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Bird Monitoring at Effigy Mounds National Monument, Iowa

Status Report 2009–2022

Prairie and forest at Effigy Mounds National Monument.
NPS/HEARTLAND NETWORK

Bird monitoring at Effigy Mounds National Monument, Iowa: Status report 2009–2022

Science Report NPS/SR—2024/131

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Abstract

In 2009, the Heartland Inventory and Monitoring Network initiated bird surveys on Effigy Mounds National Monument 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 Prairie Hardwood Transition 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.

In 14 years (2009–2022) of monitoring, 111 bird species have been recorded on the park, 93 of which are considered breeding species (permanent or summer residents). Eight of these are species of concern for the Prairie Hardwood Transition Bird Conservation Region. Thirty-eight species were observed in sufficient numbers to calculate annual abundances and trends with some degree of statistical confidence. The American Redstart, American Robin, Baltimore Oriole, Eastern Wood-pewee, and Red-eyed Vireo were the most abundant and widespread species on the park. Regional trends (2009–2019; Sauer et al. 2020) were similar to those seen on the park with a few exceptions. American Robin, Brown-headed Cowbird, Common Grackle, and White-breasted Nuthatch were declining within the region but increasing within the park. Diversity, richness, and evenness in distribution of individuals across species in the breeding bird community on the park were unchanged over the 14 years.

When sampled, habitats on the plots at Effigy Mounds National Monument consisted primarily of the woodland type, with lesser amounts of other types present. Canopy cover averaged 61 to 89% on plots with cover provided exclusively by hardwood trees. Basal area of hardwood trees averaged between 12 and 22 m^2/ha, and canopy height averaged between 20 and 23 m. Tree species from 14 different families contributed to the canopy cover and basal area of plots. Plots were primarily unvegetated at ground level, with deciduous litter and woody debris common and bare soil exposed. Total foliar cover at ground level on plots consisted primarily of forbs.

Acknowledgments

We would like to thank the staff of Effigy Mounds National Monument, Iowa, for allowing us access to the park during our site visit. We would also like to thank park staff and volunteers who assisted with bird surveys on the park: Emily K. Groom, Darwin D. Koenig, Jon W. Stravers, Jessica A. Salesman, Dennis Kirshbaum, Kat M. Busse, Jeanette R. Mueller, and Paul D. Blom Skrade.

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.

Effigy Mounds National Monument, Iowa, is in the south-central section of the Prairie Hardwood Transition 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 American native bird populations (NABCI 2024).

Prairies once dominated this region in the west and south, beech-maple forest dominated in the north and east, and these two ecotypes were separated by an oak savanna (NABCI 2024). Glaciation has resulted in numerous pothole-type wetlands, shallow lakes, and the coastal estuaries of the Great Lakes. Many rivers can be found in this region, with the Mississippi River being the largest. This region is second only to the Prairie Pothole region in terms of high densities of breeding waterfowl. Both early successional and mature woodlands provide habitat to numerous bird species as well. Approximately 133 species of breeding birds can be found in the prairie-hardwood habitat of the area around Effigy Mounds National Monument (Jackson et al. 1996). Habitat on the park lacks the extensive prairie component found in parts of the region, but the mix of deciduous trees, shrubs, permanent and seasonally flooded areas, and brushy openings (Hop et al. 2005) is similar to other parts of the region. The diverse mix of habitat (structural composition) on the park is important for the species of regional concern, as their microhabitat requirements vary (Pashley and Barrow 1993).

Data collected during the U.S. Geological Survey (USGS) annual North American Breeding Bird Surveys (BBS) between 2009 and 2019 indicate that several bird species with potential to occur at Effigy Mounds National Monument show evidence of population decline (Sauer et al. 2020). In fact, 66% of the species have populations reported to be in decline, with species such as the Common Moorhen (*Gallinula chloropus*), Grasshopper Sparrow (*Ammodramus savannarum*), Northern Bobwhite (*Colinus virginianus*), Purple Martin (*Progne subis*), Savannah Sparrow (*Passerculus sandwichensis*), Sedge Wren (*Cistothorus platensis*), and Western Meadowlark (*Sturnella neglecta*) declining at alarming rates.

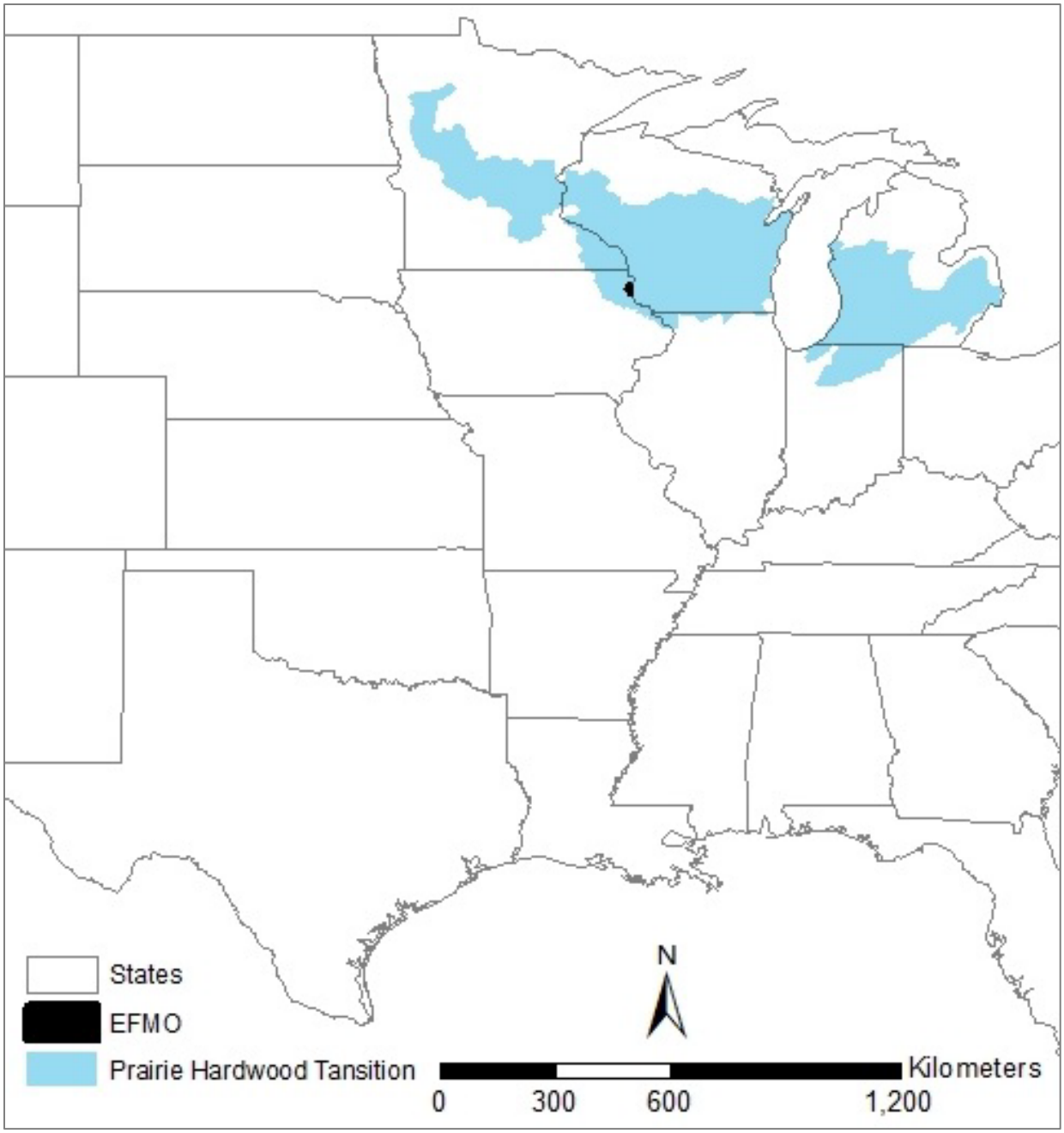

Figure 1. Location of Effigy Mounds National Monument (EFMO), Iowa, within the Prairie Hardwood Transition Bird Conservation Region.

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 Effigy Mounds National Monument. *Ecosystem integrity* is defined here 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 changes 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 implemented to restore and maintain habitat at the park.

There are two primary objectives for monitoring breeding birds at Effigy Mounds National Monument:

- 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 14 years (2009–2022) of monitoring.

Methods

Site Selection

Monitoring locations or "plots" were selected by overlaying a systematic grid of 400 x 400 m cells (originating from a random start point) across Effigy Mounds National Monument. The orientation of the grid was rotated eight degrees to prevent monitoring sites from being influenced by man-made features (roads, fences, etc.) located along cardinal directions. We established 52 plots in total (Figure 2). However, for various reasons the number of plots sampled ranged from 21 to 44 (Table 1). Four plots were in the Yellow River and four in ponds. These sites were only sampled in 2010 and 2015 using a boat. Four plots are located on slopes too steep (40%) to sample safely when wet, and two plots fell in sensitive areas and were dropped from sampling most years. Eleven plots in areas prone to flooding were only sampled in years when water levels permitted. Thirty-one plots (1–9, 12, 14–18, 20–21, 24–27, 32–33, 37–38, 42–43, 45, 47, 50, 52) were sampled frequently enough (≥10 years) for inclusion in trend analysis for this report (Appendix A). Twenty-two of the plots were in upland wooded habitat and six were in shrubby wetland habitat.

During bird surveys in 2009, monitoring plots were located using navigation waypoints (Peitz et al. 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 2013, 2017, and 2022, the habitat assessment crews worked either directly with or completely independent of the birder, and monitoring plots were located using a GNSS unit but not marked with pin flags. During bird surveys in 2010–2012, 2014–2016, and 2018–2021, years when habitat assessments were not conducted, monitoring plots were located using a GNSS unit and were not marked with pin flags.

