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AN ASSESSMENT OF VEGETATION COVER FOR GRASSLAND BIRD BREEDING HABITAT IN SOUTHEASTERN WISCONSIN[1]

J. WOLF[2]
Department of Geography
University of Wisconsin – Parkside
Kenosha, WI 53141

R. BAKER
Department of Biology
University of Wisconsin – Parkside
Kenosha, WI 53141

E. REED
Department of Geography
University of Wisconsin – Parkside
Kenosha, WI 53141

Abstract. Population declines in grassland breeding birds are a concern for land managers, acknowledging that many grassland breeding birds have specific habitat requirements to sustain viable populations. In a pilot study in collaboration with the Wisconsin Department of Natural Resources, we compared vegetation cover as a habitat indicator for nesting birds from two managed prairie sites in southeastern Wisconsin: Chiwaukee Prairie State Natural Area (CPSNA) and Richard Bong State Recreation Area (RBSRA). At CPSNA, bobolink (*Dolichonyx oryzivorus*), Henslow's sparrow (*Ammodramus henslowii*), and eastern meadowlark (*Sturnella magna*) have been in steady decline. The purpose of our study, ultimately, was to determine whether vegetation differences were linked to this trend. At CPSNA, cover plant types, recorded in belt transects, were grasses, forbs, wet matrix, trees, and shrubs, and at RBSRA cover types were grasses, forbs and shrubs. At both sites, shrub densities were high and a concern for management of grassland birds, but differing between sites were vegetation cover distributions and shrub growth stage. While some differences may be due to land management practices, a review of the Breeding Birds of Wisconsin Survey indicates that these differences may be due to habitat factors such as soil type, topography, maritime effects, fragmentation, and distance to residence. The results of this pilot study can assist land managers working on management plans to devise future strategies toward restoring breeding bird habitat in Wisconsin grasslands.

Key words: grassland breeding bird habitat, landscape structure, Lake Michigan prairie, Wisconsin

[1]Submitted 28 December 2011; accepted 12 February 2012
[2]Corresponding author: wolf@uwp.edu

EVALUACION DE LA COBERTURA VEGETAL PARA HABITAT DE REPRODUCCION DE AVES DE PRADERA EN EL SUDESTE DE WISCONSIN

Resumen. Los declives poblacionales en aves reproductoras de pradera preocupan a los gestores de recursos, resaltando que muchas especies de pradera tienen requisitos de hábitat específicos para mantener poblaciones viables. En un estudio piloto en colaboración con el Departamento de Recursos Naturales de Wisconsin, comparamos la cobertura vegetal como indicador de hábitat para aves nidificantes en dos lugares de pradera manejada en el sudeste de Wisconsin: Chiwaukee Prairie State Natural Area (CPSNA) y Richard Bong State Recreation Area (RBSRA). En CPSNA, *Dolichonyx oryzivorus, Ammodramus henslowii*, y *Sturnella magna* han mostrado un declive constante. El objetivo final de nuestro estudio fue determinar si las diferencias en vegetación estaban ligadas a esta tendencia. En CPSNA, los tipos de planta registrados en los transectos fueron hierbas, anuales y arbustos. En ambos lugares, las densidades de arbustos fueron altas y preocupantes para el manejo de aves de pradera, pero diferencias entre sitios incluyeron distribuciones de cobertura de la vegetación y estadio de crecimiento de los arbustos. Aunque algunas de las diferencias pueden ser debidas a las prácticas de manejo, una revisión en el Conteo de Aves Reproductoras de Wisconsin indica que estas diferencias pueden ser debidas a factores del hábitat como tipo de suelo, topografía, efectos marítimos, fragmentación y distancia a residencia. Los resultados de este estudio piloto puede ayudar a gestores de recursos a diseñar estrategias futuras para restaurar el hábitat de reproducción de las aves de pradera de Wisconsin.

Palabras clave: hábitat de reproducción de aves de pradera, estructura del paisaje, praderas del Lago Michigan, Wisconsin

INTRODUCTION

Like many organisms, grassland birds are especially sensitive to habitat changes and require certain habitat types for breeding. In much of the country, grasslands have been subjected to agricultural development and urbanization, thus grassland bird species have been faced with habitat loss (Sample and Mossman 1997, Coppedge et al. 2001, Ribic and Sample 2001, Vos and Ribic 2011). For these reasons as well as complex migration dynamics that are difficult to resolve, certain grassland bird population have declined along Wisconsin's Breeding Bird Survey routes (Sample and Mossman 1997).

