Bird Monitoring of Bobcat Ridge and Crossline Canyon

2021 TECHNICAL REPORT

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Technical Report: I-CC-BR-FCNAP-21

Bird Conservancy of the Rockies
Connecting People, Birds and Land

BIRD CONSERVANCY OF THE ROCKIES

***Mission**: To conserve birds and their habitats*

***Vision**: Native bird populations are sustained in healthy ecosystems*

***Core Values**: (Our goals for achieving our mission)*

1. ***Science** provides the foundation for effective bird conservation.*
2. ***Education** is critical to the success of bird conservation.*
3. ***Stewardship** of birds and their habitats is a responsibility we all share.*

Bird Conservancy accomplishes its mission by:

***Monitoring** long-term trends in bird populations as a scientific foundation for conservation action.*

***Researching** bird ecology and response to anthropogenic and natural processes. Our research informs management and conservation strategies using the best available science.*

***Educating** people of all ages to instill an awareness and appreciation for birds and a conservation ethic.*

***Fostering** good stewardship on private and public lands through voluntary, cooperative partnerships that create win-win solutions for wildlife and people.*

***Partnering** with local, state and federal agencies, private citizens, schools, universities, and other organizations for bird conservation.*

***Sharing** the latest information on bird populations, land management and conservation practices to create informed publics.*

***Delivering** bird conservation at biologically relevant scales by working across political and jurisdictional boundaries in the Americas.*

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***Cover Photo:** Bobcat Ridge Natural Area 2021. Photo by Katrina Jenkins*

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EXECUTIVE SUMMARY

Bobcat Ridge and Crossline Canyon are Fort Collins city properties that occur in the lower montane regions of the Front Range foothills with rugged canyons formed by steep, forested hillsides, topped by high open meadows, dense patches of shrubs, and several natural springs. This report combines the findings of Bird Conservancy of the Rockies 2021 surveys of both Bobcat Ridge and Crossline Canyon due to the similarity of habitat and related bird species.

The most commonly observed birds within the 2021 study area were Western Meadowlark, Cliff Swallow, Spotted Towhee, House Wren, and Mourning Dove, which together accounted for almost 40% of all individual birds observed. There were also observations of elk, mule deer, several black bears including one with a cub on the property, as well as a variety of other mammal sign, bull snakes and rattlesnakes, wildflowers, flowering/ fruiting shrubs and insects. We chose focal species for these lower montane properties based on their presence indicating healthy ponderosa pine habitat within the Southern Rockies/Colorado Plateau Bird Conservation Region (BCR 16). Focal species include Western Tanager, Western Wood-Pewee, House Wren, Western Meadowlark, and Lazuli Bunting.

The management and conservation of both properties permanently protects the Laramie foothills view shed from urban expansion. We recommend Management strive to conserve, maintain, and restore native forest habitat, heterogeneous vegetative undergrowth structure, minimize disturbance from urban expansion, natural resource development and recreation, and continue monitoring to inform management priorities and actions.

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INTRODUCTION

The Crossline Canyon and Bobcat Ridge properties are part of a larger collection of conserved lands in the Laramie Foothills Region of the Front Range of Northern Colorado. Bird Conservancy of the Rockies (Bird Conservancy) has partnered with the City of Fort Collins Natural Areas (FCNA) since 2006 to aid in the conservation and management of their Natural Areas as important conservation and recreation destinations through bird inventory and monitoring. Bird Conservancy provides the FCNA with data and management recommendations that benefit the bird and wildlife community in the Natural Areas and other properties.

The goal of this long-term monitoring is to help the FCNA conserve forest and shrubland bird species and their habitats in Crossline Canyon and Bobcat Ridge by understanding the abundance and habitat requirements of breeding birds on the properties. The area has experienced catastrophic wildfires that have significantly decreased the amount of mature forest habitat, but at the same time created temporary habitat for cavity nesting species such as Mountain Bluebirds, House Wrens, Chickadees, and Woodpeckers. The objective is to monitor bird populations, document breeding bird use of the project area and their response to landscape variables and management activities.

METHODS

Study Areas

We conducted breeding bird point count surveys on FCNA montane properties; Crossline Canyon and Bobcat Ridge Natural Area in Larimer County of northern Colorado (Fig 1). Bobcat Ridge Natural Area is a 2,606-acre property that is open to the public for recreational horseback riding, mountain biking, hiking, and wildlife viewing. There are historic structures and cultural artifacts on the property as well; adding to the value of the Natural Area for a variety of visitors. The habitat within this property is important for native wildlife such as deer, elk, mountain lion, and black bear. Much of the area in Bobcat burned in the 2020 Cameron Peak fire, creating several large stands of dead snags and open boulder fields. Bird Conservancy has surveyed this Natural Area several times since 2015.

Crossline Canyon is a 1,474-acre property comprised of very steep, forested hillsides, with a few high meadows and small springs. that is not currently open to the public. We first surveyed this property in 2020 to gather a baseline inventory of the birds and vegetation. The rugged, untouched landscape is a safe-haven for large carnivores like mountain lions and black bears, of which Bird Conservancy's technicians saw several during their surveys in 2021. The northwest portion of Crossline Canyon burned in the High Park Fire in 2012, and forest regrowth is underway, with a lot of flowering forbs and shrubs growing in under the standing burned and dead snags. In the areas that burned in 2012, those standing dead snags provide habitat for cavity-nesting species like Mountain Bluebirds, House Wrens, Chickadees, and Woodpeckers. In the ravines created by seeps and springs on the property, there are dense understory shrubs and a mix of Douglas Fir, Willow, and Rocky Mountain Maple. There we detected warbler species, and secretive flycatcher species.

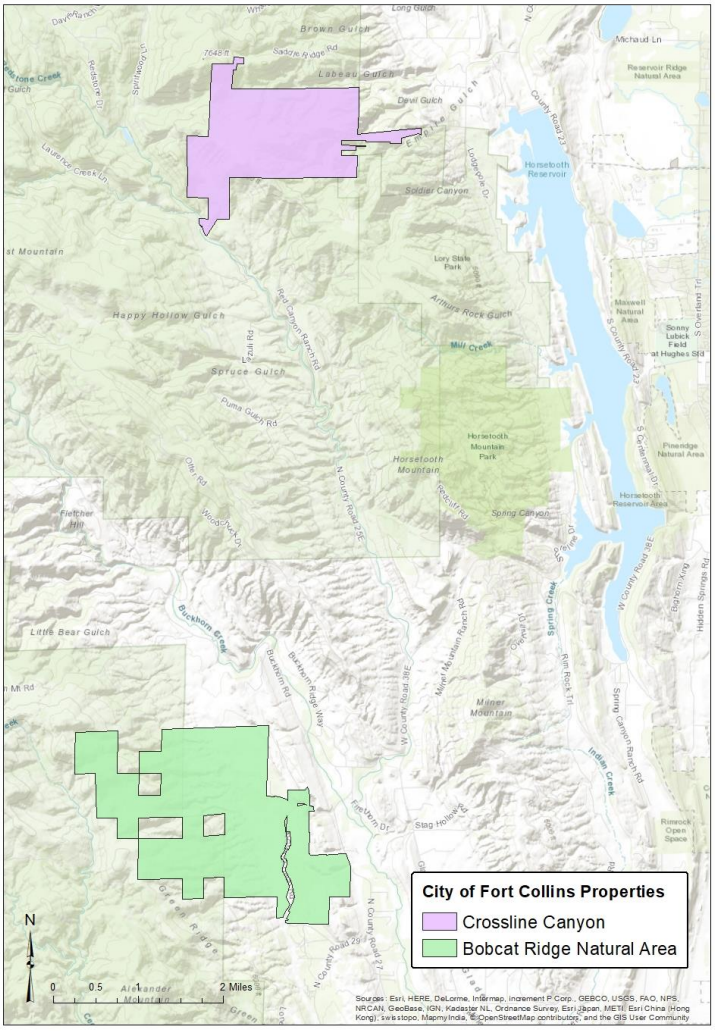


Figure 1: City of Fort Collins Properties: Crossline Canyon and Bobcat Ridge

Bobcat Ridge Natural Area is transitioning from catastrophic historic fire activity. There are remaining pockets of intact Ponderosa Pine on the north end of the property, and a small patch in the south west. The area burned has regenerated native grasses and forbs, and the City's efforts to eradicate cheatgrass have been very successful. There was a surplus of flowering forbs, which provides insect variation - a food source for many nesting birds. Standing dead and burned trees continued to house cavity nesters such as House wrens and woodpeckers. The west-facing shrubland habitat is still intact, with a variety of shrubland-obligate bird species such as Towhees, Gnatcatchers, and Chats.

Avian Point Count Surveys

Using a systematic 250-m grid of point count stations created by the FCNA, we established 99 point count stations in Crossline Canyon (there were 13 new points added in 2021 that were not surveyed in 2020 as FCNA acquired more land within the property boundary in late 2020.

) (Fig 2), and 172 point count stations in Bobcat Ridge Natural Area (Fig 5). Points were surveyed at the peak of the breeding season between June 7th and June 29th. Point count surveys started one half-hour before sunrise and ended by 10 a.m., often earlier.

Point count locations were navigated to on foot using a handheld GPS unit. We recorded atmospheric data (temperature, cloud cover, precipitation, and wind speed) and time of day at the start and end of each daily survey effort. At each station, we conducted a 6-minute point count survey consisting of six consecutive 1-minute intervals. This protocol, which is described more fully by Youngberg (2021), uses Distance sampling (Buckland et al. 2001) with removal (Farnsworth et al. 2002). For each bird detected, observers recorded species, sex, how it was detected (call, song, visual, wing beat, other), distance from observer at time of detection, and the 1-minute interval in which it was detected. We measured distances using a Bushnell Yardage Pro laser rangefinder. Point counts were not conducted during periods of heavy snow, rain, or wind greater than 10 mph. Between point count surveys, we recorded the presence of high-priority and other rare or unusual bird species, but we did not use these observations in our analyses. We also noted the presence of any other wildlife or interesting site observations.

Habitat Surveys

After each avian point count survey, we completed a rapid habitat survey by estimating several vegetation parameters. Within 5m of each point we visually estimated percent cover of grasses, forbs, bare ground, exotic/non-native plants, cactus, low woody plants (< 30cm), animal scat, rock, and 'other cover' to the nearest 1%. 'Other cover' included other minor ground cover types such as downed logs, lichen, litter, open water, or categories defined in the notes. Also within this radius, we measured average grass height with a ruler to the nearest cm and listed the dominant grass species. Within 50 m of each station we documented any shrub (> 30cm) and over-story tree species, estimated the percent cover to the nearest 1%, and the average height of each.

Density Estimation

We used a hierarchical distance-sampling model described in Sillett et al. (2012) to generate density estimates for five focal species. This hierarchical model includes sub-models that allow for the density process and the detection process to vary as functions of covariates i.e., grass height. In the density component of the model, the number of birds at each point (N_i) was modeled using a Poisson random variable. The expectation for the number of birds at a point count is $E[N_i] = \lambda$. The detection process in the model is based on classical distance sampling methods developed by Buckland et al. (2001). We used a half normal scale parameter and only considered constant models on detection. We estimated parameters of the generalized multinomial mixture model by maximizing the integrated likelihood function in R (R Development Core Team 2019) using the 'unmarked' package (Fiske et al. 2010).

We used an information theoretic approach to select the top models (Burnham and Anderson 2002). If over dispersion was detected we used QAIC (Burnham and Anderson 2002). We ranked

models by the Akaike Information Criterion (AIC) (Akaike 1973) and considered a set of candidate models to be the best if AIC values were within ΔAIC < 2.

