Breeding Bird Monitoring in the Ponderosa Pine Escarpments of Western Nebraska: Establishment and Results from Year One

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Introduction

The western panhandle of Nebraska contains diverse habitats with limited areal extent in the state, notably pine-covered escarpments and bluffs. These areas are characterized by Ponderosa Pine (*Pinus ponderosa*) woodlands, and also contain mixed deciduous forest in lower drainages, particularly near water. There are also three distinct regions of pine bluffs moving north to south in the panhandle, and while all are similar in that they share similar vegetation and topographical features, the extent, continuity, and presumed avian diversity and densities likely differ between the three. These regions are the Pine Ridge, Wildcat Hills, and Bighorn Escarpment (Fig. 1). There are several species of birds that are restricted to these areas of Nebraska because the habitat is limited. Furthermore, western Nebraska represents the eastern extent for many of these species' continental range. Most of these birds are listed in the Nebraska Natural Legacy Plan as either Tier I or Tier 2 Species of Greatest Conservation Need (SGCN; Schneider et al. 2011).

The breeding bird communities in this region have received little attention given the distance from major human population centers in the eastern portion of the state (i.e. Omaha and Lincoln), as well as the limited nature of each of these species' distributions in the area. The Nebraska Breeding Bird Atlases provided a great deal of information about western species in the state, but the last of these projects was completed in 2012 (Molhoff 2016). Outside of scattered and irregular BBS routes and anecdotal non-standardized surveys (e.g. eBird), no other monitoring efforts exists, particularly for all three regions of ponderosa pine and mixed woodland bluffs of the Nebraska panhandle. Thus, there is a need for standardized, repeatable surveys collecting basic abundance data for long-term study in this important ecosystem to Nebraska's avifauna.

The establishment of long-terms surveys will also help detect potential changes to the bird communities in response to any large-scale events that would alter the landscape in or near certain survey areas, such as fire or pine-forest management (Roberts et al. 2019). Wildfire suppression across the western US in the early 20th century has generally led to increased dry tinder, denser stands of mature trees, and irregular cycles of forest regeneration. Prolonged drought has also contributed to enhanced wildfire risk, and in the Nebraska panhandle alone there have been multiple large-scale fire events within ponderosa pine ridges in the past 20 years. In the western Great Plains, where Ponderosa Pine forests are less contiguous than in other areas of western North America (Brown and Sieg 1999), wildfires with mixed levels of severity and size may be important in maintaining a certain amount of species diversity and potential resilience to future environmental changes (Baker 2018, Roberts et al. 2020). Thus, fires can have a dramatic impact on local and population-wide plant and animal communities, particularly in western Nebraska where pine forest habitat is limited. These surveys will serve as a broad avifaunal reference to communities before and after wildfires at different time scales.

This year's efforts were the first of a planned long-term monitoring program for the unique breeding bird communities in this region. The hope is that these surveys will be completed at regular intervals (e.g. 3-5 years) to detect any long-term changes in abundance, species composition, or statewide range (Buckland et al. 2005). A similar program was successfully established in eastern Nebraska to monitor the oak-savannah management in the far eastern forests of the state (Jorgensen et al. 2014, Jorgensen et al. 2020). The surveys from the panhandle in 2022 will act as a baseline reference for future research and monitoring on the breeding bird communities in the area. In this report we summarize the results from the first year of this long-term monitoring program.

Methods

Study Area

We defined our study area as the three major Ponderosa Pine Escarpments in the Nebraska Panhandle (west of -102 degrees longitude). All areas contain ponderosa pine bluffs and savannahs and typically contain some mix of Rocky Mountain Juniper and/or Eastern Redcedar (*Juniperus sp.*) and denser, shrubbier deciduous vegetation near drainages ranging from cottonwoods (*Populus sp.*) to skunkbush (*Rhus trilobata*), chokecherry (*Prunus virginana*), and willow (*Salix sp.*). The extent of deciduous drainages, overall size and general forest continuity vary from north to south (Fig 1). The largest and most northern, the Pine Ridge, stretches west from Rushville, NE to the Wyoming border and encompasses over 45,000 hectares of ponderosa pine-savannah habitat. In the central panhandle lies the Wildcat Hills complex, generally stretching from the bluffs south of Bayard, NE west to just south of Morrill, NE and covers over 30,000 hectares. South of the Wildcat Hills lies the Bighorn escarpment (or southern Wildcat Hills), which are generally considered distinct from the Wildcat Hills proper and are predominantly within Banner and Morrill counties, are the least continuous and least dense of the three major pine complexes and encompass ~ 21,000 hectares of ponderosa pine savannah.

