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Research article

Doing more with less: Removing trees in a prairie system improves value of grasslands for obligate bird species

Jason D. Tack [a, *, 1], Frank R. Quamen [b, 2], Kyle Kelsey [c], David E. Naugle [d]

[a] Wildlife Biology Program, University of Montana, FOR 316, Missoula, MT 59812, USA
[b] Wildlife Biology Program, University of Montana, FOR 312, Missoula, MT 59812, USA
[c] US Fish and Wildlife Service, Madison Wetland Management District, 23520 SD Hwy 19, Madison, SD 57042, USA
[d] Wildlife Biology Program, University of Montana & USDA Sage Grouse Initiative, Missoula, MT 59812, USA

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ABSTRACT

Grassland birds endemic to the Northern Great Plains have declined faster and more severely than any other avian guild on the continent. Remaining prairie fragments that sustain breeding populations are continually converted to a disturbed state, or degraded by fragmentation. Planted tree rows (shelterbelts) in prairie landscapes are a prominent feature and have been implicated in propagating negative edge effects on breeding birds, perhaps through harboring a diverse suite of nest predators. We experimentally removed shelterbelts on areas in the northern tallgrass prairie in North and South Dakota USA while conducting avian surveys to evaluate hypotheses about grassland bird response to the removal of a woodland edge. We predicted that 1) grassland-nesting species would avoid shelterbelt edges, 2) removing shelterbelts would eliminate avoidance, and 3) trends in bird counts would increase at sites with shelterbelts removed. Bobolink (*Dolichonyx oryzivorus*), Savannah Sparrow (*Passerculus sandwichensis*), and Sedge Wren (*Cistothorus platensis*) demonstrated avoidance from woodland edges up to 220 m, the farthest distance considered, though results for Grasshopper Sparrows (*Ammodramus savannarum*) were equivocal. There was no evidence of avoidance following removal of shelterbelts, and predicted counts increased at greater rates in treatment compared to control sites among species that exhibited avoidance. With limited financial resources for conservation, our findings support shelterbelt removal as one cost-effective management strategy to improve grassland bird habitat in the northern tallgrass prairie.

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1. Introduction

Grassland birds in North America have declined faster, and more severely, than any other avian guild (Knopf, 1994). Many such species rely on northern tallgrass prairie habitats, which have been reduced to <2.5% of its historic range (Samson et al., 2004). Remaining fragments are threatened by expanding distributions of invasive species (Brennan and Kuvlesky Jr, 2005), anticipated effects of climate change (Johnson et al., 2005; Skagen and Adams, 2012), and habitat fragmentation from an ever-expanding anthropogenic footprint that dominates prairie landscapes (Theobald, 2010). Fragmentation acts to degrade remaining grassland bird habitats through the behavioral and demographic consequences of edge effects (Saunders et al., 1991). There are many agents that interrupt intact grasslands and one stark yet ubiquitous feature across grassland and agricultural landscapes is tree plantings that occur along fencerows, homesteads, and agricultural fields. These woodland edges have been implicated in exacerbating negative edge effects on many wildlife species (*reviewed by* Bakker, 2003; *but see* Ellison et al., 2013; Thompson et al., 2014).

The majority of grasslands in the Great Plains have been converted to cropland (Samson and Knopf, 1996), and to combat the devastating economic hardships associated with prolonged drought and soil erosion among croplands in the 1930s, then President Franklin Roosevelt initiated the Prairie States Forestry

* Corresponding author.
E-mail addresses: jason_tack@fws.gov (J.D. Tack), frank_quamen@blm.gov (F.R. Quamen), kyle_kelsey@fws.gov (K. Kelsey), david.naugle@umontana.edu (D.E. Naugle).
[1] US Fish and Wildlife Service, Habitat and Population Evaluation Team, FOR 316, University of Montana, Missoula, Montana 59812, USA.
[2] US Bureau of Land Management, Fish and Wildlife Conservation, 20 M Street SE, Washington D.C, USA.

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Project (PSFP) to conduct widespread tree plantings. Colloquially termed windbreaks, hedgerows, or shelterbelts (*hereafter* shelterbelts), tree plantings proliferated in the US following severe dust storms across the North American Great Plains in efforts to reduce soil loss. Shelterbelt establishment was extensive, with enough trees planted to span the globe 8 times (Droze, 1977).

Today, federal programs continue a legacy of tree planting as a "wildlife-friendly" agricultural practice in the Great Plains (Quinn et al., 2012). In particular, the US Department of Agriculture's Conservation Reserve Program (CRP) provides payments to private landowners for establishing shelterbelts. Currently, CRP contributions have resulted in over 15,000ha of shelterbelt plantings (>12,500 km assuming an average width of 12 m; US Department of Agriculture, 2012). Shelterbelts often occur adjacent to croplands and human structures as they are primarily designed to protect structures, soil, water, and crops from wind. Yet providing wildlife habitat is often implicated as a secondary benefit of shelterbelts (Natural Resources Conservation Service, 2011) despite a growing body of research implicating shelterbelts as agents of negative behavioral and demographic consequences on endemic prairie species (Ries et al., 2004).

