National Park Service
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Natural Resource Stewardship and Science

Bird Monitoring at Herbert Hoover National Historic Site, Iowa

Status Report 2005–2017

Natural Resource Report NPS/HTLN/NRR—2019/1936

ON THE COVER
The Birthplace Cottage at Herbert Hoover National Historic Site
Photography by NPS/Heartland Inventory and Monitoring Network

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Status Report 2005–2017

Natural Resource Report NPS/HTLN/NRR—2019/1936

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Executive Summary

In 2005, the Heartland Inventory & Monitoring Network initiated breeding bird surveys on Herbert Hoover National Historic Site, Iowa, to address two objectives: (1) to monitor changes in bird community composition and abundance, and (2) to improve our understanding of relationships between breeding birds and habitat, and the effects of management actions on those relationships. This report evaluates trends in the park's breeding bird populations in the context of trends observed within the North American Bird Conservation Initiative's (NABCI) Eastern Tallgrass Prairie Bird Conservation Region , the region in which the park is located. By doing so, we can 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 Herbert Hoover National Historic Site.

Sixty-eight species of birds were recorded during May and June site visits in the twelve years since initiating monitoring. Sixty-seven of the species are considered breeding species because they are permanent or summer residents. Seven of the breeding species recorded on Herbert Hoover National Historic Site are species of concern for the Eastern Tallgrass Prairie Bird Conservation Region. Eight species were observed during the survey period in sufficient numbers to calculate annual abundances and trends with some degree of confidence.

The American Robin (*Turdus migratorius*) and Red-winged Blackbird (*Agelaius phoeniceus*) were the most abundant and widespread species on Herbert Hoover National Historic Site. Comparing population trends on the park with regional trends suggest that populations of the most common species on the park were similar to those of the region, especially for American Goldfinch (*Spinus tristis*), Common Grackle (*Quiscalus quiscula*), Common Yellowthroat (*Geothlypis trichas*), Dickcissel (*Spiza americana*), and Mourning Dove (*Zenaida macroura*). The population of Eastern Meadowlark (*Sturnella magna*) on the park was doing slightly better than the population region-wide. One of the species that was common and widespread on the park, American Robin, had an uncertain park population trend, but a region-wide trend that was increasing. The other common and widespread species, Red-winged Blackbird, had a population trend that was declining both on the park and across the region.

This report provides current regional and local trends for breeding birds for future comparisons with bird data collected as part of the long-term monitoring efforts at Herbert Hoover National Historic Site. This information will help park staff plan management objectives and assess the effectiveness of management alternatives. These monitoring data also provide park staff with additional information for interpreting natural resources.

Acknowledgments

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

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 for 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.

Herbert Hoover National Historic Site, Iowa, is located in the north-central section of the Eastern Tallgrass Prairie Bird Conservation Region (Figure 1). This bird conservation region is one of 67 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 2012).

Historically, this region included the tallest and lushest grasslands of the Great Plains in its western sections (NABCI 2012). Beech-maple forests dominated the eastern sections of the region. A prairie and woodland ecotone between the two sections was marked by a broad and dynamic oak-dominated savanna. Today, the landscape of this region is largely

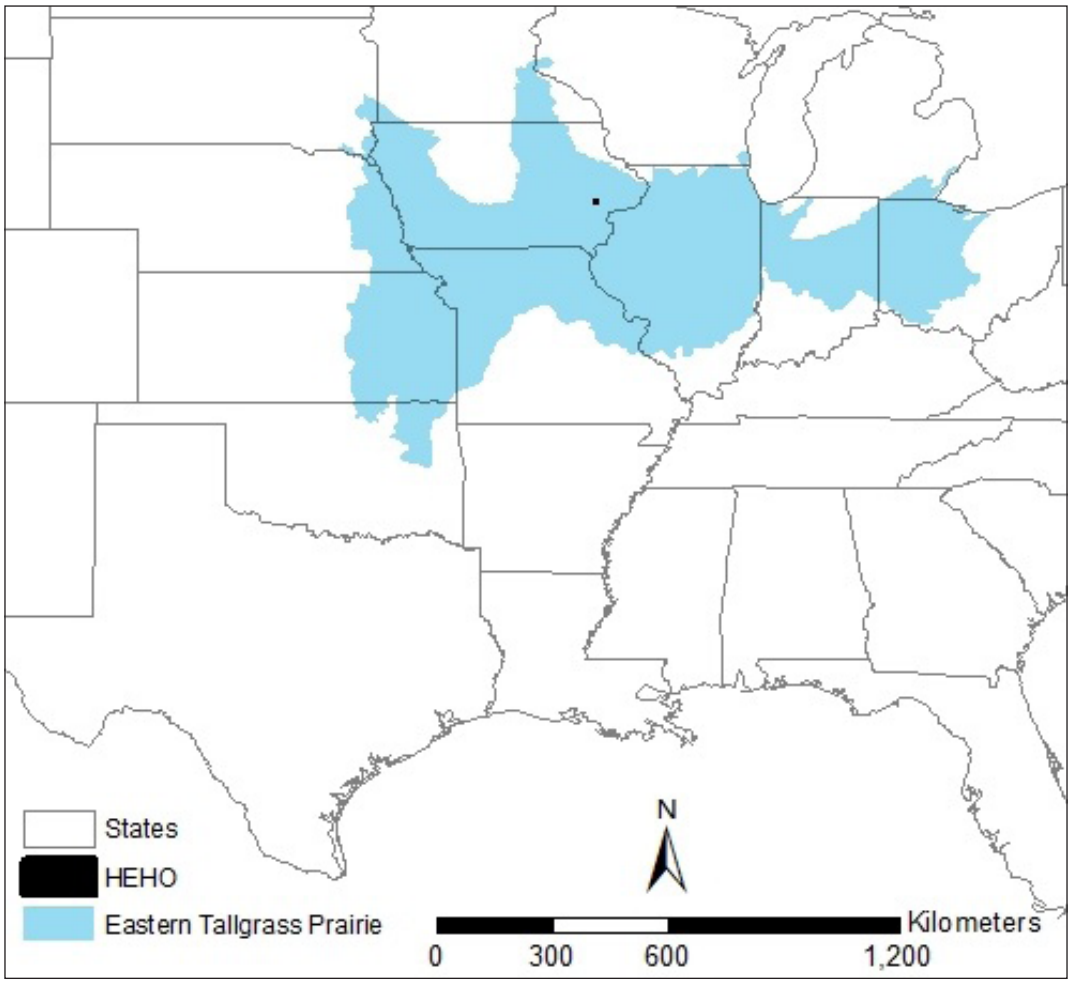

Figure 1. Location of Herbert Hoover National Historic Site (HEHO), Iowa, within the Eastern Tallgrass Prairie Bird Conservation Region.

agriculture. Approximately 124 species of breeding birds can be found in the tallgrass prairie habitat of the area around Herbert Hoover National Historic Site (Jackson et al. 1996).