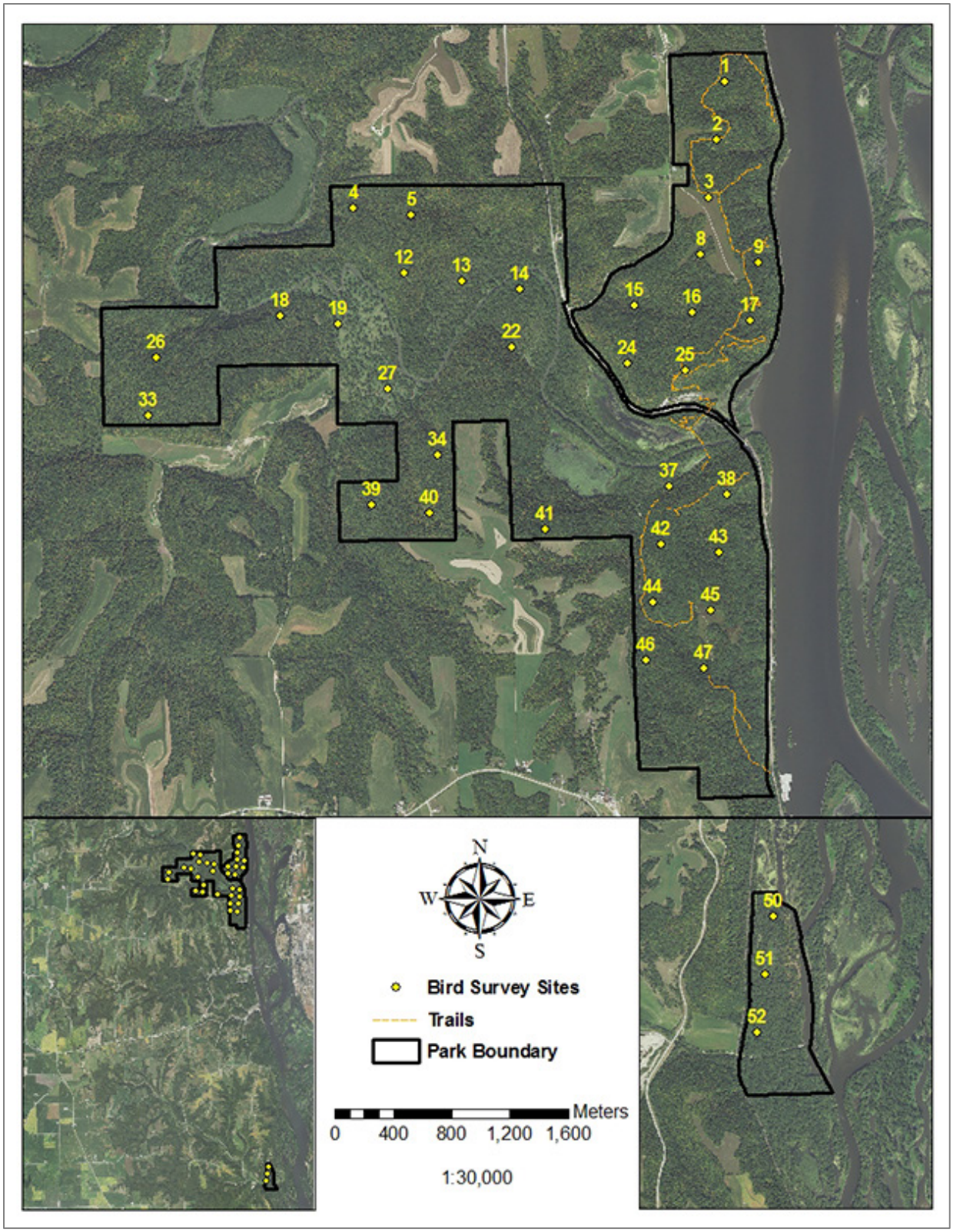

Figure 2. Bird plot locations on Effigy Mounds National Monument, Iowa.

Table 1. Number of plots sampled and sampling dates for breeding bird surveys conducted at Effigy Mounds National Monument, 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
2009	May 29–June 1	34	D. G. Peitz [A]	Yes
2010	May 20–June 10	44	E. K. Groom, D. D. Koenig, and J. W. Stravers	No
2011	May 24–June 19	39	J. A. Salesman and J. W. Stravers	No
2012	May 20–June 20	35	J. W. Stravers	No
2013	May 29–June 2	21	D. G. Peitz [A]	Yes
2014	May 20–June 6	38	E. K. Groom, D. Kirshbaum, and J. W. Stravers	No
2015	May 21–June 23	40	K. M. Busse, J. R. Mueller, P. D. Blom Skrade, and J. W. Stravers	No
2016	May 20–June 14	39	J. W. Stravers	No
2017	May 20–May 22	36	D. G. Peitz [A] and D.W. Marcum [A]	Yes
2018	May 24–June 20	31	J. W. Stravers	No
2019	May 23–June 25	34	K. M. Busse and J. W. Stravers	No
2020	May 27–June 17	32	K. M. Busse, P. D. Blom Skrade, and J. W. Stravers	No
2021	May 23–June 15	37	K. M. Busse and J. W. Stravers	No
2022	May 16–May 19	39	D. G. Peitz,[A] D. W. Marcum,[A] and K. M. Busse	Yes

[A] Heartland Inventory and Monitoring Network staff.

During bird surveys in 2009, monitoring plots were located using navigation waypoints (Peitz et al. 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 2013, 2017, and 2022, the habitat assessment crews worked either directly with or completely independent of the birder, and monitoring plots were located using a GNSS unit but not marked with pin flags. During bird surveys in 2010–2012, 2014–2016, and 2018–2021, years when habitat assessments were not conducted, monitoring plots were located using a GNSS unit and were not marked with pin flags.

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, we recorded each individual bird as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size, and not the individual bird. During analysis, each individual in a cluster or flock 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. We sampled birds 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. We recorded all birds seen or heard, including flyovers, along with distance from the observer when possible. For this report, all birds seen or heard during the 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 2009, 2013, 2017, and 2022. 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, riparian woodland/woodland, etc.) 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 cm, 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 (migrant, permanent resident, summer resident, and transient) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants and transients from analyses of breeding birds within Effigy Mounds National Monument. The park vegetation is primarily upland woodlands. 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. By doing so we can assess how widespread each individual species is across the park. However, plots with undetected individuals would not be counted as occupied therefore our estimated proportion of plots occupied is a conservative estimate.

For species with greater than 60 observations recorded (38 species), Distance software (Distance 6.0 Release 2) was used to determine the park-wide abundance of each (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 (half-normal + cosine, hazard-rate + cosine, half-normal + hermite polynomial, and hazard-rate + simple polynomial) and two without series expansion (half-normal, and hazard-rate) were considered in determining the detection function of each species. The most robust models were selected by Distance based on the lowest Akaike Information Criteria (AIC) values.

The half-normal function without series expansion was selected for 10 species: Acadian Flycatcher (*Empidonax virescens*), Blue Jay (*Cyanocitta cristata*), Eastern Towhee (*Pipilo erythrophthalmus*), Great Crested Flycatcher (*Myiarchus crinitus*), Gray Catbird (*Dumetella carolinensis*), Northern Cardinal (*Cardinalis cardinalis*), Scarlet Tanager (*Piranga olivacea*), Song Sparrow (*Melospiza melodia*), Tufted Titmouse (*Baeolophus bicolor*), and Wood Thrush (*Hylocichla mustelina*). The half-normal + cosine function was selected for American Crow (*Corvus brachyrhynchos*). The half-normal + hermite polynomial was selected for Yellow-bellied Sapsucker (*Sphyrapicus varius*). The hazard-rate + simple polynomial function was selected for two species: Baltimore Oriole (*Ictus galbula*) and Red-winged Blackbird (*Agelaius phoeniceus*). The hazard-rate function without series expansion was selected for 24 species: American Goldfinch (*Spinus tristus*), American Redstart (*Setophaga ruticilla*), American Robin (*Turdus migratorius*), Black-capped Chickadee (*Poecile atricapillus*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Brown-headed Cowbird (*Molothrus ater*), Cerulean Warbler (*Setophaga cerulea*), Common Grackle (*Quiscalus quiscula*), Common Yellowthroat (*Geothlypis trichas*), Downy Woodpecker (*Picoides pubescens*), Eastern Wood-pewee (*Contopus virens*), House Wren (*Troglodytes aedon*), Indigo Bunting (*Passerina cyanea*), Ovenbird *(Seiurus aurocapilla*), Pileated Woodpecker (*Dryocopus pileatus*), Prothonotary Warbler (*Protonotaria citrea*), Rose-breasted Grosbeak (*Pheucticus ludovicianus*), Red-bellied Woodpecker (*Melanerpes carolinus*), Red-eyed Vireo (*Vireo olivaceus*), Warbling Vireo (*Vireo gilvus*), White-breasted Nuthatch (*Sitta carolinensis*), Yellow-billed Cuckoo (*Coccyzus americanus*), Yellow Warbler (*Setophaga petechia*), and Yellow-throated Vireo (*Vireo flavifrons*). For species with fewer than 60 observations, park-wide abundance was calculated by first deriving a species density from observations recorded within a 200 m radius (12.58 ha) around each plot center and then calculating abundance based on average plot densities.

For species with adequate abundance (i.e., those with greater than 60 observations) trends were calculated by regressing abundances against survey years using a loglinear model (Poison regression) in the statistical software TRIM Version 3.54 (Pannekoek and van Strien 2005). TRIM is a program developed for the analysis of count data obtained from wildlife populations. 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 over dispersion are taken into account with this software. Although TRIM has the capacity to estimate missing data, we restricted our regression analysis to 31 plots that were surveyed in most years (Appendix A). By doing this we analyzed a consistent ratio of upland and wetland plots across years.

For this report we also obtained regional breeding bird trends for the Prairie Hardwood Transition Bird Conservation Region during the period from 2009 through 2019 from the Breeding Bird Survey (BBS) website of the USGS Patuxent Wildlife Research Center (Appendix E; 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). However, we chose the last 11-year period of available data to maximize the accuracy of regional trend results without going too far beyond the sampling period at Effigy Mounds National Monument. We compared regional trends with those calculated using TRIM for Effigy Mounds National Monument populations. Regional trends with a confidence interval that straddled zero were classified as uncertain for comparison with results from Effigy Mounds National Monument. 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 then graphing the results. Prior to trend analysis, bird community diversity values were calculated annually using the Shannon Diversity Index (*H'):*

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

where n_i/N is the proportion of the total number of individuals in a population consisting of the *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's evenness index (*J'):*

$$J' = \frac{H'}{Hmax}$$

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 not all species occurring in an area may 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; two coverage-based estimators, the ACE (Abundance Coverage-based Estimator) and ICE (Incidence Coverage-based Estimator), were found to 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.

Location and permanent abiotic measures on each plot were reported by Peitz (2010). Annual averages (±std dev) for semi-permanent plot data, including road and water cover, were calculated from plot estimates (Appendix F). Averages (±std dev) for horizontal vegetation cover at each of the vegetation profile heights (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 (±std dev) annual vertical structural diversity was estimated and reported as well. Vertical structural diversity was calculated as follows:

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

where p_i is the observed frequency for vegetation in the *ith* 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 (±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 (±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 2009 and 2022, 21 to 44 plots on Effigy Mounds National Monument were surveyed annually for breeding birds (Table 1). During this 14-year period, 499 cumulative plots were surveyed, and 111 different bird species were recorded, 93 of which are species with the potential to breed within the park (Table 2; Jackson et al. 1996). However, one breeding species, Ring-necked Pheasant (*Phasianus colchicus*), was only observed outside 5-minute survey periods. Eight of the breeding species recorded are considered species of regional concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008): Bald Eagle (*Haliaeetus leucocephalus*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Blue-winged Warbler (*Vermivora cyanoptera*), Brown Thrasher (*Toxostoma rufum*), Cerulean Warbler, Dickcissel (*Spiza americana*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), and Willow Flycatcher (*Empidonax traillii*).

