Breeding Bird Community Composition in a Patch-burn Grazing System

Cameron Duquette and Torre Hovick

North Dakota State University, School of Natural Resource Sciences, Fargo, N.D.

T.J. Hovick, NDSU

We are evaluating the effect of a patch-burn grazing management strategy on avian breeding community composition. Our treatment structure consists of four replicates of the following: (1) season-long grazing, (2) season-long grazing with dormant-season patch burning (one -fourth of pasture) at a four-year return interval, (3) season-long grazing with dormant-season (one-eighth of pasture) and growing-season (one-eighth of pasture) patch burning at a four-year return interval, and (4) twice-over rotational grazing. *Here we present preliminary results following two years 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. is privately owned and, thus, often undergoes 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-burn 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 evaluate the impacts of patch-burn grazing on breeding season avian community composition using density estimates. We will evaluate the densities of grassland species in each treatment, as well as study changes in the structure of the community among treatments and through time.

We also will compare patch-burn grazing with season-long grazing and twice-over rotational grazing, two traditional management practices in the area. 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, N.D., (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 centimeters (cm) (15.9 inches) and average annual temperatures of 4.94 C (40.9 F) (1991-2016, North Dakota Agricultural Weather Network).

Treatment Structure

Our treatment structure consists of four replicates, each consisting of a 160-acre pasture divided into eight subpatches. The treatments are: (1) season-long grazing (SLG), (2) season -long grazing with dormant-season patch burning (one-fourth of pasture) at a four-year return interval (PBG40), (3) season-long grazing with dormant-season (one-eighth of pasture) and growing-season (one-eighth of pasture) patch burning at a four-year return interval (PBG20), and (4) twice-over rotational grazing (2xROT).

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 will graze freely within pastures from May 1 to Oct. 1 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 Resource 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 the individual's 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. Additionally, at each plot, a Robel pole was used to quantify visual obstruction in each cardinal direction (Robel, 1970).

Statistics

We calculated the abundance of detected bird species using the R package *lme4*. We analyzed differences in the breeding-season community using nonmetric dimensional scaling using the R package VEGAN (Dixon 2003). We used vegetation and management to describe variation in avian community composition.

The significance of environmental variables was assessed using permutational analysis of variance (PERMANOVA, McArdle and Anderson, 2001). We used transect-level abundances to compare differences among treatments.

Results

In 2018, we had 1,324 detections from 57 species.

Abundance

After two years of data collection, we tested for differences in abundance estimates among treatments. Brown-headed cowbird abundance was higher in twice-over rotational grazing pastures, compared with season-long grazing, and PBG40 pastures had lower brown-headed cowbird abundance. Transect-level abundance in PBG20, PBG40 and 2xROT was lower than in SLG pastures.

Bobolink abundance was lowest in PBG20 pastures, followed by PBG40, 2xROT and SLG pastures (Figure 1). Brewer's blackbird abundance was higher in both patch-burn pastures than the 2XRot and SLG pastures.

Chestnut-collared longspur (*Calcarius ornatus*) abundance was higher in both patch-burn treatments, compared with the rotational grazing and season-long grazing pastures. Clay-colored sparrow abundance was lower in either patch-burn pasture, compared with season-long and rotational-grazing pastures, which were similar.

