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Breeding Season Bird Communities Associated with Tallgrass Prairies in Southeast Nebraska

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We collected data on bird communities associated with tallgrass prairies in two areas of southeast Nebraska that have been identified for focused conservation action: the Sandstone Prairies Biologically Unique Landscape (BUL) and the Southeast Prairies BUL. Our research was conducted in June and July of 2010 and 2011 at 14 privately-owned and state-owned properties located in Gage, Jefferson, Johnson, and Pawnee Counties. We detected a total of 1,108 individuals representing 41 species during 10-minute point counts with 400-m radii. The most commonly encountered species, in descending order of relative abundance (individuals detected per point count) were brown-headed cowbird, dickcissel, grasshopper sparrow, and eastern meadowlark. Many grassland bird species that have been identified as being of conservation concern were detected, with a tendency for these species to be detected at study sites within the Southeast Prairies BUL. High abundances of brown-headed cowbird at all study sites and the pervasive influence of woody vegetation within these landscapes, as indicated by the detection of a high number of bird species associated with this vegetation type, may be of concern to conservation researchers, planners, and managers.

Key words: Nebraska Natural Legacy Project, Biologically Unique Landscape, Conservation Priority, Grassland Species, Brown-headed Cowbird, Dickcissel, Grasshopper Sparrow, Meadowlark

Introduction

Within Nebraska, the Tallgrass Prairie Ecoregion occupies the approximate eastern one-third of the state and was historically characterized by extensive grassland habitats with scattered areas of upland deciduous forests and savannas, and lowland prairie or deciduous forests along riparian drainages (Kaul et al. 2011, Schneider et al. 2011). A nearly complete conversion of tallgrass prairie habitats in Nebraska to agricultural production has resulted in perhaps less than one percent of the historic amount remaining into the 21st century (Kaul et al. 2011, Schneider et al. 2011). Remaining tallgrass prairie habitats are often small and isolated from other remnants, experiencing encroachment by woody plants and invasion by exotic species, and subjected to land management activities such as grazing and haying that are focused on economic objectives without consideration of biodiversity objectives (Fitzgerald and Pashley 2000, Schneider et al. 2011). These landscape changes have had deleterious effects on many species of Nebraska flora and fauna, necessitating conservation actions. The Nebraska Natural Legacy Project (NNLP) identified a number of Biologically Unique Landscapes where focused conservation activities should be most effective at conserving the state's biodiversity (Schneider et al. 2011). Two of the Biologically Unique Landscapes (BULs), the Sandstone Prairies BUL and the Southeast Prairies BUL, are encompassed by the Tallgrass Prairie Ecoregion in Nebraska and were the locations of our study.

For decades, grassland birds have exhibited some of the steepest and most consistent declines of any group of avian species (Askins 1993, Herkert 1995, Peterjohn and Sauer 1999, Brennan and Kuvlesky 2005, North American Bird Conservation Initiative 2009). Within the Sandstone Prairies BUL and the Southeast Prairies BUL, four species of grassland birds are identified by the NNLP as Tier I species (species that are at-risk both globally or nationally and at risk of being extirpated from the State of Nebraska; greater prairie-chicken, loggerhead shrike, Bells's vireo, and Henslow's sparrow). Other regional bird conservation plans that address the geographic area represented by the Sandstone Prairies BUL and Southeast Prairies BUL categorize these four species as well as three additional grassland bird species (dickcissel, field sparrow, and bobolink) as priorities for conservation action (Fitzgerald and Pashley 2000).

As part of a larger study examining the interaction of fire and cattle grazing in southeast Nebraska tallgrass prairies (Fuhlendorf et al. 2013), we collected data on relative abundance of birds at multiple sites in the Sandstone Prairies and Southeast Prairies BULs during the breeding seasons of 2010–2011. Our data represent a valuable contribution to Nebraska ornithology by providing information on two areas of the state where conservation attention has been prioritized and for which quantitative data on bird community composition and relative abundances is minimal. We document the relative abundance of several species that have been identified as being of conservation concern and our data from two distinct BULs

in the Tallgrass Prairie Ecoregion provide insight into whether these BULs differ with regard to the bird communities they are characterized by.

