Population assessment of burrowing owls nesting in eastern Colorado

2023 Lois Webster Fund - Final Report

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Figure 1: Adult burrowing owl perched on fence line in Southeastern Colorado. Photo: Sarah Albright

INTRODUCTION

Shortgrass prairie habitat creates vital nesting and foraging habitat for many grassland birds. Habitat fragmentation and degradation is increasing in this landscape due to development in the oil and gas, urban, and agricultural sectors (Neely et al. 2006). In Colorado, approximately 50% of the historic shortgrass prairie has been converted for a variety of uses (Neely et al. 2006). This has led to population declines in multiple grassland species including black-tailed prairie dogs (Desmond et al. 2000). Black-tailed prairie dogs (*Cynomys ludovicianus*) are important drivers of ecosystem function in the shortgrass prairie because their burrowing and foraging behaviors alter the landscape and provide areas of shorter vegetation and burrow systems that support increased biodiversity of animals and plants (Cully et al. 2010). In addition, prairie dogs create vital breeding and foraging habitat for many grassland birds including burrowing owls (*Athene cunicularia*) (Smith & Lomolino 2004). Burrowing owls typically nest in burrows dug by burrowing rodents such as prairie dogs and ground squirrels (Dechant et al. 1999). These owls may prefer black-tailed prairie dog colonies because their open nature and characteristically shorter vegetation increase predator detection (Dechant et al. 1999). Benefits from prairie dog presence include increased predator detection from alarm calls, decreased predation due to the dilution effect, and reduced vegetation height (Desmond et al. 2000). Plumpton and Lutz (1993) found that burrowing owls prefer to nest in black-tailed prairie dog colonies that have high burrow density, perch availability, and percentage of bare ground.

Burrowing owl populations have been declining in some regions across the Great Plains due to nesting habitat loss, fragmentation, and degradation. This decline has been closely linked to declines in Black-tailed prairie dogs. Varying levels of population decline have created variation in the conservation status of burrowing owls across its range. This species is of conservation concern in the western US, threatened in Mexico, and endangered in Canada.The burrowing owl is currently listed as a state threatened species in Colorado and is considered a Tier 1 species of greatest conservation need in Colorado's State Wildlife Action Plan (Colorado Parks and Wildlife 2015).The last population assessment was conducted in 2005 and covered the eastern half of the state. Since this study, only small scale local surveys have been conducted and thus an updated population assessment is needed to improve conservation and management of this species.

The overall objective of this project is to conduct a population assessment of burrowing owls nesting on black-tailed prairie dog colonies in eastern Colorado. Specific research questions include how various prairie dog colony characteristics influence burrowing owl occupancy, abundance, density, and productivity. These colony characteristics include prairie dog colony size, activity status, activity level, latitude, vegetation mean height, and cover of different plant functional groups (grass, forb, shrub, tree, and bareground). Prairie dog activity status is defined as either active or inactive. The active status indicates that prairie dogs or evidence of recent prairie dog activity are present. Inactive colonies are defined as colonies where prairie dogs are absent and no fresh sign is detected (scat and digging) but there are still open burrows that burrowing owls could nest in. Prairie dog activity level can be defined as low, medium, or high

activity. Colonies with low prairie dog activity have large patches of inactive burrows including both long term and recently inactive burrows. Colonies with medium prairie dog activity have some patches of long term inactive burrows, but most of the burrows in the plot are open. In colonies with high prairie dog activity, there is a high density of active and open burrows with few or no patches of inactivity. Active colonies that span larger areas are predicted to positively influence specified population parameters. We predict that prairie dog activity level will have a positive effect on burrowing owl population parameters because prairie dogs maintain burrows that provide suitable owl nesting habitat. Colonies with higher activity levels will have a greater proportion of nesting habitat. We hypothesize that colonies with shorter vegetation and high cover of bare ground have higher occupancy, abundance, density, and productivity because these characteristics are indicative of prime nesting habitat. We hypothesize that vegetation cover surrounding the colony influences burrowing owl population parameters because burrowing owls are known to leave the prairie dog colony to forage in surrounding taller vegetation. This report includes preliminary occupancy results from the 2022 and 2023 field seasons. Final occupancy, abundance, density, and productivity results for both years will be available upon completion of the thesis in spring 2024.