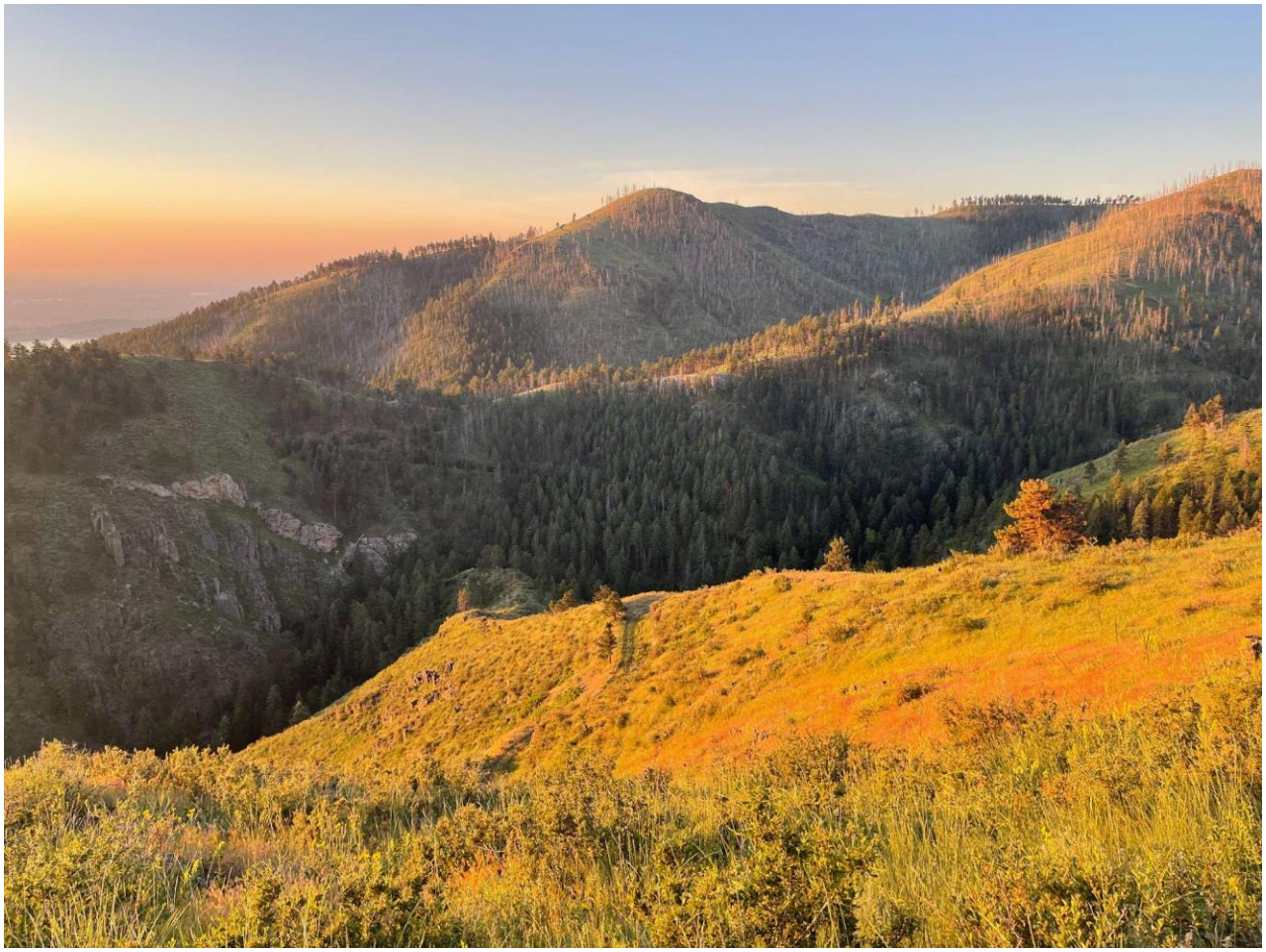
Habitat Relationships

We modeled habitat relationships for our focal species based on the habitat and bird data collected in the field. Covariates include percent canopy cover, tree height (m), shrub height (cm), percent shrub cover and shrub height (cm). For Western Meadowlark we substituted grass cover and grass height for canopy cover and tree height respectively. In program R we used the landscape metrics package (*Hesselbarth et al. 2019)* with LANDFIRE existing vegetation type layer (USGS 2014), to derive tree and shrubland cohesion within the sampling unit (250 x 250 meters square, (15.44 acres)). Cohesion characterizes how connected the habitat patches are within our sampling unit. We tested for a quadratic effect on canopy cover, shrub cover and shrub height. We developed twenty-nine models to observe bird density response to landscape and vegetation structure covariates (Appendix C). The detection model was held constant for all models.

Wildflowers in the high meadow area of Bobcat Ridge Natural Area (photo by Katrina Jenkins)

RESULTS

CROSSLINE CANYON



Crossline Canyon looking southeast across the property from the northern boundary (photo by Katrina Jenkins)

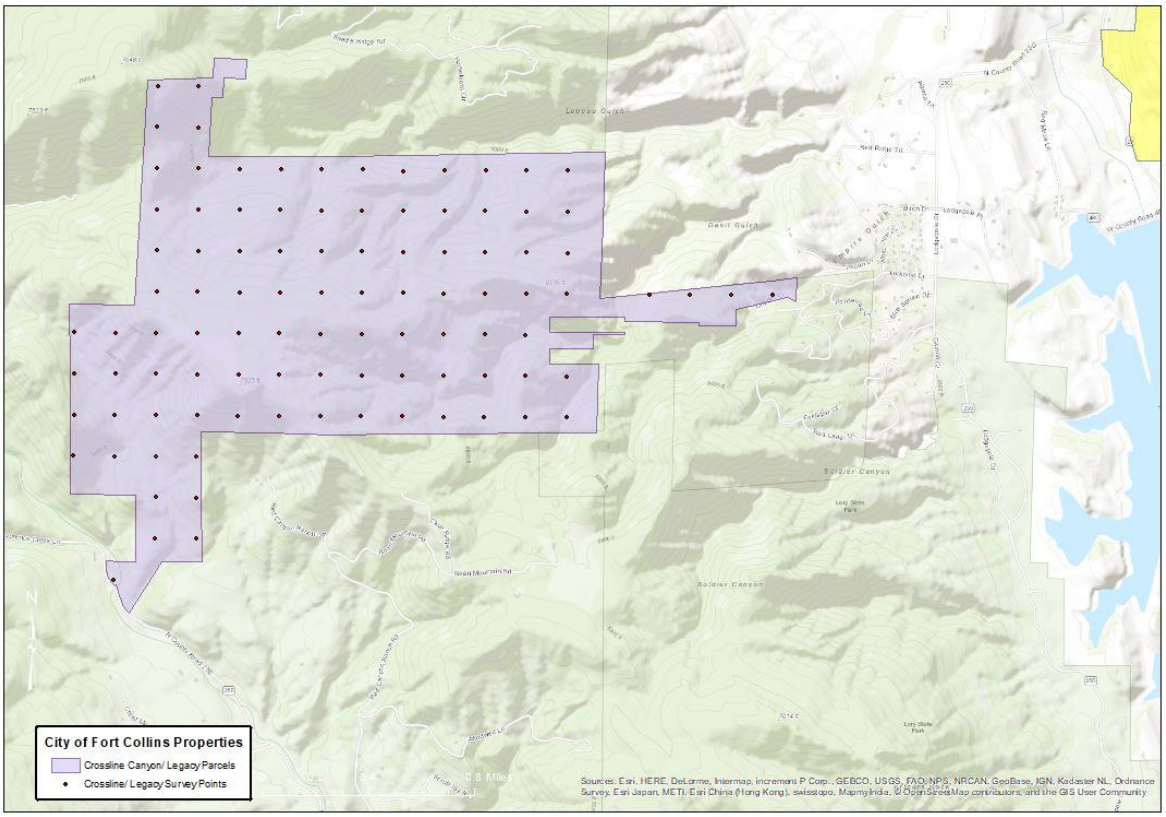


Figure 2: Survey area and point count stations in Crossline Canyon

Avian Surveys

Between June 7th and 29th of 2021, we detected 689 birds during point count surveys in Crossline Canyon, and observed 49 species. Of the species detected, 10 are of conservation interest (Appendix A: Table 5); Common Nighthawk, Northern Flicker, Cordilleran Flycatcher, Plumbeous Vireo, Pygmy Nuthatch, Rock Wren, Green-tailed Towhee, Lazuli Bunting, Mountain Bluebird, and Pine Siskin. There was an increase in Wild Turkey detections, which has been observed anecdotally along the Front Range of Colorado since the bird was reintroduced in the 1980's. Species that had a visible decrease in detections in 2021 from 2020 were; Broad-tailed Hummingbird, Violet-green Swallow, Virginia's Warbler, and American Goldfinch.

We estimated density annually for five focal species: Western Tanager, Western Wood-Pewee, Lazuli Bunting, House Wren and Western Meadowlark. Density estimates are presented in Table 1.

Table 1: Annual density estimates (2020-2021) on Crossline Canyon (D= # of birds/ acre), SE = Standard error, and 95% lower (LCL) and upper (UCL) confidence limits.

Species	D	SE	LCL	UCL	Year
House Wren	0.44	0.045	0.358	0.537	2020
	0.28	0.033	0.226	0.357	2021
Lazuli Bunting	0.19	0.027	0.145	0.253	2020
	0.22	0.028	0.171	0.281	2021
Western Meadowlark	0.02	0.006	0.012	0.037	2020
	0.01	0.004	0.004	0.021	2021
Western Tanager	0.14	0.023	0.104	0.196	2020
	0.13	0.020	0.092	0.172	2021
Western Wood-pewee	0.12	0.019	0.091	0.168	2020
	0.09	0.016	0.068	0.130	2021

Habitat Surveys

Grass was the most dominant ground cover type measured within the 50m radius at each point in Crossline Canyon (39%), followed by “Litter” (24%) in 2021 (Fig 4). There is a large decrease from grass cover in 2020 (58%) (Fig 3), perhaps due to the grasses that grew in quickly after fire disturbance became part of the “Litter” category in 2021 as dead vegetative cover. Forb cover increased slightly from the previous year (from 12% to 15%). Bare ground and “Other” showed very small decreases from 2020 (5% to 3%, and 18% to 16%, respectively), with Shrub < 30cm cover remaining at 3% both years.

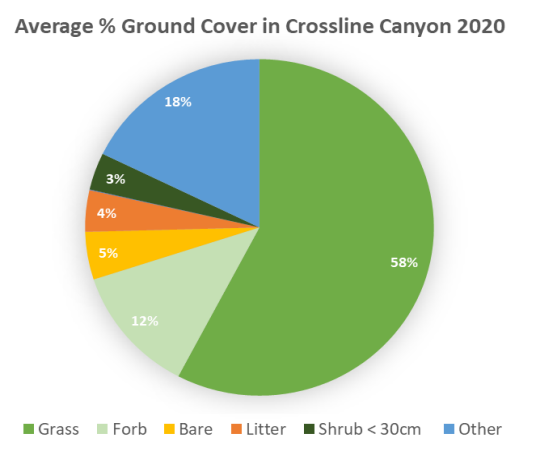


Figure 3: Average percent ground cover in Crossline Canyon in 2020

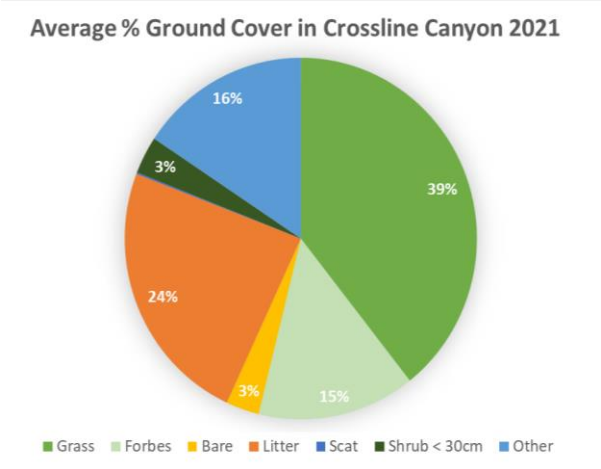


Figure 4: Average percent ground cover in Crossline Canyon in 2021

BOBCAT RIDGE

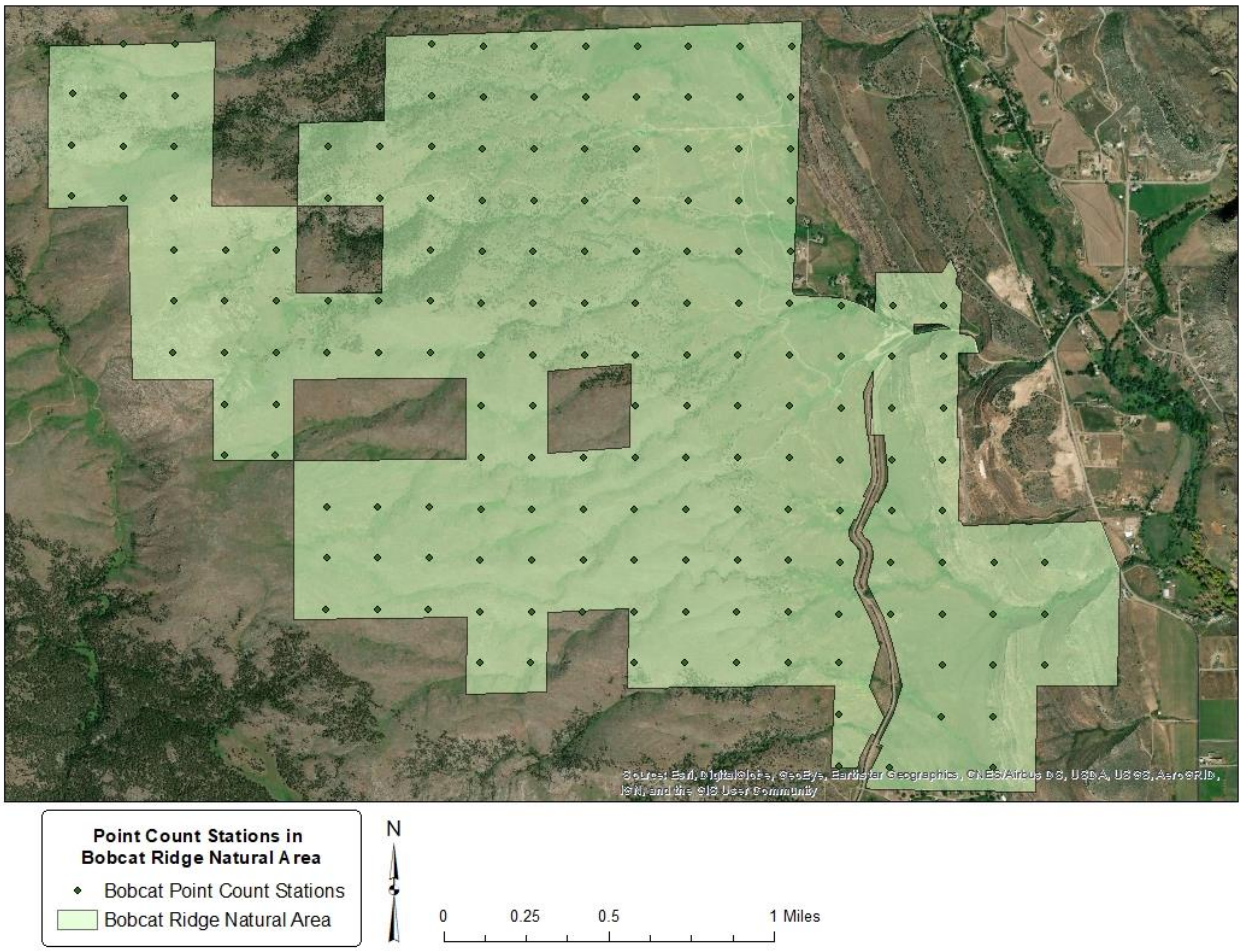


Figure 5: Survey area and point count stations in Bobcat Ridge Natural Area

Avian Surveys

At Bobcat Ridge NA in 2021 we detected 1,214 birds during point count surveys, and observed 66 species within the study area. Of the species detected, 10 are of conservation concern (Appendix A: Table 2); Common Nighthawk, Broad-tailed Hummingbird, Northern Flicker, Cordilleran Flycatcher, Plumbeous Vireo, Rock Wren, Mountain Bluebird, Virginia's Warbler, Green-tailed Towhee, and Lazuli Bunting.

