Agriculture, Ecosystems and Environment 193 (2014) 53–59

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Grassland bird communities on conservation and marginal grasslands in an agricultural landscape

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ARTICLE INFO

Article history:
Received 3 October 2013
Received in revised form 23 April 2014
Accepted 25 April 2014
Available online 24 May 2014

Keywords:
Agro-ecosystems
Avian community structure
Common yellowthroat
Dickcissel
Farmlands
Grasshopper sparrow
Grassland passerines
Sedge wren

ABSTRACT

Six years of point count data in eastern Nebraska and western Iowa, USA, were used to investigate how the community structure of grassland birds and the densities of four focal species (common yellowthroat, dickcissel, grasshopper sparrow and sedge wren) varied on conservation lands with differing management strategies (i.e., warm- versus cool-season grasses and low- to high-diversity plantings), and between conservation and unmanaged marginal grasslands (e.g., field borders and terraces). Model-selection results indicated that grasshopper sparrow and dickcissel densities were influenced by grassland type, with higher densities in parcels dominated by warm-season grasses. Species-specific changes in density in response to planting diversity reinforced the value of creating heterogeneous habitat for grassland birds. Densities for all four species were substantially lower in unmanaged marginal grasslands versus conservation parcels and the community structure between the two habitats differed significantly, with generalist species (e.g., American robins, common grackles and grassland species associated with shorter, sparse and patchy vegetation (e.g., horned lark and vesper sparrow)) largely replacing tallgrass specialists in unmanaged marginal grassland parcels.

1. Introduction

Grassland bird species have experienced the steepest long-term population declines of any avian guild in North America (Sauer and Link, 2011) and are the targets of significant conservation planning and management efforts (Rich et al., 2004; Johnson et al., 2004). Remaining grasslands are further threatened by disruption of historical grazing and fire patterns (Brennan and Kuvlesky, 2005), woody encroachment (Briggs et al., 2005), and agricultural intensification (Askins et al., 2007). The cumulative effects of these processes are seen most dramatically in the conversion of >96% of the original tallgrass prairie of the eastern Great Plains to row-crop agriculture and other non-grassland land types (Samson and Knopf, 1994).

Managing remaining grasslands to maximize the abundance and productivity of birds is a conservation priority (Rich et al., 2004). Within landscapes dominated by row crop agriculture, preservation of large grassland fragments is especially important for grassland bird species that may be edge and/or area sensitive (Winter and Faaborg, 1999; Fletcher, 2005; Ribic et al., 2009). Management on large conservation lands can vary, with warm or cool season grasses comprising the dominant plantings, which can influence the abundance of some avian species (Delisle and Savidge, 1997; McCoy et al., 2001; Johnson and Sandercock, 2010). Furthermore, varying the levels of forb and grass diversity can alter the structural characteristics of the vegetation community, which may differentially influence the abundances of grassland species (Johnson and Schwartz, 1993; Delisle and Savidge, 1997). For example, sedge wrens (*Cistothorus platensis*) and grasshopper sparrows (*Ammodramus savannarum*) both occur in tallgrass prairies, but sedge wrens typically prefer tall vegetation with moderate forb cover (Dechant et al., 2002c) whereas grasshopper sparrows (*A. savannarum*) prefer patches with shorter grasses and clumped vegetation (Dechant et al., 2002b).

Efforts to conserve European farmland birds have focused in part on managed and unmanaged field margins in agricultural landscapes (e.g., Robinson and Sutherland, 2002), and the active

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http://dx.doi.org/10.1016/j.agee.2014.04.026
0167-8809/

management of field margins has been formerly incorporated into many European Union conservation plans (Vickery et al., 2009). In the United States, by contrast, comparatively little attention has been paid to the use by grassland birds of the unmanaged grassy margins (hereafter, "unmanaged marginal grasslands") associated with the agricultural lands now dominating the landscape. Such habitat can provide food resources for birds (Vickery et al., 2009) and although densities (e.g., Hultquist and Best, 2001), reproductive performance (Best, 2000), and survival (Bro et al., 2004) may be lower than what is found in large block grasslands, unmanaged marginal grasslands often represent the best available habitat in agricultural landscapes where many species infrequently use row-crop fields for foraging or nesting (Best et al., 1995). The recent rise in commodity prices and the associated increase in conversion of grasslands to row-crop fields (Wright and Wimberly, 2013) emphasize the challenges of maintaining, much less increasing, the amount of tallgrass prairie habitat. As such, there is a continued need to manage existing prairies to maximize their conservation potential and to investigate the value of unmanaged marginal grasslands for bird conservation. This is especially urgent given recent suggestions that marginal agricultural land be devoted to the production of biomass for a feedstock for biofuels (Gelfand et al., 2013).

