Bird Monitoring and Inventory of Soapstone Prairie Natural Area

2022 Technical Report

Bird Conservancy of the Rockies
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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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EXECUTIVE SUMMARY

Soapstone Prairie Natural Area (SPNA) is a unique, high elevation landscape containing some of the last remaining high-quality, extensive shrubland and shortgrass prairie along the Colorado Front Range, literally connecting the Rocky Mountains to the Great Plains. Bird Conservancy of the Rockies (BCR) has partnered with the City of Fort Collins Natural Areas Program (FCNAP) since 2006 to aid in the conservation and management of this important conservation and recreation destination through bird inventory and monitoring, providing the FCNAP with data and management recommendations that benefit the bird and wildlife community in Soapstone and adjacent properties. The goal of this long-term monitoring is to help the FCNAP conserve grassland and shrubland bird species and their habitats on Soapstone by understanding the abundance, distribution, trends and habitat requirements of breeding birds in the Natural Area. We used a focal species approach and identified six focal species; Loggerhead Shrike, McCown's Longspur, Vesper, Brewer's, Grasshopper and Baird's Sparrow. These species integrate ecological processes that contribute to the maintenance of ecosystem function. This will allow management actions aimed at conserving the focal species to also protect a larger number of species occurring in the management area.

We surveyed 1,317 out of 1,451 available points in 2022. Surveys were conducted from 11 May to 11 July on all of Soapstone Prairie Natural Area (Figure 1). We observed 71 species, 11 of which species are species on a Watch List for the continent or Bird Conservation Region 16 designated by Partners In Flight (Appendix A).

Table 2 presents density estimates for focal species: Baird's Sparrow, Brewer's Sparrow, Grasshopper Sparrow, Loggerhead Shrike, Thick-billed Longspur, and Vesper Sparrow from the years 2019 and 2022. We generated estimates of density and population size for 66 of the 71 species detected in 2022 (Table 3). Refer to the Appendix B for pasture-level density estimates, by species, within Soapstone Prairie.

Starting this year, we have incorporated the City of Fort Collins Natural Areas Program (FCNAP) data into the analyses of our Integrated Monitoring in Bird Conservation Regions (IMBCR) bird data. Due to the way the data are structured in our database, we were only able to incorporate the 2019 and 2022 data into analyses. We plan to modify the data structure for previous years to allow the entire Soapstone data set to be analyzed next year. There are several advantages to this approach, including:

1. Efficiency – The FCNAP data can be analyze alongside IMBCR data annually to produce density estimates.
2. Sample size – We are able to pool detections for each species across the entire IMBCR and FCNAP data sets, which means we are able to produce density estimates for more species.
4. Advanced Analytical Techniques – The IMBCR analysis uses state-of-the-art Bayesian analysis framework that produces estimates with a high level of precision.
5. Trends – Once all FCNAP data have been reformatted, we will automatically generate trend estimates at the species level for FCNAP projects with at least five years of data.
6. Hierarchical Structure – IMBCR uses a nested design, meaning we can generate density estimates at the stratum level, or combine several strata together to generate a superstratum estimate that accounts for differing sample efforts and areas in each stratum. For example, we were able to generate estimates for each individual pasture in Soapstone Prairie Natural Area, as well as density estimates for the entire property as a whole.

Table of Contents

Executive Summary **1**

Introduction **3**

Methods **3**

Study Area 3

Sampling Design and Methods 5

Data Analysis 6

Distance Analysis Assumptions 6

Density Estimation 7

Automated Analysis 8

Results **8**

Discussion and Management Recommendations **13**

Acknowledgements **15**

Literature cited **17**

Appendix A: Species List. Number of detections for species recorded in the Cache la Poudre River Natural Areas in 2022. ..... **20**

Appendix B: Density estimates across Soapstone Prairie Natural Area, by Pasture, 2022. ..... **29**

INTRODUCTION

Soapstone Prairie Natural Area (SPNA) is a unique, high elevation landscape containing some of the last remaining high-quality, extensive shrubland and shortgrass prairie along the Colorado Front Range, literally connecting the Rocky Mountains to the Great Plains. Several Colorado partners have been working since 2004 to protect this biological and scenic corridor through a multi-partner project called The Laramie Foothills Mountains to Plains Project. Bird Conservancy of the Rockies (BCR) has partnered with the City of Fort Collins Natural Areas Program (FCNAP) since 2006 to aid in the conservation and management of this important conservation and recreation destination through bird inventory and monitoring, providing the FCNA with data and management recommendations that benefit the bird and wildlife community in Soapstone and adjacent properties.

The first complete survey of the property was in 2006 & 2007. The goal of this long-term monitoring is to help the FCNAP conserve grassland and shrubland bird species and their habitats on Soapstone by understanding the abundance, distribution, trends and habitat requirements of breeding birds in the Natural Area. The area has experienced several cycles of documented sylvatic plague since 2008 that have significantly decreased the Black-tailed prairie dog (Cynomys ludovicianus) populations, a keystone species that creates ideal nesting habitat for bird species of concern like Mountain Plover, Burrowing Owl and McCown's Longspur. The decreased grazing activities of the prairie dogs has encouraged more forbs to grow into the areas that were once sparsely vegetated and may create a shift in the avifauna to birds that are more tolerant to forbs and taller grasses. The objectives are to monitor populations of bird species, document the migratory and breeding bird use of the project area and their response to management activities, and to provide recommendations for conservation of sensitive bird species.

We used a focal species approach and identified six focal species; Loggerhead Shrike, McCown's Longspur, Vesper, Brewer's, Grasshopper and Baird's Sparrow. These species integrate ecological processes that contribute to the maintenance of ecosystem function. This will allow management actions aimed at conserving the focal species to also protect a larger number of species occurring in the management area.

METHODS

Study Area

Between May 11th and July 11th of 2022, we conducted breeding bird point count surveys on Soapstone Prairie Natural Area in Larimer county of northern Colorado (Figure 1).

Soapstone is dominated by native shortgrass prairie on the eastern half, with the primary species being blue grama (Bouteloua gracilis) & buffalo grass (Bouteloua dactyloides), edged on the north and west by rolling hills, wide shallow washes, and abrupt rocky outcroppings. Moving west the terrain rises into the foothills that are home to one of the largest contiguous communities of mountain mahogany (Cercocarpus montanus) in the state of Colorado (Rondeau et al. 2011). There is a large patch of old growth ponderosa pine (Pinus ponderosa) on the far west boundary, limestone cliffs in the middle running northwest to southeast, and hills dotted with skunkbrush (Rhus trilobata) and narrow-leaf yucca (Yucca glauca).

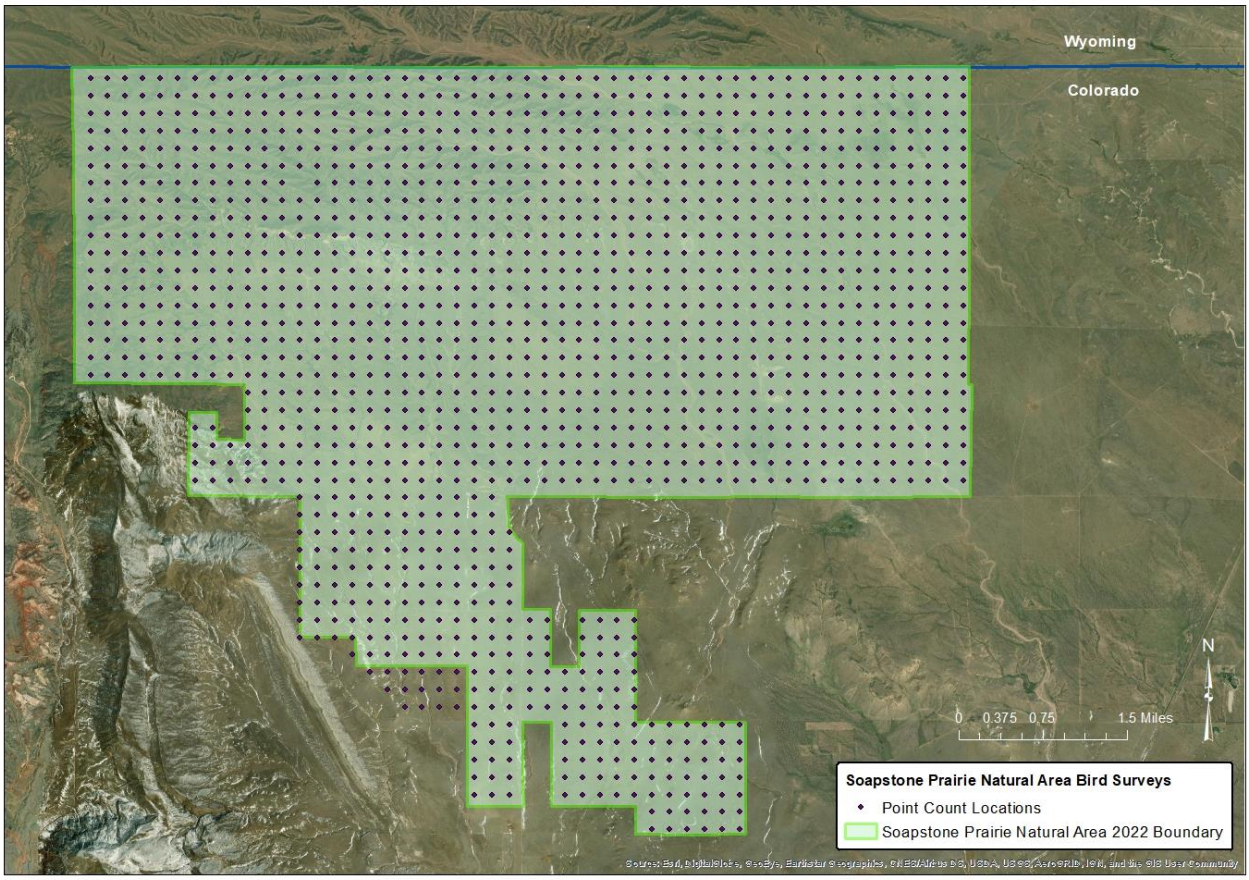

Figure 1. Point count stations within Soapstone Prairie Natural Area, 2022

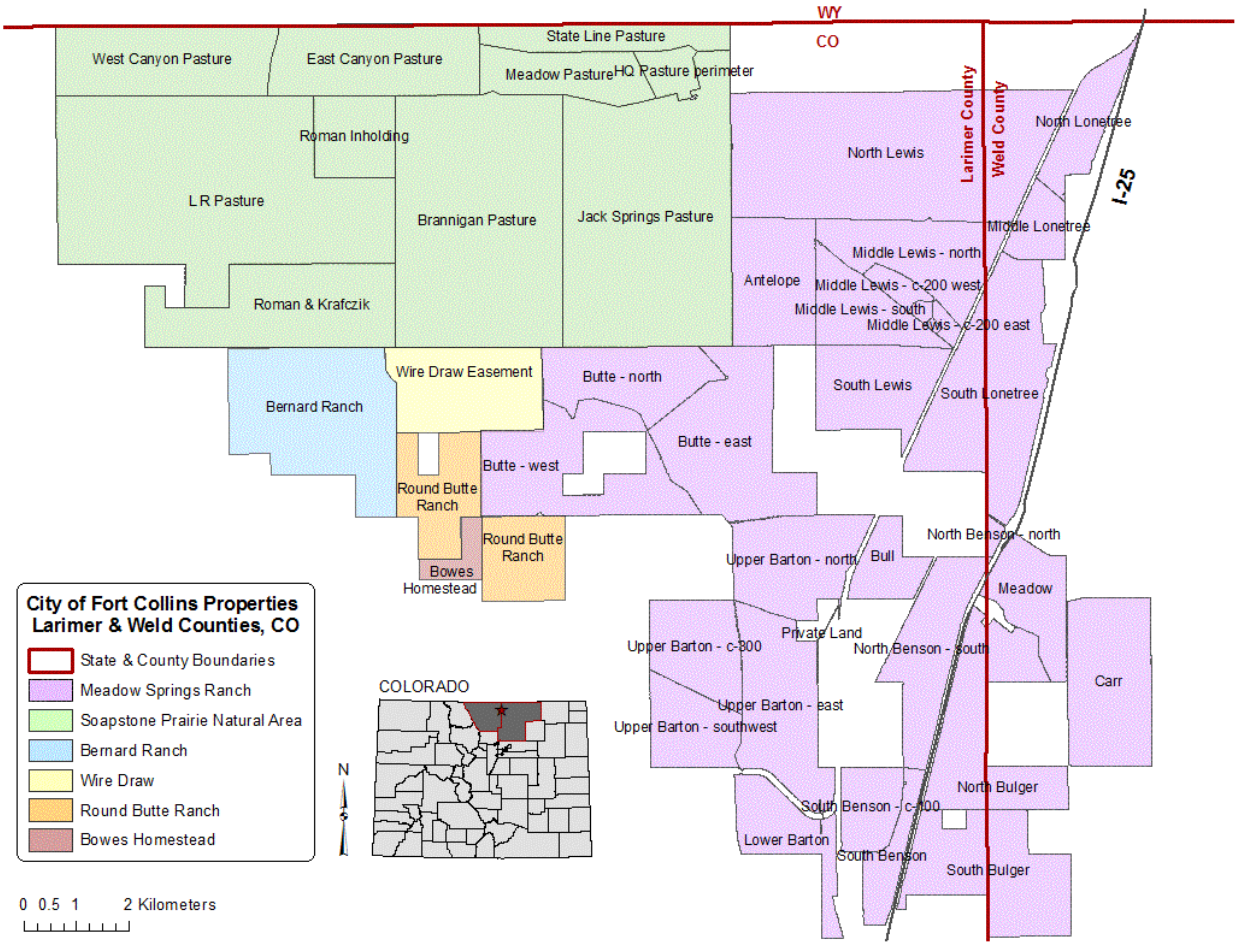

Figure 2. Map of Mountains to Plains properties owned and managed by the City of Fort Collins Natural Areas Program and Utilities: Soapstone Prairie Natural Area, Meadow Springs Ranch, Round Butte Ranch, Bernard Ranch, Wire Draw Easement, and the Bowes Homestead with pasture names.

