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Bird Community Monitoring at Tallgrass Prairie National Preserve, Kansas

Status Report 2001–2018

Natural Resource Report NPS/HTLN/NRR—2020/2072

ON THE COVER
Landscape at Tallgrass Prairie National Preserve, Kansas
Photography by NPS, Heartland Network

Bird Community Monitoring at Tallgrass Prairie National Preserve, Kansas

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Executive Summary

In 2001, the Heartland I&M Network initiated breeding bird surveys on Tallgrass Prairie National Preserve, Kansas, to assess the ecological integrity of the preserve's habitat. Birds are an important component of ecosystems and can serve as good indicators of habitat change in an ecosystem. In the 17 years of bird surveys at the preserve (2001 to 2018, excluding 2003), there were 2,089 plot visits and 119 different bird species recorded, 96 of which have the potential to breed within the preserve. These 96 species represent approximately 81% of the total species one would reasonably expect to have breeding populations on the preserve. Thirteen breeding species and four other species are considered species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region, the region in which the preserve is located. Nine breeding species and four migrant species on the preserve are grassland obligates.

Eighteen bird species in upland tallgrass prairie habitat, and nine in riparian habitat, were recorded in sufficient numbers to calculate annual abundances and population trends. The populations of two upland species, Dickcissel and Mourning Dove, and three riparian species, Northern Cardinal, Red-bellied Woodpecker, and Tufted Titmouse, significantly increased since 2001 when monitoring began. Killdeer, Lark Sparrow, Red-winged Blackbird, Upland Sandpiper, and Western Meadowlark populations significantly declined in the upland habitat. All other species in both habitats had stable or undetectable population trends.

Population trends for Barn Swallows, Brown-headed Cowbirds, Brown Thrashers, Great Crested Flycatchers, Greater Prairie-chickens, Red-bellied Woodpeckers, and Western Meadowlarks in the upland habitat mirrored trends reported by Sauer et al. (2014) for the Eastern Tallgrass Prairie Bird Conservation Region. Blue-gray Gnatcatcher, Dickcissel, Great Crested Flycatcher, Northern Cardinal, and Red-bellied Woodpecker populations in riparian habitat also mirrored regional trends. Trend results for the remaining common species in both habitats were less clear. Either a species population trend for the preserve was positive or negative, and the corresponding population trend for the region straddled zero, or the opposite was true.

The thirteen resident species on Tallgrass Prairie National Preserve that are species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region should be given special consideration in natural resource management decisions. With 94.7% of the preserve in tallgrass prairie habitat, managing this habitat for the nine breeding grassland obligate species is of high importance as well. By doing so, management would also benefit a host of other grassland species, such as the Eastern Kingbird, Northern Bobwhite, and Scissor-tailed Flycatcher. Four grassland obligate species observed in sufficient numbers to calculate annual abundances are also species of conservation concern: Dickcissel, Grasshopper Sparrow, Henslow's Sparrow, and Upland Sandpiper. Therefore, these four species offer the best opportunity to track the effectiveness of management actions on conserving species in peril, and their needs should be given the highest consideration in management decisions.

Comparing management philosophies between earlier (2001 through 2005) and later years (2006 through 2018) on the preserve helps to explain some of the bird trends observed. The number of hectares burned annually declined between the earlier and later years, as did the stocking rates of cattle. The early higher intensity management actions created habitat with shorter and sparser vegetation favored by Killdeer, Lark Sparrows, Upland Sandpipers, and Western Meadowlarks, whereas the later management practices produced taller and denser vegetation and more grass litter favored by Dickcissels, Eastern Meadowlarks, Grasshopper Sparrows, Greater Prairie-chickens, Henslow's Sparrows, and Upland Sandpipers.

This report provides current regional and local trends for breeding birds for future comparisons with bird data collected as part of the long-term monitoring efforts at Tallgrass Prairie National Preserve. This report also documents shifts in habitat characteristics resulting from changes in management philosophies. With this report, preserve staff can better account for the potential effects of management actions on breeding birds. Monitoring data also provide preserve staff with additional information useful for interpreting birds, an important natural resource on the preserve.

Acknowledgments

We would like to thank the staff of Tallgrass Prairie National Preserve, Kansas, for allowing us access to the preserve during our site visits. We would also like to thank the staff and volunteers who assisted with bird surveys on the preserve: K. J. Hase, C. D. Hase, D. L. McCullough, J. A. Rundell A. D. Page, A. U. Rutter, K. M. Rice, M. S. Wormington, and R. A. Guffy.

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. 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. Management activities intended to preserve 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). The National Park Service plays a role in bird conservation under the authority of the Migratory Bird Treaty Act of 1918 (as amended) and Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. Bird monitoring is critical as widespread habitat loss to agriculture and urban and industrial development threaten the integrity of regional habitat for birds.

Tallgrass Prairie National Preserve, Kansas, is located in the west-central section of the Eastern Tallgrass Prairie Bird Conservation Region (Figure 1). This region is one of 67 regions identified in the North American Bird Conservation Initiative (NABCI). Started in 1999, the NABCI is a coalition of government agencies and private organizations in the

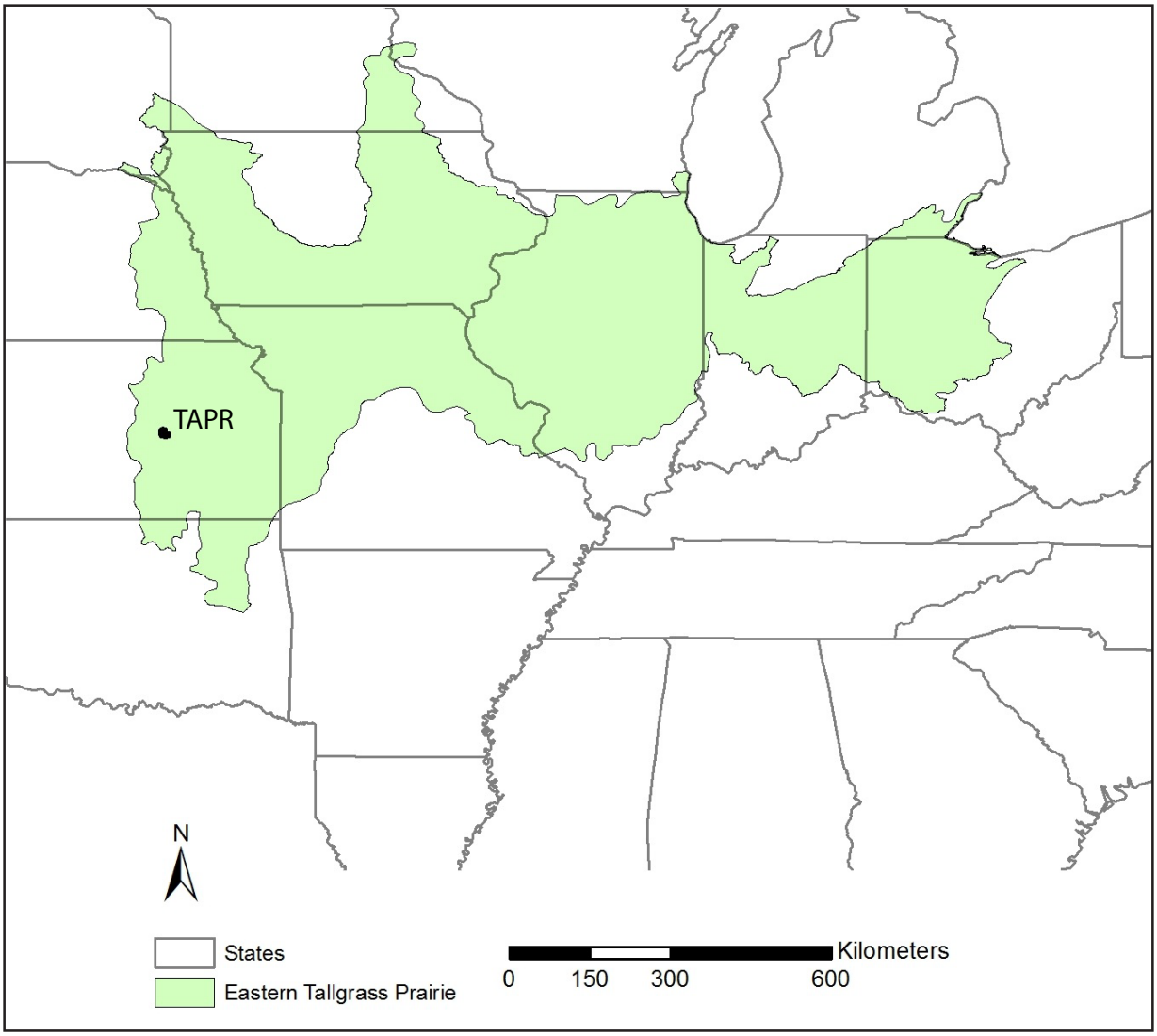


Figure 1. Location of Tallgrass Prairie National Preserve, Kansas, within the Eastern Tallgrass Prairie Bird Conservation Region.

United States working to ensure the long-term health of North America's native bird populations (NABCI 2013).

The Eastern Tallgrass Prairie Bird Conservation Region historically consisted of the tallest and lushest grasslands of the Great Plains (NABCI 2013). However, forests dominated the region in the east, creating an oak-savanna ecotone between the eastern woodlands and the western prairie. Tallgrass Prairie National Preserve is located in the western-most section of the region, which consists of the Flint Hills with its remnant native tallgrass prairie (Fitzgerald et al. 2000). The rocky, rolling terrain of the Flint Hills has been largely untouched by the plow. Threats to the upland and wetland habitats of this region include urbanization, recreational development, and agricultural expansion. High priority grassland birds that persist in some areas include the Greater Prairie-Chicken (*Tympanuchus cupido*) and Henslow's Sparrow (*Ammodramus henslowii*). Cerulean Warblers (*Setophaga cerulea*) are found in some wooded areas, and the Red-headed Woodpecker (*Melanerpes erythrocephalus*) leads the list of savanna specialists (NABCI 2013). Approximately 120 species of breeding birds can be found in the habitat of the Flint Hills around Tallgrass Prairie National Preserve (Thompson et al. 2011).

Data collected during the U.S. Geological Survey's annual North American Breeding Bird Surveys (BBS) between 1966 and 2012 indicate that a number of bird species that breed at Tallgrass Prairie National Preserve show evidence of long-term population decline (Sauer et al. 2017). In fact, 44% of the breeding species have populations reported to be in decline, with species such as the Black-billed Cuckoo (*Coccyzus erythropthalmus*), Grasshopper Sparrow (*Ammodramus savannarum*), Greater Prairie-Chicken, Loggerhead Shrike (*Lanius ludovicianus*), Red-headed Woodpecker, and Western Meadowlark (*Sturnella neglecta*) declining at alarming rates.

We use trends in bird community composition and species abundance as one of our long-term indicators of ecosystem integrity at Tallgrass Prairie National Preserve. Ecosystem integrity is defined as the system's capability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats of the region (Karr and Dudley 1981). Because birds serve as good indicators of change in ecosystems (Cairns et al. 2004; Mallory et al. 2006; Wood et al. 2006), bird monitoring can help us evaluate the effectiveness of management actions to restore and maintain the cultural landscape at Tallgrass Prairie National Preserve.

The Greater Prairie-chicken (*Tympanuchus cupido)* is a grassland obligate. Photo by Robert Bennetts

Objectives

There are two primary objectives for monitoring breeding birds at Tallgrass Prairie National Preserve:

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

This report summarizes species composition and population trends for birds recorded during 18 years of monitoring (2001–2018, excluding 2003).

Methods

Site Selection

Permanent monitoring locations (plots) were created by overlaying a systematic grid of 400 x 400-m cells (originating from a random start point) across the grassland habitat at Tallgrass Prairie National Preserve and placing plots at the intersection of grid lines. The orientation of the systematic grid was rotated 34 degrees from north to prevent sampling plots from being influenced by man-made features oriented along cardinal directions. Riparian corridors were identified as a separate stratum, with sampling extending 125 m on either side of the stream channel (Palmer and Fox Creeks). The riparian stratum makes up 5.3% of the total area (4,398 ha) of the preserve. In the riparian stratum, plots were located at 250-m intervals along the extent of a stream. Any plots from the overall grid that fell within the riparian stratum were discarded. We established 242 grassland (including brome plots) and 18 riparian plots (Figure 2). Annually, we monitored 54 to 260 plots depending on the year (Table 1).

To limit the effort needed to complete annual breeding bird surveys from 2004 through 2008, an interpenetrating, split panel revisit plan [1-0,1-4] was utilized in which plots in one panel were sampled in all years (n = 41); and plots in five additional panels were visited on a rotating basis once every five years (n = 40 or 41). Panel membership was assigned to all plots in the systematic sample by numbering plots sequentially along transects aligned northwest to southeast, starting with the most northeastern plot. Assignment to panels A through F was done in a repeated fashion to the sequenced numbers (i.e. number 1 = A, 2 = B, 3 = C, 4 = D, 5 = E, 6 = F, 7 = A, 8 = B and so on). To determine membership in the annual panel and the sequence of the remaining panels, the six letters (A–F) were randomly sequenced. The result was E, A, D, B, F and C. Therefore, panel E was visited annually, panel A in year 1, panel D in year 2, B in year 3, and so on.

Table 1. Number of plots sampled and sampling dates for breeding bird surveys conducted at Tallgrass Prairie National Preserve, Kansas, by year. Also listed are observer(s) who conducted the surveys.

Year	Sampling Dates	Number of Plots Sampled	Observer(s)
2001	May 22–June 13	176	D.G. Peitz*
2002	May 20–June 20	260	D.G. Peitz*
2004	May 10–May 27	97	D.G. Peitz*
2005	May 17–May 24	97	D.G. Peitz*
2006	May 16–May 23	99	D.G. Peitz*
2007	May 17–May 23	89	D.G. Peitz*
2008	June 2–June 8	95	D.G. Peitz*
2009	May 30–June 4	58	C.D. Hase, D.L. McCullough, J.A. Rundell, and K.J. Hase
2010	May 11–May 24	260	D.G. Peitz* and D.L. McCullough
2011	May 23–June 3	58	C.D. Hase, D.L. McCullough, J.A. Rundell, and K.J. Hase
2012	May 24–June 13	54	A.D. Page, A.U. Rutter, D.L. McCullough, J.A. Rundell, K.J. Hase, K.M. Rice, M.S. Wormington, and R.A. Guffy
2013	May 6–June 17	58	D.L. McCullough and K.J. Hase
2014	May 13–May 21	259	D.G. Peitz* and D.W. Londe*
2015	May 30–June 14	58	L.M. Walker and K.J. Hase
2016	May 14–June 12	58	K.J. Hase
2017	May 13–June 16	58	D.L. McCullough, R.M. Hicks, C.E. Defore, and K.J. Hase
2018	May 15–May 25	255	D.G. Peitz*, D.W. Londe, and B.S. Thornton*

*Heartland I&M Network staff.

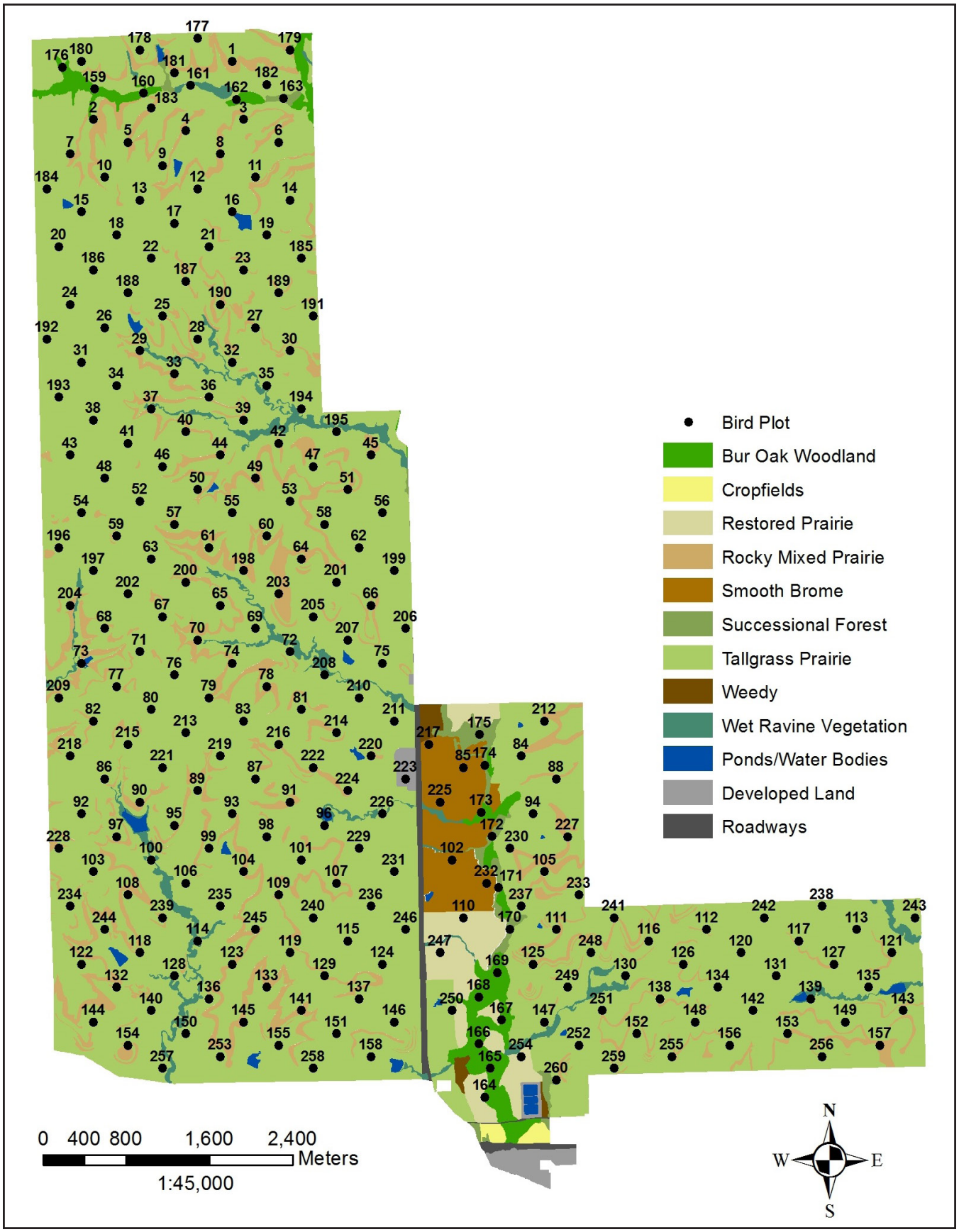


Figure 2. Bird plot locations on Tallgrass Prairie National Preserve, Kansas. Vegetation mapping and classification provided by Kindscher et al. (2011).

