Density and Distribution of Breeding Grassland Birds on City of Fort Collins Properties in the Mountains to Plains Region of Northern Colorado

FINAL REPORT

2012

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Technical Report: I-NEOTROP-MTP-12-01

ROCKY MOUNTAIN BIRD OBSERVATORY

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***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 shared responsibility.*

RMBO accomplishes its mission by:

***Monitoring** long-term bird population trends to provide a scientific foundation for conservation action.*

***Researching** bird ecology and population response to anthropogenic and natural processes to evaluate and adjust management and conservation strategies using the best available science.*

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***Delivering** bird conservation at biologically relevant scales by working across political and jurisdictional boundaries in western North America.*

Suggested Citation:

Youngberg E.N. and Panjabi, A.O. 2012, *Density and Distribution of Breeding Grassland Birds on City of Fort Collins Properties in the Mountains to Plains region of Northern Colorado: Final Report. RMBO technical report I-NEOTROP-MTP-12-01. Rocky Mountain Bird Observatory, Brighton, CO, 36pp.*

***Cover Photo**:* Burrowing Owl (*Athene cunicularia*) in a prairie dog town on Meadow Springs Ranch. Photo taken by Erin Youngberg.

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EXECUTIVE SUMMARY

The Laramie foothills contain some of the last remaining high quality, extensive shortgrass prairie along the Colorado Front Range. The area has been identified by The Nature Conservancy, Colorado Parks and Wildlife, the US Forest Service, the US Fish and Wildlife Service and others as one of the highest priority conservation areas in the Shortgrass Prairie Bird Conservation Region. Partners in Colorado have been working since 2004 to protect this biological and scenic corridor stretching between the Rocky Mountains and the Great Plains through The Laramie Foothills Mountains to Plains (MTP) Project. In 2006 Rocky Mountain Bird Observatory partnered with the City of Fort Collins in an ongoing effort to aid conservation and management of these grasslands through grassland bird inventory and monitoring on 45,000 acres of city-owned properties in the MTP region. This report summarizes the past 7 years of monitoring activities, highlights our findings of 2012, and provides a synopsis of RMBO's recommendations made through participating in the Energy By Design technical team to minimize impacts from oil and gas development within the MTP area on the important wildlife resources found here.

This region supports breeding and migratory habitat for 21 high-priority grassland bird species including: Ferruginous Hawk, Swainson's Hawk, Golden Eagle, Burrowing Owl, Mountain Plover, Prairie Falcon, Lark Bunting, McCown's and Chestnut-collared Longspur, Vesper, Grasshopper, Lark and Brewer's Sparrows and Long-billed Curlew, in addition to other grassland obligate wildlife species.

During the 2012 nesting season we conducted avian point count surveys at 302 stations in the city-owned properties in Larimer and Weld Counties of northern Colorado. We surveyed 2,233 acres of prairie dog colonies on Meadow Springs Ranch (MSR), and Soapstone Prairie Natural Area (SPNA), as well as an area of roughly 1,494 acres of four-wing saltbush (*Atriplex canescens)* on Round Butte Ranch (RBR), Bernard Ranch (BE) and the newly acquired Bowes Homestead (BH). At each station we surveyed vegetation and recorded observations of other wildlife. During 44 survey days in 2012, we observed 4,707 individual birds of 42 species. We estimated densities of all common breeding bird species across the study area using point count data from 2006 through 2012, and post-stratified estimates by prairie dog colony habitat, saltbush habitat, other grassland habitats and year.

The most common birds within the 2012 study area were Horned Lark, Western Meadowlark, McCown's Longspur and Lark Bunting, which together accounted for 83% of all birds observed. We observed active nests of Ferruginous Hawk, Golden Eagle, Prairie Falcon, Burrowing Owl, Lark Bunting, Chestnut-collared Longspur, Mourning Dove, American Crow and American Kestrel. We also observed juveniles of Sage Thrasher, Loggerhead Shrike and Mountain Plover, confirming their breeding use of the area. We detected the presence of 10 mammalian species including pronghorn, black-tailed prairie dog, striped skunk, thirteen-lined ground squirrel, badger, black and white-tailed jackrabbits, mule deer, swift fox and coyote. The two reptilian species found within the study area were greater short-horned lizard and prairie rattlesnake. In order to sustain populations of these grassland-obligate species, management should strive to protect and enhance populations and habitat of vulnerable species, conserve and augment prairie dog populations, maintain a mosaic of grassland types and structural conditions, minimize disturbance from energy development, and maintain a low-level of human presence.

ACKNOWLEDGEMENTS

This project was funded by the Neotropical Migratory Bird Conservation Act (NMBCA #4846 and #5152). The City of Fort Collins Natural Resources Department also provided valuable in-kind assistance and matching support for this project. We thank our field biologists Erin Youngberg, Jeff Birek, Jora Fogg and Rob Sparks. Thanks also to data analysis technical assistance and review from Duane Pool, Greg Levandoski, Alberto Macias-Duarte and Jennifer Blakesley.

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INTRODUCTION

North American prairies are the most threatened and anthropogenically altered terrestrial ecosystem on the continent (Samson et al. 2004; Brennan et al. 2005). The primary threat to existing prairies is conversion to crop agriculture, as well as urban and suburban development (Samson et al. 2004). Birds are the most abundant vertebrates in grasslands (Kennedy et al. 2008), and grassland birds have shown the steepest declines in the last three decades compared to any other guild of birds (Smith and Lomolino 2004). Breeding grassland birds act as environmental indicators, as individual bird species are associated with specific habitat components within the larger grassland ecosystem (Browder et al. 2002). Monitoring avian populations in remaining North American prairies is important to understanding the overall health of grassland ecosystems and can directly contribute to the adaptive management of these habitats and the species that depend on them.

The goal of this ongoing project is to help managers conserve grassland bird populations and their habitats on City of Fort Collins properties in northern Colorado by better understanding the abundance, distribution and habitat requirements of breeding bird species on the properties. The objectives are to document migratory and breeding bird use of the project area, provide locations of sensitive bird species and monitor population levels of key species, particularly in response to management actions or threats. These properties support breeding populations of more than 21 high-priority grassland bird species recognized by Colorado Parks and Wildlife, the U.S. Fish and Wildlife Service, Partners in Flight, the U.S. Shorebird Conservation Plan, The Nature Conservancy, and other conservation groups. The study area comprises the southern end of the largest remaining contiguous shortgrass prairie in North America, stretching from northeastern Colorado to Alberta and Saskatchewan and east into Nebraska and the Dakotas, and thus presents an incredible opportunity for grassland biodiversity conservation.

METHODS

Study Area

We conducted the 2012 study on five City of Fort Collins (CFC) properties in Larimer and Weld counties of northern Colorado that comprise roughly 45,000 acres of shortgrass prairie and rolling foothills: Soapstone Prairie Natural Area(SPNA), Meadow Springs Ranch (MSR), Round Butte Ranch(RBR), Bernard Ranch (BE), and the Bowes Homestead (BH) (Appendix A). SPNA is dominated by native shortgrass prairie with rolling hills, wide shallow washes, and abrupt rocky outcroppings with scattered prairie dog colonies throughout. Meadow Springs Ranch has riparian and cliff areas bordered by plains cottonwood (*Populus deltoides*) in the northern Lonetree pastures, rolling hills spotted with four-winged saltbush (*Atriplex canescens*) in the Lewis and Benson pastures, tall grass ranchland in the Meadow pasture, and an extensive gently sloping prairie dog colony in the southern Bulger pastures. Round Butte Ranch has two large buttes in the middle of the property surrounded by mountain mahogany (*Cercocarpus montanus*) which transitions to saltbush. Yucca (*Yucca* spp.) are the next most abundant ground cover, and there are several weathered sandstone outcroppings throughout the property. Bernard Ranch is dominated by saltbush and rabbitbrush (*Chrysothamnus* spp.), with steep and branching drainages running north to south where isolated patches of cottonwood and willow (*Salix* spp.) grow.

Our point counts on SPNA and MSR were limited to areas of prairie dog colony habitat (PDCH) using spatial data provided by CFC Natural Resources Department of prairie dog colony habitat that

was active in the fall of 2011. During point counts in the field new areas of PDCH that had been created during the winter were encountered, and if a point was within 200m of an active burrow it was considered to be within PDCH. Point count surveys were also conducted in two large patches of four-wing saltbush on RBR, BH and BE delineated using vegetation information from the City of Fort Collins, SW-REGAP GIS information and ground-truthing.

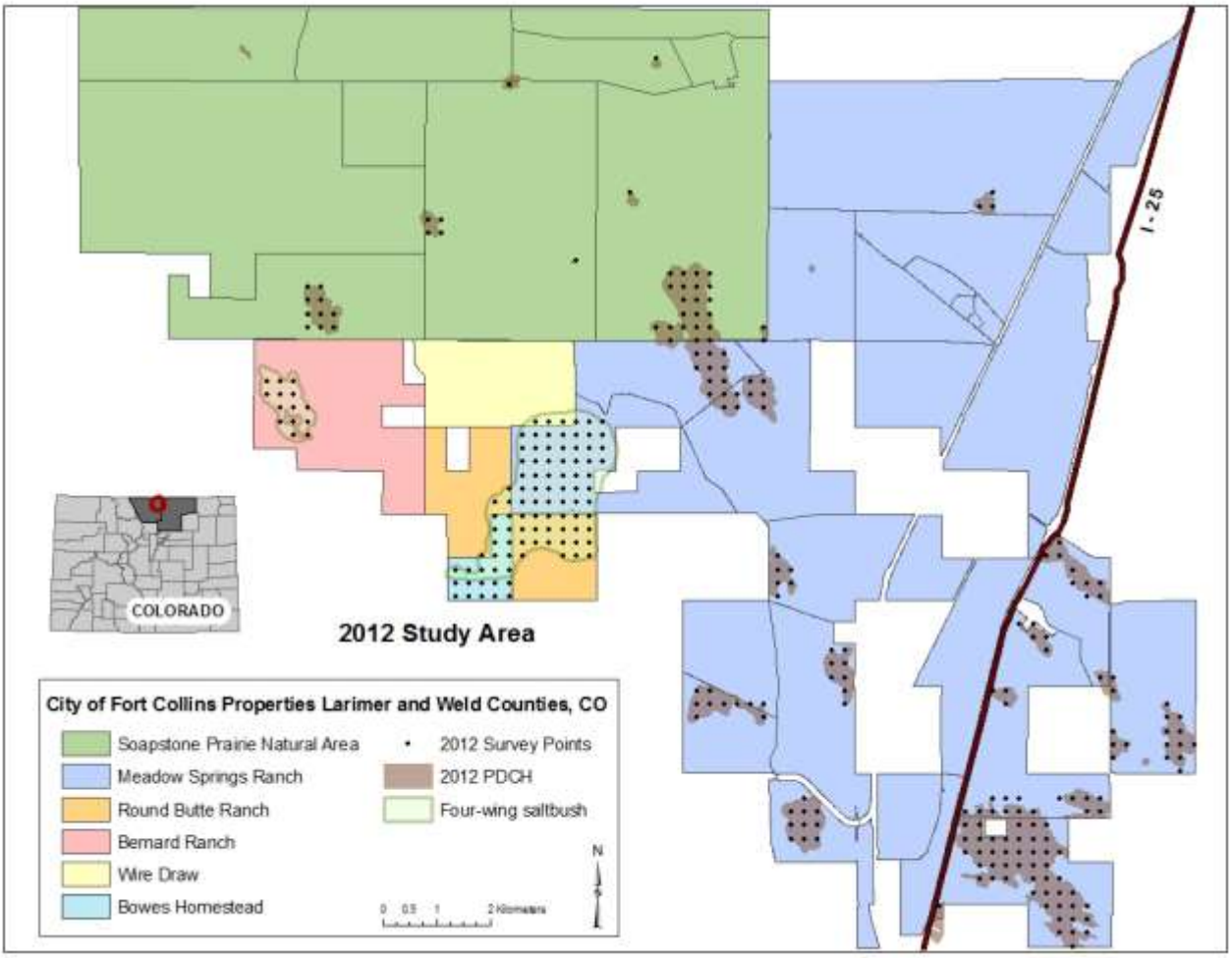

Figure 1: Study area and point count stations in 2012 on City of Fort Collins properties in the MTP region of Larimer and Weld counties, Colorado.