Sampling Design and Methods

Within the study area, we used Arc Map 9.3.1 to create a systematic grid of point count stations at 250-meter intervals covering the entire Soapstone Natural Area property. There are 1,451point count stations within the 90km^2 natural area boundary. The area is subdivided into 12 strata that represent different pastures (Figure 2, Table 1).

Table 1. Strata within Soapstone Prairie Natural area, including area (km^2) and number of point count stations in each.

Stratum Code	Stratum	Area (km^2)	Points
SS-BE	Bernard Pasture	8.82	164
SS-BR	Brannigan Pasture	15.31	247
SS-EC	East Canyon Pasture	5.36	80
SS-HQ	Headquarters Pasture	0.88	12
SS-JS	Jack Springs Pasture	15.7	249

Stratum Code	Stratum	Area (km^2)	Points
SS-LR	LR Pasture	18.85	295
SS-ME	Meadow Pasture	2.8	43
SS-RB	Round Butte Pasture	5.45	106
SS-RI	Roman Inholding Pasture	2.42	42
SS-RK	Roman Krafczik Pasture	6.42	95
SS-SL	State Line Pasture	2.48	38
SS-WC	West Canyon Pasture	5.57	80

Point count locations were navigated to on foot using a handheld GPS unit. Point count surveys started one half-hour before sunrise and ended by 11 a.m., often earlier. 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 (2022), uses Distance sampling (Buckland et al. 2001) and removal sampling (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 laser rangefinder.

Point counts were not conducted during periods of heavy snow, rain, or wind greater than 19 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.

After each avian point count survey, we completed a rapid habitat survey by estimating several vegetation parameters within a 50m radius of the point. We document the primary habitat type and record the presence of roads, cliff/rock, prairie dog town, and exotic vegetation. We record the two most prevalent overstory species (3m or taller), their average height cover, and relative abundance. We repeat this for the shrub layer, defined as anything equal to or taller than 0.25m, but shorter than 3m. We then estimate the cover provided by six different ground cover types – grass, forb, woody/succulent, bare ground, rock, litter, and other.

Data Analysis

Starting this year, we have incorporated the FCNAP data into the analyses of our Integrated Monitoring in Bird Conservation Regions (IMBCR) bird data. The following sections describe the analysis approach in detail.

Distance Analysis Assumptions

Distance sampling theory was developed to account for the decreasing probability of detecting an object of interest (e.g., a bird) with increasing distance from the observer to the object (Buckland et al., 2001). The detection probability is used to adjust the count of birds to account for birds that were present but undetected. Application of distance theory requires that five critical assumptions be met: 1) all birds at and near the sampling location (distance = 0) are detected; 2) distances to birds are measured accurately; 3) birds do not move in response to the observer's presence (Buckland et al., 2001; Thomas et al., 2010);

4) cluster sizes are recorded without error; and 5) the sampling units are representative of the entire survey region (Buckland et al. 2008).

Density Estimation

We developed a Bayesian, zero-inflated N-mixture model (Royle 2004, Sillett et al. 2012) to estimate density and abundance for all strata and superstrata across all species with sufficient data. We used distance sampling to estimate detection probabilities and adjust counts accordingly.

Bayesian approaches to density estimation provide several benefits over traditional distance sampling analyses, while providing similar and unbiased estimates of density and abundance. First, with the nested design of IMBCR, point count locations within a 1-km^2 grid cell are not independent. Therefore, with traditional methods, it is necessary to treat each point as a spatial replicate within the grid cell(i.e., average counts across points). However, it is unlikely that bird densities are uniform within a grid cell, and a better solution would be to estimate density at the point count location. Bayesian models provide the flexibility to do this, while correctly accounting for the lack of independence among points. This also allows us to incorporate the FCNAP data, which are point-based rather than aggregated into grid cells.

The second benefit, also provided by this flexibility, is the ability to include covariates to explain changes in density. This allows us to explicitly estimate the response of bird density to variables, such as habitat variables, management actions, or time (i.e., trend). Finally, Bayesian approaches allow for sharing of information across parameters. This can assist in obtaining estimates at sites with little data or provide measures of uncertainty when no birds were detected, such as at low densities and/or small sample sizes.

We fit a series of models to the data from each species that had the same model structure describing density estimation but varied in detection structure (see Observation process section below). We used zero-inflation to account for excess zeros in the data, where abundance at a point count location (N) is conditional on the point's true occupancy state (z) of a species at the point count location, and the mean abundance within a 1-km^2 grid cell was modeled as a function of year to estimate stratum-specific trends.

All points within a grid cell shared a mean abundance to account for the lack of independence of those points, but abundance was allowed to vary spatially within a grid cell (i.e., by point) through Poisson variation. To avoid predicting species occurrence outside of observed ranges, we fixed occupancy probabilities to 0 for all strata in which the species was never observed and used a prior informed by the observed proportion of grid-year combinations in a stratum in which the species was detected.

We derived density at the point count location by dividing the estimated abundance by the area of the point count circle (see Observation process section below) and multiplying by cluster size. We derived stratum-level density estimates by averaging all point-level density estimates within each stratum, and we took the area-weighted average of strata estimates to obtain superstratum estimates.

Observation process

We estimated the probability of detecting an independent cluster of individuals by fitting distance functions to the distance data collected during surveys (Buckland et al. 2001). We fit four detection models including:

1. half-normal constant (HN(.))
2. hazard rate constant (Haz(.))
3. half-normal year (HN(t))
4. hazard rate year (Haz(t))

We removed the furthest 10% of observed detection distances from the data set and binned the remaining detections into 10 evenly spaced distance classes. The furthest remaining detection distance became the radius of the point count circle with which we estimated density.

Detection model selection

To minimize computing time but find the most parsimonious detection function, we fit detection-only models to the distance data, using the four model structures described above. We used the Watanabe-Akaike Information Criterion (WAIC; Watanabe 2010, Hobbs and Hooten 2015) to select the most parsimonious detection structure and then used that structure for detection probabilities in the full model to estimate density and abundance.

Automated Analysis

In 2019, we updated our analytical methods to use Bayesian hierarchical models specifically designed for analysis of IMBCR data. We performed all data and output manipulation in R (R Core Team, 2022) and model fitting in JAGS (Plummer 2003, 2017) using the R package jagsUI (Kellner 2018). The R code called the raw data from the IMBCR Structured Query Language (SQL) server database and reformatted the data into a form usable with the JAGS code. We allowed the input of all data collected in a manner consistent with the IMBCR design to increase the number of detections available for estimating global detection rates for population density and site occupancy. The R code provided an automated framework for combining stratum-level estimates of population density and site occupancy at multiple spatial scales, as well as estimating the standard deviations and credible intervals for the combined estimates.

We fit initial models to all species with at least 30 detections for density estimation and 10 detections for occupancy estimation. For density estimation, we fit the full model after determining whether there were enough detections based on results from the detection-only model fits. In some cases, for both density and occupancy estimation, it was necessary to use a less parsimonious detection structure or simplified model structure to facilitate model convergence. We currently maintain version control of the automated analysis code in the Bird Conservancy repository on www.github.com.

RESULTS

We surveyed 1,317 out of 1,451 available points in 2022. Surveys were conducted from 11 May to 11 July on all of Soapstone Prairie Natural Area (Figure 1). We observed 71 species, 11 of which species are species on a Watch List for the continent or Bird Conservation Region 16 designated by Partners In Flight (Appendix A).

Table 2 presents density estimates for focal species: Baird's Sparrow, Brewer's Sparrow, Grasshopper Sparrow, Loggerhead Shrike, Thick-billed Longspur, and Vesper Sparrow from the years 2019 and 2022. We generated estimates of density and population size for 66 of the 71 species detected in 2022 (Table 3). Refer to the Appendix B for pasture-level density estimates, by species, within Soapstone Prairie.

In Tables 2 and 3, we provide the coefficient of variation (% CV) associated with each density and population estimate for each species. The % CV is the ratio of the standard deviation to the mean (smaller is better) or an indicator of reliability for the density and population metric. We recommend using population estimates with % CVs less than 50% to inform decisions.

Table 2. Density estimates (D) for focal species in the years 2019 and 2022. SE= standard error, LCL=95% confidence interval and UCL= Upper confidence interval.

Species	Year	D	SE	LCL	UCL
Baird's Sparrow	2019	0.12	0.07	0.04	0.35
Baird's Sparrow	2022	0.05	0.03	0.01	0.10
Brewer's Sparrow	2019	4.54	0.49	3.67	5.63
Brewer's Sparrow	2022	4.22	1.55	3.84	4.81
Grasshopper Sparrow	2019	9.66	1.23	7.53	12.40
Grasshopper Sparrow	2022	2.90	0.38	2.45	3.42
Loggerhead Shrike	2019	0.54	0.08	0.40	0.72
Loggerhead Shrike	2022	0.52	0.19	0.40	0.72
Thick-billed Longspur	2019	11.35	0.94	9.66	13.35
Thick-billed Longspur	2022	8.66	3.07	7.86	13.07
Vesper Sparrow	2019	11.62	0.57	10.55	12.80
Vesper Sparrow	2022	12.56	1.87	11.95	13.27

Table 3. Density estimates across Soapstone Prairie Natural Area, 2022. D = number of birds/km^2, % CV = Percent Coefficient of Variation, N = Population estimate, 95% lower (LCL) and upper (UCL) confidence limits on D and N, and n = number of detections used in analyses. Focal species are bolded.

