



Bird Monitoring at Herbert Hoover National Historic Site, Iowa

Status Report 2005–2022



The Birthplace Cottage at Herbert Hoover National Historic Site.
NPS/HEARTLAND NETWORK

Bird monitoring at Herbert Hoover National Historic Site, Iowa: Status report 2005–2022

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David G. Peitz

National Park Service
Heartland Inventory and Monitoring Network
Wilson's Creek National Battlefield
6424 W. Farm Road 182
Republic, Missouri 65738

Edited by Tani Hubbard

Northern Rockies Conservation Cooperative and National Park Service
Tucson, AZ

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Abstract

In 2005, the Heartland Inventory and Monitoring Network initiated bird surveys on Herbert Hoover National Historic Site to monitor changes in bird community composition and abundance and improve our understanding of relationships between breeding birds and their habitat and the effects of management actions on those relationships. This information helps park staff plan management objectives and assess the effectiveness of management alternatives. We evaluated park breeding bird trends in the context of trends observed within the North American Bird Conservation Initiative's Eastern Tallgrass Prairie Bird Conservation Region where the park is located. This allows us to assess the influence of park habitat management on bird populations with an understanding of regional population trends that are outside the influence of natural resource management activities at the park.

Seventy-four species of birds were recorded in 18 years (2005–2022). Seventy-one of the species are considered breeding species (permanent or summer residents). Seven of these are species of concern for the Eastern Tallgrass Prairie Bird Conservation Region. Nine species were observed in sufficient numbers to calculate annual abundances and trends with some degree of statistical confidence. The Red-winged Blackbird, American Robin, and Dickcissel were the most abundant and widespread species on the park. Comparisons of regional trends (2005–2019; Sauer et al. 2020) with park population trends were inconclusive. Trends in the nine abundant species on the park were uncertain. Regionally, Dickcissel and Northern Cardinal were increasing. However, American Goldfinch, American Robin, Common Grackle, Common Yellowthroat, Eastern Meadowlark, Mourning Dove, and Red-winged Blackbird were declining regionally. Diversity, richness, and evenness in distribution of individuals across species in the park breeding bird community were unchanged over the 18 years.

When sampled, habitats on the plots at Herbert Hoover National Historic Site consisted primarily of the old field/prairie type, with lesser amounts of other types present. Canopy cover averaged 2 to 13% on plots, with cover provided primarily by hardwood trees. Basal area of hardwood trees averaged between 1 and 2 m²/ha, and canopy height averaged between 4 and 5 m. Tree species from 12 different families contributed to the canopy cover and basal area of plots. Plots were primarily unvegetated at ground level, with grass litter common and bare soil exposed. Total foliar cover at ground level consisted primarily of cool season grasses and forbs.

Acknowledgments

We would like to thank the staff of Herbert Hoover National Historic Site, Iowa, for allowing us access to the park during our site visit. We would also like to thank volunteers and staff who assisted with bird surveys on the park: Chris R. Edwards, Sydney. A. Foster, David A. Kyllingstad, Jim L. Fuller, Ken L. Lowder, and Sherry Middlemis-Brown.

Introduction

Birds are an important component of park ecosystems. 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 (e.g., habitat for neotropical migrants) can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991; Maurer 1993). Birds also have a tremendous following among the public, and many parks provide information on the status and trends of birds through their interpretive programs.

Herbert Hoover National Historic Site, Iowa, is in the north-central section of the Eastern Tallgrass Prairie Bird Conservation Region (Figure 1), one of 67 bird conservation regions identified in the North American Bird Conservation Initiative (NABCI). Started in 1999, the NABCI is a coalition of government agencies and private organizations in the United States working to ensure the long-term health of North America's native bird populations (NABCI 2024).

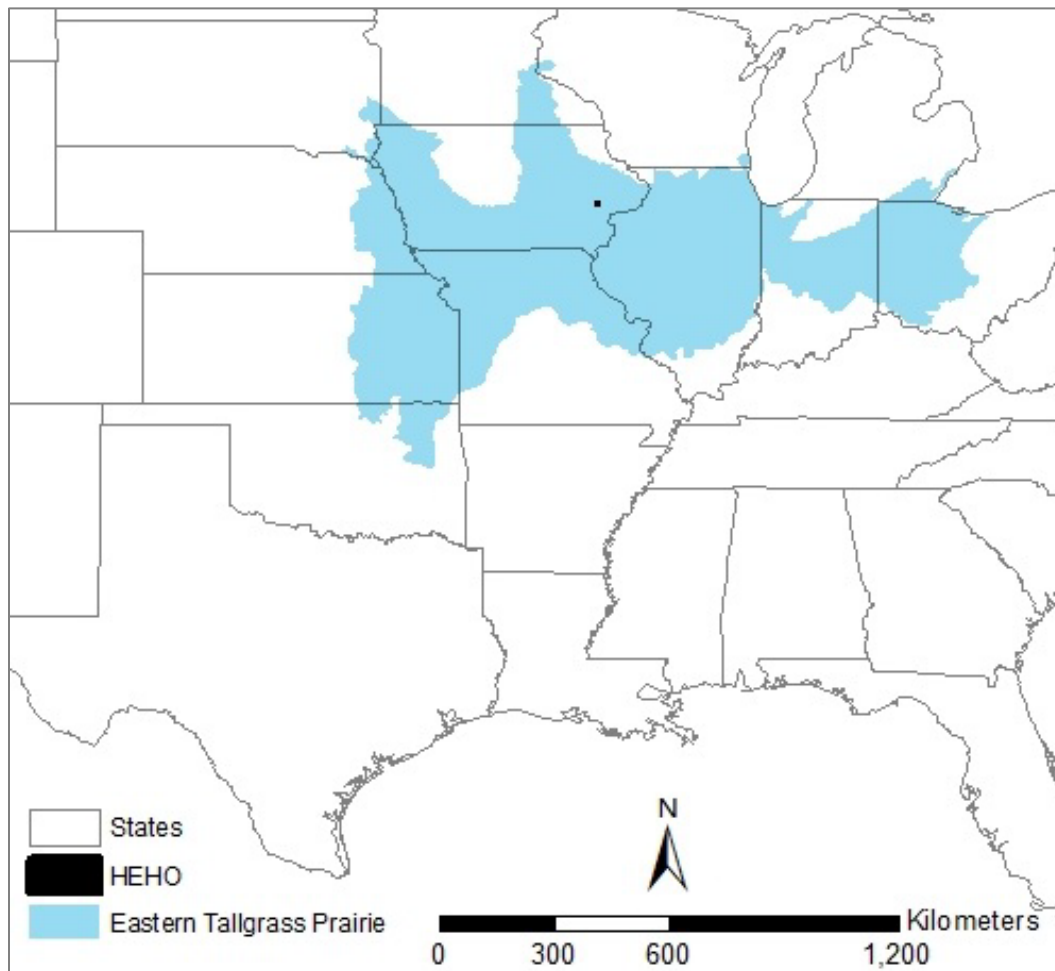


Figure 1. Location of Herbert Hoover National Historic Site (HEHO), Iowa, within the Eastern Tallgrass Prairie Bird Conservation Region.

Historically, this region includes what are the tallest and lushest grasslands of the Great Plains (NABCI 2024). Beech-maple forests dominated the eastern sections, tall, lush prairie dominated the western sections, and an ecotone between the two was marked by a broad and dynamic oak-dominated savanna. Today, the landscape of this region is largely agriculture. Approximately 108 species of breeding birds can be found in the habitat around Herbert Hoover National Historic Site (Jackson et al. 1996).

Data collected during the U.S. Geological Survey (USGS) annual North American Breeding Bird Surveys (BBS) between 2005 and 2019 indicate that 42 bird species with the potential to occur at Herbert Hoover National Historic Site show evidence of population decline (Sauer et al. 2020). In fact, 39% of the species in the Eastern Tallgrass Prairie Bird Conservation Region that breed or have some potential to breed on the park have populations reported to be in decline, with species such as the Grasshopper Sparrow (*Ammodramus savannarum*) Savannah Sparrow (*Passerculus sandwichensis*), and Western Meadowlark (*Sturnella neglecta*) declining at alarming rates.

Long-term trends in community composition and abundance of breeding bird populations provide one measure for assessing the ecological integrity in a system and detecting changes. We use trends in the composition and abundance of bird populations as long-term indicators of ecosystem integrity at Herbert Hoover National Historic Site. *Ecosystem integrity* is defined as the system's capability to support and maintain a balanced community of birds having a species composition, diversity, and functional organization comparable to that of the natural habitats of the region. Research has demonstrated that birds serve as good indicators of change in ecosystems (Cairns et al. 1993; Mallory et al. 2006; Wood et al. 2006). Therefore, changes in the numbers and composition of bird communities may reflect the effectiveness of management actions taken to restore and maintain habitat at the park.

There are two primary objectives for monitoring breeding birds at Herbert Hoover National Historic Site:

- Identify significant temporal changes in the species composition and abundance of bird communities that occur at the park during the breeding season.
- Improve our understanding of relationships between breeding birds and habitat and the effects of management actions (such as prairie restorations or prescribed fire) on bird populations by examining potential correlations between changes in specific habitat variables (e.g., vegetation structure, ground cover) and changes in bird community composition and abundance.

This report summarizes species composition and population trends for birds recorded during 18 years (2005–2022) of monitoring.

Methods

Site Selection

Permanent monitoring locations or “plots” were selected by overlaying a systematic grid of 100 m x 100 m cells (originating from a random start point). The orientation of the grid was rotated 45 degrees to prevent monitoring sites from being influenced by man-made features (roads, fences, etc.) located along cardinal directions. We established 38 plots in total (Figure 2). Nine plots are in the developed landscape and 29 are in grassland/open habitat. However, due to changes in sampling design and volunteer availability the number of plots sampled annually ranged from nine to 38 (Table 1).