An episode of sylvatic plague significantly decreased the black-tailed prairie dog (*Cynomys ludovicianus*) population in 2008, and successful efforts have been made by the City of Fort Collins and Colorado Parks and Wildlife to encourage re-colonization. There were roughly 991 acres of PDCH in 2011 and 2,233 acres of PDCH in 2012; an increase of 1,242 acres. The most notable expansion/re-colonization has occurred in the prairie dog colony in south-eastern SPNA in the Jack Springs pasture crossing into the Butte pastures of MSR, the eastern-most colony in Carr pasture, and a newly discovered colony in Upper Barton pasture. All other existing colonies showed some degree of expansion (Fig 2).

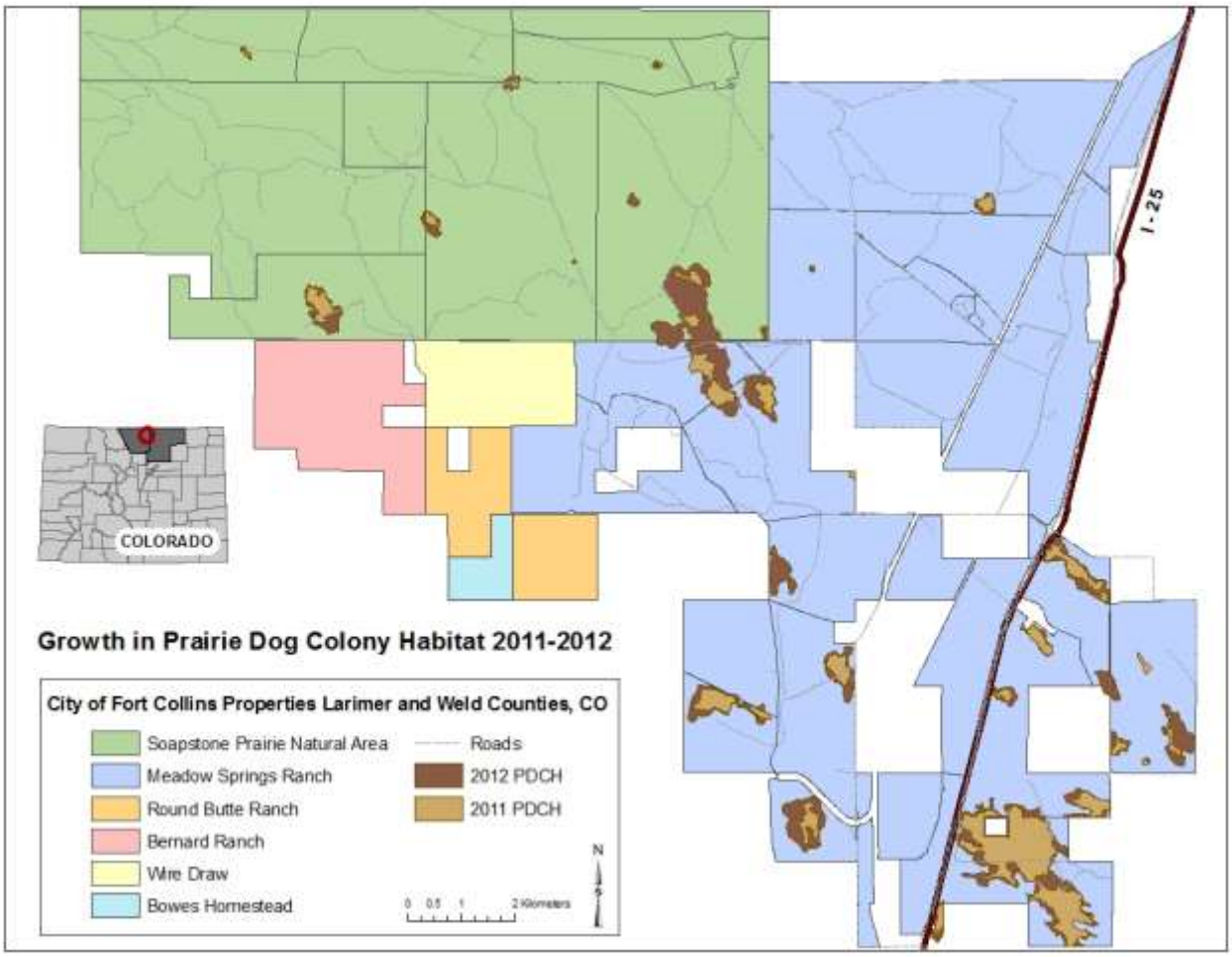

Figure 2: Growth in prairie dog colony habitat extent from 2011 (991 acres) to 2012 (2,233 acres) on Soapstone Prairie Natural Area and Meadow Springs Ranch in Larimer and Weld counties, Colorado.

Avian Point Count Surveys

We utilized a grid of point count stations used to survey the properties since 2006 and used Arc Map 9.3.1 to identify 302 point count stations in the targeted habitats in 2012, each 250 meters apart. There were 194 point count stations in PDCH and 108 points in four-wing saltbush. The entire Bowes Homestead (BH) was surveyed as this was the first year surveying the property and a thorough inventory was desired. The points surveyed on BH were dominated by saltbush habitat and were categorized as such. Points in PDCH were surveyed earlier in the season between 16 April and 1 June 2012 to increase detectability of the early nesting species, but we only analyzed point data for other species between 14 May and 6 July 2012 to eliminate migrating individuals from the analysis that were also using PDCH in late April and early May. We were primarily concerned with documenting breeding bird use. Each point count station was surveyed twice (Table 1).

Table 1: Number of point count stations surveyed, and survey effort (point-visits) in each year on City of Fort Collins properties in the MTP region for years 2006-2012.

Year	Habitat Type						Total	
	PDCH		Saltbush		Other			
	# points	Effort	# points	Effort	# points	Effort	# points	Effort
2006	64	64	0	0	736	736	800	800
2007	58	58	88	88	591	591	737	737
2008*	130	165	64	64	536	550	730	779
2009	307	307	141	141	721	721	1169	1169
2010	296	296	16	16	96	96	408	408
2011°	103	482	0	0	428	891	531	1373
2012	194	388	108	216	0	0	302	604
Total	**1152**	**1760**	**417**	**525**	**3108**	**3585**	**4677**	**5870**

* In 2008, 49 points in an area targeted for potential energy development were surveyed twice, 35 points in PDCH and 14 points in 'Other' (see data and results in Panjabi et al 2008).

° In 2011, PDCH points had 4 visits, a burn site and a corridor with high energy development potential were categorized as 'Other' and had multiple visits (4 in burn site, 2 in corridor) (see data and results in Youngberg et al. 2011).

Point count surveys started one half-hour before sunrise and ended at 11 a.m., often earlier. We navigated to each point count location 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 day's point counts. All GPS data was logged in Universal Transverse Mercator (UTM) North American Datum 1927. At each station, we conducted a 5-minute point count survey consisting of five consecutive 1-minute intervals. This protocol, which is described more fully by Hanni et al. (2009), uses Distance sampling (Buckland et al. 2001) with removal modeling (Farnsworth et al. 2002) to allow for incorporating detection probability into density estimation. For each bird detected, observers recorded species, sex, how it was detected (call, song, visual, wing beat, other), distance from observer, and the 1-minute interval in which it was detected. We measured distances using a Nikon ProStaff 550 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 including mammals and reptiles.

Habitat Surveys

After completing each point count survey we performed a rapid habitat survey at each point by estimating several vegetation parameters. Within 25 m of each point we visually estimated percent cover of grasses, forbs, bare ground, exotic plants, and 'other cover' to the nearest 1%. 'Other cover' included cactus, low woody plants, rock, and other minor ground cover types. Also within this radius we estimated average grass height by assigning it to one of five categories: (1) ≤ shoe sole height, (2) ankle height, (3) mid-calf height, (4) knee height, and (5) mid-thigh height. Within 100 m of each station we documented shrub and over story tree species and estimated percent cover (to nearest 1%) and average height of each. We recorded whether point count stations in PDCH were 'active' or 'inactive' based on the detection of at least one prairie dog within 100 m or other visible sign of active prairie dog use.

Analyses

We estimated bird species density using Program Distance 6.0 release 2 (Thomas et al.). We used Half-normal cosine, Hazard-rate cosine, and Uniform cosine detection function models to determine the best fit model for each species. We then used Goodness-of-fit tests to determine truncation points in each species dataset to eliminate outliers (generally the furthest 5-15% of observations) and improve model performance, as recommended by Buckland et al. (2001). We used Akaike's Information Criterion (AIC) to select among competing models of detectability of each species (across all strata). In this report, (n) denotes the number of detections used to estimate density after truncation.

For estimating bird densities we pooled all point count data from 2006 through 2012 to generate species-specific detection functions, and post-stratified estimates by habitat type and year (because the effort differed by habitat type in each year). Although species' density estimates calculated with less than 75 observations may be unreliable representations of true population densities (Buckland et al. 2001), we present estimates for all species with $n \geq 60$, and for high-priority species with fewer observations. Many species with relatively few observations are low-density species of high conservation interest, and having even rough estimates of density in a comparable format to other species, along with associated measures of error, can aid in the conservation and management of these species. Nonetheless, we urge that caution be used in interpreting estimates derived from relatively few observations, and that special attention be paid to %CV and confidence limits.

RESULTS

Avian Surveys

From 2006 to 2012 we detected 55,534 birds during point counts, and observed 119 species. In 2012 we detected 4,707 birds during point counts, and observed 42 species within the study area (Appendix B & C). Some species of concern, such as Long-billed Curlew, mainly use the study area during migration, when they can be locally common, especially in prairie dog colonies. Several species were detected within the study area outside of our formal survey efforts, including American Pipit, Brown Thrasher, Spotted Towhee, and Great Blue Heron. We observed a pre-migratory staging area for Mountain Plovers in the South Bulger pasture of Meadow Springs Ranch near the Ferret Center in late July 2011 and again in August 2012.

Bird Density in Prairie Dog Colonies

Areas of PDCH include both active and recently inactive prairie dog colony status, as recently inactive colonies still can provide habitat for bird species dependent on PDCH. In 2012 we detected 36 bird species in PDCH, 15 of them priority species (Appendix B). We analyzed six species and compared densities from 2006 through 2011 to estimates in 2012. All species show lower densities in 2012 except Mountain Plover and Burrowing Owl (Table 2).

Table 2: Breeding bird species densities (individuals/ km^2) in Prairie Dog Colony Habitat on City of Fort Collins properties in Larimer and Weld counties, northern Colorado.

Species	Year	Density	%CV	LCI	UCI	n
Burrowing Owl	2006-2011	0.83	10.48	0.68	1.03	68
	2012	0.92	25.16	0.55	1.53	24
Mountain Plover	2006-2011	0.83	12.88	0.64	1.06	73
	2012	0.87	24.13	0.53	1.41	27
McCown's Longspur	2006-2011	111.88	3.27	104.93	119.29	2128
	2012	46.54	16.42	33.77	64.14	390
Horned Lark	2006-2011	192.88	3.82	178.97	207.88	3387
	2012	97.40	14.73	73.07	129.82	915
Long-billed Curlew	2006-2011	0.30	22.87	0.19	0.48	25
	2012	0.08	114.65	0.00	3.91	2
Western Meadowlark	2006-2011	17.97	3.99	16.61	19.43	2171
	2012	11.96	12.67	9.34	15.32	552
Ferruginous Hawk	2006-2011	0.45	29.6	0.25	0.82	16
	2012	0.16	471.71	2.68E-11	1.01E+09	2

Mountain Plover Staging Area

Outside point-count survey efforts, three separate groups of plovers were observed in the North Bulger pasture near the U.S. Fish and Wildlife Service Black-footed Ferret Center on MSR using an area of PDCH for pre-migration staging: one group of 6 on 25 July 2011 and two groups of 4 or more on the morning of 10 Aug 2012 (Figs 3 & 4). The staging area perimeters were determined using the GPS tracking feature to walk around the extent of where the individual groups of birds were observed.