Table 2. Bird species recorded during breeding bird surveys at Effigy Mounds National Monument, Iowa, from 2009 through 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]
Acadian Flycatcher	*Empidonax virescens*	ACFL	SR
Alder Flycatcher [C]	*Empidonax alnorum*	ALFL	M
American Crow	*Corvus brachyrhynchos*	AMCR	R
American Goldfinch	*Spinus tristis*	AMGO	R
American Redstart	*Setophaga ruticilla*	AMRE	SR
American Robin	*Turdus migratorius*	AMRO	SR
Bald Eagle [B]	***Haliaeetus leucocephalus***	**BAEA**	**R**
Baltimore Oriole	*Icterus galbula*	BAOR	SR
Barn Swallow	*Hirundo rustica*	BARS	SR
Barred Owl	*Strix varia*	BADO	R
Belted Kingfisher	*Megaceryle alcyon*	BEKI	R
Black-and-white Warbler	*Mniotilta varia*	BAWW	M
Black-billed Cuckoo [B]	***Coccyzus erythropthalmus***	**BBCU**	**SR**
Blackburnian Warbler	*Setophaga fusca*	BLBW	M
Black-capped Chickadee	*Poecile atricapillus*	BCCH	R
Blackpoll Warbler	*Setophaga striata*	BLPW	M

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

[B] Species of regional concern for the Prairie Hardwood Transition 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 Effigy Mounds National Monument, Iowa, from 2009 through 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]
Black-throated Green Warbler	*Setophaga virens*	BTNW	M
Blue Jay	*Cyanocitta cristata*	BLJA	R
Blue-headed Vireo [C]	*Vireo solitarius*	BHVI	M
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	SR
Blue Grosbeak	*Passerina caerulea*	BLGR	T
Blue-winged Warbler	*Vermivora cyanoptera*	BWWA	SR
Brown Creeper	*Certhia americana*	BRCR	R
Brown-headed Cowbird	*Molothrus ater*	BHCO	SR
Brown Thrasher	*Toxostoma rufum*	BRTH	SR
Canada Goose	*Branta canadensis*	CANG	SR
Canada Warbler [C]	*Cardellina canadensis*	CAWA	M
Carolina Wren	*Thryothorus ludovicianus*	CARW	R
Cedar Waxwing	*Bombycilla cedrorum*	CEDW	SR
Cerulean Warbler [B]	***Setophaga cerulea***	**CERW**	**SR**
Chestnut-sided Warbler	*Setophaga pensylvanica*	CSWA	SR
Chimney Swift	*Chaetura pelagica*	CHSW	SR
Chipping Sparrow	*Spizella passerine*	CHSP	SR
Clay-colored Sparrow	*Spizella pallida*	CCSP	M
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	SR
Common Grackle	*Quiscalus quiscula*	COGR	SR
Common Yellowthroat	*Geothlypis trichas*	COYE	SR
Cooper's Hawk	*Accipiter cooperii*	COHA	SR
Dark-eyed Junco	*Junco hyemalis*	DEJU	M
Dickcissel [B]	***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

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

[B] Species of regional concern for the Prairie Hardwood Transition 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 Effigy Mounds National Monument, Iowa, from 2009 through 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]
Eastern Wood-pewee	*Contopus virens*	EAWP	SR
Eastern Whip-poor-will	*Antrostomus vociferus*	EWPW	SR
European Starling	*Sturnus vulgaris*	EUST	R
Field Sparrow	*Spizella pusilla*	FISP	SR
Grasshopper Sparrow	*Ammodramus savannarum*	GRSP	SR
Gray Catbird	*Dumetella carolinensis*	GRCA	SR
Great Blue Heron	*Ardea Herodias*	GBHE	SR
Great Crested Flycatcher	*Myiarchus crinitus*	GCFL	SR
Green Heron	*Butorides virescens*	GRHE	SR
Hairy Woodpecker	*Picoides villosus*	HAWO	R
Hermit Thrush	*Catharus guttatus*	HETH	M
Hooded Merganser	*Lophodytes cucullatus*	HOME	SR
Hooded Warbler	*Setophaga citrina*	HOWA	SR
House Finch	*Carpodacus mexicanus*	HOFI	T
House Wren	*Troglodytes aedon*	HOWR	SR
Indigo Bunting	*Passerina cyanea*	INBU	SR
Kentucky Warbler	*Geothlypis Formosa*	KEWA	SR
Killdeer	*Charadrius vociferus*	KILL	SR
Least Flycatcher	*Empidonax minimus*	LEFL	SR
Mallard	*Anas platyrhynchos*	MALL	SR
Mourning Dove	*Zenaida macroura*	MODO	SR
Northern Cardinal	*Cardinalis cardinalis*	NOCA	R
Northern Flicker	*Colaptes auratus*	NOFL	R
Northern Parula	*Setophaga americana*	NOPA	SR
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	SR
Olive-sided Flycatcher [C]	*Contopus cooperi*	OSFL	M
Orchard Oriole	*Icterus spurius*	OROR	SR
Ovenbird	*Seiurus aurocapilla*	OVEN	SR
Pileated Woodpecker	*Dryocopus pileatus*	PIWO	R
Prothonotary Warbler	*Protonotaria citrea*	PROW	SR

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

[B] Species of regional concern for the Prairie Hardwood Transition 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 Effigy Mounds National Monument, Iowa, from 2009 through 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]
Red-bellied Woodpecker	*Melanerpes carolinus*	RBWO	R
Red-eyed Vireo	*Vireo olivaceus*	REVI	SR
Red-headed Woodpecker [B]	***Melanerpes erythrocephalus***	**RHWO**	**R**
Red-shouldered Hawk	*Buteo lineatus*	RSHA	R
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	R
Red-winged Blackbird	*Agelaius phoeniceus*	RWBL	R
Ring-necked Pheasant [C]	*Phasianus colchicus*	RNEP	R
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	RBGR	SR
Ruby-throated Hummingbird	*Archilochus colubris*	RTHU	SR
Scarlet Tanager	*Piranga olivacea*	SCTA	SR
Sedge Wren	*Cistothorus platensis*	SEWR	SR
Song Sparrow	*Melospiza melodia*	SOSP	R
Spotted Sandpiper	*Actitis macularius*	SPSA	SR
Swainson's Thrush	*Catharus ustulatus*	SWTH	M
Swamp Sparrow	*Melospiza georgiana*	SWSP	SR
Tennessee Warbler	*Leiothlypis peregrina*	TEWA	M
Tree Swallow	*Tachycineta bicolor*	TRES	SR
Tufted Titmouse	*Baeolophus bicolor*	TUTI	R
Turkey Vulture	*Cathartes aura*	TUVU	SR
Veery	*Catharus fuscescens*	VEER	SR
Warbling Vireo	*Vireo gilvus*	WAVI	SR
White-breasted Nuthatch	*Sitta carolinensis*	WBNU	R
White-eyed Vireo	*Vireo griseus*	WEVI	SR
White-throated Sparrow [C]	*Zonotrichia albicollis*	WTSP	M
Wild Turkey	*Meleagris gallopavo*	WITU	R
Willow Flycatcher [B]	***Empidonax traillii***	**WIFL**	**SR**
Wilson's Warbler	*Cardellina pusilla*	WIWA	M
Wood Duck	*Aix sponsa*	WODU	SR
Wood Thrush	*Hylocichla mustelina*	WOTH	SR
Worm-eating Warbler	*Helmitheros vermivorum*	WEWA	T

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

[B] Species of regional concern for the Prairie Hardwood Transition 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 Effigy Mounds National Monument, Iowa, from 2009 through 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]
Yellow-bellied Sapsucker	*Sphyrapicus varius*	YBSA	SR
Yellow-breasted Chat	*Icteria virens*	YBCH	SR
Yellow-billed Cuckoo	*Coccyzus americanus*	YBCU	SR
Yellow-throated Vireo	*Vireo flavifrons*	YTVI	SR
Yellow Warbler	*Setophaga petechia*	YEWA	SR

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

[B] Species of regional concern for the Prairie Hardwood Transition 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.

Thirty-eight breeding species were observed during the survey period in sufficient numbers to calculate annual abundances with some degree of statistical confidence (Appendix B) using Distance software. Park-wide abundances for species with less than 60 observations are reported in Appendix C. Of the 38 species observed in sufficient numbers to calculate annual abundances; American Redstart, American Robin, Baltimore Oriole, Eastern Wood-pewee, and Red-eyed Vireo were the most abundant and widespread species on Effigy Mounds National Monument. The American Redstart annual estimated population ranged from 1262 to 2072 individuals; American Robin ranged from 955 to 1406 individuals; Baltimore Oriole ranged from 961 to 1293 individuals; Eastern Wood-pewee ranged from 364 to 640 individuals; and Red-eyed Vireo ranged from 840 to 1075 individuals. On average, all five bird species occupied over 50% of the plots sampled annually.

Twenty-three of the 38 breeding species observed in sufficient numbers to calculate populations abundances during the 14-year survey period had populations with trends that were uncertain (Figure 3; Appendix D). Three species had stable population sizes: Common Yellowthroat, Eastern Wood-pewee, and Red-eyed Vireo. Eleven species had moderately increasing populations: American Redstart, American Robin, Black-capped Chickadee, Brown-headed Cowbird, Gray Catbird, House Wren, Northern Cardinal, Rose-breasted Grosbeak, Red-bellied Woodpecker, Red-winged Blackbird, and White-breasted Nuthatch. One species had a strongly increasing population over the 14-year survey period: Common Grackle. Regional trends (2009–2019) reported by Sauer et al. (2020; Figure 3, Appendix E) for the Prairie Hardwood Transition Bird Conservation Region were uncertain or undefined for 27 of the 38 species, including the American Redstart, Black-capped Chickadee, Gray Catbird, House Wren, Northern Cardinal, Rose-breasted Grosbeak, and Red-winged Blackbird. Three species, including the Red-bellied Woodpecker, had populations that were increasing within the region. Eight species, including four with positive trends on the park (American Robin, Brown-headed Cowbird, Common Grackle, and White-breasted Nuthatch), had populations that were declining within the region.