During bird surveys in 2005, 2006, 2009, and 2013, monitoring plots were located using navigation waypoints (Peitz 2010) in a Trimble Geo XT GNSS unit and temporarily marked with 36-inch pin flags to aid in relocating 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. In 2017 and 2022, the habitat assessment crews worked independently from the bird surveyor, and monitoring plots were located using a GNSS unit but not marked with pin flags. During bird surveys in 2008, 2010–2012, 2014–2016, and 2021, years when habitat assessments were not conducted, monitoring plots were located using a GNSS unit and were not marked with pin flags.

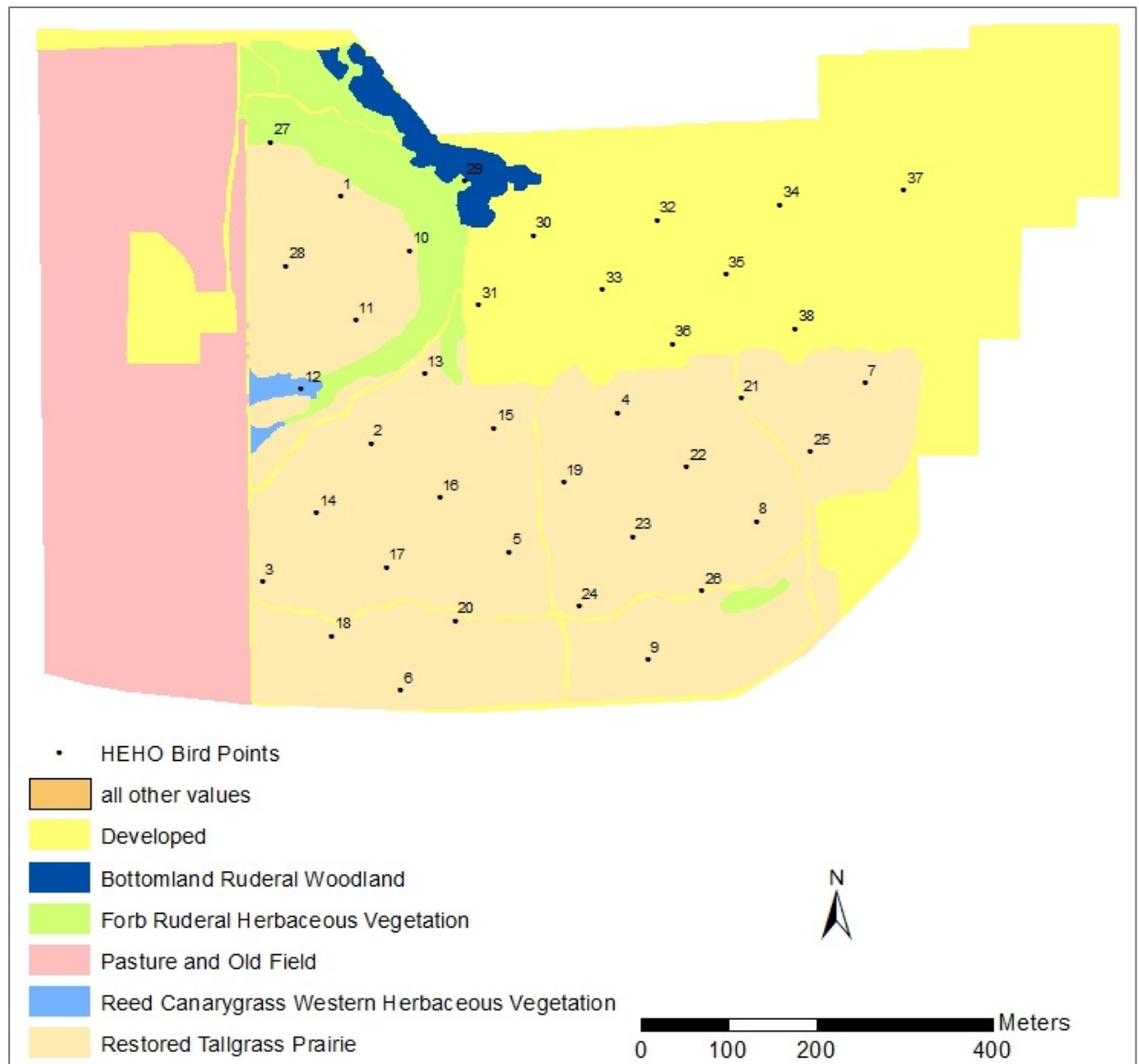


Figure 2. Bird plot locations on Herbert Hoover National Historic Site (HEHO), Iowa. Vegetation mapping and classification provided by Diamond et al. (2014).

Table 1. Number of plots sampled and sampling dates for breeding bird surveys conducted at Herbert Hoover National Historic Site, Iowa, by year. Also listed are observer(s) who conducted the surveys and whether habitat data were collected during the survey year.

Year	Sampling Dates	Number of Plots Sampled	Observer(s)	Habitat Data Collected
2005	June 4–June 4	9	D. G. Peitz ^A	Yes
2006	June 4–June 4	9	D. G. Peitz ^A	Yes
2008	June 10–June 19	38	J. L. Fuller and K. L. Lowder	No
2009	May 27–May 28	38	J. L. Fuller, K. L. Lowder, S. Middlemis-Brown, and D. G. Peitz ^A	Yes
2010	May 19–June 2	38	J. L. Fuller and K. L. Lowder	No
2011	June 16–June 17	38	D. A. Kyllingstad and K. L. Lowder	No
2012	June 13–June 14	38	D. A. Kyllingstad and K. L. Lowder	No
2013	May 28–May 28	11	D. G. Peitz ^A	Yes
2014	June 20–June 20	11	D. A. Kyllingstad and K. L. Lowder	No
2015	June 19–June 19	11	D. A. Kyllingstad	No
2016	June 12–June 12	11	C. R. Edwards and K. L. Lowder	No
2017	May 24–May 25	38	D. G. Peitz ^A	Yes
2021	June 14–June 15	15	S. A. Foster	No
2022	May 20	38	D. G. Peitz ^A and D. W. Marcum ^A	Yes

^A Heartland Inventory and Monitoring Network staff.

Bird Surveys

Bird surveys followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized in this report. 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-minute sampling periods were recorded along with their corresponding distance from the observer. For most species, each individual bird was reported as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size rather than the individual bird. During analysis, each individual in a cluster or flock was 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 GNSS unit. While traveling between plots, the observer was vigilant for the presence of species not recorded during timed surveys. These species help formulate a more complete species list for the park by identifying species missed during timed surveys. However, these observations were not included in any analysis as they did not directly relate to any individual plot. Birds were sampled in the morning from the time it was light enough to observe birds to four hours after sunrise.

Variable circular plot counts were conducted 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. All birds seen or heard were recorded, including flyovers, along

with distance from the observer when possible. For this report, all birds seen or heard during the 5-minute survey are included.

Habitat Assessment

The collection of habitat data followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized in this report. Habitat data were collected in 2005, 2006, 2009, 2013, 2017, and 2022. However, only data collected after the establishment of the bird monitoring protocol in 2008 were included in this report. During years when habitat assessments occurred, plots were visited in generally the same order they were surveyed for birds to avoid disturbing birds on a plot prior to sampling. Once the habitat crew arrived at a plot, they set up a 5 m radius subplot, a nested 1.78 m radius sample plot, and a larger 50 m radius plot.

Slope, slope variability, aspect, aspect variability, and topographic position of each 50 m radius plot were recorded during the first visit to a plot and not remeasured in subsequent years. The amount of various vegetation types (drainage, old field/prairie, shrub, woodland) and road and water cover on each 50 m plot were recorded. As 5 m subplots were sampled, horizontal vegetation cover was estimated in 0.25 m intervals from 0.0 to 2.0 m above ground surface using a 0.15 cm wide cover board. Area of the cover board obscured by vegetation was estimated at 15 m north of plot center. Using a graduated measuring rod, vertical vegetation structure was measured in 1 m increments up to 7.5 m 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 diameter 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 subplots. Lastly, at a 1.78 m sample plot nested within the subplot, ground and foliar cover were estimated. Ground cover classes included deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm diameter), and unvegetated. Foliar cover was estimated for six plant guilds, including warm-season and cool-season grasses, forbs, mosses and lichens, shrubs and vines, tree seedlings, and total foliar cover (<1.5 m tall).

Data Analysis

Prior to summary analysis, the residency status (permanent resident, summer resident, or migrant) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants from analyses of breeding birds within Herbert Hoover National Historic Site. The park vegetation is primarily grassland/open habitat. As such, all plots were grouped as a single data set for analysis. The proportion of plots occupied by each bird species was calculated (total number of plots occupied by an observed species/plots surveyed) and reported in Appendices B and C.

For each species with greater than 60 observations recorded (eight species), Distance software (Distance 6.0 Release 2) was used to determine its park-wide abundance (Buckland et al. 2001). A central part of the analysis in Distance is the modeling of a detection function to account for individuals present but not observed before calculating species abundance. Four candidate functions plus series expansion were considered in determining the detection function of each species (half-normal + cosine, uniform + cosine, half-normal + hermite polynomial, and hazard-rate + simple polynomial). The most robust models were selected by Distance based on the lowest Akaike Information Criteria (AIC) values.

