

Trends in Bird Densities at a Remnant Fescue Grassland in Saskatchewan

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Populations of grassland birds in North America have declined greatly in the past five decades. Hypothesized drivers of decline include habitat loss, fragmentation, and adverse impacts from human activities. At a remnant fescue grassland in Saskatoon, Saskatchewan numbers of Savannah Sparrow (*Passerculus sandwichensis*), Western Meadowlark (*Sturnella neglecta*), Brewer's Blackbird (*Euphagus cyanocephalus*), and Vesper Sparrow (*Pooecetes gramineus*) have been stable. Numbers of Clay-colored Sparrow (*Spizella pallida*) have increased since the 1960s. Sprague's Pipit (*Anthus spragueii*), Upland Sandpiper (*Bartramia longicauda*), and Burrowing Owl (*Athene cunicularia*) are no longer present. Baird's Sparrow (*Ammodramus bairdii*), Bobolink (*Dolichonyx oryzivorus*), and Horned Lark (*Eremophila alpestris*) have become irregular visitors. In the past 50 years, 91 species have been observed displaying territorial behaviour, feeding, nesting, or migrating at this remnant native grassland. With encroaching urban development and increased human influence at the prairie and surrounding area, the impacts on the bird communities at the site in the future are unknown.

Key Words: Bird population density trends; fescue grassland; grassland bird specialists; Saskatchewan

Introduction

In the Prairie Ecozone of southern Saskatchewan native grasslands comprise 21% of the land area (51 628 km²; Acton *et al.* 1998; Hammermeister *et al.* 2001). Most of these grasslands occur as small, fragmented patches except for a few larger contiguous patches in the extreme southwest portion of the province. In the Moist Mixed Grassland Ecoregion within this region, only 5.3% is native grassland usually in remnant patches (Gauthier and Wiken 2003), and in local areas of prime cropland less than 2% of the original prairie remains (Hammermeister *et al.* 2001).

One of the largest remnants of this type of grassland is the Kernen Prairie, a 130 ha Fescue Prairie now within the city limits of Saskatoon, Saskatchewan (52.167°N, 106.55°W, elevation 510 m). The prairie is in the Saskatoon Plain Landscape Area in the Moist Mixed Grassland Ecoregion of the Prairie Ecozone (Acton *et al.* 1998). Coupland and Brayshaw (1953) and Coupland (1961) described the Fescue Prairie in Saskatchewan, and native plant communities at Kernen Prairie have been described by Baines (1964, 1973), Pylypec (1986), and Gross and Romo (2010a,b). Plains Rough Fescue (*Festuca hallii* (Vasey) Piper) is the dominant graminoid species with Northern Porcupine Grass (*Hesperostipa curtiseta* (Hitchcock) Barkworth), Thick-spike Wildrye (*Elymus lanceolatus* (Scribner & J.G. Smith) Gould), and Slender Wildrye (*Elymus trachycaulus* (Link) Gould ex Shinners) also important species. Important shrub communities are dominated by Western Snowberry (*Symphoricarpos occidentalis* Hooker), Wolf-willow (*Elaeagnus commutata* Bernhardt ex Ryd-

berg), Prairie Rose (*Rosa arkansana* Porter), Woods' Rose (*Rosa woodsii* Lindley), and White Meadowsweet (*Spiraea alba* Du Roi). Tree species are not prominent in the prairie; four bluffs and several small patches of Trembling Aspen (*Populus tremuloides* Michaux) are present as well as several Bebb's Willow (*Salix bebbiana* Sargent) stands in depressional sites. In total, 165 species of vascular plants representing 34 families have been recorded at Kernen Prairie (Pylypec 1986).

Kernen Prairie was part of the Kernen family homestead in 1917 and was used for grazing by cattle and horses until the 1930s (Baines 1964). Between that period and the 1970s it was disturbed only minimally; some areas were lightly grazed and mowed periodically. One small area (1300 m × 10 m) 700 m from the bird study plot was tilled in 1963. That tract of land was used as an airstrip until the mid-1970s, and was revegetated with the exotic grass Smooth Brome (*Bromus inermis* Leysser) and also with native prairie species. In 1977, Mr. Fred Kernen bequeathed the prairie to the University of Saskatchewan and since that time it is being managed as an ecological reserve. The site, however, has been affected by altered disturbance regimes, invasive species, and encroaching urbanization.

Fire, either started by lightning or indigenous peoples, was a historically essential process in the prairie landscape that maintained a mosaic of vegetation patches and biodiversity (Romo 2003). At the Kernen Prairie fire was suppressed for at least a century although prescribed burns of different sizes have been used various times beginning in 1986 (Gross and Romo 2010a).

Kernen Prairie is currently undergoing invasion by a number of non-native species mainly Smooth Brome with lesser amounts of Kentucky Bluegrass (*Poa pratensis* L.), Field Sow-thistle (*Sonchus arvensis* L.), and Canada Thistle (*Cirsium arvense* (L.) Scopoli). Vegetation surveys in 2006 (B.P., unpublished data) indicated approximately 15% of the prairie was occupied by these species. Smooth Brome is an introduced species that has naturalized in Canada, and combined with its competitive superiority over several native grasses has displaced native species in many grasslands in North America including the fescue grassland at Kernen Prairie (Grilz and Romo 1995; Otfinowski *et al.* 2007). To control the spread of this species, conservation grazing with cattle at light grazing loads (0.3–0.4 animal units/ha) was initiated in 2006 for the May to September grazing period (Mori 2009) and the grazing is on-going.

