Breeding Bird Community Composition in a Patch-burn Grazing System

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We are evaluating the effect of a patch-burn grazing management strategy on avian breeding community composition. Our treatment structure includes four replicates of the following: (1) seasonlong grazing, (2) seasonlong grazing with dormant-season patch-burning (one-fourth of the pasture) at a four-year return interval and (3) seasonlong grazing with dormant-season (one-eighth of the pasture) and growing-season (one-eighth of the pasture) patch-burning at a four-year return interval. Here we present preliminary results following one year of study.

Introduction

Broad-scale threats to grassland birds include habitat loss, agricultural intensification and climate change (Hill et al., 2014; McCauley et al., 2017; Pool et al., 2014). However, at finer scales, patch area and local vegetation structure are important factors governing grassland bird communities (Hovick et al., 2015; Davis, 2004). Specifically, diversity in vegetation structure mediates grassland bird density, abundance and diversity.

The majority of remnant grasslands in the U.S. are privately owned and thus often undergo managed grazing by herbivores (Ribic et al., 2009). Many privately owned grasslands use a rotational grazing system designed to achieve a uniform foraging distribution (Briske et al., 2008). This minimizes selection by grazers and results in homogenization of vegetation structure and composition toward the middle of a disturbance gradient (Fuhlendorf and Engle, 2004).

A loss of structural heterogeneity causes associated declines in the diversity and stability of breeding bird communities (Hovick et al., 2015). Uniform grazing pressure can reduce the occurrence of bare patches on the landscape (Derner et al., 2008), which are important for migratory grassland species, most of which are insectivorous.

The absence of fire in grassland landscapes also can cause the expansion of woody cover. Many obligate grassland birds are less likely to use patches with woody vegetation due to declines in food resources and increased predation risk (Grant et al., 2004; Thompson et al., 2016).

The interaction of fire and grazing can prevent woody plant encroachment, as well as provide vegetation structure for grassland generalists and those that specialize on either end of the disturbance spectrum (Hovick et al., 2014; Ratajczak et al., 2012). Patch-burned grazing grasslands are more likely to be source habitats for grassland birds and retain a higher temporal stability in community structure (Davis et al., 2016; Hovick et al., 2015).

In this study, we are evaluating the impacts of patch-burn grazing on breeding season avian community composition using density estimates. We are evaluating the densities of grassland species in each treatment, as well as studying changes in the structure of the community among treatments and through time. Results will allow managers to promote grassland bird conservation in a working landscape.

Procedures

Study Area

The Central Grasslands Research Extension Center (CGREC) is in Kidder and Stutsman counties in North Dakota (46° 42’ 56” N, 99° 27’ 08” W) in the Missouri Coteau ecoregion of the northern mixed-grass prairie. The herbaceous community is dominated by native cool-season grasses such as green needlegrass (*Nassella viridula*), western wheatgrass (*Pascopyrum smithii*) and needle-and-thread grass (*Heterostipa comata*).

Common invasive grasses on site include Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) (Patton et al., 2007). Western snowberry (*Symphoricarpos occidentalis*) is the dominant woody species at the CGREC, although silverberry (*Eleagnus commutata*) and wild rose (*Rosa arkansana*) are present. The forb community is diverse and dominated by western ragweed (*Ambrosia psilostachya*), prairie coneflower (*Ratibida columnifera*), goldenrod (*Solidago spp.*), yarrow (*Achillea millefolium*) and Flodman’s thistle (*Cirsium flodmanii*) (Rogers et al., 2005).

The climate is characterized as temperate and experiences an average yearly rainfall of 40.28 cm (15.9 inches) and average annual temperatures of 4.94 °C (40.9 ºF) (1991-2016, North Dakota Agricultural Weather Network).

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Treatment Structure
Our treatment structure includes four replicates, each consisting of a 160-acre pasture divided into eight subpatches. The treatments are: (1) seasonlong grazing, (2) seasonlong grazing with dormant season patch-burning (one-fourth of the pasture) at a four-year return interval and (3) seasonlong grazing with dormant-season (one-eighth of the pasture) and growing-season (one-eighth of the pasture) patch-burning at a four-year return interval. Annual burn plots in treatment 3 will be two adjacent 20-acre subpatches.