Data collected during the U.S. Geological Survey's (USGS) annual North American Breeding Bird Surveys (BBS) between 2005 and 2015 indicate that a number (56) of bird species with the potential to occur at Herbert Hoover National Historic Site show evidence of population decline (Sauer et al. 2017). In fact, 43% of the bird 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 Savannah Sparrow (*Passerculus sandwichensis*), Western Meadowlark (*Sturnella neglecta*), and Whip-poor-will (*Caprimulgus vociferus*) declining at alarming rates.

Long-term trends in community composition and abundance of breeding bird populations provide one measure for assessing the ecological stability in a system, as well as any changes that occur. We will use trends in the composition and abundance of bird populations as long-term indicators of ecosystem stability at Herbert Hoover National Historic Site. *Ecosystem stability* 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. 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 actions implemented to restore and maintain the landscape of 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 12 years (2005–2017, excluding 2007) of monitoring.

Methods

Site Selection

Permanent monitoring locations or 'plots' were selected by overlaying a systematic grid of 100 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 located 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 GPS unit and temporarily marked with 36-in 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, the habitat assessment crews worked independent of the bird surveyor, and monitoring plots were located using a GPS unit, but not marked with pin flags. In 2008, 2010 to 2012, and 2014 to 2016, habitat assessments were not conducted. Bird monitoring plots in these years were also located using a GPS unit and plots were not marked with pin flags.

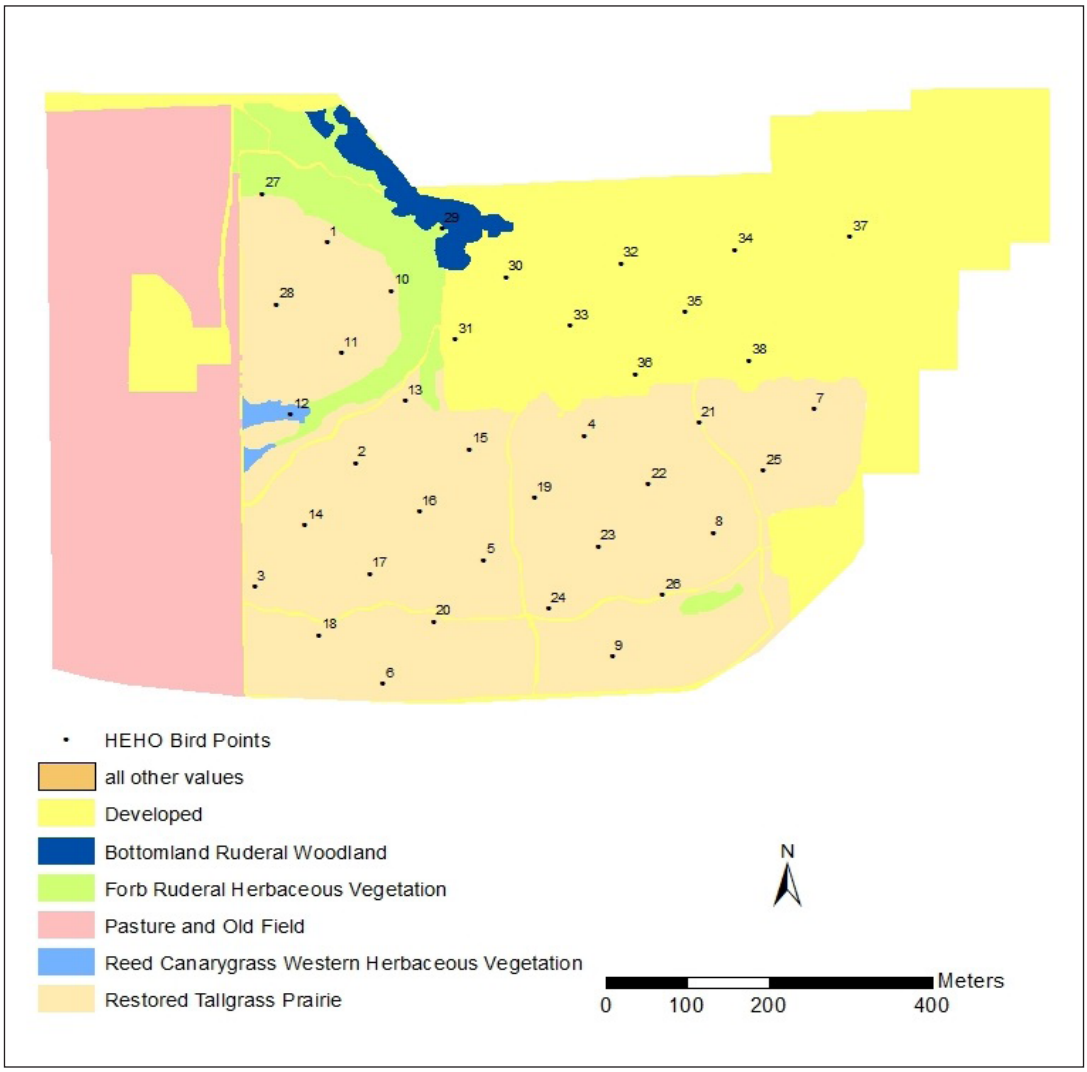

Figure 2. Bird plot locations on Herbert Hoover National Historic Site (HEHO), Iowa. Vegetation mapping and classification provided by Diamond et al. (2014).

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 or not 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*	Yes
2006	June 4 – June 4	9	D. G. Peitz*	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*	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*	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 – June12	11	C. R. Edwards and K. L. Lowder	No
2017	May 24 – May 25	38	D. G. Peitz*	Yes

* Heartland I&M 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-min 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, and not 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 GPS unit. While traveling between plots, the observer was vigilant for the presence of species not recorded during timed surveys. These species help formulate a more complete species list for the park by identifying species missed during timed surveys. However, these observations were not included in any analysis as they did not directly relate to any individual plot. We sampled birds in the morning starting when it was light enough to observe birds to four hours after sunrise.

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. 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-min surveys are included.

Data Analysis

Prior to summary analysis, the residency status (permanent resident, summer resident, or migrant) of each recorded bird species was determined. Identifying the residency of each species helps to exclude migrants from analysis of breeding birds within Herbert Hoover National Historic Site. The park’s 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 [uncorrected for imperfect detection]/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 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), and the most robust models were selected by Distance based on the lowest Akaike Information Criteria (AIC) values.