METHODS

Our study area (Figure 2) encompasses the entire eastern plains of Colorado in order to cover the overall range and distribution of black-tailed prairie dog colonies in the state. The eastern plains is characterized by a mix of habitats including shortgrass prairie, agricultural land, urban, exurban, and prairie dog colony. We focus on black-tailed prairie dog colonies because they provide critical nesting habitat for burrowing owls during the breeding season (~April-August). We conducted double observer surveys on 180 plots across the 2022 and 2023 breeding seasons. We surveyed small (<10 ha), medium (10-300 ha), and large (>300 ha) colonies. Observers visited each plot up to four times with two visits occurring before juvenile emergence (~mid-late June) and two after. This allows our assessment to include both adult and juvenile burrowing owls. Observers walked the dashed transect line within each 1km x 1km plot and counted each burrowing owl seen as well as their age class and location (Figure 3). Following line intercept methods, observers also collected 100 vegetation data points along this transect line on the third visit which corresponds to the shortgrass prairie peak biomass season (June-July). At each point, observers dropped a rod to select a sample point and measured the functional group of each plant

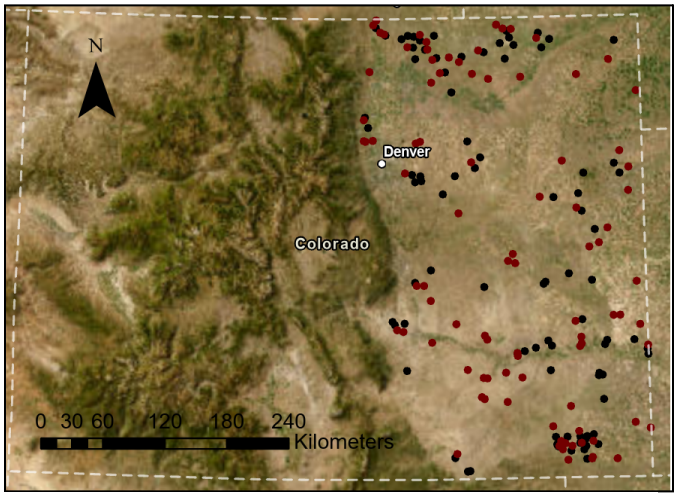

Figure 2: Map of study area where black dots are 2022 surveys and red dots are 2023 surveys.

that touched the rod as well as the height of the tallest plant. To analyze the occupancy (presence/absence) data, we use multi state occupancy models where possible states include a plot being occupied, occupied with successful reproduction, and unoccupied. The first state 'occupied' indicates that the plot is occupied in general regardless of successful reproduction. The second state 'occupied with reproduction' indicates that a plot is occupied and has successful reproduction (young). We explored models that incorporated the effect of various prairie dog colony characteristics listed in Table 1. Precipitation data is still in preparation and will be added to the analysis prior to sharing final results. In this report, we present results from a combined analysis of the 2022 and 2023 breeding seasons.

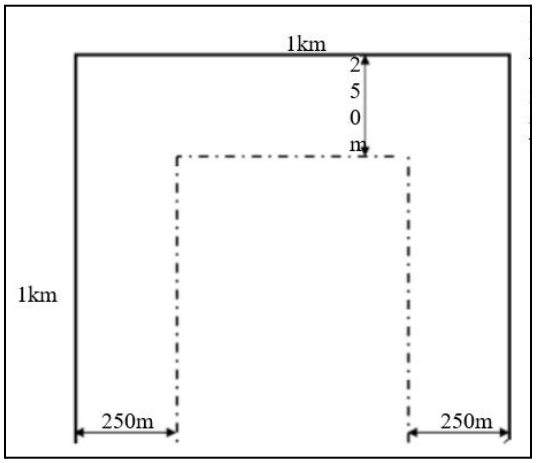

Figure 3: Diagram of the plot and transect used for burrowing owl surveys. The transect is the dashed line within the plot. Vegetation points occur ~1m off the dashed transect.

Occupancy	Probability of detection	Probability of detecting young | occupancy
-Prairie dog activity status -Prairie dog activity level -Prairie dog colony size -Presence of cattle grazing -Latitude -Vegetation height -% cover of plant functional groups (grass, forb, shrub, bareground) -Average precipitation -Survey year	-Vegetation height -Wind -Temperature -% cloud cover -Observer team -Survey time (morning/evening) -Survey year	-Vegetation height -Temperature

Table 1: List of variables that are predicted to influence occupancy, probability of detection, and probability of detecting young given that a plot is occupied.