The most commonly detected species were Spotted Towhee, Western Meadowlark, Lazuli Bunting, Mourning Dove, Rock Wren, Lesser Goldfinch, and Broad-tailed Hummingbird, making up almost 50% of all birds detected! This is similar to years' past, with a few species fluctuating in number, such as the Crossbill irruption in 2017, and a gradual reduction in the number of Mountain bluebird detections as they may have moved further up in elevation to the abundance of more recently burned sites in nearby National Forest.

We estimated annual density for five focal species; Western Tanager, Western Wood-Pewee, Lazuli Bunting, House Wren and Western Meadowlark. Density estimates are presented in Table 2.

Location maps for focal species are found in Appendix B.

Table 2: Bobcat Ridge Focal Species Annual Density Estimates

(D= # of birds per acre), SE = Standard error, and 95% lower (LCL) and upper (UCL) confidence limits. Note – there are no estimates for the years the property was not surveyed.

Species	D	SE	LCLr	UCL	Year
House Wren	0.10	0.015	0.078	0.139	2016
	0.16	0.019	0.128	0.204	2017
	0.17	0.020	0.140	0.217	2018
	0.08	0.013	0.061	0.113	2021
Lazuli Bunting	0.10	0.014	0.075	0.132	2016
	0.06	0.011	0.046	0.089	2017
	0.10	0.014	0.078	0.134	2018
	0.15	0.018	0.117	0.186	2021
Western Meadowlark	0.18	0.015	0.150	0.209	2016
	0.29	0.020	0.249	0.328	2017
	0.26	0.019	0.230	0.304	2018
	0.10	0.010	0.079	0.118	2021
Western Tanager	0.05	0.010	0.035	0.074	2016
	0.03	0.007	0.020	0.049	2017
	0.05	0.009	0.034	0.070	2018
	0.02	0.006	0.013	0.036	2021
Western Wood-pewee	0.05	0.008	0.032	0.066	2016
	0.07	0.010	0.050	0.091	2017
	0.08	0.011	0.058	0.102	2018
	0.04	0.007	0.027	0.057	2021

Habitat Surveys

Grass was the dominant ground cover type at Bobcat Ridge (40%) in 2021. Bare Ground was next at 24%, a significant increase from 2018's surveys with 9% average cover, followed by 'Other' (17%) which consisted of cover such as large rocks, downed wood/ trees, and fallen cones (Fig 7). There was 10% average coverage of forbs, down from 15% since 2018. Average 'Litter' ground cover changed significantly from 20% in 2018, to 8% in 2021 (Figs 6 and 7). The average grass height in 2021 was 26.52cm, compared to 32.13 in 2018. These changes are likely due to removal of litter and regrowth from the recent fire.

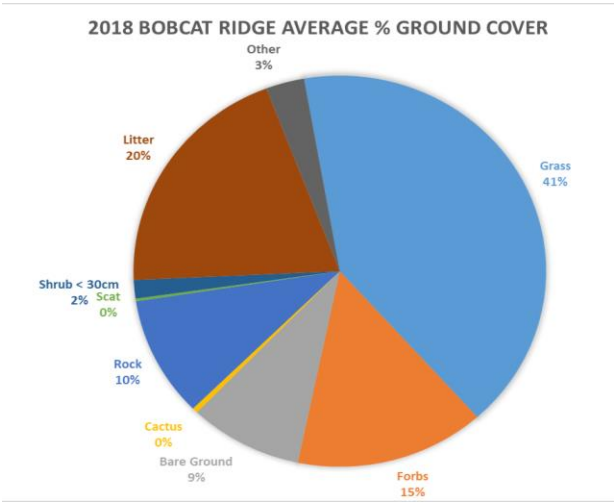


Figure 6: Average percent ground cover in Bobcat Ridge in 2018

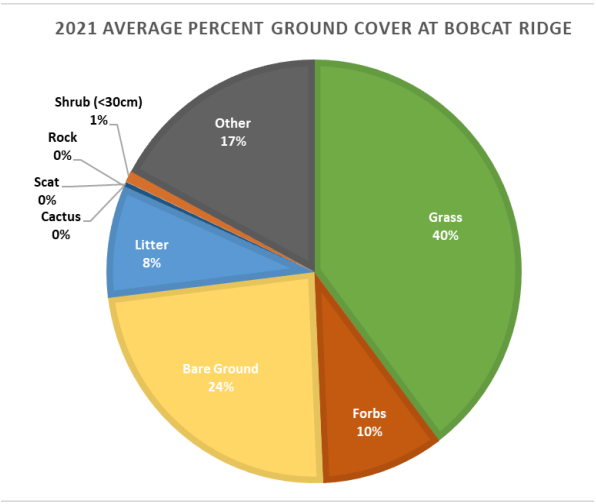


Figure 7: Average percent ground cover in Bobcat Ridge in 2021

HABITAT RELATIONSHIPS:

We estimated density and developed habitat relationships across both properties for the five focal species; Western Tanager, Western Wood-Pewee, Lazuli Bunting, House Wren and Western Meadowlark. Density model parameter estimates are presented in Appendix D.

Focal species response to vegetation covariates varied by species and all species showed strong relationships to vegetation covariates (App D, Fig. 8A-E). As expected Western Tanager and Western Wood-Pewee responded positively to percent overstory, tree cohesion and tree height. In addition, Western Wood-Pewee showed a positive relationship to shrub height (App D, Fig. 8D). An optimal amount of tree canopy was identified for Western Tanager (App D, Fig. 8C). House Wren, an open woodland species, showed a positive relationship to tree height, tree cohesion and a negative relationship with shrub height (App D, Fig. 8A). As expected Lazuli Bunting density increased with shrub cover (App D, Fig. 8E). Western Meadowlark responded positively to grass cover, grass height and negatively to shrub cover and shrub cohesion (App D, Fig. 8B). Interestingly an optimal shrub height was identified for Western Meadowlark (App D, Fig. 8B).

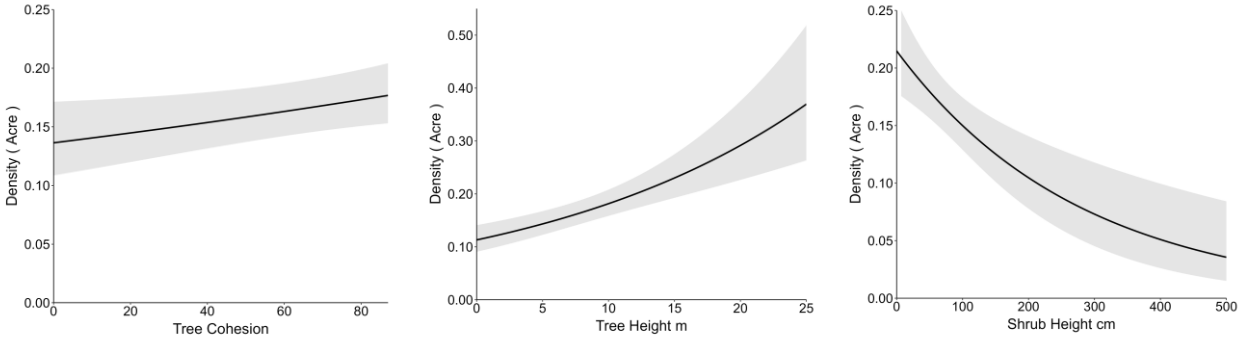


Figure 8A House Wren density in relation to Tree Cohesion and Height, and Shrub Height.

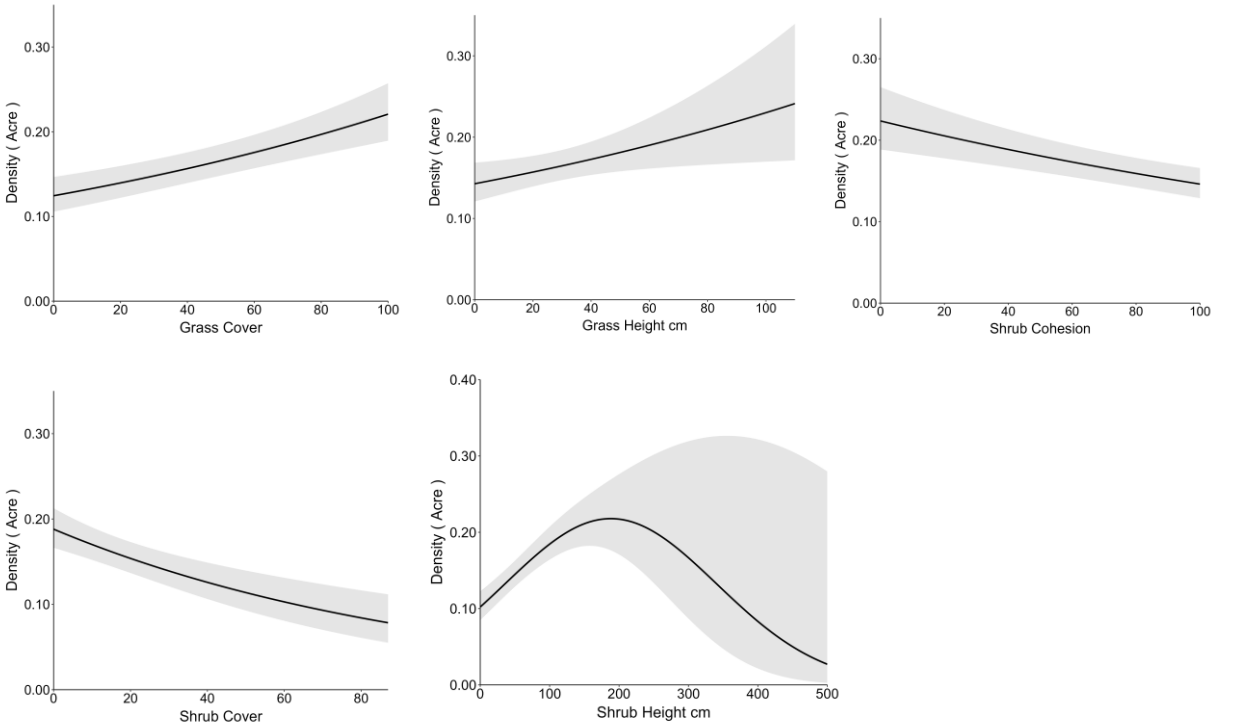


Figure 8B: Western Meadowlark density in relation to Grass % Cover and Height, Shrub Cohesion, % Cover, and Height

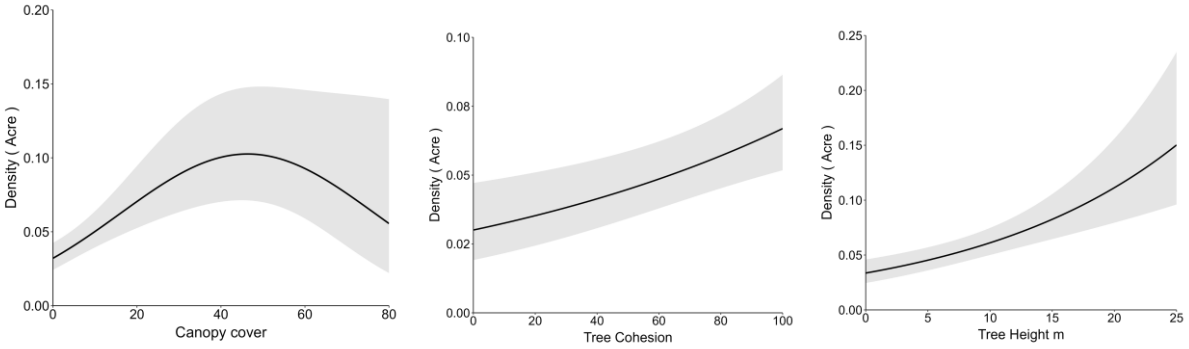


Figure 8C: Western Tanager density in relation to Canopy Cover, Tree Cohesion, and Tree Height