The Flint Hills at Tallgrass Prairie National Preserve at sunset. NPS

Along with two panels, annual sampling included the 18 riparian plots resulting in an annual work load of approximately 100 plots per year, with 50 percent of the annual sampling effort in upland tallgrass prairie allocated to the annually sampled panel. The interpenetrating, split panel revisit plan was designed by statistical consultant T. McDonald of Western Ecosystems Technology, Inc., Cheyenne, WY.

Starting in 2009, breeding bird monitoring was conducted by preserve staff and volunteers, allowing Heartland I&M Network to modify their sampling schedule to visit the preserve every fourth year. To facilitate this change, preserve staff and volunteers were asked to visit plots identified in panel E and riparian plots, and to sample as many other plots as their schedules would allow. Heartland I&M Network monitored all available plots during the fourth-year visits—2010, 2014, and 2018.

During bird surveys in 2001 to 2008, 2010, and 2014, monitoring plots were located using navigation waypoints (Peitz et al. 2008) in a Trimble Geo XT GPS unit, and plots were 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. During bird surveys in 2009, 2011 to 2013, and 2015 to 2017, years when habitat assessments were not conducted, monitoring plots were located using a GPS unit as well. However, plots were not marked with pin flags. In 2018, the habitat assessment crews worked independent of the birder and monitoring plots were located using a GPS unit and 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-min 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 GPS unit. While traveling between plots, the observer was vigilant for the presence of species not recorded during timed surveys.

These species help formulate a more complete species list for the preserve by identifying species missed during timed surveys. However, these observations were not included in any analysis as they did not directly relate to an individual plot. We sampled birds during a period when it became light enough to observe birds to four hours after sunrise.

Variable circular plot counts were conducted in an attempt to get an "instantaneous count" of all birds present. The observer recorded birds flushed from a plot when approached and the counts were started as soon as the observer reached plot center. 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-min survey are included. Individual birds recorded from a previous plot were noted and excluded from analysis except when developing detection functions using Distance software.

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 2001 to 2008, 2010, 2014, and 2018. During years when habitat assessments were made, plots were visited in generally the same order as they were monitored for birds to avoid disturbing birds on a plot prior to the bird survey. Once the habitat crew arrived at a plot, they set up a 5-m-radius subplot and completed all habitat measures for this 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 vegetation type (brome field, corn field, drainage, field/prairie, old field, upland prairie, pond, restored prairie, riparian prairie, riparian woodland, seep, or shrub) and road and water cover on each 50-m plot were recorded. As 5-m subplots were sampled, horizontal vegetation cover was estimated in 0.50-m (2001-2007, excluding 2003) or 0.25-m (2008, 2010, 2014, 2018) 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 a 15-m distances 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 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 located in riparian habitat. 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, moss 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, winter resident) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants from the analysis of breeding birds within Tallgrass Prairie National Preserve. Proportion of plots occupied by each bird species was calculated (total number of plots occupied by a species/plots surveyed) and reported in Appendices B through E.

For species with greater than 60 observations recorded, 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, Uniform + Cosine, Half-normal + Hemite polynomial, and Hazard-rate + Simple polynomial—were considered in determining the detection function of each species, and the most robust models were selected by Distance based on the lowest Akaike Information Criteria (AIC) values.

For upland plots, the Hazard-rate + Simple polynomial function was selected for 15 species: Barn Swallow (*Hirundo rustica*), Brown-headed Cowbird (*Molothrus ater*), Dickcissel (*Spiza americana*), Eastern Kingbird (*Tyrannus tyrannus*), Eastern Meadowlark (*Sturnella magna*), Grasshopper Sparrow (*Ammodramus savannarum*), Great Crested

Flycatcher (*Myiarchus crinitus*), Henslow's Sparrow (*Ammodramus henslowii*), Horned Lark (*Eremophila alpestris*), Killdeer (*Charadrius vociferus*), Lark Sparrow (*Chondestes grammacus*), Mourning Dove (*Zenaida macroura*), Red-winged Blackbird (*Agelaius phoeniceus*), Upland Sandpiper (*Bartramia longicauda*), and Western Meadowlark (*Sturnella neglecta*). The Uniform + Cosine function was chosen for three species: Brown Thrasher (*Toxostoma rufum*), Greater Prairie-chicken (*Tympanuchus cupido*), and Northern Bobwhite (*Colinus virginianus*).

For riparian plots, the Hazard-rate + Simple polynomial function was chosen for six species: Eastern Wood-Pewee (*Contopus virens*), Great Crested Flycatcher, Northern Cardinal (*Cardinalis cardinalis*), Red-bellied Woodpecker (*Melanerpes carolinus*), Red-eyed Vireo (*Vireo olivaceus*), and Tufted Titmouse (*Baeolophus bicolor*). The Uniform + Cosine function was chosen for two species, Blue-gray Gnatcatcher (*Polioptila caerulea*) and Dickcissel. The Half-normal + Cosine function was chosen for one species, Blue Jay (*Cyanocitta cristata*). Abundances for these species are reported in Appendix D.

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 (12.56 ha) around each plot center and then calculating abundance based on average plot densities. Park-wide abundances for species with less than 60 observations are reported in Appendices C and E.

For species with adequate abundance (those with greater than 60 observations), trends were calculated by regressing abundance against survey years 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 the monitoring of 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 overdispersion are taken into account with this software. Although TRIM has the capacity to estimate missing data, we restricted our regression analysis to the 40 upland plots identified in panel E for determining trends in upland tallgrass prairie habitat, and the 18 riparian plots for the riparian habitat (Appendix A). By doing this we analyzed a consistent ratio of grassland plots and riparian plots across years.

Red-eyed vireos (*Vireo olivaceus*) can be found in the riparian areas in Tallgrass Prairie National Preserve. NPS

For this report, we also obtained regional breeding bird trends for the Eastern Tallgrass Prairie Bird Conservation Region during the period of 2001 to 2015 from the Breeding Bird Survey (BBS) website of the USGS Patuxent Wildlife Research Center (Appendix G; Sauer et al. 2017). It is possible to determine trends for many bird species and many regions of interest for periods ranging from 1966 to 2015 by using the interactive calculator available at the BBS website: https://www.mbr-pwrc.usgs.gov/bbs/trend/tf15.html. However, we chose the last 15-year period of available data to maximize the accuracy of regional trend results without going beyond the sampling period at Tallgrass Prairie National Preserve.

We compared regional trends with those calculated using TRIM for the grassland and riparian areas of Tallgrass Prairie National Preserve (see Figures 3A and 3B in the Results section). Regional trends with a confidence interval that straddled zero were classified as uncertain for comparison with results

from Tallgrass Prairie National Preserve. 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 preserve were assessed by regressing each metric against survey years in the add-in statistical software of Microsoft Excel 2010, and then graphing the results. Prior to trend analysis, bird community diversity values were calculated annually using the Shannon Diversity Index:

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

where n_1/N is the proportion of the total number of individuals in a population consisting of the ith species (Shannon 1949). Species richness values were determined as the total number of bird taxa recorded annually. Species distribution evenness values were calculated using Pielou (J′):

$$J' = H'/Hmax$$

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

Because not all species occurring in an area may actually be observed in a survey (i.e., rare species may be missed), recorded species richness is often an underestimate. Statistical species richness estimators utilize the information in species distribution and abundance patterns to produce an estimate of true species richness. Species richness estimators are also useful in comparing surveys with unequal sampling effort (e.g., different numbers of plots) since more species are usually discovered with greater sampling effort. Different species richness estimators will produce varying estimates, however, and no single estimator is consistently superior to others. Nonparametric statistical estimators have generally performed better than parametric types (Walther and Moore 2005). Reese et al. (2014) recently reviewed nonparametric species richness estimators, and found that two coverage-based estimators, the Abundance Coverage-based Estimator (ACE) and Incidence Coverage-based Estimator (ICE), provided 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 et al. in 2010. Annual averages (± std dev) for semi-permanent plot data, including road and water cover, were calculated from plot estimates for both the upland tallgrass prairie and riparian habitats. In 2001 and 2002, averages (± std dev) for horizontal vegetation cover between 0–0.50 m, 0.5–1.0 m, 1.0–1.50 m, and 1.5–2.00 m were calculated by habitat type; between 2004 and 2007, averages (± std dev) for horizontal vegetation cover between 0–0.50 m, 0.25–0.75 m, 0.5–1.0 m, 0.75–1.25 m, 1.0–1.50 m, 1.25–1.75 m, and 1.5–2.00 m were calculated by habitat type; and in 2008, 2010, 2014, and 2018, averages (± std dev) for horizontal vegetation cover between 0– 0.25 m, 0.25–0.5 m, 0.5–0.75 m, 0.75–1.0 m, 1.0–1.25 m, 1.25–1.5 m, 1.5–1.75 m, and 1.75–2.0 m were calculated by habitat type. Average (± std dev) annual vertical structure diversity was estimated and reported by habitat type as well and was calculated as

$$Structural\ Diversity\ Index = \frac{((\sum p_i / 8) + a) \cdot 100}{2}$$

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 structure diversity values are weighted equally to represent both the vertical height of vegetation and how dense the vegetation is within each height increment.

Within each plot, ground cover, including deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm DBH), and unvegetated, were averaged (+ std dev) across plots within habitat types. Foliar cover by guild (warm-season and cool-season grasses, forbs, mosses and lichens, shrubs and vines, and tree seedlings) and total foliar cover (<1.5 m tall) were also averaged (± std dev) across plots within habitat types. Trees in the riparian habitat were identified to family and summed by size class.

Results

Bird Surveys

Between 2001 and 2018, 54 to 260 plots at Tallgrass Prairie National Preserve were surveyed annually for breeding birds (Table 1), excluding 2003 when no plots were sampled. During this period, 2,089 plot visits were made, and 119 different bird species were recorded, 96 of which have the potential to breed within the preserve (Table 2; Thompson et al. 2011). However, six breeding species—Blue-winged Teal (*Anas discors*), Burrowing Owl (*Athene cunicularia*), Eurasian Collared-dove (*Streptopelia decaocto*), Great Egret (*Ardea alba*), Green Heron (*Butorides virescens*), and Pileated Woodpecker (*Dryocopus pileatus*)—were only observed outside 5-min survey periods. One winter resident, Song Sparrow (*Melospiza melodia*), and three migrants, Semipalmated Sandpiper (*Calidris pusilla*), Sora (*Porzana carolina*), and White-faced Ibis (*Plegadis chihi*), were also recorded outside 5-min survey periods.

Table 2. Bird species recorded during breeding bird surveys at Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018 (excluding 2003). The American Ornithologists' Union Code (AOU code) and residency status of each species is given. Species names are valid and verified names taken from the Integrated Taxonomic Information System website (ITIS 2018, accessed 10 December 2018).

Common Name	Species Name	AOU Code	Residency[A]
Acadian Flycatcher[B]	***Empidonax virescens***	**ACFL**	**M**
American Coot	*Fulica americana*	AMCO	R
American Crow	*Corvus brachyrhynchos*	AMCR	R
American Goldfinch	*Spinus tristis*	AMGO	R
American Robin	*Turdus migratorius*	AMRO	R
American Tree Sparrow	*Spizelloides arborea*	ATSP	WR
Bald Eagle[B]	**Haliaeetus leucocephalus**	**BAEA**	**WR**
Baltimore Oriole	*Icterus galbula*	BAOR	SR
Bank Swallow	*Riparia riparia*	BANS	SR
Barn Swallow	*Hirundo rustica*	BARS	SR
Barred Owl	*Strix varia*	BDOW	R
Bell's Vireo[B]	**Vireo bellii**	**BEVI**	**SR**
Belted Kingfisher	*Megaceryle alcyon*	BEKI	R
Bewick's Wren[B]	***Thryomanes bewickii***	**BEWR**	**SR**
Black-billed Cuckoo[B]	***Coccyzus erythropthalmus***	**BBCU**	**SR**
Black-capped Chickadee	*Poecile atricapillus*	BCCH	R
Blue Jay	*Cyanocitta cristata*	BLJA	R
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	SR
Blue Grosbeak	*Passerina caerulea*	BLGR	SR
Blue-winged Teal[C]	*Anas discors*	BWTE	SR
Bobolink	*Dolichonyx oryzivorus*	BOBO	M
Brown Creeper	*Certhia americana*	BRCR	WR
Brown-headed Cowbird	*Molothrus ater*	BHCO	R

[A] Residency: M = late migrant or transient; SR = summer resident; R = year-round resident; WR = winter resident (according to Thompson et al., 2011).

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

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

Table 2 (continued). Bird species recorded during breeding bird surveys at Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018 (excluding 2003). The American Ornithologists' Union Code (AOU code) and residency status of each species is given. Species names are valid and verified names taken from the Integrated Taxonomic Information System website (ITIS 2018, accessed 10 December 2018).

Common Name	Species Name	AOU Code	Residency[A]
Brown Thrasher	*Toxostoma rufum*	BRTH	SR
Buff-breasted Sandpiper[B]	***Tryngites subruficollis***	**BBSA**	**M**
Burrowing Owl[C]	*Athene cunicularia*	BUOW	SR
Canada Goose	*Branta canadensis*	CAGO	R
Carolina Chickadee	*Poecile carolinensis*	CACH	M
Carolina Wren	*Thryothorus ludovicianus*	CARW	R
Cattle Egret	*Bubulcus ibis*	CAEG	SR
Cedar Waxwing	*Bombycilla cedrorum*	CEDW	R
Chipping Sparrow	*Spizella passerina*	CHSP	SR
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	SR
Common Grackle	*Quiscalus quiscula*	COGR	R
Common Nighthawk	*Chordeiles minor*	CONI	SR
Common Yellowthroat	*Geothlypis trichas*	COYE	SR
Dickcissel[B]	***Spiza americana***	**DICK**	**SR**
Downy Woodpecker	*Picoides pubescens*	DOWO	R
Eastern Bluebird	*Sialia sialis*	EABL	R
Eastern Kingbird	*Tyrannus tyrannus*	EAKI	SR
Eastern Meadowlark	*Sturnella magna*	EAME	R
Eastern Phoebe	*Sayornis phoebe*	EAPH	SR
Eastern Towhee	*Pipilo erythrophthalmus*	EATO	SR
Eastern Wood-pewee	*Contopus virens*	EAWP	SR
Eurasian Collared-dove[C]	*Streptopelia decaocto*	ECDO	R
Field Sparrow[B]	***Spizella pusilla***	**FISP**	**R**
Grasshopper Sparrow[B]	***Ammodramus savannarum***	**GRSP**	**SR**
Gray Catbird	*Dumetella carolinensis*	GRCA	SR
Great Blue Heron	*Ardea herodias*	GBHE	R
Great Crested Flycatcher	*Myiarchus crinitus*	GCFL	SR
Great Egret[C]	*Ardea alba*	GREG	SR
Great Horned Owl	*Bubo virginianus*	GHOW	R
Greater Prairie-chicken	*Tympanuchus cupido*	GPCH	R
Great-tailed Grackle	*Quiscalus mexicanus*	GTGR	R
Green Heron[C]	*Butorides virescens*	GRHE	SR
Golden-winged Warbler	*Vermivora chrysoptera*	GWWA	M
Hairy Woodpecker	*Picoides villosus*	HAWO	R

[A] Residency: M = late migrant or transient; SR = summer resident; R = year-round resident; WR = winter resident (according to Thompson et al., 2011).

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

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

Table 2 (continued). Bird species recorded during breeding bird surveys at Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018 (excluding 2003). The American Ornithologists' Union Code (AOU code) and residency status of each species is given. Species names are valid and verified names taken from the Integrated Taxonomic Information System website (ITIS 2018, accessed 10 December 2018).

Common Name	Species Name	AOU Code	Residency[A]
Henslow's Sparrow[B]	***Ammodramus henslowii***	**HESP**	**SR**
Horned Lark	*Eremophila alpestris*	HOLA	R
House Finch	*Haemorhous mexicanus*	HOFI	R
House Wren	*Troglodytes aedon*	HOWR	SR
Indigo Bunting	*Passerina cyanea*	INBU	SR
Kentucky Warbler[B]	***Geothlypis formosa***	**KEWA**	**SR**
Killdeer	*Charadrius vociferus*	KILL	SR
Lark Sparrow	*Chondestes grammacus*	LASP	SR
Loggerhead Shrike[B]	***Lanius ludovicianus***	**LOSH**	**R**
Louisiana Waterthrush	*Parkesia motacilla*	LOWA	SR
Mallard	*Anas platyrhynchos*	MALL	R
Mourning Dove	*Zenaida macroura*	MODO	R
Northern Bobwhite	*Colinus virginianus*	NOBO	R
Northern Cardinal	*Cardinalis cardinalis*	NOCA	R
Northern Flicker[B]	***Colaptes auratus***	**YSFL**	**R**
Northern Harrier	*Circus cyaneus*	NOHA	R
Northern Mockingbird	*Mimus polyglottos*	NOMO	R
Northern Parula	*Parula americana*	NOPA	SR
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	SR
Northern Waterthrush	*Parkesia noveboracensis*	NOWA	M
Orchard Oriole	*Icterus spurius*	OROR	SR
Palm Warbler	*Setophaga palmarum*	PAWA	M
Pied-billed grebe[B]	***Podilymbus podiceps***	**PBGR**	**M**
Pileated Woodpecker[C]	*Dryocopus pileatus*	PIWO	R
Prairie Warbler	*Setophaga discolor*	PRAW	M
Prothonotary Warbler[B]	**Protonotaria citrea**	**PROW**	**SR**
Purple Martin	*Progne subis*	PUMA	SR
Red-bellied Woodpecker	*Melanerpes carolinus*	RBWO	R
Red-eyed Vireo	*Vireo olivaceus*	REVI	SR
Red-headed Woodpecker[B]	***Melanerpes erythrocephalus***	**RHWO**	**R**
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	R
Red-winged Blackbird	*Agelaius phoeniceus*	RWBL	R
Ring-necked Pheasant	*Phasianus colchicus*	RPHE	R
Ruby-throated Hummingbird	*Archilochus colubris*	RTHU	SR

[A] Residency: M = late migrant or transient; SR = summer resident; R = year-round resident; WR = winter resident (according to Thompson et al., 2011).