Well considered land management is important not only to known declining species but also to other fauna and flora that comprise the grassland bird community (Sample and Mossman 1997). One form of management involves the incorporation of land into the Conservation Reserve Program (CRP). Using landscape metrics, one study found that indices of juniper and total tree cover increased but patch sizes decreased in agricultural land converted back to a grassland ecosystem in a CRP (Coppedge et al 2001). These structural changes led to an increase in some grassland species as well as other open-habitat generalist bird species. Other forms of management have included the assessment of cover types such as hedgerows, ephemeral wetlands, old fields, isolated trees, and ditches, followed by conversions (Ribic and Sample 2001).

In grasslands, the survival of breeding birds relies on fine scale habitat features, which vary greatly among individual species. For example, the Bank Swallow (*Riparia riparia*), found in Chiwaukee Prairie State Natural Area (CPSNA) but not at Richard Bong State Recreation Area (RBSRA; Table 1), requires specific soil texture to form its burrows (Cutright et al. 2006, Chiwaukee Prairie Preservation Fund 2010). Another example, the Blue-winged Warbler (*Vermivora pinus*), which breeds in RBSRA but not in CPSNA, nests on the ground in grass and sedge dominated habitat (Cutright et al. 2006). Since these areas offer regionally important breeding bird habitat, it is important to better understand these habitats and, hence, the reason for this study.