The hazard-rate function without an adjustment term was selected for four species: American Goldfinch (*Spinus tristis*), Dickcissel (*Spiza americana*), Eastern Meadowlark (*Sturnella magna*), and Northern Cardinal (*Cardinalis cardinalis*). The hazard-rate + simple polynomial function was selected for three species: American Robin (*Turdus migratorius*), Common Grackle (*Quiscalus quiscula*), and Red-winged Blackbird (*Agelaius phoeniceus*). The half-normal function without adjustment term was selected for Mourning Dove (*Zenaida macroura*). And the half-normal + cosine function was selected for Common Yellowthroat (*Geothlypis trichas*). Abundances for these species are reported in Appendix B.

For species with fewer than 60 observations, park-wide abundance was calculated by first deriving a species density from observations recorded within a 50 m radius (0.79 ha) around each plot center and then calculating abundance based on average plot densities. Park-wide abundances for species with less than 60 observations are reported in Appendix C.

For species with adequate abundance (those with greater than 60 observations) trends were calculated by regressing abundance against survey years in the statistical package “rtrim” (built under R version 3.6.3) and reported in Appendix F. Rtrim is the R version of the statistical software package “TRIM,” a program developed for the analysis of count data obtained from wildlife population monitoring (Pannekoek and van Strien 2005). It analyzes time series of counts using Poisson regression and produces estimates of yearly indices and trends. We employed a linear trend model with changepoints selected by a stepwise procedure. Serial correlation in count data among years and overdispersion are accounted for with this software. Although TRIM has the capacity to estimate missing data, we restricted our regression analysis to 11 plots that were surveyed in most years (Appendix A). By doing this we analyzed a consistent ratio of developed land and grassland/open plots across years.

For this report, we additionally obtained regional breeding bird trends for the Eastern Tallgrass Prairie Bird Conservation Region during the period from 2005 to 2019 from the Breeding Bird Survey (BBS) website of the USGS Patuxent Wildlife Research Center (Appendix G; Sauer et al. 2020). It is possible to determine trends for many bird species and many regions of interest for periods ranging from 1966 to 2019 by using the interactive calculator available at the [BBS Regional Trend Analysis Form website](https://www.pwrc.usgs.gov/MBR/bbs/trend/tf15.html) (https://www.pwrc.usgs.gov/MBR/bbs/trend/tf15.html). We chose the last 15-year period of available data to maximize the comparability of regional trend results. We compared regional trends with those calculated using TRIM for Herbert Hoover National Historic Site bird populations. Regional trends with a confidence interval that straddled zero were classified as uncertain for comparison with results from Herbert Hoover National Historic Site. It should be noted that trends determined by the BBS were calculated using a different methodology; due to limitations in the BBS field data collections, hierarchical modeling was used to produce an annual index of abundance, and trends were then estimated as constant annual rates based only on the first and last years of the intervals selected. Since all but the first and last year indices are ignored in this approach, trends based on BBS data tend to display variability when compared among different broadly overlapping intervals, and interpretation of BBS results should be made with caution.

Trends in the diversity, richness, and species distribution evenness of the breeding bird community on the park were assessed by regressing each metric against survey years in the add-in statistical software of Microsoft Excel and graphing the results. Prior to trend analysis, bird community diversity values were calculated annually using the Shannon Diversity Index (H'):

$$H' = -\sum_{i=1}^s \left(\frac{n_i}{N} \right) \cdot \ln \left(\frac{n_i}{N} \right)$$

where n_i/N is the proportion of the total number of individuals in a population consisting of the i th species (Shannon 1949), and s is the total number of species. Species richness values were determined as the total number of bird taxa recorded annually. Species distribution evenness values were calculated using Pielou's evenness index (J'):

$$J' = \frac{H'}{H_{max}}$$

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 ($\ln(\text{annual species richness})$). 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 were reported by Peitz (2007). Annual averages ($\pm$ std dev) for semi-permanent plot data, including road and water cover, were calculated from plot estimates (Appendices F: Table F1). Averages ($\pm$ std dev) for horizontal vegetation cover between 0–0.25 m, 0.25–0.50 m, 0.50–0.75 m, 0.75–1.00 m, 1.00–1.25 m, 1.25–1.50 m, 1.50–1.75 m, and 1.75–2.00 m were calculated and reported. Average ($\pm$ std dev) annual vertical structural diversity was estimated and reported as well. Vertical structural diversity was calculated as follows:

$$\text{Structural Diversity Index} = \frac{\left(\left(\sum_{i=1}^8 \frac{p_i}{8} \right) + a \right) \cdot 100}{2}$$

where p_i is the observed frequency for vegetation in the i th interval touching a measuring rod out of twelve measuring events, and a is the percent of intervals with recorded vegetation in eight height increments. Vertical structural 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 (>2.5 cm DBH), and unvegetated, were averaged ($\pm$ std dev) across plots and reported (Appendix F). Foliar cover, by guild of warm-season and cool-season grasses, forbs, mosses and lichens, shrubs and vines, tree seedlings, and total foliar cover (<1.5 m tall), were averaged ($\pm$ std dev) across plots as well (Appendix F). Trees were identified to family and size class before summing stems per hectare for the park (Appendix F).

Results

Bird Surveys

Between 2005 and 2022, 343 cumulative plots were surveyed, and 74 different bird species were recorded, 71 of which are species with the potential to breed within Herbert Hoover National Historic Site (Table 2; Jackson et al. 1996). Six breeding species were only observed outside the 5-minute survey periods: Blue-winged Warbler (*Vermivora cyanoptera*), Double-crested Cormorant (*Phalacrocorax auritus*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Swamp Sparrow (*Melospiza georgiana*), Sora (*Porzana carolina*), and Wild Turkey (*Meleagris gallopavo*). Seven of the breeding species recorded are considered species of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008): Blue-winged Warbler, Dickcissel, Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow, Henslow's Sparrow (*Ammodramus henslowii*), Northern Flicker (*Colaptes auratus*), and Red-headed Woodpecker.

Table 2. Bird species recorded during breeding bird surveys at Herbert Hoover National Historic Site, Iowa, between 2005 and 2022. The American Ornithologists' Union code (AOU code) and residency status of each species is given. Species names are valid and verified names taken from the Integrated Taxonomic Information System web site (ITIS 2023).

Common Name	Scientific Name	AOU Code	Residency ^A
Alder Flycatcher	<i>Empidonax alnorum</i>	ALFL	M
American Crow	<i>Corvus brachyrhynchos</i>	AMCR	R
American Goldfinch	<i>Spinus tristis</i>	AMGO	R
American Redstart	<i>Setophaga ruticilla</i>	AMRE	SR
American Robin	<i>Turdus migratorius</i>	AMRO	SR
Baltimore Oriole	<i>Icterus galbula</i>	BAOR	SR
Bank Swallow	<i>Riparia riparia</i>	BANS	SR
Barn Swallow	<i>Hirundo rustica</i>	BARS	SR
Barred Owl	<i>Strix varia</i>	BADO	R
Black-capped Chickadee	<i>Poecile atricapillus</i>	BCCH	R
Blue Jay	<i>Cyanocitta cristata</i>	BLJA	R
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>	BGGN	SR
Blue-winged Warbler ^{B, C}	<i>Vermivora pinus</i>	BWWA	SR
Bobolink	<i>Dolichonyx oryzivorus</i>	BOBO	SR
Brown-headed Cowbird	<i>Molothrus ater</i>	BHCO	SR
Brown Thrasher	<i>Toxostoma rufum</i>	BRTH	SR

^A Residency: M = migrant through the area; R = year-round resident; SR = summer resident; according to Jackson et al. (1996).

^B Species of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

^C Resident species recorded only while traveling between survey plots or at other times outside of 5-minute survey periods.

Table 2 (continued). Bird species recorded during breeding bird surveys at Herbert Hoover National Historic Site, Iowa, between 2005 and 2022. The American Ornithologists' Union code (AOU code) and residency status of each species is given. Species names are valid and verified names taken from the Integrated Taxonomic Information System web site (ITIS 2023).

Common Name	Scientific Name	AOU Code	Residency ^A
Canada Goose	<i>Branta canadensis</i>	CANG	R
Cedar Waxwing	<i>Bombycilla cedrorum</i>	CEDW	SR
Cerulean Warbler ^B	<i>Setophaga cerulea</i>	CERW	M
Chimney Swift	<i>Chaetura pelagica</i>	CHSW	SR
Chipping Sparrow	<i>Spizella passerina</i>	CHSP	SR
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	CLSW	SR
Common Grackle	<i>Quiscalus quiscula</i>	COGR	SR
Common Nighthawk	<i>Chordeiles minor</i>	CONI	SR
Common Yellowthroat	<i>Geothlypis trichas</i>	COYE	SR
Dickcissel ^B	<i>Spiza americana</i>	DICK	SR
Double-crested Cormorant ^C	<i>Phalacrocorax auritus</i>	DCCO	SR
Downy Woodpecker	<i>Picoides pubescens</i>	DOWO	R
Eastern Bluebird	<i>Sialia sialis</i>	EABL	SR
Eastern Kingbird	<i>Tyrannus tyrannus</i>	EAKI	SR
Eastern Meadowlark	<i>Sturnella magna</i>	EAME	SR
Eastern Phoebe	<i>Sayornis phoebe</i>	EAPH	SR
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	EATO	SR
Eastern Wood-pewee	<i>Contopus virens</i>	EAWP	SR
European Starling	<i>Sturnus vulgaris</i>	EUST	R
Field Sparrow ^B	<i>Spizella pusilla</i>	FISP	SR
Grasshopper Sparrow ^B	<i>Ammodramus savannarum</i>	GRSP	SR
Gray Catbird	<i>Dumetella carolinensis</i>	GRCA	SR
Great Blue Heron	<i>Ardea herodias</i>	GBHE	SR
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	GCFL	SR
Great Horned Owl	<i>Bubo virginianus</i>	GHOW	R
Henslow's Sparrow ^B	<i>Ammodramus henslowii</i>	HESP	SR
House Finch	<i>Haemorhous mexicanus</i>	HOFI	R
House Sparrow	<i>Passer domesticus</i>	HOSP	R
House Wren	<i>Troglodytes aedon</i>	HOWR	SR
Indigo Bunting	<i>Passerina cyanea</i>	INBU	SR

^A Residency: M = migrant through the area; R = year-round resident; SR = summer resident; according to Jackson et al. (1996).