The hazard-rate + simple polynomial function was selected for seven species: American Goldfinch (*Spinus tristis*), American Robin (*Turdus migratorius*), Common Grackle (*Quiscalus quiscula*), Dickcissel (*Spiza americana*), Eastern Meadowlark (*Sturnella magna*), Mourning Dove (*Zenaida macroura*), and Red-winged Blackbird (*Agelaius phoeniceus*). 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 TRIM Version 3.54 statistical software (Pannekoek and van Strien 2005). TRIM is a program developed for the analysis of count data obtained from wildlife population monitoring. 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 taken into account 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.

American Goldfinch (*Spinus tristus*). NPS

For this report we also obtained regional breeding bird trends for the Eastern Tallgrass Prairie Bird Conservation Region during the period of 2005 to 2015 from the Breeding Bird Survey (BBS) website of the USGS Patuxent Wildlife Research Center (Appendix E; Sauer et al. 2017). It is possible to determine trends for many bird species, and many regions of interest for periods ranging from 1966 to 2015 by using the interactive calculator available at https://www.mbr-pwrc.usgs.gov/bbs/trend/tf15.html. However, we chose the last 11 year period of available data to maximize the accuracy of regional trend results without going beyond the sampling period at Herbert Hoover National Historic Site.

We compared regional trends with those calculated using TRIM for Herbert Hoover National Historic Site bird populations (see Figure 3 in Results section). Regional trends with a confidence interval that straddled zero were classified as uncertain for comparison with results from the park. 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 caution should be used when interpreting BBS results.

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 2010, and then graphing the results. Prior to trend analysis, bird community diversity values were calculated annually 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 ith species (Shannon 1949). Species richness values were determined as the total number of bird taxa recorded annually. Species distribution evenness values were calculated using Pielou (J):

$$J' = H'/Hmax$$

where H' is the Shannon Diversity Index and Hmax is the maximum possible diversity for a given number of species if all species are present in equal numbers (ln(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).

Because some species occurring in an area may not actually be observed in a survey (i.e., rare species may be missed), recorded species richness is often an underestimate. Statistical species richness estimators utilize the information in species distribution and abundance patterns to produce an estimate of true species richness. Species richness estimators are also useful in comparing surveys with unequal sampling effort (e.g., different numbers of plots) since more species are usually discovered with greater sampling effort. Different species richness estimators will produce varying estimates, however, and no single estimator is consistently superior to others. Nonparametric statistical estimators have generally performed better than parametric types (Walther and Moore 2005). Reese et al. (2014) recently reviewed nonparametric species richness estimators, and found that two coverage-based estimators, the Abundance Coverage-based Estimator (ACE) and Incidence Coverage-based Estimator (ICE), provide less biased and more accurate estimates than many of the others. Thus, we employed these two species richness estimators and report estimated species richness along with observed species richness. The software application, EstimateS (Colwell 2013) was used to calculate the ACE and ICE estimators.

Results

Bird Surveys

Between 2005 and 2017 (excluding 2007), 290 cumulative plots were surveyed and 68 different bird species were recorded, 67 of which are species with the potential to breed within the Herbert Hoover National Historic Site (Table 2; Jackson et al. 1996). Five breeding species, Blue-winged Warbler (*Vermivora cyanoptera*), House Finch (*Haemorhous mexicanus*), Killdeer (*Charadrius vociferus*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), and Swamp Sparrow (*Melospiza georgiana*), were only observed outside 5-min survey periods. Seven of the breeding species recorded, Blue-winged Warbler, Dickcissel (*Spiza americana*), Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Ammodramus henslowii*), Northern Flicker (*Colaptes auratus*), and Red-headed Woodpecker, are considered species of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008).

Table 2. Bird species recorded during breeding bird surveys at Herbert Hoover National Historic Site, Iowa, 2005 through 2017, excluding 2007. 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 website (ITIS 2017).

Common name	Species name	AOU code	Residency[A]
American Crow	*Corvus brachyrhynchos*	AMCR	R
American Goldfinch	*Spinus tristis*	AMGO	R
American Redstart	*Setophaga ruticilla*	AMRE	SR
American Robin	*Turdus migratorius*	AMRO	SR
Baltimore Oriole	*Icterus galbula*	BAOR	SR
Bank Swallow	*Riparia riparia*	BANS	SR
Barn Swallow	*Hirundo rustica*	BARS	SR
Barred Owl	*Strix varia*	BDOW	R
Black-capped Chickadee	*Poecile atricapillus*	BCCH	R
Blue Jay	*Cyanocitta cristata*	BLJA	R
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	SR
Blue-winged Warbler[B]	***Vermivora pinus***	**BWWA**	**SR**
Brown Thrasher	*Toxostoma rufum*	BRTH	SR
Brown-headed Cowbird	*Molothrus ater*	BHCO	SR
Canada Goose	*Branta canadensis*	CAGO	R
Cedar Waxwing	*Bombycilla cedrorum*	CEDW	SR
Chimney Swift	*Chaetura pelagica*	CHSW	SR
Chipping Sparrow	*Spizella passerina*	CHSP	SR
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	SR
Common Grackle	*Quiscalus quiscula*	COGR	SR

[A] Residency: M = migrant through the area; R = year around resident; SR = summer resident (According to Jackson et al. [1996]).

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

[C] Species considered of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Table 2 (continued). Bird species recorded during breeding bird surveys at Herbert Hoover National Historic Site, Iowa, 2005 through 2017, excluding 2007. 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 website (ITIS 2017).