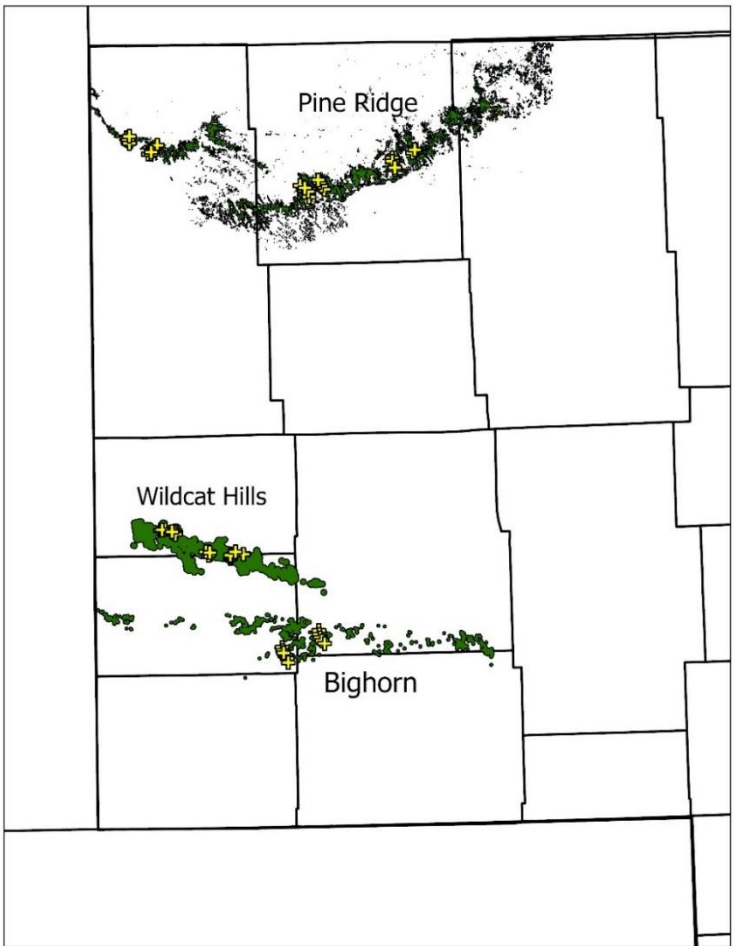

Figure 1. The three major Ponderosa Pine Regions (Green) in the western Nebraska Panhandle. Yellow crosses are locations of point transects

The majority of large-scale fires since 2000 within the study area have occurred in the Pine Ridge, with multiple points (n= 19) in areas where fires occurred in either 2006 or 2012. We had a few locations (n= 8) in both the Wildcat Hills and Bighorn escarpment that experienced smaller scale fires in 2021, most notably in parts of Buffalo Creek WMA.

Point counts

Point transects were located either along public roadways or on public lands. In the largest region (the Pine Ridge) we attempted to place counts near the western (Harrison), central (Crawford), and eastern (Chadron) edge of the target habitat. Each point transect was separated by $\geq$ 500m, and we prioritized

at least 40% walk-in points on public lands in appropriate habitat. The Bighorn escarpment does not have any public lands within the appropriate habitat and has minimal roads that bisect ponderosa pine bluffs, so all surveys in this region were roadside counts. All counts were conducted between sunrise and 11:00 a.m. Surveys were not conducted during heavy precipitation or when wind speeds were > 20 kph. Surveyors conducted five-minute point transect surveys in which they located and identified all birds seen or heard from the point transect. Visual detections were distinguished from auditory detections. Distances to all visual detections were measured using a laser range-finder. Distances to all auditory detections were estimated. Detections involving species considered to be late spring migrants were excluded. All surveys were conducted from 27 May – 27 June.