Species	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
American Crow	0.09	193	0.07	0.11	7.73	6.15	10.18	48
American Dipper	0.05	105	0.01	0.20	4.57	0.92	18.45	1
American Goldfinch	3.03	55	2.56	5.54	273.14	230.51	499.03	72
American Kestrel	0.03	53	0.01	0.06	2.50	1.01	5.43	2
Baird's Sparrow	0.05	51	0.01	0.10	4.83	0.97	9.35	1
Bank Swallow	0.53	136	0.25	3.31	48.17	22.33	298.48	4
Barn Swallow	2.75	120	2.03	8.28	248.09	182.55	745.60	36
Black-billed Magpie	0.18	55	0.14	0.33	16.56	12.81	29.98	23
Black-headed Grosbeak	1.93	12	1.63	2.28	174.26	146.88	205.15	84
Blue Grosbeak	0.22	26	0.15	0.34	19.91	13.34	30.73	9
Blue-gray Gnatcatcher	2.22	30	1.61	3.18	199.84	144.63	286.63	20
Brewer's Blackbird	10.45	88	9.15	44.94	941.34	824.41	4047.42	268
Brewer's Sparrow	4.22	35	3.84	4.81	380.30	345.88	433.05	140
Broad-tailed Hummingbird	0.51	52	0.18	1.08	46.27	16.46	97.01	2
Brown Thrasher	1.00	28	0.81	1.34	90.07	73.15	120.39	51
Brown-headed Cowbird	12.25	52	11.29	23.52	1103.17	1016.98	2118.07	406
Bullock's Oriole	1.97	27	1.61	2.63	177.50	145.15	237.03	68
Canada Goose	0.01	177	0.00	0.04	0.48	0.16	3.86	3
Chipping Sparrow	1.43	53	1.09	1.99	128.86	98.22	179.58	28
Clay-colored Sparrow	0.32	26	0.21	0.47	28.38	18.56	42.12	10
Cliff Swallow	1.62	353	1.21	12.22	145.47	108.72	1100.22	19
Common Grackle	2.43	166	1.96	13.42	218.81	176.40	1208.48	76
Common Nighthawk	0.94	96	0.80	1.31	84.71	72.16	118.31	81
Common Raven	0.12	147	0.10	0.17	10.41	8.77	15.56	78
European Starling	0.20	333	0.10	0.71	18.36	8.84	64.19	3
Grasshopper Sparrow	2.90	13	2.45	3.42	261.46	221.08	308.36	45
Great-tailed Grackle	0.04	182	0.01	0.23	3.74	0.97	20.96	2
Green-tailed Towhee	2.73	11	2.43	3.09	245.93	219.15	278.33	97

Species	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Horned Lark	94.98	42	92.75	120.48	8553.53	8352.97	10850.69	3632
House Finch	0.06	80	0.02	0.16	5.21	1.65	14.19	2
Killdeer	0.69	28	0.54	0.94	62.54	48.82	84.51	50
Lark Bunting	2.66	33	2.41	2.97	239.65	217.47	267.53	181
Lark Sparrow	3.59	38	3.12	6.07	323.55	281.39	546.74	118
Lesser Goldfinch	0.12	71	0.04	0.37	11.20	3.65	33.14	2
Lincoln's Sparrow	0.40	29	0.29	0.59	36.22	25.71	52.71	13
Loggerhead Shrike	0.52	34	0.40	0.72	47.25	36.46	65.01	26
Long-billed Curlew	0.00	108	0.00	0.01	0.20	0.04	0.76	1
Mallard	0.08	125	0.04	0.38	7.58	3.36	33.88	4
Marsh Wren	0.05	60	0.02	0.13	4.73	1.58	11.84	2
Mountain Chickadee	0.04	85	0.02	0.15	3.47	1.73	13.86	1
Mourning Dove	3.70	114	3.45	4.06	333.03	311.07	365.48	460
Northern Flicker	0.01	76	0.00	0.04	1.20	0.24	3.41	1
Northern Harrier	0.02	49	0.01	0.04	1.69	0.64	3.31	3
Northern Mockingbird	0.24	19	0.19	0.30	21.26	17.01	27.05	36
Northern Rough-winged Swallow	0.88	135	0.60	3.39	79.62	54.13	305.37	11
Prairie Falcon	0.01	79	0.00	0.04	1.31	0.24	3.92	1
Red-tailed Hawk	0.07	29	0.04	0.11	5.95	3.99	9.48	13
Red-winged Blackbird	4.63	21	4.27	5.06	417.11	384.23	455.81	320
Rock Wren	0.55	14	0.46	0.66	49.60	41.76	59.09	62
Savannah Sparrow	0.68	26	0.49	0.92	61.33	44.12	82.81	17
Say's Phoebe	0.40	20	0.32	0.51	36.45	28.56	46.37	36
Song Sparrow	0.10	43	0.05	0.19	8.70	4.06	16.82	4
Spotted Towhee	34.94	6	33.74	36.35	3147.08	3038.56	3273.38	1273
Swainson's Hawk	0.01	50	0.00	0.02	0.93	0.33	1.92	2
Thick-billed Longspur	8.66	33	7.86	13.07	779.55	708.23	1176.94	332
Tree Swallow	0.08	120	0.01	0.34	6.95	1.21	30.98	1
Turkey Vulture	0.02	199	0.01	0.06	1.71	0.66	5.15	2
Vesper Sparrow	12.56	15	11.95	13.27	1130.77	1076.20	1195.51	921
Virginia's Warbler	0.34	43	0.16	0.69	30.84	14.61	62.41	4

Species	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Western Kingbird	0.34	38	0.23	0.61	30.82	21.11	55.26	16
Western Meadowlark	22.26	19	21.69	23.52	2005.04	1953.73	2118.18	2923
Western Wood-Pewee	0.19	23	0.13	0.28	16.84	11.43	24.89	11
Wilson's Snipe	0.13	16	0.10	0.17	11.91	8.97	15.23	20
Woodhouse's Scrub-Jay	0.08	55	0.04	0.17	6.80	3.17	15.18	1
Yellow Warbler	0.71	18	0.51	0.93	63.61	46.03	83.78	21
Yellow-breasted Chat	0.12	32	0.07	0.19	11.02	6.63	16.98	8

DISCUSSION AND MANAGEMENT RECOMMENDATIONS

Soapstone Prairie Natural Area has hosted many shortgrass prairie species and other grassland species over the course of its lifetime. The discovery of Baird's Sparrow on territories on Soapstone in 2015 shows the high-quality grassland habitat this natural area has maintained. The confirmation of Baird's Sparrow fledgling in 2018 confirm that this declining species may have a future home in Northern Colorado (Youngberg et al. 2020). Baird's Sparrows have declined by 65% from 1966 to 2015 (Sauer et al. 2017). This is due to habitat fragmentation and conversion of prairies to cropland in the Great Plains region. The population at Soapstone appears stable from 2019 to 2022 (Table 2). Baird's Sparrows breed in mixed grass prairies with scattered shrub cover and a small layer of litter (Owens and Myres 1973). This means that they like species of grass from both short and tall grass prairies with grass height in between 10-30 cm. Some species of native grass recorded on their breeding grounds include: Fescue (*Fescuta* sp.), sedges (*Carex* sp.), spike oat (*Helictotrichon hookeri;* Owens and Myres 1973) , Needle-and-Thread (*Hesperostipa comata*; Kantrud and Kologiski 1983), Junegrass (*Koeleria cristata*), Blue Grama (*Bouteloua gracilis*), Western Wheatgrass (*Pascopyrum smithii*; Sutter et al. 1995, Davis and Duncan 1999, Davis et al. 1999) and bluegrass (*Poa* sp; Dale 1983).

Baird's Sparrows prefer grasslands that are ungrazed with tolerance of grazing if there is enough vegetation left (Cartwright et al. 1937, Owens and Myres 1973, Kantrud and Kologiski 1983, Arnold and Higgins 1986). Wet years with more vegetation growth could possibly tolerate more grazing (Kantrud and Kologiski 1982, Dale et al. 1999a) but heavy grazing can make the habitat unappealing to this species unless pockets of denser vegetation are available (Owens and Myres 1973, Kantrud and Kologiski 1982). This species has been found to occupy former croplands and hayfields that had exotic species of grassland as long as there was tall enough grass and few shrubs (Madden 1996). Some studies showed Baird's Sparrows to occupy pastures that contained Crested Wheatgrass (*Agropyron cristatum*), Brome (*Bromus* sp.), and alfalfa (*Medicago* sp) at the same or greater frequency than pastures of native grass(Davis et al. 1996, Davis and Duncan et al. 1996, Sutter et al. 1996, Davis et al. 1999).

Grasshopper Sparrow density dropped from 9.66 to 2.90 birds/km^2 between 2019 and 2022 (Table 2). This decline in density is most likely significant given the 95% confidence intervals do not overlap (Table 2). This species is sensitive to grazing where they breed on arid grasslands like shortgrass prairies on Soapstone (Bock and Webb 1984). Cattle grazing on arid grasslands of Arizona and California is associated with population declines and exclusion from sites (Saab et al. 1995). Reducing or stopping grazing on shortgrass prairie sites may improve density. Early spring season mowing is a cause of nest failures in many grassland birds (Bollinger et al. 1990). Mowing later in the growing season can improve breeding success for Grasshopper Sparrows (Vikery et al. 2000). This will also help many grassland birds and give these species time to nest and raise offspring successful.

Thick-billed Longspurs densities appear to be stable on Soapstone (Table 2). This species appears to respond well to intensive grazing on their breeding grounds on multiple study sites from Colorado to Canada (Giezentanner 1970; Wiens 1971; Maher 1973; Finzel 1964). On plots with high intensity grazing (60% of annual aboveground primary production), breeding pair densities were higher than plots with low intensity grazing (20% of annual aboveground productivity consumed by cattle) at the Central Plain Experimental Range in North-Central Colorado. The high intensity pastures had 46.9 pairs/ 100 ha compared to low intensity grazing breeding densities of 13.9 pairs/100 ha. Both of these densities were higher than the breeding densities for the entire Central Plains Experimental range as a whole at 11.7 pairs/ 100 ha. This shows that any increase in grazing intensity will most likely increase Longspur densities as a whole compared to the landscape. Grazing may need to be increased on known Thick-billed Longspur

breeding sites at Soapstone. If we were to assume the Thick-billed Longspur density estimate represented a member of a breeding pair mate, then our density estimate of 8.93 birds/km^2 (100 ha, Table 2) would be lower than the reported densities for lightly grazed pastures mentioned previously and even lower than the overall density mentioned for the Central Plain Experimental Range.

Overgrazed or high intensity pastures may have higher breeding densities of Thick-billed Longspurs due to lower shrub cover present on these pastures. Nests associated with shrubs were 2-3 times more likely to be depredated than with other types of vegetation (With 1994). Shrubs in some studies have been associated with Thirteen-lined Ground Squirrels, which can predate Thick-billed Longspur nests (With 1994).

Brewer's Sparrows appear to have stable populations at Soapstone (Table 2). This could indicate a healthy habitat of sagebrush on the Western side of Soapstone because Brewer's Sparrows most commonly nest in sagebrush species (*Artemisia* sp.; Rotenbury et al. 2020). Loggerhead Shrike Populations appear stable as well (Table 2) which could indicate a diversity of structure across open prairies. Loggerhead Shrikes like natural and man-made perches from which to hunt usually on isolated trees in fields or hedgerows along fences left by humans. Loggerhead shrikes nest in deciduous trees or thorny bushes (Yosef 2020).

Vesper Sparrow populations appear stable on Soapstone (Table 3) with no density estimate overlap between 2019 and 2022 (Table 2). Moderate to light grazing appears to support the habitat needs of Vesper Sparrow while heavy grazing does not (Kantrud and Kologiski 1982). Vesper Sparrows are found breeding in open habitats like grasslands with low to moderate shrub cover or tall fobs which can be a scarce cover type in heavily grazed pastures.

Overall, management recommendations are conflicting for focal species in regards to grazing. Thick-billed Longspurs benefit from grazing while Grasshopper Sparrows do not. In order to balance their habitat and nesting needs of both these species, we recommend looking at pastures where only one or the other is found. This will allow management of the polar opposite grazing needs by both species. Grasshopper Sparrows were found exclusively of Thick-billed Longspurs on SS-EC, SS-HQ, SS-LR, and SS-WC(Appendix A). Thick-billed Longspurs were found exclusively of Grasshopper Sparrows on SS-RB and SS-RI (Appendix A).

Starting this year, we have incorporated the City of Fort Collins Natural Areas Program (FCNAP) data into the analyses of our Integrated Monitoring in Bird Conservation Regions (IMBCR) bird data. Due to the way the data are structured in our database, we were only able to incorporate the 2019 and 2022 data into analyses. We plan to modify the data structure for previous years to allow the entire Soapstone data set to be analyzed next year. There are several advantages to this approach, including:

1. Efficiency – We analyze IMBCR data annually to produce density estimates. Incorporating the FCNAP data in with IMBCR data requires a small up-front time investment, but once the data sets are merged, there is little extra work involved to generate estimates for FCNAP projects.
2. Sample size – We are able to pool detections for each species across the entire IMBCR and FCNAP data sets. This results in larger sample sizes needed to generate density estimates, which means we are able to produce density estimates for more species within the Poudre River Natural Areas than we would if this were a stand-alone project.
4. Advanced Analytical Techniques – The IMBCR analysis uses state-of-the-art Bayesian analysis framework that produces estimates with a high level of precision and account for incomplete detection.
5. Trends – This year, we only incorporated the 2019 and 2022 field data into IMBCR analyses to test out feasibility. The test was a success and we plan to clean up and format historic data from FCNAP

projects so they can be incorporated as well. Once this is accomplished, we will automatically generate trend estimates at the species level for FCNAP projects with enough detections and years of data collected.

6. Hierarchical Structure – IMBCR uses a nested design, meaning we can generate density estimates at the stratum level, or combine several strata together to generate a superstratum estimate that accounts for differing sample efforts and areas in each stratum. For example, we were able to generate estimates for each individual pasture in Soapstone Prairie Natural Area, as well as density estimates for the entire property as a whole.