^B Species of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

^C Resident species recorded only while traveling between survey plots or at other times outside of 5-minute survey periods.

Table 2 (continued). Bird species recorded during breeding bird surveys at Herbert Hoover National Historic Site, Iowa, between 2005 and 2022. The American Ornithologists' Union code (AOU code) and residency status of each species is given. Species names are valid and verified names taken from the Integrated Taxonomic Information System web site (ITIS 2023).

Common Name	Scientific Name	AOU Code	Residency ^A
Killdeer	<i>Charadrius vociferus</i>	KILL	SR
Mallard	<i>Anas platyrhynchos</i>	MALL	SR
Mourning Dove	<i>Zenaidura macroura</i>	MODO	SR
Northern Cardinal	<i>Cardinalis cardinalis</i>	NOCA	R
Northern Flicker^B	<i>Colaptes auratus</i>	NOFL	R
Northern Mockingbird	<i>Mimus polyglottos</i>	NOMO	R
Purple Martin	<i>Progne subis</i>	PUMA	SR
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	RBWO	R
Red-headed Woodpecker^{B, C}	<i>Melanerpes erythrocephalus</i>	RHWO	R
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RTHA	R
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	RWBL	R
Ring-necked Pheasant	<i>Phasianus colchicus</i>	RNEP	R
Rock Dove	<i>Columba livia</i>	ROPI	R
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	RBGR	SR
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	RTHU	SR
Sedge Wren	<i>Cistothorus platensis</i>	SEWR	SR
Song Sparrow	<i>Melospiza melodia</i>	SOSP	R
Sora ^C	<i>Porzana carolina</i>	SORA	SR
Spotted Sandpiper	<i>Actitis macularius</i>	SPSA	SR
Swainson's Thrush	<i>Catharus ustulatus</i>	SWTH	M
Swamp Sparrow ^C	<i>Melospiza georgiana</i>	SWSP	SR
Tree Swallow	<i>Tachycineta bicolor</i>	TRES	SR
Turkey Vulture	<i>Cathartes aura</i>	TUVU	SR
Warbling Vireo	<i>Vireo gilvus</i>	WAVI	SR
Willow Flycatcher	<i>Empidonax traillii</i>	WIFL	SR
Wild Turkey ^C	<i>Meleagris gallopavo</i>	WITU	R
Yellow-throated Vireo	<i>Vireo flavifrons</i>	YTVI	SR
Yellow Warbler	<i>Setophaga petechia</i>	YEWA	SR

^A Residency: M = migrant through the area; R = year-round resident; SR = summer resident; according to Jackson et al. (1996).

^B Species of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

^C Resident species recorded only while traveling between survey plots or at other times outside of 5-minute survey periods.

Nine breeding species were observed during the survey period in sufficient numbers to calculate annual abundances with some degree of confidence (Appendix B). Of these nine species, Red-winged Blackbird, American Robin, and Dickcissel were the most abundant and widespread species on Herbert Hoover National Historic Site. We were unable to detect with certainty any positive or negative population trends for these nine species (Figure 3; Appendix D). Regional data (2005–2019) reported by Sauer et al. (2020; Appendix E) for the Eastern Tallgrass Prairie Bird Conservation Region showed positive population trends for two of the nine species—Dickcissel and Northern Cardinal. Regionally, populations had declined for the other seven species—American Goldfinch, American Robin, Common Grackle, Common Yellowthroat, Eastern Meadowlark, Mourning Dove, and Red-winged Blackbird.

Diversity ($P = 0.15$), richness ($P = 0.33$), and evenness in distribution of individuals across species ($P = 0.56$) in the breeding bird community on Herbert Hoover National Historic Site were unchanged over the 18 years beginning in 2005 (Figure 4). Breeding bird richness averaged 27 species annually on Herbert Hoover National Historic Site.

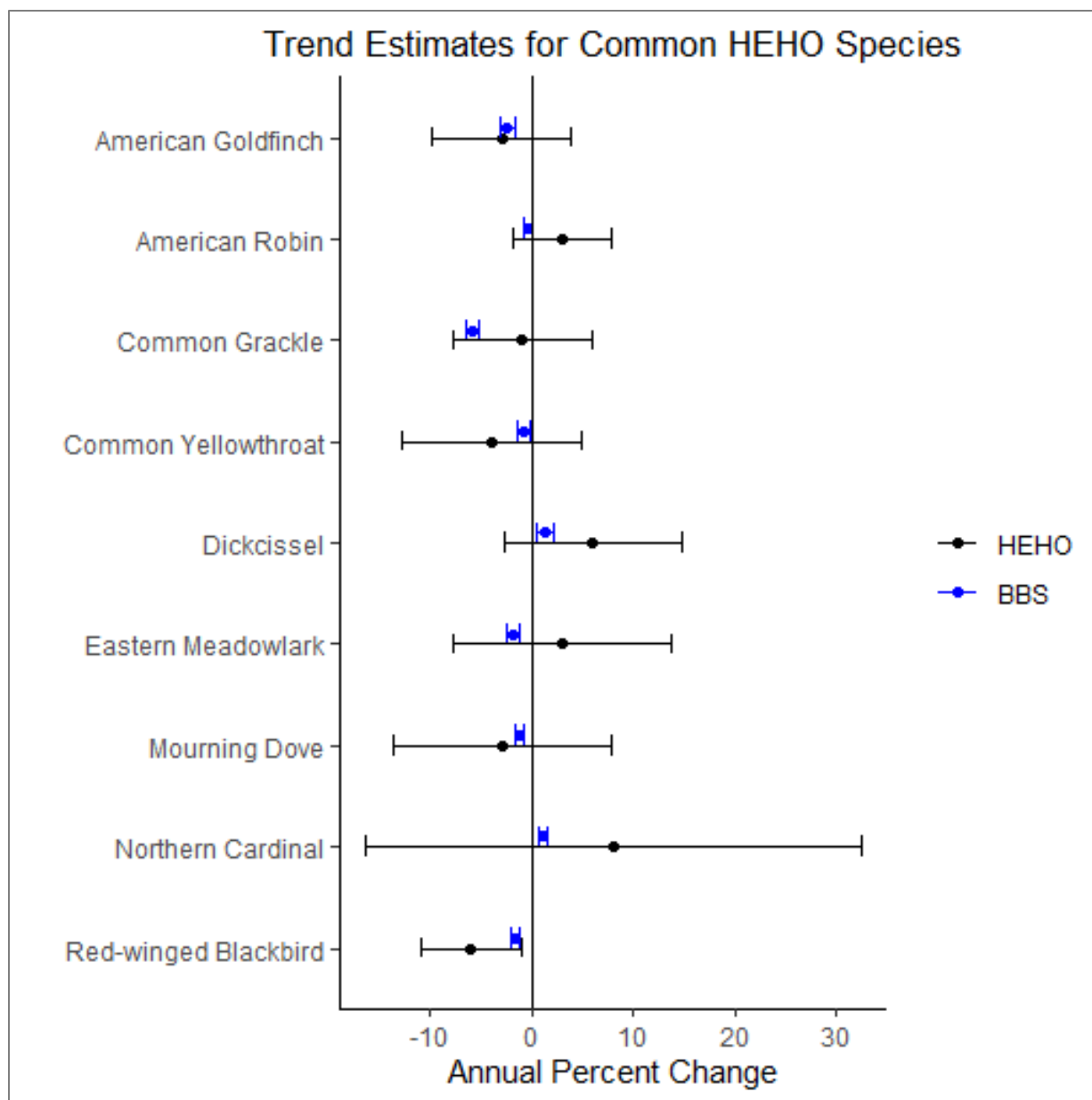


Figure 3. Comparison of bird population trends from Herbert Hoover National Historic Site (HEHO), Iowa, (2005–2022) with those of the larger Eastern Tallgrass Prairie Bird Conservation Region (2005–2019) from the USGS Breeding Bird Surveys (BBS). Error bars represent 95% confidence intervals.