Analysis

We used the Distance package in Program R (Miller et al. 2019, R Core Team 2021) to estimate individual species' density. Distance analysis estimates bird density by fitting observer detection as a function of distance to a set of models. We truncated all detections over 200 meters. We used the six candidate models suggested by Buckland et al. (2001, p. 42-50) to analyze data. Given that this was the first year of data collection, we considered intercept-only models exclusively given the relatively low sample sizes expected after only one season of surveys. Akaike's Information Criterion for small sample sizes (AICc) was used to determine relative fit of models. The model with the lowest AICc value was selected and goodness-of-fit tests were used to support model selection decisions. Counts were grouped by escarpment complex (i.e. Pine Ridge, Wildcat Hills, or Bighorn Escarpment) for density estimation. We only modeled species' density for species where we had > 45 detections (Jorgensen and Brenner 2020) with one exception. We did not estimate density for Red Crossbill (*Loxia curvirostra*) despite having ample (n = 62) detections because this species can be irruptive, is usually detected in large groups, and breeds much earlier or later in the region than other focal species in this study (Benkmen et al. 2020). A few species had large (> 0.30, Jorgensen et al. 2020) Coefficient of Variations (CVs) associated with density estimates in a particular pine forest complex due to skewed or low detections relative to other parts of the panhandle where they were more abundant. We emphasize that these estimates be taken with caution given the inherent and large uncertainty in these measurements.

Results

We completed 59 survey points and detected 82 different species with 1,086 individual detections. We completed 11 counts in the Bighorn escarpment, 18 in the Wildcat Hills, and 30 in the Pine Ridge. For the models we used to estimate density (birds/ha), the hazard rate polynomial or half normal polynomial had the best fit (lowest AICc). We had enough detections to estimate density for 6 species. Mourning doves (*Zenaida macroura;* MODO) had the highest number of detections (87) and House Wren (*Troglodytes aedon;* HOWR) had the highest estimated density in the Pine Ridge (1.44 birds/ha) and Wildcat Hills (1.16 birds/ha), with MODO having highest estimated densities in the Bighorn Escarpment (0.41 birds/ha, Table 1).

We detected 9 Tier II species across all surveys, generally in low numbers (Table 2). However, we did detect a high number of Cassin's Kingbirds (*Tyrannus vociferans;* CAKI), but these were heavily concentrated in one region with 30 of 31 detections all within the Bighorn Escarpment complex.

Our counts also led to significant nesting records within the Wildcat Hills complex. The detection of a male Cordilleran Flycatcher (*Empidonax occidentalis;* COFL) singing on 1 June within the Wildcat Hills WMA led to further territory searching and the eventual discovery of a pair nest building and incubating. This nest was determined to have eventually failed but represents only the second confirmed breeding record in the Wildcat Hills and away from the Pine Ridge in Nebraska. Multiple singing Western Tanagers (*Piranga ludoviciana*) detected at the Wildcat Hills SRA on 1 June counts led to the discovery of a successful nesting attempt by a pair of tanagers (Fig 2). This represents the first confirmed nesting record in the Wildcat Hills and away from the Pine Ridge in Nebraska. Also notable was the detection of a singing male Western Tanager in the Bighorn escarpment, but territory searching was not possible given this bird was on private land. Confirmed nesting records have been submitted to the Nebraska Heritage Program.

Table 1. Estimated densities (birds/ha) in the three major ponderosa pine-savannah forest regions of western Nebraska. Confidence intervals (95%) and model coefficient of variation are presented in parenthesis (LCL-UCL; CV). NA = not enough detections to estimate density.