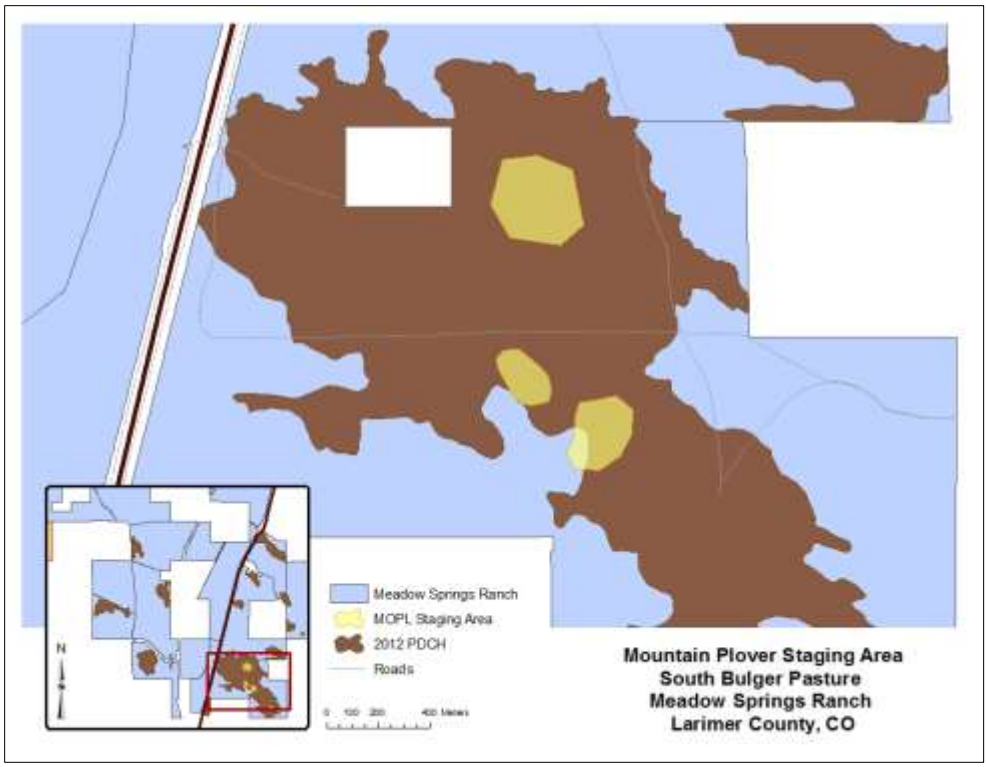

Figure 3: Mountain plover pre-migration staging area on City of Fort Collins Properties in Larimer County, Colorado.

Nine Burrowing Owl nests were recorded during point count surveys in 2012. To confirm the use of a burrow as a nest, we inspected the burrow entrance and surrounding mound for feathers, owl feces, discarded bones, and owl pellets (Figs 4 & 5). Eight of the nine nests detected occurred on prairie dog towns of less than 150 acres.

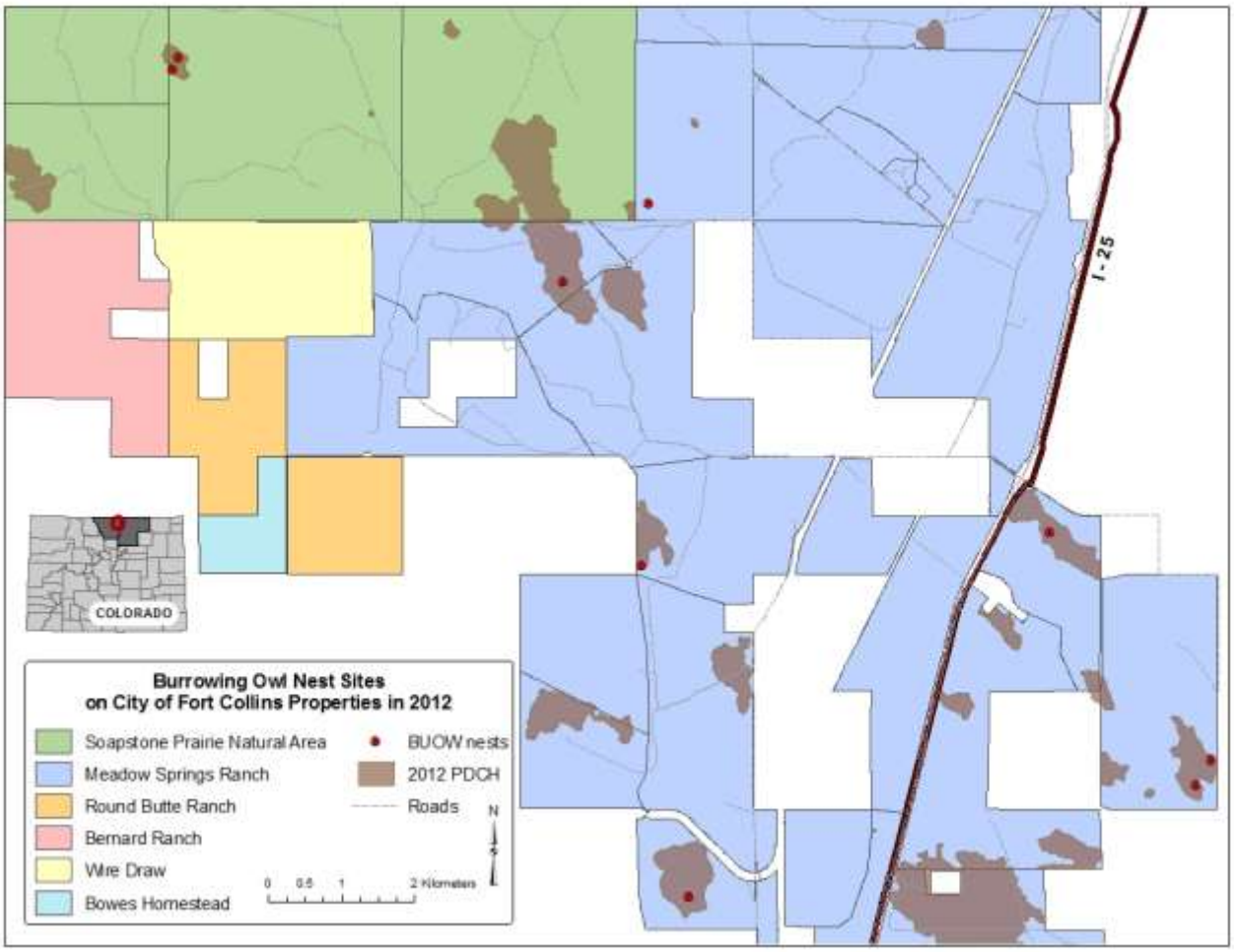

Figure 4: Locations of Burrowing owl nests on City of Fort Collins properties in 2012

Figure 5: A Burrowing Owl pair on a nest in the North Butte pasture of Meadow Springs Ranch.
Photo by E. Youngberg

Bird Density in Saltbush

We detected 57 bird species in the saltbush habitat from 2006-2012, 12 of them species of special concern (Appendix C). Densities of six shrubland obligate species were analyzed using data from years with adequate survey effort in shrubland habitat (2008, 2009, 2010, and 2012) and three of those species were determined to favor saltbush; Brewer's sparrow, Lark Bunting, and Vesper sparrow (Table 3 & Fig. 6).

Table 3: Density (birds/ km^2) comparison of three species that prefer saltbush habitat in the MTP region. (Other cover = Rabbitbrush, Yucca, Mountain Mahogany, Skunkbush Sumac, Ribes spp., Kotia, Snowberry, Sagebrush, and Willow).

		Density	% CV	LCI	UCI
Brewer's Sparrow	PDCH	3.7	95	3.1	4.4
	Saltbush	53.9	9.3	44.9	64.9
	Other	25.78	18.6	21.5	30.9
Lark Bunting	PDCH	4.59	4.1	4.2	4.9
	Saltbush	88.57	4.4	81.2	96.6
	Other	71.99	4.4	66.4	78.1
Vesper Sparrow	PDCH	2.67	6.7	2.3	3
	Saltbush	14.06	6.7	12.3	16
	Other	9.37	13.4	8.2	10.7

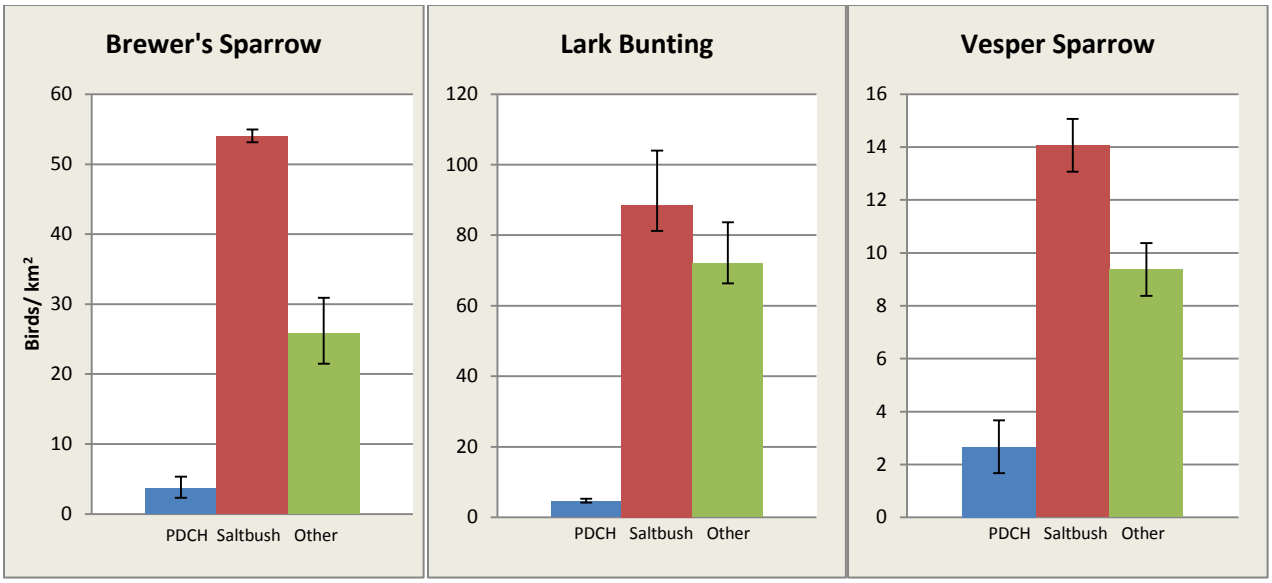

Figure. 6: Density comparison of three species that prefer saltbush habitat in the MTP region. (Other cover = Rabbitbrush, Yucca, Mountain Mahogany, Skunkbush Sumac, Ribes spp., Kotia, Snowberry, Sagebrush, and Willow).

Vegetation

Grass was the dominant ground cover type in the 2012 study area, across both PDCH and Saltbush habitats, followed by bare ground (Fig. 7). 'Other' cover consisted of cactus, woody vegetation, forbs, cow pies, litter, rocks, etc. Average grass height was comparatively short in both habitat types. The dominant grass height in PDCH was category 1 (shoe sole height) and the dominant grass height in Saltbush was category 2 (ankle height). The edges of PDCH had a high occurrence of grass in height category 3 (mid-calf height) (Fig. 7).