Common name	Species name	AOU code	Residency[A]
Common Nighthawk	*Chordeiles minor*	CONI	SR
Common Yellowthroat	*Geothlypis trichas*	COYE	SR
Dickcissel[C]	***Spiza americana***	**DICK**	**SR**
Downy Woodpecker	*Picoides pubescens*	DOWO	R
Eastern Bluebird	*Sialia sialis*	EABL	SR
Eastern Kingbird	*Tyrannus tyrannus*	EAKI	SR
Eastern Meadowlark	*Sturnella magna*	EAME	SR
Eastern Phoebe	*Sayornis phoebe*	EAPH	SR
Eastern Towhee	*Pipilo erythrophthalmus*	EATO	SR
Eastern Wood-pewee	*Contopus virens*	EAWP	SR
European Starling	*Sturnus vulgaris*	EUST	R
Field Sparrow[C]	***Spizella pusilla***	**FISP**	**SR**
Grasshopper Sparrow[C]	***Ammodramus savannarum***	**GRSP**	**SR**
Gray Catbird	*Dumetella carolinensis*	GRCA	SR
Great Blue Heron	*Ardea herodias*	GBHE	SR
Great Crested Flycatcher	*Myiarchus crinitus*	GCFL	SR
Great Horned Owl	*Bubo virginianus*	GHOW	R
Henslow's Sparrow[C]	***Ammodramus henslowii***	**HESP**	**SR**
House Finch[B]	*Haemorhous mexicanus*	HOFI	R
House Sparrow	*Passer domesticus*	HOSP	R
House Wren	*Troglodytes aedon*	HOWR	SR
Indigo Bunting	*Passerina cyanea*	INBU	SR
Killdeer[B]	*Charadrius vociferus*	KILL	SR
Mallard	*Anas platyrhynchos*	MALL	SR
Mourning Dove	*Zenaida macroura*	MODO	SR
Northern Cardinal	*Cardinalis cardinalis*	NOCA	R
Northern Flicker[C]	***Colaptes auratus***	**YSFL**	**R**
Northern Mockingbird	*Mimus polyglottos*	NOMO	R
Purple Martin	*Progne subis*	PUMA	SR
Red-bellied Woodpecker	*Melanerpes carolinus*	RBWO	R

[A] Residency: M = migrant through the area; R = year around resident; SR = summer resident (According to Jackson et al. [1996]).

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

[C] Species considered of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Table 2 (continued). Bird species recorded during breeding bird surveys at Herbert Hoover National Historic Site, Iowa, 2005 through 2017, excluding 2007. 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 website (ITIS 2017).

Common name	Species name	AOU code	Residency[A]
Red-headed Woodpecker[B,C]	***Melanerpes erythrocephalus***	**RHWO**	**R**
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	R
Red-winged Blackbird	*Agelaius phoeniceus*	RWBL	R
Ring-necked Pheasant	*Phasianus colchicus*	RPHE	R
Rock Dove	*Columba livia*	RODO	R
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	RBGR	SR
Ruby-throated Hummingbird	*Archilochus colubris*	RTHU	SR
Sedge Wren	*Cistothorus platensis*	SEWR	SR
Song Sparrow	*Melospiza melodia*	SOSP	R
Swainson's Thrush	*Catharus ustulatus*	SWTH	M
Swamp Sparrow[B]	*Melospiza georgiana*	SWSP	SR
Tree Swallow	*Tachycineta bicolor*	TRES	SR
Turkey Vulture	*Cathartes aura*	TUVU	SR
Warbling Vireo	*Vireo gilvus*	WAVI	SR
Willow Flycatcher	*Empidonax traillii*	WIFL	SR
Wild Turkey[B]	*Meleagris gallopavo*	WITU	R
Yellow Warbler	*Setophaga petechia*	YWAR	SR
Yellow-throated Vireo	*Vireo flavifrons*	YTVI	SR

[A] Residency: M = migrant through the area; R = year around resident; SR = summer resident (According to Jackson et al. [1996]).

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

[C] Species considered of regional concern for the Eastern Tallgrass Prairie Bird Conservation Region (USFWS 2008; also in bold).

Eight breeding species were observed during the survey period in sufficient numbers to calculate annual abundances with some degree of confidence (Appendix B). Of these eight species, American Robin (*Turdus migratorius*) and Red-winged Blackbird (*Agelaius phoeniceus*), were the most abundant and widespread species on Herbert Hoover National Historic Site. However, Red-winged Blackbird was the only species that had a change in population size (decline) over the twelve years of monitoring (Figure 3; Appendix D). We were unable to detect with certainty either positive or negative population trends for the remaining seven species reported (Figure 3; Appendix D). Regional trends (2005–2015) reported by Sauer et al. (2017; Appendix E) for the Eastern Tallgrass Prairie Bird Conservation Region were uncertain for two of the eight species. Five species, including the Red-winged Blackbird, had populations in decline. The remaining species, American Robin, had a regional population that increased.

Diversity ($p = 0.60$), richness ($p = 0.14$), and evenness ($p = 0.09$) in distribution of individuals across species in the breeding bird community on Herbert Hoover National Historic Site were unchanged over the twelve monitoring years beginning in 2005 (Figure 4). Bird richness averaged 26 species annually on the park. Average estimated species richness was 38 by the ACE estimator and 42 by the ICE estimator. These results should be interpreted with caution, however, as inter-annual variability in the number of plots sampled may have influenced estimation metrics.