Both CPSNA and RBSRA have been identified as viable grassland habitat for

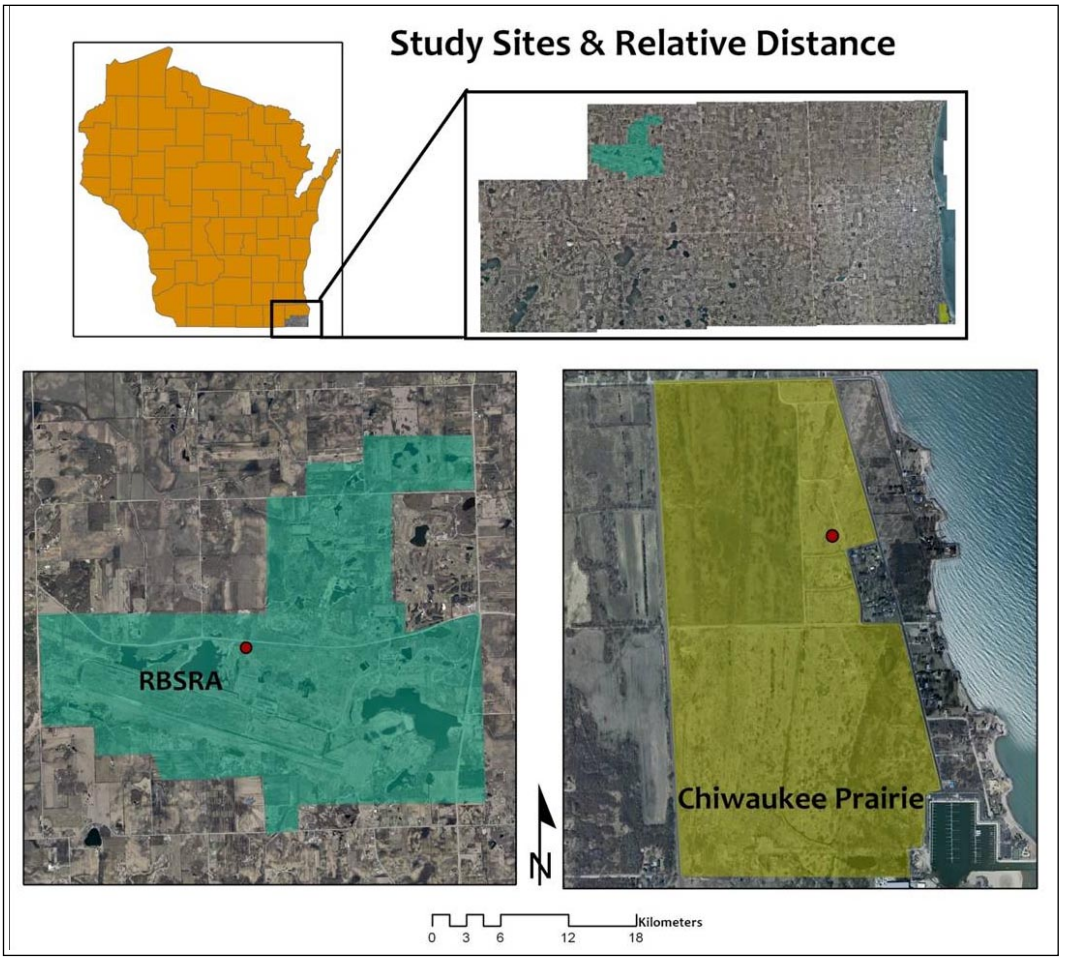

FIGURE 1. Study sites for breeding bird habitat at Richard Bong State Recreation Area (RBSRA) and Chiwaukee Prairie State Natural Area in southeastern Wisconsin.

breeding bird species in southeastern Wisconsin, where grassland habitats are considered threatened (Henderson and Krause 1995). CPSNA is an internationally known coastal prairie remnant on Lake Michigan that supports many nesting bird species. CPSNA consists of ridges with dry-mesic prairie and swales with wet-mesic prairie and is rich in grasses, sedges, cattails, spring ephemerals, and later forbs. At this site, the dry-mesic prairie is managed as nesting bird habitat.

Thirty-six kilometers inland, RBSRA consists of dry to mesic prairie, oak savanna, and wetland habitat, but has been subjected to intense disturbance. Historically, the land had been developed for agriculture and in the 1950's the area was slated to become an airstrip. Despite this, a variety of nesting birds use the grasslands of RBSRA, and as a result the National Audubon Society (2010) designates it as a priority site for grassland birds.

The purpose of this study was to compare CPSNA and RBSRA, both being managed by the Wisconsin Department of Natural Resources (WDNR), so that managers could better understand why some bird populations are in decline in CPSNA but not at RBSRA. Differences in vegetation identified may help to design surveys by which to explain differences in the

TABLE 1. Breeding birds observed in Chiwaukee Prairie State Natural Area (CPSNA) and Richard Bong State Recreation Area (RBSRA), with the preferred habitat and nesting vegetation noted for each. Species in RBSRA use open grasslands with short vegetation. Species in CPSNA rely on wet grasslands with tall vegetation. Both locations also support species that are dependent on shrub habitat for nesting (Chiwaukee Prairie Preservation Fund 2010, Wisconsin Society for Ornithology 2006).

CPSNA		
Alder Flycatcher	*Empidonax alnorum*	scrub/shrub
Bank Swallow	*Riparia riparia*	lake or pond/burrow
Chimney Swift	*Chaetura pelagica*	urban/building
Henslow's Sparrow	*Ammodramus henslowii*	tall grassland/ground
Sedge Wren	*Cistothorus platensis*	marsh/shrub
Yellow-breasted Chat	*Icteria virens*	scrub/shrub
RBSRA		
Clay-colored Sparrow	*Spizella pallida*	grassland/shrub
Eastern Towhee	*Pipilo erythrophthalmus*	scrub/ground
Grasshopper Sparrow	*Ammodramus savannarum*	open grassland/ground
Horned Lark	*Eremophila alpestris*	short grassland/ground
Savannah Sparrow	*Passerculus sandwichensis*	grassland/ground
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	wet-prairie/shrub

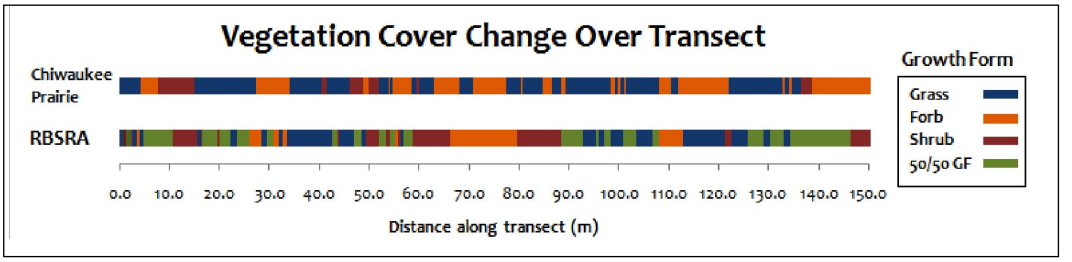

FIGURE 2. Spatial distribution of vegetation cover transects in Chiwaukee Prairie and Richard Bong State Recreation Area (RBSRA) and Chiwaukee Prairie State Natural Area in southeastern Wisconsin.

composition and population trends of the grassland bird populations.