Study Sites and Methodology

Study Sites

Our study sites were located in four counties of southeast Nebraska: Gage, Jefferson, Johnson, and Pawnee. Average annual precipitation during 1981–2010 at Beatrice (40.2994°, -96.75°), which was approximately equidistant between our west-most and east-most study sites, was 80.26 cm (<http://www.ncdc.noaa.gov>). Annual precipitation amounts during 2009, 2010, and 2011 were 83%, 104%, and 88%, respectively, of the 1981–2010 average. Vegetation of the study sites was typical of upland tallgrass prairie in this region (Kaul et al. 2011). Predominant grasses included *Andropogon gerardii* Vitman, *Bromus inermis* Leyss., *Poa pratensis* L., *Schizachyrium scoparium* (Michx.) Nash, and *Sorghastrum nutans* (L.) Nash; common forbs included *Ambrosia psilostachya* DC, *Aster ericoides* L., *Solidago canadensis* L., and *Vernonia baldwinii* Torr. (nomenclature follows Kaul et al. 2011). The Sandstone Prairies and Southeast Prairies BULs are notable for having extensive areas of grassland vegetation, relative to much of the Tallgrass Prairie Ecoregion in Nebraska, representing both remnant tallgrass prairies and Conservation Reserve Program planted grasslands (Henebry et al. 2005, Schneider et al. 2011, Matthews et al. 2013). In addition to the matrix of grassland vegetation our study sites were situated within, the landscapes of our study sites were characterized by the presence of woody plant communities along fencerows, in shelterbelts, within topographical drainages, and along watercourses.

Locations for point counts were established within pastures that were part of a broader study of how the interaction of fire and grazing affects vegetation and birds in southeast Nebraska (Fuhlendorf et al. 2013). Four of our study sites were located in the Sandstone Prairies BUL (Jefferson County) and 10 of our sites were in the Southeast Prairies BUL (Johnson, Pawnee, and Gage Counties; Table 1). Seven of the sites were on properties owned and managed by the Nebraska Game and Parks Commission; the remaining seven sites were located on private land. During the study, all study sites were grazed at a moderate rate (2–2.5 ha per cow/calf pair) from May to October; the study sites on private land had a long history of being used for grazing while the properties owned by the Nebraska Game and Parks Commission had a history of alternating management practices that included prescribed burning, grazing, haying, and rest. All study sites had been treated with at least one prescribed fire during the period 2009–2011. Some sites were treated with a single prescribed fire across the entire pasture in 2009, other sites were treated with what is known as “patch burn grazing” whereby successive portions of a pasture are treated with prescribed fire in alternating years (Fuhlendorf et al. 2013; see also Fuhlendorf and Engle 2001, 2004, Fuhlendorf et al. 2006, Fuhlendorf et al. 2009).

Point count locations were established within grassland habitats by examining aerial photos of each study site in a Geographic Information System. We attempted to center point count circles within study sites such that the count circle encompassed a minimal amount of woody vegetation within the 400-m radius of the count circle while still retaining the greatest amount of the count circle within the study site. The outer edges of many count circles extended beyond the

Table 1. Study sites where bird point counts were conducted during June and July, 2010 and 2011, in southeast Nebraska. NG&PC = Nebraska Game and Parks Commission.