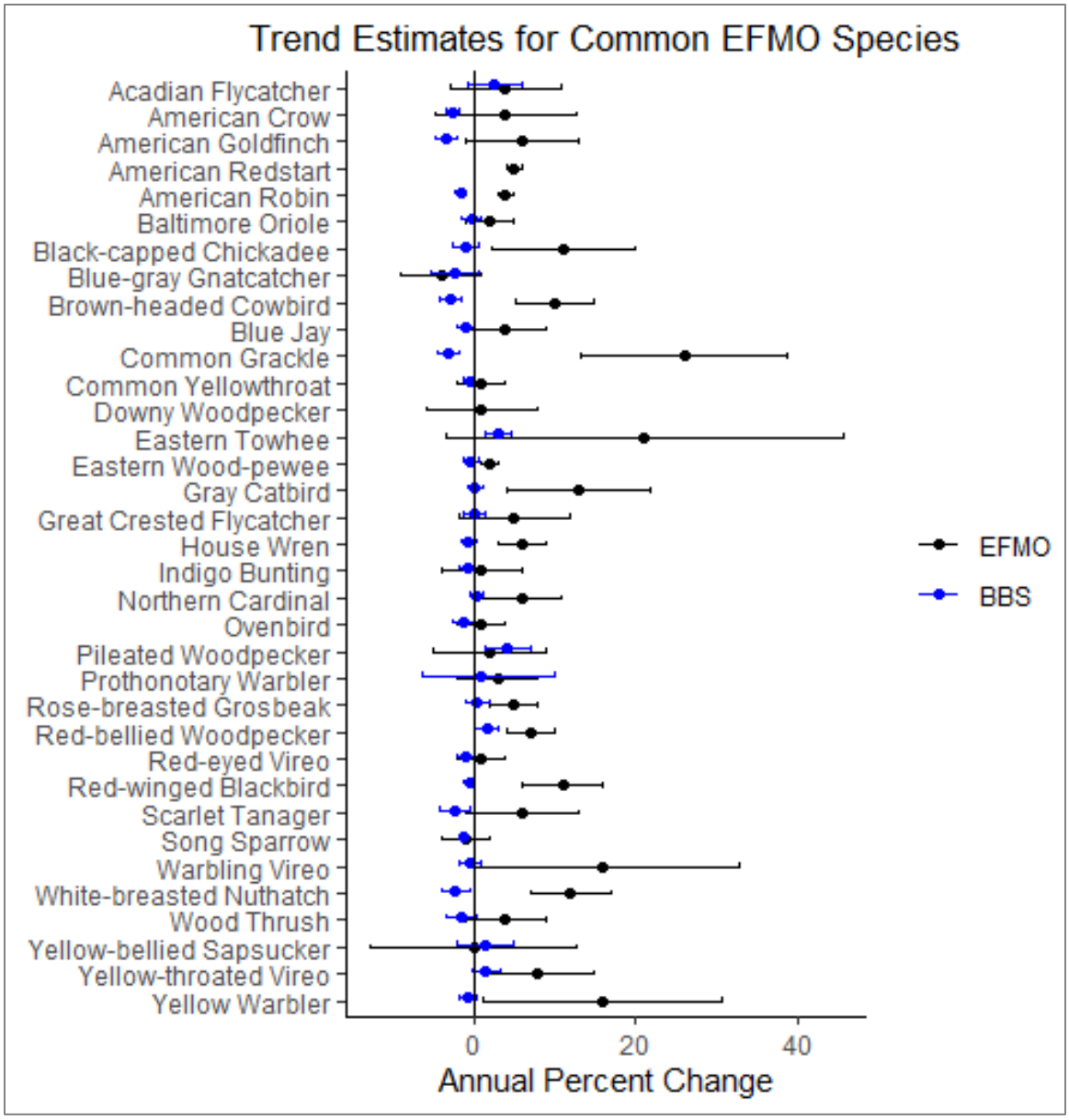

Figure 3. Comparison of bird population trends from Effigy Mounds National Monument, Iowa (2009–2022), with those of the larger Prairie Hardwood Transition Bird Conservation Region (2009–2019) from the USGS Breeding Bird Surveys (BBS). Error bars represent 95% confidence intervals. Excluded are Cerulean Warbler and Yellow-billed Cuckoo since their confidence intervals were large for the region and Tufted Titmouse since its confidence interval is large for the park.

Diversity, richness, and evenness in distribution of individuals across species in the breeding bird community on Effigy Mounds National Monument were unchanged over the 14 monitoring years beginning in 2009 (Figure 4). Bird community richness averaged 57 (59 with 2013 data excluded) species annually on the park. Average estimated species richness was 64 by the ACE estimator and 66 by the ICE estimator. These results should be interpreted with caution, however, as interannual variability in the number of plots sampled may have influenced these metrics. For example, the dip in

diversity and richness and spike in evenness in 2013 are almost certainly artifacts of missing wetland species due to wetland sites not being sampled because of flooding.

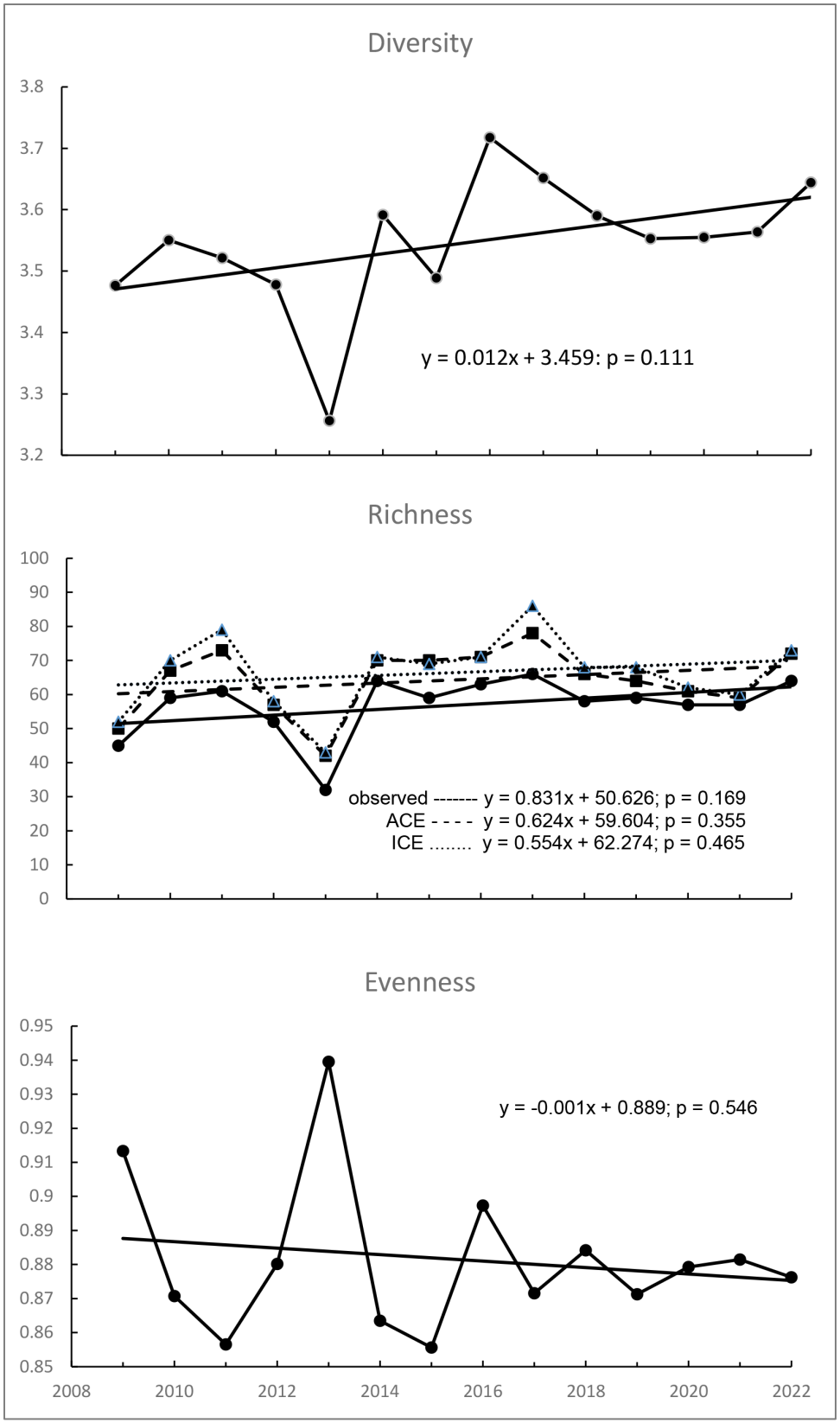

Figure 4. Trends in bird community diversity, richness, and species distribution evenness on Effigy Mounds National Monument, Iowa, 2009–2022.

Habitat Assessment

When sampled, habitats on the plots at Effigy Mounds National Monument consisted primarily of the woodland (61–88%) and floodplain/old field/prairie (4–19%) types, with lesser amounts of other types present (Appendix F). Canopy cover averaged 61 to 89% on plots (Appendix F), with cover provided exclusively by hardwood trees. Basal area of hardwood trees averaged between 12 and 22 m^2/ha, and canopy height averaged 20 to 23 m. Tree species from 14 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 structural diversity estimates across years ranged from 4 to 13% on plots.

When sampled, plots were primarily unvegetated (63–80% cover) at ground level, with deciduous litter (38–54% cover) and woody debris (6–15% cover) common and bare soil (10–20% cover) exposed (Appendix F). Grass litter (2–8% cover) and rock (<1–5% cover) were also recorded on plots. Total foliar cover (40–53% cover) on plots consisted primarily of forbs (23–49% cover), with lesser amounts of cool-season grasses (6–12% cover), woody shrubs and vines (2–3% cover), moss and lichens (1–6% cover), and warm-season grasses (<1–1% cover) present.

Discussion

Breeding bird surveys were initiated at Effigy Mounds National Monument in 2009 to assist the park in assessing the integrity of their wetlands, grasslands, and woodlands through time. During the 14 years of monitoring, a cumulative total of 499 plots have been surveyed and 111 bird species have been recorded, 93 of which are permanent or summer residents to the area (Jackson et al. 1996). Data collected for these 93 species are valuable for characterizing the park's breeding bird community and the habitat they rely on. The eight breeding species of concern for the Prairie Hardwood Transition Bird Conservation Region should be given additional consideration in the management of natural resources on Effigy Mounds National Monument: Bald Eagle, Black-billed Cuckoo, Blue-winged Warbler, Brown Thrasher, Cerulean Warbler, Dickcissel, Red-headed Woodpecker, and Willow Flycatcher. However, only Cerulean Warbler was abundant enough on Effigy Mounds National Monument to assess the influences of managing for their needs (Appendix D). If it is not feasible to manage habitat for these less common species directly, then at least habitat should be managed in a way that does not conflict with their needs. For example, complete removal of riparian woodland habitat would be detrimental to the Bald Eagle and Cerulean Warbler, and conversion of prairie to woodland would be detrimental to the Dickcissel.

Thirty-eight of the 93 breeding species were observed during the survey period in sufficient numbers to calculate annual abundances and trends with some degree of statistical confidence. The American Redstart, American Robin, Baltimore Oriole, Eastern Wood-pewee, and Red-eyed Vireo were the most abundant and widespread species on Effigy Mounds National Monument, and their habitat preferences provide the best characterization of habitat currently present at the park. The American Redstart utilizes mixed woodland and thickets, American Robin is a habitat generalist that uses a wide range of habitat, Baltimore Oriole is found in deciduous trees near open areas, Eastern Wood-pewee is found in open woodlands, and Red-eyed Vireo is found in deciduous woodlands of varying basal area (Stokes and Stokes 1996). Habitat on Effigy Mounds National Monument is a mix of deciduous trees, shrubs, permanent and seasonally flooded areas, and brushy openings (Hop et al. 2005). The diverse mix of habitat (structural composition) on Effigy Mounds National Monument is important for the species of regional concern, as their microhabitat requirements vary (Pashley and Barrow 1993). For example, Bald Eagle and Cerulean Warbler prefer mature deciduous trees along streams and swampy or coastal areas; Red-headed Woodpecker prefers farmlands, open woodlands, orchards, and urban/suburban forest; Dickcissel prefers prairies and weedy fields; and most other species of regional concern require thick shrubby or old field habitat (Stokes and Stokes 1996).