While querying raw data for this report, we discovered that 134 point count locations at Soapstone Prairie went unsampled in 2022. The lead Avian Ecologist for this program left Bird Conservancy after the 2022 field season, so there is a gap in our institutional knowledge surrounding this project. The Avian Ecologist believes that all points were completed and does not recall any reports of incomplete points from field staff. There are a few possible explanations for the missing data. It is possible that the data were collected, but were accidentally not entered into the database. Another possibility is a miscommunication amongst field technicians regarding what points were or were not sampled. It is also possible that some of the data were incorrectly entered under the wrong point count. We noticed that there are several points entered twice in the database for 2022, despite the fact that all points were only visited once. We plan to dedicate time after the field season to reviewing data in the database to hard copies of the data collected to resolve this issue. This will be a part of our larger effort to restructure and organize historic data from Soapstone Prairie so that the entire data set can be analyzed in conjunction with the larger IMBCR data set. Once the data are reformatted, density and trend estimates will be generated for all species with sufficient detections for all Soapstone pastures, and Soapstone as a whole, across all years. This will happen the next time IMBCR analyses are run in the fall of 2024, even though we aren't sampling Soapstone Prairie next year. The analysis generates estimates for all years every year it is run, so we expect to provide updated numbers to the City of Fort Collins in the spring of 2025.

By analyzing these data with the IMBCR analysis framework, we will have the added advantage of generating trend estimates across Soapstone Prairie. We currently have up to eight years of data on different pastures, which should provide ample data to generate trends that can be used to paint a fuller picture of the health of bird populations within the natural area. Bird Conservancy Research Scientists are also in the process of developing data integration analyses that bring together Breeding Bird Survey, eBird, and IMBCR data to produce spatially-explicit estimates of population density, trend, survival, and recruitment. These finer-resolution predictions across different biological levels (abundance, trend, recruitment, survival) are a major step towards our goal of understanding how and where future management actions can maximize conservation efforts for grassland birds. Within the next couple of years, these spatially-explicit estimates will allow us to develop decision support analyses that can help better target and spatially prioritize management actions to achieve conservation objectives. Finally, given our model includes data from three open-source and broad-scale monitoring programs, it can be leveraged across a larger geography, capturing a wider range of conditions in both space and time. We believe this effort can help to better target conservation actions that improve population levels and related outcomes both at the local scale of Soapstone Prairie Natural Area, and across the entire Great Plains.

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APPENDIX A: SPECIES LIST. SUM OF COUNTS FOR SPECIES RECORDED IN EACH PASTURE ON SOAPSTONE PRAIRIE NATURAL AREA IN 2022.

*Watch list Yellow-D (steep declines and major threats), Regional Concern, and Regional Stewardship species are designations from the Avian Conservation and Assessment Database Scores for Bird Conservation Region 18 and North America (Partners in Flight)

Species	Stratum	Count	Conservation status
American Crow	SS-BE	4	
American Crow	SS-BR	10	
American Crow	SS-EC	4	
American Crow	SS-HQ	5	
American Crow	SS-JS	32	
American Crow	SS-LR	6	
American Crow	SS-RI	2	
American Crow	SS-SL	3	
American Crow	SS-WC	1	
American Dipper	SS-BE	1	
American Goldfinch	SS-BE	11	
American Goldfinch	SS-BR	3	
American Goldfinch	SS-EC	2	
American Goldfinch	SS-JS	4	
American Goldfinch	SS-LR	48	
American Goldfinch	SS-RI	2	
American Goldfinch	SS-RK	12	
American Goldfinch	SS-SL	1	
American Goldfinch	SS-WC	9	
American Kestrel	SS-LR	1	
American Kestrel	SS-RK	1	
Baird's Sparrow	SS-JS	1	Watch List Yellow-D (PIF)
Bank Swallow	SS-BE	6	
Bank Swallow	SS-BR	1	
Bank Swallow	SS-JS	2	
Bank Swallow	SS-LR	2	
Barn Swallow	SS-BR	1	
Barn Swallow	SS-HQ	9	
Barn Swallow	SS-JS	31	
Barn Swallow	SS-LR	3	
Barn Swallow	SS-ME	2	
Barn Swallow	SS-SL	6	
Black-billed Magpie	SS-BR	9	

Species	Stratum	Count	Conservation status
Black-billed Magpie	SS-LR	19	
Black-billed Magpie	SS-RK	7	
Black-billed Magpie	SS-WC	10	
Black-headed Grosbeak	SS-BE	1	
Black-headed Grosbeak	SS-BR	2	
Black-headed Grosbeak	SS-EC	21	
Black-headed Grosbeak	SS-LR	44	
Black-headed Grosbeak	SS-RI	4	
Black-headed Grosbeak	SS-RK	3	
Black-headed Grosbeak	SS-WC	22	
Blue Bunting	SS-LR	1	
Blue Grosbeak	SS-BE	6	
Blue Grosbeak	SS-BR	1	
Blue Grosbeak	SS-LR	2	
Blue-gray Gnatcatcher	SS-BR	1	
Blue-gray Gnatcatcher	SS-EC	1	
Blue-gray Gnatcatcher	SS-LR	15	
Blue-gray Gnatcatcher	SS-RI	1	
Blue-gray Gnatcatcher	SS-RK	5	
Brewer's Blackbird	SS-BE	44	
Brewer's Blackbird	SS-BR	25	
Brewer's Blackbird	SS-EC	56	
Brewer's Blackbird	SS-HQ	5	
Brewer's Blackbird	SS-LR	121	
Brewer's Blackbird	SS-ME	1	
Brewer's Blackbird	SS-RB	9	
Brewer's Blackbird	SS-RI	64	
Brewer's Blackbird	SS-RK	31	
Brewer's Blackbird	SS-SL	6	
Brewer's Blackbird	SS-WC	68	
Brewer's Sparrow	SS-BE	58	
Brewer's Sparrow	SS-BR	4	
Brewer's Sparrow	SS-EC	39	
Brewer's Sparrow	SS-LR	26	
Brewer's Sparrow	SS-RB	13	
Brewer's Sparrow	SS-RI	10	
Brewer's Sparrow	SS-RK	2	
Brewer's Sparrow	SS-WC	13	
Broad-tailed Hummingbird	SS-BE	1	Watch List Yellow-D (PIF)
Broad-tailed Hummingbird	SS-BR	1	
Broad-tailed Hummingbird	SS-EC	1	

Species	Stratum	Count	Conservation status
Broad-tailed Hummingbird	SS-LR	1	
Broad-tailed Hummingbird	SS-RB	1	
Broad-tailed Hummingbird	SS-WC	1	
Brown Thrasher	SS-BR	4	
Brown Thrasher	SS-EC	15	
Brown Thrasher	SS-LR	23	
Brown Thrasher	SS-RI	7	
Brown Thrasher	SS-RK	2	
Brown Thrasher	SS-WC	4	
Brown-headed Cowbird	SS-BE	34	
Brown-headed Cowbird	SS-BR	14	
Brown-headed Cowbird	SS-EC	32	
Brown-headed Cowbird	SS-LR	250	
Brown-headed Cowbird	SS-ME	2	
Brown-headed Cowbird	SS-RB	7	
Brown-headed Cowbird	SS-RI	20	
Brown-headed Cowbird	SS-RK	77	
Brown-headed Cowbird	SS-SL	2	
Brown-headed Cowbird	SS-WC	63	
Bullock's Oriole	SS-BE	3	
Bullock's Oriole	SS-BR	5	
Bullock's Oriole	SS-EC	2	
Bullock's Oriole	SS-HQ	2	
Bullock's Oriole	SS-LR	20	
Bullock's Oriole	SS-RB	3	
Bullock's Oriole	SS-RI	5	
Bullock's Oriole	SS-RK	33	
Bullock's Oriole	SS-WC	12	
Canada Goose	SS-BR	24	
Canada Goose	SS-LR	3	
Chipping Sparrow	SS-BR	2	
Chipping Sparrow	SS-HQ	8	
Chipping Sparrow	SS-JS	19	
Chipping Sparrow	SS-LR	7	
Chipping Sparrow	SS-ME	1	
Chipping Sparrow	SS-RI	1	
Chipping Sparrow	SS-SL	1	
Clay-colored Sparrow	SS-EC	8	
Clay-colored Sparrow	SS-RI	1	
Clay-colored Sparrow	SS-WC	1	
Cliff Swallow	SS-BE	3	

Species	Stratum	Count	Conservation status
Cliff Swallow	SS-HQ	1	
Cliff Swallow	SS-LR	14	
Cliff Swallow	SS-RB	2	
Cliff Swallow	SS-RK	2	
Common Grackle	SS-BE	3	
Common Grackle	SS-BR	11	
Common Grackle	SS-EC	24	
Common Grackle	SS-LR	22	
Common Grackle	SS-ME	3	
Common Grackle	SS-RK	5	
Common Grackle	SS-WC	31	
Common Merganser	SS-LR	1	
Common Nighthawk	SS-BE	16	
Common Nighthawk	SS-BR	14	
Common Nighthawk	SS-EC	2	
Common Nighthawk	SS-LR	33	
Common Nighthawk	SS-RB	1	
Common Nighthawk	SS-RI	1	
Common Nighthawk	SS-RK	89	
Common Nighthawk	SS-WC	3	
Common Raven	SS-BE	14	
Common Raven	SS-BR	15	
Common Raven	SS-HQ	1	
Common Raven	SS-JS	17	
Common Raven	SS-LR	19	
Common Raven	SS-ME	2	
Common Raven	SS-RB	3	
Common Raven	SS-RI	2	
Common Raven	SS-SL	1	
Common Raven	SS-WC	8	
European Starling	SS-BR	2	
European Starling	SS-JS	1	
Grasshopper Sparrow	SS-BR	20	Regional Concern (PIF)
Grasshopper Sparrow	SS-EC	2	
Grasshopper Sparrow	SS-HQ	4	
Grasshopper Sparrow	SS-JS	22	
Grasshopper Sparrow	SS-LR	2	
Grasshopper Sparrow	SS-ME	3	
Grasshopper Sparrow	SS-SL	2	
Grasshopper Sparrow	SS-WC	1	
Great-tailed Grackle	SS-BR	3	

Species	Stratum	Count	Conservation status
Green-tailed Towhee	SS-BE	3	
Green-tailed Towhee	SS-BR	1	
Green-tailed Towhee	SS-EC	4	
Green-tailed Towhee	SS-LR	92	
Green-tailed Towhee	SS-RI	3	
Green-tailed Towhee	SS-RK	9	
Green-tailed Towhee	SS-WC	27	
Horned Lark	SS-BE	787	
Horned Lark	SS-BR	1149	
Horned Lark	SS-EC	10	
Horned Lark	SS-HQ	19	
Horned Lark	SS-JS	1127	
Horned Lark	SS-LR	419	
Horned Lark	SS-ME	107	
Horned Lark	SS-RB	618	
Horned Lark	SS-RK	143	
Horned Lark	SS-SL	207	
Horned Lark	SS-WC	59	
House Finch	SS-JS	1	
House Finch	SS-LR	1	
House Finch	SS-RB	1	
House Wren	SS-JS	1	
Killdeer	SS-BE	8	
Killdeer	SS-BR	16	
Killdeer	SS-JS	12	
Killdeer	SS-LR	16	
Killdeer	SS-ME	3	
Killdeer	SS-RB	1	
Killdeer	SS-RI	2	
Killdeer	SS-SL	3	
Lark Bunting	SS-BE	36	Regional Concern and Regional Stewardship Species (PIF)
Lark Bunting	SS-BR	94	
Lark Bunting	SS-EC	2	
Lark Bunting	SS-HQ	4	
Lark Bunting	SS-JS	86	
Lark Bunting	SS-LR	5	
Lark Bunting	SS-ME	4	
Lark Bunting	SS-RB	5	
Lark Bunting	SS-RI	1	
Lark Sparrow	SS-BE	14	

Species	Stratum	Count	Conservation status
Lark Sparrow	SS-BR	7	
Lark Sparrow	SS-EC	4	
Lark Sparrow	SS-HQ	2	
Lark Sparrow	SS-JS	6	
Lark Sparrow	SS-LR	44	
Lark Sparrow	SS-ME	1	
Lark Sparrow	SS-RB	6	
Lark Sparrow	SS-RI	1	
Lark Sparrow	SS-RK	44	
Lark Sparrow	SS-WC	8	
Lesser Goldfinch	SS-LR	2	
Lincoln's Sparrow	SS-BR	3	
Lincoln's Sparrow	SS-EC	6	
Lincoln's Sparrow	SS-JS	1	
Lincoln's Sparrow	SS-LR	1	
Lincoln's Sparrow	SS-RI	1	
Lincoln's Sparrow	SS-SL	1	
Lincoln's Sparrow	SS-WC	2	
Loggerhead Shrike	SS-BE	1	Regional Concern (PIF)
Loggerhead Shrike	SS-BR	2	
Loggerhead Shrike	SS-EC	4	
Loggerhead Shrike	SS-JS	1	
Loggerhead Shrike	SS-LR	11	
Loggerhead Shrike	SS-RB	5	
Loggerhead Shrike	SS-RK	2	
Loggerhead Shrike	SS-WC	4	
Long-billed Curlew	SS-HQ	2	
Mallard	SS-JS	1	
Mallard	SS-LR	11	
Marsh Wren	SS-HQ	2	
Mountain Chickadee	SS-LR	2	
Mourning Dove	SS-BE	55	
Mourning Dove	SS-BR	51	
Mourning Dove	SS-EC	88	
Mourning Dove	SS-JS	12	
Mourning Dove	SS-LR	182	
Mourning Dove	SS-ME	2	
Mourning Dove	SS-RB	17	
Mourning Dove	SS-RI	42	
Mourning Dove	SS-RK	59	
Mourning Dove	SS-SL	10	