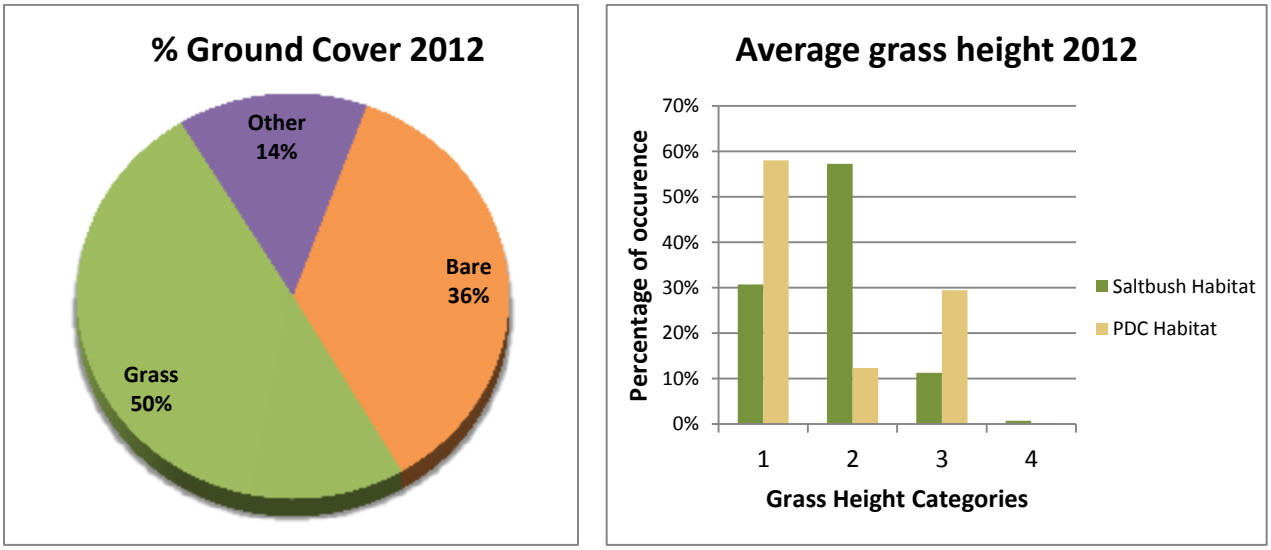

Figure 7: Average % ground cover and % occurrence of grass height categories in the 2012 study area.

Saltbush percent cover was recorded at each survey point location and the cover categories were fairly evenly distributed. Of the saltbush habitat, the most widely available category is 0-5% shrub cover. The least available category is 6 - 20% shrub cover (Fig 8).

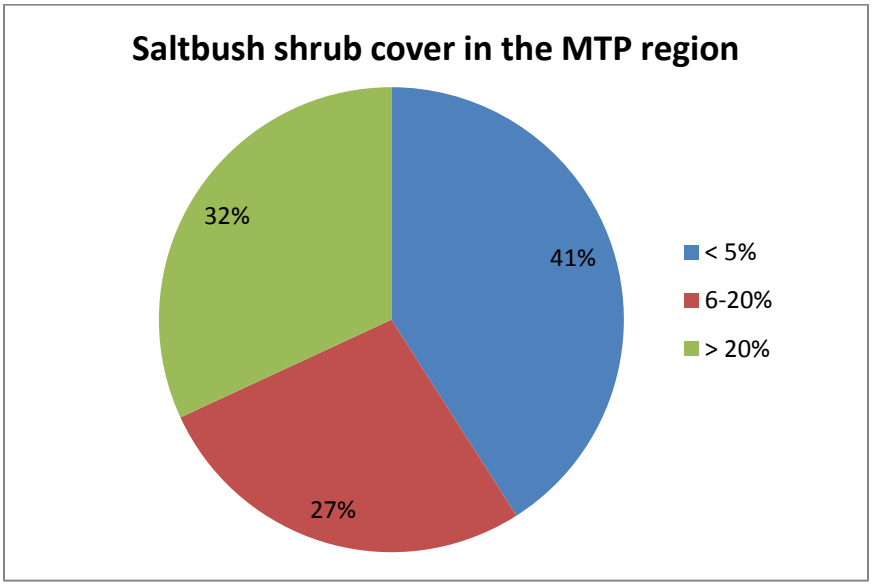

Figure 8: Percent cover categories of saltbush at point count stations

Other Wildlife

We observed several mammal species on the CFC properties. Pronghorn Antelope (*Atilocapra americana*) were the most common native ungulate and were observed almost daily. Two Badgers (*Taxidea taxus*) were seen in the North Bulger pasture actively digging burrows (Fig. 9), and one was observed in Jack Springs pasture. We regularly encountered Black-tailed Jackrabbits (*Lepus californicus*) and a few White-tailed Jackrabbits (*L. townsendii*), as well as Cottontail rabbits (*Lepus sylvaticus*). Thirteen-lined ground squirrels (*Ictidomys tridecemlineatus*) were abundant, as were coyotes (*Canus latrans*) and Mule deer (*Odocioleus hemeonus*). A lone swift fox (*Vulpez velox*) was identified in Jack Springs pasture. There were fewer observations of greater short-horned lizards (*Phrynosoma hernandesi*) than have been noted in previous years. A prairie rattlesnake (*Crotalus* viridis) was encountered in the North Bulger pasture, and an unidentified snake carcass was discovered in Lower Barton pasture.

Figure 9: Badger observed in the S. Bulger pasture of MSR on 10-Aug-2012. *Photo by E. Youngberg*

DISCUSSION

The Mountains to Plains region supports a rich and diverse shortgrass prairie fauna, including more than 21 grassland bird species that have been identified as high concern for conservation and are declining or extirpated in much of their range. Due to the unique geographical location in the transition zone between the southern Rocky Mountains and the Western Great Plains, the properties surveyed provide not only high-quality breeding habitat for grassland birds, but also critical migratory stopover habitat (Sparks et al. 2007). Appropriate conservation and management of these areas can play an important role in sustaining regional populations of grassland birds and other wildlife.

In the first years following the plague event of 2008 we focused survey effort on PDCH to monitor the effect on the birds breeding here. Although our PDCH survey data do not include all PDCH areas prior to 2009, they indicate that Mountain Plover and Burrowing Owl numbers decreased sharply after the plague event and have since increased. Our calculations show that plover density has increased from 0.46 birds/ km^2 in 2008 & 2009 global estimates (Panjabi 2009) to 0.87 birds/km^2 in 2012. Burrowing owl density has almost quadrupled from 0.22 birds/km^2 in 2008 & 2009 (Panjabi 2009) to 0.92 birds/km^2 in 2012.

Even with this increase in numbers, continued regular monitoring of prairie dog-dependent bird species within the study area will allow managers to identify and respond to conservation concerns and guide management actions in a time-sensitive manner that increases the probability of success in conserving these species and their habitat (Panjabi et al. 2009).

Management Recommendations

The shortgrass prairie habitats of Meadow Springs Ranch and Soapstone Prairie Natural Area were historically maintained by a combination of ungulate grazing (e.g. bison and pronghorn), small herbivore activity (e.g. prairie dogs), drought and fire. These ecological conditions result in a mosaic of vegetation structures, composition, and ecosystem dynamics (Winter et al. 2002; Smith and Lomolino 2004).

Figure 10: A Mountain plover observed on the staging area in S. Bulger pasture of MSR 8/10/2012. *Photo by E. Youngberg*

Prairie dogs are a keystone species in prairie ecosystems, meaning their presence and activity is essential to structuring and maintaining the habitat which sustains other species. Prairie dogs are also an important food source to predatory birds such as Ferruginous Hawk and Golden Eagle (Giovanni et al. 2007). Long-term prairie dog colony stability leads to significant changes in plant community composition with elevated levels of bare soil, forbs and reduced cover (Augustine, et al. 2007), preferred conditions for nesting habitat for several shortgrass obligate species such as Burrowing Owl, Mountain Plover (Fig. 10), McCown's Longspur and others (Kennedy et al. 2008). However, we found McCown's Longspur density to be higher outside of PDCH, in relatively flat, short grass areas with patchy bare soil and low to zero shrub cover.

An effort by the City of Fort Collins Natural Areas program to maintain shortgrass habitat and encourage prairie dog expansion by burning previously inhabited prairie dog colony areas has been

successful in the Jack Springs pasture of SPNA. Prairie dogs have re-colonized the 300+ acre colony they inhabited in pre-plague years and we observed the return of mountain plovers to the burn area in both 2011 and 2012.

Although moderate to intense grazing has been thought to create ideal nesting habitat for the mountain plover (Augustine et al. 2008), moderate grazing alone may not be an effective substitute for prairie dogs and fire in creating plover habitat (Augustine 2012). Augustine found that plovers showed an increase in density on prescribed burn sites and areas grazed by prairie dogs in the Pawnee National Grasslands compared to areas with moderate grazing by cattle. The continued use of fire as a tool is recommended to encourage prairie dog town expansion and create plover nesting habitat.

Burrowing Owl density has been positively linked to prairie dog colony size (Desmond et al. 2000). Desmond et al. suggested that owls' vulnerability to predators like badgers & Golden Eagles may be reduced by the abundance of alternative prey species. Desmond et al. also found owls nesting in clusters, thereby possibly benefitting from a larger colony with more burrows to choose from. However, these observations are inconsistent with what we have found in the MTP region. We found that Burrowing Owls tended to select smaller prairie dog colonies for nesting in 2012. A simple 2-tailed T-Test analysis showed no significant difference ($P = .764$) in the prairie dog colony size available and size of the prairie dog colonies observed to have nesting burrowing owls. However, more research and analysis is needed to better understand site selection and colony size preference by burrowing owls.

Studies in Colorado have shown that Mountain Plovers need 25-50 acres to forage and at least 70 acres of suitable habitat to raise their young (May, 2001). With that in mind, and our observations of Burrowing Owl site preference, we recommend maintaining both large and small prairie dog colony sizes.

Management strategies utilizing fire, grazing, and conservation of native species like prairie dogs to alter vegetation structure at a pasture-level scale, will generate heterogeneity of habitat and a shifting mosaic in the entire ecosystem (Fuhlendorf et al. 2006). Encouraging discrete spatial and temporal disturbances in grassland habitat can serve to increase biodiversity of the ecological system as a whole.

Energy By Design – Best Management Practices

Organized and led by The Nature Conservancy, the Energy by Design (EBD) Technical Team met once in 2011 and three times in 2012 to help the Colorado State Land Board develop a plan to identify strategies that minimize, mitigate, and avoid potential impacts from oil and gas development on the sensitive flora and fauna in Soapstone Prairie Natural Area and Meadow Springs Ranch. Based on existing research, literature and data collected by RMBO in the MTP area since 2006, RMBO compiled and submitted the following recommendations and Best Management Practices for sensitive bird species in the region regarding energy development. Although we were successful in increasing the level of protection afforded to these species, The Nature Conservancy stopped short of fully adopting these recommendations. However, we feel that wherever possible it would be prudent to follow these guidelines to ensure the long term persistence of populations of these sensitive and declining species in the MTP area. The species targeted for avoidance, minimization, and/or mitigation by the EBD project were: Mountain Plover, Burrowing Owl, Chestnut-collared Longspur, McCown's Longspur, and Lark Bunting. Before any development activity takes place, RMBO recommends that species-specific surveys be conducted to determine presence and location of these sensitive species.

Mountain Plover:

Mountain Plover was previously listed as an Endangered Species Candidate by The US Fish and Wildlife Service, currently listed as a Bird of Conservation Concern by the U.S. Fish and Wildlife Service and the United States Shorebird Conservation Plan, and is considered a Species of Special Concern by the Colorado Parks and Wildlife. Their global population is estimated at 15,000 - 20,000 individuals, with more than 60% of the global breeding population believed to breed in Colorado (CPW 2012). The following recommendations will help maintain known key areas of concentrated Mountain Plover breeding habitat and large habitat complexes within the MTP area:

- *No surface occupancy* within ½ mile of suitable nesting habitat and known aggregation areas (BLM 2005). The amount and nature of ground disturbing activities should be avoided to reduce the abandonment of suitable nesting habitat (e.g. prairie dog colonies, agricultural fields, and grassland sites) with known occurrence of breeding mountain plover or post-breeding flocks (Lock 2010).
- Construction of ancillary facilities (e.g.; compressor stations, processing plants, etc.) should be avoided within ½ mile of suitable nesting habitat and known aggregation areas (BLM 2005).
- Avoid constructing roads through plover breeding and nesting habitat when possible, as vehicles can be a source of collision-caused mortality to adult and juvenile plovers (Andres & Stone 2009). Speed limits should be posted at 25 mph on dirt surface resource roads, and 35 mph on local county dirt surface roads during the brood-rearing period (June 1 to July 31) (BLM 2005).
- If possible, work schedules and shift changes should be set to avoid the periods from one-half hour before sunrise to 9:00am and from 5:00pm to one-half hour after sunset from June 1 to July 31, when Mountain Plovers and other wildlife are most active (BLM 2005).