RESULTS

Our preliminary occupancy analysis of the 2022 and 2023 field seasons indicate that prairie dog activity level and latitude influence burrowing owl occupancy. Across the two years we surveyed 180 plots and found that 72% of plots were occupied with burrowing owls and 52% of plots had successful reproduction as evidenced by juvenile emergence from the nest burrow. We found that 27% of plots were unoccupied by burrowing owls. We ran occupancy models that explored how prairie dog colony size, activity level, latitude, and vegetation characteristics affected burrowing owl presence and successful reproduction (Table 1). Overall, our estimates from the top model show that the probability of a plot being occupied and having successful reproduction is higher ($\psi 2$=0.81, 95% CI=0.66-0.90) than the probability of a plot being

occupied regardless of successful reproduction (ψ1=0.78, 95% CI=0.68-0.86). Our top model indicates that prairie dog activity level had a significant positive effect on the probability of a plot being occupied and having successful reproduction. Prairie dog colonies with higher prairie dog activity level have a greater probability of being occupied by burrowing owls that successfully reproduced young (Figure 4). Prairie dog activity level has a significant effect on the occupancy probability for plots that were occupied but did not have successful reproduction. Latitude had a negative effect such that as latitude increases, the probability that a plot is occupied by burrowing owls decreases. Southern Colorado had the highest probability of burrowing owl occupancy compared to central and northern Colorado. Prairie dog colony characteristics that did not have a significant effect on burrowing owl occupancy include colony size, colony activity status, presence of cattle grazing,vegetation height, and percent cover of grass, forb, shrub, and bareground. The probability of detecting at least one burrowing owl was greater on plots with successful reproduction (pr(detect)=0.90, 95% CI=0.86-0.93) compared to plots without successful reproduction (pr(detect)=0.33, 95% CI=0.20-0.49). We only detected juvenile burrowing owls on the third and fourth visits to our plots because these occurred after juvenile emergence. The probability of detecting at least one juvenile was pr(detect)=0.83 (95% CI= 0.74-0.89) and 0.80 (95% CI=0.71-0.86) for visits 3 and 4 respectively. Temperature had a negative effect on juvenile detection probability. At higher temperatures (>90 F), juveniles were more likely to be underground in a burrow and unavailable for detection.

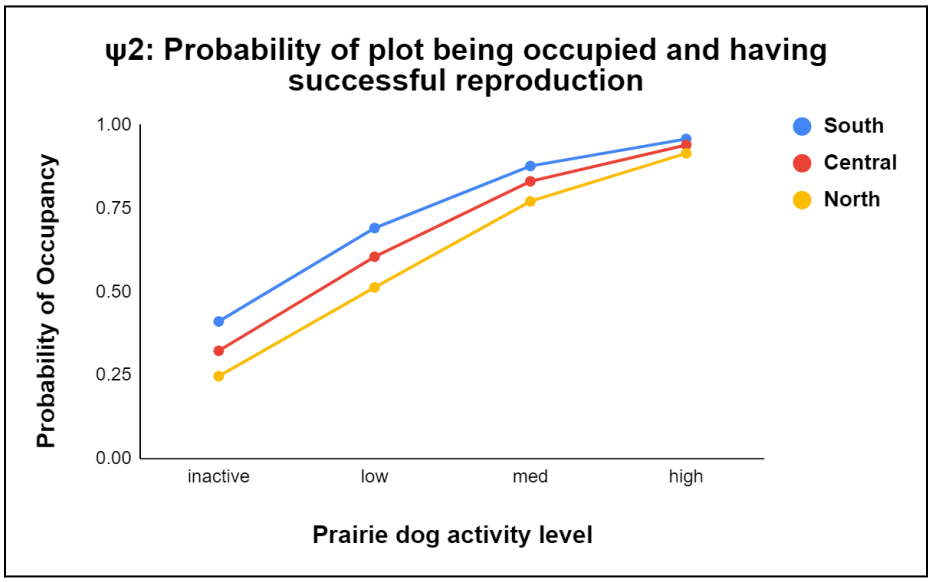

Figure 4: The probability of burrowing owl occupancy and successful reproduction for colonies of various prairie dog activity levels for southern, central, and northern Colorado. As activity level increases, so does the probability that a plot is occupied by burrowing owls and has successful reproduction. Southern Colorado has a higher probability of occupancy compared to central and northern Colorado.

DISCUSSION AND CONSERVATION IMPLICATIONS

Our preliminary occupancy results show strong positive effects of prairie dog activity level and negative effects of latitude on burrowing owl occupancy. Prairie dogs play a vital role in maintaining burrows that provide critical nesting habitat for burrowing owls. Their burrowing behaviors help keep burrows open and clear such that burrowing owls are able to nest inside and

effectively rear young. Colonies with higher levels of prairie dog activity have better burrowing owl nesting conditions because there is a higher density of available nesting burrows that are well maintained. Therefore, conserving prairie dog colonies with activity levels that are high enough to support greater suitable burrow density should be prioritized over inactive or lowly active colonies. Latitude was also a significant predictor of burrowing owl occupancy. Plots in southern Colorado had a higher probability of being occupied by burrowing owls than Central and Northern Colorado. Southern Colorado also had a higher probability of having plots with successful reproduction. This spatial pattern could be driven by differences in precipitation and temperature regimes across the state, sylvatic plague dynamics and subsequent effects on prairie dogs, differences in land use, or some other factor. We are still compiling data to explain this effect. The important takeaway is that occupancy in northern Colorado is lower than in other parts of the state and may be in need of conservation action now or in the near future. Our abundance, density, and productivity analyses should clarify the severity of this spatial pattern. For example, if burrowing owl occupancy is lower in northern Colorado, but abundance, density, and productivity are similar to other regions of the state, then burrowing owls may still be able to breed and have enough successful reproduction to have a stable population. If these other parameters are also lower in the north, this may indicate that more intensive conservation action is needed in the north.