METHODS

We collected vegetation cover data at the time of year appropriate for land management restoration such as prescribed burning. Data were collected along separate transect lines at CPSNA on 22 September, and at RBSRA on 13 October 2010. At each location, five 150 m transects were guided through the selected area perpendicularly to a bearing transect line at the edge of the habitat (Table 2). Along each transect line, to the nearest 0.1 m, the dominant vegetation cover type was noted along with the distance it persisted along the transect line.

At CPSNA, the bearing transect line ran south to north to accommodate the vegetation boundaries constrained by the ridge and swale topography from glacial Lake Chicago. Vegetation cover data were collected in the eastern portion of the site by the Al Krampert Trail located near 42°30′09″N, 87°48′35″W. At RBSRA, vegetation cover data were collected in a section of managed breeding bird habitat in the north-central portion of the site near 42°30′09″N, 87°48′35″W. The transect line ran west to east to utilize the fire break road for an origin mark.

The data were analyzed to compare suitable habitat between CPSNA and RBSRA, ultimately to be related to bird species assemblages. We used percent cover to represent density by dividing each cover type by the total of all cover types along the transect (Table 2). Relative importance values (RIV) for each cover type were expressed as cover type density divided by

TABLE 2. Ground cover, standard deviation, standard error, density, mean and range for vegetation in transects (trans) in breeding habitat in Chiwaukee Prairie. RIV = relative importance value.

Cover Type	Trans 1	Trans 2	Trans 3	Trans 4	Trans 5	Mean (m)	Transect Density	RIV	St Dev	St Error	Range
Grasses	45.00	55.40	68.40	80.50	69.10	63.68	40.87	0.409	13.71	6.13	35.50
Forbs	26.00	74.20	31.90	53.90	56.50	48.50	31.13	0.311	19.59	8.76	48.20
Shrubs	59.00	17.67	48.20	15.60	22.90	32.67	20.97	0.210	19.66	8.79	43.40
Wet	19.00	3.80	22.00	0.00	0.00	8.96	5.75	0.058	10.70	4.79	22.00
Trees	10.00	0.00	0.00	0.00	0.00	2.00	1.28	0.013	4.47	2.00	10.00
Total Cover	159.00	151.06	170.50	150.00	148.50	155.81	100.00				

100. To account for differences in bird species composition between the two areas (Table 1), we tested for differences in habitat type. This was done with two-tailed t-tests on the means and variances for the vegetation cover using the data from all transects between the two areas. Significance level was set at 0.05. Prior to conducting the *t*-tests, *F*-tests were performed to test whether the variances between the groups of the two locations were significantly different from each other. Heterogeneity of cover types was expressed by a diversity index, using the equation from Turner et al. (2001):

$$H = -\sum_{i=1}^{ns} (p_i \ln p_i / \ln s),$$

where H = diversity, p_i = cover type proportion and s = the number of cover types.

RESULTS

While both sites are used by grassland birds, there are differences in the species that nest in each, as noted (Table 1). Possibly related to these differences, CPSNA transects varied in the proportional distance that shrubs occupied each transect. At CPSNA, shrub encroachment is high, especially from *Rhamnus frangula* and *Cornus stolonifera* (Table 2). Shrubs within the prairie matrix are more clustered in CPSNA, a pattern that could reflect high or low density.

Variance was not significantly different for vegetation cover type between CPSNA and RBSRA (grasses, $F = 0.603$; forbs, $F = 0.840$; shrubs, $F = 0.590$). Overall, grasses were more dominant at CPSNA as compared to RBSRA (Table 2) and the *t*-test shows significant differences in grass cover between CPSNA and RBSRA (P = 0.049). Mean forb ($P = 0.297$) and shrub cover ($P = 0.833$) did not differ between sites. The diversity indices (H) between sites were similar (CPSNA = 206.61 vs RBSRA = 232.28). Although one should expect the diversity index to increase with the number of cover types, CPSNA had one extra cover type; the statistic was lower because density was not as even. The dominant cover type in CPSNA was grasses (mean: 63.68m and density: 40.87m), and shrubs and forbs were also high in density (shrubs: 20.97 and forbs: 31.13). Forb density may be higher depending on season. This study was conducted past peak in the growing season. Wet matrix species, such as *Typa* and *Carex*, only had a density of 5.75, possibly due to the wet area vegetation growing within the swales, which was not dominant in the area surveyed. *Populus tremuloides* was recorded in Transect 1; however, these trees were not noted in any other transect.