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

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

Table 2 (continued). Bird species recorded during breeding bird surveys at Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018 (excluding 2003). 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 2018, accessed 10 December 2018).

Common Name	Species Name	AOU Code	Residency[A]
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	M
Scarlet Tanager	*Piranga olivacea*	SCTA	SR
Scissor-tailed Flycatcher	*Tyrannus forficatus*	STFL	SR
Semipalmated Sandpiper[C]	*Calidris pusilla*	SESA	M
Sedge Wren	*Cistothorus platensis*	SEWR	M
Song Sparrow[C]	*Melospiza melodia*	SOSP	WR
Sora[C]	*Porzana carolina*	SORA	M
Solitary Sandpiper	*Tringa solitaria*	SOSA	M
Spotted Sandpiper	*Actitis macularius*	SPSA	SR
Summer Tanager	*Piranga rubra*	SUTA	SR
Tufted Titmouse	*Baeolophus bicolor*	TUTI	R
Turkey Vulture	*Cathartes aura*	TUVU	SR
Upland Sandpiper[B]	***Bartramia longicauda***	**UPSA**	**SR**
Veery	*Catharus fuscescens*	VEER	M
Vesper Sparrow	*Pooecetes gramineus*	VESP	M
Warbling Vireo	*Vireo gilvus*	WAVI	SR
Western Kingbird	*Tyrannus verticalis*	WEKI	SR
Western Meadowlark	*Sturnella neglecta*	WEME	R
White-breasted Nuthatch	*Sitta carolinensis*	WBNU	R
White-eyed Vireo	*Vireo griseus*	WEVI	M
White-faced Ibis[C]	*Plegadis chihi*	WFIB	M
Wild Turkey	*Meleagris gallopavo*	WITU	R
Wood Duck	*Aix sponsa*	WODU	SR
Yellow-bellied Sapsucker	*Sphyrapicus varius*	YBSA	WR
Yellow-billed Cuckoo	*Coccyzus americanus*	YBCU	SR
Yellow-breasted Chat	*Icteria virens*	YBCH	SR
Yellow-throated Vireo	*Vireo flavifrons*	YTVI	SR
Yellow Warbler	*Steophaga petechia*	YEWA	SR

[A] Residency: M = late migrant or transient; SR = summer resident; R = year-round resident; WR = winter resident (according to Thompson et al., 2011).

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

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

Thirteen breeding species—Bell's Vireo (*Vireo bellii*), Bewick's Wren (*Thryomanes bewickii*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Dickcissel (*Spiza americana*), Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Ammodramus henslowii*), Kentucky Warbler (*Geothlypis formosa*), Loggerhead Shrike (*Lanius ludovicianus*), Northern Flicker (*Colaptes auratus*), Prothonotary Warbler (*Protonotaria citrea*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), and Upland Sandpiper (*Bartramia longicauda*)—are considered species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region, the region in which Tallgrass Prairie National Preserve is located (Table 2; USFWS 2008). Four other species of conservation concern were also observed: Acadian Flycatcher (*Empidonax virescens*), Bald Eagle (*Haliaeetus leucocephalus*), Buff-breasted Sandpiper (*Tryngites subruficollis*), and Pied-billed Grebe (*Podilymbus podiceps*). However, these species are not likely to breed within habitats found on Tallgrass Prairie National Preserve.

Nine breeding species—Dickcissel, Eastern Meadowlark (*Sturnella magna*), Grasshopper Sparrow, Greater Prairie-chicken (*Tympanuchus cupido*), Henslow's Sparrow, Horned Lark (*Eremophila alpestris*), Northern Harrier (*Circus cyaneus*), Upland Sandpiper, and Western Meadowlark (*Sturnella neglecta*)—and four migrant species—Bobolink (*Dolichonyx oryzivorus*), Savannah Sparrow (*Passerculus sandwichensis*), Sedge Wren (*Cistothorus platensis*), and Vesper Sparrow (*Pooecetes gramineus*)—are considered grassland obligates (USGS 2014).

Eighteen breeding species in upland tallgrass prairie habitat and nine in riparian habitat on Tallgrass Prairie National Preserve were observed in sufficient numbers to calculate annual abundances with some degree of confidence (Appendices B and D). Two of the 18 species in upland habitats—Dickcissel and Mourning Dove (Zenaida macroura)—have populations with significant increases over the 17 monitoring years since 2001 (Figure 3A, Appendix F). Three of the nine species in riparian habitats—Northern Cardinal (Cardinalis cardinalis), Red-bellied Woodpecker, and Tufted Titmouse—have populations with significant increases during the monitoring period (Figure 3B; Appendix F). In the upland habitat, five species—Killdeer (Charadrius vociferus), Lark Sparrow (*Chondestes grammacus*), Red-winged Blackbird (*Agelaius phoeniceus*), Upland Sandpiper, and Western Meadowlark—had populations with significant declines since our monitoring began. None of the common species in riparian habitat showed evidence of significant decline.

Northern Flicker (*Colaptes auratus*) is a species of conservation concern at Tallgrass Prairie National Preserve, Kansas. NPS

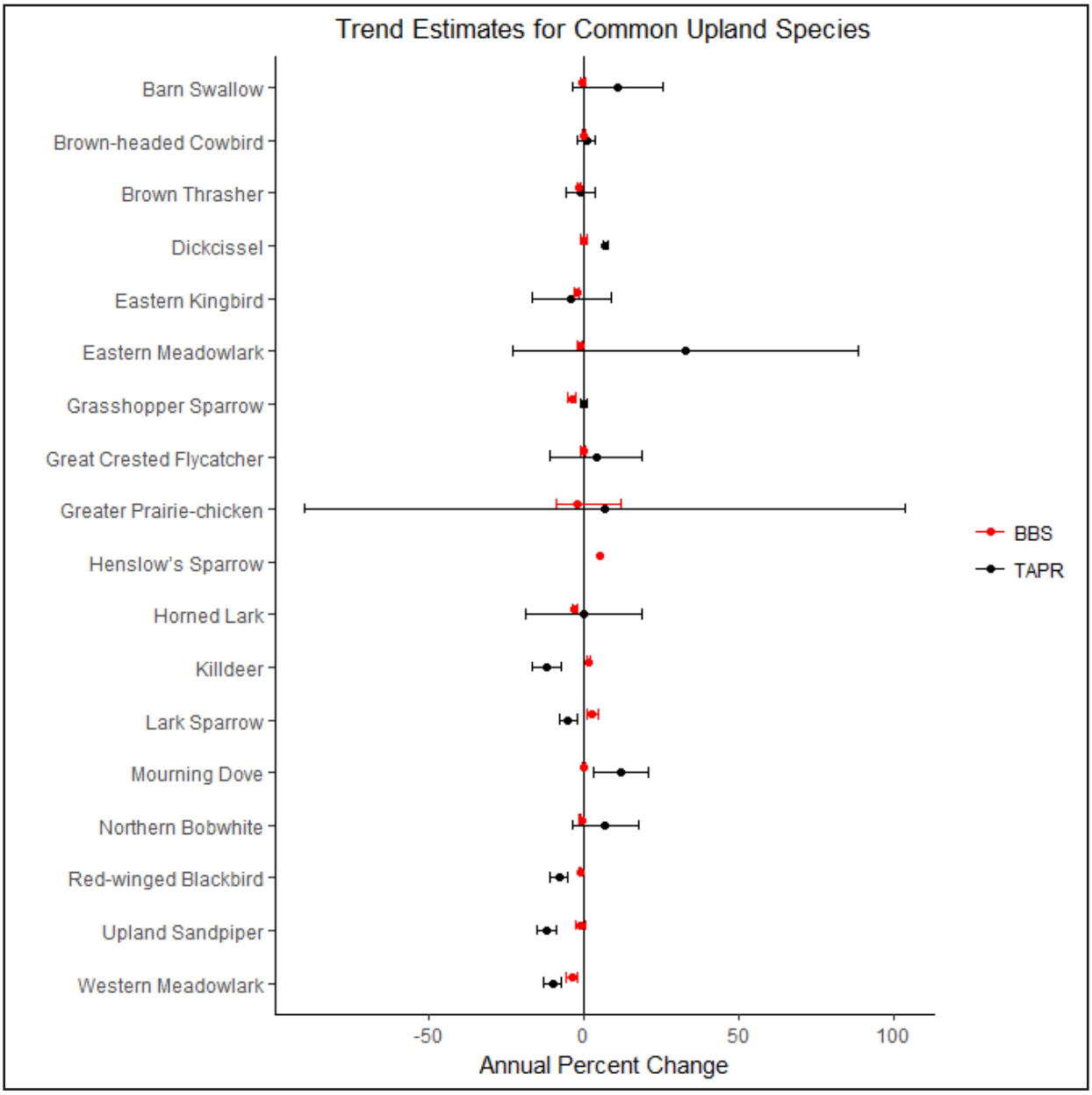


Figure 3A. Comparison of upland habitat bird population trends (2001–2018, excluding 2003) on Tallgrass Prairie National Preserve, Kansas, with those of the larger Eastern Tallgrass Prairie Bird Conservation Region (2001–2015). Error bars represent 95% confidence intervals. The Henslow's Sparrow population trend in upland habitat was not graphed due to an exceedingly large confidence interval.

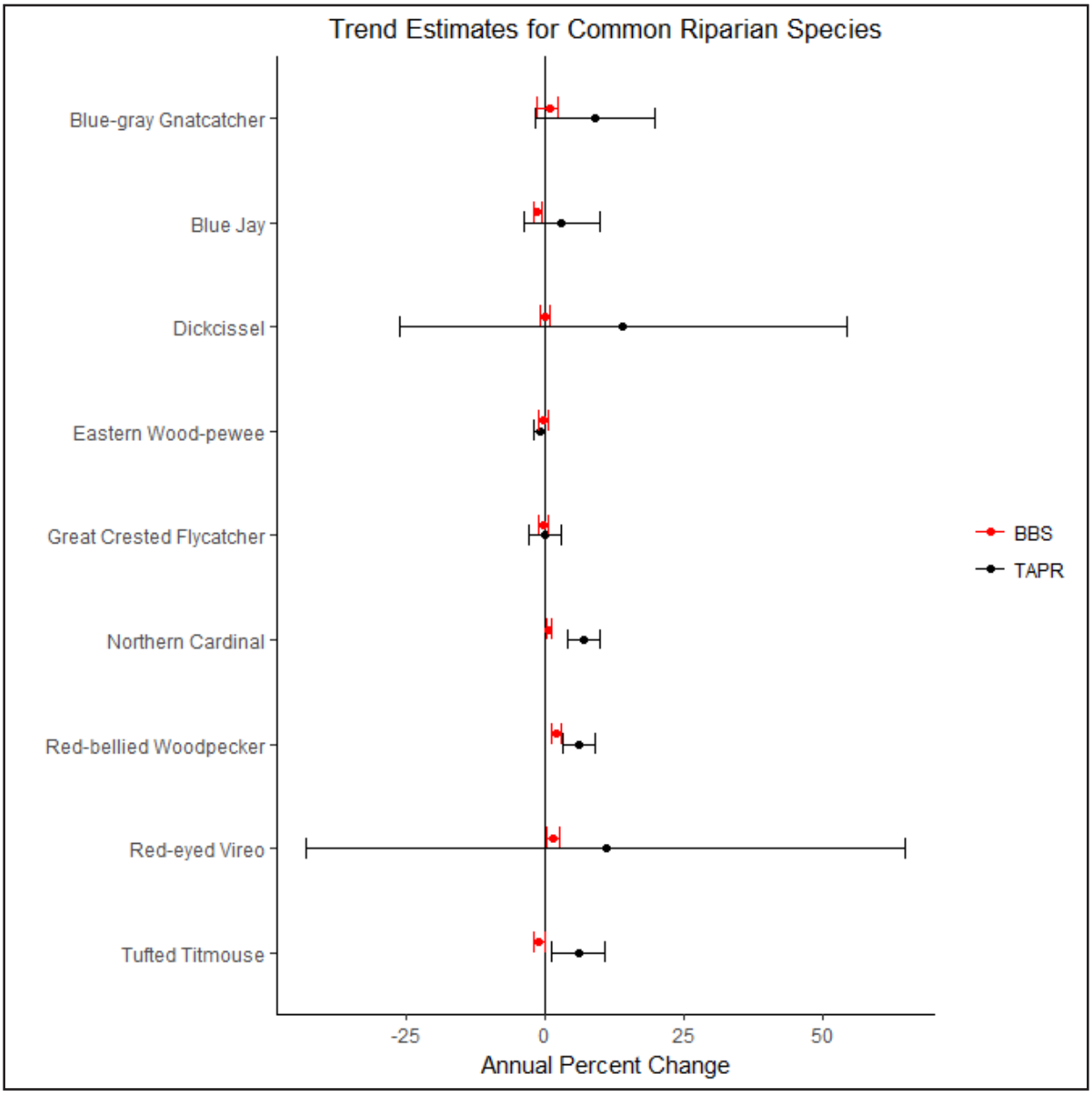


Figure 3B. Comparison of riparian habitat bird population trends (2001–2018, excluding 2003) on Tallgrass Prairie National Preserve, Kansas, with those of the larger Eastern Tallgrass Prairie Bird Conservation Region (2001–2015). Error bars represent 95% confidence intervals.

Trend results for seven common upland species—Barn Swallow (*Hirundo rustica*), Brown-headed Cowbird (*Molothrus ater*), Brown Thrasher (*Toxostoma rufum*), Great Crested Flycatcher (*Myiarchus crinitus*), Greater Prairie-chicken, Red-bellied Woodpecker, and Western Meadowlark—on Tallgrass Prairie National Preserve mirrored trends reported by Sauer et al. (2017; Appendix G) for the Eastern Tallgrass Prairie Bird Conservation Region. Five common riparian species—Blue-gray Gnatcatcher (*Polioptila caerulea*), Dickcissel, Great Crested Flycatcher, Northern Cardinal, and Red-bellied Woodpecker—also had trends that mirrored those seen in the region. Trend results for the remaining common species in both habitats were less clear; either a species population trend for Tallgrass Prairie National Preserve was positive or negative while the corresponding population trend for the Eastern Tallgrass Prairie Bird Conservation Region was opposite, or straddled zero.

For the upland tallgrass prairie habitat on Tallgrass Prairie National Preserve, diversity (P = 0.15), richness (P = 0.62), and evenness (P = 0.19) in distribution of individuals across species in the breeding bird community were unchanged over the 17 monitoring years since 2001 (Figure 4A). Likewise, diversity (P = 0.19), richness (P = 0.18), and evenness (P = 0.89) in distribution of individuals across species in the breeding bird community in the riparian habitat were unchanged (Figure 4B). Bird richness averaged 37 species annually in the upland tallgrass prairie habitat at the preserve. Average estimated species richness was 49 by the ACE estimator and 54 by the ICE estimator for this habitat. Bird richness averaged 31 species annually in riparian habitat at the preserve. Average estimated species richness was 41 by the ACE estimator and 46 by the ICE estimator for this habitat. These results should be interpreted with caution, however, as inter-annual variability in the number of plots sampled may have influenced estimation metrics.

Habitat Assessment

When sampled, habitats on the upland tallgrass prairie plots consisted primarily of the tallgrass prairie type (85–93%), with lesser amounts of other types present (Appendix H). Habitats on riparian plots consisted primarily of the riparian woodland (50–88%) and stream (10–31%) types, with lesser amounts of other types present (Appendix I).

Canopy cover averaged 66 to 89% when sampled on riparian plots, with cover provided entirely by hardwood trees. Canopy cover was minimal on grassland plots; therefore, it was not reported. Basal area of hardwood trees on riparian plots averaged between 6.38 m^2/ha and 11.22 m^2/ha when sampled, and canopy height averaged 16.81 m to 25.88 m. Hardwood tree species from 18 different families contributed to the canopy cover and basal area (Appendix J). However, most of the largest trees occurred in the Ulmaceae and Platanaceae families.

Across all upland tallgrass prairie plots, the horizontal profile height of vegetation at the time of assessment (mid-May to mid-June) was generally below 0.75 m, when sampled (Appendix H). However, it should be noted that maximum vegetation height and variability across plots increased in later years, with vegetation cover recorded in all horizontal profile height classes to 2.0 m in 2014 and 2018. In all years, the horizontal profile height of vegetation across riparian plots was recorded in all classes to 2.0 m (Appendix I). Average vertical structure diversity estimates across years ranged between 9 and 11% for upland tallgrass prairie plots, and 25 to 34% for riparian plots.

When sampled, upland tallgrass prairie plots were primarily unvegetated (59–87%) at ground level with bare soil (17–74%) exposed (Appendix H). Grass litter (7–50%) dominated areas with cover, followed by rock (3–11%), woody debris (<1%), and deciduous litter (<1%). Riparian plots were primarily unvegetated (60–90%) at ground level as well, with bare soil (14–68%) exposed and deciduous litter (15–62%) common (Appendix I). Grass litter (4–15%), woody debris (3–10%), and rock (1–5%) were present, but in lesser amounts on riparian plots.