Because Mountain Plover populations have shown strong fidelity to traditional nesting sites in the MTP region, surface-disturbing activities occurring outside of the nesting period of 10 April - 10 July have the potential to permanently damage or destroy occupied Mountain Plover nesting habitat, thus reducing the carrying capacity of the landscape for the species. RMBO's recommendations followed the BLM's guidelines but modified the no surface occupancy on suitable habitat to no surface occupancy on occupied habitat to allow more opportunities for energy development while ensuring no loss of existing plover populations.

Burrowing Owl:

The Burrowing Owl is listed as Bird of Conservation Concern by the US Fish and Wildlife Service, and a Colorado Threatened Species (USFS 2003, CPAW 2012). Burrowing Owl densities and numbers are highest on prairie dog colonies, which provide ideal nesting habitat in short vegetation, and high prey diversity (Klute et al. 2003). There are federal laws and fines for killing Burrowing Owls, but no legal implications for destruction of habitat (USFS 2003). Burrowing Owls have a mean home range of approximately 2.4 km^2 (Haug 1993). The following recommendations will help maintain Burrowing Owl populations in the MTP area:

- *No surface occupancy* within 150m of occupied nesting burrows, and maintain a buffer of 300m, within which insecticide applications, rodent control, and other human disturbances should be limited (VerCauteren 2010).
- Avoid development in prairie dog colonies, both active and inactive (VerCauteren 2010) as Burrowing Owls exhibit high site fidelity, reusing burrows year after year (Rich 1984, Feeney 1992). Burrowing owls may occupy abandoned prairie dog colonies for several years following the loss of prairie dogs (Klute et al. 2003). A site should be assumed occupied if at least one burrowing owl has been observed occupying a burrow there within the last three years (Rich 1984).
- Avoid constructing roads through owl breeding and nesting habitat when possible, as roads and other infrastructure associated with [energy] developments may act as corridors for generalist predators which may prey upon Burrowing Owls and/or nests (VerCauteren 2012). Owls tend to be attracted to fragmented features and are particularly susceptible to collisions with moving vehicles (Haug 1993).
- Traffic should be minimized by car-pooling and organizing work activities to minimize trips on dirt surfaced roads during the brood rearing period (June 1 to July 31) (BLM 2005).
- Speed limits should be posted at 25 mph on dirt surface resource roads, and 35 mph on local county dirt surface roads If possible, work schedules and shift changes should be set to avoid the periods from one-half hour before sunrise to 9:00am and from 5:00pm to one-half hour after sunset when [owls] and other wildlife are most active (BLM 2005).

Any efforts to eradicate prairie dogs or destroy abandoned prairie dog towns should occur outside period of 15 March – 31 October when Owls may be present (CDOW 2008). Conserving existing prairie dog towns is more favorable and cost effective than creating new ones. (VerCauteren 2010). RMBO recommended no surface occupancy in known nesting and occupied areas.

Chestnut-collared Longspur:

Chestnut-collared Longspur is listed by the US Fish and Wildlife Service as a Bird of Conservation Concern (USFWS 2008), a Partners in Flight species of high Tri-National concern (Berlanga et al. 2010), and is considered "Near Threatened" under the IUCN 'Red List of Threatened Species' (Birdlife International 2012). Research by Linnen (2008) found that Chestnut-collared Longspurs are sensitive to oil & gas developments. The following recommendations will help maintain known aggregation, feeding, and breeding areas of Chestnut-collared Longspur in the MTP area:

- Maintain a buffer of at least 100 m from occupied habitat as Longspurs have been found to avoid shallow gas and traditional well developments within 100 m (Linnen 2008).
- Avoid constructing roads through known breeding and nesting habitat when possible, as roads and other disturbances created by building infrastructure associated with [energy] development causes an "edge effect" that can increase brood parasitism by Brown-headed Cowbirds (Linnen 2008). According to a study in Canada by Sutter et al. 2000, longspurs also decrease in abundance near roads and trails.
- Enforce a seasonal noise limitation to 49 dBA or less from 1 April through 30 June to reduce the effects of continuous noise levels within breeding habitat of songbird species that rely on aural cues for successful breeding (WY Game & Fish Dept. 2010, Inglefinger 2001).
- Cover or net all waste ponds to eliminate possible use as a water source by songbirds (Esmoil 1991, Esmoil and Anderson 1995).

Male Chestnut-collared Longspurs need territories of 0.4 - 0.8 hectares (~1 - 2 acres) and show strong philopatry to their breeding sites (Sedgewick 2004). Conserving contiguous areas of level mid-to-shortgrass native shortgrass prairie would benefit the preservation of this species' limited breeding habitat in the MTP area. RMBO recommended no surface occupancy in known breeding sites with a 150m buffer, along with the seasonal limitations.

McCown's Longspur:

McCown's Longspur is considered a Colorado Species of Greatest Conservation Need (SGCN) in the State Wildlife Action Plan (CDOW 2006). The following recommendations will help maintain suitable breeding areas and large habitat complexes for McCown's Longspur in the MTP area:

- Recommended 300 m avoidance buffer from known breeding and aggregation sites as observed by Linnen 2008.
- Enforce a seasonal noise limitation to 49 dBA or less from 1 April through 30 June to reduce the effects of continuous noise levels within breeding habitat of songbird species that rely on aural cues for successful breeding (WY Game & Fish Dept. 2010, Inglefinger 2001).
- Cover or net all waste ponds to eliminate possible use as a water source by songbirds (Esmoil 1991, Esmoil and Anderson 1995).

RMBO recommended restricted surface occupancy in the core occupied areas, plus 150m buffer along with the seasonal limitations.

Lark Bunting:

According to BBS and CBC data, Lark Bunting populations have shown a 50% loss since the mid-1960s (Berlanga et al. 2010). They are on the USFWS list of Birds of Conservation Concern (USFWS 2008), and Colorado's list of Species of Greatest Conservation Need (SGCN) in the State Wildlife Action Plan (CDOW 2006). The following recommendations will help maintain suitable breeding areas and large habitat complexes for the Lark Bunting in the MTP area:

- Recommended 150m avoidance buffer from known breeding and aggregation sites (RMBO unpublished data 2012).
- Enforce a seasonal noise limitation to 49 dBA or less from 1 April through 30 June to reduce the effects of continuous noise levels within breeding habitat of songbird species that rely on aural cues for successful breeding (WY Game & Fish Dept. 2010, Inglefinger 2001).
- Cover or net all waste ponds to eliminate possible use as a water source by songbirds (Esmoil 1991, Esmoil and Anderson 1995).

RMBO recommended restricted surface occupancy in the core occupied areas, plus 150m buffer along with the seasonal limitations.

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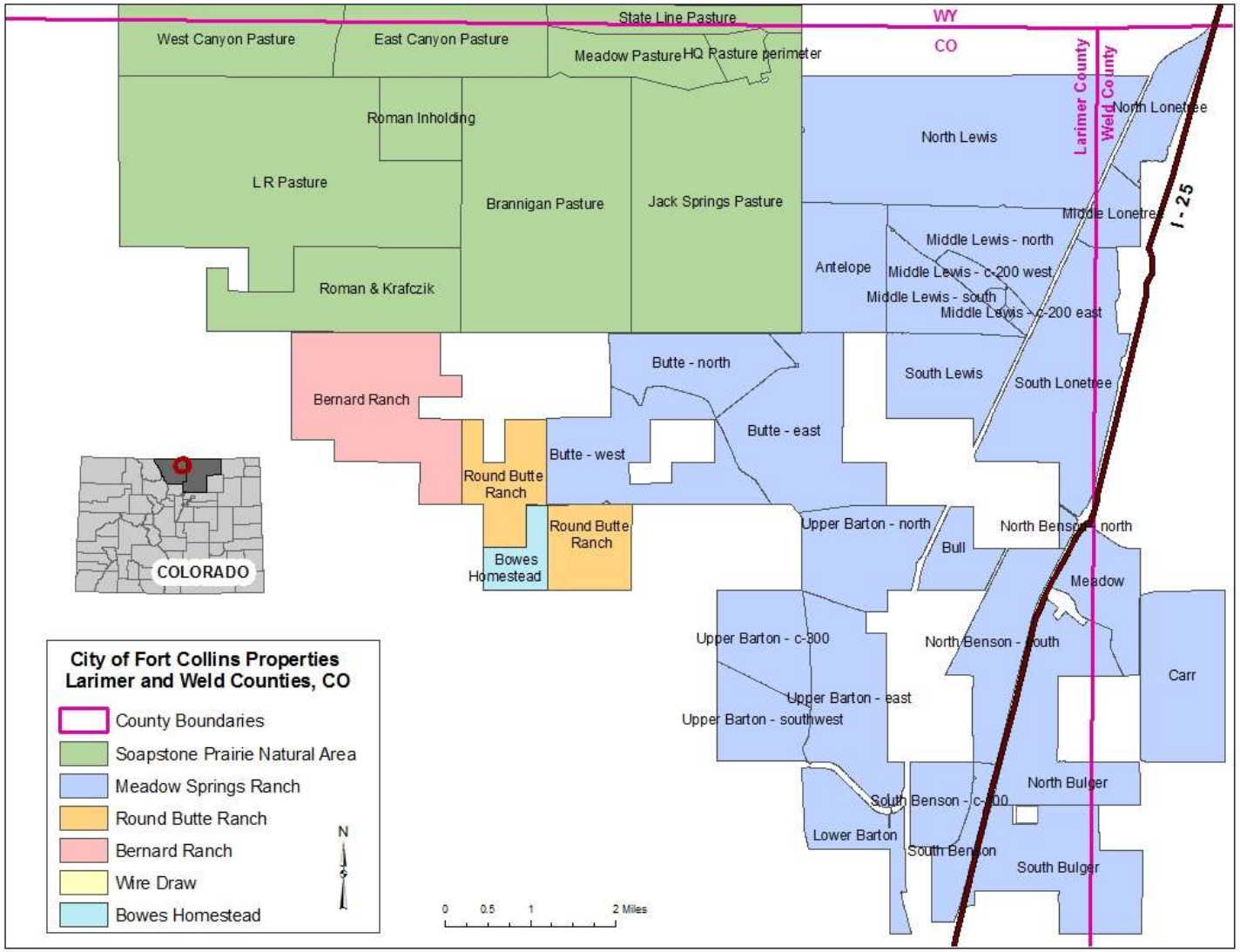
Appendix (A): Map of Fort Collins Properties

City of Fort Collins property map of Soapstone Prairie Natural Area, Meadow Springs Ranch, Round Butte Ranch, Bernard Ranch, Wire Draw Easement, and the Bowes Homestead with pasture names.



Appendix (B): Species Detections in Prairie Dog Colony Habitat

Number of individuals of all species detected during point counts in PDCH on Fort Collins properties from 2006 – 2012.