At RBSRA, the vegetative cover was more uniform for both grasses and forbs overall, but varied greatly from transect to transect (Table 3). Similar to CPSNA, shrub density was either very high or low; but the range was narrower. A high degree of variance existed between forbs and the mixed category of 50/50 grass/forb, perhaps due to the ambiguousness of the mixed category. Depending on individual group data collection standards, this category could possibly skew the overall results.

The data for the cover types in RBSRA reflect similar densities. Unlike CPSNA, grasses were only slightly higher at RBSRA (mean: 45.80, density: 29.23). Cover type densities were similar to grasses and each other. Forbs had a mean of 35.36 and an overall density of 22.57, the mixture category had a mean of 40.30 and an overall density of 25.72, and shrubs had a mean of 35.06 and an overall density of 22.37. Based

TABLE 3. Ground cover, standard deviation, standard error, density, mean and range for vegetation types in transects (trans) in breeding habitat in Richard Bong State Recreation Area. RIV = relative importance value.

Cover Type	Trans 1	Trans 2	Trans 3	Trans 4	Trans 5	Mean (m)	Density* (ni)	RIV	St Dev	St Error	Range
Grasses	32.00	59.70	44.90	51.00	41.40	45.80	29.23	0.292	10.38	4.64	27.70
Forbs	60.00	21.20	24.10	23.50	48.00	35.36	22.57	0.226	17.57	7.86	38.80
50/50 GF	36.00	58.50	52.00	18.00	37.00	40.30	25.72	0.257	15.77	7.05	40.50
Shrubs	23.00	42.10	29.00	57.50	23.70	35.06	22.37	0.224	14.70	6.57	34.50
No Cover	0.00	0.00	0.00	0.00	0.90	0.18	0.11	0.001	0.40	0.18	0.90
Total Cover	151.00	181.50	150.00	150.00	151.00	156.70	100.00				

* Density is represented by percent cover for each cover type.

on these data, the cover types at RBSRA are more uniform with respect to abundance. The site at RBSRA is a dry-mesic prairie, thus no wet matrix was recorded. Transect 5 contained a section of bare cover (density = 0.11). These trends regarding the composition of RBSRA cover types are reflected in the RIVs (Table 3).

DISCUSSION

Many factors including vegetation structure and type, habitat fragmentation, urbanization, surrounding landscapes and management history may influence the composition of breeding bird species, some of which could explain the differences in avian composition at the two study sites. In prairies, shrubs can encroach into native grasslands, thus changing vegetative structure, leading to a decrease in certain grassland birds but an increase in bird species that require shrub habitat. Shrub dominance was apparent at both study sites and seemed to occur in clusters throughout, as indicated by the varying shrub data. In CPSNA, areas dominated by forbs had few grasses and a mixture of the two was not common like it was at RBSRA. In addition, the swales in CPSNA support wet habitat species. The ridge-swale topography would influence the clustered cover types in CPSNA. Understanding cover type diversity may be a useful reference when managing CPSNA. Indeed, one study showed that in areas that had less diversity in cover types, bird densities were higher (Ribic and Sample 2001).

In both areas, shrub density is a concern to management of grasslands and their birds. Some shrubs are necessary, but without control measures there is potential for encroachment. Cutright et al. (2006) note that grassland/prairie habitats, whether native or non-native, have < 25% woody vegetation cover, a pattern noted previously (Northern Prairie Wildlife Research Center 2006): "unsuitable habitats for grassland birds include grasslands with too much woody cover (i.e., generally more than 30% cover)." Based on our data, both study sites have high shrub densities (CPSNA shrub density = 20.97, RBSRA shrub density = 22.37), but there were differences in the growth patterns and life stages of the shrubs. Shrubs at CPSNA appeared to form dense thickets, were taller and possibly older than those at RBSRA. This could be due to topography differences, but shrubs at RBSRA (mostly *Cornus*) were shorter and less dense in the area sampled (although other areas at RBSRA have tall, dense shrubs). The species in wet matrix habitat in the swales may not have been well represented in the data.