Study Site	County	Location	Ownership
Jefferson County 1	Jefferson	T1N, R1E, ne ¼ of section 24 and se ¼ of section 13	private
Jefferson County 2	Jefferson	T1N, R1E, ne ¼ of section 24 and se ¼ of section 13	private
Gage County 1	Gage	T2N, R6E, ne ¼ of section 18	private
Gage County 2	Gage	T2N, R6E, ne ¼ of 18	private
Burchard Lake 1	Pawnee	T2N, R10E, section 4	NG&PC
Burchard Lake 2	Pawnee	T2N, R10E, section 4	NG&PC
Burchard Lake 3	Pawnee	T2N, R10E, section 4	NG&PC
Burchard Lake 4	Pawnee	T2N, R10E, se ¼ of section 5	private
Pawnee Prairie 1	Pawnee	T1N, R10E, n ½ of section 29	NG&PC
Pawnee Prairie 2	Pawnee	T1N, R10E, n ½ of section 29	NG&PC
Rock Glen 1	Jefferson	T2N, R3E, ne ¼ of section 35	NG&PC
Rock Glen 2	Jefferson	T2N, R3E, ne ¼ of section 35	NG&PC
Johnson County 1	Johnson	T4N, R9E, e ½ of section 20	private
Johnson County 2	Johnson	T4N, R9E, e ½ of section 20	private

boundaries of the study site they were located in but in the majority of these cases adjacent land was also grassland vegetation (tallgrass prairie grazed by cattle or Conservation Reserve Program planted grasslands). In instances where count circles overlapped cropland adjacent to study sites, the amount of cropland relative to the total amount grassland vegetation in the count circles was minimal.

Methods

To assess grassland bird communities during the breeding season, point counts were conducted twice at all sites during each year of the study (2010 and 2011) from 15 June through 1 July. Point counts were conducted during the 2 hours post-sunrise when wind speeds were less than 25 km/hr, it was not raining, and cloud cover was less than 75%. During each 10-minute point count, the presence of all bird species within a 400-m radius of the point was recorded. Only individuals observed landing, sitting on, or flushing from the ground or vegetation within the 400-m count radius, or could be detected by call or song within the 400-m count radius were recorded. Our point count radii were identical to those used by the North American Breeding Bird Survey (Robbins et al. 1986, Sauer and Link 2011). Additionally, we wanted to collect data on northern bobwhite, a game bird of high importance to wildlife managers (National Bobwhite Technical Committee 2011). Point counts with radii of up to 500-m are commonly used for surveys of northern bobwhite (Murray et al. 2011, Evans et al. 2013) while point counts with shorter radii may not effectively detect this species (Applegate et al. 2011).

Analyses

For Sandstone prairies BUL study sites and Southeast prairies BUL study sites, we calculated descriptive statistics of the following variables: relative abundance (mean \pm SE individuals per point) of each individual species; relative abundance of all individuals of all species combined; and relative species richness (mean \pm SE species per point). Our measures of relative abundance represent indices of abundance as defined by Conroy and Carroll (2009; p 318): "...any measure or count of a species based on direct observation or observation of sign of the species that provides some numerical scale of observation without a measure of detection rate (β).” Indices of abundance are considered appropriate for monitoring bird populations, particularly when the restrictive assumptions and practical limitations associated with the quantification of detectability are considered (Johnson 2008).

We conducted statistical analyses with portions of the dataset that allowed robust comparisons: relative

abundance of all individuals, relative abundance of the four most commonly encountered species (brown-headed cowbird, dickcissel, eastern meadowlark, and grasshopper sparrow; see Table 2 for scientific nomenclature), and relative species richness. For all analyses, values of these variables at study sites in the Sandstone prairies BUL were compared to those in the Southeast prairies BUL. Our analyses using measures of relative abundance assume that detectability did not differ for any species between sites in the Sandstone prairies BUL and sites in the Southeast prairies BUL. Two factors that could influence detectability of birds differently between the two BULs, observer and vegetation structure, were similar at all sites (SLW was the observer at all sites; all sites were characterized by a matrix of tallgrass prairie vegetation encompassing occasional linear strips or patches of trees and shrubs). Statistical analyses consisted of t-tests and Mann-Whitney Rank Sum tests when data violated the assumptions of the t-test. Statistical analyses were conducted using SigmaPlot Version 12.3 (Systat Software, San Jose, CA; <http://www.sigmaplot.com>). For all analyses, statistical significance was set at $\alpha = 0.05$.

