

University of Alberta

Effects of natural gas development on three grassland bird species in CFB
Suffield, Alberta, Canada

by

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in partial fulfillment of the requirements for the degree of

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in

Ecology

Department of Biological Sciences

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PREVIEW

Abstract

I investigated the effect of energy sector development and introduced crested wheatgrass (*Agropyron cristatum*) on grassland birds on Canadian Forces Base Suffield. I conducted point counts and mapped breeding territories in 2007 and 2008 for Savannah sparrows (*Passerculus sandwichensis*), chestnut-collared longspurs (*Calcarius ornatus*), and Sprague's pipits (*Anthus spragueii*). I found that Savannah sparrows favored areas with taller vegetation, human disturbances and crested wheatgrass in both years. Longspurs used shorter vegetation and were tolerant of disturbance. Crested wheatgrass was avoided by longspurs in both years. Pipit territories contained similar vegetation to longspurs, were sensitive to disturbance, and avoided placing territories in areas containing crested wheatgrass or trails in both years. Well sites, pipelines and junctions were not avoided by the three species. My research suggests that reducing the number of trails and the spread of crested wheatgrass will increase habitat availability for sensitive species of grassland birds.

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PREVIEW

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Chapter 1

Introduction

Grassland birds have suffered greater population declines in more species than any other avian guild in North America (Sauer et al., 2008). Steady declines, especially in the last 20 years (Sauer et al., 2008), have become a serious concern for biologists despite the majority of habitat loss occurring in the late 1800s and early 1900s (as reviewed by Samson et al., 2004). In order to preserve remaining populations of grassland birds, research has focused on the effects of fragmentation and degradation of the remaining native grasslands (as reviewed by Samson et al., 2004; Askins et al., 2007). Researchers throughout the prairies have attempted to define the effect of edge and patch size upon bird populations (as reviewed by Askins et al., 2007). The introduction of non-native grass species that are associated with edge habitats has potentially aggravated the loss of grassland bird populations (Wilson and Belcher, 1989; Sutter and Brigham, 1998; Madden et al., 2000; Lloyd and Martin, 2005; Flanders et al., 2006). There remains as little as 43% of native prairie in Alberta (~ 160,000 km²) and only 1.1% (~1,800 km²) of that is managed for conservation purposes (Gauthier and Wiken, 2003).

Despite the prevalence of oil and gas development in the Canadian prairies, the effects of this industry on grassland birds has rarely been studied (Askins et al., 2007). Infrastructure associated with natural gas extraction in this study consists primarily of below ground well sites, pipelines, junctions and

access trails for well maintenance. These disturbances may persist for more than 30 years after their initial creation, such as in the case of pipelines (Rowland, 2008). Studies that have investigated the effects of oil and gas development in open country habitat have found that songbirds avoid roads, off-road vehicle trails, seismic lines, and wells (Ingelfinger and Anderson 2004, Ashenurst and Hannon, 2008, Linnen 2008), and populations decrease with increased infrastructure and activity (Dale et al., 2009).

In this study, I investigated the effects of oil and gas development on the occurrence of birds at point counts, placement of territories, and nesting success of three grassland species. Three study species, Savannah sparrow (*Passerculus sandwichensis*), chestnut-collared longspur (*Calcarius ornatus*) and Sprague's pipit (*Anthus spragueii*), were chosen to represent different responses to vegetation and human disturbances found on Canadian Forces Base Suffield in southeast Alberta.

Study area

On Canadian Forces Base (CFB) Suffield, 458 km² of mixed and short grass prairie has been set-aside in a National Wildlife Area (NWA) to preserve and protect native habitat. There are 20 “species at risk” listed under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) found in the NWA. The NWA was officially established in 2003 and has been off-limits to military troop activities since 1971. Soils are composed primarily of orthic brown chernozems formed on glacial tills or sand dunes (Rowland, 2008). Cattle

currently graze on the southern block of the NWA at low densities to simulate the grazing pressure of bison that no longer occur on the base (CEAR, 2007).

The first well sites were established in the NWA in 1975 and currently there are 1154 wells, with the structure mainly below ground. The average number of wells was originally set at 4 wells/square mile but currently ranges as high as 16 wells/sq. mile although the current average in the NWA is 8 wells/sq. mile. The energy sector recently applied for more wells to be drilled to raise the density of well sites to approximately 16 wells/ sq. mile (CEAR, 2009). This request was denied due to lack of information regarding on the impact of development on sensitive species, including Sprague's pipit (CEAR, 2009).