A comparison of population trends on the park with regional trends for the Prairie Hardwood Transition Bird Conservation Region (Figure 3) suggests that the bird community at Effigy Mounds National Monument is faring better than in the region as a whole. Populations of half of the 38 species we analyzed were doing significantly better on the park than in the region, especially American Robin, Brown-headed Cowbird, Common Grackle, and White-breasted Nuthatch. All four species had positive population trends on Effigy Mounds National Monument (Figure 3, Appendix D) but negative trends within the region (Figure 3, Appendix E).

Over the 14 years of bird monitoring on Effigy Mounds National Monument, the stable diversity, richness, and evenness values suggest habitat on the park has remained similar or improved over time (Figure 4) and provides for a rich array of breeding species. However, this species rich bird community structure could be altered if significant portions of the park's woodland were cut or lost to fire or if the remaining prairie was converted to woodlands. While changes in population sizes, especially of common and widely distributed species, may be utilized to assess changing habitat conditions, weather and climate also play a role in determining habitat and should always be considered.

A word of caution is needed here; since we have a limited number of survey years within the Effigy Mounds National Monument, 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 Effigy Mounds National Monument in the context of those seen in the larger Prairie Hardwood Transition Bird Conservation Region and should help the park make more informed natural resource management decisions. Our reported data also contribute information to efforts by other agencies researching the full life cycle of migratory birds (Partners in Flight, US Geological Survey, US 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 Effigy Mounds National Monument, Iowa, between 2009 and 2022 and gross habitat type. “Yes” indicates plot was sampled in that year; “No” indicates it was not sampled.

Plot	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Plot Type
1 [A]	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
2 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
3 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
4 [A]	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Upland**
5 [A]	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
6 [A]	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
7 [A]	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Wetland**
8 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Upland**
9 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
10	No	Yes	Yes	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Upland
11	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Wetland
12 [A]	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
13	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Wetland
14 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Wetland**
15 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Upland**
16 [A]	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Upland**
17 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
18 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Upland**
19	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No	No	Yes	Yes	Wetland
20 [A]	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Wetland**
21 [A]	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Wetland**
22	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Wetland

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

Table 3 (continued). Plots sampled on Effigy Mounds National Monument, Iowa, between 2009 and 2022 and gross habitat type. "Yes" indicates plot was sampled in that year; "No" indicates it was not sampled.

Plot	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Plot Type
23	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Wetland
24 [A]	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Upland**
25 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Upland**
26 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Upland**
27 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Wetland**
28	No	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	No	Yes	No	Upland
29	No	No	Yes	No	No	No	No	No	No	No	No	No	Yes	Yes	Upland
30	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	Wetland
31	No	No	Yes	No	No	Yes	No	Yes	No	No	Yes	No	No	No	Wetland
32 [A]	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Wetland**
33 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Upland**
34	Yes	Yes	No	No	No	No	Yes	Yes	Yes	No	No	No	No	Yes	Upland
35	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	Wetland
36	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	No	Yes	No	No	Wetland
37 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Wetland**
38 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Upland**
39	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	Yes	Upland
40	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	Yes	Upland
41	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	No	Yes	Upland
42 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Upland**
43 [A]	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Upland**
44	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Upland
45 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
46	Yes	No	No	No	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Upland

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

Table 3 (continued). Plots sampled on Effigy Mounds National Monument, Iowa, between 2009 and 2022 and gross habitat type. “Yes” indicates plot was sampled in that year; “No” indicates it was not sampled.

Plot	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Plot Type
47 [A]	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Upland**
48	No	Yes	No	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Upland
49	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Upland
50 [A]	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Wetland**
51	No	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Wetland
52 [A]	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Wetland**

[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 Effigy Mounds National Monument, Iowa, during the 2009 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.

	Proportion of Plots Occupied (Abundance)													
Common Name	**2009 (n=34)**	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Acadian Flycatcher	0.06 (970)	0.14 (970)	0.26 (1261)	0.20 (970)	0.14 (970)	0.05 (970)	0.28 (1146)	0.18 (1109)	0.11 (1213)	0.23 (970)	0.21 (970)	0.22 (970)	0.27 (706)	0.13 (970)
American Crow	0.09 (212)	0.11 (255)	0.10 (212)	0.23 (212)	0.00 (0)	0.08 (212)	0.15 (255)	0.23 (212)	0.11 (283)	0.16 (212)	0.03 (212)	0.19 (212)	0.19 (212)	0.21 (186)
American Goldfinch	0.03 (1097)	0.34 (598)	0.41 (717)	0.34 (594)	0.00 (0)	0.50 (613)	0.48 (670)	0.62 (598)	0.14 (548)	0.48 (609)	0.29 (548)	0.41 (670)	0.49 (666)	0.23 (548)
American Redstart	0.15 (1262)	0.59 (1618)	0.69 (2023)	0.83 (1705)	0.19 (1841)	0.87 (1402)	0.73 (1632)	0.90 (1502)	0.64 (1417)	0.84 (1537)	0.76 (1523)	0.88 (1615)	0.84 (2072)	0.67 (1699)
American Robin	0.29 (955)	0.89 (1114)	0.69 (1090)	0.63 (1049)	0.10 (796)	0.66 (1019)	0.73 (1043)	0.77 (960)	0.56 (754)	0.65 (1074)	0.79 (1406)	0.75 (1194)	0.86 (1326)	0.54 (947)
Baltimore Oriole	0.12 (961)	0.43 (1038)	0.62 (1270)	0.63 (1293)	0.38 (769)	0.79 (1215)	0.63 (1260)	0.82 (1201)	0.22 (672)	0.71 (1188)	0.59 (1076)	0.59 (930)	0.68 (1045)	0.44 (1085)
Black-capped Chickadee	0.03 (741)	0.09 (926)	0.08 (741)	0.06 (741)	0.14 (741)	0.18 (741)	0.18 (741)	0.21 (741)	0.06 (370)	0.19 (741)	0.06 (741)	0.22 (741)	0.41 (988)	0.26 (803)
Blue-gray Gnatcatcher	0.18 (1282)	0.25 (1399)	0.46 (1567)	0.51 (1475)	0.14 (1282)	0.45 (1282)	0.25 (1374)	0.59 (1282)	0.28 (1282)	0.29 (1282)	0.53 (1282)	0.22 (855)	0.27 (1515)	0.10 (1539)
Brown-headed Cowbird	0.09 (–)	0.11 (754)	0.28 (942)	0.17 (942)	0.00 (0)	0.13 (942)	0.18 (942)	0.21 (942)	0.25 (1257)	0.16 (942)	0.21 (942)	0.16 (942)	0.38 (1145)	0.33 (1280)

[A] Species of conservation concern for the Prairie Hardwood Transition Conservation Region (USFWS 2008; also in bold).

Table 4 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using Distance software) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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.

	Proportion of Plots Occupied (Abundance)													
Common Name	**2009 (n=34)**	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Blue Jay	0.12 (346)	0.32 (411)	0.33 (346)	0.31 (346)	0.14 (346)	0.21 (390)	0.23 (378)	0.38 (346)	0.06 (–)	0.26 (346)	0.29 (346)	0.29 (404)	0.35 (416)	0.59 (328)
Cerulean Warbler [A]	**0.18 (662)**	**0.30 (573)**	**0.23 (662)**	**0.03 (496)**	**0.00 (0)**	**0.05 (496)**	**0.03 (496)**	**0.18 (496)**	**0.08 (827)**	**0.10 (496)**	**0.18 (496)**	**0.28 (496)**	**0.16 (579)**	**0.15 (496)**
Common Grackle	0.00 (0)	0.07 (697)	0.08 (697)	0.09 (697)	0.00 (0)	0.18 (813)	0.23 (697)	0.41 (743)	0.03 (697)	0.55 (697)	0.35 (755)	0.31 (929)	0.35 (965)	0.13 (929)
Common Yellowthroat	0.09 (440)	0.41 (709)	0.41 (793)	0.49 (699)	0.10 (440)	0.47 (587)	0.33 (677)	0.44 (518)	0.28 (396)	0.39 (514)	0.24 (489)	0.41 (474)	0.32 (542)	0.31 (624)
Downy Woodpecker	0.09 (1150)	0.27 (925)	0.36 (925)	0.23 (863)	0.00 (0)	0.42 (863)	0.38 (863)	0.49 (863)	0.17 (1007)	0.29 (863)	0.26 (863)	0.34 (863)	0.22 (863)	0.18 (863)
Eastern Towhee	0.03 (–)	0.05 (551)	0.00 (0)	0.09 (551)	0.05 (551)	0.05 (551)	0.23 (612)	0.23 (551)	0.08 (918)	0.16 (551)	0.24 (620)	0.25 (620)	0.27 (771)	0.23 (551)
Eastern Wood-pewee	0.62 (426)	0.64 (560)	0.67 (568)	0.74 (637)	0.24 (537)	0.58 (549)	0.78 (534)	0.72 (560)	0.47 (364)	0.61 (613)	0.68 (584)	0.66 (584)	0.73 (640)	0.62 (429)
Gray Catbird	0.03 (444)	0.14 (444)	0.03 (444)	0.11 (444)	0.05 (444)	0.18 (444)	0.05 (444)	0.21 (444)	0.08 (592)	0.35 (484)	0.24 (493)	0.19 (444)	0.22 (499)	0.15 (518)
Great Crested Flycatcher	0.21 (632)	0.11 (758)	0.10 (632)	0.06 (632)	0.14 (632)	0.05 (632)	0.03 (632)	0.05 (632)	0.22 (474)	0.00 (0)	0.12 (632)	0.13 (722)	0.24 (632)	0.28 (517)
House Wren	0.15 (541)	0.73 (761)	0.38 (794)	0.26 (721)	0.14 (541)	0.29 (591)	0.33 (708)	0.46 (541)	0.36 (708)	0.48 (686)	0.59 (619)	0.69 (763)	0.70 (875)	0.49 (704)
Indigo Bunting	0.18 (682)	0.25 (806)	0.18 (780)	0.26 (682)	0.14 (682)	0.18 (682)	0.15 (796)	0.18 (682)	0.17 (455)	0.23 (682)	0.18 (682)	0.28 (834)	0.14 (955)	0.23 (758)

[A] Species of conservation concern for the Prairie Hardwood Transition Conservation Region (USFWS 2008; also in bold).

Table 4 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using Distance software) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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.