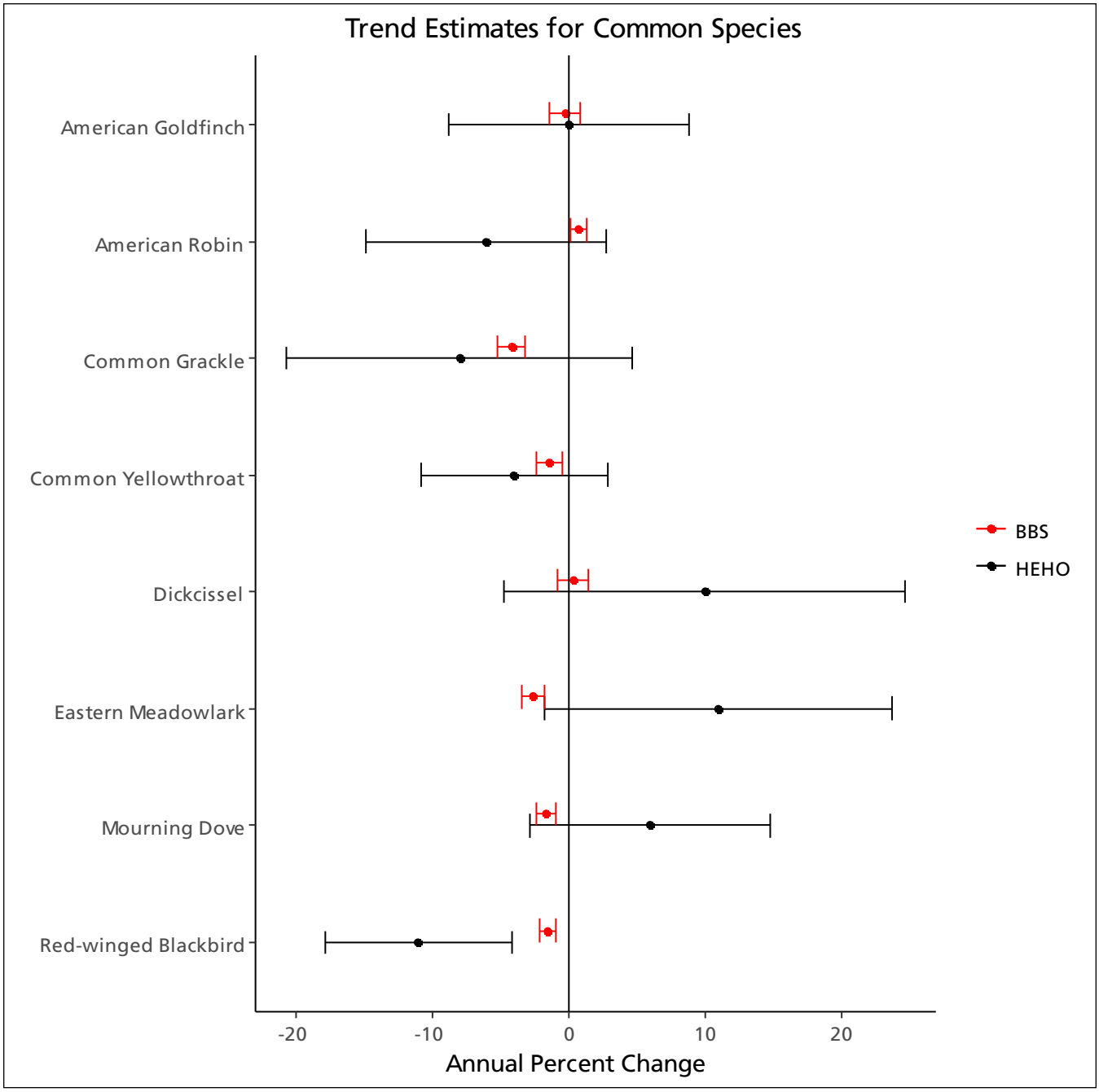

Figure 3. Comparison of bird population trends from Herbert Hoover National Historic Site (HEHO), Iowa, (2005 through 2017, excluding 2007) with those of the larger Eastern Tallgrass Prairie Bird Conservation Region (2005 through 2015) from the Breeding Bird Surveys (BBS). Error bars represent 95% confidence intervals.

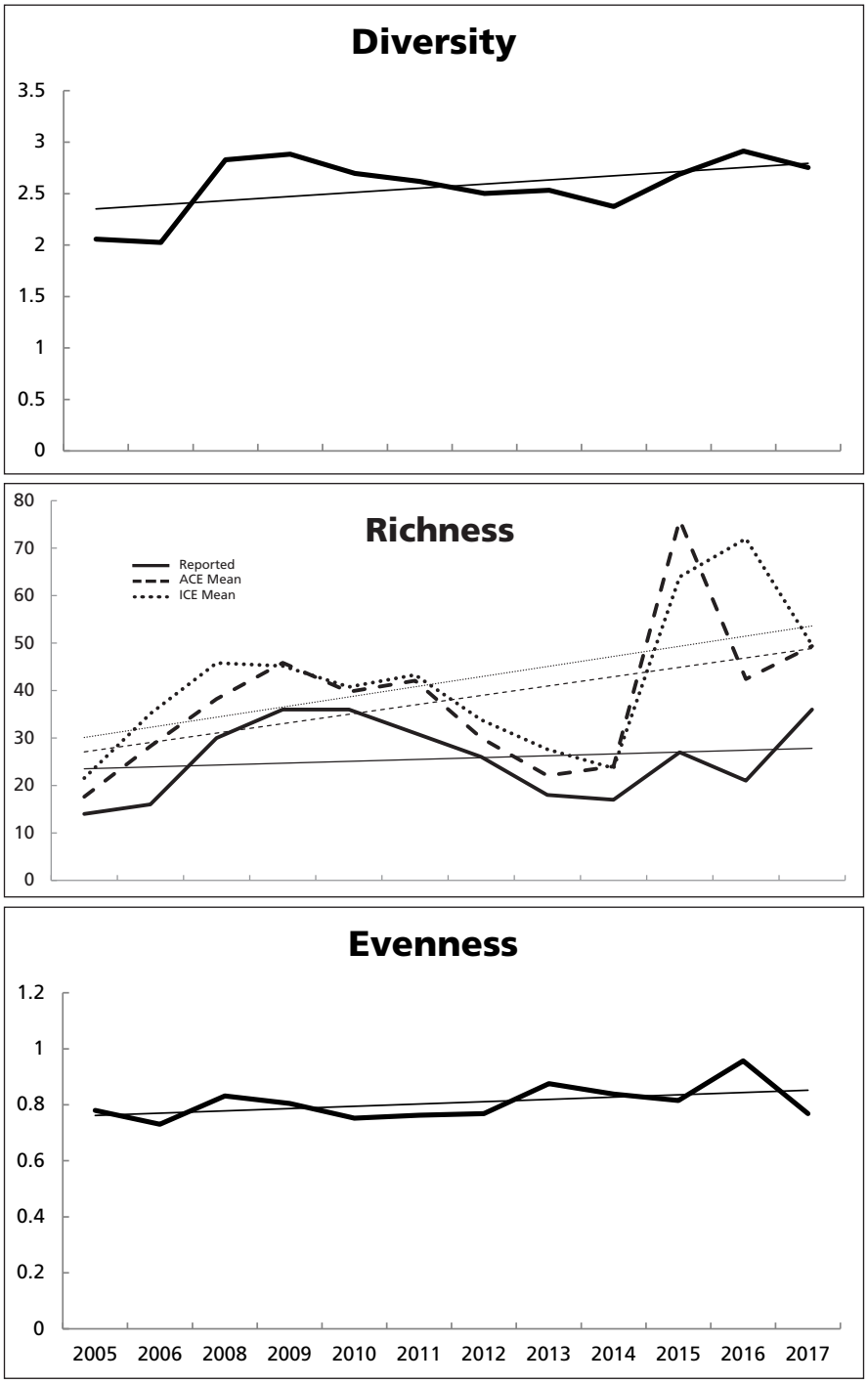

Figure 4. Trends in bird community diversity, richness, and species distribution evenness on Herbert Hoover National Historic Site, Iowa, from 2005 through 2017, excluding 2007.

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 12 years of monitoring, 68 bird species have been recorded. Sixty-seven are permanent or summer residents to the area (Jackson et al. 1996). Therefore, these 67 species have some value in characterizing the breeding bird community of the park, and their habitat.

The seven breeding species of concern for the Eastern Tallgrass Prairie Bird Conservation Region should be given additional consideration when managing natural resources on the park: Blue-winged Warbler (*Vermivora pinus*), Dickcissel (*Spiza americana*), Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Ammodramus henslowii*), Northern Flicker (*Colaptes auratus*), and Red-headed Woodpecker (*Melanerpes erythrocephalus*). 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.