A bird inventory began on CFB Suffield in 1994 and 1995 as part of a larger project to determine which species occurred on the base. Annual bird monitoring began in 2000 and continues to the present. Annual bird surveys are performed between mid-May to early June on both the north and south block of the NWA. These data were recently used to develop a series of habitat models using landscape variables (Wiens et al., 2008) and to determine how well-density affected abundance of grassland songbirds (Dale et al., 2009). The latter study found that increased well density was associated with increased abundance of Savannah sparrows and decreased abundance of Sprague's pipit. Linnen (2008) determined that traditional oil wells on CFB Suffield, and associated trails, were avoided by Sprague's pipit and chestnut-collared longspur. Despite this, the effects of individual components of infrastructure associated with the wells,

including trails, exotic species spread, pipelines and vehicle traffic on the grassland birds are poorly understood.

Crested wheatgrass

Crested wheatgrass (*Agropyron cristatum*) is a Eurasian C₃ grammanoid that is persistent where it has been planted throughout the North American prairies, primarily as forage for cattle (Henderson and Naeth, 2005; Ambrose and Wilson, 2003). Crested wheatgrass is taller, has more standing dead vegetation, and leaves more bare ground than native vegetation in the mixed-grass prairies (Sutter and Brigham, 1998; Christian and Wilson, 1999; but see Lloyd and Martin, 2005). It is associated with lower native vegetation diversity (Christian and Wilson, 1999; Heidinga and Wilson, 2002; Henderson and Naeth, 2005), low arthropod diversity (McIntyre and Thompson, 2003; Flanders et al., 2006), decreased abundance of grassland birds (Sutter and Brigham, 1998), may alter grassland bird diversity (Chapman et al., 2004) and lowers nesting success of some species (Lloyd and Martin, 2005). Crested wheatgrass spreads primarily through the dispersal of seeds (as reviewed by Henderson and Naeth, 2005).

Crested wheatgrass is present on CFB Suffield as it was used to remediate areas following disruption by oil and gas disturbances. The presence of crested wheatgrass on CFB Suffield is of concern due to its spread to areas that had not been directly seeded with the species (Smith, 2007). Roads and trails can serve as vectors for the transportation of exotic species (Trombulak and Frissell, 2000; von der Lippe and Kowarik, 2007) and crested wheatgrass is commonly associated

with drainage ditches alongside roads (Henderson and Naeth, 2005). As off-road vehicle trails are common throughout the NWA, there is a potential for crested wheatgrass to spread and affect breeding bird habitat.

Study species

Savannah sparrow

The Savannah sparrow is a small passerine in the family *Emberizidae* and is the only member of its genus found in North America (Wheelwright and Rising, 2008). There are 28 subspecies of *Passerculus sandwichensis* recognized in North America (Wheelwright and Rising, 2008). Based on the distribution the subspecies, the Savannah sparrows in this study were *P. s. nevadensis*. The breeding and wintering range for Savannah sparrows extends from the high arctic to Mexico and from the east to the west coast (Figure 1.1). Nesting occurs on the ground in open habitat throughout their range and typically occurs in tall, lush non-woody vegetation (as reviewed by Wheelwright and Rising, 2008).

The Savannah sparrow populations are significantly decreasing throughout its range in North America at a rate of 1.0% per year between 1966 and 2006 (Sauer et al., 2008). Breeding bird surveys in Alberta, however, have a non-significant rate of decline of 0.3% per year (Sauer et al., 2008).

Savannah sparrows have a wide geographic distribution and are tolerant of a range of vegetation conditions, including human disturbance (Wheelwright and Rising, 2008). They can be found in both native and non-native vegetation and restored prairie, such as the Conservation Reserve Program (CRP) in the United States (Fletcher and Koford, 2002) and planted pastures or the Permanent Cover

Program (PCP) in Canada (Sutter and Brigham, 1998; McMaster and Davis, 2001; McMaster et al., 2005). Throughout the prairies, Savannah sparrows do not appear to be sensitive to small habitat patch sizes (Madden et al., 2000; Davis, 2004; Koper and Schmiegelow, 2006) and are more common in taller planted vegetation found near roads or in hayfields in Saskatchewan (Dale et al., 1997; Sutter et al., 2000). In this thesis, I use the term “sensitive” to describe a species that is highly responsive to a given change in its habitat whereas “tolerant” denotes a species that does not change its behaviour noticeably in the face of habitat alteration.