Interestingly, prairie dog colony size and vegetation characteristics did not have a significant effect on burrowing owl occupancy. Small, medium, and large colonies had similar occupancy rates. Therefore, burrowing owls are effectively using prairie dog colonies for breeding regardless of colony size. This is important because if burrowing owls can successfully reproduce on smaller prairie dog colonies, they may be more resilient to breeding season habitat loss, degradation, and fragmentation. Since our analysis showed that prairie dog colony activity level has a significant effect on occupancy probability, it would be important that these smaller colonies have active prairie dog populations with medium to high burrow maintenance activity. Vegetation height and percent cover of different plant functional groups did not influence burrowing owl occupancy probability.

The last large scale burrowing owl study in eastern Colorado took place in 2005 (Tipton et al. 2008). The study focused on burrowing owl and mountain plover occupancy and abundance on prairie dog colony, grassland, and dryland agriculture plots throughout eastern Colorado. The estimates from their top model indicate that the probability of a prairie dog colony plot being occupied by burrowing owls is 0.80 (95% CI=0.66-0.89) (Tipton et al. 2008). Our estimate for burrowing owl occupancy is 0.78 (95% CI=0.68-0.86). The occupancy estimates are not significantly different between our two studies. These studies occurred 17 years apart so there is no information from large scale studies between these time points. However, the similar probability of occupancy points to burrowing owl populations generally being stable in the time between these studies. Though there were likely both population increases and decreases over the last 17 years. It is worth noting that this study occurred during the first part of the burrowing owl

breeding season and did not evaluate juvenile burrowing owl occupancy or abundance. So, there is no comparison for successful reproduction between our two studies.

This study aims to help improve burrowing owl monitoring and management in Colorado and other regions where burrowing owls are heavily relying on prairie dog colonies during the breeding season. Understanding which prairie dog colony characteristics support burrowing owl presence and reproduction can help Colorado Parks and Wildlife and other regulatory entities (including federal and local) target their conservation efforts. Our preliminary analysis suggests that Northern Colorado may need more intensive conservation action if our abundance, density, and productivity analyses indicate potential for large population decline. In addition, the preliminary results indicate that we should focus our conservation efforts on colonies with higher prairie dog activity levels to ensure that vital burrowing owl nesting grounds are protected. This large scale study provides an updated population assessment of burrowing owl populations in eastern Colorado and will be used to inform Colorado Parks and Wildlife conservation and management plans for this species. In this report, we present only occupancy results, one of four population parameters of interest in this project. We are currently working on analyzing the data using distance sampling methods to obtain burrowing owl density and abundance estimates. To assess productivity, we will construct a productivity index using the ratio of adults to juveniles. Due to the large scale of this project, we were unable to conduct nest searching surveys and use this productivity index as a proxy for productivity. Preliminary results for these analyses will be presented at the annual LWF program in April. The finalized results will be available upon completion of the M.S. thesis in spring 2024.

LOIS WEBSTER FUND

The Lois Webster Fund provided $2,720 to support this project in 2023. These funds were used in their entirety to hire a field technician to assist with contacting private landowners to secure permission to conduct burrowing owl surveys. Most of our surveys occurred on private land across the eastern plains in Colorado and this work would not have been possible without these funds for this vital portion of the project.

Figure 5: Juvenile burrowing owl perched near nest burrow in southeastern Colorado. Photo: Sarah Albright

ACKNOWLEDGEMENTS

This project is supported by the Lois Webster Fund, Colorado Parks and Wildlife, and Colorado State University. We are so grateful for the support of our field technicians and collaborators that have made significant contributions to this project. Reesa Conrey from Colorado Parks and Wildlife has provided valuable insight into burrowing owl study design and natural history. Bill Kendall (Principal Investigator)

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FINANCIAL REPORT

Estimated Lois Webster Fund Use	**Actual Lois Webster Fund Use**
4 weeks of pay (40 hrs/week, $17/hour) for a technician to assist with landowner contact to secure access to 2023 survey plots.	4 weeks of pay (40 hrs/week, $17/hour) for a technician to assist with landowner contact to secure access to 2023 survey plots.
Total requested: $2,720	**Total spent: $2,720**