Species	Stratum	Count	Conservation status
Mourning Dove	SS-WC	47	
Northern Flicker	SS-LR	1	
Northern Harrier	SS-JS	2	
Northern Harrier	SS-WC	1	
Northern Mockingbird	SS-BE	2	
Northern Mockingbird	SS-BR	2	
Northern Mockingbird	SS-EC	11	
Northern Mockingbird	SS-LR	9	
Northern Mockingbird	SS-RI	3	
Northern Mockingbird	SS-RK	11	
Northern Mockingbird	SS-SL	2	
Northern Mockingbird	SS-WC	2	
Northern Rough-winged Swallow	SS-BE	7	
Northern Rough-winged Swallow	SS-BR	1	
Northern Rough-winged Swallow	SS-JS	3	
Northern Rough-winged Swallow	SS-LR	1	
Northern Rough-winged Swallow	SS-RK	1	
Prairie Falcon	SS-JS	1	Regional Concern (PIF)
Red-tailed Hawk	SS-BR	1	
Red-tailed Hawk	SS-HQ	2	
Red-tailed Hawk	SS-LR	5	
Red-tailed Hawk	SS-RK	5	
Red-winged Blackbird	SS-BE	22	
Red-winged Blackbird	SS-BR	108	
Red-winged Blackbird	SS-EC	2	
Red-winged Blackbird	SS-HQ	60	
Red-winged Blackbird	SS-JS	119	
Red-winged Blackbird	SS-LR	8	
Red-winged Blackbird	SS-ME	41	
Red-winged Blackbird	SS-SL	61	
Red-winged Blackbird	SS-WC	6	
Rock Wren	SS-BE	10	Regional Concern (PIF)
Rock Wren	SS-LR	33	
Rock Wren	SS-RK	26	
Savannah Sparrow	SS-BE	1	
Savannah Sparrow	SS-BR	4	
Savannah Sparrow	SS-HQ	3	
Savannah Sparrow	SS-JS	3	
Savannah Sparrow	SS-LR	2	
Savannah Sparrow	SS-ME	1	
Savannah Sparrow	SS-SL	3	

Species	Stratum	Count	Conservation status
Savannah Sparrow	SS-WC	1	
Say's Phoebe	SS-BE	2	
Say's Phoebe	SS-EC	5	
Say's Phoebe	SS-HQ	3	
Say's Phoebe	SS-LR	14	
Say's Phoebe	SS-RI	3	
Say's Phoebe	SS-RK	7	
Say's Phoebe	SS-WC	4	
Song Sparrow	SS-JS	4	
Spotted Towhee	SS-BE	49	
Spotted Towhee	SS-BR	37	
Spotted Towhee	SS-EC	178	
Spotted Towhee	SS-LR	764	
Spotted Towhee	SS-RB	3	
Spotted Towhee	SS-RI	75	
Spotted Towhee	SS-RK	147	
Spotted Towhee	SS-SL	5	
Spotted Towhee	SS-WC	206	
Swainson's Hawk	SS-BR	2	
Thick-billed Longspur	SS-BR	27	Watch List Yellow-D (PIF)
Thick-billed Longspur	SS-JS	351	
Thick-billed Longspur	SS-ME	3	
Thick-billed Longspur	SS-RB	1	
Thick-billed Longspur	SS-RI	1	
Thick-billed Longspur	SS-SL	3	
Tree Swallow	SS-JS	1	
Tree Swallow	SS-LR	1	
Turkey Vulture	SS-LR	3	
Vesper Sparrow	SS-BE	315	
Vesper Sparrow	SS-BR	180	
Vesper Sparrow	SS-EC	14	
Vesper Sparrow	SS-HQ	10	
Vesper Sparrow	SS-JS	66	
Vesper Sparrow	SS-LR	130	
Vesper Sparrow	SS-ME	11	
Vesper Sparrow	SS-RB	143	
Vesper Sparrow	SS-RI	10	
Vesper Sparrow	SS-RK	71	
Vesper Sparrow	SS-SL	16	
Vesper Sparrow	SS-WC	62	
Virginia's Warbler	SS-LR	4	Watch List Yellow-D (PIF)

Species	Stratum	Count	Conservation status
Western Bluebird	SS-EC	1	
Western Bluebird	SS-WC	1	
Western Kingbird	SS-BR	1	Regional Stewardship (PIF)
Western Kingbird	SS-EC	1	
Western Kingbird	SS-JS	8	
Western Kingbird	SS-LR	2	
Western Kingbird	SS-RB	2	
Western Kingbird	SS-RK	6	
Western Kingbird	SS-WC	1	
Western Meadowlark	SS-BE	310	Regional Concern (PIF)
Western Meadowlark	SS-BR	529	
Western Meadowlark	SS-EC	177	
Western Meadowlark	SS-HQ	42	
Western Meadowlark	SS-JS	401	
Western Meadowlark	SS-LR	603	
Western Meadowlark	SS-ME	86	
Western Meadowlark	SS-RB	247	
Western Meadowlark	SS-RI	87	
Western Meadowlark	SS-RK	237	
Western Meadowlark	SS-SL	76	
Western Meadowlark	SS-WC	225	
Western Sandpiper	SS-RK	1	
Western Wood-Pewee	SS-LR	2	
Western Wood-Pewee	SS-RK	9	
Wilson's Snipe	SS-BE	7	
Wilson's Snipe	SS-BR	8	
Wilson's Snipe	SS-EC	1	
Wilson's Snipe	SS-JS	1	
Wilson's Snipe	SS-ME	1	
Wilson's Snipe	SS-SL	3	
Woodhouse's Scrub-Jay	SS-LR	1	
Yellow Warbler	SS-LR	19	
Yellow Warbler	SS-RI	1	
Yellow Warbler	SS-RK	2	
Yellow-breasted Chat	SS-LR	5	
Yellow-breasted Chat	SS-WC	3	

APPENDIX B: DENSITY ESTIMATES ACROSS SOAPSTONE PRAIRIE NATURAL AREA, BY PASTURE, 2022.

D = number of birds/km2, % CV = Percent Coefficient of Variation, N = Population estimate, 95% lower (LCL) and upper (UCL) confidence limits on D and N, and n = number of detections used in analyses. Focal species are bolded.

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
American Crow	SS-BE: Bernard Pasture	0.05	224	0.02	0.14	0.47	0.16	1.25	3
American Crow	SS-BR: Brannigan Pasture	0.07	133	0.04	0.13	1.06	0.58	1.92	7
American Crow	SS-EC: East Canyon Pasture	0.11	419	0.05	0.25	0.6	0.25	1.35	4
American Crow	SS-HQ: Headquarters Pasture	0.4	173	0.11	1.14	0.35	0.09	1.01	2
American Crow	SS-JS: Jack Springs Pasture	0.21	213	0.15	0.31	3.24	2.3	4.9	21
American Crow	SS-LR: LR Pasture	0.05	120	0.03	0.1	0.98	0.49	1.86	6
American Crow	SS-RI: Roman Inholding Pasture	0.09	158	0.03	0.33	0.22	0.07	0.79	2
American Crow	SS-SL: State Line Pasture	0.12	126	0.03	0.37	0.29	0.08	0.92	2
American Crow	SS-WC: West Canyon Pasture	0.02	123	0	0.1	0.13	0.02	0.54	1
American Dipper	SS-BE: Bernard Pasture	0.52	105	0.1	2.09	4.57	0.92	18.45	1
American Goldfinch	SS-BE: Bernard Pasture	2.97	58	1.89	6.68	26.18	16.69	58.9	9
American Goldfinch	SS-EC: East Canyon Pasture	1.55	69	0.57	4.18	8.3	3.06	22.42	2
American Goldfinch	SS-JS: Jack Springs Pasture	0.67	74	0.3	1.65	10.5	4.77	25.93	3
American Goldfinch	SS-LR: LR Pasture	7.38	57	5.87	13.69	139.14	110.7	258.04	35
American Goldfinch	SS-RI: Roman Inholding Pasture	3.24	77	1.08	8.38	7.85	2.62	20.28	2
American Goldfinch	SS-RK: Roman Krafczik Pasture	7.21	61	4.81	13.92	46.32	30.9	89.38	12
American Goldfinch	SS-SL: State Line Pasture	1.19	101	0.4	3.59	2.95	0.99	8.9	1
American Goldfinch	SS-WC: West Canyon Pasture	5.3	61	3.21	10.47	29.51	17.88	58.31	8
American Kestrel	SS-LR: LR Pasture	0.05	73	0.01	0.14	0.9	0.23	2.72	1
American Kestrel	SS-RK: Roman Krafczik Pasture	0.18	70	0.04	0.5	1.13	0.23	3.18	1
Baird's Sparrow	SS-JS: Jack Springs Pasture	0.18	57	0.06	0.43	2.9	0.97	6.78	1
Bank Swallow	SS-BR: Brannigan Pasture	0.38	187	0.06	2.89	5.87	0.98	44.21	1
Bank Swallow	SS-JS: Jack Springs Pasture	2.09	135	0.8	12.6	32.81	12.53	197.85	2
Bank Swallow	SS-LR: LR Pasture	0.28	162	0.06	1.93	5.23	1.05	36.31	1
Barn Swallow	SS-BR: Brannigan Pasture	0.26	125	0.05	1.27	3.91	0.76	19.43	1
Barn Swallow	SS-HQ: Headquarters Pasture	37.26	123	18.19	116.3	32.79	16.01	102.34	4
Barn Swallow	SS-JS: Jack Springs Pasture	8.91	119	5.83	25.16	139.95	91.46	394.94	20

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Barn Swallow	SS-LR: LR Pasture	0.79	138	0.3	2.54	14.83	5.7	47.81	3
Barn Swallow	SS-ME: Meadow Pasture	5.78	171	2.33	17.27	16.17	6.53	48.36	2
Barn Swallow	SS-SL: State Line Pasture	15.98	130	8.32	47.41	39.63	20.64	117.59	6
Black-billed Magpie	SS-BR: Brannigan Pasture	0.14	65	0.07	0.28	2.21	1.11	4.32	3
Black-billed Magpie	SS-LR: LR Pasture	0.43	60	0.29	0.85	8.13	5.47	15.96	12
Black-billed Magpie	SS-RK: Roman Krafczik Pasture	0.49	63	0.26	1.1	3.13	1.64	7.03	4
Black-billed Magpie	SS-WC: West Canyon Pasture	0.44	62	0.22	1.03	2.43	1.23	5.73	4
Black-headed Grosbeak	SS-BE: Bernard Pasture	0.11	81	0.06	0.51	1	0.5	4.52	1
Black-headed Grosbeak	SS-BR: Brannigan Pasture	0.24	58	0.1	0.57	3.6	1.54	8.75	2
Black-headed Grosbeak	SS-EC: East Canyon Pasture	6.56	19	4.92	8.71	35.17	26.38	46.71	18
Black-headed Grosbeak	SS-LR: LR Pasture	3.94	15	3.21	4.96	74.28	60.52	93.53	35
Black-headed Grosbeak	SS-RI: Roman Inholding Pasture	3.32	35	1.56	5.56	8.03	3.78	13.45	4
Black-headed Grosbeak	SS-RK: Roman Krafczik Pasture	0.95	43	0.43	1.73	6.1	2.77	11.09	3
Black-headed Grosbeak	SS-WC: West Canyon Pasture	7.48	19	5.64	9.99	41.69	31.41	55.65	21
Blue Grosbeak	SS-BE: Bernard Pasture	0.82	39	0.48	1.56	7.27	4.2	13.74	6
Blue Grosbeak	SS-BR: Brannigan Pasture	0.05	77	0.03	0.23	0.78	0.39	3.5	1
Blue Grosbeak	SS-LR: LR Pasture	0.4	39	0.2	0.74	7.53	3.76	14	2
Blue-gray Gnatcatcher	SS-BR: Brannigan Pasture	0.48	83	0.16	1.61	7.4	2.47	24.66	1
Blue-gray Gnatcatcher	SS-EC: East Canyon Pasture	1.99	74	0.49	6.39	10.65	2.63	34.23	1
Blue-gray Gnatcatcher	SS-LR: LR Pasture	6.43	32	4.34	9.99	121.26	81.73	188.36	13
Blue-gray Gnatcatcher	SS-RK: Roman Krafczik Pasture	7.86	41	4.14	13.65	50.46	26.56	87.64	5
Brewer's Blackbird	SS-BE: Bernard Pasture	8.31	91	5.43	31.94	73.32	47.86	281.7	22
Brewer's Blackbird	SS-BR: Brannigan Pasture	5.55	91	4.1	23.19	84.97	62.82	354.96	21
Brewer's Blackbird	SS-EC: East Canyon Pasture	26.76	88	20.08	109.36	143.42	107.61	586.17	41
Brewer's Blackbird	SS-HQ: Headquarters Pasture	4.24	141	0.85	21.23	3.73	0.75	18.68	1
Brewer's Blackbird	SS-LR: LR Pasture	13.09	87	10.79	56.09	246.74	203.33	1057.28	67
Brewer's Blackbird	SS-ME: Meadow Pasture	4.88	98	1.69	18.17	13.67	4.74	50.86	1
Brewer's Blackbird	SS-RI: Roman Inholding Pasture	44.75	89	32.51	170.83	108.31	78.67	413.41	40
Brewer's Blackbird	SS-RK: Roman Krafczik Pasture	14.09	94	9.95	60.75	90.47	63.89	390.01	21
Brewer's Blackbird	SS-SL: State Line Pasture	8.57	100	4.03	32.74	21.25	10.01	81.2	5
Brewer's Blackbird	SS-WC: West Canyon Pasture	31.7	91	24.64	139.07	176.56	137.25	774.64	49