We investigated how land-use and conservation practices influenced the abundance and community structure of grassland birds using 6 years of point count data recorded in tallgrass prairies and unmanaged marginal grasslands associated with agricultural fields in eastern Nebraska and western Iowa, USA. Intensification of land use in this region since the 1920's has produced a landscape with larger fields dominated by corn and soybeans, and less land devoted to grains, pasture, and other crops (Brown and Schulte, 2011). Loss of marginal grasslands from these changes has been at least partially offset by farm programs intended to reduce soil erosion through the planting of grassed terraces, waterways, and bufferstrips (Brady, 2007). Within this landscape, we assessed how abundances of four focal species and the overall avian community structure differed (1) between block conservation grasslands and unmanaged marginal grasslands, (2) between warm- and cool-season dominated conservation grasslands, and (3) as a function of planting diversity within warm-season conservation grasslands. The four focal species were grasshopper sparrow, dickcissel, sedge wren, and common yellowthroat (*Geothylpis trichas*). U.S. Breeding Bird Survey (BBS) data suggest that the sedge wren has exhibited a modest long-term population increase in the United States during 1966–2011 whereas the other three species have exhibited significant declines (Sauer et al., 2012). For conservation efforts within the Western Hemisphere, Rich et al. (2004) categorized the dickcissel as a "Watch Species" because of its declining trends and the grasshopper sparrow as a "Stewardship Species" because its populations are concentrated in a single biome.

2. Methods

2.1. Data collection

Point counts were performed on 131 parcels in eastern Nebraska and western Iowa during 2002–2007. Field and parcel boundaries were defined by landowners and managers and represented distinct management practices and histories (Klug et al., 2009). Most counts in conservation parcels ($n = 109$) occurred in management units within the Boyer Chute and DeSoto National Wildlife Refuges on the eastern border of Nebraska along the Missouri River. Conservation parcels at both refuges were managed under varying seeding and fire regimes and were interspersed among forested and agricultural management units. Other conservation sites included three Conservation Reserve Program (CRP) parcels, three parcels at the Allwine Prairie Preserve (a restored prairie owned and managed by the University of Nebraska at Omaha), one parcel at Cuming City Cemetery (a remnant prairie managed by Dana College), and three privately-owned parcels converted to grasslands for conservation purposes. The mean size of conservation parcels was 16.1 ha (SE 1.8 ha, range 1.6–128 ha). Some conservation parcels ($n = 31$) had originally been planted with seed mixes consisting predominantly of cool season grasses, eight of which were converted from cool- to warm-season planting during the course of the study. Conservation parcels planted with warm season grasses were categorized based on the diversity of plant species included in the seed mix. Low diversity grasslands had been planted with seed mixes containing fewer than 35 species, medium diversity sites were planted with mixes that included 35–65 species, and high diversity sites had been planted with more than 65 species. Some of the older restorations had been over seeded with additional species and their categories were adjusted to reflect the added plant diversity at the time of the surveys. Both Allwine Prairie Preserve and Cuming City Cemetery were classified as high diversity because data provided by land managers indicated >65 species occurred on both preserves. Marginal parcels ($n = 22$) were surveyed within corn and soybean row-crop fields typical of the study region. Marginal grasslands consisted of small linear grassy terraces and/or waterways within the row crops fields and grassy habitat along the field margins. In contrast to the CRP land, which was planted with native species, no marginal grasslands were managed for wildlife conservation. The mean size of the row crop fields surveyed was 62.1 ha (SE 11.3 ha, range 9.9–224.7 ha), with a mean marginal grassland area of 2.5 ha (SE 0.3 ha, range 0.5–5.9 ha). The linear nature of the marginal grasslands resulted in edge to interior ratios (0.308 ± 0.124 m/m^2 SE) that were substantially greater than those for conservation parcels (0.022 ± 0.001 m/m^2 SE).

Between 18 May and 15 June each year parcels were visited 1–11 times (mean = 2.1 ± 0.1 SE) on the basis of parcel area for fields and length for linear buffers, terraces, and roadsides. Each year points were selected within parcels in a manner that maximized coverage of the parcel while minimizing overlap, with points placed $\geq$100 m from parcel edges except for nine parcels for which the edge was <100 m. Some overlap between points occurred, but distance sampling is robust to violations of the assumption of geographic independence among points even when overlap is severe (Buckland, 2006). Point locations within parcels were not fixed across years. Five-minute, unlimited radius counts (except on seven small conservation parcels, where the radii were truncated to avoid counting birds in adjacent parcels) were performed by 16 total observers from 06:00 to 10:00 or 18:00–20:45 when weather conditions were appropriate (i.e., no fog, no or very light precipitation, wind speeds $\leq$25 kmph). Observers were experienced in identifying birds by sight and sound and their competence was confirmed prior to any data collections. Observers generally used range finders to estimate the distance to each observed bird, but they were also trained to estimate the distance when a bird could not be reliably sampled with a range-finder. Nine parcels (7%) were sampled in all 5 years of the study. An addition 39 parcels (29%) were surveyed in 3–4 years of the study and the remaining parcels (64%) were either sampled once or twice.

2.2. Analysis

Subsets of the overall dataset were used for each of three habitat comparisons (unmanaged marginal versus conservation parcels, warm- versus cool-season parcels, and planting diversity within warm-season parcels) because the sampling effort within management regimes changed across years depending upon study objectives. A hierarchical, distance-based model was used to estimate densities of the four focal species that was originally