Overwhelmingly, it has been demonstrated that grassland birds avoid woodland edges (Cunningham and Johnson, 2006; Ellison et al., 2013; Thompson et al., 2014). Mechanisms of grassland obligate birds avoiding woodland edges may be linked to poor habitat quality near shelterbelts. Wooded areas within grasslands support an increased abundance and diversity of nest predators (Chalfoun et al., 2002) and brood parasites (Johnson and Temple, 1990), which can depress nest survival near edges (Ries et al., 2004). Removing shelterbelts from prairie landscapes has been identified as a potential management strategy for effectively increasing habitat for prairie birds in lieu of land acquisition (Ellison et al., 2013; Thompson et al., 2014). However, little is known about the spatial and temporal scales at which grassland birds may respond to shelterbelt removal (*but see* Ellison et al., 2013).

We conducted a field experiment to test the efficacy of shelterbelt removal for improving grassland bird habitats in a northern tallgrass prairie system. We had three main objectives in evaluating prairie bird response to shelterbelts and their removal in the northern tallgrass prairie: 1) at what distance do grassland obligate birds avoid shelterbelts? 2) Does removing shelterbelts lead to different spatial patterns of grassland birds? And, 3) can removing shelterbelts support increased numbers of birds in existing grasslands? We used mixed-effects generalized linear regression models of grassland bird counts to evaluate avoidance and treatment impacts. Using model output, we predicted the potential impact of removing shelterbelts as a management tool by conservation practitioners in northern tallgrass prairie landscapes.

2. Materials and methods

2.1. Study area

Our study encompassed northern tallgrass prairie remnants in the eastern prairie pothole region of North and South Dakota (Fig. 1). Historically, this landscape was a matrix of grassland and wetlands, where fire and grazing by bison (*Bison bison*) restricted natural tree growth to riparian floodplains, wooded draws, islands within lakes, and small patches along leeward wetland edges (Higgins, 1986). The current land use is dominated by agricultural production of corn and soybeans, with less than 1% native tallgrass remaining (Knopf, 1994).

Our study was conducted on grasslands owned and managed by the US Fish and Wildlife Service (FWS) as Waterfowl Production

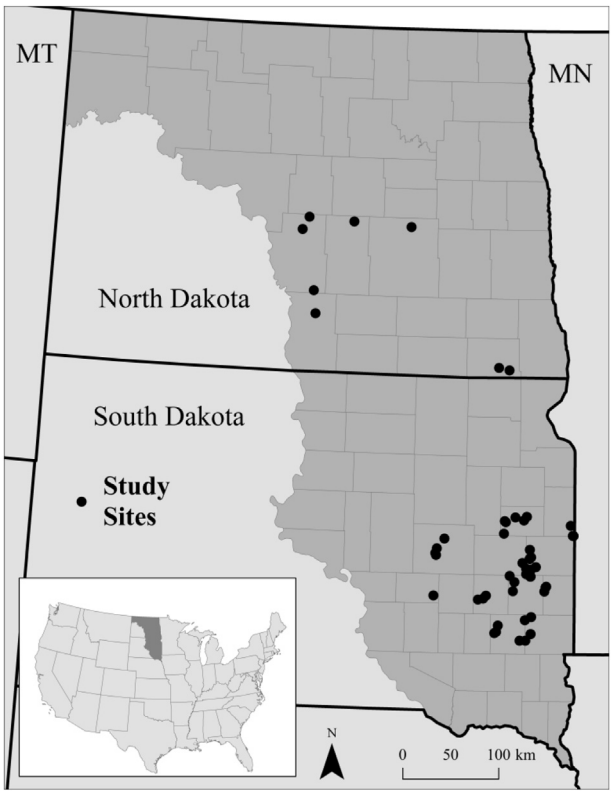

Fig. 1. Study sites in eastern US portion of the prairie pothole region. Avian counts were conducted across 14 US counties in North and South Dakota.

Areas (n = 40) or National Wildlife Refuges (n = 3). Most properties were purchased from private landowners and were enrolled as restored grasslands under the CRP. Over 1.7 million ha of agricultural row crops are cultivated in counties encompassing sampled sites (www.nass.usda.gov), compared to 307,000ha enrolled as grasslands in CRP. Many properties contained at least one shelterbelt approximately 5–20 m in width which were composed primarily of multiple rows of mature Green ash (*Fraxinus pennsylvanica*), while often including Eastern red cedar (*Juniperus virginia*), Blue spruce (*Picea pungens*), or Plains cottonwood (*Populus deltoides*). Grasslands were typically composed of native warm- (*Andropogon gerardii*, *Schizachyrium scoparium*, *Sorghastrum nutans*, and *Panicum virgatum*) and cool-season (*Elymus trachycaulus*, *Pascopyrum smithii*, *Nassella viridula*, and *E. canadensis*) grasses, with small patches of exotic grasses (*Bromus inermis* and *Poa pratensis*) interspersed. Mean temperature during surveys was normal across sample seasons (~19.4 °C) as was precipitation (~33 cm) except for 2006, which received less precipitation during survey months than usual (~9.6 cm).

2.2. Data collection

We conducted a before-after control impact study from 2004 to 2006, which included avian surveys at control (grasslands with shelterbelt) and treatment (grasslands with shelterbelt removed) sites. Sites needed to contain one contiguous (≥100 m) shelterbelt with uninterrupted grassland out to 440 m from the woodland edges. Half of the shelterbelts were selected as treatment sites and half control. Treatment shelterbelts would be removed following one year of avian surveys. In 2004, four treatment and four control sites were surveyed, while the study expanded in 2005 to encompass an additional 15 treatment and control sites each (2004 n = 8;