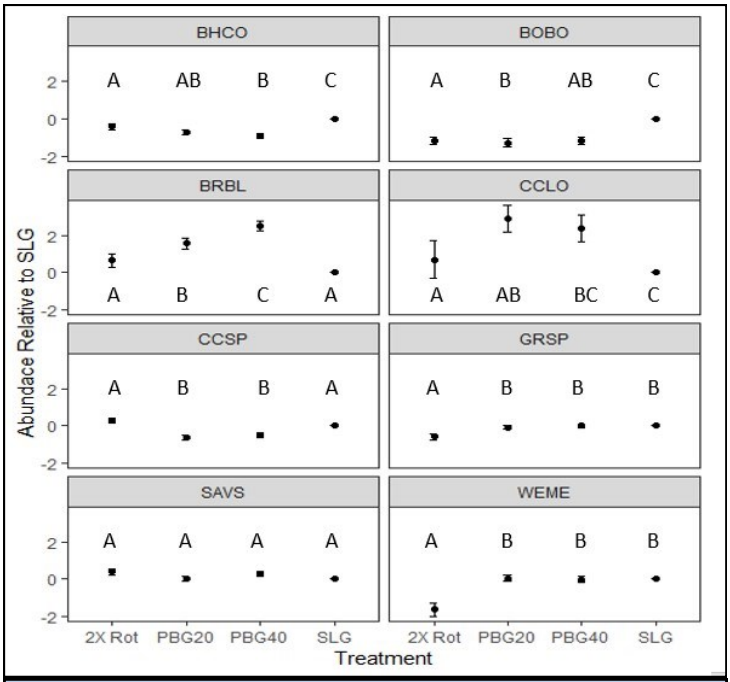

Figure 1. Estimates of the abundances of eight grassland bird species at the Central Grasslands Research Extension Center northwest of Streeter, N.D., in 2017 and 2018.

Species	Density Model
Grasshopper Sparrow	Litter Depth +
Bobolink	Cool-season Grasses +
Brewer's Blackbird	Bare Ground +
Savannah Sparrow	Cool-season Grasses +
Clay-colored Sparrow	Woody Vegetation +
Western Meadowlark	Litter Depth +
Chestnut-Collared Longspur	Bare Ground +

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 and 2018.

Grasshopper abundance was lower in 2XROT pastures, compared with season-long grazing and both patch-burn pastures. Western meadowlark abundance followed a similar pattern. Savannah sparrow abundance did not vary among treatments.

Cover Variables Affecting Abundance

Grasshopper sparrow abundances increased with increasing litter depth. Bobolink abundance increased with the cover of cool-season grasses. Brewer's blackbird and Savannah sparrow abundance increased with bare ground.

Clay-colored sparrow abundance increased with increasing cover of woody vegetation. Western meadowlarks responded positively to increasing litter depth. Finally, chestnut-collared longspurs increased with increasing bare ground and shorter vegetation (Table 1 and Figure 2).

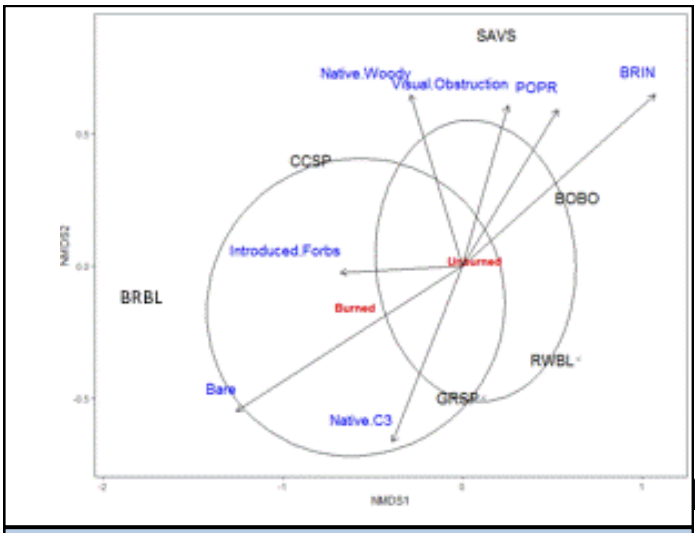

Figure 2. Nonmetric dimensional scaling (NMDS) ordination plot for abundances of six grassland bird species in a landscape managed with patch-burn grazing at the Central Grasslands Research Extension Center near Streeter, N.D. Abbreviations for environmental variables are as follows: BRIN: smooth brome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

Discussion

Following two years of data collection, we demonstrate distinct preferences for vegetation structure in the breeding bird community. 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.

We expect to find a divergence in the breeding community as our treatment structure is further implemented (Pillsbury et al., 2011).

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T.J. Hovick, NDSU