Kernen Prairie can be considered as an island of native vegetation in a matrix of cropland and urban development (Forman 1995). Aerial photographs of the area from 1944 show this remnant prairie was already surrounded by cropland. Gravel roads along the north and east sides were established in the 1960s. In 2010 urban housing development began 800 m west of the prairie, and in 2015 the area at the northern boundary of the prairie was developed for future urban expansion.

Grassland birds have declined sharply over the past five decades due to habitat loss and degradation (Owens and Myres 1973; Kantrud and Kologiski 1982; Davis 2004; Askins *et al.* 2007; Henderson and Davis 2014). These grassland bird declines are more severe than those documented for any other behavioural or ecological guild of North American birds (Knopf 1994; Sampson and Knopf 1994). Eight species recorded at Kernen Prairie have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; SARA Registry 2017). Burrowing Owl (*Athene cunicularia*) is listed in Schedule 1 of the *Species at Risk Act* (SARA) as endangered while Loggerhead Shrike (*Lanius ludovicianus*) and Sprague's Pipit (*Anthus spragueii*) are listed as threatened. Long-billed Curlew (*Numenius americanus*), Short-eared Owl (*Asio flammeus*), and Baird's Sparrow (*Ammodramus bairdii*) are listed as species of special concern (SARA Registry 2017). Bobolink (*Dolichonyx oryzivorus*) and Lark Bunting (*Calamospiza melanocorys*) have been assessed as threatened by COSEWIC but are not yet on Schedule 1 (SARA Registry 2017).

The objectives of this study are to (1) document changes in the densities of breeding populations of grassland bird specialists over the past 50 years at a remnant native fescue grassland, (2) relate these to habitat and landscape changes at the study site over the same period, and (3) compare with trends in southern Saskatchewan as indicated in the Breeding Bird Survey (BBS) for 1970–2012.

Methods

Breeding bird densities were studied at an 18.6 ha gridded plot with grid markers at 60 m intervals that was established in 1966. Bird populations were first studied by M. R. Lein and D. J. Karasiuk from 1966 to 1970 (Lein 1968; Karasiuk 1973). This study was from 1987 to 1989 (Pylypec 1991) and then from 2005 to 2016. All of these studies were conducted on the same plot and the same methods were used to determine breeding bird densities.

Breeding birds were censused using the mapping method described by Kendeigh (1944) and Davis (1965). Censuses of approximately 2.5 h duration were conducted approximately twice weekly during the breeding season from May to July in each of the years of this study. The censuses were conducted between 08:00 and 10:30 when weather conditions were favourable for seeing and hearing singing males. During each census, locations of birds exhibiting territorial behaviour such as singing at perches, aerial flight displays, and conflicts between neighbouring males were recorded on a map of the plot. These data points were used to map the breeding territories of each species and to determine their breeding density. For example, if 30 territories were noted on the plot, the density was determined to be 1.61 pairs/ha.

Brewer's Blackbirds (*Euphagus cyanocephalus*) nested in two loose colonies at the plot. As these birds do not exhibit well-defined individual breeding territories, their densities were estimated from the maximum number of males observed showing territorial behaviour at the colonies. Observations of migrating birds and birds in the immediate vicinity of the plot were also noted.

Bird population data and habitat descriptions prior to this study were obtained from earlier studies at the site (Lein 1968; Karasiuk 1973; Pylypec 1991). Also, historical aerial photographs of the prairie were examined. Status and abundance for all species observed at the prairie were determined using definitions given by Roy (1996), Smith (1996), Leighton *et al.* (2002), and Saskatoon Nature Society (2010; Table 1). Annual trend, indicated as average annual percent change in the population, was noted for each species using BBS data for the pothole region of southern Saskatchewan (BCR11) for the 1970–2012 period (Environment Canada 2014).

Results and Discussion

A total of 91 species were observed displaying territorial behaviour, feeding, nesting, or migrating at Kernen Prairie from 1966 to 2016. Twenty-one species were recorded with definite breeding records, 52 species as summer residents in the Saskatoon area but with no definite breeding records at the Kernen Prairie, five species as permanent residents in the Saskatoon area but with no definite breeding records at the prairie, and 13 spring transients (Table 1).

TABLE 1. List of species observed at Kernen Prairie, their occurrence* and abundance† at Kernen Prairie and in the Saskatoon area, and Breeding Bird Survey (BBS) trends‡ in southern Saskatchewan.