When sampled, foliar cover on upland tallgrass prairie plots was dominated by warm-season grasses (18–53%) and forbs (8–22%), followed by cool-season-grasses (3–10%), woody shrubs and vines (1–5%), and mosses and lichens (<1–2%; Appendix H). Foliar cover on riparian plots was dominated by cool-season grasses (13–31%), forbs (6–21%), and woody shrubs and vines (3–21%), followed by tree seedlings (0–10%), warm-season grasses (<1–5%), and moss and lichens (0–3%; Appendix I). Total foliar coverage averaged 33 to 74% across upland tallgrass prairie plots, and 33 to 71% on riparian plots.

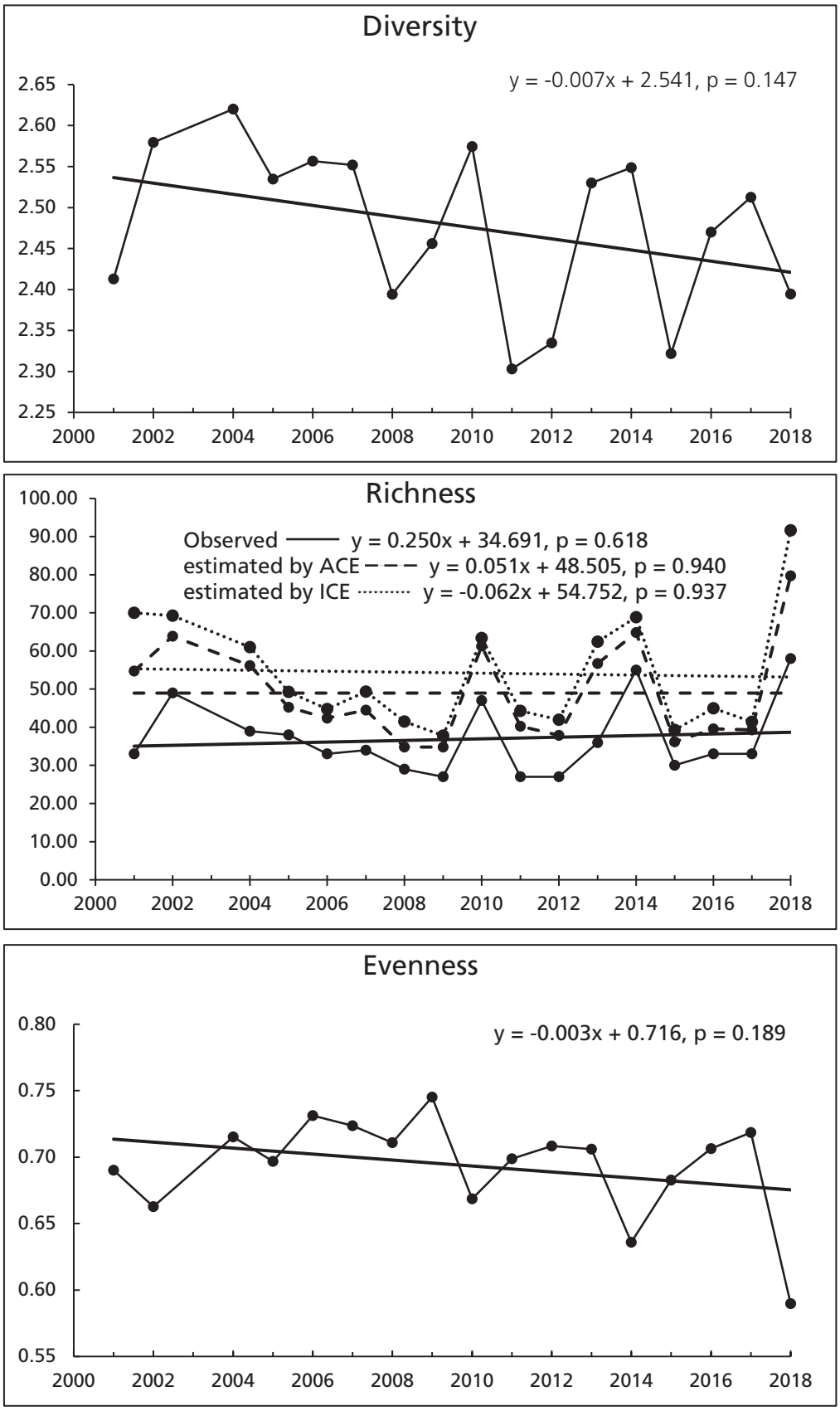


Figure 4A. Trends in upland habitat bird community diversity, richness, and species distribution evenness on Tallgrass Prairie National Preserve, Kansas (2001–2018, excluding 2003).

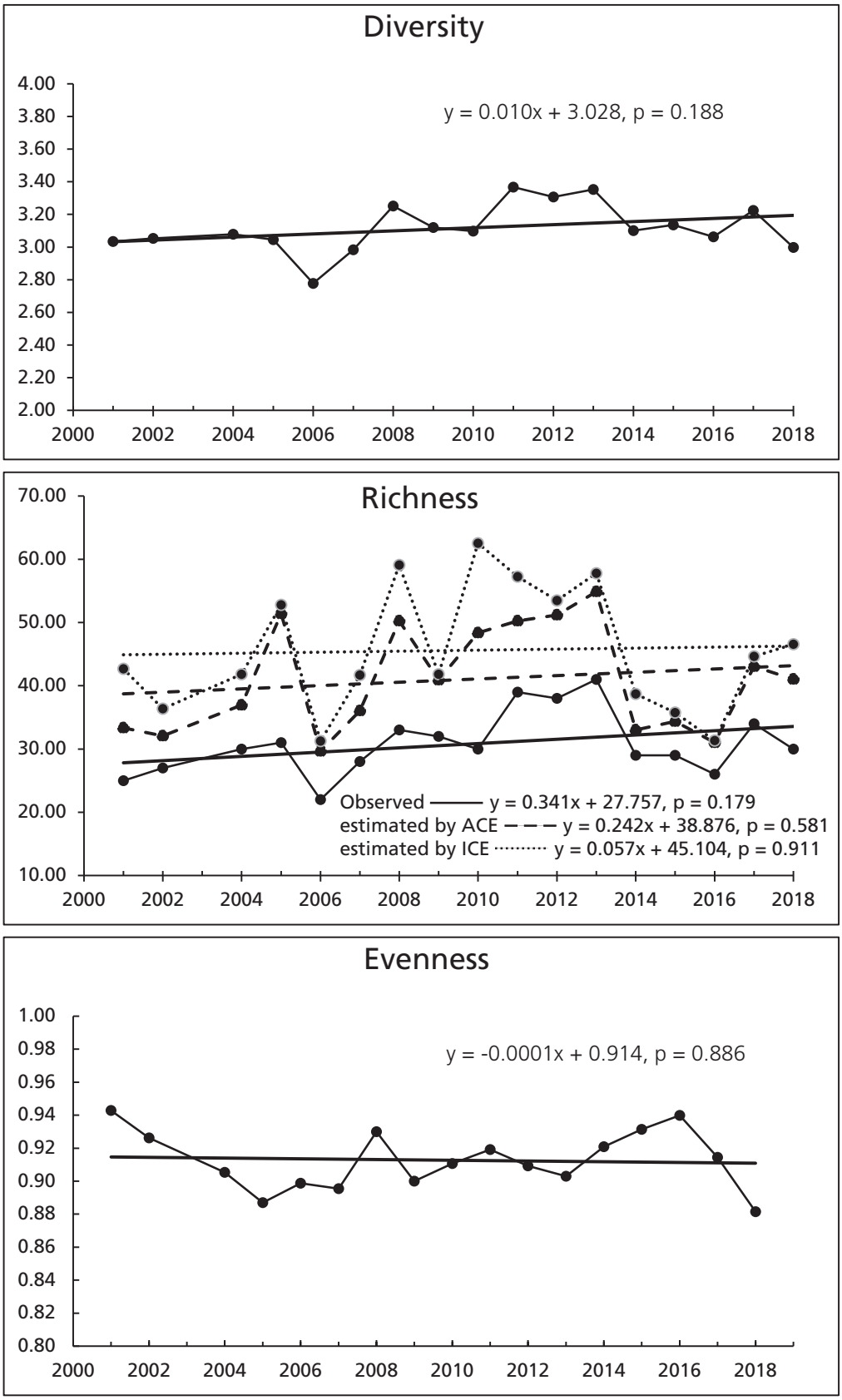


Figure 4B. Trends in riparian habitat bird community diversity, richness, and species distribution evenness on Tallgrass Prairie National Preserve, Kansas (2001–2018, excluding 2003).

Discussion

Breeding bird surveys initiated in 2001 at Tallgrass Prairie National Preserve assist the preserve in assessing the integrity of habitat through time. During the 17 monitoring years since 2001, 119 bird species were recorded. Ninety-six are permanent or summer residents to the area (Thompson et al. 2011). Therefore, these 96 species have some value in characterizing the breeding bird community of Tallgrass Prairie National Preserve and the habitat upon which they rely. These 96 species represent approximately 81% of the species one would reasonably expect to have breeding populations on the preserve (Thompson et al. 2011).

The thirteen resident species on the preserve that are species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region should be given special consideration in natural resource management decisions. Four of these species of conservation concern occur exclusively in one of the two habitat types—Henslow's Sparrow (*Ammodramus henslowii*) and Loggerhead Shrike (*Lanius ludovicianus*) in the upland tallgrass prairie, and Kentucky Warbler (*Geothlypis formosa*) and Prothonotary Warbler (*Protonotaria citrea*) in riparian habitat. Thus, the needs of these four species should be given additional management considerations in their respective habitat types. The remaining nine species of conservation concern occur in both habitats on Tallgrass Prairie National Preserve; therefore, their needs should be given management considerations in both.

The tallgrass prairie habitat makes up 94.7% of Tallgrass Prairie National Preserve (Peitz and Rowell 2003), so managing this habitat for the nine breeding grassland obligate bird species is of high importance. By doing so, management would also benefit four migrant grassland obligates recorded on the preserve, as well as a host of other grassland species, including the Eastern Kingbird (*Tyrannus tyrannus*), Northern Bobwhite (*Colinus virginianus*), and Scissor-tailed Flycatcher (*Tyrannus forficatus*).

Four grassland obligate species—Dickcissel (*Spiza americana*), Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow, and Upland Sandpiper (*Bartramia longicauda*)—were observed in sufficient numbers to calculate annual abundances and are also species of conservation concern. Therefore, these four species offer the best opportunity to track the effectiveness of management actions on conserving species in peril, and their needs should be given the highest consideration in management decisions. Positive trends in the Dickcissel population in upland tallgrass prairie habitat (Figure 3A, Appendix F) suggest current management actions favor their need for tall grass and thick grass litter, an old-field appearance (Dechant et al. 1999 [revised 2002]; Dechant et al. 2003; Hull 2003; Stokes and Stokes 1996). Negative trends in the Upland Sandpiper population suggest the opposite. The Grasshopper Sparrow has a stable population on Tallgrass Prairie National Preserve, suggesting management actions are neither positively or negatively influencing their population. The uncertain population trend of the Henslow's Sparrow is an artifact of the species rarely being observed in the early years of monitoring. Therefore, recent management actions toward more tall grasses and increased grass litter (Appendix H) appears to be favoring their habitat needs, which are similar to the Dickcissel (Stokes and Stokes 1996).

Comparing population trends on the preserve with regional trends for the Eastern Tallgrass Prairie Bird Conservation Region (Figure 3A and 3B) suggest that the bird community at Tallgrass Prairie National Preserve is faring similarly to that of the region as a whole. Killdeer (*Charadrius vociferus*) and Lark Sparrows (*Chondestes grammacus*) are the exceptions to this similarity, as both species appear to be faring slightly better in the region than in the upland tallgrass prairie habitat on the preserve. Increasing vegetation height and grass litter (Appendix H) are less favorable to these species, as they prefer short vegetation and thin grass litter (Stokes and Stokes 1996). Declines in the number of Upland Sandpipers and Western Meadowlarks (*Sturnella neglecta*) observed on the preserve are in all likelihood a result of their preference for short vegetation and thin grass litter (Stokes and Stokes 1996) as well.

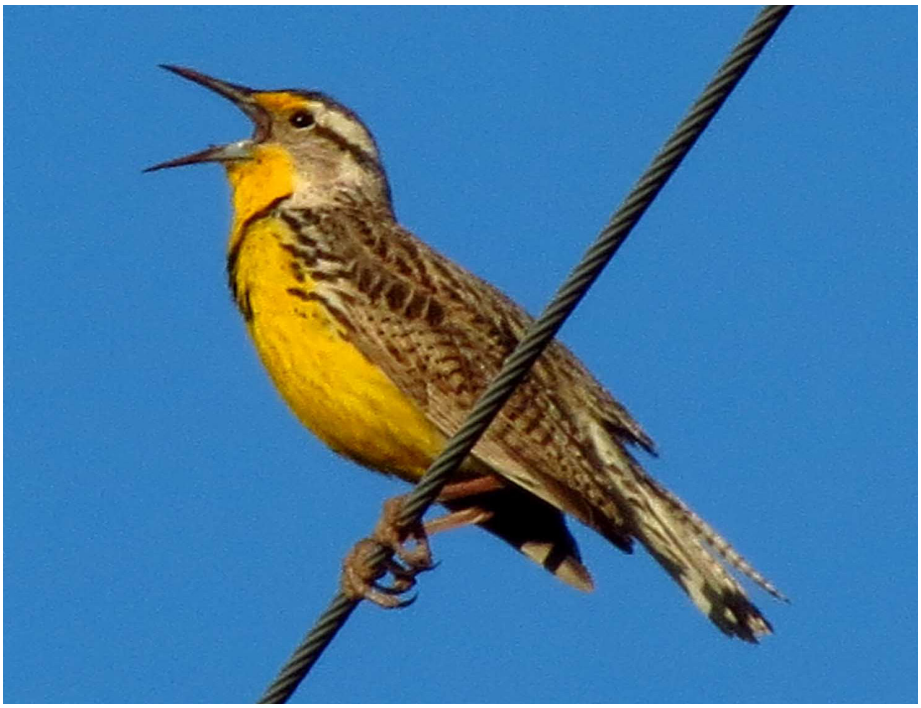
Co-occurring with the declining number of Western Meadowlarks is an increase in the number of Eastern Meadowlarks (*Sturnella magna*), likely as a result of the changing habitat. The change in management philosophies on the preserve from the early years (2001 through 2005) to the later years (2005 through 2018) helps explain the increase in Eastern

Meadowlarks and decrease in Western Meadowlarks. The number of hectares burned annually declined an average of 48%, and grazing stocking rates declined on average from one animal per 0.40 ha to one animal per 0.58 ha. Additionally, in 2009, cattle were removed from the 436-ha Windmill Pasture and replaced with 13 head of bison (*Bison bison*). By 2018, over 100 head of bison were roaming Windmill Pasture. Overall, the higher intensity management in earlier years created a habitat with shorter (Leis et al. 2013) and sparser vegetation favored by Western Meadowlarks for nesting and brood rearing (Dechant et al. 1999 [revised 2002]) and the management in later years produces taller and denser vegetation favored by Eastern Meadowlark (Granfors et al. 1996; Hull 2003).

While changes in population sizes of common and widely distributed species on the preserve may be utilized to assess changing habitat conditions, weather and climate also play a role in determining habitat and should always be considered. In spite of improving habitat structure on the preserve, declining Red-winged Blackbird (*Agelaius phoeniceus*) populations suggest that climate can override the effects of management in some cases. Drought conditions across Kansas in the mid-2010s (National Weather Service Weather Forecast Office 2014) have reduced brushy-cattail habitat along waterways and ponds on the preserve, a habitat that is utilized by the Red-winged Blackbird for roosting (Thompson et al. 2011). In the absence of suitable habitat, the number of Red-winged Blackbirds has declined significantly.

Vegetation management decisions should consider the potential impacts to bird habitat, especially for those species identified as species of conservation concern for the Eastern Tallgrass Prairie Bird Conservation Region. However, species once common to the preserve, such as the Red-winged Blackbird, may need consideration within the broader context of bird conservation when making management decisions.

Over the 17 years of bird monitoring on Tallgrass Prairie National Preserve, the unchanging diversity, richness, and evenness in distribution of individuals across species values suggests that the ability of preserve habitat to meet most species' needs has remained similar (Figure 4A and B) and provides for a rich array of breeding species (average of 37 species observed annually in upland tallgrass prairie habitat and 31 species observed annually in riparian habitat). However, this species-rich, stable community structure could be altered if significant portions of the preserve were returned to more frequent fire return intervals and more intense grazing pressure.