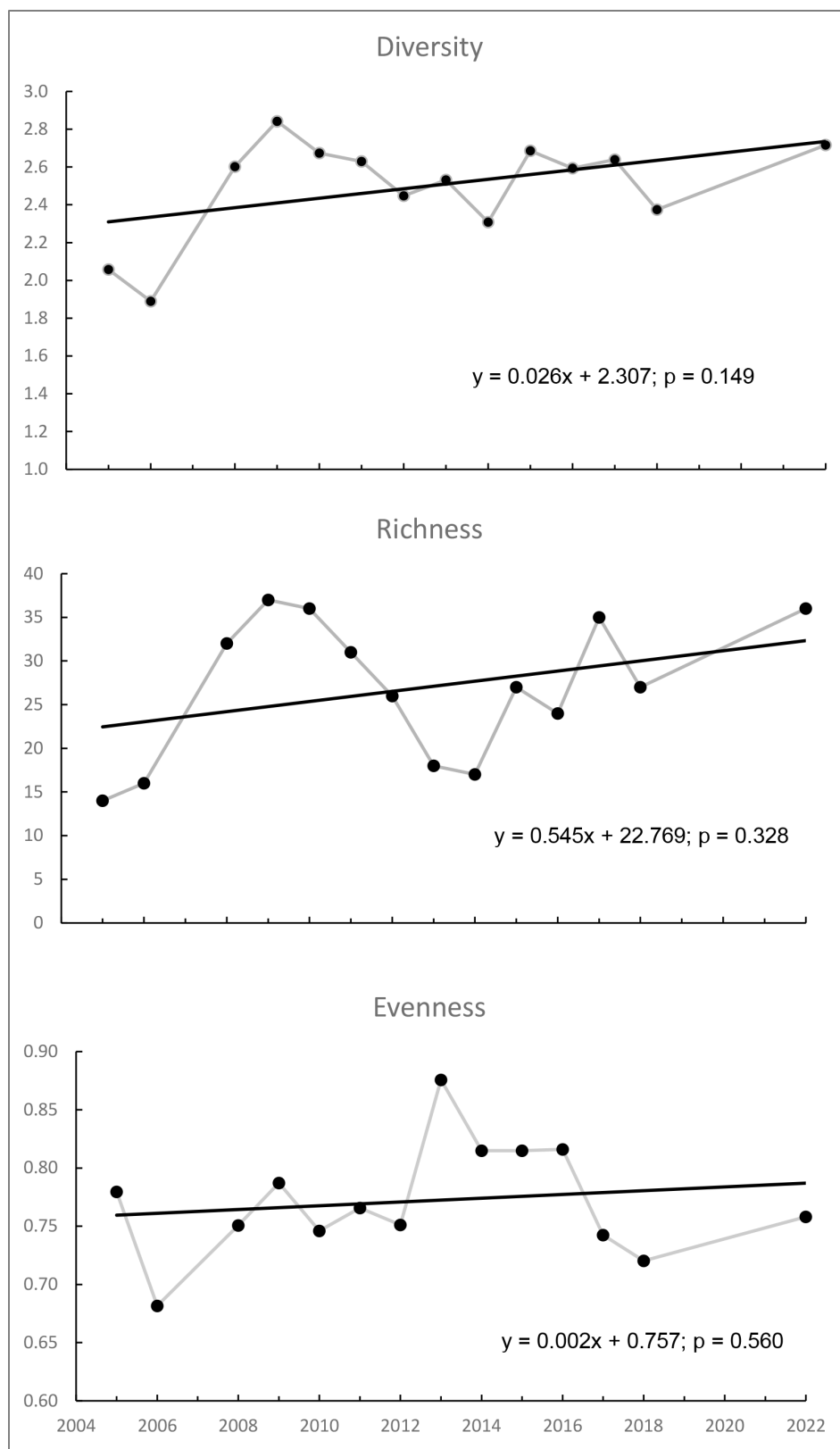


Figure 4. Trends in bird community diversity, richness, and species distribution evenness on Herbert Hoover National Historic Site, Iowa, from 2005 through 2022.

Habitat Assessment

When sampled, habitats on the plots at Herbert Hoover National Historic Site consisted primarily of the old field/prairie (62–81%) and lawn (14–17%) types, with lesser amounts of other types present (Appendix F). Canopy cover averaged 2 to 13% on plots (Appendix F), with cover provided primarily by hardwood trees. Basal area of hardwood trees averaged between 1 and 2 m²/ha, and canopy height averaged 4 to 5 m. Basal area of conifer trees averaged between 0 and 1 m²/ha, and canopy height averaged 1 to 2 m. Tree species from 12 different families contributed to the canopy cover and basal area of plots (Appendix F).

Across all plots, the densest vegetation measures at the time of assessment (mid-May to mid-June) occurred in horizontal profile heights below 0.75 m (Appendix F). However, vegetation was measured in all height classes to 2.0 m. Average vertical structure diversity estimates across years ranged from 3 to 16% on plots.

When sampled, plots were primarily unvegetated (54–76% cover) at ground level, with grass litter (38–57% cover) common, and bare soil (1–19% cover) exposed (Appendix F). Deciduous litter (1–4% cover), conifer litter (<1–2% cover), and rock (0 to <1% cover) were also recorded on plots. Total foliar cover (54–79% cover) on plots consisted primarily of cool-season grasses (20–68% cover) and forbs (22–36% cover), with lesser amounts of warm-season grasses (1–9% cover), shrubs and vines (<1–2% cover), tree seedlings (0–1% cover), and moss and lichens (0 to <1% cover) present.

Discussion

Breeding bird surveys were initiated at Herbert Hoover National Historic Site in 2005 to assist the park in assessing the integrity of their grasslands and developed area through time. During the 18 years of monitoring, 74 bird species have been recorded, 71 of which are permanent or summer residents to the area (Jackson et al. 1996). Data collected for these species are valuable for characterizing the park's breeding bird community and the habitat they rely on. The seven breeding species of concern for the Eastern Tallgrass Prairie Bird Conservation Region should be given additional consideration in the management of natural resources on the park: Blue-winged Warbler, Dickcissel, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Northern Flicker, and Red-headed Woodpecker. However, only the Dickcissel was recorded in sufficient numbers to assess trends in its population and weigh the influences of managing habitat for their needs (Appendix B). If it is not feasible to manage habitat for the six remaining species directly, then habitat should at least be managed in a way that does not conflict with their needs. For example, conversion of the park grasslands to woodlands would be detrimental to the Field Sparrow, Grasshopper Sparrow, and Henslow's Sparrow. Conversely, converting developed areas to grasslands would benefit these species.

Nine breeding species, including the Dickcissel, were observed during the survey period in sufficient numbers to calculate annual abundances and trends with some degree of confidence. The Red-winged Blackbird, American Robin, and Dickcissel were the most abundant and widespread species on Herbert Hoover National Historic Site, and their habitat preferences provide the best characterization of habitat currently present at the park. The American Robin is a habitat generalist using a wide range of habitat types, the Red-winged Blackbird uses marshy areas and meadows, and the Dickcissel uses tallgrass prairie areas and old fields (Stokes and Stokes 1996). Habitat on Herbert Hoover National Historic Site is a mix of developed areas, ruderal wetland vegetation in seasonally flooded areas, and restored tallgrass prairie (Diamond et al. 2014), habitat that is ideal for the three common species. The mix of habitats (structural composition) on the park is also important for the species of regional concern because their microhabitat requirements vary (Pashley and Barrow 1993). For example, Northern Flicker and Red-headed Woodpecker prefer farmlands, open woodlands, orchards, and urban/suburban forest; Dickcissel, Grasshopper Sparrow, and Henslow's Sparrow prefer tallgrass prairie and old fields; and the Blue-winged Warbler and Field Sparrow prefer shrubby or old field habitat (Stokes and Stokes 1996).

A comparison of population trends on Herbert Hoover National Historic Site with regional trends in the Eastern Tallgrass Prairie Bird Conservation Region was inconclusive. We were unable to detect with certainty any positive or negative population trends in any of the nine species analyzed (Figure 3). Regionally, Dickcissel and Northern Cardinal had increasing population trends, while American Goldfinch, American Robin, Common Grackle, Common Yellowthroat, Eastern Meadowlark, Mourning Dove, and Red-winged blackbird had declining population trends.

Over the 18 years of bird monitoring on Herbert Hoover National Historic Site, the stable diversity, richness, and evenness in distribution of individuals across species suggest that habitat on the park

has remained similar over time (Figure 4) and provides for a rich array of breeding species. However, this stable species community structure could be altered if significant portions of the park's grasslands were converted to woodlands or developed.

A word of caution is needed here; since we have a limited number of survey years in Herbert Hoover National Historic Site, trends and indices may change as more years of data are collected. However, our reported data provide baseline information for understanding bird population trends at Herbert Hoover National Historic Site in the context of those seen in the larger Eastern Tallgrass Prairie Bird Conservation Region and should help the park make more informed natural resource management decisions. Our reported data also contribute information to efforts of other agencies researching the full life cycle of migratory birds (Partners in Flight, U.S. Geological Survey, U.S. Fish and Wildlife Service, Cornell Lab, Bird Conservancy of the Rockies, etc.).

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Appendix A. Plots Sampled

Table 3. Plots sampled on Herbert Hoover National Historic Site, Iowa, between 2005 and 2022 and gross habitat type. “Yes” indicates plot was sampled; “No” indicates it was not sampled.

Plot	2005	2006	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2021	2022	Plot Type
HEHO1 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Grassland/Open
HEHO2 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Grassland/Open
HEHO3 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Grassland/Open
HEHO4 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Grassland/Open
HEHO5 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Grassland/Open
HEHO6 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Grassland/Open
HEHO7 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Grassland/Open
HEHO8 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Grassland/Open
HEHO9 ^A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Grassland/Open
HEHO10	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO11	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO12	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO13	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO14	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO15	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO16	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO17	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO18	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO19	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO20	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO21	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO22	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open

^A Plots that were included in analysis of individual bird species trends (also in bold).

Table 3 (continued). Plots sampled on Herbert Hoover National Historic Site, Iowa, between 2005 and 2022 and gross habitat type. “Yes” indicates plot was sampled; “No” indicates it was not sampled.

Plot	2005	2006	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2021	2022	Plot Type
HEHO23	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO24	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO25	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO26	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO27	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Grassland/Open
HEHO28	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO29	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Grassland/Open
HEHO30	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Developed land
HEHO31^A	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Developed land
HEHO32	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Developed land
HEHO33	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Developed land
HEHO34	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Developed land
HEHO35^A	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Developed land
HEHO36	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Developed land
HEHO37	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Developed land
HEHO38	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Developed land

^A Plots that were included in analysis of individual bird species trends (also in bold).