Occurrence	Abundance				BBS trend in southern SK 1970–2012
	1966–1970	Kernen Prairie 1987–1989	2005–2016	Saskatoon area 2002	
A. Summer and permanent residents with definite breeding records (n = 21)					
Gadwall (<i>Anas strepera</i>)	common	fairly common	fairly common	common	4.140
Mallard (<i>Anas platyrhynchos</i>)	common	common	common	common	-1.230
Blue-winged Teal (<i>Anas discors</i>)	common	fairly common	fairly common	fairly common	1.640
Northern Pintail (<i>Anas acuta</i>)	common	fairly common	fairly common	common	-4.500
Sharp-tailed Grouse (<i>Tympanuchus phasianellus</i>)	common	fairly common	fairly common	fairly common	-1.240
Northern Harrier (<i>Circus cyaneus</i>)	common	fairly common	fairly common	fairly common	-1.740
Swainson's Hawk (<i>Buteo swainsoni</i>)	fairly common	fairly common	absent	uncommon	0.745
Upland Sandpiper (<i>Bartramia longicauda</i>)	fairly common	fairly common	absent	fairly common	4.180
Great Horned Owl (<i>Bubo virginianus</i>)	fairly common	absent	absent	fairly common	0.455
Burrowing Owl (<i>Athene cucularia</i>)	common	common	fairly common	irregular	ID
Eastern Kingbird (<i>Tyrannus tyrannus</i>)	common	common	common	common	0.119
Black-billed Magpie (<i>Pica hudsonia</i>)	abundant	abundant	irregular	common	-0.902
Sprague's Pipit (<i>Anthus spragueii</i>)	common	abundant	abundant	uncommon	-3.830
Clay-colored Sparrow (<i>Spizella pallida</i>)	common	common	common	common	-0.366
Vesper Sparrow (<i>Pooecetes gramineus</i>)	abundant	abundant	abundant	common	0.595
Savannah Sparrow (<i>Passerculus sandwichensis</i>)	common	common	abundant	common	1.040
Baird's Sparrow (<i>Ammodramus bairdii</i>)	uncommon	absent	rare	uncommon	-1.850
Bobolink (<i>Dolichonyx oryzivorus</i>)	common	absent	irregular	fairly common	0.703
Western Meadowlark (<i>Sturnella neglecta</i>)	common	common	common	common	-2.620
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	common	common	common	common	-1.970
Brown-headed Cowbird (<i>Molothrus ater</i>)	common	uncommon	uncommon	common	1.190
B. Permanent residents but no breeding records (n = 5)					
Gray Partridge (<i>Perdix perdix</i>)	fairly common	uncommon	uncommon	fairly common	-0.057
Rock Pigeon (<i>Columba livia</i>)		uncommon	uncommon	common	-1.230
Downy Woodpecker (<i>Dryobates pubescens</i>)		absent	irregular	fairly common	-0.804
Hairy Woodpecker (<i>Picoides villosus</i>)		absent	irregular	fairly common	3.820
Pileated Woodpecker (<i>Dryocopus pileatus</i>)		absent	irregular	rare	ND
C. Summer residents but no definite breeding records (n = 52)					
Canada Goose (<i>Branta canadensis</i>)		fairly common	fairly common	common	9.030
American Wigeon (<i>Anas americana</i>)		absent	irregular	common	-3.670
Northern Shoveler (<i>Anas clypeata</i>)		irregular	irregular	common	2.330
Green-winged Teal (<i>Anas crecca</i>)		absent	irregular	common	1.150
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)		irregular	irregular	uncommon	4.680
Great Blue Heron (<i>Ardea herodias</i>)		absent	irregular	uncommon	-3.190

TABLE 1. (continued) List of species observed at Kernen Prairie, their occurrence* and abundance† at Kernen Prairie and in the Saskatoon area, and Breeding Bird Survey (BBS) trends‡ in southern Saskatchewan.

Occurrence	Abundance		BBS trend in southern SK 1970–2012
	Kernen Prairie 1987–1989	2005–2016	
Turkey Vulture (<i>Cathartes aura</i>)	absent	irregular	rare
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	irregular	irregular	common
American Kestrel (<i>Falco sparverius</i>)	irregular	irregular	uncommon
Merlin (<i>Falco columbarius</i>)	absent	irregular	fairly common
Sora (<i>Porzana carolina</i>)	absent	irregular	common
American Coot (<i>Fulica americana</i>)	uncommon	uncommon	fairly common
Killdeer (<i>Charadrius vociferus</i>)	absent	irregular	common
American Avocet (<i>Recurvirostra americana</i>)	uncommon	uncommon	fairly common
Willet (<i>Tringa semipalmata</i>)	irregular	irregular	common
Lesser Yellowlegs (<i>Tringa flavipes</i>)	absent	irregular	uncommon
Long-billed Curlew (<i>Numenius americanus</i>)	uncommon	uncommon	fairly common
Marbled Godwit (<i>Limosa fedoa</i>)	irregular	uncommon	uncommon
Wilson's Snipe (<i>Gallinago delicata</i>)	uncommon	irregular	fairly common
Franklin's Gull (<i>Larus delawarensis</i>)	uncommon	uncommon	fairly common
Black Tern (<i>Chlidonias niger</i>)	uncommon	uncommon	common
Mourning Dove (<i>Zenaidura macroura</i>)	irregular	irregular	common
Northern Flicker (<i>Colaptes auratus</i>)	irregular	irregular	fairly common
Western Wood Pewee (<i>Contopus sortidaltus</i>)	absent	irregular	irregular
Least Flycatcher (<i>Empidonax minimus</i>)	absent	irregular	common
Say's Phoebe (<i>Sayornis saya</i>)	absent	irregular	uncommon
Western Kingbird (<i>Tyrannus verticalis</i>)	irregular	irregular	common
Loggerhead Shrike (<i>Lanius ludovicianus</i>)	absent	irregular	uncommon
Red-eyed Vireo (<i>Vireo olivaceus</i>)	absent	irregular	common
American Crow (<i>Corvus brachyrhynchos</i>)	fairly common	fairly common	common
Common Raven (<i>Corvus corax</i>)	absent	uncommon	uncommon
Horned Lark (<i>Eremophila alpestris</i>)	fairly common	uncommon	fairly common
Tree Swallow (<i>Iridoprocne bicolor</i>)	uncommon	uncommon	common
Barn Swallow (<i>Hirundo rustica</i>)	uncommon	uncommon	common
House Wren (<i>Troglodytes aedon</i>)	irregular	irregular	common
Sedge Wren (<i>Cistothorus platensis</i>)	absent	irregular	common
American Robin (<i>Turdus migratorius</i>)	absent	irregular	uncommon
Gray Catbird (<i>Dumetella carolinensis</i>)	absent	irregular	fairly common
Brown Thrasher (<i>Toxostoma rufum</i>)	irregular	irregular	fairly common
European Starling (<i>Sturnus vulgaris</i>)	irregular	absent	uncommon
Cedar Waxwing (<i>Bombusilla cedrorum</i>)	irregular	irregular	common
Yellow Warbler (<i>Setophaga petechia</i>)	absent	irregular	common
Ovenbird (<i>Seiurus aurocapilla</i>)	absent	irregular	uncommon