Western Meadowlark (*Sturnella neglecta)*. NPS/Michael Wheeler

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Appendix A. Plots Sampled

Table A1. Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR1	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR2	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR3	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR4*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR5	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR6	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR7	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR8	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR9*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR10*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR11	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR12	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR13	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR14	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR15	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR16	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR17	Yes	No	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR18	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR19	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR20	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR21	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR22	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR23	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR24	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR25*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Rocky Mixed Prairie**

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR26	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR27	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR28	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR29	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR30	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR31*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR32	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR33	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR34	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR35	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR36	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR37	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR38*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR39*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR40	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR41	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR42	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR43	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR44	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR45*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR46	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR47	Yes	Yes	Yes	No	No	No	No	NO	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR48	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR49	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR50	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR51	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR52	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR53*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR54	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR55	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR56	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR57	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR58	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR59	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR60	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR61*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR62	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR63	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR64*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR65	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR66	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR67*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR68	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR69*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR70	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR71	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR72	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR73	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR74	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR75	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR76	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR77	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR78	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR79	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR80	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR81	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR82	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR83*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR84*	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR85*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Smooth Brome**
TAPR86	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR87	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR88	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR89	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR90	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR91	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR92	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR93	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR94	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR95*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR96	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR97	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR98*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR99	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR100*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Wet Ravine Vegetation**
TAPR101	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR102	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Smooth Brome
TAPR103	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR104	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR105	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR106	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR107	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR108	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR109	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR110*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Restored Prairie**
TAPR111	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR112	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	No	Tallgrass Prairie
TAPR113*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR114*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Wet Ravine Vegetation**
TAPR115	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR116	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR117	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR118	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR119	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR120	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	No	Tallgrass Prairie
TAPR121	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR122	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR123	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR124*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR125	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR126	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR127	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR128	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR129	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR130	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR131	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR132	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR133	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR134	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR135	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR136	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR137*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR138	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR139*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Wet Ravine Vegetation**
TAPR140	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR141	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR142	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR143*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR144	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR145	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR146	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR147*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR148*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR149	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR150	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR151	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR152	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR153	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR154	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR155*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR156	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR157	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR158	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR159*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR160*	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR161*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR162*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR163*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Successional Forest**
TAPR164*	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR165*	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR166*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR167*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR168*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR169*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR170*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Successional Forest**
TAPR171*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Successional Forest**
TAPR172*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Successional Forest**
TAPR173*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR174*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Successional Forest**
TAPR175*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Successional Forest**
TAPR176*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Bur Oak Woodland**
TAPR177	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR178*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR179	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR180	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR181	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR182	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR183	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR184	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR185	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR186	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR187	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie

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Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR188	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR189	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR190*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR191*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR192	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR193	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR194	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR195	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR196	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR197	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR198	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR199	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR200	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR201	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR202	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR203	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR204	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR205	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR206	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR207	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR208	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Wet Ravine Vegetation
TAPR209*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR210	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR211	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR212	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR213	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR214	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie

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Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR215	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR216	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR217	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Smooth Brome
TAPR218	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR219*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR220*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR221	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR222	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR223	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	No	No	No	No	No	Developed Land
TAPR224	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR225	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Smooth Brome
TAPR226	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Wet Ravine Vegetation
TAPR227	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Rocky Mixed Prairie
TAPR228	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR229	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR230	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR231	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR232*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Smooth Brome**
TAPR233	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR234*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR235	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR236	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR237	No	Yes	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR238	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR239	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR240	No	Yes	N	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR241*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**

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

Table A1 (continued). Plots sampled on Tallgrass Prairie National Preserve, Kansas, between 2001 and 2018, and gross habitat type. "Yes" indicates the plot was sampled in that year; "No" indicates it was not.

Plot	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Plot Type
TAPR242	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	No	Tallgrass Prairie
TAPR243	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR244	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR245	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR246	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR247	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Restored Prairie
TAPR248	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR249	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR250	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR251	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR252	No	Yes	No	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR253*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR254	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Restored Prairie
TAPR255	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No	No	No	No	Tallgrass Prairie
TAPR256*	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Tallgrass Prairie**
TAPR257	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR258	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR259	No	Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie
TAPR260	No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Tallgrass Prairie

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

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

Table B1. Annual proportion of upland plots occupied by each breeding bird species and estimated abundance in parentheses (determined using Distance software) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) 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 annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	2002 n=242	2004 n=81	2005 n=79	2006 n=81	2007 n=71	2008 n=77	2009 n=40	2010 n=242	2011 n=40	2012 n=39	2013 n=40	2014 n=241	2015 n=40	2016 n=40	2017 n=40	2018 n=237
Barn Swallow	0.04 (–)	0.01 (–)	0.10 (–)	0.10 (–)	0.12 (30)	0.01 (–)	0.01 (–)	0.18 (103)	0.07 (34)	0.15 (–)	0.13 (316)	0.15 (47)	0.22 (53)	0.05 (54)	0.13 (364)	0.13 (193)	0.10 (–)
Brown-headed Cowbird	0.37 (137)	0.51 (210)	0.42 (100)	0.49 (162)	0.44 (154)	0.51 (192)	0.42 (183)	0.50 (78)	0.47 (152)	0.53 (239)	0.41 (274)	0.63 (111)	0.53 (217)	0.45 (127)	0.63 (394)	0.55 (177)	0.38 (106)
Brown Thrasher	0.02 (5)	0.05 (10)	0.09 (15)	0.03 (4)	0.06 (11)	0.03 (4)	0.01 (4)	0.03 (6)	0.04 (4)	0.03 (4)	0.00 (0)	0.00 (0)	0.01 (2)	0.08 (10)	0.05 (5)	0.05 (6)	0.02 (2)
Dickcissel*	**0.38 (686)**	**0.38 (661)**	**0.35 (450)**	**0.46 (552)**	**0.58 (888)**	**0.54 (675)**	**0.83 (1014)**	**0.93 (929)**	**0.56 (712)**	**0.88 (1062)**	**0.97 (1371)**	**0.98 (1038)**	**0.66 (932)**	**0.98 (1289)**	**0.80 (868)**	**0.93 (1289)**	**0.98 (1421)**
Eastern Kingbird	0.02 (8)	0.04 (49)	0.06 (48)	0.05 (51)	0.09 (65)	0.10 (99)	0.01 (9)	0.08 (48)	0.01 (11)	0.00 (0)	0.03 (20)	0.05 (29)	0.04 (3)6	0.05 (17)	0.03 (14)	0.05 (30)	0.04 (22)
Eastern Meadowlark	0.18 (139)	0.02 (4)	0.01 (4)	0.00 (0)	0.00 (0)	0.01 (10)	0.43 (192)	0.90 (357)	0.75 (463)	0.93 (440)	0.85 (402)	0.98 (485)	0.81 (501)	0.90 (355)	0.90 (504)	0.85 (360)	0.81 (361)
Grasshopper Sparrow*	**0.65 (4185)**	**0.60 (2760)**	**0.73 (2615)**	**0.70 (2624)**	**0.62 (2243)**	**0.68 (2747)**	**0.75 (2820)**	**0.70 (1951)**	**0.66 (2426)**	**0.33 (1100)**	**0.23 (691)**	**0.78 (2229)**	**0.63 (2507)**	**0.80 (2501)**	**0.60 (1675)**	**0.55 (1391)**	**0.69 (2038)**
Great Crested Flycatcher	0.00 (0)	0.03 (2)	0.14 (15)	0.06 (7)	0.04 (4)	0.07 (6)	0.04 (4)	0.00 (0)	0.03 (3)	0.03 (3)	0.00 (0)	0.03 (2)	0.04 (5)	0.05 (5)	0.15 (12)	0.05 (4)	0.07 (7)
Greater Prairie-chicken	0.01 (27)	0.02 (9)	0.01 (11)	0.00 (0)	0.01 (–)	0.00 (0)	0.01 (10)	0.00 (0)	0.05 (51)	0.00 (0)	0.05 (22)	0.00 (0)	0.04 (25)	0.03 (–)	0.03 (16)	0.00 (0)	0.01 (9)
Henslow's Sparrow*	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.01 (42)**	**0.01 (25)**	**0.09 (299)**	**0.10 (146)**	**0.08 (225)**	**0.23 (882)**	**0.05 (45)**	**0.10 (132)**	**<0.01 (7)**	**0.10 (190)**	**0.30 (516)**	**0.38 (718)**	**0.30 (633)**
Horned Lark	0.02 (33)	0.00 (0)	0.28 (281)	0.11 (121)	0.12 (122)	0.06 (29)	0.00 (0)	0.03 (21)	0.04 (42)	0.00 (0)	0.00 (0)	0.03 (19)	0.02 (17)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (58)
Killdeer	0.06 (18)	0.10 (42)	0.17 (86)	0.25 (137)	0.23 (114)	0.11 (49)	0.09 (21)	0.05 (18)	0.06 (20)	0.05 (24)	0.03 (22)	0.05 (16)	0.04 (26)	0.03 (–)	0.08 (16)	0.03 (–)	0.04 (12)

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

Table B1 (continued). Annual proportion of upland plots occupied by each breeding bird species and estimated abundance in parentheses (determined using Distance software) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) 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 annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	**2002 n=242**	**2004 n=81**	**2005 n=79**	**2006 n=81**	**2007 n=71**	**2008 n=77**	**2009 n=40**	**2010 n=242**	**2011 n=40**	**2012 n=39**	**2013 n=40**	**2014 n=241**	**2015 n=40**	**2016 n=40**	**2017 n=40**	**2018 n=237**
Lark Sparrow	0.01 (22)	0.07 (220)	0.04 (179)	0.08 (108)	0.02 (25)	0.11 (264)	0.08 (150)	0.00 (0)	0.02 (38)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (166)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (109)
Mourning Dove	0.07 (9)	0.05 (32)	0.01 (11)	0.01 (–)	0.02 (10)	0.04 (37)	0.08 (31)	0.10 (36)	0.05 (23)	0.03 (–)	0.15 (131)	0.25 (96)	0.08 (47)	0.18 (92)	0.25 (172)	0.23 (149)	0.09 (45)
Northern Bobwhite	0.00 (0)	0.04 (0)	0.04 (2)	0.10 (5)	0.14 (6)	0.08 (4)	0.05 (5)	0.28 (15)	0.05 (3)	0.20 (6)	0.36 (8)	0.15 (7)	0.05 (3)	0.13 (6)	0.10 (5)	0.18 (10)	0.14 (10)
Red-winged Blackbird	0.06 (49)	0.15 (70)	0.26 (66)	0.20 (63)	0.25 (72)	0.20 (72)	0.13 (26)	0.25 (40)	0.16 (50)	0.18 (54)	0.21 (61)	0.28 (41)	0.07 (20)	0.08 (10)	0.15 (40)	0.15 (37)	0.14 (39)
Upland Sandpiper*	**0.27 (109)**	**0.62 (85)**	**0.75 (17)**	**0.57 (17)**	**0.60 (5)**	**0.46 (25)**	**0.39 (38)**	**0.48 (55)**	**0.26 (10)**	**0.43 (136)**	**0.41 (90)**	**0.23 (58)**	**0.18 (36)**	**0.28 (10)**	**0.20 (8)**	**0.13 (52)**	**0.12 (5)**
Western Meadowlark	0.23 (110)	0.72 (275)	0.88 (368)	0.85 (478)	0.89 (388)	0.83 (267)	0.42 (164)	0.00 (0)	0.03 (11)	0.00 (0)	0.00 (0)	0.03 (–)	<0.01 (1)	0.00 (0)	0.03 (5)	0.00 (0)	0.00 (0)

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

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

Table C1. Annual proportion of upland plots occupied by each breeding bird species and estimated abundance (determined using birds within 200-m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when annual abundance value could not be calculated because the species was present, but outside of 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	2002 n=242	2004 n=81	2005 n=79	2006 n=81	2007 n=71	2008 n=77	2009 n=40	2010 n=242	2011 n=40	2012 n=39	2013 n=40	2014 n=241	2015 n=40	2016 n=40	2017 n=40	2018 n=237
American Coot	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)
American Crow	0.00 (0)	0.06 (–)	0.06 (–)	0.01 (–)	0.05 (–)	0.04 (–)	0.00 (0)	0.05 (–)	<0.01 (–)	0.10 (–)	0.05 (9)	0.10 (8)	0.02 (–)	0.13 (–)	0.10 (–)	0.13 (17)	<0.01 (–)
American Goldfinch	0.00 (0)	<0.01 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)	0.00 (0)	0.00 (0)	0.03 (8)	0.03 (18)	0.03 (–)	0.05 (8)	0.00 (0)	0.01 (–)
American Robin	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)
Baltimore Oriole	0.00 (0)	0.00 (0)	0.00 (0)	0.04 (8)	0.02 (4)	0.06 (23)	0.06 (22)	0.03 (8)	0.01 (5)	0.03 (8)	0.00 (0)	0.03 (8)	0.01 (4)	0.05 (8)	0.00 (0)	0.00 (0)	0.04 (10)
Bank Swallow	0.01 (–)	0.05 (–)	0.05 (–)	0.04 (–)	0.02 (–)	0.00 (0)	0.05 (–)	0.00 (0)	0.06 (–)	0.08 (–)	0.03 (9)	0.10 (–)	0.05 (3)	0.03 (–)	0.05 (–)	0.00 (0)	<0.01 (–)
Bell's Vireo*	**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)**	**0.02 (4)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.02 (8)**
Bewick's Wren*	**0.00 (0)**	**0.01 (4)**	**0.01 (4)**	**0.01 (4)**	**0.00 (0)**	**0.01 (5)**	**0.01 (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)**	**0.00 (0)**	**0.00 (0)**
Black-billed Cuckoo*	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.01 (–)**	**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)**
Black-capped Chickadee	0.00 (0)	0.01 (3)	0.01 (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)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Blue-gray Gnatcatcher	0.01 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (4)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)
Blue Grosbeak	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)

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

Table C1 (continued). Annual proportion of upland plots occupied by each breeding bird species and estimated abundance (determined using birds within 200-m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when annual abundance value could not be calculated because the species was present, but outside of 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	2002 n=242	2004 n=81	2005 n=79	2006 n=81	2007 n=71	2008 n=77	2009 n=40	2010 n=242	2011 n=40	2012 n=39	2013 n=40	2014 n=241	2015 n=40	2016 n=40	2017 n=40	2018 n=237
Blue Jay	0.01 (–)	0.04 (–)	0.02 (4)	0.05 (–)	0.06 (–)	0.06 (9)	0.00 (0)	0.05 (–)	<0.01 (–)	0.05 (17)	0.00 (0)	0.10 (17)	0.02 (1)	0.00 (0)	0.03 (–)	0.05 (8)	0.01 (–)
Canada Goose	0.00 (0)	0.01 (–)	0.06 (–)	0.01 (–)	0.06 (–)	0.01 (–)	0.01 (–)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.03 (–)	0.01 (–)
Carolina Wren	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)	0.03 (–)	0.00 (0)	0.03 (8)	0.01 (3)
Cattle Egret	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Chipping 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)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (43)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Cliff Swallow	0.08 (–)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (–)	0.00 (0)	0.03 (–)	0.02 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (–)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)
Common Grackle	0.01 (–)	0.00 (0)	0.01 (4)	0.01 (–)	0.01 (8)	0.00 (00	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)
Common Nighthawk	0.11 (6)	0.19 (4)	0.04 (–)	0.32 (–)	0.14 (–)	0.17 (–)	0.09 (4)	0.10 (8)	0.09 (3)	0.03 (–)	0.21 (26)	0.05 (8)	0.05 (1)	0.05 (8)	0.08 (17)	0.05 (–)	0.08 (1)
Common Yellowthroat	0.00 (0)	<0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (7)	0.00 (0)	0.03 (–)	0.00 (0)	0.04 (14)
Downy Woodpecker	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Eastern Bluebird	0.01 (2)	0.00 (0)	0.00 (0)	0.03 (13)	0.00 (0)	0.01 (5)	0.01 (17)	0.03 (8)	<0.01 (1)	0.00 (0)	0.03 (9)	0.03 (8)	0.03 (14)	0.00 (0)	0.05 (25)	0.03 (17)	<0.01 (1)
Eastern Phoebe	0.00 (0)	<0.01 (1)	0.02 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (00	0.03 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Eastern Towhee	0.01 (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)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Eastern Wood-pewee	0.00 (0)	0.01 (1)	0.00 (0)	0.01 (4)	0.00 (0)	0.00 (0)	0.01 (4)	0.00 (0)	0.01 (4)	0.00 (0)	0.00 (0)	0.03 (8)	0.01 (3)	0.00 (0)	0.03 (8)	0.00 (0)	0.02 (6)

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

Table C1 (continued). Annual proportion of upland plots occupied by each breeding bird species and estimated abundance (determined using birds within 200-m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when annual abundance value could not be calculated because the species was present, but outside of 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	2002 n=242	2004 n=81	2005 n=79	2006 n=81	2007 n=71	2008 n=77	2009 n=40	2010 n=242	2011 n=40	2012 n=39	2013 n=40	2014 n=241	2015 n=40	2016 n=40	2017 n=40	2018 n=237
Field Sparrow*	**0.00 (0)**	**<0.01 (1)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.01 (10**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.02 (6)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.01 (3)**
Great Blue Heron	0.01 (–)	<0.01 (–)	0.01 (–)	0.04 (–)	0.04 (–)	0.01 (–)	0.03 (4)	0.08 (8)	0.02 (3)	0.00 (0)	0.03 (9)	0.00 (0)	0.02 (4)	0.00 (0)	0.03 (–)	0.03 (–)	0.02 (–)
Great Horned Owl	0.00 (0)	<0.01 (–)	0.00 (0)	0.00 (00	0.00 (00	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)
Great-tailed Grackle	0.01 (–)	0.00 (0)	0.01 (8)	0.01 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Hairy Woodpecker	0.01 (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)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Indigo Bunting	0.00 (0)	<0.01 (1)	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)	<0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Loggerhead Shrike*	**0.00 (0)**	**<0.01 (1)**	**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)**	**0.01 (5)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Louisiana Waterthrush	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)
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)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Northern Cardinal	0.00 (0)	0.05 (8)	0.01 (–)	0.03 (8)	0.01 (4)	0.03 (9)	0.00 (0)	0.00 (0)	<0.01 (1)	0.03 (8)	0.05 (–)	0.08 (25)	0.02 (8)	0.03 (8)	0.08 (8)	0.05 (17)	0.02 (6)
Northern Flicker*	**0.00 (0)**	**<0.01 (–)**	**0.01 (–)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.03 (8)**	**0.00 (0)**	**0.03 (–)**	**0.05 (17)**	**0.03 (8)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**<0.01 (–)**
Northern Harrier	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (–)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	<0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Northern Mockingbird	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (–)	0.01 (–)	0.01 (5)	0.00 (0)	0.05 (8)	<0.01 (10)	0.03 (8)	0.00 (0)	0.03 (8)	0.02 (4)	0.00 (0)	0.00 (0)	0.03 (–)	0.01 (1)
Northern Parula	0.00 (0)	0.00 (0)	0.01 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)	0.03 (8)	0.00 (0)	0.00 (0)	<0.01 (1)