Although cover density was similar with a high diversity index, other variables may influence the breeding birds that live and nest in the two study sites. On a broad scale, CPSNA and RBSRA have different ecological landscapes. CPSNA is part of the Southern Lake Michigan Costal Ecological Landscape composed of areas with the unique ridge and swale topography and sandy plains (CPSNA is mentioned as a Lake Plain prairie; Cutright et al. 2006). Avian species found in this community include the Peregrine Falcon (*Falco peregrinus*), Prairie Warbler (*Dendroica discolor*), Yellow-crowned Night-heron (*Nyctanassa violacea*), Tufted Titmouse (*Baeolophus bicolor*), Bell's Vireo (*Vireo bellii*), White-eyed Vireo (*Vireo griseus*), Cerulean Warbler (*Dendroica cerulea*), Orchard Oriole (*Icterus spurius*), and Henslow's Sparrow (*Ammodramus henslowii*). RBSRA is also in this

ecological region, but it closely borders the Southeast Glacial Plains, which are dominated by prairies, oak savannas, and wet-mesic prairies, and does not have ridge and swale topography.

Vegetative height also can have important implications to grassland birds. The height differences may be better understood by soil texture. CPSNA's unique coastal prairie community consists of wet-mesic species in the swales and dry-mesic species on the ridges; the soil is > 90% sand. Although RBSRA is southeastern Wisconsin's largest managed prairie, it also has large components of oak savanna and wetland, with more clayey soil.

An important difference between CPSNA and RBSRA is in the landscape surrounding these sites. While the degree of isolation certainly influences the suitable habitat of the local landscape, adjacent cover types would limit or facilitate habitat-based species (Ribic and Sample 2001). As well, as noted by the Northern Prairie Wildlife Research Center (2006), "the character of the surrounding land use may affect bird occupancy of a habitat patch and in some cases the nature of the habitat around a site may be more important than the field or patch size". CPSNA, as noted by WDNR (2010), is roughly 166 hectares. This is a large tract of land, but some nesting birds require expansive habitat. In addition, some species are sensitive to patch area, such as the Boblink (*Dolichonyx oryzivorus*), Baird's Sparrow (*Ammodramus bairdii*), and Grasshopper Sparrow (*Ammodramus savannarum*), which are found in larger patches (Johnson and Igl 2001). Patch vegetation or disturbance intensity also plays a role in bird assemblages. Some species such as Vesper Sparrow (*Pooecetes gramineus*) prefer smaller patches with shorter vegetation and woody cover (Vos and Ribic 2011). Overall, larger patches of native habitat in a landscape sustain more of the obligate grassland birds that are considered of management concern.

A confounding factor is that many parcels of the land in CPSNA are privately owned, and can be severely overgrown. This degradation of habitat structure and quality fragments the managed areas, and may deter some breeding bird species from finding CPSNA to be suitable for nesting. Although RBSRA has a history of severe disturbance, it encompasses 1827 hectares and is surrounded by agricultural land (WDNR 2009). Its larger size and similar surrounding land provide a contiguous habitat for breeding birds. Indeed, the smallest reasonable management size for grassland habitat for birds should be either 2023 hectare or 404 hectare blocks (Sample and Mossman 1997). At this scale, it is more likely that ecological processes (indeed, resistance to shrubs) that maintain viable grassland habitat can also operate, such as fire, grazing and drought (Askins et al. 2007).

In addition, the nesting bird habitat at CPSNA consists of a remnant, species-rich coastal prairie, with *Typha* and shrub encroachment. The area sampled at RBSRA is also a known nesting bird habitat with shrub encroachment but this was difficult to detect without close observation. This study confirmed that the shrubs were much shorter than at CPSNA due to management practices.

While vegetative cover is an important component, it alone does not provide information as to the quality of the habitat. Breeding bird nesting strategies and habitats are dynamic. When land is converted to CRP, "row crops can be used to buffer managed grassland habitat from woody edges and nest predation" (Northern Prairie Wildlife Research Center 2006). Other considerations should include management history, topography, soil characteristics, vegetative height/species variations, vegetative cover type, patch size, and the management of the surrounding land.

While data were collected late in the season for land management purposes, future vegetative surveys should give a more comprehensive perspective of reasons behind bird population fluctuations. That is, bird use information taken during the breeding season such as the number of males present and nest locations would allow for more detailed information to better understand characteristics that may contribute to the differences in breeding bird species between these two habitats. Bird locations can differ as a result from cover type manipulations, precipitation patterns, or location preference regardless of disturbance (Weins and Rotenberry 1986). Management decisions to facilitate bird movement may consider corridors that could link fragmented grasslands. To further help with land management decisions, more focus should

be placed on specific vegetation, including structure, that birds use for resources and nest placement.

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