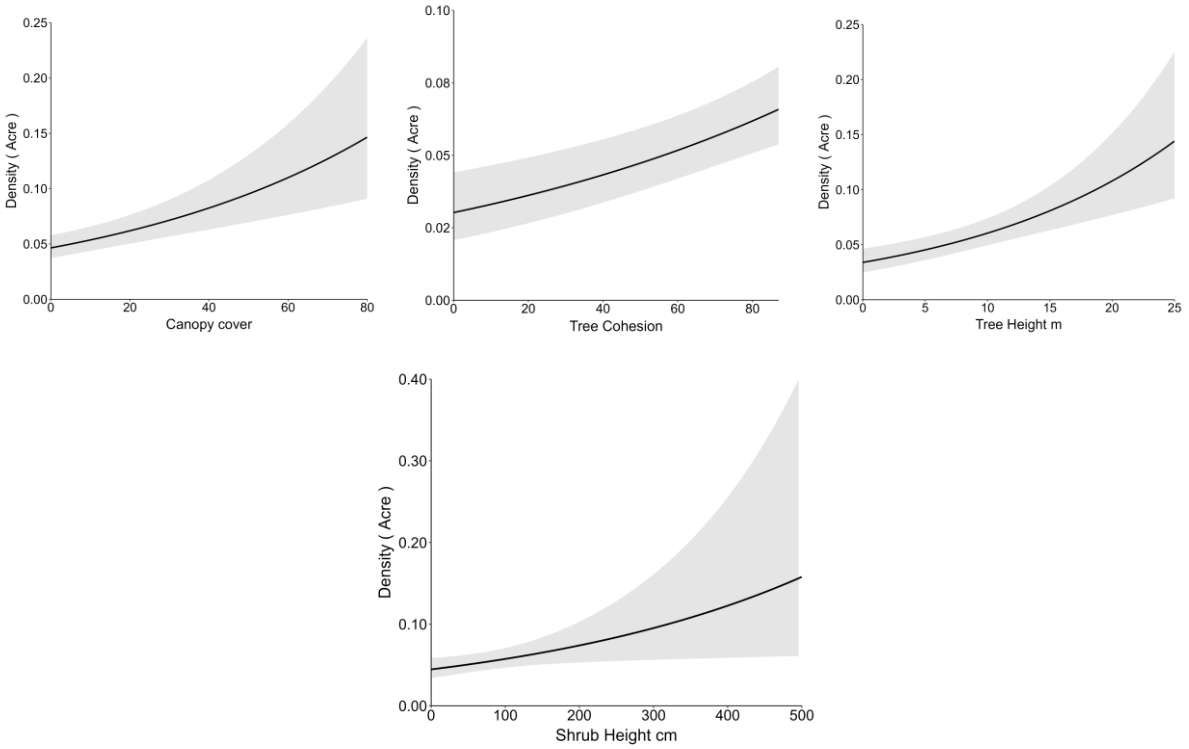


Figure 8D: Western Wood-pewee density in relation to Canopy Cover, Tree Cohesion, and Tree and Shrub Height

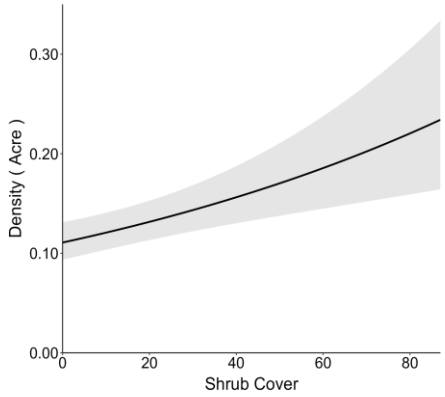


Figure 8E: Lazuli Bunting density in relation to % Shrub Cover

Figure 8: (A-E) Habitat relationships for 5 focal species across Bobcat and Crossline natural areas

DISCUSSION AND MANAGEMENT RECOMMENDATIONS

A focal species approach can be used as a management tool to assist with natural areas planning. Management that focuses on single species outcomes may be too narrow to meet conservation goals (Moilanen 2005). An alternative approach is to identify focal species that integrate ecological processes that contribute to the maintenance of the ecosystem function (Lindenmayer et al. 2014). This will allow management actions aimed at conserving the focal species to also protect a larger number of species occurring in the management area. Species density relationships to tree and shrub cohesion along with habitat variables can be used as an effective tool to assist with management planning. Vegetation and landscape variables influenced focal species bird density along both ends of the landscape and vegetation continuum. We found strong support for non-linear relationships for Western Tanager and Western Meadowlark. These non-linear relationships show bird density increasing up to an optimal level of canopy cover and shrub height and then decreasing past a certain threshold. These optimal levels can be used as management guidelines for these species.

Of the bird species detected both in Bobcat Ridge and Crossline Canyon, four of them are “Common Birds in Steep Decline”, meaning their populations have declined by an estimated 50% or more since 1970: Common Nighthawk, Northern Flicker, Rock Wren, and Pine Siskin. These are native species that provide vital ecosystem services, and should be monitored for healthy population trends. Major threats to these species include urbanization, climate change, agricultural conversion, and contaminants (Rosenberg et al., 2016).

Three of the bird species in Crossline Canyon are considered “Birds of Regional Concern”, meaning their populations in this region of the continent have documented declines and are experiencing moderate threats to their populations: Williamson’s Sapsucker, Mountain Bluebird, and Lazuli Bunting (Rosenberg et al., 2016). Five of the species detected at Bobcat Ridge are

“Birds of Regional Concern”: Lewis’s Woodpecker, Mountain Bluebird, Brewer’s Sparrow, Grasshopper Sparrow, and Lazuli Bunting. Eight species detected are considered “Birds of Regional Stewardship”; Broad-tailed Hummingbird, Cordilleran Flycatcher, Plumbeous Vireo, Pygmy Nuthatch, Rock Wren, Virginia’s Warbler, Green-tailed Towhee, and Pine Siskin. Management should strive to reduce loss or degradation of habitat.

Five species are listed as “Birds of Regional Stewardship”, which indicate the presence of adequate habitat required for abundance of these species within the BCR (Bird Conservation Region), but not elsewhere on the continent. These migratory breeding species are: Cordilleran Flycatcher, Plumbeous Vireo, Rock Wren, Green-tailed Towhee, and Pine Siskin. Management should strive to reduce loss or degradation of habitat, and reduce threats related to urbanization, climate change, and contaminants to ensure these characteristic species of the region stay common.

There were several differences in detections between the two years at Crossline Canyon. Specifically, Mountain bluebird was only detected in 2021, Virginia’s Warbler was present in 2020, but not in 2021. There was a drastic decrease in Broad-tailed Hummingbird, Rock Wren, and Townsend’s Solitaire detections. There were also no detections of Red Crossbill in 2021, which is indicative of their irruptive behavior. (Appendix A). Bird detections can vary between years due to several factors; changes in habitat, weather, and different observers. The spring of 2021 was the wettest in several years, with the 4th largest spring snowstorm in Colorado for over one hundred years on March 13th and 14th (weather.gov). That was followed by June - Aug as one of the hottest Colorado summers on record (noaa.gov). These drastic changes in weather can have a negative effect on bird survival, especially weather events that affect insect populations, as many of these birds are insectivores and rely on a healthy insect population to feed their young. There is often variability between years, and continued monitoring can establish a deeper understanding of bird populations trends over time within properties and across a region like the Front Range.

Interestingly, all detections of focal species occurred in the northern half of Bobcat Ridge, in the remaining ponderosa forest, and where there is more native grassland and shrubland than the southern portion of the property (Appendix B). With recovery of native grassland in the southern valley of Bobcat Ridge, we can expect to see more grassland bird species like Western Meadowlark, Grasshopper Sparrow, and Vesper Sparrow. This may take several cycles of grazing, burning, and re-seeding to achieve desirable effects (Dechant, 2000).

The only Tri-National bird of concern in both properties is the Virginia’s Warbler, which relies on tall, dense understory with open Ponderosa pine habitat. Management should target conservation of as much of that habitat type as possible to continue hosting this species.

Bird Conservancy technicians also documented several individual black bears during surveys in Crossline Canyon in 2021 including 1 female with a cub, a young black male, and a young cinnamon male in several different sightings (Table 4, Fig 9) (Photos captured from videos taken by Bird Conservancy technician Katrina Jenkins in a folder shared with City Natural Areas).

Figure 9: (Clockwise from top left: Mom + cub, single black bear, another single black bear, and Cinnamon bear)

Table 3: Bear sightings by date, time, and point location with video reference to the videos contained in the aforementioned folder.

	Date and Time	Point # video taken at	Video #
Mom + cub	6/23/21 at 5:23am	CC - 036	3879, 3883, 3888
Single black bear	6/24/21 at 7:13am	CC - 083	3918, 3920, 3924
Mom + cub*	6/24/21 at 7:44am	CC - 083	3927, 3929, 3931, 3933*, 3934
Single black bear	6/28/21 at 6:46am	CC - 093	4033
Cinnamon bear	6/28/21 at 7:02am	CC - 096	4036, 4039, 4042
Running bear	6/28/21 at 7:38am	CC - 097	4044

* Cub does not come down from mountain with mom, enters in video 3933.

ALL bears seen on and after 6/24 were observed coming down from hillside between points 75 and 83.

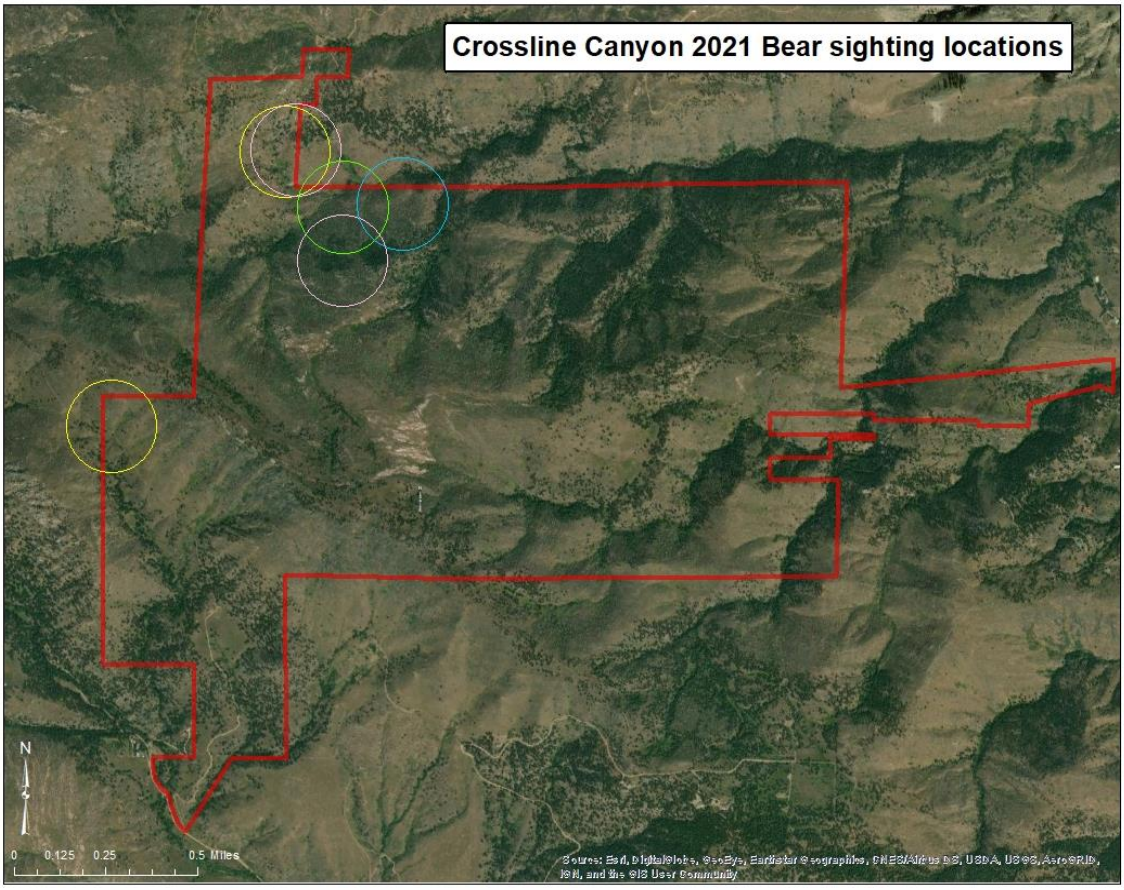


Figure 10: Bear sighting locations: Yellow circle = Mom + cub, Pink circle = single black bear, Green circle = Cinnamon bear, Blue circle = running bear

Annual meetings with the Natural Areas Department, managers, and Bird Conservancy to share data and results and determine management and conservation goals help inform and direct future actions and survey efforts.