TABLE 1. (continued) List of species observed at Kernen Prairie, their occurrence* and abundance† at Kernen Prairie and in the Saskatoon area, and Breeding Bird Survey (BBS) trends‡ in southern Saskatchewan.

Occurrence	Abundance				BBS trend in southern SK 1970–2012
	Kernen Prairie		Saskatoon area		
	1966–1970	1987–1989	2005–2016	2002	
Chipping Sparrow (<i>Spizella passerina</i>)		absent	irregular	common	1.810
Lark Bunting (<i>Calamospiza melanocorys</i>)		irregular	absent	rare	-5.760
Grasshopper Sparrow (<i>Ammodramus saviannarum</i>)	irregular	absent	absent	irregular	-2.360
LeConte's Sparrow (<i>Ammodramus leconteii</i>)		absent	irregular	fairly common	0.996
Song Sparrow (<i>Melospiza melodia</i>)		absent	irregular	fairly common	-1.080
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	common	uncommon	uncommon	abundant	-0.286
Yellow-headed Blackbird (<i>Xanthocephalus xanthocephalus</i>)		irregular	irregular	common	1.630
American Goldfinch (<i>Spinus tristis</i>)	uncommon	uncommon	uncommon	common	0.016
D. Spring transients ($n = 13$)					
Greater White-fronted Goose (<i>Anser albifrons</i>)		irregular	irregular	abundant	ID
Snow Goose (<i>Chen caerulescens</i>)		absent	irregular	abundant	ID
Tundra Swan (<i>Cygnus columbianus</i>)		absent	irregular	abundant	ID
Bald Eagle (<i>Haliaeetus leucocephalus</i>)		absent	irregular	fairly common	ND
Cooper's Hawk (<i>Accipiter cooperii</i>)		absent	irregular	uncommon	-1.200
Rough-legged Hawk (<i>Buteo lagopus</i>)		irregular	irregular	uncommon	ID
Sandhill Crane (<i>Grus canadensis</i>)		irregular	irregular	common	3.660
American Golden-plover (<i>Pluvialis dominica</i>)		irregular	irregular	fairly common	ID
Sanderling (<i>Calidris alba</i>)		absent	irregular	fairly common	ID
Snowy Owl (<i>Nyctea scandiaca</i>)		absent	irregular	fairly common	ID
Short-eared Owl (<i>Asio flammeus</i>)	irregular	irregular	irregular	irregular	-5.400
White-throated Sparrow (<i>Zonotrichia albicollis</i>)		absent	irregular	common	1.330
White-crowned Sparrow (<i>Zonotrichia leucophrys</i>)		irregular	absent	fairly common	-2.500

*Occurrence of species in the Saskatoon area (Leighton *et al.* 2002):

Summer resident – species normally arrives in spring and departs in the fall;

Permanent resident – species remains throughout the year;

Spring resident – species passes through area in March to June en-route to northern breeding grounds;

Definite breeding record at Kernen Prairie – nest containing eggs or young, or newly fledged young observed.

†Abundance – indication of likelihood of a sighting assuming an experienced observer is in the preferred habitat of the species (Roy 1996; Smith 1996):

Abundant – can be found without any particular search, often in large numbers;

Common – can be found in substantial numbers with a minimum of searching;

Fairly common – can generally be found but usually in small numbers and with some searching;

Uncommon – may not be found on every trip and usually in small numbers or alone;

Rare – difficult to find because of extremely limited numbers;

Irregular – not present every year.

‡Percent annual change (1970–2012) indicated in BBS data (Environment Canada 2014); ID = insufficient data; ND = no data.

Nine of 21 species with breeding records on the plot (Figure 1) established breeding territories and were recorded regularly in censuses throughout the duration of this study (Lein 1968; Karasiuk 1973; Pylypec 1991). The most common was the Savannah Sparrow (*Passerculus sandwichensis*; Figure 1a). Breeding density averaged 1.50 pairs/ha (or 28 territories on the plot) and numbers have declined somewhat over the past 50 years (R Development Core Team 2016; Spearman rank correlation coefficient, $r_s = -0.641$, $P = 0.007$). Numbers were 1.61 pairs/ha in 1967 (Lein 1968), 1.70 pairs/ha in 1987–1989 (Pylypec 1991) and ranged from 1.18 pairs/ha to 1.75 pairs/ha in 2005–2016. In the pothole region of southern Saskatchewan BBS data for the 1970–2012 period indicates an average annual increase of 1.04% (Environment Canada 2014). This species utilizes shrubs for nesting cover and song perches but also feeds in open grassland vegetation (Lein 1968; Karasiuk 1973); these vegetation types were present throughout the duration of this study.

Clay-colored Sparrows (*Spizella pallida*) averaged 1.40 pairs/ha (26 territories on the plot) (Figure 1b). Densities were lowest (0.38 pairs/ha) in 1968 and 1969 (Karasiuk 1973) and numbers have increased ($r_s = 0.874$, $P < 0.001$) to a high of 2.02 pairs/ha in 2015.