Eight 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 American Robin (*Turdus migratorius*) and Red-winged Blackbird (*Agelaius phoeniceus*) were the most abundant and widespread species on Herbert Hoover National Historic Site and provide the best characterization of habitat present. The American Robin is a habitat generalist utilizing a wide range of habitat types, while the Red-winged Blackbird utilizes marshy areas

Red Winged Blackbird (*Agelaius phoeniceus*) at Herbert Hoover National Historic Site. NPS

and meadows (Stokes and Stokes 1996). Habitat on the park 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 two 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 prairies and weedy fields; and the Blue-winged Warbler and Field Sparrow prefer shrubby or old field habitat (Stokes and Stokes 1996).

Comparing population trends on the park with regional trends for the Eastern Tallgrass Prairie Bird Conservation Region was inconclusive, but suggests that the bird community at Herbert Hoover National Historic Site is faring similarly to that in the region as a whole. We were unable to detect with certainty either positive or negative population trends for seven of the species reported (Figure 3). The population trends for American Goldfinch (*Spinus tristis*), Common Grackle (*Quiscalus quiscula*), Common Yellowthroat (*Geothlypis trichas*), Dickcissel, and Mourning Dove (*Zenaida macroura*) appear similar to those of the Region. The population of the Eastern Meadowlark (*Sturnella magna*) on the park was doing slightly better than the region-wide population. One of the species that was common and widespread on the park, American Robin, had an uncertain park population trend, but a region-wide trend that was increasing. The other common and widespread species, Red-winged Blackbird, had a population trend that was declining both on the park and across the region.

Over the 12 years of bird monitoring on Herbert Hoover National Historic Site, the unchanging diversity, richness, and evenness in distribution of individuals across species suggest that habitat on the park has remained similar across years (Figure 4), and provides for an array of breeding bird species (average of 26 species annually). However, this stable species community structure could be altered if significant portions of the parks grasslands were converted to woodlands or developed.

Our reported data are a baseline for placing bird populations at the park into the context of those seen in the larger Eastern Tallgrass Prairie Bird Conservation Region, and should help the park make 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 A1. Plots sampled on Herbert Hoover National Historic Site, Iowa, between 2005 and 2017 and gross habitat type. "Yes" indicates plot was sampled; "No" indicates it was not sampled.

	Year sampled												
Plot	**2005**	**2006**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Plot type**
HEHO1*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO2*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO3*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO4*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO5*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO6*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO7*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO8*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO9*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Grassland/Open**
HEHO10	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO11	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO12	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO13	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO14	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO15	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO16	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO17	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO18	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO19	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO20	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO21	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO22	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO23	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO24	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open

*Plots included in the analysis of individual bird species trends (also in bold).

Table A1 (continued). Plots sampled on Herbert Hoover National Historic Site, Iowa, between 2005 and 2017 and gross habitat type. "Yes" indicates plot was sampled; "No" indicates it was not sampled.

Plot	Year sampled												Plot type
	2005	2006	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
HEHO25	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO26	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO27	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO28	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO29	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Grassland/Open
HEHO30	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land
HEHO31*	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Developed land**
HEHO32	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land
HEHO33	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land
HEHO34	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land
HEHO35*	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Developed land**
HEHO36	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land
HEHO37	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land
HEHO38	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Developed land

*Plots included in the analysis of individual bird species trends (also in bold).

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

Table B1. 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 2017 (excluding 2007) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance using Distance does not.

	Proportion of plots occupied (Abundance)											
Common name	**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**
American Goldfinch	0.33 (26)	0.44 (77)	0.11 (18)	0.26 (18)	0.61 (118)	0.50 (36)	0.50 (55)	0.27 (42)	0.27 (21)	0.27 (10)	0.27 (42)	0.42 (36)
American Robin	0.44 (37)	0.22 (12)	0.32 (59)	0.53 (59)	0.84 (153)	0.63 (88)	0.47 (100)	0.64 (71)	0.55 (30)	0.64 (41)	0.18 (132)	0.63 (135)
Common Grackle	0.22 (24)	0.11 (12)	0.40 (28)	0.47 (25)	0.74 (99)	0.74 (62)	0.34 (25)	0.55 (29)	0.46 (0)	0.46 (10)	0 (0)	0.29 (14)
Common Yellowthroat	0.67 (36)	0.56 (60)	0.24 (40)	0.37 (30)	0.71 (34)	0.29 (19)	0.34 (24)	0.46 (30)	0.46 (15)	0.73 (20)	0.09 (35)	0.47 (64)
Dickcissel*	**0.44 (21)**	**0.33 (37)**	**0.05 (10)**	**0.13 (9)**	**0.53 (37)**	**0.53 (34)**	**0.55 (30)**	**0.18 (22)**	**0.36 (35)**	**0.64 (43)**	**0.09 (65)**	**0.61 (69)**
Eastern Meadowlark	0.22 (5)	0.22 (8)	0.21 (13)	0.21 (5)	0.68 (12)	0.40 (12)	0.47 (11)	0.55 (15)	0.64 (15)	0.73 (15)	0.09 (24)	0.29 (14)
Mourning Dove	0.11 (0)	0.11 (0)	0.24 (10)	0.18 (1)	0.39 (12)	0.37 (5)	0.45 (7)	0.64 (6)	0.55 (8)	0.55 (6)	0.09 (22)	0.24 (8)
Red-winged Blackbird	0.89 (96)	1.00 (159)	0.32 (64)	0.58 (62)	0.92 (86)	0.76 (67)	0.79 (75)	0.73 (70)	0.73 (65)	0.82 (39)	0.18 (96)	0.63 (63)

*Species considered of regional 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 C1. 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 2017 (excluding 2007) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when a species was present, but outside of 50 m from the plot center, and therefore their annual abundance value could not be calculated.