ACKNOWLEDGEMENTS

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APPENDIX A: BIRD DETECTION TABLES

Table 4: Individual Bird detections in Crossline Canyon in survey years 2020-2021

Common Name	*Scientific Name*	Detections in 2020	Detections in 2021	Total
American Goldfinch	*Carduelis tristis*	10		10
American Kestrel	*Falco sparverius*	2	3	5
American Robin	*Turdus migratorius*	50	37	87
American Three-toed Woodpecker	*Picoides dorsalis*	1	1	2
Bald Eagle	*Haliaeetus leucocephalus*	1		1
Black-billed Magpie	Pica hudsonia		12	12
Black-capped Chickadee	*Poecile atricapillus*	2		2
Black-headed Grosbeak	*Pheucticus melanocephalus*	5	10	15
Blue-gray Gnatcatcher	*Polioptila caerulea*	4		4
Broad-tailed Hummingbird°	*Selasphorus platycercus*	36		36
Brown-headed Cowbird	*Molothrus ater*	2		2
Bullock's Oriole	Icterus bullockii		2	2
Canyon Wren	*Catherpes mexicanus*	7	1	8
Cedar Waxwing	Bombycilla cedrorum		3	3
Chipping Sparrow	*Spizella passerina*	37	20	57
Common Nighthawk†	*Chordeiles minor*	1	5	6
Common Raven	*Corvus corax*	16	13	29
Cooper's Hawk	Accipiter cooperii		1	1
Cordilleran Flycatcher°	*Empidonax occidentalis*	4	1	5
Dark-eyed Junco	*Junco hyemalis*	9	9	18
Downy Woodpecker	*Picoides pubescens*	2	1	3
Dusky Grouse	*Dendragapus obscurus*	5	2	7
Golden Eagle	Aquila chrysaetos		1	1
Great Horned Owl	*Bubo virginianus*	1	1	2
Green-tailed Towhee°	*Pipilo chlorurus*	36	13	49
Hairy Woodpecker	*Picoides villosus*	17	18	35
Hammond's Flycatcher	*Empidonax hammondii*	5	5	10
House Finch	*Carpodacus mexicanus*	1		1
House Wren	*Troglodytes aedon*	123	92	215
Lark Sparrow	*Chondestes grammacus*	1		1
Lazuli Bunting†	*Passerina amoena*	62	80	142
Lesser Goldfinch	*Carduelis psaltria*	54	17	71
MacGillivray's Warbler	*Oporornis tolmiei*	13	8	21
Mallard	*Anas platyrhynchos*	1		1
Mountain Bluebird†	*Sialia currucoides*	25	8	33
Mountain Chickadee	*Poecile gambeli*	1	4	5

Mourning Dove	*Zenaida macroura*	51	57	108
Northern Flicker*	*Colaptes auratus*	7	18	25
Pine Siskin*°	*Carduelis pinus*	2	1	3
Plumbeous Vireo°	*Vireo plumbeus*	14	2	16
Pygmy Nuthatch°	*Sitta pygmaea*	20	5	25
Red Crossbill	*Loxia curvirostra*	12		12
Red-breasted Nuthatch	*Sitta canadensis*	5	2	7
Red-headed Woodpecker	Melanerpes erythrocephalus		1	1
Red-tailed Hawk	*Buteo jamaicensis*	2	3	5
Rock Wren*°	*Salpinctes obsoletus*	58	6	64
Sharp-shinned Hawk	*Accipiter striatus*	1		1
Spotted Towhee	*Pipilo maculatus*	41	61	102
Steller's Jay	*Cyanocitta stelleri*	20	25	45
Townsend's Solitaire	*Myadestes townsendi*	23	1	24
Turkey Vulture	*Cathartes aura*	2	2	4
Violet-green Swallow	*Tachycineta thalassina*	12		12
Virginia's Warbler[!]°	*Vermivora virginiae*	16		16
Warbling Vireo	*Vireo gilvus*	1	1	2
Western Bluebird	*Sialia mexicana*	4		4
Western Meadowlark	*Sturnella neglecta*	14	6	20
Western Tanager	*Piranga ludoviciana*	56	56	112
Western Wood-Pewee	*Contopus sordidulus*	52	46	98
White-breasted Nuthatch	Sitta carolinensis		1	1
Wild Turkey	*Meleagris gallopavo*	3	16	19
Williamson's Sapsucker†	*Sphyrapicus thyroideus*	1		1
Wilson's Warbler	*Wilsonia pusilla*	5	1	6
Wood Duck	*Aix sponsa*	1		1
Yellow Warbler	*Dendroica petechia*	5	7	12
Yellow-breasted Chat	*Icteria virens*	1	3	4
Yellow-rumped Warbler	*Dendroica coronata*	5		5
	Total	**958**	**689**	**1647**

Partners in Flight Watchlist Designations:

[!] Birds of Tri-national Concern

* Common Birds in Steep Decline

° Birds of Regional Stewardship

† Birds of Regional Concern

Table 5: Individual Bird detections in Bobcat Ridge Natural Area in survey years 2015 - 2021

Common Name	Scientific Name	2015	2016	2017	2018	2021	TOTAL
American Crow	*Corvus brachyrhynchos*	3					**3**
American Goldfinch	*Carduelis tristis*	22	8	10	33	16	**89**
American Kestrel	*Falco sparverius*	1	18	12	17	7	**55**
American Robin	*Turdus migratorius*	29	33	55	55	24	**196**
Barn Swallow	*Hirundo rustica*	22	3	12	10		**47**
Black-billed Magpie	*Pica hudsonia*	96	26	61	52	25	**260**
Black-capped Chickadee	*Poecile atricapillus*	4	1	6	1		**12**
Black-headed Grosbeak	Pheucticus melanocephalus			11	6	2	**19**
Blue Grosbeak	*Passerina caerulea*	12	6	8	13	3	**42**
Blue Jay	*Cyanocitta cristata*	10		2			**12**
Blue-gray Gnatcatcher	*Polioptila caerulea*	22	28	25	58	23	**156**
Brewer's Blackbird	*Euphagus cyanocephalus*		57	68	82	7	**214**
Brewer's Sparrow	*Spizella breweri*	2	7		2		**11**
Broad-tailed Hummingbird°	*Selasphorus platycercus*	61	22	36	106	55	**280**
Brown Thrasher	Toxostoma rufum			1	1	1	**3**
Brown-headed Cowbird	*Molothrus ater*	26	15	19	23	22	**105**
Bullock's Oriole	*Icterus bullockii*	67	27	41	53	49	**237**
Bushtit	*Psaltriparus minimus*				3	1	**4**
Canada Goose	*Branta canadensis*	8		25		3	**36**
Canyon Wren	Catherpes mexicanus			7	5		**12**
Cedar Waxwing	*Bombycilla cedrorum*				11		**11**
Chipping Sparrow	*Spizella passerina*		23	11	32	30	**96**
Clark's Nutcracker	Nucifraga columbiana			2			**2**
Clay-colored Sparrow	*Spizella pallida*	5					**5**
Cliff Swallow	*Petrochelidon pyrrhonota*	247	45	321	176	48	**837**
Common Grackle	*Quiscalus quiscula*	33	10	3	6		**52**
Common Nighthawk*	*Chordeiles minor*		2	6	13	18	**39**
Common Poorwill	*Phalaenoptilus nuttallii*				1		**1**
Common Raven	*Corvus corax*	13	5	31	30	8	**87**
Common Yellowthroat	Geothlypis trichas			4	1		**5**
Cooper's Hawk	*Accipiter cooperii*				1	2	**3**
Cordilleran Flycatcher°	Empidonax occidentalis			3	2	1	**6**
Dark-eyed Junco	Junco hyemalis			1	1	1	**3**
Dickcissel	*Spiza americana*		2				**2**
Downy Woodpecker	*Picoides pubescens*		5	3	2		**10**

Dusky Flycatcher	*Empidonax oberholseri*		4	1	3	2	**10**
Dusky Grouse	Dendragapus obscurus			2	4	4	**10**
Eastern Kingbird	*Tyrannus tyrannus*	3		8	3	1	**15**
Eurasian Collared-Dove	*Streptopelia decaocto*	20	1	1	2		**24**
European Starling	*Sturnus vulgaris*	101		2	5	30	**138**
Gadwall	Anas strepera			3			**3**
Grasshopper Sparrow†	*Ammodramus savannarum*	3	7		2		**12**
Gray Catbird	*Dumetella carolinensis*		2		1		**3**
Great Blue Heron	*Ardea herodias*	2			3		**5**
Great Horned Owl	*Bubo virginianus*				3	2	**5**
Green-tailed Towhee°	*Pipilo chlorurus*	9	67	29	67	24	**196**
Hairy Woodpecker	*Picoides villosus*	2		1	1	5	**9**
Hammond's Flycatcher	*Empidonax hammondii*		1		4	2	**7**
House Finch	*Carpodacus mexicanus*	14	1	1	2	7	**25**
House Sparrow	*Passer domesticus*	7	1				**8**
House Wren	*Troglodytes aedon*	45	67	94	127	45	**378**
Killdeer	*Charadrius vociferus*	1				1	**2**
Lark Sparrow	*Chondestes grammacus*	24	34	13	57	39	**167**
Lazuli Bunting†	*Passerina amoena*	66	61	46	88	95	**356**
Least Flycatcher	Empidonax minimus			1		1	**2**
Lesser Goldfinch	*Carduelis psaltria*		14	55	73	56	**198**
Lewis's Woodpecker†	*Melanerpes lewis*		3	6	2		**11**
Lincoln's Sparrow	*Melospiza lincolnii*		4				**4**
MacGillivray's Warbler	*Oporornis tolmiei*		1	3	3		**7**
Mallard	*Anas platyrhynchos*	5		2	3		**10**
Mountain Bluebird†	*Sialia currucoides*		10	14	5	1	**30**
Mountain Chickadee	*Poecile gambeli*		5			2	**7**
Mourning Dove	*Zenaida macroura*	39	33	113	162	86	**433**
Northern Flicker*	*Colaptes auratus*	22	30	28	17	10	**107**
Northern Goshawk	Accipiter gentilis					2	**2**
Northern Mockingbird	*Mimus polyglottos*		1		1		**2**
Peregrine Falcon	Falco peregrinus					2	**2**
Pine Siskin	Carduelis pinus			1			**1**
Plumbeous Vireo°	*Vireo plumbeus*		9	18	27	1	**55**
Prairie Falcon	*Falco mexicanus*		1				**1**
Pygmy Nuthatch°	Sitta pygmaea			6	7		**13**
Red Crossbill	Loxia curvirostra			80	8		**88**
Red-breasted Nuthatch	Sitta canadensis			1		1	**2**
Red-tailed Hawk	*Buteo jamaicensis*	3	11	11	13	2	**40**
Red-winged Blackbird	*Agelaius phoeniceus*	77	26	24	34	25	**186**

Rock Pigeon	*Columba livia*	2	3			2	**7**
Rock Wren*°	*Salpinctes obsoletus*	15	71	96	120	64	**366**
Ruby-crowned Kinglet	Regulus calendula			1			**1**
Sage Thrasher	*Oreoscoptes montanus*		2				**2**
Savannah Sparrow	*Passerculus sandwichensis*	3					**3**
Say's Phoebe	*Sayornis saya*	5	4	2	7	3	**21**
Sharp-shinned Hawk	Accipiter striatus			1		1	**2**
Song Sparrow	*Melospiza melodia*		2	6	6		**14**
Spotted Towhee	*Pipilo maculatus*	187	188	198	187	112	**872**
Steller's Jay	*Cyanocitta stelleri*	2	8	9	3	3	**25**
Swainson's Thrush	Catharus ustulatus			1			**1**
Townsend's Solitaire	Myadestes townsendi					1	**1**
Tree Swallow	*Tachycineta bicolor*	9	21	19	10		**59**
Turkey Vulture	*Cathartes aura*	22	11	15	11	12	**71**
Vesper Sparrow	*Pooecetes gramineus*	149	22	29	31	17	**248**
Violet-green Swallow	*Tachycineta thalassina*	16	1	3	7	5	**32**
Virginia's Warbler[!]°	*Vermivora virginiae*	3	13	4	18	2	**40**
Warbling Vireo	*Vireo gilvus*		1	3	15	3	**22**
Western Bluebird	*Sialia mexicana*		1	4	3		**8**
Western Kingbird	*Tyrannus verticalis*	52	6	23	16	21	**118**
Western Meadowlark	*Sturnella neglecta*	454	197	393	367	102	**1513**
Western Tanager	*Piranga ludoviciana*		39	28	57	17	**141**
Western Wood-Pewee	*Contopus sordidulus*	16	41	73	92	33	**255**
Western/ Woodhouse's Scrub-Jay	*Aphelocoma californica*	4	1		3		**8**
White-breasted Nuthatch	*Sitta carolinensis*	2	4	5	9		**20**
White-crowned Sparrow	*Zonotrichia leucophrys*	1					**1**
White-throated Swift	Aeronautes saxatalis			2	1		**3**
Wild Turkey	*Meleagris gallopavo*	1		14		8	**23**
Yellow Warbler	*Setophaga petechia*	5	13	8	10	2	**38**
Yellow-breasted Chat	*Icteria virens*	24	39	67	73	13	**216**
Yellow-rumped Warbler	*Dendroica coronata*		3	1	3	1	**8**
	Total	**3,355**	**3,031**	**3,679**	**3,864**	**2,998**	**13,929**

Partners in Flight Watchlist Designations:

[!] Birds of Tri-national Concern

* Common Birds in Steep Decline

° Birds of Regional Stewardship

† Birds of Regional Concern

APPENDIX B: FOCAL SPECIES LOCATION MAPS - CROSSLINE CANYON

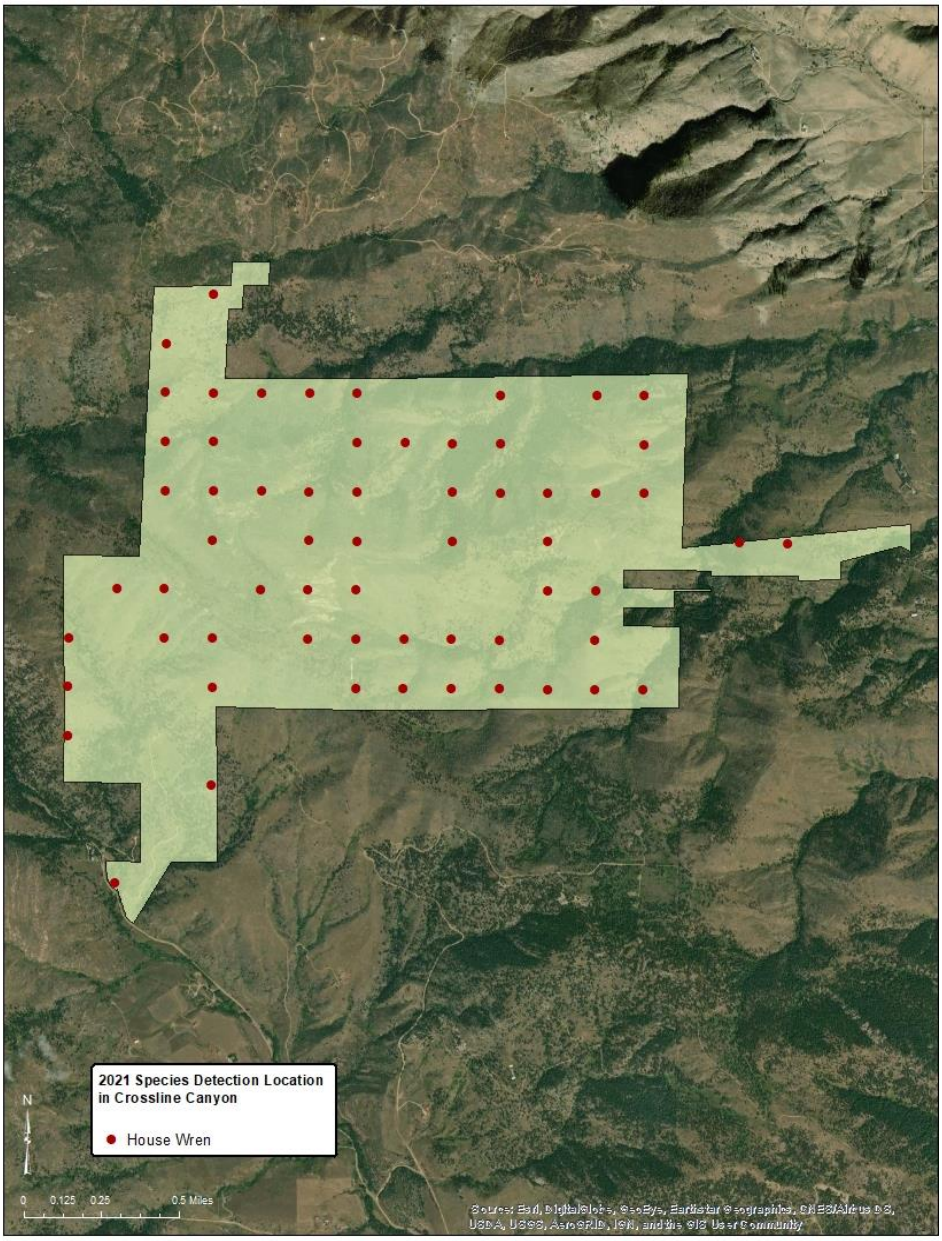

Figure 11: House Wren detections at point count stations in Crossline Canyon in 2021

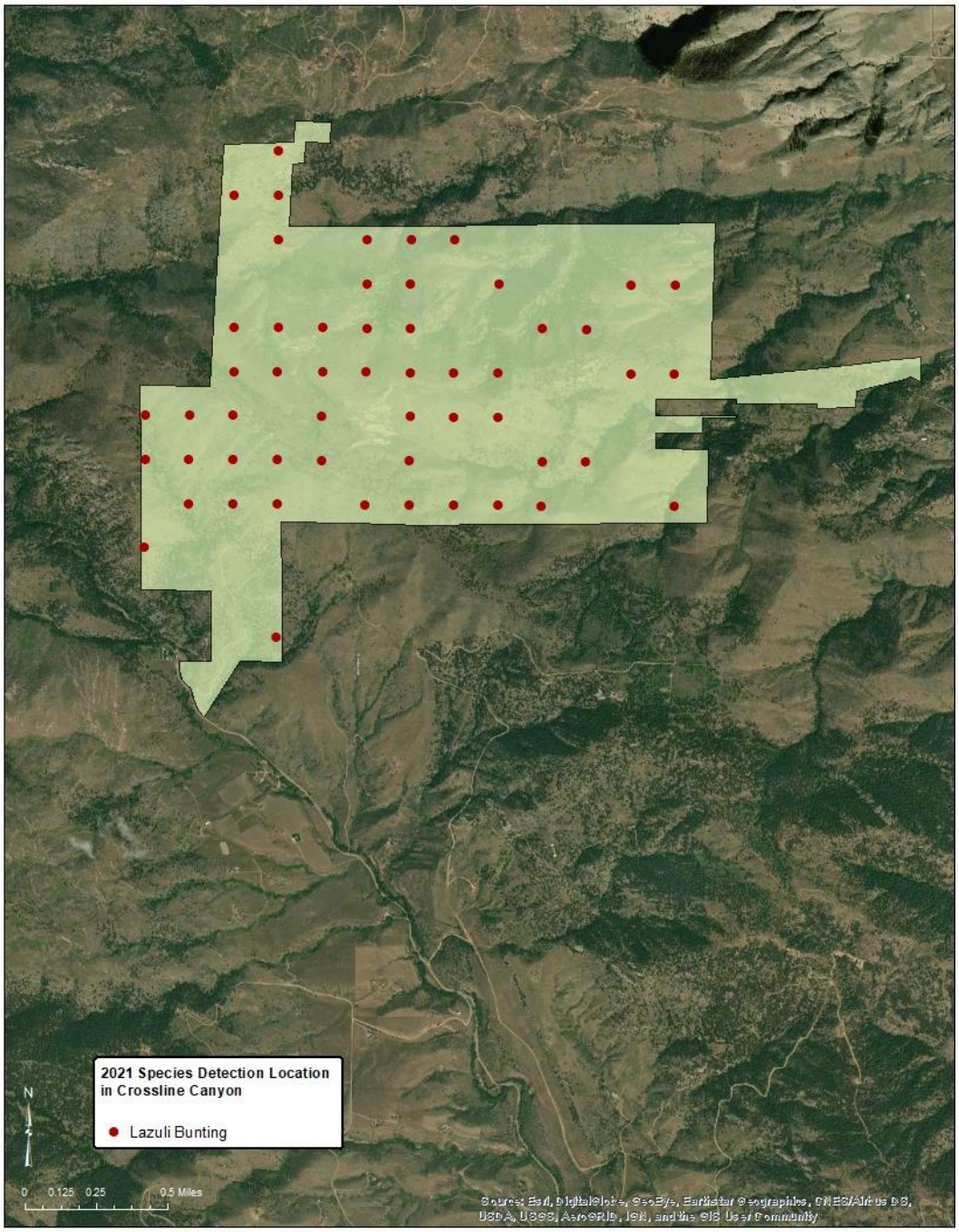

Figure 12: Lazuli Bunting detections at point count stations in Crossline Canyon in 2021

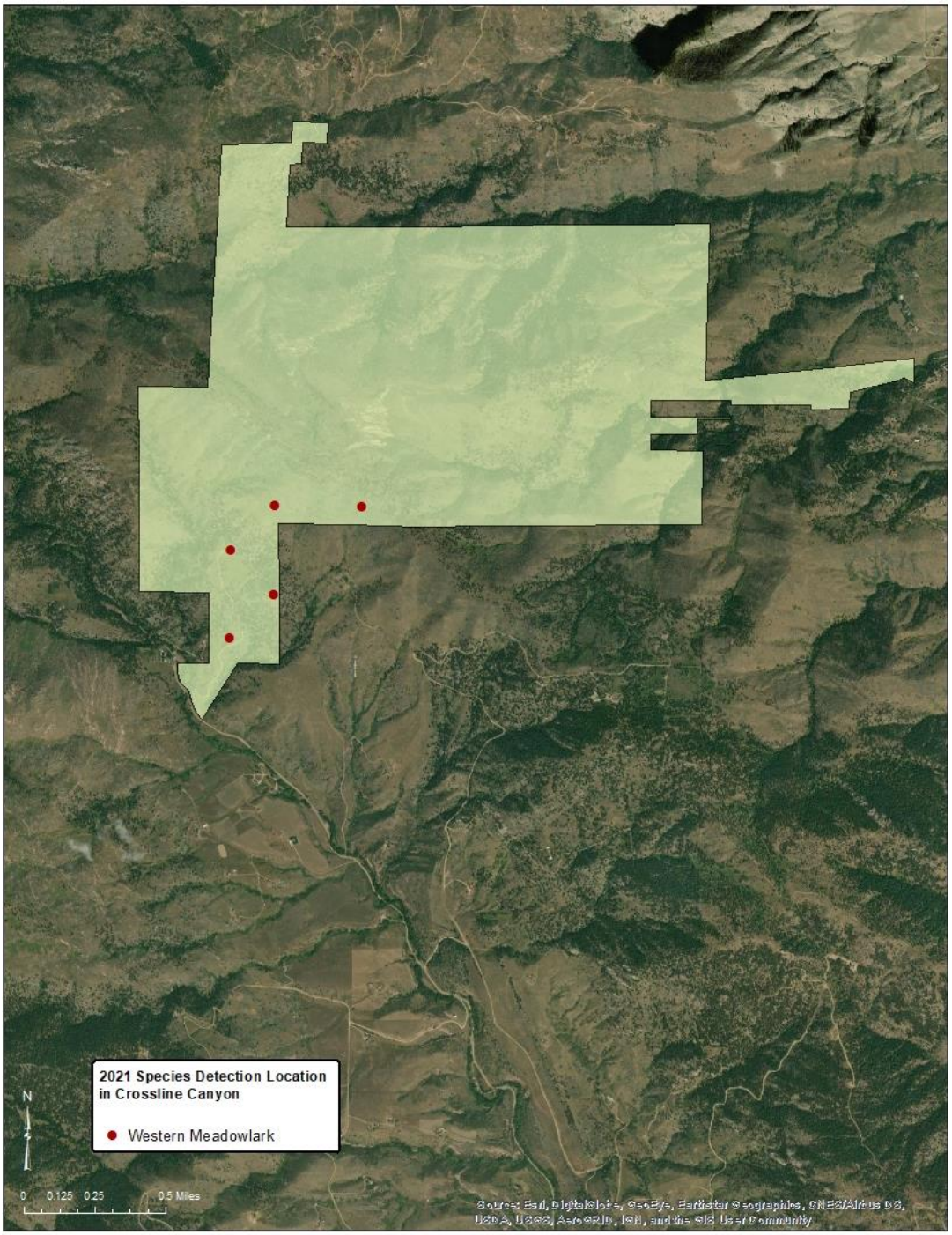

Figure 13: Western Meadowlark detections at point count stations in Crossline Canyon in 2021

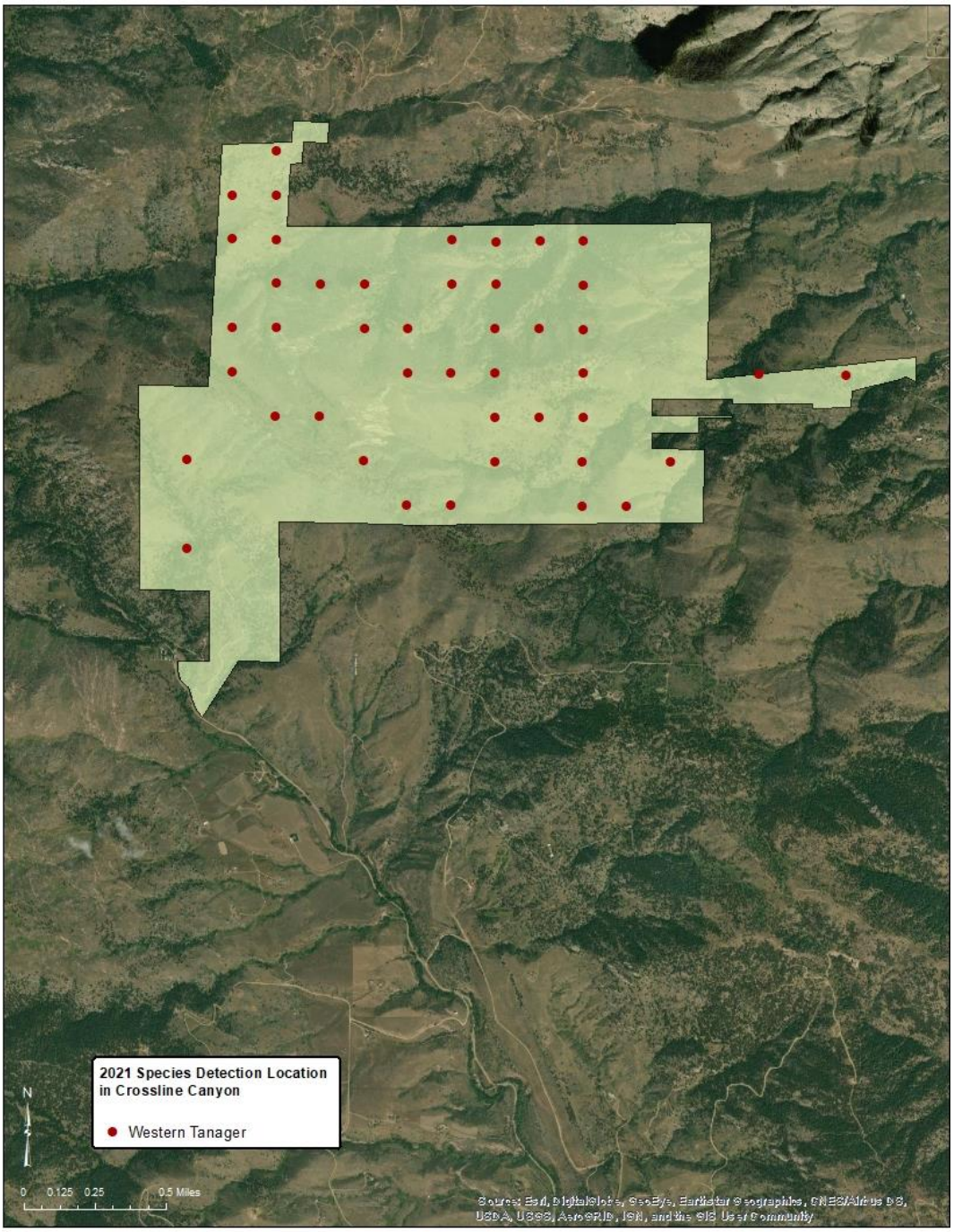

Figure 14: Western Tanager detections at point count stations in Crossline Canyon in 2021