In contrast, BBS data indicate an average annual decline of 0.366% for the same period in southern Saskatchewan (Environment Canada 2014). The preferred habitat of this species is dense brush patches (Knapton 1978; Kantrud and Kologiski 1982; Arnold and Higgins 1986; Madden *et al.* 2000). Judging from historical aerial photographs of the Kern Prairie this vegetation type was less prevalent in the 1960s than at present.

Western Meadowlark (*Sturnella neglecta*) and Sprague's Pipit are two grassland birds that feed and nest primarily in open grassland (Maher 1973). Numbers of Western Meadowlark have declined somewhat ($r_s = -0.637$, $P = 0.004$) averaging 0.21 pairs/ha or 3.91 pairs at the plot since 1968 (Figure 1d). BBS data indicate an annual decline of 2.62% in southern Saskatchewan (Environment Canada 2014). Sprague's Pipits were relatively common (0.27 pairs/ha or 5.0 pairs at the plot) in 1968–1970 (Karasiuk 1973) and 1987–1989 (Pylypec 1991) but since 2005 numbers declined tremendously ($r_s = -0.845$, $P < 0.001$) and the last territory at the plot was noted in 2010 (Figure 1e). The species has declined (–3.83% annually) also in southern Saskatchewan (Environment Canada 2014). Sprague's Pipit is listed as threatened (SARA Registry 2017).

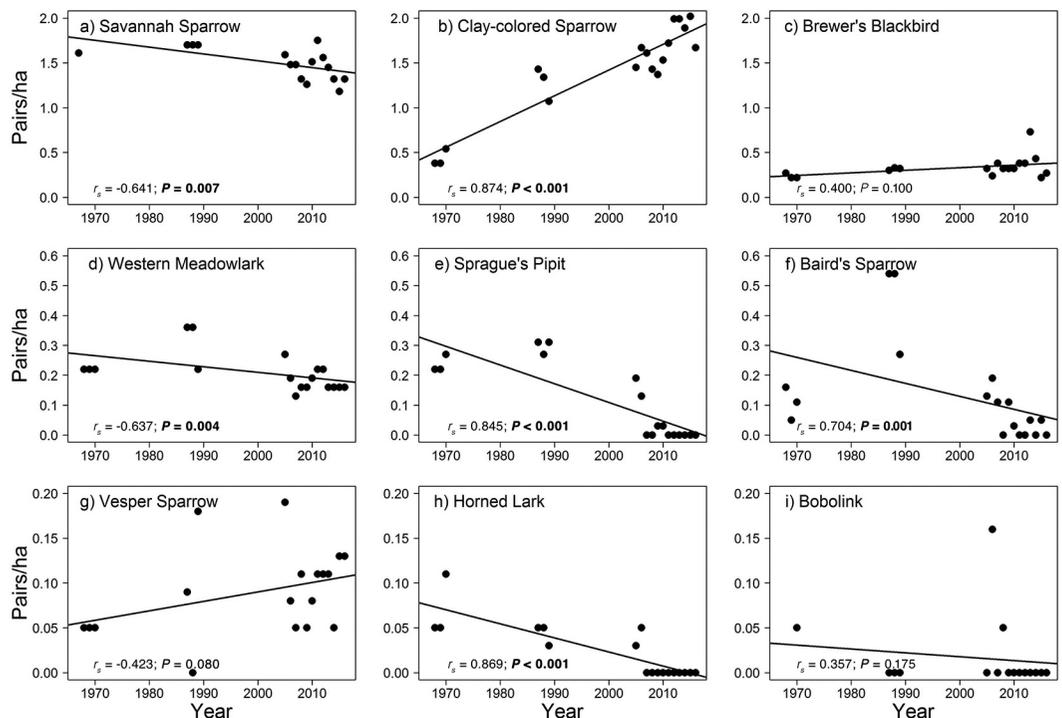


FIGURE 1. Breeding bird densities at Kern Prairie: 1966–1970 (Lein 1968; Karasiuk 1973), 1987–1989 (Pylypec 1991), and 2005–2016. Spearman's non-parametric correlation coefficients between year and the abundance of each species (r_s) and P -values are indicated; bold P -values are significant following a Bonferroni correction for multiple tests (0.05/9 = 0.0055).

Baird's Sparrow is another passerine that feeds and nests in open grassland with a thick vegetative canopy (Lein 1968; Maher 1973). This species does not occur in grassland that been heavily grazed, recently burned, or in cultivated areas. The species is "uncommon" in the Saskatoon area (Leighton *et al.* 2002). At the Kernen Prairie highest densities (0.54 pairs/ha) were noted in 1987 and 1988 (Pylypec 1991) but since 2008 it has been observed in very low numbers and was absent in five of nine years ($r_s = -0.704$, $P = 0.001$; Figure 1f). BBS data indicate the species declining 1.85% annually in southern Saskatchewan (Environment Canada 2014). The species is listed as a species of special concern (SARA Registry 2017).

Vesper Sparrow (*Pooecetes gramineus*) numbers were relatively low (averaged 0.09 pairs/ha) but were consistent over the past 50 years (Figure 1g). In southern Saskatchewan, the species has increased annually (0.595%) during 1970–2012 (Environment Canada 2014). Vesper Sparrow is an "edge species" typically occupying fence lines between cultivated fields and native grassland (Owens and Myres 1973) but at Kernen Prairie it was also present in ecotonal areas around dense brush patches and aspen bluffs.