Common Name	***Scientific Name***	**2006** (64 pts)	**2007** (58 pts)	**2008** (165 pts)[+]	**2009** (307 pts)	**2010** (296 pts)	**2011** (482 pts)[+]	**2012** (388 pts)[+]	**Total (1152)**
Canada Goose	*Branta canadensis*					11			**11**
Mallard	*Anas platyrhynchos*				3	3	1		**7**
Double-crested Cormorant	*Phalacrocorax auritus*				7	6			**13**
Great Blue Heron	*Ardea herodias*				19	4			**23**
Turkey Vulture	*Cathartes aura*		1						**1**
Northern Harrier *	*Circus cyaneus*				8	7	2	4	**21**
Sharp-shinned Hawk	*Accipiter striatus*						1		**1**
Cooper's Hawk	*Accipiter cooperii*					2			**2**
Swainson's Hawk *	*Buteo swainsoni*		1		8	8	6	2	**25**
Red-tailed Hawk	*Buteo jamaicensis*				5		4	2	**11**
Ferruginous Hawk *	*Buteo regalis*	1			3	1	22	2	**29**
Golden Eagle *	*Aquila chrysaetos*				2	3	1	1	**7**
American Kestrel	*Falco sparverius*				17	12	25	6	**60**
Merlin	*Falco columbarius*				1				**1**
Peregrine Falcon	*Falco peregrinus*					1			**1**
Prairie Falcon *	*Falco mexicanus*	1			4	7	4	1	**17**
Sandhill Crane *	*Grus canadensis*					2			**2**
Killdeer	*Charadrius vociferus*				18	13	12	8	**51**
Mountain Plover *	*Charadrius montanus*	6	18		41	13	13	30	**121**
Greater Yellowlegs	*Tringa melanoleuca*				1				**1**
Long-billed Curlew *	*Numenius americanus*				9	3	56	11	**79**
Wilson's Snipe	*Gallinago delicata*	1			1			2	**4**
Common Snipe	*Gallinago gallinago*						1		**1**
Wilson's Phalarope	*Phalaropus tricolor*					1			**1**
Rock Pigeon	*Columba livia*					3	9		**12**
Mourning Dove	*Zenaida macroura*	1			5	22	28	2	**58**
Burrowing Owl *	*Athene cunicularia*	3	2		19	10	43	30	**107**

Common Name	*Scientific Name*	2006 (64 pts)	2007 (58 pts)	2008 (165 pts)+	2009 (307 pts)	2010 (296 pts)	2011 (482 pts)+	2012 (388 pts)+	Total (1152)
Common Nighthawk	*Chordeiles minor*	4	1				3		**8**
Broad-tailed Hummingbird	*Selasphorus platycercus*					1			**1**
Say's Phoebe	*Sayornis saya*				11	3	15	6	**35**
Western Kingbird	*Tyrannus verticalis*		1		1	4	10	6	**22**
Eastern Kingbird	*Tyrannus tyrannus*					1			**1**
Loggerhead Shrike *	*Lanius ludovicianus*	1			6	1	14	3	**25**
Common Raven	*Corvus corax*				3	7	9		**19**
Horned Lark	*Eremophila alpestris*	227	107	3	1714	1302	1812	1256	**6421**
Tree Swallow	*Tachycineta bicolor*				3		1		**4**
Violet-green Swallow	*Tachycineta thalassina*	7			4				**11**
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	1				4	2		**7**
Cliff Swallow	*Petrochelidon pyrrhonota*	3	1		3	12	47	2	**68**
Barn Swallow	*Hirundo rustica*	2			10	11	41	1	**65**
Rock Wren	*Salpinctes obsoletus*				7	10	8	2	**27**
Western Bluebird	*Sialia mexicana*				1				**1**
Swainson's Thrush	*Catharus ustulatus*						2		**2**
American Robin	*Turdus migratorius*					2			**2**
Northern Mockingbird	*Mimus polyglottos*				1				**1**
Sage Thrasher	*Oreoscoptes montanus*						1		**1**
European Starling	*Sturnus vulgaris*				2	11	13	1	**27**
Yellow Warbler	*Dendroica petechia*						1		**1**
Green-tailed Towhee	*Pipilo chlorurus*					2			**2**
Cassin's Sparrow *	*Peucaea cassinii*			1			2		**3**
Chipping Sparrow	*Spizella passerina*				8	5	22		**35**
Clay-colored Sparrow	*Spizella pallida*				1	4	1		**6**
Brewer's Sparrow *	*Spizella breweri*				40	50	53	15	**158**
Vesper Sparrow *	*Pooecetes gramineus*	6	1		46	49	81	31	**214**
Lark Sparrow	*Chondestes grammacus*				2	3	46	3	**54**
Lark Bunting *	*Calamospiza melanocorys*	4	21	2	95	91	534	110	**857**
Savannah Sparrow	*Passerculus sandwichensis*				7	2			**9**

Common Name	*Scientific Name*	2006 (64 pts)	2007 (58 pts)	2008 (165 pts)+	2009 (307 pts)	2010 (296 pts)	2011 (482 pts)+	2012 (388 pts)+	Total (1152)
Grasshopper Sparrow *	*Ammodramus savannarum*				1	23	18		**42**
McCown's Longspur *	*Rhyncophanes mccownii*	324	163		891	733	1037	480	**3628**
Chestnut-collared Longspur *	*Calcarius ornatus*	4			6	65	9	12	**96**
Bobolink *	*Dolichonyx oryzivorus*					2			**2**
Red-winged Blackbird	*Agelaius phoeniceus*	1			30	20	32	15	**98**
Eastern Meadowlark	*Sturnella magna*					1		4	**5**
Western Meadowlark	*Sturnella neglecta*	182	9	5	357	631	1241	581	**3006**
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*				1				**1**
Brewer's Blackbird	*Euphagus cyanocephalus*	3			28	19	6	3	**59**
Common Grackle	*Quiscalus quiscula*				10		4		**14**
Great-tailed Grackle	*Quiscalus mexicanus*						43		**43**
Brown-headed Cowbird	*Molothrus ater*				14	7	5	2	**28**
House Finch	*Carpodacus mexicanus*				1				**1**
American Goldfinch	*Spinus tristis*					1	1		**2**
House Sparrow	*Passer domesticus*				2		1		**3**
Totals	***72 species***	**782**	**326**	**11**	**3477**	**3209**	**5343**	**2634**	**15782**

+ Number of points used indicates survey effort (point visits) in PDCH each year with 35 points visited twice in 2008, 103 points visited 4 times (35 of them 6 times) in 2011, and all points in 2012 visited twice)

*** Indicates species of special concern and/or high conservation priority status in Canada and the U.S. as determined by Partners In Flight, the USFWS and Colorado Parks & Wildlife.**

Appendix (C): Species Detections in Four-wing Saltbush Habitat

Number of individuals of all species detected during point counts in Saltbush Habitat on Fort Collins properties from 2006 – 2012. (2006, 2010, and 2011 are excluded due to inconsistent survey effort in adequate saltbush habitat).

Common Name	***Scientific Name***	**2007** (88 pts)	**2008** (64 pts)	**2009** (141 pts)	**2012** (216 pts)+	**Total**
Mallard	*Anas platyrhynchos*			5		**5**
Great Blue Heron	*Ardea herodias*			2		**2**
Turkey Vulture	*Cathartes aura*	2		1		**3**
Swainson's Hawk *	*Buteo swainsoni*			1	2	**3**
Red-tailed Hawk	*Buteo jamaicensis*		2			**2**
Golden Eagle *	*Aquila chrysaetos*				1	**1**
American Kestrel	*Falco sparverius*	1	2		6	**7**
Prairie Falcon *	*Falco mexicanus*	2				**2**
Killdeer	*Charadrius vociferus*	5		3	1	**9**
Wilson's Snipe	*Gallinago delicata*			1		**1**
Rock Pigeon	*Columba livia*	2				**2**
Mourning Dove	*Zenaida macroura*	21	15	5	20	**46**
Barn Owl	*Tyto alba*	1				**1**
Burrowing Owl *	*Athene cunicularia*		4		3	**3**
Common Nighthawk	*Chordeiles minor*	2	8	1	8	**11**
Broad-tailed Hummingbird	*Selasphorus platycercus*	1				**1**
Say's Phoebe	*Sayornis saya*	4	2	6	4	**14**
Western Kingbird	*Tyrannus verticalis*		3	5	3	**8**
Eastern Kingbird	*Tyrannus tyrannus*		1	1		**1**
Loggerhead Shrike *	*Lanius ludovicianus*	5	2		20	**25**
Black-billed Magpie	*Pica hudsonia*	1			1	**2**
Common Raven	*Corvus corax*	3			5	**8**
Horned Lark	*Eremophila alpestris*	91	201	135	530	**756**
Violet-green Swallow	*Tachycineta thalassina*	1				**1**
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	3			4	**7**
Cliff Swallow	*Petrochelidon pyrrhonota*	2	17	4	10	**16**
Barn Swallow	*Hirundo rustica*			1	1	**2**
Rock Wren	*Salpinctes obsoletus*	10	16		11	**21**
Blue-gray Gnatcatcher	*Polioptila caerulea*	6				**6**
American Robin	*Turdus migratorius*	1				**1**
Northern Mockingbird	*Mimus polyglottos*	2			3	**5**
Sage Thrasher	*Oreoscoptes montanus*		1		20	**20**
Brown Thrasher	*Toxostoma rufum*	3				**3**
European Starling	*Sturnus vulgaris*		4			
Virginia's Warbler	*Oreothylpis virginiae*	1				**1**
Green-tailed Towhee	*Pipilo chlorurus*	24			1	**25**

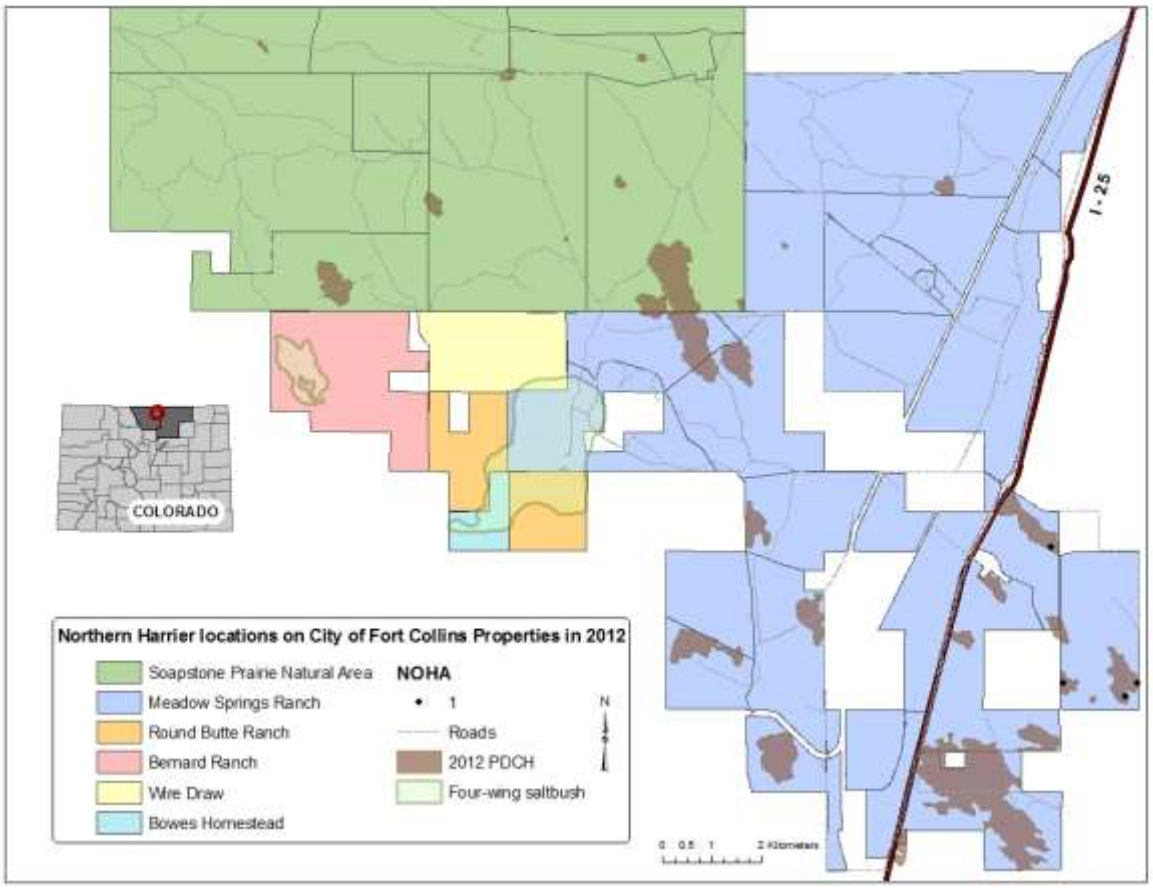
Common Name	*Scientific Name*	2007 (88 pts)	2008 (64 pts)	2009 (141 pts)	2012 (216 pts)[+]	Total
Spotted Towhee	*Pipilo maculatus*	39				**39**
Cassin's Sparrow *	*Peucaea cassinii*		43	6		**6**
Chipping Sparrow	*Spizella passerina*			2		**2**
Clay-colored Sparrow	*Spizella pallida*			3		**3**
Brewer's Sparrow *	*Spizella breweri*	5	167	92	179	**276**
Vesper Sparrow *	*Pooecetes gramineus*	20	137	7	162	**189**
Lark Sparrow	*Chondestes grammacus*	15	12		30	**45**
Lark Bunting *	*Calamospiza melanocorys*	69	208	529	376	**974**
Grasshopper Sparrow *	*Ammodramus savannarum*		4	6		**6**
McCown's Longspur *	*Rhyncophanes mccownii*	1	8	19	10	**30**
Black-headed Grosbeak	*Pheucticus melanocephalus*	1				**1**
Lazuli Bunting *	*Passerina amoena*	3				**3**
Red-winged Blackbird	*Agelaius phoeniceus*	2		8	3	**13**
Eastern Meadowlark	*Sturnella magna*				2	**2**
Western Meadowlark	*Sturnella neglecta*	63	149	93	491	**647**
Brewer's Blackbird	*Euphagus cyanocephalus*	46	1	3	6	**55**
Brown-headed Cowbird	*Molothrus ater*	49				**49**
Bullock's Oriole	*Icterus bullockii*	1	4		2	**3**
House Finch	*Carpodacus mexicanus*	2				**2**
Pine Siskin	*Spinus pinus*	1				**1**
Lesser Goldfinch	*Spinus psaltria*	1				**1**
American Goldfinch	*Spinus tristis*	3			2	**5**
House Sparrow	*Passer domesticus*			1		**1**
Totals	***57 Species***	**515**		**940**	**1917**	**3372**