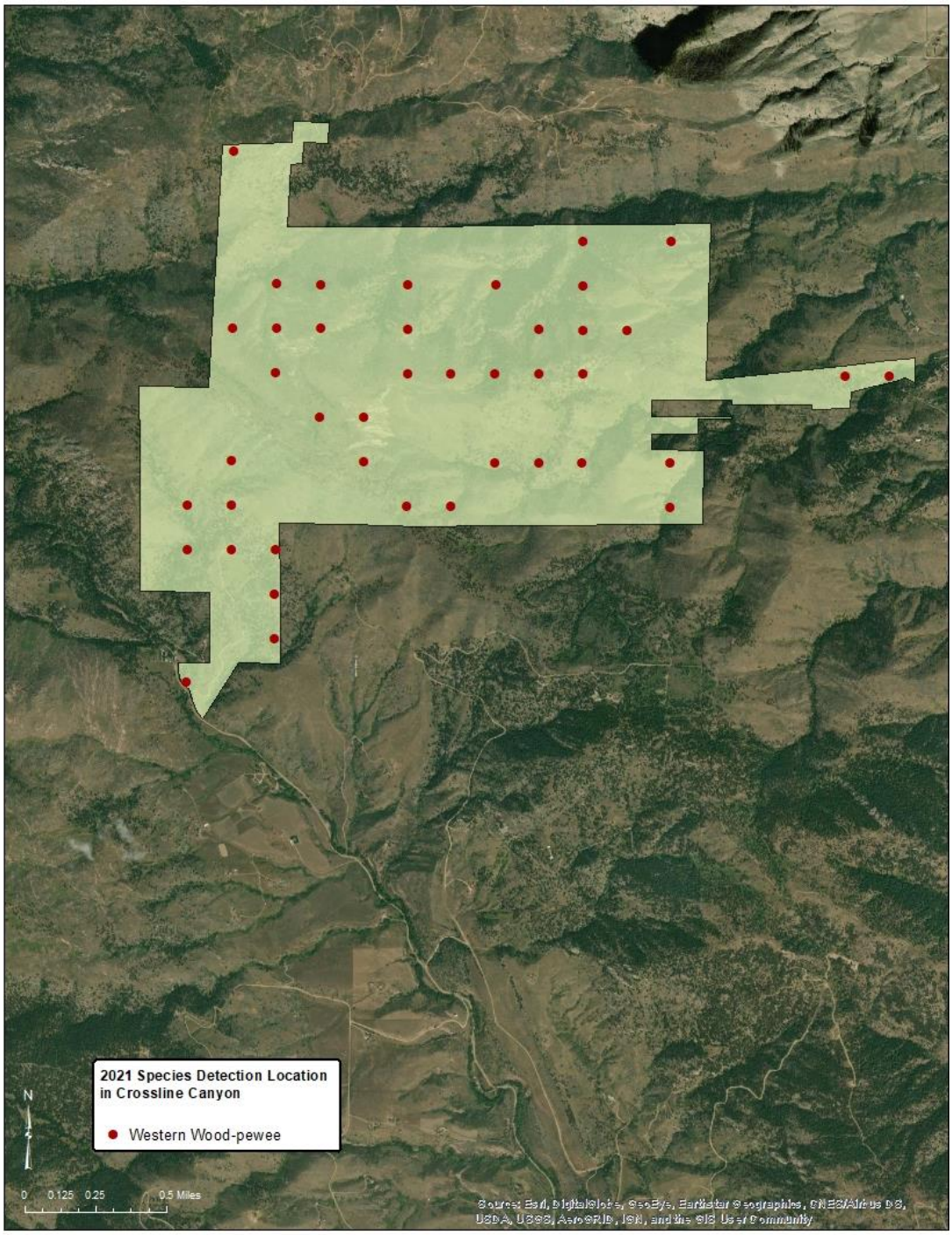

Figure 15: Western Wood-pewee detections at point count stations in Crossline Canyon in 2021

APPENDIX C: FOCAL SPECIES LOCATION MAPS - BOBCAT RIDGE

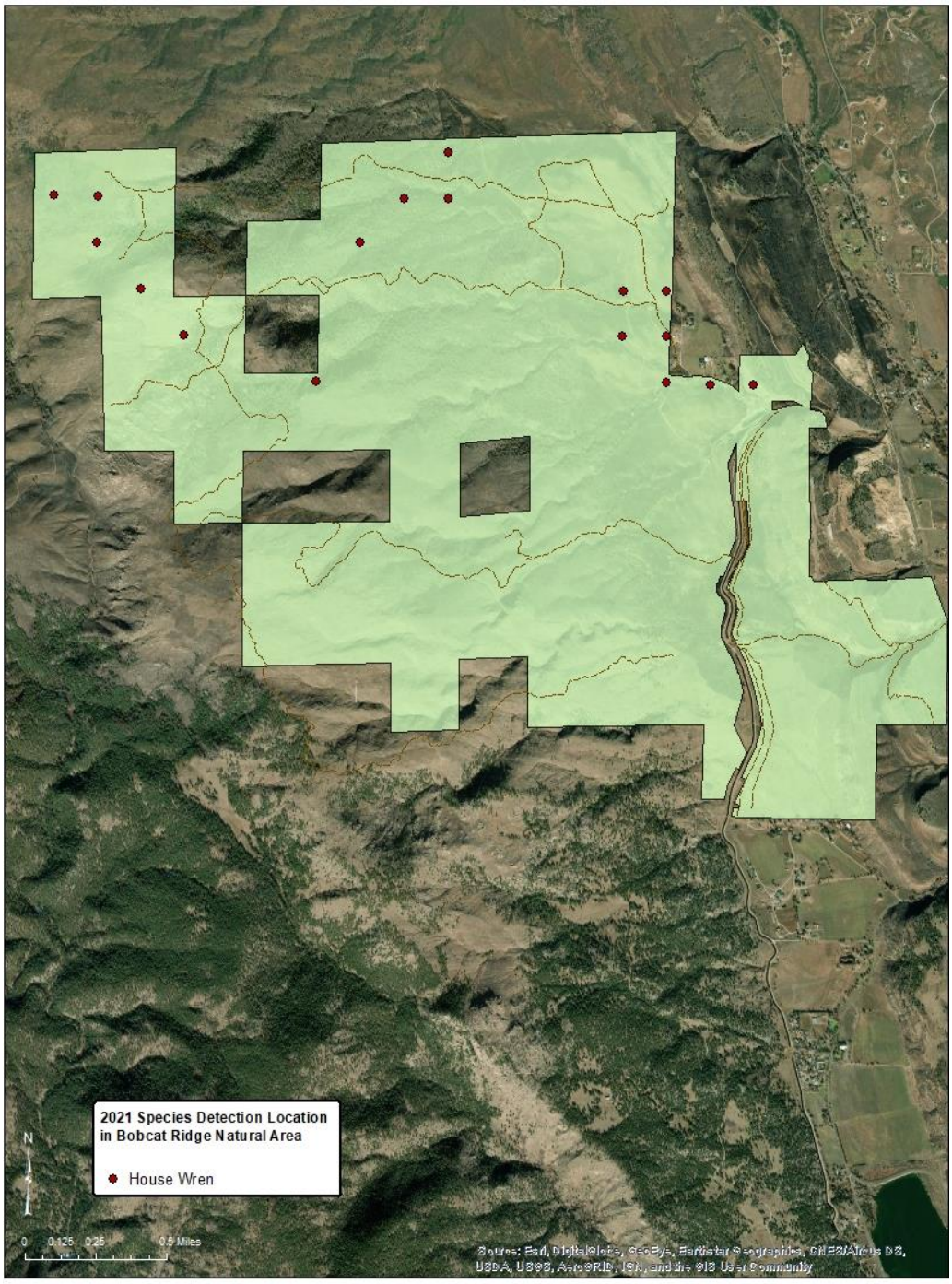

Figure 16: House Wren detections at point count stations in Bobcat Ridge Natural Area in 2021

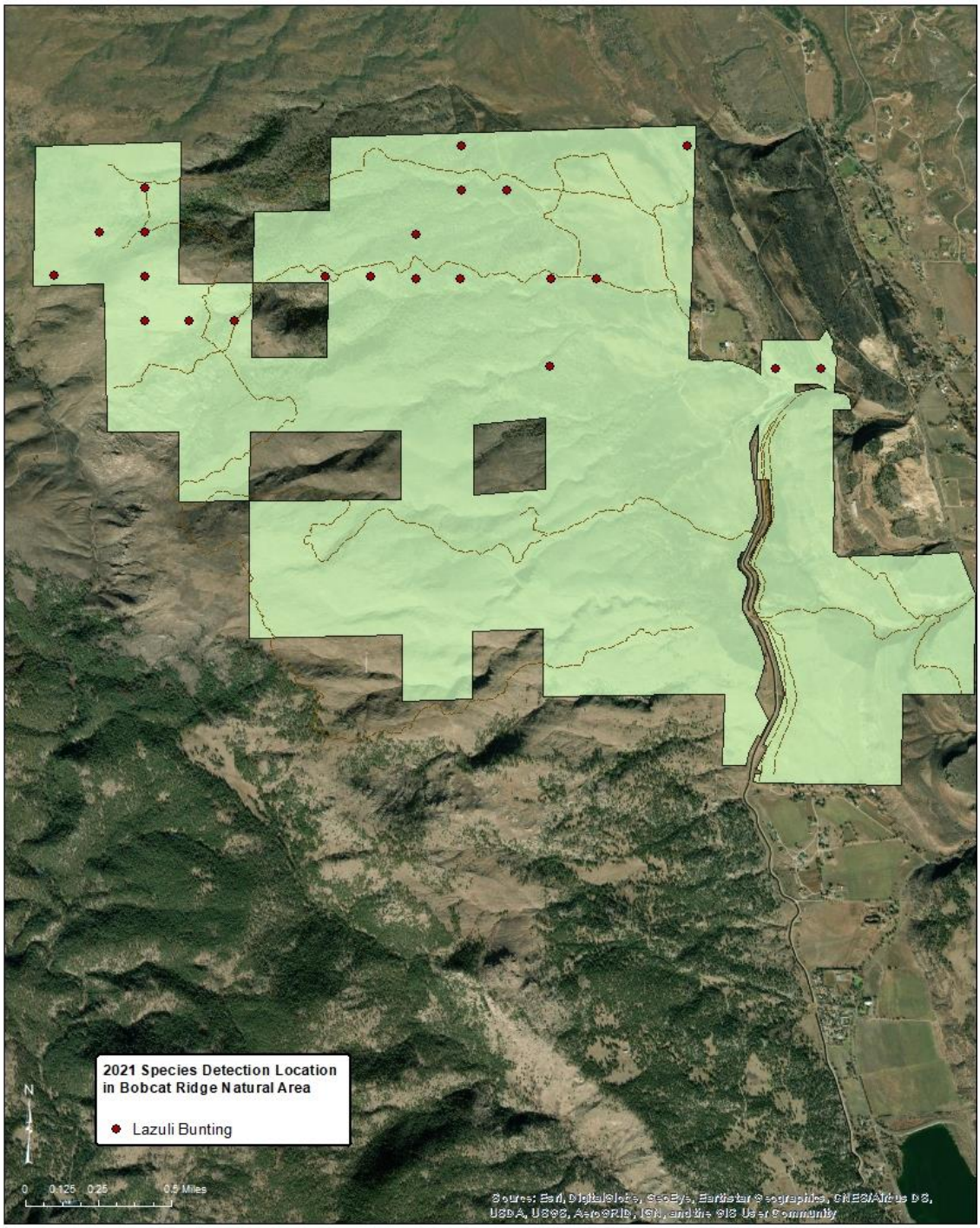

Figure 17: Lazuli Bunting detections at point count stations in Bobcat Ridge Natural Area in 2021

