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Avian Habitat Following Grazing Native Warm-Season Forages in the Mid-South United States

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ABSTRACT

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Native warm-season grasses (NWSG) currently are being promoted for livestock forage and biofuels feedstock in the Mid-South. However, there are no published data on how NWSGs managed with livestock in the Mid-South may affect habitat for wildlife. We conducted a study to evaluate habitat for grassland songbirds and northern bobwhite *(Colinus virginianus)* in response to two cattle grazing treatments in NWSG pastures across three sites in Tennessee, 2010 and 2011. We evaluated vegetation composition and structure along with invertebrate availability during the primary nesting season for grassland songbirds and the typical brood-rearing season for the northern bobwhite. Grazing treatments included full-season (May to August) grazing and early-season (30 days beginning in May) grazing, after which subsequent growth was taken as a biofuel harvest postdormancy. Forage treatments included big bluestem/indiangrass mixture, switchgrass, and eastern gamagrass. Vegetation composition was dominated by the planted forages in all pastures. All forage types and both grazing treatments provided suitable structure for grassland songbirds and bobwhite during the primary nesting season. Full-season grazing maintained suitable structure through the brooding period, with greater openness at the ground level and angle of obstruction, as well as optimal vegetation height (<60 cm). Structure within early-season grazing treatments became dense after cattle were removed with less openness at ground level than what brooding bobwhites typically use. Invertebrate biomass was sufficient in all forage types and grazing treatments to support bobwhite broods. We recommend livestock producers in the Mid-South use full-season grazing that maintains grass height of approximately 40 cm in production stands of NWSG to maximize benefits for grassland birds and northern bobwhite.

Introduction

Grassland birds are declining faster than any other group of North American birds with more than two-thirds of grassland species showing significant declines (Vickery and Herkert, 2001; Sauer et al., 2011). Among the species experiencing declines are the grasshopper sparrow *(Ammodramus savannarum)* and northern bobwhite (hereafter bobwhite). Habitat loss, habitat degradation, and agricultural intensification are primary factors contributing to grassland bird declines (Herkert, 1994; Brennan and Kuvlesky, 2005).

Native grasslands have virtually disappeared in the Mid-South region of the United States. However, there are more than 20 million acres in non-native grasslands as either pasture or hayfield (Nickerson et al., 2011). Typical grazing and hay operations in the Mid-South are based on tall fescue (*Schedonorus phoenix* Scop.), which is typically grazed continually throughout the year or hayed two to three times from May through September (Ball et al., 2007). This type of management does not promote the vegetation structure necessary to maintain diverse grassland bird populations (Giuliano and Daves, 2002; Wilson et al., 2005; Rahmig et al., 2009).

The Natural Resources Conservation Service (NRCS) and state wildlife agencies in the Mid-South are promoting native warm-season grasses (NWSG), such as big bluestem (*Andropogon gerardii* Vitman), indiangrass (*Sorghastrum nutans* L.), switchgrass (*Panicum virgatum* L.), and eastern gamagrass (*Tripsacum dactyloides* L.), for forage production and wildlife habitat improvement (USDA-NRCS, 2005). NWSGs can complement forage systems dominated by cool-season grasses because of their differing seasonality (Ball et al., 2007) and can benefit various wildlife species because of a taller and more diverse structure (Harper et al.,

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2007). However, in grazing systems, stocking rate and duration determine suitability for grassland wildlife, regardless of grass species (Guthery et al., 1990; Hickman et al., 2004).

Incorporation of NWSG into grazing systems can provide a unique opportunity to provide high-quality forage with intensive grazing during the early part of the growing season and then defer grazing to allow grass growth for biofuels feedstock (Roth et al., 2005; Bies, 2006; Fike et al., 2006; Mulkey et al., 2008). Discontinuation of grazing through the remainder of summer will create a different vegetation structure than that following continuous grazing, which can have implications for wildlife (Hammerquist-Wilson and Crawford, 1981; Murray and Best, 2003; Murray et al., 2003).

Habitat quality for grassland wildlife following incorporation of NWSG into grazing systems or grazing strategies with NWSG have not been evaluated in the Mid-South.

Although grazing strategies for NWSG have been evaluated for grassland wildlife in more arid regions (George et al., 1979; Hammerquist-Wilson and Crawford, 1981; Fuhlendorf et al., 2006; Rahmig et al., 2009), vegetation structure and amount of bare ground can differ greatly in a different region of the country where vegetation composition differs and there is increased precipitation.

Evaluation of grazing strategies for NWSG on grassland wildlife habitat is needed in order for federal and state agencies to provide accurate recommendations when delivering conservation programs. We conducted a field experiment to evaluate avian habitat in production stands of NWSG under two grazing management strategies in the Mid-South. We measured various structural parameters and invertebrate biomass, which is a key food resource for young birds and an important determinant of habitat quality. We hypothesized continuous grazing and mixtures of NWSG would create a more diverse and suitable structure for grassland birds than early, intensive grazing and monoculture stands. Furthermore, we hypothesized continuous grazing would encourage more forb cover, which would lead to more diverse and abundant invertebrate populations than monoculture plantings with less diverse structure.