Horned Lark (*Eremophila alpestris*) is a grassland bird whose preferred habitat is grazed native grassland as opposed to "ungrazed" grassland (Maher 1973; Owens and Myres 1973). It also is the only passerine species in fescue grasslands of Alberta that uses cultivated land to any degree (Owens and Myres 1973). At Kernen Prairie the species was present at low numbers (0.05 pairs/ha) in 1968–1970 (Karasiuk 1973), 1987–1989 (Pylypec 1991), and 2005–2006 (Figure 1h). Since 2007 the species was absent at the native grassland ($r_s = -0.869$, $P < 0.001$) but a few individuals were noted in an adjacent cultivated field. In southern Saskatchewan, BBS data indicate a large annual decline (–4.39%) from 1970 to 2012 (Environment Canada 2014).

Two uncommon non-passerine birds of note have nested at Kernen Prairie in the past but are no longer present. Burrowing Owl, listed as endangered (SARA Registry 2017), was recorded as a resident on the prairie in 1966 and 1967 (Lein 1968). Two pairs were last noted in 1980, and the last pair in the area nested 1 km from the prairie in 1982. The species was not recorded in 1987–1989 (Pylypec 1991) or in 2005–2016. Upland Sandpiper (*Bartramia longicauda*), an uncommon summer resident in the Saskatoon area (Leighton *et al.* 2002), nested on the plot in 1988 and was last observed in 1989 (Pylypec 1991). It was not recorded in 2005–2016. However, in southern Saskatchewan BBS data indicate an annual increase of 4.18% (Environment Canada 2014).

Two additional non-passerine birds listed under SARA (SARA Registry 2017) have been observed at the Kernen Prairie. Long-billed Curlew is an "uncommon summer resident" in the Saskatoon area (Leighton

et al. 2002) and is listed as a species of special concern. This study has only one record (28 June 2010). Loggerhead Shrike Prairie subspecies (*Lanius ludovicianus excubitorides*) is also an "uncommon summer resident" in the Saskatoon area (Leighton *et al.* 2002) and is listed as threatened (SARA Registry 2017). At Kernen Prairie it has been recorded as "irregular" in the past 50 years (Table 1). BBS data indicate the species declining 3.05% annually in southern Saskatchewan (Environment Canada 2014).

Bobolink was assessed as threatened in April 2010 but is not yet on Schedule 1 of SARA (SARA Registry 2017). The species was recorded nesting at Kernen Prairie in 1966 and 1970 (Karasiuk 1973; Leighton *et al.* 2002). Territorial birds were last observed in 2006 and 2008 (Figure 1i). Two males were observed 1 km from the prairie on 8 July 2011 but no birds were observed from 2012 to 2016. In southern Saskatchewan, an annual increase of 0.703% has been noted from 1970 to 2012 (Environment Canada 2014).

Lark Bunting also was assessed as threatened in April 2017 but is not yet on Schedule 1 of SARA (SARA Registry 2017). The species was last seen at Kernen Prairie in 1989 (Pylypec 1991). BBS data indicate significant annual decline (–5.76%) of the species in southern Saskatchewan in 1970–2012 (Environment Canada 2014).

A number of other species have been recorded as nesting at the prairie during the duration of this study (Table 1). Of note, several duck species: Mallard (*Anas platyrhynchos*), Northern Pintail (*Anas acuta*), Blue-winged Teal (*Anas discors*), and Gadwall (*Anas strepera*) have nested in dense vegetation even though no permanent wetlands are present at the prairie. Also, Sharp-tailed Grouse (*Tympanuchus phasianellus*) broods have been observed at the prairie, and a lek 200 m from the plot was used from 1987 to 2013.

One colonial species has nested in loose colonies at Kernen Prairie throughout the duration of this study. Crude density numbers of Brewer's Blackbird were 0.22–0.27 pairs/ha in 1968–1970 (Karasiuk 1973), 0.30–0.33 pairs/ha in 1987–1989 (Pylypec 1991), and 0.22–0.73 pairs/ha in 2005–2016 (Figure 1c).

Conclusions

Kernen Prairie has provided breeding habitat for a number of grassland bird specialists over the past 50 years. This remnant 130 ha fescue grassland has been surrounded by cultivated land for at least 75 years and in the past decade urban development has encroached. Vegetation structure and composition at the prairie has been affected by a number of invasive species, Smooth Brome in particular being prominent. The invasive plant species have decreased the quality of habitat for grassland birds as they utilize patches of Smooth Brome, for example, much less than areas dominated by native vegetation (e.g., Plains Rough Fescue or Western Snowberry). Current management of the prairie using prescribed burns and conservation grazing by

cattle is attempting to maintain the composition and structure of native vegetation at the site while also improving the habitat for birds and other animals. Isolation of this native grassland and land uses of surrounding areas probably have also impacted bird populations.

Numbers of Savannah Sparrow, Western Meadowlark, Brewer's Blackbird, and Vesper Sparrow have been stable over this time period and do not appear to have been affected significantly by management practices at the prairie and surrounding areas. In contrast, Clay-colored Sparrow numbers have increased since the 1960s. This may be attributed to an increase in the amount of shrubbery at the prairie that has provided more suitable habitat for the species. The increase in the amount of shrubbery over the last 50 years can probably be attributed to the lack of grazing by cattle since the 1960s to 2006, and low intensity grazing since then.