	Proportion of plots occupied (Abundance)											
Common name	**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**
American Crow	0 (0)	0 (0)	0 (0)	0.03 (–)	0.18 (–)	0 (0)	0 (0)	0 (0)	0.09 (–)	0.09 (–)	0 (0)	0.03 (–)
American Redstart	0 (0)	0 (0)	0.03 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (–)
Baltimore Oriole	0 (0)	0 (0)	0.08 (3)	0.05 (3)	0.11 (3)	0.03 (3)	0 (0)	0.18 (18)	0 (0)	0.09 (9)	0.09 (9)	0 (0)
Bank Swallow	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.08 (–)	0 (0)	0 (0)	0.27 (–)	0 (0)	0 (0)	0 (0)
Barn Swallow	0.11 (–)	0 (0)	0.08 (3)	0.26 (0)	0.26 (8)	0.18 (–)	0.42 (30)	0.18 (–)	0 (0)	0.09 (–)	0.18 (–)	0.16 (–)
Barred Owl	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (–)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Black-capped Chickadee	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (3)	0 (0)	0 (0)	0.09 (1)8	0 (0)	0.09 (9)	0 (0)	0.05 (3)
Blue Jay	0.11 (–)	0 (0)	0.03 (3)	0.05 (–)	0.11 (18)	0.03 (–)	0.03 (–)	0 (0)	0.18 (–)	0.09 (–)	0 (0)	0.03 (–)
Blue-gray Gnatcatcher	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (–)	0.03 (3)
Brown Thrasher	0 (0)	0.11 (–)	0.05 (–)	0.03 (3)	0.18 (3)	0.03 (3)	0.11 (8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brown-headed Cowbird	0.22 (11)	0.11 (–)	0.05 (–)	0.18 (15)	0.08 (13)	0.03 (–)	0 (0)	0 (0)	0 (0)	0.09 (9)	0 (0)	0.05 (–)
Canada Goose	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

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

Table C1 (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 2017 (excluding 2007) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when a species was present, but outside of 50 m from the plot center, and therefore their annual abundance value could not be calculated.

	Proportion of plots occupied (Abundance)											
Common name	**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**
Cedar Waxwing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0.09 (–)	0 (0)
Chimney Swift	0 (0)	0 (0)	0.05 (–)	0.05 (–)	0.08 (–)	0.05 (–)	0.18 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Chipping Sparrow	0 (0)	0 (0)	0 (0)	0.03 (3)	0.18 (8)	0.08 (13)	0 (0)	0.09 (–)	0 (0)	0.09 (18)	0 (0)	0.05 (5)
Cliff Swallow	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Common Nighthawk	0 (0)	0 (0)	0.03 (3)	0.03 (–)	0.03 (–)	0 (0)	0.03 (3)	0 (0)	0 (0)	0.09 (–)	0 (0)	0 (0)
Downy Woodpecker	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eastern Bluebird	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (9)	0 (0)	0 (0)	0.09 (–)	0.03 (3)
Eastern Kingbird	0.11 (11)	0 (0)	0 (0)	0.05 (–)	0.05 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eastern Phoebe	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (3)	0 (0)	0 (0)	0.09 (–)	0 (0)	0.08 (3)
Eastern Towhee	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (3)
Eastern Wood-pewee	0 (0)	0.11 (0)	0.03 (0)	0.05 (3)	0.08 (5)	0.05 (3)	0.03 (3)	0 (0)	0 (0)	0 (0)	0.09 (–)	0.05 (–)
European Starling	0.11 (–)	0 (0)	0.11 (3)	0.13 (10)	0.13 (13)	0.13 (3)	0.13 (3)	0.09 (–)	0.09 (–)	0 (0)	0.09 (–)	0.05 (3)
Field Sparrow*	**0 (0)**	**0 (0)**	**0 (0)**	**0.05 (–)**	**0.08 (–)**	**0.03 (3)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.09 (–)**	**0.09 (–)**	**0 (0)**
Grasshopper Sparrow*	**0 (0)**	**0.11 (11)**	**0 (0)**	**0 (0)**	**0.05 (3)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.08 (8)**

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

Table C1 (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 2017 (excluding 2007) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when a species was present, but outside of 50 m from the plot center, and therefore their annual abundance value could not be calculated.

	Proportion of plots occupied (Abundance)											
Common name	**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**
Gray Catbird	0 (0)	0 (0)	0.05 (3)	0.08 (3)	0.05 (3)	0 (0)	0.05 (–)	0 (0)	0.09 (9)	0.09 (9)	0 (0)	0.11 (8)
Great Blue Heron	0 (0)	0 (0)	0 (0)	0.03 (–)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Great Crested Flycatcher	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (–)	0 (0)	0 (0)
Great Horned Owl	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (–)	0.09 (–)	0 (0)
Henslow's Sparrow*	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.13 (–)**
House Sparrow	0 (0)	0 (0)	0 (0)	0.03 (–)	0.08 (3)	0.05 (3)	0.03 (3)	0 (0)	0 (0)	0 (0)	0.09 (9)	0.03 (3)
House Wren	0 (0)	0 (0)	0 (0)	0.13 (–)	0.08 (5)	0.08 (8)	0.11 (8)	0.09 (9)	0 (0)	0 (0)	0.09 (–)	0.18 (18)
Indigo Bunting	0 (0)	0 (0)	0.03 (–)	0.08 (8)	0.24 (10)	0.11 (10)	0.11 (3)	0.09 (–)	0.09 (0)	0.18 (18)	0.09 (–)	0.08 (3)
Mallard	0 (0)	0 (0)	0 (0)	0.08 (–)	0.03 (–)	0.03 (–)	0 (0)	0.09 (–)	0 (0)	0.18 (–)	0.09 (9)	0.03 (–)
Northern Cardinal	0 (0)	0.11 (11)	0.11 (3)	0.21 (8)	0.34 (13)	0.26 (23)	0.13 (8)	0.09 (–)	0 (0)	0.09 (–)	0 (0)	0.18 (5)
Northern Flicker*	**0 (0)**	**0 (0)**	**0.03 (3)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.03 (–)**
Northern Mockingbird	0 (0)	0.11 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Purple Martin	0 (0)	0 (0)	0 (0)	0.05 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Red-bellied Woodpecker	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (–)

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

Table C1 (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 2017 (excluding 2007) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when a species was present, but outside of 50 m from the plot center, and therefore their annual abundance value could not be calculated.

	Proportion of plots occupied (Abundance)											
Common name	**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**
Red-tailed Hawk	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ring-necked Pheasant	0.11 (–)	0.22 (–)	0 (0)	0.11 (–)	0 (0)	0.05 (3)	0.03 (–)	0 (0)	0.09 (9)	0.09 (–)	0 (0)	0.03 (–)
Rock Dove	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (–)	0 (0)
Rose-breasted Grosbeak	0 (0)	0 (0)	0.08 (–)	0.03 (–)	0 (0)	0 (0)	0.03 (3)	0 (0)	0.09 (–)	0 (0)	0 (0)	0 (0)
Ruby-throated Hummingbird	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0.03 (0)
Sedge Wren	0 (0)	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Song Sparrow	0 (0)	0 (0)	0.11 (5)	0.21 (10)	0.21 (10)	0.16 (18)	0.08 (5)	0 (0)	0.09 (–)	0.09 (–)	0 (0)	0.08 (5)
Tree Swallow	0 (0)	0 (0)	0 (0)	0.03 (–)	0 (0)	0.08 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Turkey Vulture	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Warbling Vireo	0 (0)	0 (0)	0 (0)	0 (0)	0.08 (3)	0.03 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Willow Flycatcher	0 (0)	0 (0)	0.03 (3)	0.05 (5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Yellow Warbler	0 (0)	0.11 (–)	0 (0)	0.03 (–)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (–)
Yellow-throated Vireo	0 (0)	0 (0)	0 (0)	0 (0)	0.13 (8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

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

Appendix D. Herbert Hoover National Historic Site Trends

Table D1. Trends, annual change in abundance (individuals), of breeding birds recorded on Herbert Hoover National Historic Site, Iowa (2005 through 2017, excluding 2007).