Methods

Study Location

We conducted our research at three Research and Education Centers (REC) in Tennessee including Ames Plantation (APREC) located near Grand Junction, TN (35°6′N, 89°13′W), Highland Rim (HRREC) located near Springfield, TN (36°28′N, 86°50′W), and Greeneville (RECGRN) located near Greeneville, TN (36°6′N, 82°51′W). We planted three forages or forage mixtures (hereafter forages) in separate pastures in 2008: 1) Alamo switchgrass (SG), 2) OZ-70 big bluestem/Rumsey indiangrass mixture (BB/IG), and 3) Pete eastern gamagrass (EG). The big bluestem/indiangrass mixture included 65% big bluestem and 35% indiangrass based on seed mass. We used a no-till drill to plant each SG and BB/IG pasture and a corn planter to plant EG. We planted 6.72 kg Pure Live Seed (PLS)/ha, 10.08 kg PLS/ha, and 13.44 kg PLS/ha for SG, BB/IG, and EG, respectively. All pastures (1.2 ha each) were predominantly tall fescue before our study began. In the fall of 2007, pastures were clipped with a rotary mower and, after appropriate regrowth (> 15 cm), treated with glyphosate (2.24kg ai/ha) to control cool-season grass and weed competition. A final glyphosate treatment (1.12 kg ai/ha) was applied in April 2008 in preparation for planting. Pastures planted to BB/IG were sprayed with imazapic (0.11kg ai/ha) to control competition in the establishment year. Our SG plantings at APREC failed in 2008 and were successfully replanted in spring 2009. Soil samples were taken from pastures in 2010 and 2011. We amended soils with lime, nitrogen, phosphorus, and potassium in April each year according to soil test recommendations from the University of Tennessee Soil Testing Laboratory. We did not fertilize pastures during establishment to avoid stimulating competitive species.

We imposed two grazing strategies, early-season and full-season, in a factorial combination with the three forages for a total of six treatments. Early-season grazing lasted 30 days beginning each May and was designed to graze the high-quality early forage growth and allow regrowth to accumulate for a biofuels harvest in the fall. Full-season grazing was designed to maximize grazing days from early May through late summer. We managed grazing under a put-and-take system to maintain grass canopies at approximately 38–47 cm in full-season treatments. For early-season grazing, our target was to reduce canopies to 25 cm by the end of the 30-d period. Grazing strategies were designed to maximize forage performance and cattle weight gain. We initiated grazing for both grazing strategies and all three forages on the same date at each location when the average canopy for BB/IG reached approximately 30 cm. We used Angus-cross weaned steers (273 kg starting weight) in all years at all locations. Tennessee Livestock Producers (Columbia, TN) provided steers. All animal care was in accordance with UT-IACUC Protocol No. 1264. All grazing animals were provided a general cattle mineral free choice and access to water, and each pasture had adequate shade structures.

We planted SG, BB/IG, and EG at APREC in three replicates for a total of 18 experimental pastures. In the spring of 2010 and 2011, we burned the pastures to remove residual biomass from the previous year. In 2010, we initiated grazing on May 28. We concluded all early-season grazing on June 28 and concluded full-season grazing on August 9, July 26, and August 30 for SG, BB/IG, and EG, respectively. In 2011, we initiated grazing on May 4 on all pastures. We concluded early-season grazing on June 6 and concluded full-season grazing on August 9 for all pastures.

We planted SG and BB/IG at HRREC in three replicates for a total of 12 pastures. In the spring of 2010 and 2011, we clipped the pastures to 20 cm with a rotary mower to remove residual biomass from the previous year. In 2010, we initiated grazing on May 7. We concluded early-season grazing on all pastures on June 7, and we concluded full-season grazing on August 9. In 2011, we initiated grazing on May 6 on all pastures. We concluded early-season grazing on June 6 and concluded full-season grazing on August 29 for all pastures.

We planted BB/IG at RECGRN in three replicates for a total of 6 pastures. In the spring of 2010 and 2011, we burned the pastures to remove residual biomass from the previous year. In 2010, we initiated grazing on May 21. We concluded early-season grazing on June 21 and concluded full- season grazing on August 16 for all pastures. In 2011, we initiated grazing on May 20 for all pastures. We concluded early-season grazing on June 20 and concluded full-season grazing on August 15 for all pastures.

Vegetation Surveys

We conducted vegetation surveys twice during 2010 and 2011, once during late May through mid-June, and once during late June through mid-July to evaluate vegetation corresponding to nesting periods for grassland songbirds and nesting and brood-rearing periods for northern bobwhite in the Mid-South region. We measured vegetation composition and litter depth along five 10-m transects in each pasture, with observations made every 10 cm. At each 10-cm intercept, we recorded all plants bisecting the transect. We summed the total number of observations for the transect to determine percent cover by species. We recorded litter and bare ground when present. We defined litter as ground covered by dead vegetation without overhead cover of live plants, and bare ground was ground without dead vegetation or overhead cover of live plants. We established transects randomly throughout the pasture, and we used different locations during every sampling period. We measured litter depth at 1, 5, and 10 meters.

We measured vegetation structure from a stationary point at the beginning of each 10-m transect, totaling 5 points per pasture during each sampling period. Ground sighting distance, a measure of structure and openness at ground level, was measured in each cardinal direction