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Brewer's Sparrow	SS-BE: Bernard Pasture	12.42	36	9.93	15.74	109.51	87.57	138.81	44
Brewer's Sparrow	SS-BR: Brannigan Pasture	0.67	58	0.31	1.34	10.27	4.74	20.54	4
Brewer's Sparrow	SS-EC: East Canyon Pasture	18.73	36	15.2	23.45	100.39	81.47	125.69	35
Brewer's Sparrow	SS-LR: LR Pasture	4.35	39	3.49	5.74	81.93	65.88	108.11	25
Brewer's Sparrow	SS-RB: Round Butte Pasture	3.75	43	2.3	5.86	20.45	12.54	31.93	10
Brewer's Sparrow	SS-RI: Roman Inholding Pasture	8.99	46	5.7	14.69	21.76	13.78	35.55	10
Brewer's Sparrow	SS-RK: Roman Krafczik Pasture	0.66	68	0.27	1.86	4.25	1.7	11.91	2
Brewer's Sparrow	SS-WC: West Canyon Pasture	5.35	41	3.31	8.03	29.81	18.42	44.71	10
Broad-tailed Hummingbird	SS-BE: Bernard Pasture	1.57	87	0.52	5.47	13.84	4.61	48.22	1
Broad-tailed Hummingbird	SS-RB: Round Butte Pasture	2.17	81	0.72	7.97	11.84	3.95	43.43	1
Brown Thrasher	SS-BR: Brannigan Pasture	0.41	48	0.21	0.79	6.2	3.21	12.09	4
Brown Thrasher	SS-EC: East Canyon Pasture	4.09	45	2.53	7.14	21.93	13.57	38.28	13
Brown Thrasher	SS-LR: LR Pasture	2.03	24	1.52	2.76	38.22	28.61	52.09	22
Brown Thrasher	SS-RI: Roman Inholding Pasture	3.7	46	2.35	6.54	8.95	5.7	15.83	6
Brown Thrasher	SS-RK: Roman Krafczik Pasture	0.94	45	0.43	1.73	6.05	2.74	11.14	2
Brown Thrasher	SS-WC: West Canyon Pasture	1.24	47	0.59	2.3	6.88	3.28	12.8	4
Brown-headed Cowbird	SS-BE: Bernard Pasture	8.48	56	6.11	15.28	74.81	53.88	134.77	29
Brown-headed Cowbird	SS-BR: Brannigan Pasture	2.48	59	1.65	5.2	37.92	25.28	79.55	13
Brown-headed Cowbird	SS-EC: East Canyon Pasture	15.74	48	12.12	28.83	84.36	64.96	154.51	29
Brown-headed Cowbird	SS-LR: LR Pasture	27.58	54	24.96	51.9	519.87	470.45	978.3	195
Brown-headed Cowbird	SS-ME: Meadow Pasture	2.7	60	1.2	6.85	7.57	3.36	19.17	2
Brown-headed Cowbird	SS-RB: Round Butte Pasture	2.48	61	1.33	4.67	13.51	7.26	25.47	6
Brown-headed Cowbird	SS-RI: Roman Inholding Pasture	21.88	50	16.3	43.22	52.96	39.45	104.59	16
Brown-headed Cowbird	SS-RK: Roman Krafczik Pasture	27.57	52	23.53	56.88	177	151.08	365.14	67
Brown-headed Cowbird	SS-SL: State Line Pasture	1.99	69	0.67	5.57	4.94	1.65	13.81	2
Brown-headed Cowbird	SS-WC: West Canyon Pasture	24.24	54	19.36	45.67	135	107.83	254.38	47
Bullock's Oriole	SS-BE: Bernard Pasture	0.48	70	0.16	1.34	4.21	1.4	11.8	2
Bullock's Oriole	SS-BR: Brannigan Pasture	0.91	41	0.44	1.64	13.9	6.71	25.13	4
Bullock's Oriole	SS-EC: East Canyon Pasture	0.86	63	0.29	2.3	4.61	1.55	12.34	2
Bullock's Oriole	SS-HQ: Headquarters Pasture	1.91	108	0.64	8.91	1.68	0.56	7.85	1
Bullock's Oriole	SS-LR: LR Pasture	1.91	34	1.33	2.87	35.92	25.12	54.05	16

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Bullock's Oriole	SS-RB: Round Butte Pasture	0.66	63	0.22	1.62	3.6	1.2	8.84	2
Bullock's Oriole	SS-RI: Roman Inholding Pasture	1.64	59	0.57	4	3.96	1.38	9.69	2
Bullock's Oriole	SS-RK: Roman Krafczik Pasture	10.94	29	8.25	15.92	70.23	52.97	102.21	27
Bullock's Oriole	SS-WC: West Canyon Pasture	5.82	36	3.44	9.02	32.43	19.18	50.24	12
Canada Goose	SS-BR: Brannigan Pasture	0.02	205	0.01	0.17	0.3	0.08	2.57	2
Canada Goose	SS-LR: LR Pasture	0.01	177	0	0.07	0.13	0.02	1.37	1
Chipping Sparrow	SS-HQ: Headquarters Pasture	33.86	74	17.82	58.81	29.8	15.68	51.76	6
Chipping Sparrow	SS-JS: Jack Springs Pasture	3.69	55	2.42	5.58	57.98	38.04	87.65	13
Chipping Sparrow	SS-LR: LR Pasture	1.37	58	0.76	2.55	25.82	14.35	47.99	6
Chipping Sparrow	SS-ME: Meadow Pasture	1.02	107	0.51	5.09	2.85	1.43	14.26	1
Chipping Sparrow	SS-RI: Roman Inholding Pasture	1.02	94	0.51	5.09	2.46	1.23	12.32	1
Chipping Sparrow	SS-SL: State Line Pasture	1.69	80	0.56	5.07	4.19	1.4	12.56	1
Clay-colored Sparrow	SS-EC: East Canyon Pasture	4.05	30	2.58	6.26	21.71	13.82	33.56	8
Clay-colored Sparrow	SS-RI: Roman Inholding Pasture	1.05	66	0.35	3.16	2.55	0.85	7.64	1
Clay-colored Sparrow	SS-WC: West Canyon Pasture	0.37	66	0.18	0.92	2.05	1.03	5.13	1
Cliff Swallow	SS-BE: Bernard Pasture	1.08	384	0.27	11.13	9.49	2.39	98.17	2
Cliff Swallow	SS-HQ: Headquarters Pasture	12.91	333	2.15	66.21	11.36	1.89	58.26	1
Cliff Swallow	SS-LR: LR Pasture	3.31	392	2.21	24.59	62.37	41.58	463.48	12
Cliff Swallow	SS-RB: Round Butte Pasture	1.61	352	0.5	15.9	8.8	2.71	86.64	2
Cliff Swallow	SS-RK: Roman Krafczik Pasture	1.48	303	0.41	8.62	9.53	2.62	55.35	2
Common Grackle	SS-BE: Bernard Pasture	1.04	178	0.35	4.49	9.14	3.08	39.64	3
Common Grackle	SS-BR: Brannigan Pasture	1.09	155	0.61	4.91	16.64	9.36	75.19	7
Common Grackle	SS-EC: East Canyon Pasture	10.1	169	6.76	56.76	54.13	36.25	304.25	18
Common Grackle	SS-LR: LR Pasture	2.15	167	1.38	11	40.58	26.07	207.27	15
Common Grackle	SS-RK: Roman Krafczik Pasture	1.42	147	0.61	7.12	9.15	3.92	45.68	4
Common Grackle	SS-WC: West Canyon Pasture	15.95	177	11.5	79.02	88.84	64.04	440.13	29
Common Nighthawk	SS-BE: Bernard Pasture	1.5	80	1.07	2.6	13.2	9.43	22.91	16
Common Nighthawk	SS-BR: Brannigan Pasture	0.83	105	0.55	1.3	12.77	8.49	19.91	14
Common Nighthawk	SS-EC: East Canyon Pasture	0.38	145	0.17	1.05	2.06	0.92	5.62	2
Common Nighthawk	SS-LR: LR Pasture	1.13	101	0.82	1.75	21.35	15.38	32.91	18
Common Nighthawk	SS-RB: Round Butte Pasture	0.1	123	0.03	0.4	0.54	0.18	2.17	1

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Common Nighthawk	SS-RI: Roman Inholding Pasture	0.57	131	0.08	1.87	1.38	0.21	4.53	1
Common Nighthawk	SS-RK: Roman Krafczik Pasture	4.47	99	3.53	6.88	28.67	22.66	44.14	26
Common Nighthawk	SS-WC: West Canyon Pasture	0.55	142	0.26	1.34	3.06	1.43	7.45	3
Common Raven	SS-BE: Bernard Pasture	0.17	148	0.1	0.32	1.48	0.9	2.79	11
Common Raven	SS-BR: Brannigan Pasture	0.12	136	0.08	0.18	1.82	1.18	2.78	14
Common Raven	SS-HQ: Headquarters Pasture	0.13	127	0.03	0.6	0.12	0.02	0.53	1
Common Raven	SS-JS: Jack Springs Pasture	0.13	176	0.09	0.2	2.01	1.34	3.1	17
Common Raven	SS-LR: LR Pasture	0.13	171	0.09	0.22	2.42	1.67	4.07	19
Common Raven	SS-ME: Meadow Pasture	0.09	93	0.03	0.25	0.26	0.09	0.71	2
Common Raven	SS-RB: Round Butte Pasture	0.06	246	0.02	0.15	0.32	0.12	0.79	3
Common Raven	SS-RI: Roman Inholding Pasture	0.16	111	0.06	0.36	0.39	0.15	0.87	2
Common Raven	SS-SL: State Line Pasture	0.05	180	0.01	0.16	0.12	0.02	0.41	1
Common Raven	SS-WC: West Canyon Pasture	0.2	99	0.12	0.38	1.11	0.68	2.14	8
European Starling	SS-BR: Brannigan Pasture	0.56	317	0.18	2.16	8.59	2.77	33.13	2
European Starling	SS-JS: Jack Springs Pasture	0.39	192	0.12	1.69	6.05	1.86	26.58	1
Grasshopper Sparrow	SS-BR: Brannigan Pasture	5.41	21	4.02	7.27	82.79	61.56	111.34	15
Grasshopper Sparrow	SS-EC: East Canyon Pasture	0.85	72	0.42	2.11	4.53	2.27	11.33	1
Grasshopper Sparrow	SS-HQ: Headquarters Pasture	19.73	36	11.28	35.52	17.37	9.92	31.26	4
Grasshopper Sparrow	SS-JS: Jack Springs Pasture	5.84	17	4.48	7.61	91.72	70.39	119.45	20
Grasshopper Sparrow	SS-LR: LR Pasture	0.6	53	0.24	1.32	11.35	4.54	24.96	1
Grasshopper Sparrow	SS-ME: Meadow Pasture	7.25	39	4.03	13.25	20.3	11.28	37.1	2
Grasshopper Sparrow	SS-SL: State Line Pasture	5.34	47	2.67	10.39	13.25	6.62	25.76	2
Great-tailed Grackle	SS-BR: Brannigan Pasture	0.24	182	0.06	1.37	3.74	0.97	20.96	2
Green-tailed Towhee	SS-BE: Bernard Pasture	0.64	44	0.32	1.36	5.61	2.85	12.02	3
Green-tailed Towhee	SS-BR: Brannigan Pasture	0.21	66	0.05	0.59	3.28	0.82	9.03	1
Green-tailed Towhee	SS-EC: East Canyon Pasture	1.96	39	1.14	3.76	10.52	6.13	20.16	4
Green-tailed Towhee	SS-LR: LR Pasture	7.68	14	6.52	9.19	144.77	122.84	173.25	56
Green-tailed Towhee	SS-RI: Roman Inholding Pasture	3.11	40	1.56	5.61	7.54	3.77	13.57	3
Green-tailed Towhee	SS-RK: Roman Krafczik Pasture	2.62	28	1.79	4.13	16.79	11.49	26.52	8
Green-tailed Towhee	SS-WC: West Canyon Pasture	9.48	18	7.36	12.99	52.82	40.98	72.35	22
Horned Lark	SS-BE: Bernard Pasture	162.36	41	153.92	207.08	1432.02	1357.53	1826.41	595