Appendix B. Proportion of Plots Occupied and Abundance (Corrected for Undetected Individuals)

Table 4. Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using Distance software) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance using Distance does not. “–” denotes when an annual abundance value could not be calculated because the species was present but distance measures from observers could not be determined.

Common Name	Proportion of Plots Occupied (Abundance)													
	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
American Goldfinch	0.33 (47)	0.44 (140)	0.24 (140)	0.26 (140)	0.64 (249)	0.50 (112)	0.50 (143)	0.27 (187)	0.27 (47)	0.27 (–)	0.45 (117)	0.42 (214)	0.27 (94)	0.39 (164)
American Robin	0.44 (119)	0.22 (119)	0.53 (253)	0.53 (178)	0.89 (254)	0.63 (238)	0.47 (273)	0.64 (208)	0.55 (475)	0.64 (119)	0.82 (204)	0.76 (266)	0.67 (104)	0.68 (204)
Common Grackle	0.22 (563)	0.11 (422)	0.74 (156)	0.47 (402)	0.78 (377)	0.74 (188)	0.34 (211)	0.55 (211)	0.45 (–)	0.45 (–)	0.73 (141)	0.29 (169)	0.47 (949)	0.63 (352)
Common Yellowthroat	0.67 (78)	0.67 (104)	0.68 (91)	0.39 (104)	0.75 (99)	0.29 (93)	0.34 (124)	0.45 (94)	0.45 (78)	0.73 (78)	0.55 (52)	0.74 (117)	0.40 (78)	0.39 (94)
Dickcissel^A	0.44 (60)	0.44 (90)	0.21 (53)	0.16 (70)	0.56 (89)	0.53 (85)	0.55 (72)	0.18 (120)	0.36 (180)	0.64 (120)	0.91 (80)	0.68 (127)	0.60 (53)	0.71 (154)
Eastern Meadowlark	0.22 (23)	0.33 (16)	0.61 (23)	0.24 (27)	0.72 (26)	0.39 (31)	0.47 (34)	0.55 (33)	0.64 (41)	0.73 (23)	0.82 (29)	0.42 (31)	0.40 (23)	0.68 (34)
Mourning Dove	0.11 (–)	0.11 (–)	0.50 (37)	0.18 (24)	0.42 (32)	0.63 (28)	0.45 (26)	0.64 (47)	0.55 (47)	0.55 (24)	0.55 (28)	0.29 (30)	0.13 (24)	0.21 (32)
Northern Cardinal	0.00 (0)	0.11 (38)	0.26 (38)	0.21 (44)	0.36 (51)	0.26 (47)	0.13 (38)	0.09 (38)	0.00 (0)	0.09 (38)	0.36 (27)	0.18 (45)	0.33 (38)	0.58 (42)
Red-winged Blackbird	0.89 (115)	1.00 (157)	0.84 (93)	0.61 (118)	0.97 (124)	0.76 (118)	0.79 (182)	0.73 (95)	0.73 (95)	0.82 (65)	1.00 (107)	0.76 (106)	0.73 (50)	0.71 (86)

^A Species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Appendix C. Proportion of Plots Occupied and Abundance (Not Corrected for Undetected Individuals)

Table 5. Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 50 m of plot center) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. “–” denotes when an annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined or the species was outside of 50 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
American Crow	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.19 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.09 (–)	0.00 (0)	0.03 (–)	0.00 (0)	0.24 (–)
American Redstart	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.07 (–)	0.00 (0)
Baltimore Oriole	0.00 (0)	0.00 (0)	0.11 (3)	0.05 (3)	0.11 (3)	0.03 (3)	0.00 (0)	0.18 (18)	0.00 (0)	0.09 (9)	0.09 (9)	0.00 (0)	0.13 (–)	0.16 (–)
Bank Swallow	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (–)	0.00 (0)	0.00 (0)	0.27 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Barn Swallow	0.11 (–)	0.00 (0)	0.26 (3)	0.26 (–)	0.28 (8)	0.18 (–)	0.42 (30)	0.18 (–)	0.00 (0)	0.09 (–)	0.27 (–)	0.16 (–)	0.27 (–)	0.08 (–)
Barred Owl	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Black-capped Chickadee	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.09 (18)	0.00 (0)	0.09 (9)	0.00 (0)	0.05 (3)	0.13 (–)	0.03 (–)
Blue Jay	0.11 (–)	0.00 (0)	0.05 (3)	0.05 (–)	0.11 (18)	0.03 (–)	0.03 (–)	0.00 (0)	0.18 (–)	0.09 (–)	0.00 (0)	0.03 (–)	0.13 (–)	0.08 (3)
Blue-gray Gnatcatcher	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.03 (3)	0.00 (0)	0.03 (–)

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Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 50 m of plot center) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. “–” denotes when an annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined or the species was outside of 50 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
Bobolink	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)
Brown-headed Cowbird	0.22 (11)	0.11 (–)	0.11 (–)	0.18 (15)	0.08 (13)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (9)	0.00 (0)	0.05 (–)	0.27 (13)	0.58 (20)
Brown Thrasher	0.00 (0)	0.11 (–)	0.08 (–)	0.03 (3)	0.19 (3)	0.03 (3)	0.11 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Canada Goose	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (–)	0.00 (0)
Cedar Waxwing	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.18 (–)	0.00 (0)	0.00 (0)	0.00 (0)
Chimney Swift	0.00 (0)	0.00 (0)	0.11 (–)	0.05 (–)	0.08 (–)	0.05 (–)	0.18 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Chipping Sparrow	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)	0.19 (8)	0.08 (13)	0.00 (0)	0.09 (–)	0.00 (0)	0.09 (18)	0.00 (0)	0.05 (5)	0.13 (6)	0.18 (18)
Cliff Swallow	0.00 (0)	0.00 (0)	0.05 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Common Nighthawk	0.00 (0)	0.00 (0)	0.03 (3)	0.03 (–)	0.03 (–)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)
Downy Woodpecker	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (–)	0.00 (0)
Eastern Bluebird	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (9)	0.00 (0)	0.00 (0)	0.09 (–)	0.03 (3)	0.00 (0)	0.03 (3)

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Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 50 m of plot center) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. “–” denotes when an annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined or the species was outside of 50 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
Eastern Kingbird	0.11 (11)	0.00 (0)	0.03 (–)	0.05 (–)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (5)
Eastern Phoebe	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (3)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.13 (3)	0.00 (0)	0.00 (0)
Eastern Towhee	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)
Eastern Wood-pewee	0.00 (0)	0.11 (–)	0.05 (–)	0.08 (3)	0.08 (5)	0.05 (3)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.18 (–)	0.08 (–)	0.07 (–)	0.05 (–)
European Starling	0.11 (–)	0.00 (0)	0.11 (3)	0.13 (10)	0.14 (13)	0.13 (3)	0.13 (3)	0.09 (–)	0.09 (–)	0.00 (0)	0.18 (–)	0.05 (3)	0.00 (0)	0.11 (3)
Field Sparrow ^A	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)	0.08 (–)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.55 (–)	0.00 (0)	0.60 (6.4)	0.47 (13)
Grasshopper Sparrow ^A	0.00 (0)	0.11 (11)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (8)	0.00 (0)	0.55 (81)
Gray Catbird	0.00 (0)	0.00 (0)	0.08 (3)	0.08 (3)	0.06 (3)	0.00 (0)	0.05 (–)	0.00 (0)	0.09 (9)	0.09 (9)	0.09 (–)	0.11 (8)	0.27 (6)	0.13 (13)
Great Blue Heron	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (–)	0.00 (0)
Great Crested Flycatcher	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)
Great Horned Owl	0.00 (0)	0.00 (0)	0.03 (–)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.00 (0)

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Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 50 m of plot center) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. “–” denotes when an annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined or the species was outside of 50 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
Henslow’s Sparrow^A	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.16 (18)	0.00 (0)	0.00 (0)
House Finch	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (6)	0.03 (–)
House Sparrow	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.08 (3)	0.05 (3)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (9)	0.03 (3)	0.00 (0)	0.05 (3)
House Wren	0.00 (0)	0.00 (0)	0.00 (0)	0.13 (–)	0.08 (5)	0.08 (7)	0.11 (8)	0.09 (8)	0.00 (0)	0.00 (0)	0.09 (–)	0.18 (18)	0.00 (0)	0.05 (–)
Indigo Bunting	0.00 (0)	0.00 (0)	0.08 (–)	0.08 (8)	0.25 (10)	0.11 (10)	0.11 (3)	0.09 (–)	0.09 (–)	0.18 (18)	0.45 (–)	0.08 (3)	0.07 (6)	0.29 (15)
Killdeer	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.07 (–)	0.00 (0)
Mallard	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (–)	0.03 (–)	0.03 (–)	0.00 (0)	0.09 (–)	0.00 (0)	0.18 (–)	0.09 (9)	0.03 (–)	0.00 (0)	0.00 (0)
Northern Flicker^A	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)
Northern Mockingbird	0.00 (0)	0.11 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Purple Martin	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Red-bellied Woodpecker	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)	0.00 (0)	0.00 (0)

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Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 50 m of plot center) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. “–” denotes when an annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined or the species was outside of 50 m from the plot center.