Results

A total of 1,108 individuals representing 41 species were detected during the two years of study: 311 individuals representing 25 species at study sites in the Sandstone Prairies BUL and 797 individuals representing 38 species at study sites in the Southeast Prairies BUL (Table 2). The most commonly encountered species, in descending order of relative abundance (individuals per point count) were brown-headed cowbird, dickcissel, grasshopper sparrow, and eastern meadowlark (Table 2). There was no difference in relative abundance of brown-headed cowbird ($U = 310.5$; $T = 446.5$; $n_1 = 16$, $n_2 = 40$; $P = 0.869$), dickcissel ($t_{54} = -1.132$; $P = 0.263$), or all individuals ($t_{54} = -0.308$; $P = 0.759$) when comparisons of these variables were made between study sites in the Sandstone Prairies BUL and study sites in the Southeast Prairies BUL. The relative abundance of eastern meadowlark was significantly higher ($U = 175.5$; $T = 311.5$; $n_1 = 16$, $n_2 = 40$; $P = 0.007$) at study sites in the Southeast Prairies BUL than at study sites in the Sandstone Prairies BUL, and the marginally higher relative abundance of grasshopper sparrow at study sites in the Southeast Prairies BUL compared to study sites in the Sandstone Prairies BUL approached statistical significance ($U = 219.0$; $T = 355$; $n_1 = 16$, $n_2 = 40$; $P = 0.059$). Relative species richness was higher ($t_{54} = -3.126$; $P = 0.003$) at study sites in the Sandstone Prairies BUL (mean \pm SE = 10.31 ± 0.63) than at study sites in the Southeast Prairies BUL (mean \pm SE = 8.30 ± 0.32).

Table 2. Relative abundance (mean \pm SE individuals per point) of each species, and all individuals of all species combined, of breeding season birds detected during 10-minute point counts at study sites in the Sandstone Prairies Biologically Unique Landscape (BUL) and the Southeast Prairies BUL during 2010 and 2011 (all data from both years combined).