	Proportion of Plots Occupied (Abundance)													
Common Name	**2009 (n=34)**	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Northern Cardinal	0.06 (325)	0.20 (325)	0.26 (355)	0.23 (325)	0.05 (325)	0.26 (325)	0.25 (355)	0.28 (325)	0.08 (325)	0.26 (366)	0.21 (325)	0.22 (362)	0.41 (386)	0.41 (366)
Ovenbird	0.24 (495)	0.25 (560)	0.21 (550)	0.17 (514)	0.14 (440)	0.13 (440)	0.18 (503)	0.21 (440)	0.22 (440)	0.19 (513)	0.26 (538)	0.16 (616)	0.22 (660)	0.23 (489)
Pileated Woodpecker	0.09 (163)	0.27 (325)	0.23 (325)	0.17 (380)	0.00 (0)	0.18 (325)	0.25 (325)	0.33 (325)	0.11 (217)	0.29 (325)	0.29 (325)	0.31 (325)	0.24 (362)	0.08 (217)
Prothonotary Warbler	0.03 (666)	0.11 (666)	0.18 (951)	0.17 (999)	0.00 (0)	0.21 (916)	0.15 (999)	0.23 (814)	0.03 (666)	0.19 (666)	0.18 (666)	0.16 (799)	0.22 (916)	0.13 (1332)
Rose-breasted Grosbeak	0.15 (960)	0.52 (805)	0.46 (762)	0.54 (830)	0.00 (0)	0.71 (838)	0.43 (927)	0.69 (737)	0.39 (637)	0.61 (722)	0.65 (716)	0.50 (882)	0.62 (810)	0.61 (943)
Red-bellied Woodpecker	0.12 (631)	0.48 (661)	0.33 (683)	0.63 (659)	0.19 (631)	0.39 (673)	0.43 (705)	0.51 (694)	0.28 (490)	0.65 (694)	0.53 (631)	0.63 (811)	0.76 (878)	0.51 (631)
Red-eyed Vireo	0.21 (960)	0.48 (1080)	0.62 (1132)	0.63 (955)	0.38 (1050)	0.50 (840)	0.70 (930)	0.64 (840)	0.47 (938)	0.48 (840)	0.38 (840)	0.41 (1034)	0.49 (1000)	0.64 (1075)
Red-winged Blackbird	0.03 (–)	0.07 (1329)	0.15 (1861)	0.26 (1255)	0.05 (664)	0.45 (955)	0.23 (1181)	0.44 (955)	0.06 (1107)	0.39 (941)	0.44 (812)	0.34 (675)	0.30 (767)	0.28 (1329)
Scarlet Tanager	0.24 (528)	0.18 (469)	0.15 (469)	0.14 (469)	0.00 (0)	0.13 (469)	0.20 (469)	0.23 (469)	0.19 (469)	0.23 (469)	0.18 (469)	0.22 (536)	0.32 (541)	0.15 (469)
Song Sparrow	0.12 (325)	0.36 (498)	0.33 (570)	0.23 (447)	0.05 (325)	0.37 (442)	0.23 (542)	0.36 (442)	0.03 (651)	0.39 (407)	0.29 (488)	0.31 (456)	0.14 (521)	0.15 (380)
Tufted Titmouse	0.06 (645)	0.30 (744)	0.03 (645)	0.03 (645)	0.05 (645)	0.08 (645)	0.15 (645)	0.08 (645)	0.28 (451)	0.00 (0)	0.06 (645)	0.19 (645)	0.03 (645)	0.28 (645)

[A] Species of conservation concern for the Prairie Hardwood Transition Conservation Region (USFWS 2008; also in bold).

Table 4 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using Distance software) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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.

	Proportion of Plots Occupied (Abundance)													
Common Name	**2009 (n=34)**	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Warbling Vireo	0.00 (0)	0.11 (596)	0.08 (992)	0.20 (638)	0.14 (496)	0.24 (607)	0.20 (558)	0.15 (662)	0.08 (496)	0.13 (620)	0.18 (579)	0.25 (744)	0.32 (620)	0.26 (546)
White-breasted Nuthatch	0.09 (970)	0.20 (1078)	0.13 (970)	0.37 (1044)	0.05 (970)	0.16 (1248)	0.15 (970)	0.26 (1059)	0.28 (776)	0.29 (1186)	0.32 (1051)	0.25 (1091)	0.41 (1455)	0.49 (1024)
Wood Thrush	0.12 (325)	0.14 (434)	0.10 (407)	0.29 (391)	0.10 (325)	0.16 (380)	0.23 (362)	0.15 (325)	0.14 (217)	0.16 (325)	0.21 (366)	0.25 (407)	0.24 (391)	0.23 (289)
Yellow-bellied Sapsucker	0.09 (1745)	0.07 (1047)	0.15 (873)	0.20 (1197)	0.05 (1047)	0.24 (943)	0.15 (1047)	0.18 (898)	0.06 (1047)	0.26 (1047)	0.21 (1047)	0.03 (1047)	0.22 (1280)	0.15 (1047)
Yellow-billed Cuckoo	0.12 (108)	0.18 (325)	0.23 (325)	0.23 (325)	0.19 (325)	0.05 (325)	0.23 (362)	0.18 (325)	0.00 (0)	0.10 (325)	0.09 (325)	0.16 (325)	0.14 (391)	0.18 (465)
Yellow-throated Vireo	0.00 (0)	0.11 (479)	0.59 (499)	0.29 (527)	0.00 (0)	0.42 (509)	0.18 (479)	0.49 (479)	0.19 (342)	0.29 (479)	0.50 (479)	0.31 (479)	0.68 (537)	0.28 (479)
Yellow Warbler	0.00 (0)	0.02 (919)	0.03 (919)	0.26 (1022)	0.10 (919)	0.16 (919)	0.05 (919)	0.15 (919)	0.06 (919)	0.10 (919)	0.09 (919)	0.19 (1073)	0.16 (1073)	0.23 (1022)

[A] Species of conservation concern for the Prairie Hardwood Transition 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 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2009 (n=34)	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Bald Eagle [A]	**0.00 (0)**	**0.00 (0)**	**0.08 (10)**	**0.06 (2)**	**0.00 (0)**	**0.11 (9)**	**0.08 (4)**	**0.13 (4)**	**0.00 (0)**	**0.03 (–)**	**0.06 (5)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Barn Swallow	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.03 (–)	0.03 (2)	0.03 (–)	0.00 (0)	0.06 (–)	0.00 (0)	0.03 (–)	0.03 (–)	0.03 (–)
Barred Owl	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)	0.06 (8)	0.00 (0)	0.00 (0)
Black-billed Cuckoo [A]	**0.06 (2)**	**0.02 (2)**	**0.05 (4)**	**0.00 (0)**	**0.00 (0)**	**0.05 (4)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Belted Kingfisher	0.00 (0)	0.02 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.03 (–)	0.00 (0)	0.03 (3)	0.00 (0)	0.00 (0)	0.03 (–)	0.03 (2)
Blue-winged Warbler [A]	**0.00 (0)**	**0.07 (7)**	**0.08 (10)**	**0.03 (2)**	**0.00 (0)**	**0.08 (6)**	**0.03 (2)**	**0.08 (6)**	**0.08 (9)**	**0.10 (8)**	**0.00 (0)**	**0.09 (8)**	**0.00 (0)**	**0.03 (2)**

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2009 (n=34)	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Brown Creeper	0.03 (2)	0.05 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.05 (4)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (4)	0.00 (0)
Brown Thrasher [A]	**0.03 (2)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.05 (4)**	**0.03 (2)**	**0.00 (0)**	**0.03 (2)**	**0.00 (0)**	**0.03 (3)**	**0.03 (2)**	**0.00 (0)**	**0.05 (4)**	**0.00 (0)**
Canada Goose	0.00 (0)	0.02 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (4)	0.00 (0)	0.00 (0)	0.06 (–)	0.03 (–)	0.06 (5)	0.03 (5)	0.00 (0)	0.21 (17)
Carolina Wren	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Cedar Waxwing	0.00 (0)	0.02 (2)	0.03 (2)	0.00 (0)	0.00 (0)	0.03 (2)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Chestnut-sided Warbler	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)	0.05 (4)
Chimney Swift	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 (–)	0.00 (0)	0.00 (0)	0.03 (–)
Chipping Sparrow	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.05 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.03 (–)	0.06 (5)	0.00 (0)	0.00 (0)
Cliff Swallow	0.00 (0)	0.00 (0)	0.08 (–)	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)

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2009 (n=34)	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Cooper's Hawk	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Dickcissel [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)**	**0.03 (2)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Eastern Bluebird	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.03 (2)	0.10 (8)	0.05 (4)	0.03 (2)	0.03 (3)	0.06 (5)	0.00 (0)	0.00 (0)	0.05 (2)
Eastern Kingbird	0.03 (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)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Eastern Meadowlark	0.00 (0)	0.00 (0)	0.03 (2)	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)
Eastern Phoebe	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.03 (2)	0.08 (6)	0.03 (2)	0.06 (5)	0.00 (0)	0.03 (2)	0.06 (5)	0.08 (9)	0.00 (0)
Eastern Whip-poor-will	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)	0.05 (4)	0.00 (0)
European Starling	0.00 (0)	0.02 (2)	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 (2)	0.00 (0)
Field Sparrow	0.03 (2)	0.02 (4)	0.03 (2)	0.06 (5)	0.00 (0)	0.03 (4)	0.08 (8)	0.05 (6)	0.03 (2)	0.10 (10)	0.03 (5)	0.13 (13)	0.05 (7)	0.00 (0)