[+] Number of points used indicates survey effort (point visits) in Saltbush Habitat each year (2012 points were visited twice)

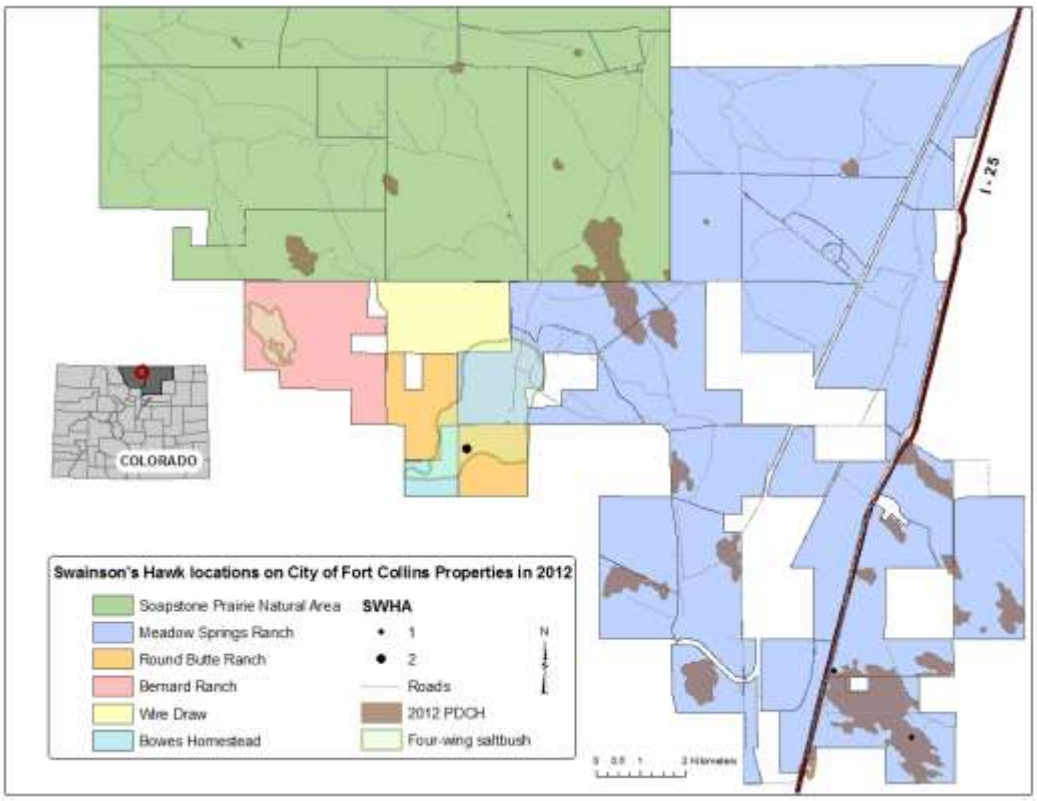
*** Indicates species of special concern and/or high conservation priority status in Canada and the U.S. as determined by Partners In Flight, the USFWS and Colorado Parks & Wildlife.**

Appendix (D): Species Accounts

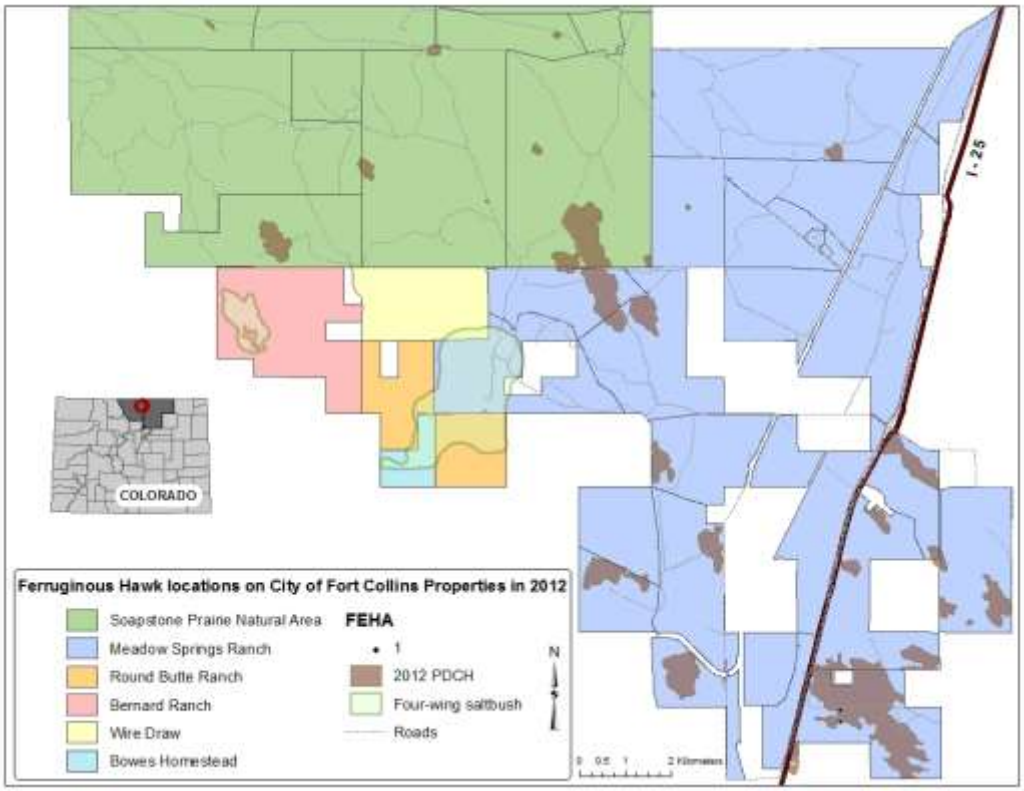
This section presents distribution maps for species of high priority conservation concern in the Mountains to Plains Area. Prairie dog colonies and saltbush habitat were the only habitats surveyed in 2012 and presented here. The map for each species indicates location and number of observations recorded during the point count surveys between 14 May, 2012 and 6 July, 2012.