Common Name	Scientific Name	Relative Abundance (mean \pm SE)	
		Sandstone Prairies BUL	Southeast Prairies BUL
Red-tailed hawk	<i>Buteo jamaicensis</i>	0	0.05 \pm 0.05
Ring-necked pheasant	<i>Phasianus colchicus</i>	0.06 \pm 0.06	0
Wild turkey	<i>Meleagris gallopavo</i>	0	0.05 \pm 0.04
Northern bobwhite	<i>Colinus virginianus</i>	0.50 \pm 0.16	0.18 \pm 0.07
Upland sandpiper	<i>Bartramia longicauda</i>	0	0.03 \pm 0.03
Mourning dove	<i>Zenaidura macroura</i>	0.50 \pm 0.20	0.33 \pm 0.10
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	0.06 \pm 0.06	0
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	0.25 \pm 0.11	0.08 \pm 0.04
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	0.63 \pm 0.22	0.03 \pm 0.03
Northern flicker	<i>Colaptes auratus</i>	0.31 \pm 0.15	0.13 \pm 0.05
Great crested flycatcher	<i>Myiarchus crinitus</i>	0	0.03 \pm 0.03
Eastern kingbird	<i>Tyrannus tyrannus</i>	0.88 \pm 0.32	0.50 \pm 0.10
Loggerhead shrike	<i>Lanius ludovicianus</i>	0	0.05 \pm 0.04
Bell's vireo	<i>Vireo bellii</i>	0	0.08 \pm 0.04
Blue jay	<i>Cyanocitta cristata</i>	0.50 \pm 0.18	0.18 \pm 0.08
American crow	<i>Corvus brachyrhynchos</i>	0	0.03 \pm 0.03
Barn swallow	<i>Hirundo rustica</i>	0	0.08 \pm 0.08
White-breasted nuthatch	<i>Sitta carolinensis</i>	0.13 \pm 0.09	0
House wren	<i>Troglodytes aedon</i>	0.38 \pm 0.16	0.08 \pm 0.06
Eastern bluebird	<i>Tyrannus tyrannus</i>	0.63 \pm 0.22	0.10 \pm 0.08
Gray catbird	<i>Dumetella carolinensis</i>	0.06 \pm 0.06	0.08 \pm 0.06
Northern mockingbird	<i>Mimus polyglottos</i>	0.13 \pm 0.09	0.18 \pm 0.09
Brown thrasher	<i>Toxostoma rufum</i>	0.56 \pm 0.18	0.38 \pm 0.11
Common yellowthroat	<i>Geothlypis trichas</i>	0	0.15 \pm 0.07
Eastern towhee	<i>Pipilo erythrophthalmus</i>	0.31 \pm 0.12	0.08 \pm 0.04
Field sparrow	<i>Spizella pusilla</i>	0.31 \pm 0.12	0.13 \pm 0.05
Lark sparrow	<i>Chondestes grammacus</i>	0.13 \pm 0.09	0.03 \pm 0.03
Grasshopper sparrow	<i>Ammodramus savannarum</i>	2.38 \pm 0.24	2.95 \pm 0.18
Henslow's sparrow	<i>Ammodramus henslowii</i>	0	0.45 \pm 0.12
Northern cardinal	<i>Cardinalis cardinalis</i>	0.38 \pm 0.16	0.10 \pm 0.05
Indigo bunting	<i>Passerina cyanea</i>	0	0.03 \pm 0.03
Dickcissel	<i>Spiza americana</i>	3.12 \pm 0.33	3.58 \pm 0.21
Bobolink	<i>Dolichonyx oryzivorus</i>	0	0.18 \pm 0.07
Red-winged blackbird	<i>Agelaius phoeniceus</i>	0	0.90 \pm 0.27
Eastern meadowlark	<i>Sturnella magna</i>	1.06 \pm 0.17	2.03 \pm 0.20
Western meadowlark	<i>Sturnella neglecta</i>	0	0.13 \pm 0.06
Common grackle	<i>Quiscalus quiscula</i>	0	0.05 \pm 0.03
Brown-headed cowbird	<i>Molothrus ater</i>	3.50 \pm 0.70	3.70 \pm 0.47
Orchard oriole	<i>Icterus spurius</i>	0	0.03 \pm 0.03
Baltimore oriole	<i>Icterus galbula</i>	0.50 \pm 0.18	0.13 \pm 0.05
American goldfinch	<i>Spinus tristis</i>	0.06 \pm 0.06	0.38 \pm 0.17
Unidentified individuals		2.13 \pm 0.40	2.38 \pm 0.28
All individuals		19.44 \pm 1.45	19.93 \pm 0.82

Discussion

Our study documented a variety of bird species associated with tallgrass prairie habitats of southeast Nebraska. Most of the species detected do not represent grassland specialists, however, suggesting a pervasive influence of woody vegetation on bird communities within these landscapes. Further highlighting this point is the fact that we attempted to locate our point count locations in areas where the 400-m radius would encompass the greatest amount of grassland vegetation as possible. In spite of this study design criteria, we still detected a high number of species that are not characteristic of grassland habitats. The profound influence of woody vegetation on bird communities in prairie landscapes has been noted by others (Cully and Winter 2000, Winter et al. 2000, Bakker 2003, Cunningham and Johnson 2006, Ellison et al. 2013). We did not quantify the extent or amount of woody vegetation associated with our study sites but it is possible the higher relative species richness in the Sandstone Prairies BUL study sites reflects a greater amount of woody vegetation associated with those sites. Future analyses of this dataset may reveal a relationship between the extent of woody vegetation of our study landscapes and the composition of the bird communities we detected.

While other studies in the central United States have reported relatively high abundances of brown-headed cowbirds (Cully and Winter 2000, Powell 2008, Rahmig et al. 2009, Pillsbury et al. 2011, Powell and Busby 2013), a result of our study that may be of interest to conservationists is the fact that brown-headed cowbirds were the most abundant species we detected in both the Sandstone Prairies BUL and the Southeast Prairies BUL. Because we used point count circles with 400-m radii, we detected a large number of birds ($n=139$) at the outer limits of the point count circles that could not be identified to species. It is possible that enough of these unidentified individuals were grasshopper sparrows, dickcissels, or meadowlarks, such that any of these species may have in fact been more abundant than brown-headed cowbirds at our study sites.