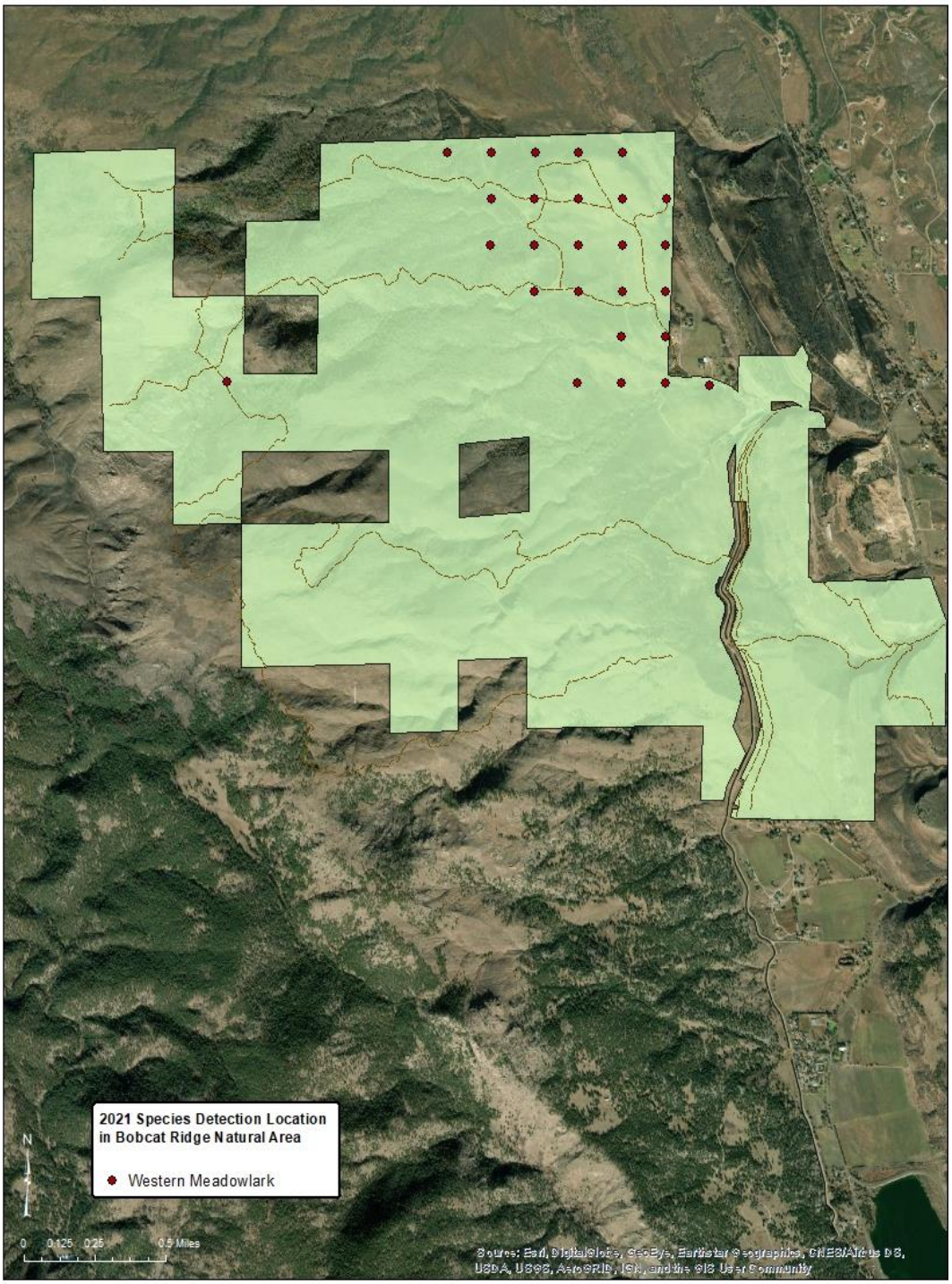

Figure 18: Western Meadowlark detections at point count stations in Bobcat Ridge Natural Area in 2021

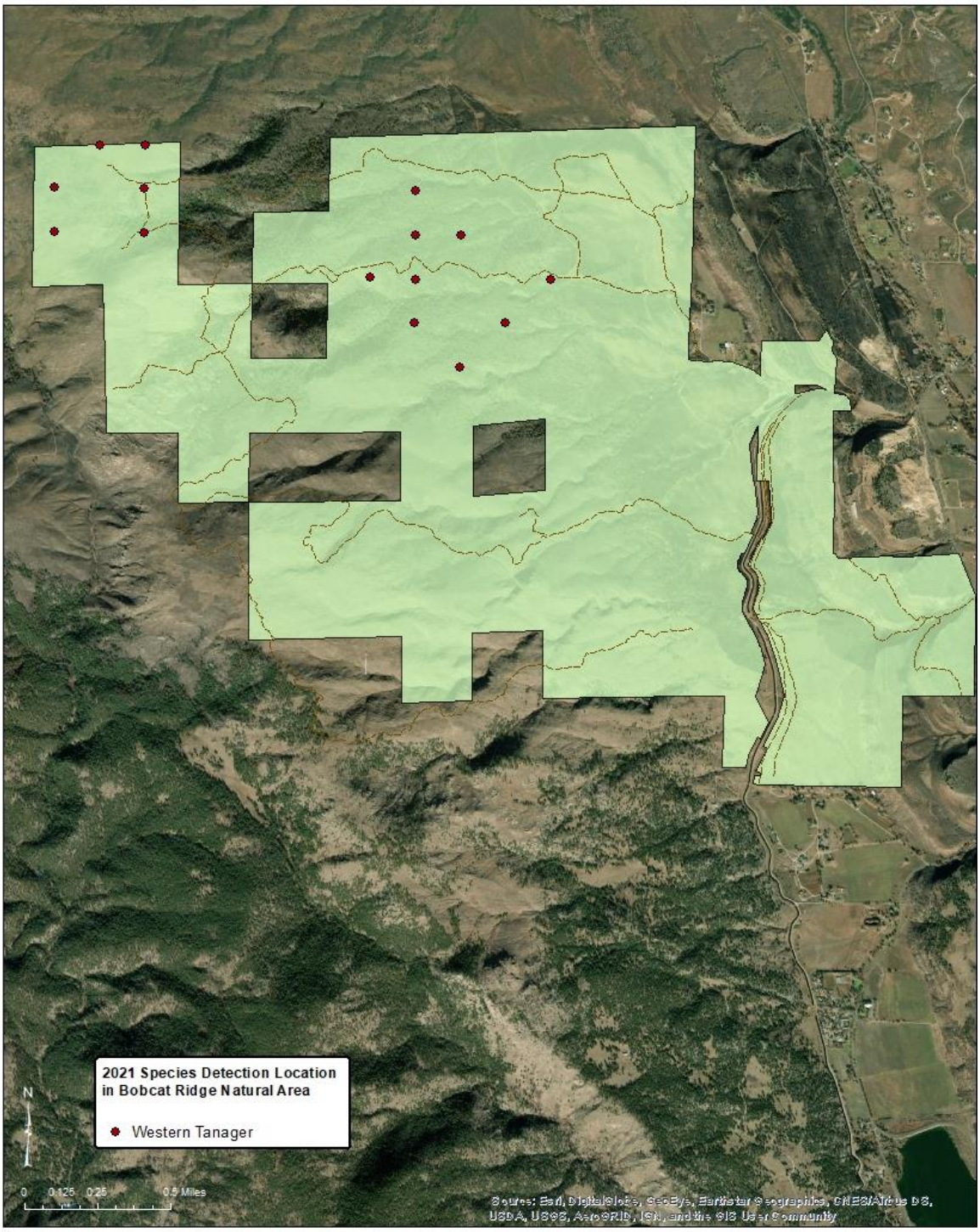

Figure 19: Western Tanager detections at point count stations in Bobcat Ridge Natural Area in 2021

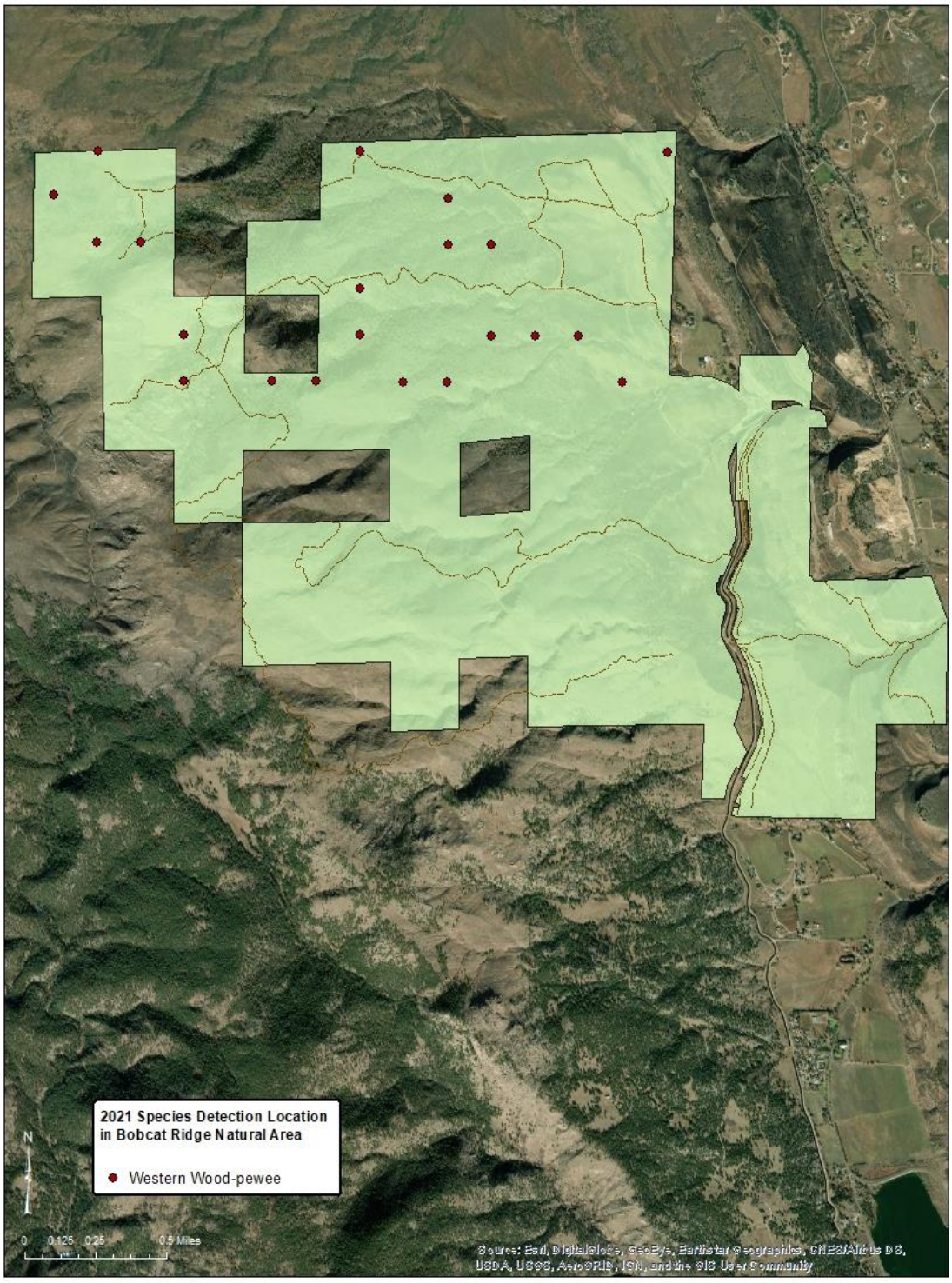

Figure 20: Western Wood-pewee detections at point count stations in Bobcat Ridge Natural Area in 2021

APPENDIX D: HABITAT RELATIONSHIP DENSITY MODELS

Best model parameter estimates and standard errors (SE) of focal species.

Species	Model	Estimate	SE
House Wren	(Intercept)	0.9331	0.0693
	TreeCohesion	0.1221	0.0561
	CanopyCover	0.0831	0.044
	TreeHeight	0.2561	0.0535
	ShrubHeight	-0.1838	0.051
Western Meadowlark	(Intercept)	0.9269	0.057
	ShrubCohesion	-0.1377	0.031
	GrassCover	0.1727	0.034
	GrassHeight	0.0706	0.0321
	ShrubCover	-0.188	0.0424
	ShrubHeight	0.2503	0.0415
	ShrubHeight^2	-0.0556	0.0184
Western Tanager	(Intercept)	-0.258	0.1229
	Tree Cohesion	0.328	0.1038
	Canopy Cover	0.612	0.1323
	Canopy Cover^2	-0.131	0.0456
	Tree Height	0.245	0.0863
Western Wood-pewee	(Intercept)	-0.191	0.1039
	TreeCohesion	0.366	0.088
	CanopyCover	0.223	0.051
	TreeHeight	0.324	0.0708
	ShrubHeight	0.129	0.0578
Lazuli Bunting	(Intercept)	0.651	0.0764
	ShrubCover	0.161	0.0439