Horned Larks were last observed at the prairie in 2006. The species preferred habitat is "grazed native grassland" (Maher 1973; Owens and Myres 1973). Absence of the species on the prairie probably can be attributed to unsuitable habitat for the species due to the increase in shrubbery and dense graminoid vegetation.

Burrowing Owl, Sprague's Pipit, and Upland Sandpiper are no longer present at the prairie. All of these species are rare or uncommon in Saskatchewan (Smith 1996), and with the exception of Upland Sandpiper, have been assessed by COSEWIC and are listed as species at risk (SARA Registry 2017). Also listed (SARA Registry 2017) are Baird's Sparrow, Loggerhead Shrike Prairie subspecies, Long-billed Curlew, and Short-eared Owl; these species plus Bobolink and Lark Bunting (assessed but not listed) have been recorded as "irregular" summer residents. Absence or rarity of these species at the prairie probably can be attributed to its isolation as a native grassland surrounded by cropland and urban development. The prairie has been surrounded by cropland for at least the past 75 years. Until 2000 the city limits of Saskatoon were 5 km away. Urban development started 800 m from the prairie in 2010 and by 2015 had encroached to the prairie. Impacts of fragmentation of habitat on grassland birds have also been shown by other studies (e.g., Bakker *et al.* 2002; Ribic *et al.* 2009; Buxton and Benson 2016).

A number of studies (e.g., Herkert 1994; Knopf 1994; Askins *et al.* 2007; Henderson and Davis 2014) have documented the decline in grassland bird specialists in North American native grasslands (tall grass prairie, shortgrass prairie, and mixed prairie types) due to habitat loss. This long-term study documented similar declines of some species of grassland specialist birds at a remnant Fescue Prairie also impacted by encroachment of urban development and long-term habitat alteration.

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Literature Cited

- Acton, D. F., G. A. Padbury,** and **C. T. Stushnoff.** 1998. The ecoregions of Saskatchewan. Canadian Plains Research Centre, University of Regina, Regina, Saskatchewan, Canada.
- Arnold, T. W.,** and **K. F. Higgins.** 1986. Effects of shrub coverages on birds of North Dakota mixed-grass prairies. *Canadian Field-Naturalist* 100: 10–14.
- Askins, R., F. Chavez-Ramirez, B. C. Dale, C. A. Haas, J. F. Herkert, F. Knopf,** and **P. D. Vickery.** 2007. Conservation of grassland birds in North America: understanding ecological processes in different regions. *Ornithological Monographs* 64: 1–46. <https://doi.org/10.2307/40166905>
- Baines, G. B. K.** 1964. Plant distributions on a Saskatchewan prairie in relation to edaphic and physiographic factors. M.Sc. thesis, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.
- Baines, G. B. K.** 1973. Plant distributions on a Saskatchewan prairie. *Vegetatio* 28: 99–123. <https://doi.org/10.1007/BF02386216>
- Bakker, K. K., D. E. Naugle,** and **K. F. Higgins.** 2002. Incorporating landscape models for migratory grassland bird conservation. *Conservation Biology* 16: 1638–1646. <https://doi.org/10.1046/j.1523-1739.2002.01328.x>
- Buxton, V. L.,** and **T. J. Benson.** 2016. Conservation-priority grassland bird response to urban landcover and habitat fragmentation. *Urban Ecosystems* 19: 599–613. <https://doi.org/10.1007/s11252-016-0527-3>
- Coupland, R. T.** 1961. A reconsideration of grassland classification in the Northern Great Plains of North America. *Journal of Ecology* 49: 135–167. <https://doi.org/10.2307/2257431>
- Coupland, R. T.,** and **T. C. Brayshaw.** 1953. The Fescue Grassland in Saskatchewan. *Ecology* 34: 386–405. <https://doi.org/10.2307/1930904>
- Davis, J.** 1965. The "singing male" method of censusing birds: a warning. *Condor* 67: 86–87.
- Davis, S. K.** 2004. Area sensitivity in grassland passerines: effects of patch size, patch shape, and vegetation structure on bird abundance and occurrence in southern Saskatchewan. *The Auk* 121: 1130–1145. [https://doi.org/10.1642/004-8038\(2004\)121\[1130:ASIGPE\]2.0.CO;2](https://doi.org/10.1642/004-8038(2004)121[1130:ASIGPE]2.0.CO;2)
- Environment Canada.** 2014. North American Breeding Bird Survey-Canada Trends, Data – version 2012. Accessed 3 September 2017. <https://wildlife-species.canada.ca/breeding-bird-survey-results>.
- Forman, R. T. T.** 1995. *Land Mosaics: The Ecology of Landscapes and Regions.* Cambridge University Press, London, United Kingdom.
- Gauthier, D. A.,** and **E. B. Wiken.** 2003. Monitoring the conservation of grassland habitats, Prairie Ecozone, Canada. *Environmental Monitoring and Assessment* 88: 343–364. <https://doi.org/10.1023/A:1025585527169>
- Grilz, P. L.,** and **J. T. Romo.** 1995. Management considerations for controlling smooth brome in fescue prairie. *Natural Areas Journal* 15: 148–156.