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Horned Lark	SS-BR: Brannigan Pasture	139.02	43	133.58	180.91	2128.38	2045.12	2769.75	914
Horned Lark	SS-EC: East Canyon Pasture	3.71	71	2.4	6.33	19.89	12.87	33.94	8
Horned Lark	SS-HQ: Headquarters Pasture	39.3	49	26.2	58.98	34.58	23.05	51.9	11
Horned Lark	SS-JS: Jack Springs Pasture	132.5	42	127.01	165.78	2080.25	1994.07	2602.81	884
Horned Lark	SS-LR: LR Pasture	43.57	42	40.67	55.43	821.31	766.71	1044.87	328
Horned Lark	SS-ME: Meadow Pasture	81.51	40	72.77	105.21	228.22	203.76	294.6	91
Horned Lark	SS-RB: Round Butte Pasture	180.72	43	171.48	235.97	984.94	934.58	1286.04	472
Horned Lark	SS-RK: Roman Krafczik Pasture	41.92	44	37.8	53.21	269.11	242.67	341.6	113
Horned Lark	SS-SL: State Line Pasture	173.28	40	157.45	217.23	429.73	390.47	538.72	166
Horned Lark	SS-WC: West Canyon Pasture	24.77	41	20.21	34.37	137.95	112.54	191.44	50
House Finch	SS-LR: LR Pasture	0.12	111	0.05	0.44	2.35	0.92	8.35	1
House Finch	SS-RB: Round Butte Pasture	0.4	90	0.13	1.32	2.17	0.72	7.22	1
Killdeer	SS-BE: Bernard Pasture	0.97	44	0.54	1.87	8.57	4.74	16.49	8
Killdeer	SS-BR: Brannigan Pasture	0.98	34	0.64	1.47	15.02	9.85	22.5	13
Killdeer	SS-JS: Jack Springs Pasture	0.7	35	0.42	1.15	10.98	6.64	17.98	8
Killdeer	SS-LR: LR Pasture	0.79	39	0.47	1.25	14.82	8.9	23.61	13
Killdeer	SS-ME: Meadow Pasture	1.49	56	0.53	2.91	4.17	1.48	8.14	2
Killdeer	SS-RB: Round Butte Pasture	0.12	87	0.04	0.46	0.65	0.19	2.51	1
Killdeer	SS-RI: Roman Inholding Pasture	0.7	75	0.26	1.84	1.7	0.64	4.46	2
Killdeer	SS-SL: State Line Pasture	1.74	49	0.78	3.47	4.33	1.92	8.59	3
Lark Bunting	SS-BE: Bernard Pasture	4.01	35	3.14	5.31	35.37	27.71	46.83	30
Lark Bunting	SS-BR: Brannigan Pasture	7.27	35	6.41	8.58	111.36	98.21	131.4	90
Lark Bunting	SS-EC: East Canyon Pasture	0.39	66	0.2	1.11	2.09	1.05	5.97	2
Lark Bunting	SS-HQ: Headquarters Pasture	11.7	48	6.5	18.85	10.3	5.72	16.59	4
Lark Bunting	SS-JS: Jack Springs Pasture	3.51	33	2.85	4.29	55.09	44.76	67.39	40
Lark Bunting	SS-LR: LR Pasture	0.25	43	0.17	0.39	4.71	3.14	7.33	5
Lark Bunting	SS-ME: Meadow Pasture	3.71	45	1.86	6.32	10.4	5.2	17.68	4
Lark Bunting	SS-RB: Round Butte Pasture	0.98	40	0.6	1.58	5.31	3.27	8.59	5
Lark Bunting	SS-RI: Roman Inholding Pasture	0.37	78	0.19	1.11	0.9	0.45	2.7	1
Lark Sparrow	SS-BE: Bernard Pasture	2.95	40	1.85	5.15	26.06	16.35	45.43	10
Lark Sparrow	SS-BR: Brannigan Pasture	1.6	45	0.92	2.85	24.51	14.11	43.63	5

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Lark Sparrow	SS-EC: East Canyon Pasture	2.07	53	1.01	4.47	11.1	5.39	23.98	4
Lark Sparrow	SS-HQ: Headquarters Pasture	2.4	95	0.99	9.86	2.11	0.87	8.68	1
Lark Sparrow	SS-JS: Jack Springs Pasture	1.19	48	0.69	2.42	18.74	10.9	37.92	6
Lark Sparrow	SS-LR: LR Pasture	4.84	40	3.79	7.94	91.3	71.36	149.75	36
Lark Sparrow	SS-ME: Meadow Pasture	0.85	99	0.28	2.99	2.37	0.79	8.38	1
Lark Sparrow	SS-RB: Round Butte Pasture	1.93	66	1.02	3.97	10.54	5.58	21.61	5
Lark Sparrow	SS-RI: Roman Inholding Pasture	0.85	101	0.28	2.86	2.05	0.68	6.93	1
Lark Sparrow	SS-RK: Roman Krafczik Pasture	17.52	41	14.2	28.59	112.49	91.18	183.55	42
Lark Sparrow	SS-WC: West Canyon Pasture	3.7	41	2.07	6.57	20.6	11.55	36.62	7
Lesser Goldfinch	SS-LR: LR Pasture	0.57	71	0.19	1.51	10.78	3.6	28.45	2
Lincoln's Sparrow	SS-BR: Brannigan Pasture	0.34	60	0.14	0.88	5.17	2.07	13.44	2
Lincoln's Sparrow	SS-EC: East Canyon Pasture	3.09	38	1.85	5.35	16.56	9.93	28.7	6
Lincoln's Sparrow	SS-JS: Jack Springs Pasture	0.13	82	0.07	0.46	2.08	1.04	7.27	1
Lincoln's Sparrow	SS-LR: LR Pasture	0.12	84	0.06	0.47	2.21	1.11	8.84	1
Lincoln's Sparrow	SS-RI: Roman Inholding Pasture	0.78	84	0.39	3.14	1.9	0.95	7.59	1
Lincoln's Sparrow	SS-SL: State Line Pasture	0.87	84	0.43	3.47	2.15	1.08	8.6	1
Lincoln's Sparrow	SS-WC: West Canyon Pasture	0.41	80	0.21	1.49	2.29	1.15	8.3	1
Loggerhead Shrike	SS-BE: Bernard Pasture	0.15	89	0.05	0.45	1.31	0.44	3.94	1
Loggerhead Shrike	SS-BR: Brannigan Pasture	0.21	75	0.09	0.47	3.14	1.35	7.18	2
Loggerhead Shrike	SS-EC: East Canyon Pasture	1.16	61	0.54	2.43	6.23	2.87	13.01	4
Loggerhead Shrike	SS-JS: Jack Springs Pasture	0.09	80	0.03	0.29	1.35	0.45	4.51	1
Loggerhead Shrike	SS-LR: LR Pasture	0.85	33	0.58	1.33	15.95	10.94	25.01	9
Loggerhead Shrike	SS-RB: Round Butte Pasture	0.62	64	0.27	1.44	3.37	1.5	7.87	3
Loggerhead Shrike	SS-RK: Roman Krafczik Pasture	0.68	55	0.3	1.53	4.35	1.93	9.83	2
Loggerhead Shrike	SS-WC: West Canyon Pasture	1.41	45	0.67	2.68	7.87	3.72	14.95	4
Long-billed Curlew	SS-HQ: Headquarters Pasture	0.19	115	0.05	0.8	0.17	0.04	0.71	1
Mallard	SS-JS: Jack Springs Pasture	0.18	121	0.05	0.84	2.87	0.75	13.11	1
Mallard	SS-LR: LR Pasture	0.22	151	0.07	1.03	4.2	1.4	19.44	3
Marsh Wren	SS-HQ: Headquarters Pasture	5.38	60	1.79	13.45	4.73	1.58	11.84	2
Mountain Chickadee	SS-LR: LR Pasture	0.18	85	0.09	0.74	3.47	1.73	13.86	1
Mourning Dove	SS-BE: Bernard Pasture	3.43	125	2.75	4.35	30.27	24.27	38.35	45

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Mourning Dove	SS-BR: Brannigan Pasture	1.76	107	1.42	2.3	26.9	21.77	35.28	42
Mourning Dove	SS-EC: East Canyon Pasture	9.08	102	7.74	10.87	48.67	41.49	58.24	68
Mourning Dove	SS-JS: Jack Springs Pasture	0.27	133	0.14	0.48	4.32	2.25	7.49	6
Mourning Dove	SS-LR: LR Pasture	6.29	111	5.63	7.08	118.62	106.17	133.49	157
Mourning Dove	SS-ME: Meadow Pasture	0.35	76	0.07	1.13	0.99	0.2	3.18	1
Mourning Dove	SS-RB: Round Butte Pasture	1.56	109	1.12	2.29	8.51	6.08	12.48	15
Mourning Dove	SS-RI: Roman Inholding Pasture	9.36	135	7.62	12.5	22.64	18.45	30.25	35
Mourning Dove	SS-RK: Roman Krafczik Pasture	6.42	124	5.38	8.11	41.24	34.51	52.06	52
Mourning Dove	SS-SL: State Line Pasture	2.27	136	1.33	3.64	5.63	3.3	9.02	7
Mourning Dove	SS-WC: West Canyon Pasture	4.28	116	3.35	5.8	23.84	18.65	32.33	32
Northern Flicker	SS-LR: LR Pasture	0.04	87	0.01	0.15	0.72	0.24	2.86	1
Northern Harrier	SS-JS: Jack Springs Pasture	0.07	55	0.03	0.16	1.05	0.42	2.46	2
Northern Harrier	SS-WC: West Canyon Pasture	0.08	94	0.02	0.28	0.46	0.12	1.57	1
Northern Mockingbird	SS-BR: Brannigan Pasture	0.06	52	0.03	0.14	0.92	0.46	2.1	2
Northern Mockingbird	SS-EC: East Canyon Pasture	1.24	28	0.83	1.8	6.66	4.44	9.62	11
Northern Mockingbird	SS-LR: LR Pasture	0.18	28	0.12	0.29	3.46	2.22	5.43	7
Northern Mockingbird	SS-RI: Roman Inholding Pasture	0.7	47	0.35	1.49	1.7	0.85	3.61	3
Northern Mockingbird	SS-RK: Roman Krafczik Pasture	0.93	26	0.62	1.36	5.97	3.98	8.71	10
Northern Mockingbird	SS-SL: State Line Pasture	0.49	56	0.19	1.16	1.22	0.48	2.88	2
Northern Mockingbird	SS-WC: West Canyon Pasture	0.09	82	0.05	0.3	0.51	0.26	1.65	1
Northern Rough-winged Swallow	SS-BE: Bernard Pasture	3.1	154	1.47	9.96	27.36	12.94	87.83	5
Northern Rough-winged Swallow	SS-BR: Brannigan Pasture	0.37	190	0.07	1.41	5.65	1.02	21.58	1
Northern Rough-winged Swallow	SS-JS: Jack Springs Pasture	0.91	130	0.33	3.33	14.28	5.22	52.25	3
Northern Rough-winged Swallow	SS-LR: LR Pasture	0.65	154	0.21	3.23	12.29	4.03	60.9	1
Northern Rough-winged Swallow	SS-RK: Roman Krafczik Pasture	2.2	162	0.68	7.77	14.15	4.39	49.87	1
Prairie Falcon	SS-JS: Jack Springs Pasture	0.04	89	0.01	0.13	0.64	0.16	2.08	1
Red-tailed Hawk	SS-BR: Brannigan Pasture	0.02	90	0.01	0.08	0.31	0.08	1.23	1
Red-tailed Hawk	SS-HQ: Headquarters Pasture	0.82	70	0.31	2.36	0.72	0.27	2.07	2
Red-tailed Hawk	SS-LR: LR Pasture	0.11	43	0.06	0.21	2.06	1.07	4.04	5
Red-tailed Hawk	SS-RK: Roman Krafczik Pasture	0.39	40	0.18	0.7	2.49	1.16	4.52	5
Red-winged Blackbird	SS-BE: Bernard Pasture	2.83	29	1.96	3.98	24.97	17.28	35.07	21