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2009 (n=34)	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Grasshopper Sparrow	0.00 (0)	0.02 (2)	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)
Great Blue Heron	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.05 (–)	0.05 (4)	0.03 (–)	0.03 (2)	0.03 (2)	0.03 (2)	0.03 (2)	0.03 (3)	0.00 (0)	0.03 (2)
Green Heron	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 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Hairy Woodpecker	0.00 (0)	0.20 (16)	0.13 (10)	0.06 (5)	0.00 (0)	0.00 (0)	0.15 (14)	0.08 (7)	0.00 (0)	0.03 (3)	0.03 (2)	0.00 (0)	0.08 (7)	0.05 (2)
Hooded Merganser	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (6)
Hooded Warbler	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (7)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)
Kentucky Warbler	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Killdeer	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)	0.03 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Least Flycatcher	0.00 (0)	0.02 (2)	0.13 (10)	0.11 (9)	0.00 (0)	0.05 (4)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2009 (n=34)	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Mallard	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 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Mourning Dove	0.00 (0)	0.05 (4)	0.00 (0)	0.03 (2)	0.00 (0)	0.05 (4)	0.00 (0)	0.10 (8)	0.00 (0)	0.06 (5)	0.15 (14)	0.19 (18)	0.19 (15)	0.13 (10)
Northern Flicker	0.00 (0)	0.02 (2)	0.08 (6)	0.00 (0)	0.00 (0)	0.08 (4)	0.00 (0)	0.10 (8)	0.03 (2)	0.06 (5)	0.00 (0)	0.03 (3)	0.00 (0)	0.05 (4)
Northern Parula	0.06 (5)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.08 (7)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Northern Rough-winged Swallow	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 (–)	0.06 (–)	0.05 (2)	0.00 (0)
Orchard Oriole	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)
Red-headed Woodpecker [A]	**0.00 (0)**	**0.11 (11)**	**0.03 (2)**	**0.00 (0)**	**0.00 (0)**	**0.11 (9)**	**0.05 (4)**	**0.08 (8)**	**0.03 (2)**	**0.06 (5)**	**0.12 (10)**	**0.06 (5)**	**0.05 (4)**	**0.03 (2)**
Red-shouldered Hawk	0.00 (0)	0.02 (2)	0.03 (6)	0.00 (0)	0.00 (0)	0.08 (6)	0.00 (0)	0.05 (2)	0.00 (0)	0.06 (5)	0.12 (10)	0.03 (3)	0.05 (4)	0.03 (2)
Red-tailed Hawk	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 (2)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)													
	2009 (n=34)	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Ruby-throated Hummingbird	0.06 (2)	0.05 (4)	0.05 (4)	0.00 (0)	0.00 (0)	0.05 (4)	0.03 (2)	0.08 (6)	0.03 (–)	0.00 (0)	0.09 (7)	0.00 (0)	0.11 (9)	0.08 (4)
Sedge Wren	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 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Spotted Sandpiper	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)
Swamp Sparrow	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 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)
Tree Swallow	0.00 (0)	0.00 (0)	0.05 (17)	0.06 (9)	0.00 (0)	0.08 (6)	0.03 (4)	0.05 (–)	0.00 (0)	0.06 (3)	0.06 (–)	0.06 (–)	0.05 (–)	0.00 (0)
Turkey Vulture	0.00 (0)	0.02 (–)	0.03 (–)	0.00 (0)	0.00 (0)	0.05 (–)	0.03 (–)	0.08 (–)	0.03 (–)	0.03 (–)	0.03 (–)	0.00 (0)	0.05 (4)	0.00 (0)
Veery	0.06 (2)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (4)
White-eyed Vireo	0.00 (0)	0.02 (2)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Wild Turkey	0.06 (16)	0.07 (5)	0.03 (2)	0.00 (0)	0.10 (4)	0.05 (2)	0.00 (0)	0.03 (2)	0.14 (7)	0.03 (3)	0.00 (0)	0.03 (3)	0.03 (2)	0.08 (–)
Willow Flycatcher [A]	**0.06 (5)**	**0.02 (2)**	**0.03 (2)**	**0.06 (5)**	**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)**
Wood Duck	0.00 (0)	0.11 (5)	0.00 (0)	0.03 (5)	0.00 (0)	0.05 (6)	0.05 (2)	0.03 (2)	0.14 (9)	0.03 (3)	0.06 (12)	0.06 (8)	0.08 (4)	0.15 (17)

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 5 (continued). Annual proportion of plots occupied by each breeding bird species and estimated abundance (determined using birds within 200 m of plot center) of each species at Effigy Mounds National Monument, Iowa, during the 2009 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 200 m from the plot center.

	Proportion of Plots Occupied (Abundance)													
Common Name	**2009 (n=34)**	**2010 (n=44)**	**2011 (n=39)**	**2012 (n=35)**	**2013 (n=21)**	**2014 (n=38)**	**2015 (n=40)**	**2016 (n=39)**	**2017 (n=36)**	**2018 (n=31)**	**2019 (n=34)**	**2020 (n=32)**	**2021 (n=37)**	**2022 (n=39)**
Yellow-breasted Chat	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (2)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Appendix D. Effigy Mounds National Monument Trends

Table 6. Trends, annual change in abundance (individuals), of breeding birds recorded on Effigy Mounds National Monument, from 2009 through 2022.

Bird Common Name	Trend [A]	SE of Slope	Trend Classification [B]
Acadian Flycatcher	1.04	0.04	Uncertain
American Crow	1.04	0.05	Uncertain
American Goldfinch	1.06	0.04	Uncertain
American Redstart	1.05	0.01	Moderate increase
American Robin	1.04	0.01	Moderate increase
Baltimore Oriole	1.02	0.02	Uncertain
Black-capped Chickadee	1.11	0.05	Moderate increase
Blue-gray Gnatcatcher	0.96	0.03	Uncertain
Brown-headed Cowbird	1.10	0.03	Moderate increase
Blue Jay	1.04	0.03	Uncertain
Cerulean Warbler [C]	**1.03**	**0.56**	**Uncertain**
Common Grackle	1.26	0.07	Strong increase
Common Yellowthroat	1.01	0.02	Stable
Downy Woodpecker	1.01	0.04	Uncertain
Eastern Towhee	1.21	0.13	Uncertain
Eastern Wood-pewee	1.02	0.01	Stable
Gray Catbird	1.13	0.05	Moderate increase
Great Crested Flycatcher	1.05	0.04	Uncertain
House Wren	1.06	0.02	Moderate increase
Indigo Bunting	1.01	0.03	Uncertain
Northern Cardinal	1.06	0.03	Moderate increase

[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 ±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 considered of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Table 6 (continued). Trends, annual change in abundance (individuals), of breeding birds recorded on Effigy Mounds National Monument, from 2009 through 2022.

Bird Common Name	Trend [A]	SE of Slope	Trend Classification [B]
Ovenbird	1.01	0.02	Uncertain
Pileated Woodpecker	1.02	0.04	Uncertain
Prothonotary Warbler	1.03	0.03	Uncertain
Rose-breasted Grosbeak	1.05	0.02	Moderate increase
Red-bellied Woodpecker	1.07	0.02	Moderate increase
Red-eyed Vireo	1.01	0.02	Stable
Red-winged Blackbird	1.11	0.03	Moderate increase
Scarlet Tanager	1.06	0.04	Uncertain
Song Sparrow	0.99	0.02	Uncertain
Tufted Titmouse	1.06	0.18	Uncertain
Warbling Vireo	1.16	0.09	Uncertain
White-breasted Nuthatch	1.12	0.03	Moderate increase
Wood Thrush	1.04	0.03	Uncertain
Yellow-bellied Sapsucker	1.00	0.07	Uncertain
Yellow-billed Cuckoo	1.01	0.05	Uncertain
Yellow-throated Vireo	1.08	0.04	Uncertain
Yellow Warbler	1.16	0.08	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 ±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 considered of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

Appendix E. Regional Trends

Table 7. Regional trends (Prairie Hardwood Transition Bird Conservation Region) in breeding birds recorded on Effigy Mounds National Monument, Iowa, from 2009 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. "–" denotes when regional trend values were not available.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
Acadian Flycatcher	2.66	−0.60	6.10
American Crow	−2.50	−3.34	−1.66
American Goldfinch	−3.42	−4.71	−2.11
American Redstart	–	–	–
American Robin	−1.57	−2.18	−0.98
Bald Eagle [A]	**6.17**	**−0.03**	**12.75**
Baltimore Oriole	−0.21	−1.42	1.03
Barn Swallow	−2.27	−3.34	−1.21
Barred Owl	−0.38	−4.48	3.50
Belted Kingfisher	−2.18	−4.85	0.32
Black-billed Cuckoo [A]	**−3.44**	**−7.05**	**0.14**
Black-capped Chickadee	−0.91	−2.43	0.68
Blue Jay	−0.95	−1.92	0.07
Blue-gray Gnatcatcher	−2.38	−5.27	0.64
Blue-winged Warbler [A]	**−1.32**	**−4.70**	**2.08**
Brown Creeper	1.43	−4.55	8.77
Brown-headed Cowbird	−2.82	−4.06	−1.57
Brown Thrasher [A]	**0.42**	**−1.01**	**1.93**
Canada Goose	5.28	−3.02	15.06
Carolina Wren	8.36	1.42	17.12
Cedar Waxwing	−6.16	−8.25	−4.09
Cerulean Warbler [A]	**−0.62**	**−5.76**	**4.81**
Chestnut-sided Warbler	0.21	−2.40	3.08
Chimney Swift	−2.74	−4.42	−1.01
Chipping Sparrow	−2.86	−3.62	−2.10
Cliff Swallow	0.64	−3.16	4.16
Common Grackle	−3.00	−4.30	−1.67
Common Yellowthroat	−0.45	−1.15	0.25

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

[B] Species recorded between point transects or other times outside of 5-minute survey periods.

Table 7 (continued). Regional trends (Prairie Hardwood Transition Bird Conservation Region) in breeding birds recorded on Effigy Mounds National Monument, Iowa, from 2009 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. "–" denotes when regional trend values were not available.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
Cooper's Hawk	−1.69	−5.33	1.92
Dickcissel [A]	**4.61**	**0.72**	**9.03**
Downy Woodpecker	–	–	–
Eastern Bluebird	−4.74	−6.70	−2.82
Eastern Kingbird	−0.69	−2.17	0.87
Eastern Meadowlark	−3.57	−4.93	−2.23
Eastern Phoebe	−5.26	−7.11	−3.39
Eastern Towhee	3.13	1.58	4.72
Eastern Wood-pewee	−0.30	−1.33	0.74
Eastern Whip-poor-will	2.02	−4.54	9.70
European Starling	−2.78	−4.13	−1.42
Field Sparrow	−2.65	−3.99	−1.32
Grasshopper Sparrow	−6.08	−10.13	−2.13
Gray Catbird	0.17	−0.71	1.08
Great Blue Heron	−1.85	−4.12	0.43
Great Crested Flycatcher	0.01	−1.34	1.39
Green Heron	−2.41	−4.87	0.02
Hairy Woodpecker	0.61	−1.41	2.72
Hooded Merganser	5.45	1.55	9.28
Hooded Warbler	0.39	−6.03	7.34
House Wren	−0.56	−1.49	0.38
Indigo Bunting	−0.75	−1.65	0.13
Kentucky Warbler	–	–	–
Killdeer	−1.43	−2.68	−0.15
Least Flycatcher	−1.89	−4.22	0.35
Mallard	−0.85	−3.77	2.09
Mourning Dove	−1.67	−2.57	−0.81
Northern Cardinal	0.44	−0.39	1.28
Northern Flicker	–	–	–
Northern Parula	2.54	−2.66	10.03

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

[B] Species recorded between point transects or other times outside of 5-minute survey periods.