Growing season burns are incorporated to increase forage quality for livestock in the middle of the season (Scasta et al., 2016). Fire return intervals are designed to mimic the historical disturbance regime of mixed-grass prairie.

Cow-calf pairs graze freely within pastures from mid-May to mid-Sept. each year at a moderate stocking rate designed to achieve 30 percent forage utilization. Soil type and vegetation communities are similar among replicates, as defined by Natural Resources Conservation Service ecological site descriptions and equivalent land use histories.

Community Monitoring
From June 1 to July 15, we monitored the breeding season avian community in each of our experimental pastures. In each subpatch (one-eighth of a 160-acre pasture), we conducted a 150-meter (m) transect survey four times during the season (384 surveys total). Each time a bird was detected, we recorded the species, sex and behavior of the bird, as well as its straight-line distance from the transect. Detections greater than 50 m from the transect were censored from analysis.

Vegetation Monitoring
Along each community transect, we performed vegetation surveys. On each side of the transect, we measured the cover of vegetation functional groups using a Daubenmire frame (20 frames/transect; Daubenmire, 1959). The cover of vegetation functional groups was recorded.

Kentucky bluegrass and smooth brome were included as separate categories because they have a unique vegetation structure and are of management interest. Additionally, at each plot, a Robel pole was used to quantify visual obstruction in each cardinal direction (Robel, 1970).

Statistics
We calculated the density of detected bird species using the unmarked package in R. We calculated breeding bird density using a constant density model, and then evaluated the effects of vegetation and treatment using an AICc modeling framework (Burnham and Anderson, 1998; Marques et al., 2007). We analyzed differences in the breeding season community using nonmetric dimensional scaling in the VEGAN package in R (Dixon, 2003).

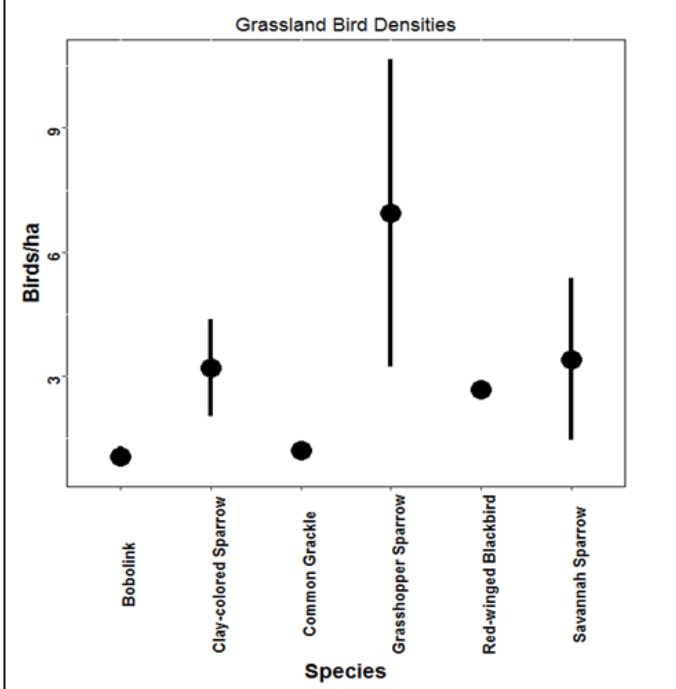

Figure 1. Estimates of the breeding season densities of six grassland bird species at the Central Grasslands Research Extension Center northwest of Streeter, N.D. in 2017.

Species	Density Model
Grasshopper sparrow (GRSP)	Litter depth +
Bobolink (BOBO)	Smooth brome +
Common grackle (COGR)	Bare ground +
Savannah sparrow (SAVS)	Kentucky bluegrass +
Clay-colored sparrow (CCSP)	Woody vegetation +
Red-winged blackbird (RWBL)	Litter depth +

Table 1. Variables and directionality of the top-performing univariate models influencing breeding season bird density at the Central Grasslands Research Extension Center near Streeter, N.D. in 2017.

We used vegetation and management to describe variation in avian community composition. Significance of environmental variables was assessed using permutational analysis of variance (PERMANOVA, McArdle and Anderson, 2001). We used the anosim function in VEGAN to assess the difference between communities in burned and unburned patches.

