0	2.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	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
Horizontal vegetation profile at 15-m										
0.0 – 0.25 m (%)	97.5	97.5	97.5	97.5	62.5	97.5	97.5	97.5	85.0	85.0
0.25 – 0.5 m (%)	37.5	97.5	97.5	3.0	0.5	62.5	97.5	97.5	0.5	37.5
0.5 – 0.75 m (%)	0.5	85.0	37.5	0.0	0.0	0.0	97.5	15.0	0.0	0.0
1.5 – 1.75 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	37.5	0.0	0.0	0.0
0.75 – 1.0 m (%)	0.0	85.0	3.0	0.0	0.0	0.0	97.5	0.5	0.0	0.0
1.0 – 1.25 m (%)	0.0	37.5	0.5	0.0	0.0	0.0	62.5	0.0	0.0	0.0
1.25 – 1.5 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	62.5	0.0	0.0	0.0
1.75 – 2.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	85.0	0.0	0.0	0.0

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Habitat Parameter	Plot									
	61	62	63	64	65	66	67	68	69	70
Vertical Profile: Deciduous										
0.0 – 1.0 m (%)	0.0	25.0	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	50.0	0.0	0.0	0.0
2.0 – 3.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
3.0 – 4.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
4.0 – 5.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0
5.0 – 6.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0
6.0 – 7.0 m (%)	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0
7.0 – 7.5 m (%)	0.0	0.0	0.0	0.0	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
1.0 – 2.0 m (%)	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
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
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
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
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
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
Vertical Profile: Herbaceous										
0.0 – 1.0 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	75.0	100.0	100.0	100.0
1.0 – 2.0 m (%)	0.0	25.0	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
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
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
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
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
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
1.78 meter sample plot coverage										
Deciduous litter (%)	0.5	0.5	0.5	0.0	0.0	0.5	3.0	0.0	0.0	0.0
Conifer litter (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grass litter (%)	0.5	37.5	85.0	0.5	0.5	0.5	3.0	85.0	3.0	0.5
Bare soil (%)	85.0	37.5	3.0	97.5	97.5	85.0	62.5	3.0	85.0	85.0

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Habitat Parameter	Plot									
	61	62	63	64	65	66	67	68	69	70
Rock (%)	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.5
Woody debris (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Unvegetated (%)	85.0	85.0	85.0	97.5	97.5	85.0	85.0	85.0	97.5	85.0
Warm-season grass (%)	3.0	0.0	0.0	3.0	0.5	15.0	0.0	0.0	3.0	15.0
Cool-season grass (%)	15.0	37.5	37.5	0.5	3.0	0.5	15.0	37.5	3.0	3.0
Forb (%)	3.0	3.0	0.5	3.0	3.0	3.0	15.0	3.0	3.0	15.0
Moss and lichen (%)	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0
Woody shrub and vine (%)	15.0	0.0	3.0	0.0	0.0	15.0	37.5	0.0	0.5	0.0
Tree seedling (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total foliar (%)	37.5	37.5	37.5	15.0	15.0	37.5	62.5	37.5	15.0	37.5

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/



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National Park Service
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