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

Table C1 (continued). Annual proportion of upland plots occupied by each breeding bird species and estimated abundance (determined using birds within 200-m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when annual abundance value could not be calculated because the species was present, but outside of 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	2002 n=242	2004 n=81	2005 n=79	2006 n=81	2007 n=71	2008 n=77	2009 n=40	2010 n=242	2011 n=40	2012 n=39	2013 n=40	2014 n=241	2015 n=40	2016 n=40	2017 n=40	2018 n=237
Northern Rough-winged Swallow	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (33)	0.01 (–)
Orchard Oriole	0.01 (2)	0.01 (3)	0.00 (0)	0.00 (0)	0.06 (20)	0.00 (0)	0.01 (4)	0.00 (0)	0.04 (14)	0.03 (8)	0.05 (17)	0.05 (–)	0.02 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (10)
Purple Martin	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)
Red-bellied Woodpecker	0.01 (2)	0.03 (7)	0.02 (4)	0.03 (4)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (9)	0.05 (8)	0.01 (3)	0.00 (0)	0.05 (17)	0.05 (8)	0.02 (7)
Red-eyed Vireo	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 (8)	0.01 (3)	0.00 (0)	0.00 (0)	0.03 (8)	<0.01 (1)
Red-headed Woodpecker*	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.03 (13)**	**0.04 (8)**	**0.00 (0)**	**0.00 (0)**	**0.03 (–)**	**<0.01 (1)**	**0.00 (0)**	**0.00 (0)**	**0.03 (–)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**<0.01 (3)**
Red-tailed Hawk	0.00 (0)	0.00 (0)	0.01 (4)	0.01 (–)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (8)	0.03 (9)	0.00 (0)	0.01 (4)	0.00 (0)	0.08 (–)	0.05 (–)	<0.01 (–)
Ring-necked Pheasant	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)	0.03 (–)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Scarlet Tanager	0.00 (0)	<0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Scissor-tailed Flycatcher	0.00 (0)	0.01 (–)	0.04 (16)	0.03 (8)	0.05 (12)	0.04 (23)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (3)
Spotted Sandpiper	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (26)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Summer Tanager	0.00 (0)	0.01 (4)	0.00 (0)	0.03 (4)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)	0.03 (8)	0.00 (0)	0.03 (8)	<0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)
Tufted Titmouse	0.00 (0)	0.06 (5)	0.02 (4)	0.00 (0)	0.02 (4)	0.03 (5)	0.01 (4)	0.00 (0)	0.01 (1)	0.00 (0)	0.00 (0)	0.05 (8)	0.02 (4)	0.03 (–)	0.10 (17)	0.08 (17)	0.02 (7)
Turkey Vulture	0.01 (–)	0.01 (–)	0.01 (–)	0.01 (–)	0.04 (–)	0.01 (–)	0.03 (–)	0.13 (8)	0.05 (3)	0.05 (–)	0.08 (–)	0.18 (33)	0.03 (6)	0.08 (–)	0.03 (–)	0.20 (8)	0.01 (–)

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

Table C1 (continued). Annual proportion of upland plots occupied by each breeding bird species and estimated abundance (determined using birds within 200-m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes when annual abundance value could not be calculated because the species was present, but outside of 200 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=158	2002 n=242	2004 n=81	2005 n=79	2006 n=81	2007 n=71	2008 n=77	2009 n=40	2010 n=242	2011 n=40	2012 n=39	2013 n=40	2014 n=241	2015 n=40	2016 n=40	2017 n=40	2018 n=237
Warbling Vireo	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (–)	0.00 (0)	0.00 (0)	0.04 (16)
Western Kingbird	0.02 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (1)	0.03 (–)	0.00 (0)	0.05 (25)	0.00 (0)	0.00 (0)	0.03 (8)	0.05 (8)	0.00 (0)
White-breasted Nuthatch	0.00 (0)	0.02 (3)	0.00 (0)	0.01 (4)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.08 (17)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (17)	0.05 (17)	<0.01 (1)
Wild Turkey	0.00 (0)	<0.01 (–)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (26)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Wood Duck	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (–)	0.00 (0)	0.00 (0)	0.00 (0)	<0.01 (–)	0.03 (–)	0.00 (0)	0.00 (0)	0.01 (–)
Yellow-billed Cuckoo	0.00 (0)	0.04 (1)	0.02 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (8)	0.05 (8)	0.03 (–)	<0.01 (1)
Yellow-breasted Chat	0.00 (0)	0.02 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Yellow-throated Vireo	0.00 (0)	<0.01 (1)	0.01 (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)	0.00 (0)	<0.01 (1)	0.03 (8)	0.00 (0)	0.00 (0)	0.00 (0)
Yellow Warbler	0.01 (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)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.03 (8)	0.00 (0)	0.03 (8)	0.00 (0)

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

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

Table D1. Annual proportion of riparian plots occupied by each breeding bird species and estimated abundance (determined using Distance software) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) 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 annual abundance value could not be calculated because the species was present, but distance measures from observers could not be determined.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=18	2002 n=18	2004 n=16	2005 n=18	2006 n=18	2007 n=18	2008 n=18	2009 n=18	2010 n=18	2011 n=18	2012 n=15	2013 n=18	2014 n=18	2015 n=18	2016 n=18	2017 n=18	2018 n=18
Blue-gray Gnatcatcher	0.06 (52)	0.00 (0)	0.13 (46)	0.28 (102)	0.22 (76)	0.17 (58)	0.28 (199)	0.06 (23)	0.11 (46)	0.17 (59)	0.13 (36)	0.44 (114)	0.28 (105)	0.17 (48)	0.28 (80)	0.28 (64)	0.44 (92)
Blue Jay	0.11 (12)	0.11 (–)	0.13 (16)	0.33 (14)	0.17 (4)	0.11 (5)	0.11 (–)	0.17 (21)	0.06 (–)	0.22 (14)	0.33 (26)	0.22 (12)	0.06 (–)	0.17 (8)	0.11 (8)	0.33 (21)	0.17 (19)
Dickcissel*	**0.00 (0)**	**0.17 (30)**	**0.00 (0)**	**0.11 (7)**	**0.11 (3)**	**0.17 (11)**	**0.06 (7)**	**0.33 (29)**	**0.22 (21)**	**0.22 (16)**	**0.47 (39)**	**0.22 (16)**	**0.11 (3)**	**0.17 (9)**	**0.11 (12)**	**0.33 (23)**	**0.22 (14)**
Eastern Wood-pewee	0.33 (48)	0.56 (46)	0.44 (30)	0.72 (41)	0.78 (42)	0.72 (50)	0.22 (44)	0.72 (63)	0.56 (47)	0.67 (43)	0.47 (30)	0.61 (30)	0.50 (32)	0.44 (24)	0.50 (27)	0.33 (14)	0.78 (34)
Great Crested Flycatcher	0.22 (80)	0.22 (43)	0.75 (83)	0.56 (42)	0.61 (44)	0.44 (45)	0.17 (31)	0.22 (23)	0.28 (30)	0.11 (7)	0.33 (23)	0.33 (19)	0.50 (49)	0.44 (37)	0.39 (29)	0.33 (20)	0.72 (47)
Northern Cardinal	0.17 (25)	0.28 (40)	0.13 (22)	0.28 (25)	0.17 (9)	0.28 (23)	0.17 (48)	0.39 (44)	0.17 (22)	0.44 (28)	0.33 (31)	0.50 (34)	0.44 (42)	0.44 (31)	0.33 (23)	0.50 (34)	0.67 (47)
Red-bellied Woodpecker	0.17 (26)	0.39 (20)	0.19 (23)	0.22 (15)	0.33 (28)	0.17 (10)	0.28 (29)	0.11 (17)	0.17 (17)	0.44 (32)	0.47 (40)	0.50 (28)	0.39 (34)	0.39 (28)	0.50 (39)	0.33 (19)	0.56 (34)
Red-eyed Vireo	0.00 (0)	0.22 (63)	0.19 (21)	0.17 (18)	0.28 (34)	0.22 (23)	0.11 (24)	0.06 (7)	0.17 (21)	0.56 (40)	0.27 (22)	0.44 (34)	0.22 (21)	0.28 (24)	0.28 (24)	0.44 (31)	0.17 (14)
Tufted Titmouse	0.06 (25)	0.44 (30)	0.44 (33)	0.17 (14)	0.39 (31)	0.39 (32)	0.11 (19)	0.00 (0)	0.33 (38)	0.39 (24)	0.27 (21)	0.44 (27)	0.28 (21)	0.44 (30)	0.39 (30)	0.72 (43)	0.33 (19)

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

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

Table E1. Annual proportion of riparian plots occupied by each breeding bird species and estimated abundance (determined using birds within 125 m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes annual abundance value could not be calculated because the species was present, but outside of 125 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=18	2002 n=18	2004 n=16	2005 n=18	2006 n=18	2007 n=18	2008 n=18	2009 n=18	2010 n=18	2011 n=18	2012 n=15	2013 n=18	2014 n=18	2015 n=18	2016 n=18	2017 n=18	2018 n=18
American Crow	0.06 (–)	0.22 (–)	0.00 (0)	0.06 (–)	0.06 (–)	0.06 (–)	0.06 (–)	0.06 (–)	0.00 (0)	0.11 (5)	0.27 (9)	0.22 (3)	0.06 (8)	0.22 (3)	0.22 (5)	0.22 (–)	0.06 (–)
American Goldfinch	0.06 (11)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (3)	0.06 (5)	0.13 (6)	0.11 (8)	0.28 (18)	0.11 (5)	0.11 (5)	0.11 (3)	0.00 (0)
American Robin	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.17 (5)	0.11 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)
Baltimore Oriole	0.00 (0)	0.00 (0)	0.00 (0)	0.17 (13)	0.28 (13)	0.06 (–)	0.06 (3)	0.22 (11)	0.00 (0)	0.22 (11)	0.07 (3)	0.17 (5)	0.00 (0)	0.06 (–)	0.11 (5)	0.11 (5)	0.11 (5)
Bank Swallow	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (8)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Barn Swallow	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.13 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Barred Owl	0.06 (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)	0.11 (3)	0.13 (6)	0.00 (0)	0.06 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Bell's Vireo*	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.07 (3)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Belted Kingfisher	0.06 (–)	0.00 (0)	0.06 (3)	0.06 (–)	0.00 (0)	0.06 (–)	0.06 (3)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.06 (3)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Bewick's Wren*	**0.11 (5)**	**0.11 (3)**	**0.06 (3)**	**0.06 (3)**	**0.00 (0)**	**0.11 (5)**	**0.06 (8)**	**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)**	**0.00 (0)**
Black-billed Cuckoo*	**0.06 (–)**	**0.06 (3)**	**0.00 (0)**	**0.33 (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)**
Black-capped Chickadee	0.06 (5)	0.33 (21)	0.25 (11)	0.11 (5)	0.00 (0)	0.00 (0)	0.11 (8)	0.06 (3)	0.06 (3)	0.17 (11)	0.33 (22)	0.22 (11)	0.11 (5)	0.39 (26)	0.28 (18)	0.11 (5)	0.11 (5)

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

Table E1 (continued). Annual proportion of riparian plots occupied by each breeding bird species and estimated abundance (determined using birds within 125 m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes annual abundance value could not be calculated because the species was present, but outside of 125 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=18	2002 n=18	2004 n=16	2005 n=18	2006 n=18	2007 n=18	2008 n=18	2009 n=18	2010 n=18	2011 n=18	2012 n=15	2013 n=18	2014 n=18	2015 n=18	2016 n=18	2017 n=18	2018 n=18
Blue Grosbeak	0.00 (0)	0.00 (0)	0.13 (9)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (3)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)
Brown-headed Cowbird	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.06 (3)	0.11 (3)	0.00 (0)	0.11 (8)	0.07 (3)	0.33 (8)	0.11 (5)	0.28 (–)	0.33 (8)	0.17 (3)	0.00 (0)
Brown Thrasher	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)
Canada Goose	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	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)
Carolina Wren	0.17 (8)	0.00 (0)	0.00 (0)	0.11 (5)	0.11 (5)	0.11 (5)	0.06 (3)	0.00 (0)	0.06 (3)	0.28 (13)	0.20 (6)	0.28 (13)	0.06 (3)	0.22 (11)	0.22 (11)	0.11 (5)	0.11 (5)
Cedar Waxwing	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 (53)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Chipping Sparrow	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.22 (18)	0.00 (0)	0.11 (5)	0.00 (0)	0.00 (0)	0.00 (0)
Cliff Swallow	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Common Nighthawk	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Common Yellowthroat	0.00 (0)	0.17 (11)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.17 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)
Downy Woodpecker	0.11 (5)	0.22 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.06 (3)	0.11 (8)	0.20 (9)	0.28 (13)	0.06 (3)	0.17 (11)	0.06 (3)	0.17 (8)	0.00 (0)
Eastern Bluebird	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.11 (11)	0.06 (5)	0.00 (0)	0.11 (5)	0.00 (0)	0.00 (0)	0.07 (3)	0.06 (8)	0.17 (11)	0.11 (5)	0.06 (3)	0.17 (8)	0.00 (0)
Eastern Kingbird	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Eastern Meadowlark	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (5)	0.06 (3)	0.11 (3)	0.00 (0)	0.06 (3)	0.00 (0)	0.22 (11)	0.28 (5)	0.00 (0)	0.06 (3)

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

Table E1 (continued). Annual proportion of riparian plots occupied by each breeding bird species and estimated abundance (determined using birds within 125 m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes annual abundance value could not be calculated because the species was present, but outside of 125 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=18	2002 n=18	2004 n=16	2005 n=18	2006 n=18	2007 n=18	2008 n=18	2009 n=18	2010 n=18	2011 n=18	2012 n=15	2013 n=18	2014 n=18	2015 n=18	2016 n=18	2017 n=18	2018 n=18
Eastern Phoebe	0.00 (0)	0.11 (3)	0.19 (9)	0.06 (–)	0.06 (–)	0.06 (3)	0.06 (3)	0.11 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.22 (16)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (5)
Eastern Towhee	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Field 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)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.17 (8)**	**0.00 (0)**
Grasshopper 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)**	**0.00 (0)**	**0.00 (0)**	**0.07 (–)**	**0.11 (5)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.06 (3)**
Gray Catbird	0.06 (3)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (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)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.17 (5)	0.06 (3)	0.11 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Great Horned Owl	0.00 (0)	0.01 (–)	0.00 (0)	0.06 (–)	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)	0.06 (3)
Hairy Woodpecker	0.00 (0)	0.00 (0)	0.19 (9)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
House Finch	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
House Wren	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.07 (3)	0.11 (5)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)
Indigo Bunting	0.06 (3)	0.11 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (5)	0.39 (21)	0.11 (8)	0.06 (3)	0.22 (18)	0.13 (9)	0.22 (13)	0.39 (34)	0.06 (5)	0.17 (11)	0.06 (5)	0.06 (5)
Kentucky 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)**	**0.06 (–)**	**0.00 (0)**	**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)	0.00 (0)	0.00 (0)	0.11 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Lark Sparrow	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)

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

Table E1 (continued). Annual proportion of riparian plots occupied by each breeding bird species and estimated abundance (determined using birds within 125 m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes annual abundance value could not be calculated because the species was present, but outside of 125 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=18	2002 n=18	2004 n=16	2005 n=18	2006 n=18	2007 n=18	2008 n=18	2009 n=18	2010 n=18	2011 n=18	2012 n=15	2013 n=18	2014 n=18	2015 n=18	2016 n=18	2017 n=18	2018 n=18
Louisiana Waterthrush	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)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)
Mourning Dove	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.06 (–)	0.17 (11)	0.11 (5)	0.00 (0)	0.06 (–)	0.13 (3)	0.06 (–)	0.00 (0)	0.00 (0)	0.33 (13)	0.17 (5)	0.06 (3)
Northern Bobwhite	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.06 (5)
Northern Flicker*	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.06 (3)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.39 (18)**	**0.00 (0)**	**0.11 (–)**	**0.27 (13)**	**0.06 (–)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Northern Mockingbird	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Northern Parula	0.00 (0)	0.11 (8)	0.19 (9)	0.06 (3)	0.11 (5)	0.11 (5)	0.17 (11)	0.11 (5)	0.17 (5)	0.28 (16)	0.07 (6)	0.28 (13)	0.22 (16)	0.22 (11)	0.22 (11)	0.06 (3)	0.28 (18)
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)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Orchard Oriole	0.06 (3)	0.06 (5)	0.06 (3)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.06 (5)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (8)
Prothonotary Warbler*	**0.11 (5)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.06 (3)**	**0.06 (3)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**
Red-headed Woodpecker*	**0.00 (0)**	**0.06 (–)**	**0.13 (9)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.11 (3)**	**0.00 (0)**	**0.06 (3)**	**0.00 (0)**	**0.06 (–)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.11 (5)**	**0.00 (0)**
Red-tailed Hawk	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.07 (3)	0.06 (–)	0.00 (0)	0.06 (–)	0.00 (0)	0.06 (–)	0.00 (0)
Red-winged Blackbird	0.00 (0)	0.06 (5)	0.06 (–)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Ruby-throated Hummingbird	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (3)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Scarlet Tanager	0.00 (0)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (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)

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

Table E1 (continued). Annual proportion of riparian plots occupied by each breeding bird species and estimated abundance (determined using birds within 125 m of plot center) of each species at Tallgrass Prairie National Preserve, Kansas, during the 2001 to 2018 (excluding 2003) spring bird surveys (n = number of plots sampled). Note that the proportion of plots occupied includes flyovers, whereas estimated abundance does not. "–" denotes annual abundance value could not be calculated because the species was present, but outside of 125 m from the plot center.