Results
In 2017, we had 1,910 detections from 48 species.

Density
We were able to calculate density metrics on every species with 60 or more detections (six species total; Figure 1). The density of grasshopper sparrows (*Ammodramus savannarum*) was 6.93 ±

3.72 birds/hectare (ha). The density of grasshopper sparrows increased with increasing litter depth (Table 1).

Bobolink (*Dolichonyx oryzivorus*) occurred at a density of 1.06 ± 0.25 birds/ha, and density increased in areas with a greater cover of smooth brome. Common grackles (*Quiscalus quiscula*) occurred at a density of 1.19 ± 0.24 birds/ha, and density increased with the cover of bare ground.

Savannah sparrows (*Passerculus sandwichensis*) occurred at a density of 3.40 ±1.96 birds/ha and occurred at a greater density in areas with a high cover of Kentucky bluegrass. Clay-colored sparrows (*Spizella pallida*) occurred at a density of 3.20 ±1.18 birds/ha and were more dense in areas with a higher cover of woody vegetation. Red-winged blackbirds (*Agelaius phoeniceus*) occurred at a density of 2.68 ± 0.04 birds/ha and density increased with increasing litter depth.

After one year of data collection, we found no statistically significant differences in the avian community in burned and unburned areas.

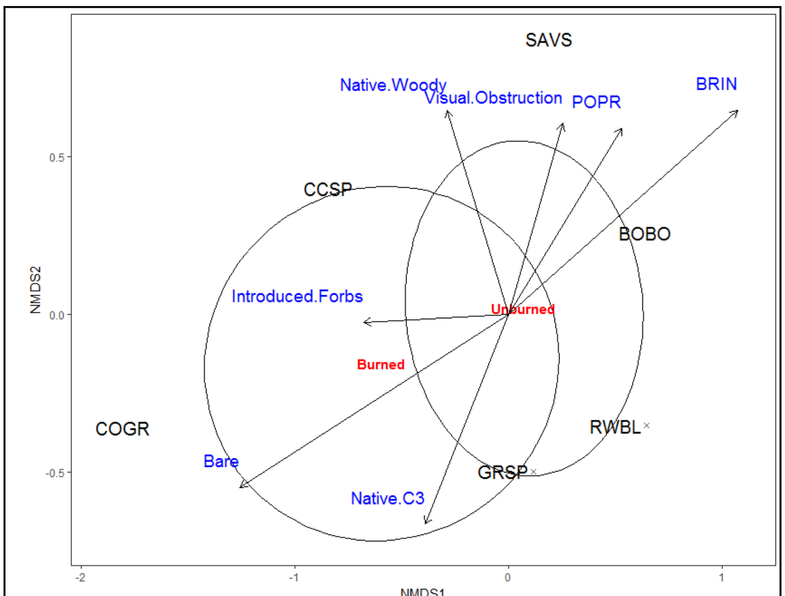

Figure 2. Nonmetric dimensional scaling (NMDS) ordination plot for abundances of six grassland bird species in a landscape managed with patch-burn grazing at the Central Grasslands Research Extension Center near Streeter, N.D. Abbreviations for environmental variables are as follows: BRIN: smooth brome (*Bromus inermis*), POPR: Kentucky bluegrass (*Poa pratensis*), Native C_3: native cool-season grasses. Bird species are those listed in Table 1.

Discussion

Following one year of data collection, we demonstrated distinct preferences for vegetation structure in the breeding bird community. Bobolink and savannah sparrow density increased with the cover of smooth brome and Kentucky bluegrass, respectively (Figure 2). These nonnative grasses likely provide the most common dense graminoid vegetation structure due to their dominance.

As we further implement our treatment structure, we will look for changes in vegetation community composition in burned plots and whether birds switch preferred vegetation groups through time.

For similar reasons, we were unable to detect a stratification in the bird community by time since fire. Our treatment structure consists of patches burned this year and patches that were not burned at all.

Newly burned patches benefit a unique suite of species (Powell, 2008), and all species unable to exploit these new burns likely used unburned areas. We expect to find a divergence in the breeding community as our treatment structure is further implemented (Pillsbury et al., 2011).

Grasshopper sparrow

Clay-colored sparrow

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Common grackle

Red-winged blackbird