- Gross, D. V., and J. T. Romo.** 2010a. Temporal changes in species composition in fescue prairie: relationships with burning history, time of burning, and environmental conditions. *Plant Ecology* 208: 137–153. <https://doi.org/10.1007/s11258-009-9693-1>
- Gross, D. V., and J. T. Romo.** 2010b. Burning history, time of burning, and year effects on plant community structure and heterogeneity in fescue prairie. *Botany* 88: 1–12. <https://doi.org/10.1139/B09-091>
- Hammermeister, A., D. Gauthier, and K. McGovern.** 2001. Saskatchewan's Native Prairie: Statistics of a Vanishing Ecosystem and Dwindling Resource. Native Plant Society of Saskatchewan, Inc., Saskatoon, Saskatchewan, Canada.
- Henderson, A. E., and S. K. Davis.** 2014. Rangeland health assessment: a useful tool for linking range management and grassland bird conservation? *Rangeland Ecology and Management* 67: 88–98. <https://doi.org/10.2111/REM-D-12-00140.1>
- Herkert, J. R.** 1994. The effects of habitat fragmentation on midwestern grassland bird communities. *Ecological Applications* 4: 461–471. <https://doi.org/10.2307/1941950>
- Kantrud, H. A., and R. L. Kologiski.** 1982. Effects of Soils and Grazing on Breeding Birds of Uncultivated Upland Grasslands of the Northern Great Plains. United States Department of the Interior Fish and Wildlife Service. Wildlife Research Report 15. Washington, D.C., U.S.A.
- Karasiuk, D. J.** 1973. The feeding ecology of the savannah sparrow, *Passerculus sandwichensis* (Gmelin) at Saskatoon, Saskatchewan. M.Sc. thesis, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.
- Kendeigh, S. C.** 1944. Measurement of bird populations. *Ecological Monographs* 14: 67–106. <https://doi.org/10.2307/1961632>
- Knapton, R. W.** 1978. Breeding ecology of the clay-colored sparrow. *The Living Bird* 17: 137–158.
- Knopf, F. L.** 1994. Avian assemblages on altered grasslands. Pages 247–257 in *A Century of Avifaunal Change in Western North America. Proceedings of an International Symposium at the Centennial Meeting of the Cooper Ornithological Society. Edited by J. R. Jehl, Jr. and N. K. Johnson.* Studies in Avian Biology, No. 15, Sacramento, California, USA.
- Leighton, A. L., J. Hay, C. S. Houston, J. F. Roy, S. Shadick, and M. Gilliland.** 2002. Birds of the Saskatoon area. Saskatchewan Natural History Society (Nature Saskatchewan) Special Publication no. 23, Saskatoon, Saskatchewan, Canada.
- Lein, M. R.** 1968. The breeding biology of the savannah sparrow, *Passerculus sandwichensis* (Gmelin) at Saskatoon, Saskatchewan. M.Sc. thesis, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.
- Madden, E. M., R. K. Murphy, A. J. Hansen, and L. Murray.** 2000. Models for guiding management of prairie bird habitat in northwestern North Dakota. *American Midland Naturalist* 144: 377–392. [https://doi.org/10.1674/0003-0031\(2000\)144\[0377:MFGMOP\]2.0.CO;2](https://doi.org/10.1674/0003-0031(2000)144[0377:MFGMOP]2.0.CO;2)
- Maher, W. J.** 1973. Birds: I. Population dynamics. Canadian Committee for the International Biological Programme (Matador Project) Technical Report no. 34. University of Saskatchewan, Saskatoon, Saskatchewan, Canada.
- Mori, N.** 2009. Composition and structure of fescue prairie respond to burning and environmental conditions more than to grazing or burning and grazing in the short-term. M.Sc. thesis, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.
- Offinowski, R., N. C. Kenkel, and P. M. Catling.** 2007. The biology of Canadian weeds. 134. *Bromus inermis* Leys. *Canadian Journal of Plant Science* 87: 183–198. <https://doi.org/10.4141/P06-071>
- Owens, R. A., and M. T. Myres.** 1973. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. *Canadian Journal of Zoology* 51: 697–713. <https://doi.org/10.1139/z73-104>
- Pylypec, B.** 1986. The Kernen Prairie—a relict fescue grassland near Saskatoon, Saskatchewan. *Blue Jay* 44: 222–231.
- Pylypec, B.** 1991. Impacts of fire on bird populations in a fescue prairie. *Canadian Field-Naturalist* 105: 346–349.
- R Development Core Team.** 2016. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
- Ribic, C. A., R. R. Koford, J. R. Herkert, D. H. Johnson, N. D. Niemuth, D. E. Naugle, K. K. Bakker, D. W. Sample, and R. B. Renfrew.** 2009. Area sensitivity in North American grassland birds: patterns and processes. *The Auk* 126: 233–244. <https://doi.org/10.1525/auk.2009.1409>
- Romo, J. T.** 2003. Reintroducing fire for conservation of Fescue Prairie Association remnants in the Northern Great Plains. *Canadian Field-Naturalist* 117: 89–99.
- Roy, J. F.** 1996. Birds of the Elbow. Saskatchewan Natural History Society Special Publication no. 21. Nature Saskatchewan, Regina, Saskatchewan, Canada.
- Sampson, F., and F. Knopf.** 1994. Prairie conservation in North America. *BioScience* 44: 418–421. <https://doi.org/10.2307/1312365>
- SARA (Species at Risk Act) Registry.** 2017. Species at risk public registry. Accessed 9 August 2017. http://sararegistry.gc.ca/sar/assessment/status_e.cfm
- Saskatoon Nature Society.** 2010. Saskatoon Area Birds: a Seasonal Checklist. Nature Saskatchewan, Regina, Saskatchewan, Canada.
- Smith, A. R.** 1996. Atlas of Saskatchewan Birds. Saskatchewan Natural History Society (Nature Saskatchewan) Special Publication no. 22. Nature Saskatchewan, Regina, Saskatchewan, Canada.

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