Common Name	Proportion of Plots Occupied (Abundance)																
	2001 n=18	2002 n=18	2004 n=16	2005 n=18	2006 n=18	2007 n=18	2008 n=18	2009 n=18	2010 n=18	2011 n=18	2012 n=15	2013 n=18	2014 n=18	2015 n=18	2016 n=18	2017 n=18	2018 n=18
Summer Tanager	0.00 (0)	0.06 (3)	0.13 (6)	0.06 (3)	0.11 (5)	0.28 (13)	0.06 (3)	0.06 (3)	0.06 (5)	0.17 (11)	0.07 (3)	0.11 (5)	0.22 (11)	0.00 (0)	0.11 (5)	0.22 (13)	0.22 (11)
Turkey Vulture	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	0.11 (5)	0.06 (–)	0.07 (6)	0.06 (–)	0.06 (–)	0.06 (3)	0.00 (0)	0.06 (–)	0.00 (0)
Upland Sandpiper*	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.06 (–)**
Warbling Vireo	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)	0.17 (5)	0.13 (6)	0.17 (8)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (3)
Western Kingbird	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (8)	0.00 (0)
Western Meadowlark	0.00 (0)	0.11 (–)	0.19 (9)	0.00 (0)	0.06 (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)
White-breasted Nuthatch	0.00 (0)	0.39 (11)	0.06 (6)	0.17 (5)	0.28 (13)	0.17 (11)	0.11 (5)	0.11 (8)	0.11 (5)	0.22 (11)	0.5 (28)	0.17 (8)	0.11 (5)	0.06 (3)	0.06 (3)	0.33 (16)	0.11 (8)
Wild Turkey	0.00 (0)	0.00 (0)	0.06 (–)	0.06 (3)	0.00 (0)	0.11 (3)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.20 (16)	0.06 (–)	0.17 (32)	0.00 (0)	0.00 (0)	0.06 (–)	0.00 (0)
Wood Duck	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (5)	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (13)	0.11 (11)	0.00 (0)	0.06 (–)	0.00 (0)
Yellow-billed Cuckoo	0.11 (3)	0.28 (–)	0.50 (24)	0.00 (0)	0.00 (0)	0.00 (0)	0.22 (11)	0.17 (3)	0.00 (0)	0.11 (3)	0.13 (6)	0.11 (3)	0.00 (0)	0.17 (8)	0.11 (5)	0.22 (3)	0.28 (8)
Yellow-breasted Chat	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.06 (–)	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)
Yellow-throated Vireo	0.06 (3)	0.06 (–)	0.13 (3)	0.17 (8)	0.00 (0)	0.06 (3)	0.17 (8)	0.11 (5)	0.11 (5)	0.06 (3)	0.00 (0)	0.00 (0)	0.11 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (5)
Yellow Warbler	0.17 (11)	0.00 (0)	0.25 (9)	0.11 (5)	0.22 (16)	0.00 (0)	0.06 (3)	0.00 (0)	0.06 (3)	0.06 (3)	0.13 (6)	0.11 (5)	0.06 (5)	0.11 (5)	0.28 (16)	0.11 (5)	0.33 (16)

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

Appendix F. Tallgrass Prairie National Preserve Trends

Table F1. Trends, annual change in abundance (individuals), of breeding birds recorded on Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018.

Habitat	Bird Common Name	Trend[A]	SE of Slope	Trend Classification[B]
Upland	Barn Swallow	1.11	0.08	Uncertain
	Brown-headed Cowbird	1.01	0.02	Stable
	Brown Thrasher	0.99	0.03	Uncertain
	Dickcissel[C]	**1.07**	**0.01**	**Strong Increase**
	Eastern Kingbird	0.96	0.07	Uncertain
	Eastern Meadowlark	1.33	0.29	Uncertain
	Grasshopper Sparrow[C]	**1.00**	**0.01**	**Stable**
	Great Crested Flycatcher	1.04	0.08	Uncertain
	Greater Prairie-chicken	1.07	0.50	Uncertain
	Henslow's Sparrow[C]	**1.36**	**1.00**	**Uncertain**
	Horned Lark	1.00	0.10	Uncertain
	Killdeer	0.88	0.03	Steep Decline
	Lark Sparrow	0.95	0.02	Moderate Decline
	Mourning Dove	1.12	0.05	Moderate Increase
	Northern Bobwhite	1.07	0.06	Uncertain
	Red-winged Blackbird	0.92	0.02	Moderate Decline
	Upland Sandpiper[C]	**0.88**	**0.02**	**Steep Decline**
	Western Meadowlark	0.90	0.02	Steep Decline
Riparian	Blue-gray Gnatcatcher	1.09	0.06	Uncertain
	Blue Jay	1.03	0.04	Uncertain
	Dickcissel[C]	**1.14**	**0.21**	**Uncertain**
	Eastern Wood-pewee	0.99	0.01	Stable
	Great Crested Flycatcher	1.00	0.02	Stable
	Northern Cardinal	1.07	0.02	Moderate Increase
	Red-bellied Woodpecker	1.06	0.02	Moderate Increase
	Red-eyed Vireo	1.11	0.28	Uncertain
	Tufted Titmouse	1.06	0.03	Moderate Increase

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

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

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

Appendix G. Regional Trends

Table G1. Regional trends in breeding birds recorded on Tallgrass Prairie National Preserve, Kansas, from 2001 to 2015. Regional trend data was obtained from BBS surveys (Sauer et al. 2017). Trend is defined as an interval-specific geometric mean of proportional changes in population size (Link and Sauer 1998), expressed as a percentage.

Common Name	Annual Percent Change in Population Size	95% Confidence Interval	
		Lower	Upper
American Coot	-9.90	-20.69	2.23
American Crow	-1.98	-2.62	-1.31
American Goldfinch	-0.53	-1.35	0.30
American Robin	1.05	0.62	1.49
Baltimore Oriole	-0.83	-1.54	0.18
Bank Swallow	0.14	-4.18	4.28
Barn Swallow	-0.35	-0.99	0.34
Barred Owl	5.83	3.12	9.34
Bell's Vireo[A]	**0.64**	**-1.39**	**2.66**
Belted Kingfisher	-1.56	-3.84	0.50
Bewick's Wren[A]	**-2.48**	**-8.22**	**2.99**
Black-billed Cuckoo[A]	**-3.40**	**-6.24**	**-0.31**
Black-capped Chickadee	-0.19	-1.63	1.22
Blue Jay	-1.36	-2.08	-0.66
Blue-gray Gnatcatcher	0.74	-1.33	2.47
Blue Grosbeak	4.18	2.84	5.95
Blue-winged Teal[B]	6.53	-1.87	18.53
Brown-headed Cowbird	0.04	-0.52	0.68
Brown Thrasher	-1.38	-1.91	-0.80
Burrowing Owl[B]	–	–	–
Canada Goose	9.44	4.53	14.85
Carolina Wren	6.30	4.27	8.40
Cattle Egret	-18.86	-32.85	-2.97
Cedar Waxwing	0.65	-1.22	2.57
Chipping Sparrow	2.05	1.26	2.89
Cliff Swallow	16.23	11.96	19.36
Common Grackle	-2.57	-3.29	-1.88
Common Nighthawk	-0.49	-2.16	1.54
Common Yellowthroat	-1.37	-2.07	-0.66
Dickcissel[A]	**-0.04**	**-0.89**	**0.82**
Downy Woodpecker	-0.04	-1.06	0.94
Eastern Bluebird	0.26	-1.07	1.57
Eastern Kingbird	-2.25	-3.02	-1.48
Eastern Meadowlark	-1.15	-1.81	-0.41

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

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

Table G1. Regional trends in breeding birds recorded on Tallgrass Prairie National Preserve, Kansas, from 2001 to 2015. Regional trend data was obtained from BBS surveys (Sauer et al. 2017). Trend is defined as an interval-specific geometric mean of proportional changes in population size (Link and Sauer 1998), expressed as a percentage.

Common Name	Annual Percent Change in Population Size	95% Confidence Interval	
		Lower	Upper
Eastern Phoebe	1.42	0.23	2.56
Eastern Towhee	1.66	0.61	2.75
Eastern Wood-pewee	-0.21	-1.02	0.56
Eurasian Collared-dove[B]	39.67	35.12	44.22
Field Sparrow[A]	**-0.96**	**-1.68**	**-0.16**
Grasshopper Sparrow[A]	**-3.71**	**-5.05**	**-2.40**
Gray Catbird	0.86	0.16	1.56
Great Blue Heron	0.87	-0.45	2.18
Great Crested Flycatcher	-0.14	-1.07	0.73
Great Egret[B]	9.85	4.67	16.21
Great Horned Owl	-2.25	-4.24	-0.30
Greater Prairie-chicken	-1.86	-8.62	11.82
Great-tailed Grackle	2.02	-4.62	8.90
Green Heron[B]	-2.48	-4.07	-1.13
Hairy Woodpecker	0.60	-1.32	2.57
Henslow's Sparrow[A]	**5.42**	**1.27**	**9.08**
Horned Lark	-2.85	-3.63	-2.04
House Finch	-2.06	-3.88	0.05
House Wren	0.43	-0.21	1.10
Indigo Bunting	-0.80	-1.32	-0.31
Kentucky Warbler[A]	**1.77**	**-0.66**	**4.09**
Killdeer	1.58	0.82	2.36
Lark Sparrow	2.62	0.93	4.52
Loggerhead Shrike[A]	**-4.35**	**-6.65**	**-1.88**
Louisiana Waterthrush	6.50	3.22	9.61
Mallard	0.81	-1.72	3.32
Mourning Dove	-0.06	-0.56	0.49
Northern Bobwhite	-0.29	-1.39	-0.85
Northern Cardinal	0.59	0.18	1.04
Northern Flicker[A]	**-2.65**	**-3.33**	**-1.87**
Northern Harrier	-0.83	-5.13	3.34
Northern Mockingbird	-0.19	-1.14	0.83
Northern Parula	3.60	1.88	5.27
Northern Rough-winged Swallow	1.15	-0.69	2.76
Orchard Oriole	0.24	-1.13	1.62
Pileated Woodpecker[B]	5.72	3.68	8.00

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

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

Table G1. Regional trends in breeding birds recorded on Tallgrass Prairie National Preserve, Kansas, from 2001 to 2015. Regional trend data was obtained from BBS surveys (Sauer et al. 2017). Trend is defined as an interval-specific geometric mean of proportional changes in population size (Link and Sauer 1998), expressed as a percentage.

Common Name	Annual Percent Change in Population Size	95% Confidence Interval	
		Lower	Upper
Prothonotary Warbler[A]	**4.64**	**1.46**	**8.22**
Purple Martin	1.15	-1.42	3.78
Red-bellied Woodpecker	2.07	1.26	2.90
Red-eyed Vireo	1.43	0.25	2.54
Red-headed Woodpecker[A]	**-3.74**	**-4.91**	**-2.54**
Red-tailed Hawk	1.31	0.33	2.24
Red-winged Blackbird	-1.24	-1.69	-0.80
Ring-necked Pheasant	-0.64	-2.73	-1.60
Ruby-throated Hummingbird	2.21	0.22	3.93
Scarlet Tanager	0.73	-1.38	2.90
Scissor-tailed Flycatcher	0.57	-0.57	1.75
Spotted Sandpiper	2.04	-3.59	7.87
Summer Tanager	4.32	2.73	5.99
Tufted Titmouse	-1.05	-2.15	0.04
Turkey Vulture	6.56	4.69	8.08
Upland Sandpiper[A]	**-1.06**	**-2.64**	**0.72**
Warbling Vireo	0.34	-0.58	1.23
Western Kingbird	0.87	-1.87	4.43
Western Meadowlark	-3.83	-5.73	-1.93
White-breasted Nuthatch	1.63	0.07	3.02
Wild Turkey	9.51	5.84	12.93
Wood Duck	3.13	1.32	5.10
Yellow-billed Cuckoo	-0.29	-1.79	1.24
Yellow-breasted Chat	0.33	-0.99	1.83
Yellow-throated Vireo	3.55	1.64	5.50
Yellow Warbler	-0.17	-1.45	1.15

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

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

Appendix H. Habitat Parameters in the Upland Tallgrass Prairie

Tables H1 through H3 show the averages for habitat parameters in three different sized plots in the upland tallgrass prairie at Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018 (excluding 2003).

Table H1. Average percent cover of each habitat type in 50-m plots in the upland tallgrass prairie at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). Total percent coverages 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	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Brome Field (%)	–	3.24	6.02	7.41	3.61	4.12	3.80	2.38	2.02	2.37
Disturbed Floodplain (%)	–	–	–	0.19	–	0.65	1.58	–	–	–
Drainage (%)	–	–	–	–	–	–	–	0.40	0.16	1.18
Intermittent Water Cover (%)	–	<0.01	–	–	–	–	–	–	–	0.11
Lawn (%)	–	–	–	–	–	–	–	–	–	0.26
Old Field (%)	–	–	–	–	–	–	–	–	–	0.4
Open Woodland (%)	–	–	–	–	–	–	–	–	–	<0.01
Other (%)	–	–	–	–	–	–	–	–	–	0.17
Pasture Road (%)	–	0.32	0.70	0.32	0.31	0.30	0.66	0.64	0.18	0.38
Paved Road (%)	–	–	–	–	–	–	–	0.01	0.01	<0.01
Pond (%)	–	0.43	1.39	0.23	0.39	0.22	0.49	0.39	0.28	0.39
Restored/Riparian Prairie (%)	–	–	–	1.34	–	–	0.76	1.11	2.70	1.46
Riparian Woodland (%)	–	0.18	0.25	0.01	0.12	0.01	0.19	0.17	–	0.91
Seep (%)	–	–	–	0.04	–	–	0.05	–	–	<0.01
Shrub (%)	–	0.08	–	0.95	–	–	–	–	–	0.44
Stream (%)	–	0.80	0.67	1.04	0.41	0.60	0.72	0.24	0.21	0.32
Trail (%)	–	–	–	–	–	–	–	–	–	<0.01
Tallgrass Prairie (%)	–	91.81	85.12	86.90	92.81	87.96	88.57	89.23	90.83	87.98

Table H2. Average percent cover (± standard deviation) of vegetation at various horizontal height increments to 2.0 m and vertical structure diversity in 5-m subplots in the upland tallgrass prairie at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). For percent cover data, 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	Height Increment	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Horizontal Vegetation Profile—measured at 15 m north of plot center (% cover ± standard deviation at different height increments)	0.00–0.25 m	–	–	–	–	–	–	91.27 (±12.23)	78.51 (±23.56)	63.33 (±32.77)	94.21 (±9.31)
	0.00–0.50 m	82.91 (±23.53)	65.87 (±29.89)	61.99 (±31.72)	53.73 (±28.90)	67.60 (±30.61)	71.90 (±24.30)	–	–	–	–
	0.25–0.50 m	–	–	–	–	–	–	46.27 (±39.51)	37.57 (±37.99)	20.55 (±34.64)	66.56 (±35.82)
	0.25–0.75 m	–	–	18.02 (±29.01)	10.46 (±25.63)	12.34 (±23.43)	16.97 (±30.52)	–	–	–	–
	0.50–0.75 m	–	–	–	–	–	–	5.66 (±21.72)	3.97 (±14.21)	2.89 (±13.32)	9.80 (±21.60)
	0.50–1.00 m	4.10 (±14.26)	4.52 (±18.52)	2.97 (±13.50)	1.38 (±6.33)	2.51 (±12.38)	5.63 (±20.54)	–	–	–	–
	0.75–1.00 m	–	–	–	–	–	–	4.68 (±20.11)	0.66 (±3.79)	1.37 (±9.59)	3.91 (±15.03)
	0.75–1.25 m	–	–	0.66 (±4.47)	0.00	0.66 (±4.47)	0.43 (±2.50)	–	–	–	–
	1.00–1.25 m	–	–	–	–	–	–	3.64 (±18.22)	0.05 (±0.29)	0.15 (±1.37)	2.17 (±12.06)
	1.00–1.50 m	0.01 (±0.06)	0.09 (±1.00)	0.00	0.19 (±1.69)	0.00	0.00	–	–	–	–
	1.25–1.50 m	–	–	–	–	–	–	0.04 (±0.34)	<0.01 (±0.05)	0.08 (±0.99)	1.42 (±10.86)
	1.25–1.75 m	–	–	0.00	0.19 (±1.69)	0.00	0.00	–	–	–	–
	1.50–1.75 m	–	–	–	–	–	–	0.00	0.00	0.07 (±0.97)	0.16 (±2.41)
	1.50–2.00 m	0.63 (±7.81)	0.16 (±2.42)	0.00	0.00	0.00	0.00	–	–	–	–
	1.75–2.00 m	–	–	–	–	–	–	0.00	0.00	<0.01 (±0.05)	0.41 (±4.68)
Vertical Structure Diversity (%)	n/a	9.50 (±2.42)	9.54 (±2.09)	9.26 (±0.48)	9.68 (±2.48)	9.60 (±3.01)	9.40 (±0.44)	10.77 (±5.46)	9.60 (±0.66)	9.56 (±1.73)	9.83 (±2.07)

Table H3. Average soil substrate percent cover and plant guild percent cover (+ standard deviation) in 1.78-m sample plots in the upland tallgrass prairie at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). Total percent coverages 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	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Deciduous Litter (%)	0.12 (±1.22)	0.43 (±0.98)	0.17 (±0.58)	0.30 (±0.25)	0.36 (±0.38)	0.30 (±0.52)	0.40 (±0.37)	0.45 (±0.60)	0.10 (±0.27)	0.07 (±0.31)
Grass Litter (%)	9.59 (±17.43)	28.53 (±20.89)	11.45 (±14.60)	7.30 (±14.56)	9.57 (±15.28)	29.58 (±19.23)	23.36 (±28.17)	26.92 (±18.55)	19.70 (±24.73)	49.87 (±32.21)
Bare Soil (%)	49.74 (±21.22)	50.64 (±23.35)	67.54 (±16.92)	74.15 (±16.70)	70.38 (±22.22)	59.75 (±15.66)	61.51 (±26.94)	27.54 (±14.27)	35.17 (±27.24)	16.91 (±19.80)
Rock (%)	7.11 (±13.24)	7.51 (±11.98)	10.79 (±16.40)	8.34 (±13.24)	7.91 (±13.56)	9.05 (±16.77)	3.11 (±7.88)	8.87 (±13.89)	6.39 (±11.90)	5.48 (±12.73)
Woody Debris (%)	0.02 (±0.24)	0.01 (±0.06)	1.14 (±9.44)	0.01 (±0.06)	0.06 (±0.34)	1.25 (±10.09)	0.05 (±0.35)	0.60 (±1.70)	0.18 (±1.01)	0.10 (±0.97)
Unvegetated (%)	81.61 (±9.06)	84.25 (±8.39)	84.69 (±15.26)	84.78 (±8.83)	86.79 (±12.24)	85.21 (±3.73)	86.23 (±6.72)	58.57 (±11.13)	63.41 (±12.77)	71.16 (±22.61)
Warm-season Grass (%)	19.90 (±15.51)	38.78 (±18.48)	25.21 (±14.50)	25.40 (±14.21)	17.67 (±16.00)	31.89 (±17.01)	20.04 (±14.20)	32.08 (±13.21)	25.70 (±15.13)	53.21 (±21.50)
Cool-season Grass (%)	3.80 (±11.43)	6.64 (±16.87)	9.96 (±14.77)	7.16 (±16.55)	3.48 (±10.87)	4.17 (±15.92)	5.12 (±12.30)	5.68 (±10.01)	3.70 (±11.17)	5.21 (±12.42)
Forb (%)	20.54 (±12.40)	9.49 (±9.86)	17.35 (±10.13)	15.34 (±9.58)	8.20 (±9.18)	10.50 (±12.07)	8.60 (±10.28)	15.23 (±6.17)	17.52 (±12.09)	21.68 (±14.84)
Moss and Lichen (%)	<0.01 (±0.04)	0.48 (±1.54)	1.53 (±2.94)	0.99 (±2.03)	0.33 (±0.72)	0.31 (±1.81)	0.26 (±0.25)	0.61 (±2.06)	0.14 (±0.30)	0.05 (±0.15)
Woody Shrub and Vine (%)	1.37 (±7.83)	4.67 (±7.07)	1.28 (±5.01)	3.07 (±4.26)	2.71 (±4.03)	1.68 (±3.11)	2.45 (±3.25)	1.77 (±3.91)	1.03 (±5.91)	1.96 (±7.24)
Total Foliar (%)	53.14 (±19.85)	44.48 (±17.57)	52.04 (±16.21)	41.23 (±14.75)	33.31 (±20.18)	58.06 (±14.65)	41.11 (±13.25)	42.69 (±12.50)	38.28 (±14.40)	73.61 (±16.58)

Appendix I. Habitat Parameters in Riparian Areas

Tables I1 through I3 show the averages for habitat parameters in three different sized plots in the riparian areas at Tallgrass Prairie National Preserve, Kansas, from 2001 through 2018 (excluding 2003).