Common name	Trend[A]	SE of slope	Trend Classification[B]
American Goldfinch	1.00	0.05	Uncertain
American Robin	0.94	0.05	Uncertain
Common Grackle	0.92	0.07	Uncertain
Common Yellowthroat	0.96	0.04	Uncertain
Dickcissel	1.10	0.08	Uncertain
Eastern Meadowlark	1.11	0.07	Uncertain
Mourning Dove	1.06	0.05	Uncertain
Red-winged Blackbird	0.89	0.04	Moderate Decline

[A] Trends were determined using the statistical software TRIM Version 3.54 (2006).

[B] Trend classification types depending on statistical significance and magnitude (Pannekoek and van Strien 2005; Van Strien et al. 2001), and following 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 ± 1.96 times the standard error of the slope). Strong increase – increase significantly more than 5% per year. Criterion: lower limit of confidence interval > 1.05. Moderate increase – significant increase, but not significantly more than 5% per year. Criterion: 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: 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: 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: 0.95 < upper limit of confidence interval < 1.00. Steep decline – decline significantly more than 5% per year. Criterion: upper limit of confidence interval < 0.95.

Appendix E. Regional Trends

Table E1. Regional trends (Eastern Tallgrass Prairie Bird Conservation Region) in breeding birds recorded on Herbert Hoover National Historic Site, Iowa, from 2005 through 2015. Regional trend data from the BBS surveys (Sauer et al. 2017).

		95% Confidence Interval	
Common name	**Trend**	**Lower**	**Upper**
American Crow	0.41	-0.52	1.32
American Goldfinch	-0.24	-1.36	0.92
American Redstart	4.10	-1.16	11.84
American Robin	0.77	0.18	1.36
Baltimore Oriole	-1.68	-2.74	-0.75
Bank Swallow	0.14	-5.53	5.46
Barn Swallow	-0.88	-1.80	0.05
Barred Owl	5.32	1.49	9.63
Black-capped Chickadee	1.02	-0.80	2.91
Blue Jay	-0.88	-1.82	0.10
Blue-gray Gnatcatcher	1.41	-0.94	3.55
Blue-winged Warbler[A,B]	**1.88**	**-7.52**	**9.24**
Brown Thrasher	-1.71	-2.40	-1.02
Brown-headed Cowbird	-0.66	-1.45	0.14
Canada Goose	16.17	9.25	23.31
Cedar Waxwing	1.27	-1.26	3.88
Chimney Swift	-4.23	-5.32	-3.18
Chipping Sparrow	1.83	0.74	2.95
Cliff Swallow	16.18	10.86	19.94
Common Grackle	-4.15	-5.17	-3.18
Common Nighthawk	-0.50	-2.79	1.98
Common Yellowthroat	-1.40	-2.39	-0.44
Dickcissel[B]	**0.34**	**-0.80**	**1.49**
Downy Woodpecker	0.48	-0.86	1.89
Eastern Bluebird	-0.68	-2.46	1.15
Eastern Kingbird	-2.38	-3.46	-1.35
Eastern Meadowlark	-2.58	-3.42	-1.73
Eastern Phoebe	0.17	-1.35	1.69
Eastern Towhee	1.83	0.46	3.28
Eastern Wood-pewee	-0.61	-1.69	0.43
European Starling	-1.25	-2.19	-0.39
Field Sparrow[B]	**-1.62**	**-2.62**	**-0.63**
Grasshopper Sparrow[B]	**-4.84**	**-6.76**	**-3.10**
Gray Catbird	1.33	0.42	2.25

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

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

Table E1 (continued). Regional trends (Eastern Tallgrass Prairie Bird Conservation Region) in breeding birds recorded on Herbert Hoover National Historic Site, Iowa, from 2005 through 2015. Regional trend data from the BBS surveys (Sauer et al. 2017).

		95% Confidence Interval	
Common name	**Trend**	**Lower**	**Upper**
Great Blue Heron	0.69	-1.09	2.46
Great Crested Flycatcher	-1.17	-2.61	0.13
Great Horned Owl	-1.16	-3.57	1.58
Henslow's Sparrow[B]	**3.13**	**-5.11**	**8.74**
House Finch[A]	1.39	-1.24	4.35
House Sparrow	-3.15	-4.05	-2.12
House Wren	0.41	-0.45	1.33
Indigo Bunting	-0.60	-1.29	0.07
Killdeer[A]	0.36	-0.74	1.42
Mallard	2.06	-1.44	5.68
Mourning Dove	-1.69	-2.37	-0.98
Northern Cardinal	0.75	0.18	1.35
Northern Flicker[B]	**-3.27**	**-4.23**	**-2.31**
Northern Mockingbird	-1.46	-2.73	-0.17
Purple Martin	1.66	-1.26	5.43
Red-bellied Woodpecker	1.24	0.13	2.31
Red-headed Woodpecker[A,B]	**-3.15**	**-4.72**	**-1.46**
Red-tailed Hawk	0.61	-0.79	1.92
Red-winged Blackbird	-1.52	-2.12	-0.94
Ring-necked Pheasant	-2.29	-5.21	0.73
Rock Dove	-2.41	-3.64	-0.99
Rose-breasted Grosbeak	0.77	-0.49	1.97
Ruby-throated Hummingbird	1.49	-1.60	3.72
Sedge Wren	-3.55	-11.46	4.06
Song Sparrow	-2.20	-3.10	-1.31
Swamp Sparrow[A]	-0.19	-8.85	6.50
Tree Swallow	4.35	1.29	7.54
Turkey Vulture	6.42	4.08	8.31
Warbling Vireo	-0.13	-1.39	1.06
Willow Flycatcher	-0.44	-2.14	1.19
Wild Turkey[A]	8.42	3.95	12.81
Yellow Warbler	1.00	-0.79	2.87
Yellow-throated Vireo	4.06	1.71	6.22

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

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

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