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Red-winged Blackbird	SS-BR: Brannigan Pasture	6.6	21	5.63	7.66	100.99	86.21	117.29	84
Red-winged Blackbird	SS-EC: East Canyon Pasture	0.53	60	0.19	1.21	2.85	1.04	6.47	2
Red-winged Blackbird	SS-HQ: Headquarters Pasture	62.8	26	50.09	79.19	55.26	44.08	69.69	41
Red-winged Blackbird	SS-JS: Jack Springs Pasture	7.43	22	6.26	8.75	116.71	98.33	137.4	89
Red-winged Blackbird	SS-LR: LR Pasture	0.39	39	0.22	0.64	7.26	4.15	12.04	6
Red-winged Blackbird	SS-ME: Meadow Pasture	16.52	25	12.84	21.11	46.24	35.95	59.11	30
Red-winged Blackbird	SS-SL: State Line Pasture	22.68	27	18.2	28.93	56.24	45.14	71.76	43
Red-winged Blackbird	SS-WC: West Canyon Pasture	0.87	48	0.39	1.66	4.84	2.15	9.27	4
Rock Wren	SS-BE: Bernard Pasture	0.71	28	0.46	1.12	6.23	4.05	9.88	8
Rock Wren	SS-LR: LR Pasture	1.12	17	0.87	1.43	21.15	16.45	27.01	28
Rock Wren	SS-RK: Roman Krafczik Pasture	3.24	18	2.46	4.24	20.78	15.78	27.21	26
Savannah Sparrow	SS-BE: Bernard Pasture	0.24	74	0.12	0.94	2.08	1.04	8.31	1
Savannah Sparrow	SS-BR: Brannigan Pasture	0.7	47	0.35	1.35	10.64	5.32	20.7	4
Savannah Sparrow	SS-HQ: Headquarters Pasture	15.55	47	7.07	31.5	13.68	6.22	27.72	3
Savannah Sparrow	SS-JS: Jack Springs Pasture	0.54	52	0.27	1.19	8.55	4.28	18.69	3
Savannah Sparrow	SS-LR: LR Pasture	0.12	87	0.06	0.48	2.28	1.14	9	1
Savannah Sparrow	SS-ME: Meadow Pasture	2.42	52	0.81	5.25	6.78	2.26	14.7	1
Savannah Sparrow	SS-SL: State Line Pasture	3.74	44	1.79	7.14	9.27	4.43	17.71	3
Savannah Sparrow	SS-WC: West Canyon Pasture	0.42	79	0.21	1.48	2.36	1.18	8.27	1
Say's Phoebe	SS-BE: Bernard Pasture	0.09	85	0.03	0.29	0.78	0.26	2.58	1
Say's Phoebe	SS-EC: East Canyon Pasture	0.79	45	0.42	1.42	4.26	2.27	7.59	5
Say's Phoebe	SS-HQ: Headquarters Pasture	3.18	46	1.62	6.52	2.8	1.43	5.74	3
Say's Phoebe	SS-LR: LR Pasture	0.66	27	0.45	0.95	12.51	8.41	17.99	13
Say's Phoebe	SS-RI: Roman Inholding Pasture	1.01	46	0.4	2.05	2.44	0.98	4.97	3
Say's Phoebe	SS-RK: Roman Krafczik Pasture	0.89	35	0.54	1.58	5.73	3.44	10.13	7
Say's Phoebe	SS-WC: West Canyon Pasture	0.69	42	0.37	1.33	3.84	2.07	7.42	4
Song Sparrow	SS-JS: Jack Springs Pasture	0.55	43	0.26	1.07	8.7	4.06	16.82	4
Spotted Towhee	SS-BE: Bernard Pasture	8.15	15	6.41	10.11	71.85	56.54	89.16	32
Spotted Towhee	SS-BR: Brannigan Pasture	5.07	15	3.98	6.26	77.6	60.89	95.82	31
Spotted Towhee	SS-EC: East Canyon Pasture	77.37	8	69.69	85.87	414.7	373.55	460.26	168
Spotted Towhee	SS-LR: LR Pasture	83.9	6	79.81	87.87	1581.45	1504.47	1656.36	645

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Spotted Towhee	SS-RB: Round Butte Pasture	0.23	84	0.11	0.91	1.24	0.62	4.96	1
Spotted Towhee	SS-RI: Roman Inholding Pasture	70.33	10	61.17	81.1	170.19	148.04	196.25	71
Spotted Towhee	SS-RK: Roman Krafczik Pasture	55.81	8	50.84	62.33	358.3	326.39	400.17	140
Spotted Towhee	SS-SL: State Line Pasture	4.98	35	2.8	8.72	12.36	6.95	21.63	5
Spotted Towhee	SS-WC: West Canyon Pasture	82.7	8	75.15	92.15	460.62	418.59	513.27	180
Swainson's Hawk	SS-BR: Brannigan Pasture	0.03	62	0.01	0.07	0.52	0.14	1.15	2
Thick-billed Longspur	SS-BR: Brannigan Pasture	4.89	31	3.86	7.25	74.87	59.15	110.98	24
Thick-billed Longspur	SS-JS: Jack Springs Pasture	43.72	33	39.67	66.53	686.44	622.81	1044.45	300
Thick-billed Longspur	SS-ME: Meadow Pasture	2.46	55	1.09	5.58	6.87	3.06	15.63	3
Thick-billed Longspur	SS-RB: Round Butte Pasture	0.28	79	0.14	0.99	1.54	0.77	5.4	1
Thick-billed Longspur	SS-RI: Roman Inholding Pasture	0.7	88	0.35	2.46	1.7	0.85	5.94	1
Thick-billed Longspur	SS-SL: State Line Pasture	2.33	61	1.16	6.1	5.77	2.88	15.12	3
Tree Swallow	SS-LR: LR Pasture	0.26	120	0.06	1.21	4.82	1.21	22.78	1
Turkey Vulture	SS-LR: LR Pasture	0.08	220	0.03	0.25	1.41	0.55	4.78	2
Vesper Sparrow	SS-BE: Bernard Pasture	37.69	15	34.81	41.02	332.42	307.04	361.8	277
Vesper Sparrow	SS-BR: Brannigan Pasture	12.84	16	11.61	14.31	196.52	177.81	219.11	159
Vesper Sparrow	SS-EC: East Canyon Pasture	3.63	25	2.59	4.71	19.43	13.88	25.23	14
Vesper Sparrow	SS-HQ: Headquarters Pasture	13.81	28	8.98	20.71	12.15	7.9	18.23	9
Vesper Sparrow	SS-JS: Jack Springs Pasture	5.28	16	4.49	6.19	82.82	70.53	97.24	61
Vesper Sparrow	SS-LR: LR Pasture	7.49	16	6.81	8.51	141.19	128.4	160.33	112
Vesper Sparrow	SS-ME: Meadow Pasture	5.72	24	3.95	8.09	16.02	11.07	22.65	10
Vesper Sparrow	SS-RB: Round Butte Pasture	24.06	18	21.35	27.6	131.13	116.37	150.43	128
Vesper Sparrow	SS-RI: Roman Inholding Pasture	4.34	27	2.96	6.2	10.5	7.16	15.01	10
Vesper Sparrow	SS-RK: Roman Krafczik Pasture	13.61	16	11.51	15.91	87.35	73.91	102.16	69
Vesper Sparrow	SS-SL: State Line Pasture	8.5	22	6.11	11.39	21.09	15.14	28.24	16
Vesper Sparrow	SS-WC: West Canyon Pasture	13.88	17	11.81	16.36	77.31	65.77	91.15	56
Virginia's Warbler	SS-LR: LR Pasture	1.64	43	0.77	3.22	30.84	14.61	60.78	4
Western Kingbird	SS-BR: Brannigan Pasture	0.16	70	0.05	0.49	2.46	0.8	7.55	1
Western Kingbird	SS-EC: East Canyon Pasture	0.2	110	0.08	0.97	1.09	0.43	5.18	1
Western Kingbird	SS-JS: Jack Springs Pasture	0.54	48	0.28	1.11	8.48	4.36	17.43	4
Western Kingbird	SS-LR: LR Pasture	0.16	61	0.07	0.45	3.09	1.29	8.48	2

Species	Stratum	D	% CV	LCL_D	UCL_D	N	LCL_N	UCL_N	n
Western Kingbird	SS-RB: Round Butte Pasture	0.43	83	0.13	1.27	2.36	0.69	6.9	2
Western Kingbird	SS-RK: Roman Krafczik Pasture	1.42	49	0.8	3.13	9.1	5.11	20.09	5
Western Kingbird	SS-WC: West Canyon Pasture	0.24	88	0.08	0.89	1.34	0.45	4.97	1
Western Meadowlark	SS-BE: Bernard Pasture	22.05	20	20.43	24.08	194.51	180.18	212.35	302
Western Meadowlark	SS-BR: Brannigan Pasture	22.39	20	21.2	23.92	342.82	324.6	366.19	515
Western Meadowlark	SS-EC: East Canyon Pasture	21.45	18	19.55	24.03	114.98	104.79	128.79	169
Western Meadowlark	SS-HQ: Headquarters Pasture	31.81	22	26.62	40.45	27.99	23.43	35.59	38
Western Meadowlark	SS-JS: Jack Springs Pasture	17.72	20	16.77	19.2	278.18	263.29	301.45	385
Western Meadowlark	SS-LR: LR Pasture	21.85	18	20.74	23.61	411.87	390.87	445.09	582
Western Meadowlark	SS-ME: Meadow Pasture	22.27	18	19.66	25.63	62.37	55.04	71.76	84
Western Meadowlark	SS-RB: Round Butte Pasture	25.69	19	23.62	28.28	140	128.72	154.12	237
Western Meadowlark	SS-RI: Roman Inholding Pasture	21.24	22	18.47	23.89	51.39	44.7	57.81	86
Western Meadowlark	SS-RK: Roman Krafczik Pasture	27.12	18	25.11	30.15	174.1	161.21	193.58	229
Western Meadowlark	SS-SL: State Line Pasture	19.98	20	17.42	22.76	49.55	43.2	56.44	74
Western Meadowlark	SS-WC: West Canyon Pasture	28.37	19	26.03	31.4	157.99	145.01	174.88	222
Western Wood-Pewee	SS-LR: LR Pasture	0.13	57	0.06	0.35	2.39	1.2	6.58	2
Western Wood-Pewee	SS-RK: Roman Krafczik Pasture	2.06	26	1.41	3.21	13.25	9.03	20.6	9
Wilson's Snipe	SS-BE: Bernard Pasture	0.3	36	0.16	0.52	2.65	1.4	4.56	7
Wilson's Snipe	SS-BR: Brannigan Pasture	0.18	33	0.1	0.3	2.8	1.6	4.63	7
Wilson's Snipe	SS-EC: East Canyon Pasture	0.1	71	0.02	0.27	0.51	0.09	1.45	1
Wilson's Snipe	SS-JS: Jack Springs Pasture	0.13	40	0.05	0.24	2.09	0.8	3.69	1
Wilson's Snipe	SS-ME: Meadow Pasture	0.52	49	0.21	1.1	1.44	0.59	3.09	1
Wilson's Snipe	SS-SL: State Line Pasture	0.67	41	0.3	1.24	1.66	0.75	3.07	3
Woodhouse's Scrub-Jay	SS-LR: LR Pasture	0.34	53	0.14	0.72	6.35	2.72	13.6	1
Yellow Warbler	SS-LR: LR Pasture	2.91	20	1.97	3.91	54.9	37.15	73.62	18
Yellow Warbler	SS-RI: Roman Inholding Pasture	0.89	87	0.22	3.1	2.14	0.54	7.5	1
Yellow Warbler	SS-RK: Roman Krafczik Pasture	0.69	62	0.2	1.86	4.4	1.26	11.94	2
Yellow-breasted Chat	SS-LR: LR Pasture	0.38	38	0.22	0.65	7.21	4.07	12.22	5
Yellow-breasted Chat	SS-WC: West Canyon Pasture	0.58	50	0.23	1.17	3.25	1.3	6.51	3