Table I1. Average percent cover of each habitat type in 50-m plots in the riparian areas at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). Total percent coverages 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	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Brome Field (%)	3.14	3.14	9.72	11.44	5.83	0.17	4.53	2.92	2.08	4.67
Corn Field (%)	–	–	–	–	2.08	1.00	–	–	–	–
Intermittent Water Cover (%)	20.14	–	–	–	–	–	–	–	–	0.83
Old Field (%)	–	–	–	–	–	–	0.86	–	–	0.33
Pasture Road (%)	–	–	–	–	0.17	0.03	0.03	0.17	–	0.75
Pond (%)	–	–	0.19	–	–	–	–	–	–	–
Restored/Riparian Prairie (%)	–	–	–	2.08	2.08	2.08	10.44	2.08	2.08	2.08
Riparian Woodland (%)	88.19	88.19	72.03	67.81	58.75	60.56	50.36	79.44	79.44	65.83
Shrub (%)	–	–	–	0.03	–	–	0.17	–	–	–
Stream (%)	24.17	24.17	15.58	30.00	27.92	23.58	31.25	10.06	18.50	24.33
Tallgrass Prairie (%)	2.08	2.08	5.41	8.81	1.83	0.17	8.83	0.83	3.47	3.86

Table I2. Average (± standard deviation) percent canopy cover, canopy height, basal area, percent cover of vegetation at various horizontal height increments to 2.0 m, and vertical structure diversity in 5-m subplots in the riparian area at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). For percent cover data, total percent coverages 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	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Canopy Cover	Hardwood (%)	80.66 (±21.47)	66.37 (±18.45)	85.04 (±14.00)	88.00 (±18.22)	85.70 (±16.19)	83.97 (±17.81)	87.43 (±21.99)	89.32 (±18.33)	86.18 (±20.32)	77.71 (±24.90)
	Total cover (%)	80.66 (±21.47)	66.37 (±18.45)	85.04 (±14.00)	88.00 (±18.22)	85.70 (±16.19)	83.97 (±17.81)	87.43 (±21.99)	89.32 (±18.33)	86.18 (±20.32)	77.71 (±24.90)
Canopy Height	Hardwood (m)	19.91 (±8.29)	20.85 (±7.07)	25.88 (±7.06)	16.81 (±7.07)	20.96 (±7.62)	17.59 (±6.36)	21.61 (±7.83)	21.10 (±11.00)	21.72 (±7.34)	18.50 (±8.77)
Basal Area	Hardwood (m^2/ha)	7.83 (±4.22)	7.28 (±3.37)	6.38 (±4.13)	8.50 (±4.50)	8.78 (±4.37)	7.94 (±4.26)	8.17 (±3.91)	9.56 (±4.54)	7.67 (±2.89)	11.22 (±4.07)
	Total (m^2/ha)	7.83 (±4.22)	7.28 (±3.37)	6.38 (±4.13)	8.50 (±4.50)	8.78 (±4.37)	7.94 (±4.26)	8.17 (±3.91)	9.56 (±4.54)	7.67 (±2.89)	11.22 (±4.07)
Horizontal Vegetation Profile—measured at 15 m north of plot center (% cover ± standard deviation at different height increments)	0.00–0.25 m	–	–	–	–	–	–	97.50 (±0.00)	97.50 (±0.00)	88.92 (±23.19)	80.56 (±37.19)
	0.00–0.50 m	90.28 (±17.34)	92.25 (±22.27)	93.75 (±9.35)	80.42 (±33.22)	97.50 (±0.00)	94.17 (±14.14)	–	–	–	–
	0.25–0.50 m	–	–	–	–	–	–	96.81 (±2.95)	92.08 (±14.43)	79.50 (±32.36)	75.17 (±41.38)
	0.25–0.75 m	–	–	75.81 (±35.97)	70.22 (±40.25)	90.14 (±15.94)	78.22 (±32.64)	--	--	--	--
	0.50–0.75 m	–	–	–	–	–	–	48.31 (±41.88)	58.53 (±38.67)	37.75 (±41.57)	53.50 (±41.91)
	0.50–1.00 m	48.17 (±35.34)	43.31 (±39.32)	36.28 (±36.40)	32.00 (±36.62)	53.31 (±44.13)	51.83 (±43.77)	–	–	–	–
	0.75–1.00 m	–	–	–	–	–	–	25.28 (±37.56)	26.81 (±38.45)	15.44 (±29.26)	33.67 (±41.78)
	0.75–1.25 m	–	–	17.22 (±29.32)	22.67 (±38.20)	29.92 (±37.35)	35.69 (±41.65)	–	–	–	–
	1.00–1.25 m	–	–	–	–	–	–	17.56 (±33.45)	21.17 (±40.36)	11.56 (±27.05)	36.42 (±42.59)
	1.00–1.50 m	9.81 (±26.47)	10.11 (±26.36)	8.63 (±25.47)	21.42 (±35.35)	12.20 (±26.99)	21.44 (±32.40)	–	–	–	–
	1.25–1.50 m	–	–	–	–	–	–	10.36 (±24.98)	16.28 (±37.38)	9.39 (±23.99)	28.08 (±41.56)

Table I2 (continued). Average (± standard deviation) percent canopy cover, canopy height, basal area, percent cover of vegetation at various horizontal height increments to 2.0 m, and vertical structure diversity in 5-m subplots in the riparian area at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). For percent cover data, total percent coverages 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	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Horizontal Vegetation Profile—measured at 15 m north of plot center (% cover ± standard deviation at different height increments) (continued)	1.25–1.75 m	–	–	8.63 (±25.47)	18.36 (±31.30)	15.19 (±33.42)	23.14 (±36.29)	–	–	–	–
	1.50–1.75 m	–	–	–	–	–	–	11.31 (±23.21)	21.97 (±38.46)	16.42 (±33.85)	30.00 (±42.63)
	1.50–2.00 m	14.92 (±24.99)	15.33 (±29.43)	2.38 (±9.37)	19.47 (±33.62)	19.81 (±34.50)	28.14 (±42.11)	–	–	–	–
	1.75–2.00 m	–	–	–	–	–	–	16.69 (±28.58)	26.00 (±39.57)	17.81 (±34.20)	29.19 (±43.07)
Vertical Structure Diversity (%)	n/a	33.51 (±13.68)	31.16 (±9.59)	33.15 (±13.39)	25.52 (±11.25)	27.13 (±9.83)	27.91 (±12.56)	27.60 (±12.31)	31.25 (±12.15)	31.08 (±12.70)	25.30 (±13.82)

Table I3. Average percent of soil substrate cover and plant guild cover (± standard deviation) in 1.78-m sample plots in the riparian areas at Tallgrass Prairie National Preserve, Kansas, during the bird breeding seasons from 2001 to 2018 (excluding 2003). 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	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
Deciduous Litter (%)	36.36 (±28.68)	43.00 (±24.81)	14.72 (±15.69)	17.25 (±18.67)	42.00 (±26.77)	20.69 (±20.97)	62.22 (±26.66)	34.08 (±18.09)	34.67 (±22.67)	45.06 (±25.15)
Grass Litter (%)	4.67 (±9.40)	7.72 (±14.89)	6.91 (±10.24)	7.75 (±14.53)	3.58 (±9.14)	10.92 (±19.54)	4.64 (±14.49)	14.86 (±13.85)	7.72 (±12.03)	14.39 (±16.47)
Bare Soil (%)	35.11 (±27.76)	22.92 (±29.50)	67.50 (±20.25)	66.42 (±25.09)	52.94 (±26.74)	54.75 (±18.42)	17.78 (±22.01)	14.25 (±7.39)	15.63 (±21.94)	21.67 (±19.69)
Rock (%)	1.22 (±3.57)	3.50 (±6.36)	2.31 (±5.00)	4.92 (±9.87)	3.58 (±9.17)	2.50 (±8.79)	1.94 (±4.80)	2.72 (±4.62)	1.25 (±3.56)	2.92 (±9.32)
Woody Debris (%)	4.11 (±9.02)	5.89 (±6.70)	9.59 (±6.36)	5.19 (±5.50)	4.11 (±5.16)	5.94 (±14.87)	2.67 (±3.33)	7.58 (±9.04)	7.25 (±6.42)	4.11 (±6.10)
Unvegetated (%)	82.67 (±24.22)	82.64 (±14.94)	79.69 (±14.63)	70.00 (±15.51)	83.61 (±14.53)	88.47 (±5.76)	89.86 (±6.27)	59.58 (±11.45)	65.28 (±17.13)	80.14 (±11.93)
Warm-season Grass (%)	0.94 (±3,51)	1.69 (±4.84)	2.16 (±5.07)	3.86 (±9.67)	1.89 (±4.82)	5.31 (±9.71)	0.22 (±0.71)	3.19 (±5.57)	0.86 (±3.53)	3.47 (±14.73)
Cool-season Grass (%)	13.17 (±14.67)	21.89 (±26.08)	13.72 (±17.65)	26.81 (±21.90)	17.31 (±14.25)	17.86 (±22.69)	14.03 (±15.75)	19.41 (±15.75)	21.31 (±19.24)	30.83 (±26.89)
Forb (%)	10.50 (±9.37)	15.44 (±13.61)	20.63 (±10.06)	14.89 (±14.61)	14.97 (±17.61)	6.36 (±6.39)	6.72 (±6.07)	15.58 (±6.16)	5.58 (±6.12)	18.39 (±23.34)
Moss and Lichen (%)	0.00	0.61 (±0.90)	3.47 (±5.83)	1.19 (±3.58)	1.22 (±3.57)	0.03 (±0.12)	0.50 (±0.66)	0.06 (±0.16)	0.17 (±0.71)	0.86 (±3.53)
Woody Shrub and Vine (%)	9.31 (±24.02)	6.83 (±12.48)	10.63 (±14.43)	9.33 (±11.94)	7.28 (±11.84)	2.67 (±5.72)	6.44 (±9.72)	6.03 (±9.39)	12.56 (±14.82)	21.28 (±23.96)
Tree Seedling (%)	0.22 (±0.26)	0.97 (±1.31)	1.13 (±3.77)	0.00	0.64 (±1.11)	1.78 (±3.55)	2.69 (±5.67)	2.50 (±4.74)	3.06 (±4.57)	10.19 (±11.75)
Total Foliar (%)	36.86 (±25.77)	33.36 (±21.15)	42.81 (±23.22)	43.61 (±19.33)	43.47 (±17.58)	38.06 (±16.30)	34.89 (±22.01)	39.75 (±13.23)	36.55 (±18.93)	71.11 (±23.86)

Appendix J. Trees Found in the Riparian Area on Tallgrass Prairie National Preserve

Table J1. Stems per hectare for trees found in the riparian area on Tallgrass Prairie National Preserve, Kansas, by size class, during the 2001 to 2018 (excluding 2003) bird breeding seasons. Tree stems per hectare are reported by family.

Stem Size Class	Family	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
<1.0 cm	Cornaceae	78	0	143	14	71	127	7	149	141	0
	Cupressaceae	0	0	0	0	0	0	0	0	14	0
	Fabaceae	0	0	0	0	0	0	0	0	21	0
	Fagaceae	0	7	0	0	0	0	0	0	0	0
	Oleaceae	0	0	0	0	0	0	0	0	42	0
	Rutaceae	0	0	0	0	7	0	0	0	50	0
	Shrub	0	0	0	0	0	0	28	0	0	0
	Simaroubaceae	0	0	8	0	0	0	0	0	0	0
	Ulmaceae	0	0	0	0	0	0	28	0	311	14
1.1–2.85 cm	Anacardiaceae	0	0	0	7	0	0	0	0	0	0
	Cornaceae	42	28	48	28	78	7	28	64	0	0
	Cupressaceae	0	0	0	0	0	0	0	0	7	0
	Fabaceae	0	0	0	0	0	0	7	0	0	21
	Fagaceae	7	0	0	0	0	7	0	0	0	0
	Juglandaceae	0	0	0	0	0	0	14	0	7	0
	Oleaceae	0	7	0	0	0	0	0	0	0	7
	Rosaceae	0	0	0	7	0	0	7	0	0	0
	Shrub	0	0	0	0	0	0	106	0	0	0
	Snag	0	0	0	0	0	0	14	0	0	0
	Ulmaceae	21	7	16	7	0	0	21	0	14	14
2.6–8.0 cm	Cornaceae	0	0	0	21	21	28	7	57	0	0
	Fabaceae	14	0	0	0	0	0	0	0	0	0
	Fagaceae	28	7	0	7	7	0	7	7	14	0
	Hippocastanaceae	28	28	8	50	21	14	21	14	14	0

Table J1 (continued). Stems per hectare for trees found in the riparian area on Tallgrass Prairie National Preserve, Kansas, by size class, during the 2001 to 2018 (excluding 2003) bird breeding seasons. Tree stems per hectare are reported by family.

Stem Size Class	Family	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
2.6–8.0 cm (continued)	Juglandaceae	21	7	0	14	0	21	7	0	7	28
	Oleaceae	0	14	0	7	7	14	7	14	14	0
	Shrub	0	0	0	0	0	0	21	0	0	0
	Snag	14	28	8	7	7	0	0	0	0	0
	Ulmaceae	78	127	111	64	57	50	92	50	35	50
8.1–15.0 cm	Fabaceae	7	7	0	14	7	7	0	0	0	0
	Fagaceae	0	21	0	0	7	7	7	0	0	0
	Hippocastanaceae	0	0	0	14	0	7	0	0	0	0
	Juglandaceae	7	14	16	7	21	21	21	14	0	14
	Oleaceae	7	14	0	21	35	7	7	14	21	21
	Platanaceae	0	7	0	0	0	0	0	0	0	0
	Salicaceae	0	0	0	0	0	7	0	0	0	0
	Sapindaceae	0	0	8	0	0	0	0	0	0	0
	Snag	14	35	24	7	14	0	7	0	0	21
	Ulmaceae	113	120	103	85	78	50	71	71	92	64
15.1–23.0 cm	Fabaceae	7	0	0	0	0	0	7	7	7	7
	Fagaceae	7	0	0	0	0	0	0	7	7	7
	Hippocastanaceae	0	0	0	0	0	7	0	0	0	0
	Juglandaceae	0	0	0	0	0	0	14	0	14	14
	Oleaceae	7	7	24	21	14	21	14	21	14	0
	Platanaceae	7	0	0	7	0	0	0	0	0	0
	Salicaceae	0	0	8	14	7	7	7	0	0	0
	Snag	0	14	16	0	7	0	7	0	14	21
	Tiliaceae	0	0	0	0	0	0	0	0	0	7
	Ulmaceae	92	92	72	71	71	50	57	42	57	57

Table J1 (continued). Stems per hectare for trees found in the riparian area on Tallgrass Prairie National Preserve, Kansas, by size class, during the 2001 to 2018 (excluding 2003) bird breeding seasons. Tree stems per hectare are reported by family.

Stem Size Class	Family	2001	2002	2004	2005	2006	2007	2008	2010	2014	2018
23.1–38.0 cm	Aceraceae	0	0	8	0	7	0	0	0	0	0
	Fabaceae	0	0	8	7	7	7	0	0	0	0
	Fagaceae	0	0	0	7	7	7	7	7	7	0
	Juglandaceae	0	0	0	7	0	0	0	7	0	0
	Moraceae	0	0	0	0	0	0	0	0	7	0
	Oleaceae	14	0	8	7	14	14	14	7	0	7
	Platanaceae	0	7	0	0	7	7	7	7	7	7
	Salicaceae	7	0	0	0	0	0	0	7	7	0
	Snag	0	7	8	7	0	0	7	0	7	0
	Tiliaceae	0	0	0	7	7	7	7	0	0	0
	Ulmaceae	57	50	64	85	92	106	92	99	78	35
>38.0 cm	Fabaceae	0	7	8	14	7	7	7	7	7	7
	Fagaceae	7	7	0	0	0	0	0	0	0	14
	Juglandaceae	0	0	8	0	0	0	0	7	0	0
	Oleaceae	14	0	0	0	7	7	7	7	7	7
	Platanaceae	7	14	8	21	14	14	14	14	14	14
	Salicaceae	7	0	0	0	0	0	0	0	0	0
	Snag	0	0	0	0	0	0	0	0	0	7
	Ulmaceae	35	42	48	42	21	28	14	21	50	42

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

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