Species	Pine Ridge	Wildcat Hills	Bighorn Escarpment
Mourning Dove	0.23 (0.15 – 0.34; 0.20)	0.31 (0.23 – 0.39; 0.17)	0.41 (0.26 – 0.63; 0.21)
House Wren	1.44 (1.07 – 1.94; 0.15)	1.16 (0.79 – 1.69; 0.19)	0.36 (0.14 – 0.97; 0.47)
Western Wood-Pewee	0.44 (0.35 – 0.56; 0.12)	0.18 (0.09 – 0.35; 0.33)	0.23 (0.07 – 0.45; 0.31)
Spotted Towhee	0.84 (0.56 – 1.25; 0.20)	0.96 (0.62 – 1.47; 0.21)	0.33 (0.12 – 87; 0.46)
Yellow Warbler	1.18 (0.78 – 1.80; 0.21)	1.02 (0.49 – 2.11; 0.37)	NA
Yellow-breasted Chat	0.45 (0.31 – 0.65; 0.19)	0.39 (0.21 – 0.72; 0.30)	NA

Table 2. Total detections of Tier II Legacy Species by major region in the Nebraska panhandle in 2022.

Species	Pine Ridge	Wildcat Hills	Bighorn Escarpment	Total
Black-and-white warbler	5	0	0	5
Bullock's Oriole	2	0	7	9
Cassin's Kingbird	0	1	30	31
Cordilleran Flycatcher	6	1	0	7
Golden Eagle	1	0	0	1
Plumbeous Vireo	4	0	0	4
Pygmy Nuthatch	10	2	0	12
Violet-green Swallow	3	1	0	4
White-throated Swift	0	1	0	1

Figure 2. Male Western Tanager with food visiting a nest at Wildcat Hills SRA.

Discussion

The primary purpose of this project was to initiate a standardized and repeatable long-term monitoring program for 3 unique ecosystems and suite of species in the state of Nebraska. While initial density estimates are limited to common species, most of these species are representative of the target habitat (i.e. Ponderosa Pine forest with shrubby deciduous drainages) and any changes to these estimates will be useful in future conservation efforts or large-scale land management actions. Additionally, the raw numbers of total detections of Legacy Species in each focal region of the panhandle will still serve as a baseline for tracking the populations of these birds, particularly as climate and habitat structure change over time.

Densities of Western wood-pewee (*Contopus sordidulus;* WEWP) in the Pine Ridge and Wildcat Hills are generally lower than their eastern counterpart (Eastern Wood-Pewee) at both Ponca State Park in northeastern Nebraska and Indian Cave State Park in southeastern Nebraska (Jorgensen et al. 2020). However, the size of both eastern sites is remarkably smaller compared to the whole of the Pine Ridge and Wildcat Hills, and this lower density likely reflects the lower density of western forest-specialists compared to birds in the forests of the eastern USA in general. High HOWR densities could be indicative of ample nest-site availability via snags from historic burns, but additional years of data will be needed to confirm this. For the shrub associated species in our study, Spotted towhee (*Pipilo maculatus;* SPTO) and Yellow-breasted chat (*Icteria virens;* YBCH), densities were similar in the Pine Ridge and Wildcat Hills (Table 1). This could indicate structural similarity between the deciduous drainages in these two distinct systems, and certainly points to the rather widespread nature of these species in appropriate habitat in all of western Nebraska. With the exception of MODO, there was higher uncertainty in the estimates of species density in the Bighorn escarpment compared to the other two regions (Table 1). Given the

smaller size of this region, limited number of sampled points and sparse nature of the focal habitat, this is somewhat expected.

We had relatively low overall detections of SGCN across our counts, which is to be expected given their status in the state and the limited sampling of specific nesting areas (such as bare cliffs) for some of these species such as White-throated Swift (*Aeronautes saxatalis*) and Golden Eagle (*Aquila chrysaetos*). A notable exception to this was the 30 CAKI we detected over just 11 points in the Bighorn escarpment. CAKI are also usually detected in good numbers at the far western edge of the Bighorn escarpment in Long Canyon (Silcock and Jorgensen 2022, ebird.org), which was not sampled as part of this study. This high concentration is encouraging given the observed density in a relatively small area, but this also indicates that this apparently high-quality location is critical to the state's CAKI population and thus any major changes to the habitat in the Bighorn Escarpment could be detrimental to most CAKI in Nebraska.