Chestnut-collared longspur

The chestnut-collared longspur is a small passerine in the family *Emberizidae* with four species occurring within the genus *Calcarius* in North America (Hill and Gould, 1997). There are no recognized subspecies according to Hill and Gould (1997). *Calcarius ornatus* breeds throughout the short and mixed-grass prairie and overwinters in the southern U.S. and in Mexico (Figure 1.2). Nests are located on the ground in partially grazed or sparsely vegetated areas with shorter grasses and more bare ground than surrounding prairie (Hill and Gould, 1997; Davis 2005; Lloyd and Martin, 2005)

The chestnut-collared longspur population significantly decreased throughout its range at a rate of 2.9% per year between 1966 and 2006 (Sauer et al., 2008). In Alberta there is a similar rate of decline of 2.7% per year, however, the population decrease is non-significant (Sauer et al., 2008).

Chestnut-collared longspurs are somewhat sensitive to small patch sizes in Saskatchewan (Davis, 2004; Davis et al., 2006) and are known to avoid roads and oil development in Alberta and Saskatchewan (Sutter et al., 2000; Koper and Schmiegelow, 2006; Linnen, 2008). They will nest in taller non-native vegetation (Davis et al., 1999) although there is some evidence that nests located in exotic grasses produce fewer and smaller young at fledging (Lloyd and Martin, 2005). Longspurs will nest in restored prairie, in the form of the Permanent Cover Program, in Saskatchewan (McMaster and Davis, 2001; McMaster et al., 2005).

Sprague's pipit

Sprague's pipit is a small passerine in the family *Motacillidae* which contains three species in the genus *Anthus* in North America with no recognized subspecies (Robbins and Dale, 1999). The breeding range for *Anthus spragueii* is limited to short and mixed-grass prairie that has not been heavily disturbed whereas the wintering range occurs in open habitat in the southern U.S. and Mexico (Robbins and Dale, 1999; Figure 1.3). Nests are built on the ground with a domed canopy of standing dead vegetation (Sutter, 1997). Breeding habitat is characterized by intermediate vegetation height, less bare ground, more standing dead vegetation and greater litter depth than surrounding prairie (Dale, 1983; Sutter, 1997; Robbins and Dale, 1999; Dieni and Jones, 2003; Davis, 2005).

Sprague's pipit is significantly decreasing throughout its range at a rate of 3.9% per year between 1966 and 2006 (Sauer et al., 2008). Breeding bird surveys in Alberta indicated a higher rate of decline of 4.5% per year (Sauer et al., 2008).

Sprague's pipit are sensitive to small patch sizes (Davis, 2004; Davis et al., 2006), avoids roads (Sutter et al., 2000), and Linnen (2008) found pipits were more common further from oil and gas development in CFB Suffield and Saskatchewan. Higher densities of natural gas wells were correlated with reduced pipit abundance (Dale et al., 2009) and a decreased probability of occurrence (CEAR, 2009) on CFB Suffield. Pipits were uncommon on restored prairie, in the form of the Permanent Cover Program, in Saskatchewan (McMaster and Davis, 2001). Sprague's pipit is currently listed as "threatened" under the Species At Risk Act in Canada (COSEWIC, 2000) and provincially is listed as a "species of special concern" (Prescott, 1997).

Thesis goals and outline

The goal of my study was to determine if Savannah sparrows, chestnut-collared longspurs and Sprague's pipits avoid disturbances to grasslands caused by natural gas extraction and to identify which types of disturbance are avoided or used by birds establishing breeding territories. In Chapter 2, I examine the distribution of the three study species within the south block of the NWA on CFB Suffield. In this chapter I use point counts to detail the relative abundances of the species as well as to create a series of *a priori* generalized linear mixed-effect models to determine what, if any, landscape features or human disturbances may affect the occurrence of any of the species.

In Chapter 3, to further determine the effect of human disturbances on breeding males, I investigate where breeding territories were established and

defended, in the south block of the NWA on CFB Suffield. I focus on distance from territory edge to the nearest well site, pipeline, junction and off-road vehicle trail. I also compare actual territories to simulated territories to determine what habitat features the study species were or were not including within their territories. Additionally, the relative amount of crested wheatgrass present in the territories was compared both to areas surrounding the territories (landscape scale) and to neighboring areas that males did not defend (local scale).