Table 7 (continued). Regional trends (Prairie Hardwood Transition Bird Conservation Region) in breeding birds recorded on Effigy Mounds National Monument, Iowa, from 2009 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. "–" denotes when regional trend values were not available.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
Northern Rough-winged Swallow	−3.29	−6.01	−0.49
Orchard Oriole	1.15	−1.67	3.90
Ovenbird	−1.25	−2.55	0.05
Pileated Woodpecker	4.06	1.38	7.00
Prothonotary Warbler	1.06	−6.25	9.88
Red-bellied Woodpecker	1.66	0.25	3.14
Red-eyed Vireo	−0.94	−1.98	0.09
Red-headed Woodpecker [A]	**−0.71**	**−3.32**	**1.99**
Red-shouldered Hawk	4.94	−0.42	11.34
Red-tailed Hawk	−0.94	−2.75	0.87
Red-winged Blackbird	−0.52	−1.22	0.19
Ring-necked Pheasant [B]	−4.73	−7.45	−1.84
Rose-breasted Grosbeak	0.48	−0.82	1.87
Ruby-throated Hummingbird	−2.43	−4.83	0.05
Scarlet Tanager	−2.26	−4.10	−0.36
Sedge Wren	−3.83	−7.94	0.42
Song Sparrow	−1.24	−1.87	−0.57
Spotted Sandpiper	−2.24	−5.43	0.86
Swamp Sparrow	0.50	−1.56	2.65
Tree Swallow	−4.10	−6.21	−2.10
Tufted Titmouse	–	–	–
Turkey Vulture	6.47	3.24	9.66
Veery	1.53	−0.31	3.54
Warbling Vireo	−0.35	−1.62	0.91
White-breasted Nuthatch	−2.18	−4.01	−0.28
White-eyed Vireo	−0.80	−6.31	4.61
Wild Turkey	1.92	−2.09	6.06
Willow Flycatcher [A]	**−2.66**	**−4.15**	**−1.18**
Wood Duck	1.76	−2.08	5.90
Wood Thrush	−1.50	−3.42	0.40

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

[B] Species recorded between point transects or other times outside of 5-minute survey periods.

Table 7 (continued). Regional trends (Prairie Hardwood Transition Bird Conservation Region) in breeding birds recorded on Effigy Mounds National Monument, Iowa, from 2009 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. "–" denotes when regional trend values were not available.

Common Name	Annual Percent Change in Population Size	Lower End of 95% Confidence Interval	Upper End of 95% Confidence Interval
Yellow-bellied Sapsucker	1.39	−1.97	4.86
Yellow-billed Cuckoo	−0.48	−4.18	3.34
Yellow-breasted Chat	−0.46	−6.05	5.53
Yellow-throated Vireo	1.56	−0.21	3.45
Yellow Warbler	−0.76	−1.87	0.38

[A] Species of conservation concern for the Prairie Hardwood Transition Bird Conservation Region (USFWS 2008; also in bold).

[B] Species recorded between point transects or other times outside of 5-minute survey periods.

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 (±standard deviation) of each habitat type in 50 m plots at Effigy Mounds National Monument, 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 = 34)	2013 (n = 21)	2017 (n = 36)	2022 (n = 39)
Floodplain/Old Field/Prairie (%)	18.94 (±36.48)	4.07 (±18.54)	8.82 (±26.64)	9.04 (±27.14)
Pond (%)	0.09 (±0.51)	0.00	0.83 (±3.48)	1.60 (±10.00)
Shrub (%)	0.00	1.79 (±8.18)	1.04 (±6.25)	0.00
Drainage/Stream (%)	0.00	0.00	2.21 (±7.00)	2.17 (±8.36)
Trail (%)	1.03 (±2.72)	0.43 (±1.08)	0.68 (±2.59)	1.10 (±3.40)
Woodland (%)	73.66 (±45.44)	88.45 (±22.44)	71.26 (±41.18)	60.92 (±44.81)

Table 9. Average (±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 Effigy Mounds National Monument, 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 = 34)	2013 (n = 21)	2017 (n = 36)	2022 (n = 39)
Canopy Cover	Hardwood (%)	83.76 (±34.25)	88.98 (±21.83)	71.41 (±34.62)	61.13 (±39.12)
	Total Cover (%)	83.76 (±34.25)	88.98 (±21.83)	71.41 (±34.62)	61.13 (±39.12)
Canopy Height	Hardwood (m)	22.84 (±11.64)	21.96 (±8.83)	20.83 (±11.96)	19.52 (±13.57)
Basal Area	Hardwood (m^2/ha)	22.36 (±15.01)	12.14 (±6.14)	16.94 (±10.78)	17.50 (±14.00)
	Total (m^2/ha)	22.36 (±15.01)	12.14 (±6.14)	16.94 (±10.78)	17.50 (±14.00)
Horizontal Vegetation Profile—measured at 15 m north of plot center (percent cover at different height increments)	0.00–0.25 m (%)	83.23 (±32.63)	95.24 (±7.98)	83.89 (±30.52)	66.35 (±43.18)
	0.25–0.50 m (%)	69.26 (±44.74)	72.76 (±37.30)	63.79 (±40.63)	52.81 (±46.62)
	0.50–0.75 m (%)	31.20 (±42.07)	31.67 (±42.31)	21.85 (±34.24)	30.71 (±40.95)
	0.75–1.00 m (%)	19.01 (±35.60)	16.00 (±33.54)	18.40 (±33.65)	20.91 (±35.84)
	1.00–1.25 m (%)	14.56 (±31.05)	9.45 (±29.28)	8.47 (±23.73)	14.79 (±30.81)
	1.25–1.50 m (%)	4.20 (±14.79)	15.83 (±33.62)	7.17 (±23.19)	12.01 (±27.15)
	1.50–1.75 m (%)	8.41 (±22.71)	18.48 (±34.39)	7.26 (±22.70)	11.47 (±27.28)
	1.75–2.00 m (%)	12.00 (±29.73)	24.17 (±39.61)	6.74 (±18.22)	11.41 (±27.21)
Vertical Structure Diversity (%)	n/a	9.52 (±6.49)	3.89 (±9.69)	12.01 (±8.10)	12.52 (±9.50)

Table 10. Average percent (±standard deviation) soil substrate cover and plant guild cover in 1.78 m sample plots at Effigy Mounds National Monument, Iowa, during the bird breeding seasons from 2009 to 2022 (n = number of subplots sampled). Total percent coverages 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=34)	2013 (n=21)	2017 (n=36)	2022 (n=39)
Deciduous Litter (%)	49.91 (±33.81)	54.21 (±30.74)	37.5 (±30.18)	49.51 (± 37.36)
Grass Litter (%)	6.57 (±22.13)	6.38 (±21.12)	2.03 (±4.70)	7.53 (± 25.15)
Bare Soil (%)	10.04 (±15.03)	13.10 (±15.75)	19.76 (±21.28)	9.72 (± 17.12)
Rock (%)	4.26 (±16.77)	0.52 (±1.05)	4.82 (±14.79)	0.27 (± 0.81)
Woody Debris (%)	15.37 (±14.02)	5.81 (±6.05)	15.49 (±19.89)	7.15 (± 8.35)
Unvegetated (%)	71.93 (±28.51)	63.00 (±28.84)	80.49 (±29.84)	65.38 (± 38.39)
Warm-season Grass (%)	0.43 (±2.54)	0.14 (±0.65)	1.36 (±6.25)	0.01 (± 0.08)
Cool-season Grass (%)	6.70 (±17.46)	11.83 (±17.48)	5.79 (±19.66)	7.28 (± 21.02)
Forb (%)	23.00 (±24.14)	49.41 (±26.42)	25.88 (±20.56)	26.39 (± 27.40)
Moss and Lichen (%)	2.91 (±5.17)	2.64 (±4.29)	6.29 (±8.18)	1.42 (± 3.36)
Woody Shrub and Vine (%)	3.09 (±3.21)	3.26 (±8.48)	2.13 (±6.60)	1.85 (± 4.00)
Tree Seedling (%)	1.46 (±3.59)	1.69 (±4.43)	1.25 (±3.48)	4.32 (± 10.50)
Total Foliar (%)	39.87 (±30.27)	52.74 (±26.79)	43.15 (±29.51)	39.59 (± 32.78)

Table 11. Stems per hectare for trees found at Pipestone National Monument, Minnesota, 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=34)	2013 (n=21)	2017 (n=36)	2022 (n=39)
< 1.0 cm	Aceraceae	4	0	0	0
	Anacardiaceae	0	6	0	0
	Betulaceae	0	0	14	20
	Cornaceae	22	0	0	0
	Fagaceae	0	0	0	3
	Juglandaceae	0	0	4	0
	Oleaceae	4	0	0	35
	Rutaceae	0	36	14	0
	Salicaceae	0	12	0	0
	Snag	0	0	7	3
	Tiliaceae	0	6	0	0
	Ulmaceae	19	12	0	0

Table 11 (continued). Stems per hectare for trees found at Pipestone National Monument, Minnesota, 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=34)	2013 (n=21)	2017 (n=36)	2022 (n=39)
1.1–2.5 cm	Aceraceae	11	0	4	0
	Betulaceae	0	12	25	10
	Caprifoliaceae	0	0	7	0
	Fagaceae	0	0	4	0
	Juglandaceae	7	6	11	10
	Oleaceae	4	0	4	3
	Rosaceae	4	0	0	0
	Rutaceae	0	42	14	0
	Salicaceae	0	0	4	0
	Snag	11	0	4	0
	Ulmaceae	22	12	4	0
2.6–8.0 cm	Aceraceae	67	91	67	29
	Betulaceae	22	18	32	16
	Cornaceae	4	0	0	0
	Caprifoliaceae	0	0	7	0
	Fagaceae	4	0	4	13
	Juglandaceae	37	36	11	23
	Moraceae	0	0	4	0
	Oleaceae	11	0	4	13
	Rosaceae	4	0	4	7
	Rutaceae	0	139	0	0
	Salicaceae	0	0	18	3
	Snag	37	12	24	3
	Tiliaceae	7	0	4	10
	Ulmaceae	97	85	0	10
8.1–15.0 cm	Aceraceae	52	49	35	20
	Betulaceae	7	12	21	29
	Fagaceae	4	0	4	0
	Juglandaceae	19	30	7	7
	Oleaceae	4	6	24	7
	Rosaceae	4	6	7	0
	Snag	15	6	4	20
	Tiliaceae	22	0	7	3
	Ulmaceae	41	55	0	26

Table 11 (continued). Stems per hectare for trees found at Pipestone National Monument, Minnesota, 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=34)	2013 (n=21)	2017 (n=36)	2022 (n=39)
15.1–23.0 cm	Aceraceae	37	18	28	13
	Fagaceae	4	12	7	0
	Juglandaceae	15	18	4	0
	Oleaceae	19	0	14	0
	Rosaceae	4	12	0	3
	Snag	4	6	7	13
	Tiliaceae	11	0	7	7
	Ulmaceae	7	6	7	3
23.1–38.0 cm	Aceraceae	41	42	35	45
	Fagaceae	7	12	17	13
	Juglandaceae	0	6	4	3
	Oleaceae	0	0	11	10
	Rosaceae	4	6	4	0
	Salicaceae	4	12	0	0
	Snag	7	6	0	13
	Tiliaceae	7	6	7	0
	Ulmaceae	4	6	4	0
>38.0 cm	Aceraceae	34	6	21	29
	Betulaceae	0	0	4	0
	Fagaceae	11	30	21	10
	Juglandaceae	0	6	0	0
	Oleaceae	4	12	7	0
	Salicaceae	0	12	0	0
	Snag	11	18	7	3
	Tiliaceae	4	12	0	0
	Ulmaceae	0	0	4	3

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