These counts were also established to determine any differences in breeding bird communities in areas with varying wildfire history. Additional years of data will make it possible to analyze any differences in species numbers or community structure based on fire history and time since fire. Particularly of note is the recent catastrophic fire in Cedar Canyon WMA and Carter Canyon WMA occurring on 30 July 2022. Nine point transects from this summer occurred in the area impacted by the fire, and future counts at these locations will serve as a direct measurement of avian colonization in the region following wildfires, and other points in unburned areas of the nearby Wildcat Hills region will also serve as a reference to the future of populations in this area as wildfire risk continues to grow. (Fig. 3)

Figure 3. Cedar Canyon WMA in June 2022 (pre-fire, upper) and in September 2022 (post-fire, lower).

Literature Cited

Baker, W. L. 2018. Transitioning western US dry forests to limited committed warming with bet-hedging and natural disturbances. Ecosphere: (9), e02288.

Benkman, C. W. and M. A. Young (2020). Red Crossbill (Loxia curvirostra), version 1.0. In Birds of the World (S. M. Billerman, B. K. Keeney, P. G. Rodewald, and T. S. Schulenberg, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.redcro.01

Brown, P.M. and Sieg, C.H., 1999. Historical variability in fire at the ponderosa pine-Northern Great Plains prairie ecotone, southeastern Black Hills, South Dakota. Ecoscience: 6(4), pp.539-547.

Buckland, S.T., Magurran, A.E., Green, R.E. and Fewster, R.M., 2005. Monitoring change in biodiversity through composite indices. Philosophical Transactions of the Royal Society B: Biological Sciences, 360(1454), pp.243-254.

Jorgensen, J.G., L.R. Dinan, M.A. Brogie, W.R. Silcock, J. Rink, C. Klaphake, and G. Steinauer. 2014. Breeding Bird Diversity, Abundance and Density at Indian Cave and Ponca State Parks, Nebraska 2012-2014. Nongame Bird Program of the Nebraska Game and Parks Commission. Lincoln, Nebraska, USA.

Jorgensen, J.G., S.J. Brenner and G. Steinauer. 2020. Interim evaluation of breeding bird response to oak woodland restoration at Indian Cave and Ponca state parks, Nebraska, USA. Nongame Bird Program, Nebraska Game and Parks Commission, Lincoln, Nebraska USA.

Miller D.L., E. Rexstad, L. Thomas, L. Marshall and J.L. Laake. 2019. Distance Sampling in R. Journal of Statistical Software, 89(1), 1-28.

Mollhoff, W.J. 2016. The Second Nebraska Breeding Bird Atlas. Bull. Univ. Nebraska State Museum Vol 29. University of Nebraska State Museum, Lincoln, Nebraska, USA.

Roberts, C.P., Donovan, V.M., Wonkka, C.L., Powell, L.A., Allen, C.R., Angeler, D.G., Wedin, D.A. and Twidwell, D., 2019. Fire legacies in eastern ponderosa pine forests. Ecology and Evolution, 9(4), pp.1869-1879.

Roberts, C.P., Donovan, V.M., Nodskov, S.M., Keele, E.B., Allen, C.R., Wedin, D.A. and Twidwell, D., 2020. Fire legacies, heterogeneity, and the importance of mixed-severity fire in ponderosa pine savannas. Forest Ecology and Management: 459, p.117853.

Schneider, R., K. Stoner, G. Steinauer, M. Panella, and M. Humpert. 2011. The Nebraska Natural Legacy Project: State Wildlife Action Plan 2nd ed. Nebraska Game and Parks Commission, Lincoln, NE.

Silcock, W.R., and J.G. Jorgensen. 2022 Cassin's Kingbird (Tyrannus vociferans). In Birds of Nebraska — Online. www.BirdsofNebraska.org

Thomas, L., S.T. Buckland, E.A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R.B. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47: 5-14. DOI: 10.1111/j.1365-2664.2009.01737.x