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	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
Red-tailed Hawk	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Ring-necked Pheasant	0.11 (–)	0.22 (–)	0.00 (0)	0.11 (–)	0.00 (0)	0.05 (3)	0.03 (–)	0.00 (0)	0.09 (9)	0.09 (–)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)
Rock Dove	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.00 (0)
Rose-breasted Grosbeak	0.00 (0)	0.00 (0)	0.08 (–)	0.03 (–)	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Ruby-throated Hummingbird	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.03 (–)
Sedge Wren	0.00 (0)	0.00 (0)	0.00 (0)	0.09 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Song Sparrow	0.00 (0)	0.00 (0)	0.13 (5)	0.24 (10)	0.22 (10)	0.16 (18)	0.08 (5)	0.00 (0)	0.09 (–)	0.09 (–)	0.00 (0)	0.08 (5)	0.00 (0)	0.13 (–)
Spotted Sandpiper	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (3)
Tree Swallow	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.08 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Turkey Vulture	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)
Warbling Vireo	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.08 (3)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (6)	0.00 (0)

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Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 50 m of plot center) of each species at Herbert Hoover National Historic Site, Iowa, during the 2005 to 2022 spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. “–” denotes when an annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined or the species was outside of 50 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2005 (n=9)	2006 (n=9)	2008 (n=38)	2009 (n=38)	2010 (n=38)	2011 (n=38)	2012 (n=38)	2013 (n=11)	2014 (n=11)	2015 (n=11)	2016 (n=11)	2017 (n=38)	2021 (n=15)	2022 (n=38)
Willow Flycatcher	0.00 (0)	0.00 (0)	0.03 (3)	0.05 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.13 (6)	0.00 (–)
Yellow-throated Vireo	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.14 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)
Yellow Warbler	0.00 (0)	0.11 (–)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)	0.00 (0)	0.00 (0)

^A Species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Appendix D. Herbert Hoover National Historic Site Trends

Table 6. Trends, annual change in abundance (individuals), of breeding birds recorded on Herbert Hoover National Historic Site, Iowa, from 2005 through 2022.

Common Name	Trend ^A	SE of Slope	Trend Classification ^B
American Goldfinch	0.97	0.04	Uncertain
American Robin	1.03	0.03	Uncertain
Common Grackle	0.99	0.04	Uncertain
Common Yellowthroat	0.96	0.05	Uncertain
Dickcissel ^C	1.06	0.05	Uncertain
Eastern Meadowlark	1.03	0.06	Uncertain
Mourning Dove	0.97	0.06	Uncertain
Northern Cardinal	1.08	0.13	Uncertain
Red-winged Blackbird	0.94	0.03	Uncertain

^A Trends were determined using the statistical software package 'rtrim' built under R version 3.6.3.

^B Trend classification types depend on statistical significance and magnitude (Pannekoek and van Strien 2005; van Strien et al. 2001) and follow Gregory et al. (2007). The multiplicative overall slope estimate in TRIM was converted into one of the following categories depending on the overall slope as well as its 95% confidence interval (= slope $\pm$ 1.96 times the standard error of the slope). Strong increase: increase significantly more than 5% per year; criterion is lower limit of confidence interval > 1.05. Moderate increase: significant increase, but not significantly more than 5% per year; criterion is 1.00 < lower limit of confidence interval < 1.05. Stable: no significant increase or decline, and it is certain that trends are less than 5% per year; criterion is confidence interval encloses 1.00 but lower limit > 0.95 and upper limit < 1.05. Uncertain: no significant increase or decline, but not certain if trends are less than 5% per year; criterion is confidence interval encloses 1.00 but lower limit < 0.95 or upper limit > 1.05. Moderate decline: significant decline, but not significantly more than 5% per year; criterion is 0.95 < upper limit of confidence interval < 1.00. Steep decline: decline significantly more than 5% per year; criterion is upper limit of confidence interval < 0.95.

^C Species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Appendix E. Regional Trends

Table 7. Regional trends (Eastern Tallgrass Prairie Bird Conservation Region) in breeding birds recorded on Herbert Hoover National Historic Site, Iowa, from 2005 through 2019. Regional trend data were obtained from the USGS Breeding Bird Surveys (BBS) Program (Sauer et al. 2020). Trend is defined as an interval-specific geometric mean of proportional changes in population size (Link and Sauer 1998), expressed as a percentage. NA signifies that few observations of the species were made so calculations of trends could not be made.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
American Crow	-0.81	-1.40	-0.21
American Goldfinch	-2.42	-3.22	-1.60
American Redstart	NA	NA	NA
American Robin	-0.45	-0.85	-0.07
Baltimore Oriole	-3.51	-4.36	-2.69
Bank Swallow	-4.24	-9.29	1.17
Barn Swallow	-1.58	-2.22	-0.94
Barred Owl	2.58	0.27	4.81
Black-capped Chickadee	-1.85	-3.24	-0.41
Blue Jay	-0.80	-1.43	-0.16
Blue-gray Gnatcatcher	-0.68	-2.34	0.88
Blue-winged Warbler ^A	-2.82	-7.95	2.47
Bobolink	-2.79	-4.77	-0.77
Brown-headed Cowbird	-1.06	-1.71	-0.39
Brown Thrasher	-1.09	-1.77	-0.43
Canada Goose	3.74	-0.30	8.26
Cedar Waxwing	-3.71	-5.50	-1.91
Chimney Swift	-5.24	-6.19	-4.32
Chipping Sparrow	-0.67	-1.35	0.05
Cliff Swallow	5.25	1.18	9.21
Common Grackle	-5.84	-6.48	-5.20
Common Nighthawk	-0.72	-2.94	1.43
Common Yellowthroat	-0.86	-1.46	-0.22
Dickcissel ^A	1.31	0.49	2.16
Double-crested Cormorant	2.34	-3.51	9.11
Downy Woodpecker	NA	NA	NA
Eastern Bluebird	-2.39	-3.45	-1.34
Eastern Kingbird	-3.20	-4.04	-2.37

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Table 7 (continued). Regional trends (Eastern Tallgrass Prairie Bird Conservation Region) in breeding birds recorded on Herbert Hoover National Historic Site, Iowa, from 2005 through 2019. Regional trend data were obtained from the USGS Breeding Bird Surveys (BBS) Program (Sauer et al. 2020). Trend is defined as an interval-specific geometric mean of proportional changes in population size (Link and Sauer 1998), expressed as a percentage. NA signifies that few observations of the species were made so calculations of trends could not be made.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
Eastern Meadowlark	-1.94	-2.56	-1.33
Eastern Phoebe	-1.06	-2.00	-0.13
Eastern Towhee	1.85	0.76	2.99
Eastern Wood-pewee	0.16	-0.60	0.92
European Starling	-3.88	-4.63	-3.15
Field Sparrow^A	-0.48	-1.22	0.28
Grasshopper Sparrow^A	-8.84	-10.25	-7.37
Gray Catbird	1.48	0.77	2.26
Great Blue Heron	-1.87	-3.06	-0.65
Great Crested Flycatcher	0.02	-0.83	0.86
Great Horned Owl	-1.24	-3.45	1.04
Henslow's Sparrow^A	-1.05	-5.21	3.10
House Finch	-0.28	-1.94	1.43
House Sparrow	-3.06	-3.79	-2.32
House Wren	1.40	0.67	2.19
Indigo Bunting	-1.10	-1.56	-0.63
Killdeer	-0.71	-1.38	-0.05
Mallard	-2.19	-4.46	0.04
Mourning Dove	-1.29	-1.76	-0.80
Northern Cardinal	1.06	0.64	1.48
Northern Flicker^A	NA	NA	NA
Northern Mockingbird	-1.35	-2.24	-0.50
Purple Martin	0.06	-2.33	2.56
Red-bellied Woodpecker	0.90	0.12	1.66
Red-headed Woodpecker^A	1.08	-0.14	2.31
Red-tailed Hawk	-0.95	-1.97	0.04
Red-winged Blackbird	-1.69	-2.14	-1.22
Ring-necked Pheasant	-2.87	-4.79	-0.88
Rock Dove	-3.42	-5.04	-1.72
Rose-breasted Grosbeak	0.01	-1.13	1.21
Ruby-throated Hummingbird	0.32	-1.26	1.88

^A Species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Table 7 (continued). Regional trends (Eastern Tallgrass Prairie Bird Conservation Region) in breeding birds recorded on Herbert Hoover National Historic Site, Iowa, from 2005 through 2019. Regional trend data were obtained from the USGS Breeding Bird Surveys (BBS) Program (Sauer et al. 2020). Trend is defined as an interval-specific geometric mean of proportional changes in population size (Link and Sauer 1998), expressed as a percentage. NA signifies that few observations of the species were made so calculations of trends could not be made.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
Sedge Wren	-2.74	-7.20	2.10
Song Sparrow	-1.22	-1.77	-0.66
Sora	-0.60	-6.49	4.68
Spotted Sandpiper	1.01	-0.89	3.05
Swamp Sparrow	1.31	-1.40	4.78
Tree Swallow	0.09	-2.08	2.40
Turkey Vulture	5.20	3.48	6.93
Warbling Vireo	-0.48	-1.29	0.38
Willow Flycatcher	NA	NA	NA
Wild Turkey	0.78	-2.01	3.68
Yellow-throated Vireo	3.24	1.39	5.12
Yellow Warbler	0.15	-1.02	1.36

^A Species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Appendix F. Habitat Parameters

Habitat parameter averages in three different plot sizes are shown in Tables 8 through 10. Table 11 shows stem densities of trees by size class.