Nest parasitism by brown-headed cowbirds represents a threat to the conservation of some bird species (Smith et al. 2013) and there can be a positive relationship between proximity of a nest to woody vegetation and the probability of that nest being parasitized in tallgrass prairie landscapes (Patten et al. 2011). However, there can be substantial variation in the amount of actual nest parasitism experienced by grassland bird species in tallgrass prairie (Jensen and Cully 2005, Rivers et al. 2010) and there are instances where an inverse relationship has been found between the probability of a grassland bird nest being parasitized and the prevalence of woody plants in the landscape, presumably because

bird species characteristic of forests and other woody plant communities are preferred hosts for brown-headed cowbirds (Pietz et al. 2009, Hovick and Miller 2013). Thus, whether or not the high abundance of brown-headed cowbirds at our study sites is of conservation concern is a question that deserves further study.

We detected three NNLP Tier I grassland bird species at study sites within the Southeast prairies BUL (loggerhead shrike, Bell's vireo, and Henslow's sparrow) but these species were not detected at study sites within the Sandstone Prairies BUL. Loggerhead shrike was only detected at two locations: one of the state-owned Burchard Lake sites and one of the privately-owned sites in Johnson County. Additionally, we noted fledgling loggerhead shrikes at one of the Burchard Lake study sites in 2011. Bell's vireo was only detected at the state-owned Pawnee Prairie sites and one of the privately-owned Johnson County sites. Henslow's sparrows were only detected at the state-owned Burchard Lake sites and the privately-owned site adjacent to them, locations where they have been observed since 1985 and where breeding has been documented (Silcock and Jorgensen 2006). However, there were a limited number of study sites available for sampling in the Sandstone Prairies BUL and this may in part explain the absence of these species from our dataset representing that BUL. While we did not detect any greater prairie chicken, another NNLP Tier I species, during point counts at any of our study sites we did observe many individuals of this species at our study sites during three summers (2009–2011) of field work associated with this study and other projects (Fuhlendorf et al. 2013).

The Partners in Flight (PIF) Bird Conservation Plan for the Dissected Till Plains (Fitzgerald and Pashley 2000), a region that encompasses both the Sandstone Prairies BUL and the Southeast Prairies BUL, identifies four additional priority grassland bird species that we detected in our study; dickcissel, field sparrow, and grasshopper sparrow were detected at many study sites in both the Sandstone Prairies BUL and the Southeast Prairies BUL, while bobolink were only detected within the Southeast Prairies BUL (one of the state-owned Burchard Lake sites and at both of the privately-owned Johnson County sites). Additional PIF non-grassland priority species that we detected during our point counts were northern bobwhite, red-headed woodpecker, eastern kingbird, brown thrasher, orchard oriole, and Baltimore oriole. In addition to northern bobwhite being a PIF priority species, they are a game bird of high importance to wildlife managers (National Bobwhite Technical Committee 2011). We detected relatively few individuals of this species during our point counts and most of the individuals we recorded were detected at the outer edges of the point count circles,

exemplifying the necessity of using count circles with a large radii in order to adequately sample this species (Applegate et al. 2011).

In summary, our study documented the presence of many species that have been identified as being of conservation concern in the tallgrass prairies of southeast Nebraska and the surrounding regions. Many of the grassland bird species we detected were only found at study sites within the Southeast Prairies BUL or had higher abundances in the Southeast Prairies BUL compared to the Sandstone Prairies BUL. However, in spite of the high number of study sites ($n = 14$) where we collected data, some grassland bird species were rarely detected. Furthermore, the high abundances of brown-headed cowbirds at our study sites may be of concern within the framework of bird conservation within this region. Finally, woody vegetation seemed to have a pervasive influence on our results as indicated by the high number of non-grassland bird species we detected in spite of our attempts to design the study in a way that maximized sampling of grassland habitats.

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