Chapter 4 presents nest data for chestnut-collared longspurs and Sprague's pipit from nests found incidentally during territory surveys. Prior to my work, there was a lack of nesting information for CFB Suffield. Finally, Chapter 5 provides a synthesis of my research results as well as offering management recommendations for the mixed-grass prairie found on CFB Suffield as impacts to the National Wildlife Area may decrease its value for preserving grassland birds and their breeding habitat.

The effect of energy development on grassland birds is poorly understood, especially the effects of well sites, pipelines, junctions and access trails. My study seeks to identify landscape variables which can be used to predict the occurrence of Savannah sparrows, chestnut-collared longspurs and Sprague's pipit rather than using only fine-scale local vegetation. Additionally, I seek to determine if human disturbances are affecting breeding territories of the three species and which forms of disturbance have the greatest effects upon territory placement, a relationship that has not been studied in the mixed-grass prairie.

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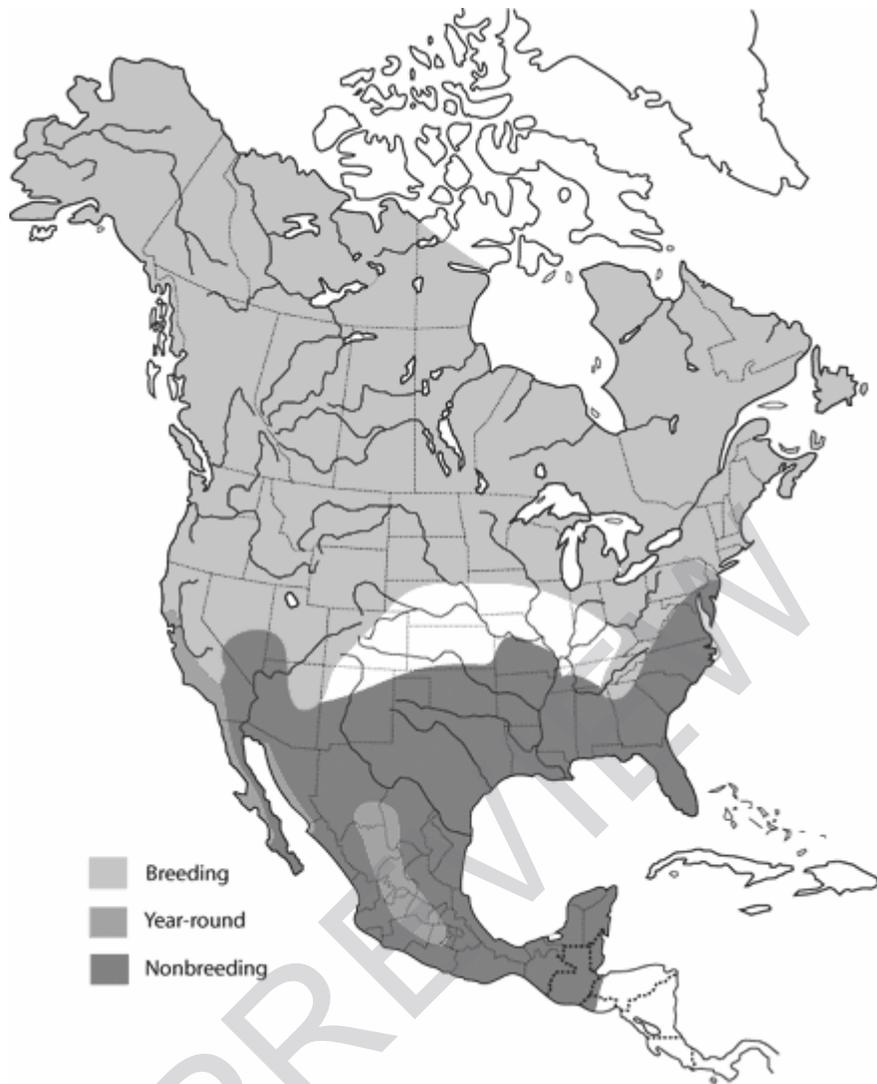


Figure 1.1: Distribution map of the Savannah sparrow (*Passerculus sandwichensis*) in North America (Distribution map reprinted with permission from <http://bna.birds.cornell.edu> and the Cornell Lab of Ornithology).