Table 8. Average percent cover ($\pm$ standard deviation) of each habitat type in 50 m plots at Herbert Hoover National Historic Site, Iowa, during the bird breeding seasons from 2009 to 2022 (n = number of plots sampled). Total percent cover across habitat types may not 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	2009 (n = 38)	2013 (n = 11)	2017 (n = 38)	2022 (n = 38)
Old Field/Prairie (%)	78.03 ($\pm$ 36.39)	81.14 ($\pm$ 36.56)	73.22 ($\pm$ 37.62)	61.84 ($\pm$ 41.85)
Highway Right of Way (%)	0.08 ($\pm$ 0.49)	0.00	0.16 ($\pm$ 0.68)	2.32 ($\pm$ 13.78)
Intermittent Water Cover (%)	0.99 ($\pm$ 6.08)	0.00	0.79 ($\pm$ 3.39)	7.53 ($\pm$ 25.52)
Lawn (%)	15.95 ($\pm$ 32.93)	14.55 ($\pm$ 33.29)	14.42 ($\pm$ 29.84)	17.28 ($\pm$ 32.02)
Pasture Road/Trail (%)	1.97 ($\pm$ 4.08)	0.00	1.97 ($\pm$ 3.44)	0.75 ($\pm$ 1.20)
Paved Road (%)	1.63 ($\pm$ 6.49)	0.55 ($\pm$ 1.21)	2.82 ($\pm$ 7.41)	2.88 ($\pm$ 7.40)
Woodland/Shrub (%)	0.40 ($\pm$ 1.03)	0.00	1.42 ($\pm$ 4.11)	3.68 ($\pm$ 10.35)
Stream (%)	0.55 ($\pm$ 2.50)	0.00	0.24 ($\pm$ 0.82)	0.57 ($\pm$ 2.50)
Other (%)	0.08 ($\pm$ 0.49)	0.00	0.40 ($\pm$ 2.43)	0.49 ($\pm$ 2.48)

Table 9. Average ($\pm$ standard deviation) canopy cover, canopy height, basal area, percent cover of vegetation at various horizontal height increments to 2.0 m, and vertical structural diversity in 5 m subplots at Herbert Hoover National Historic Site, Iowa, during the bird breeding seasons from 2009 to 2022 (n = number of subplots sampled). For percent cover data, total percent cover may not 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	Subcategory	2009 (n = 38)	2013 (n = 11)	2017 (n = 38)	2022 (n = 38)
Canopy Cover	Hardwood (%)	10.78 ($\pm$ 29.11)	1.63 ($\pm$ 3.91)	11.93 ($\pm$ 27.82)	10.02 ($\pm$ 22.56)
	Conifer (%)	2.63 ($\pm$ 16.20)	0.00	1.07 ($\pm$ 5.31)	0.00
	Total Cover (%)	13.34 ($\pm$ 32.46)	1.63 ($\pm$ 3.91)	13.01 ($\pm$ 28.21)	10.02 ($\pm$ 22.56)
Canopy Height	Hardwood (m)	4.21 ($\pm$ 8.23)	3.68 ($\pm$ 8.20)	4.63 ($\pm$ 9.38)	5.32 ($\pm$ 9.47)
	Conifer (m)	0.63 ($\pm$ 3.44)	2.23 ($\pm$ 7.39)	1.26 ($\pm$ 4.85)	2.45 ($\pm$ 7.12)
Basal Area	Hardwood (m ² /ha)	1.91 ($\pm$ 3.70)	1.14 ($\pm$ 2.59)	1.78 ($\pm$ 3.90)	2.11 ($\pm$ 4.74)
	Conifer (m ² /ha)	0.59 ($\pm$ 3.26)	1.14 ($\pm$ 3.77)	0.59 ($\pm$ 2.28)	0.00
	Total (m ² /ha)	2.24 ($\pm$ 4.64)	1.82 ($\pm$ 4.20)	2.37 ($\pm$ 5.10)	2.11 ($\pm$ 4.74)
Horizontal Vegetation Profile— measured at 15 m north of plot center (percent cover at different height increments)	0.00–0.25 m (%)	82.13 ($\pm$ 30.28)	86.59 ($\pm$ 24.71)	85.83 ($\pm$ 30.84)	82.65 ($\pm$ 29.39)
	0.25–0.50 m (%)	54.53 ($\pm$ 42.85)	65.68 ($\pm$ 34.89)	73.82 ($\pm$ 35.62)	61.62 ($\pm$ 42.17)
	0.50–0.75 m (%)	32.95 ($\pm$ 39.90)	22.50 ($\pm$ 28.06)	30.61 ($\pm$ 31.69)	14.83 ($\pm$ 27.25)
	0.75–1.00 m (%)	10.50 ($\pm$ 20.85)	7.68 ($\pm$ 18.71)	19.53 ($\pm$ 28.37)	9.49 ($\pm$ 23.48)
	1.00–1.25 m (%)	3.29 ($\pm$ 10.67)	1.46 ($\pm$ 4.50)	10.55 ($\pm$ 23.72)	3.28 ($\pm$ 10.45)
	1.25–1.50 m (%)	1.93 ($\pm$ 10.12)	0.00	2.79 ($\pm$ 13.92)	0.59 ($\pm$ 2.50)
	1.50–1.75 m (%)	2.24 ($\pm$ 8.46)	1.36 ($\pm$ 4.52)	2.66 ($\pm$ 13.93)	0.58 ($\pm$ 2.50)
	1.75–2.00 m (%)	0.11 ($\pm$ 0.50)	7.73 ($\pm$ 25.60)	2.33 ($\pm$ 13.80)	1.04 ($\pm$ 6.08)
Vertical Structure Diversity (%)	n/a	12.62 ($\pm$ 7.16)	3.15 ($\pm$ 5.28)	15.87 ($\pm$ 13.03)	10.96 ($\pm$ 5.14)

Table 10. Average percent ($\pm$ standard deviation) soil substrate cover and plant guild cover in 1.78 m subplots at Herbert Hoover National Historic Site, Iowa, during the bird breeding seasons from 2009 to 2022 (n = number of subplots sampled). Total percent cover 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	2009 (n = 38)	2013 (n = 11)	2017 (n = 38)	2022 (n = 38)
Deciduous Litter (%)	2.55 ($\pm$ 4.53)	0.55 ($\pm$ 0.85)	3.95 ($\pm$ 14.79)	3.99 ($\pm$ 14.95)
Conifer Litter (%)	2.25 ($\pm$ 13.79)	0.32 ($\pm$ 0.90)	0.03 ($\pm$ 0.11)	0.41 ($\pm$ 2.43)
Grass Litter (%)	37.79 ($\pm$ 36.90)	57.14 ($\pm$ 32.94)	38.07 ($\pm$ 30.66)	53.76 ($\pm$ 40.92)
Bare Soil (%)	6.95 ($\pm$ 9.75)	0.77 ($\pm$ 1.13)	2.91 ($\pm$ 3.10)	19.41 ($\pm$ 28.26)
Rock (%)	0.00	0.00	0.00	0.01 ($\pm$ 0.08)
Woody Debris (%)	1.09 ($\pm$ 2.61)	0.05 ($\pm$ 0.15)	0.59 ($\pm$ 2.45)	1.39 ($\pm$ 6.07)
Unvegetated (%)	53.83 ($\pm$ 29.90)	54.41 ($\pm$ 33.56)	75.87 ($\pm$ 26.40)	75.99 ($\pm$ 25.89)
Warm-season Grass (%)	8.89 ($\pm$ 16.00)	0.64 ($\pm$ 0.81)	1.66 ($\pm$ 2.60)	2.12 ($\pm$ 4.56)
Cool-season Grass (%)	29.91 ($\pm$ 30.48)	68.18 ($\pm$ 18.51)	25.33 ($\pm$ 27.85)	20.37 ($\pm$ 22.85)
Forb (%)	22.20 ($\pm$ 21.58)	35.91 ($\pm$ 22.09)	25.58 ($\pm$ 20.56)	24.78 ($\pm$ 25.74)
Moss and Lichen (%)	0.01 ($\pm$ 0.08)	0.00	0.00	0.03 ($\pm$ 0.11)
Shrubs and Vines (%)	2.36 ($\pm$ 10.34)	0.32 ($\pm$ 0.90)	2.00 ($\pm$ 4.61)	2.05 ($\pm$ 4.61)
Tree Seedling (%)	0.00	0.45 ($\pm$ 0.88)	1.21 ($\pm$ 3.45)	0.05 ($\pm$ 0.16)
Total Foliar (%)	56.58 ($\pm$ 26.32)	79.09 ($\pm$ 13.98)	61.25 ($\pm$ 25.87)	53.84 ($\pm$ 28.08)

Table 11. Stems per hectare for trees found at Herbert Hoover National Historic Site, Iowa, by size class, during the 2009 to 2022 bird breeding seasons (n = number of plots sampled). Tree stems per hectare are reported by family.

Stem Size Class	Family	2009 (n = 38)	2013 (n = 11)	2017 (n = 38)	2022 (n = 38)
<1.0 cm	Cornaceae	0	46	0	0
	Elaeagnaceae	0	58	10	0
	Hippocastanaceae	0	0	0	3
	Moraceae	0	0	3	7
	Pinaceae	0	0	0	3
	Rosaceae	0	0	7	7
1.1–2.5 cm	Hippocastanaceae	0	0	0	7
	Juglandaceae	0	0	0	3
	Moraceae	0	0	3	7
	Oleaceae	0	0	3	3
	Rosaceae	0	0	7	3
2.6–8.0 cm	Aceraceae	3	0	0	0
	Juglandaceae	0	0	0	13
	Moraceae	0	0	0	17
	Oleaceae	0	0	0	3
	Pinaceae	13	0	0	0
	Rosaceae	0	0	0	3
8.1–15.0 cm	Pinaceae	0	0	3	0
>38.0 cm	Fabaceae	3	0	3	3
	Fagaceae	3	0	0	3
	Pinaceae	3	0	0	0
	Plantanaceae	3	0	3	3

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1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525