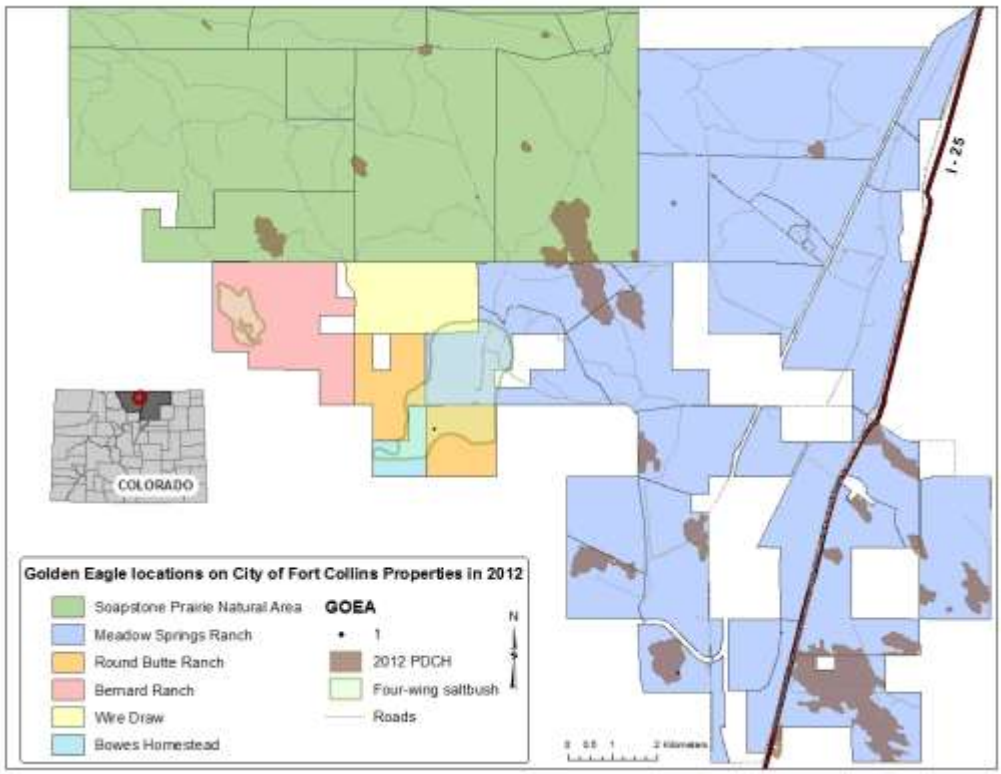
Northern Harrier (*Circus cyaneus)*



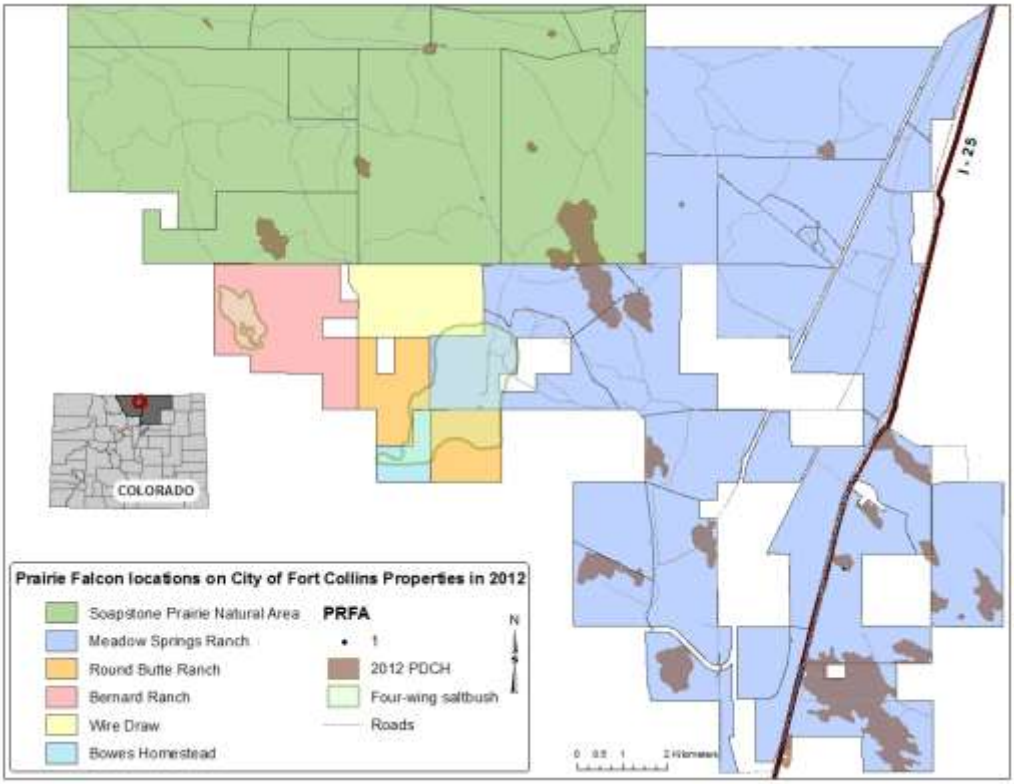
Swainson's Hawk (*Buteo swainsoni)*



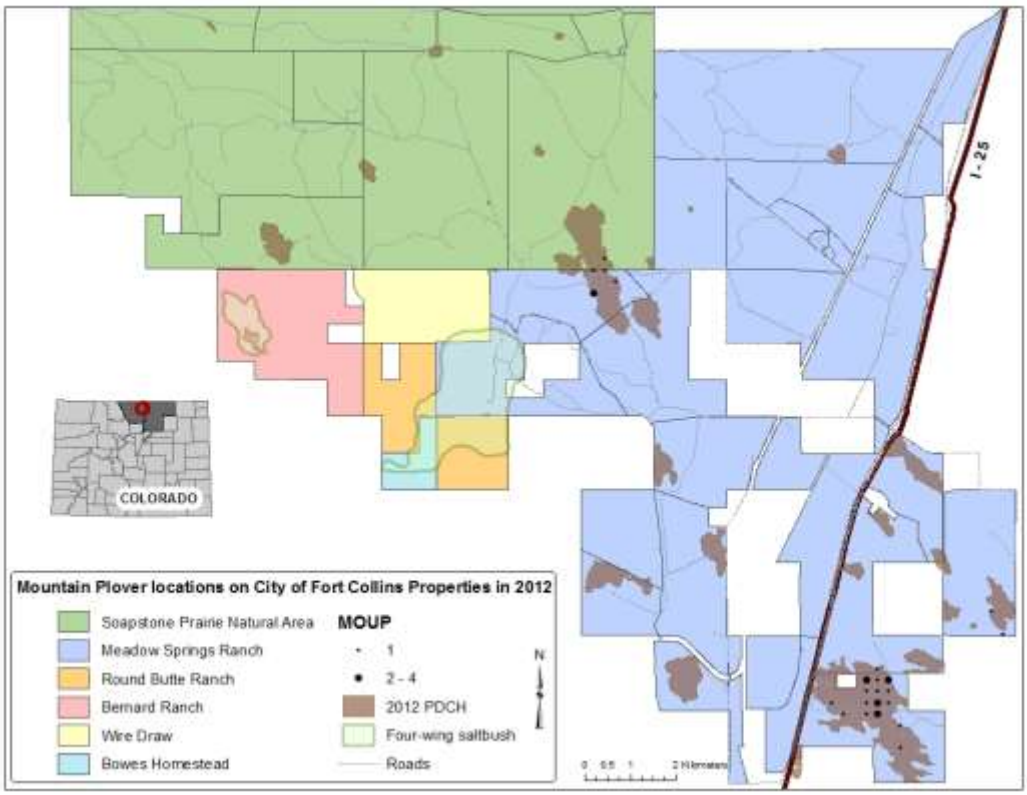
Ferruginous Hawk *(Buteo regalis)*



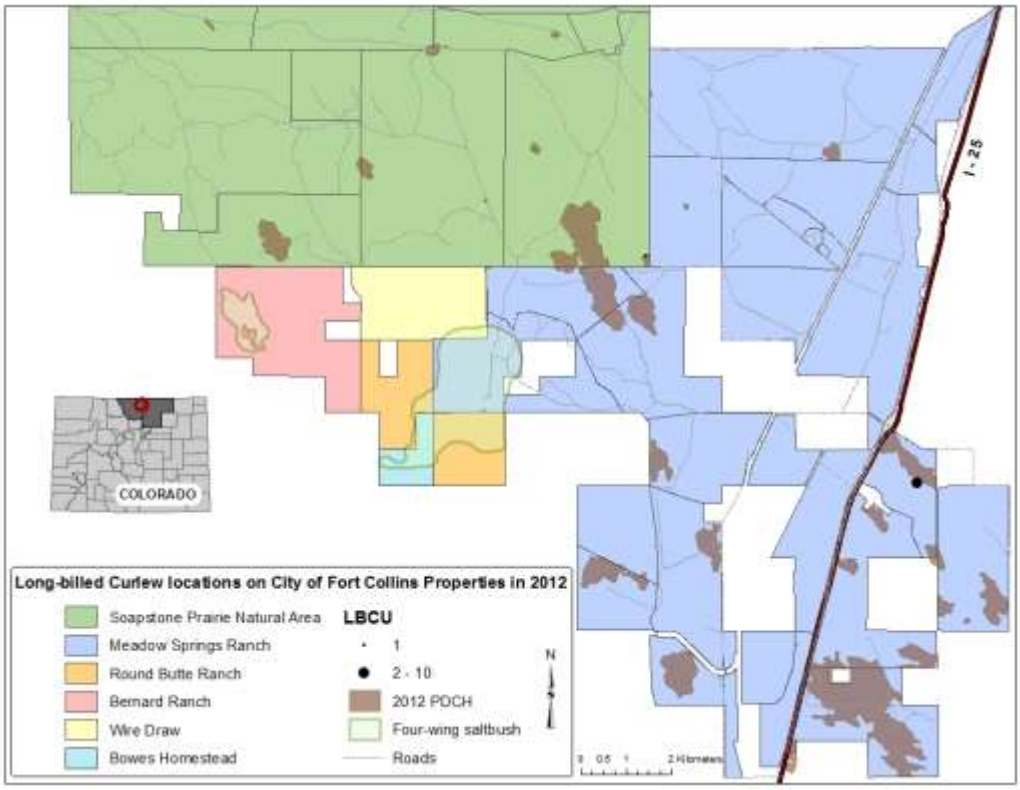
Golden Eagle *(Aquila chrysaetos)*



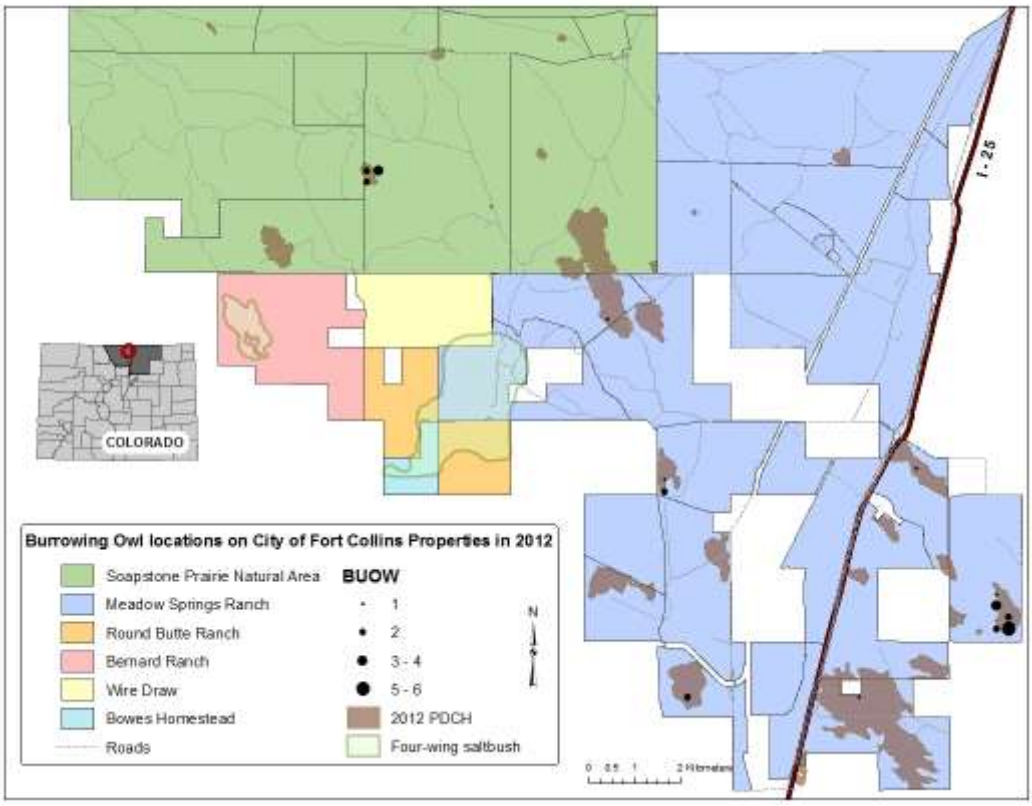
Prairie Falcon *(Falco mexicanus)*



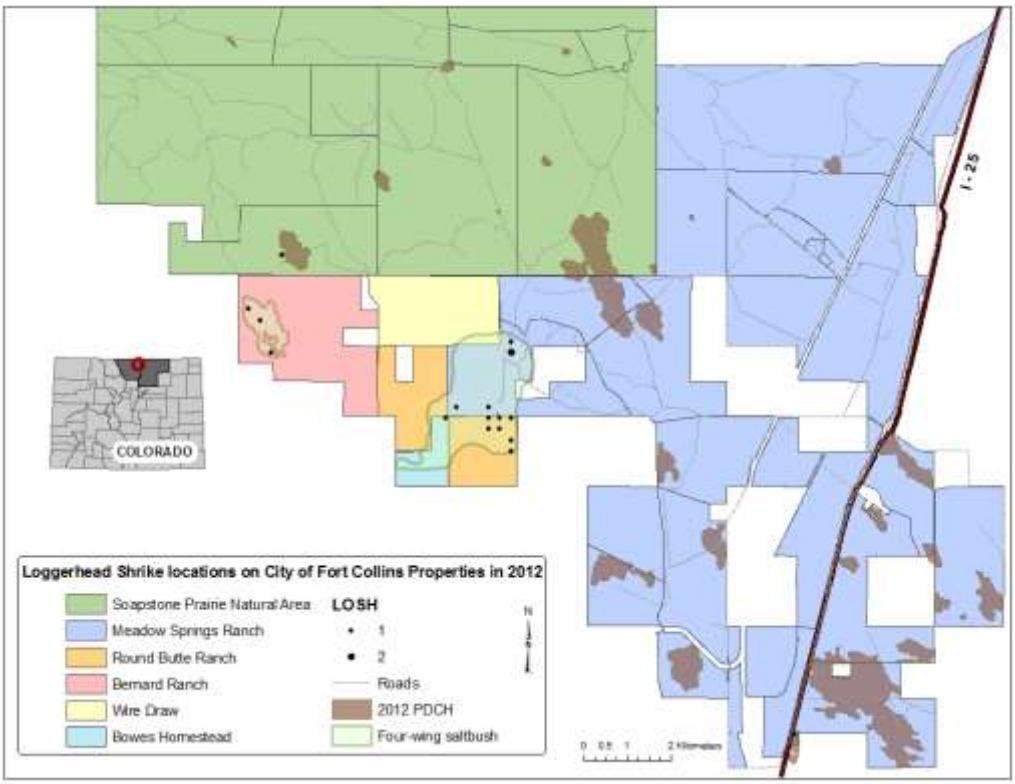
Mountain Plover (*Charadrius montanus)*



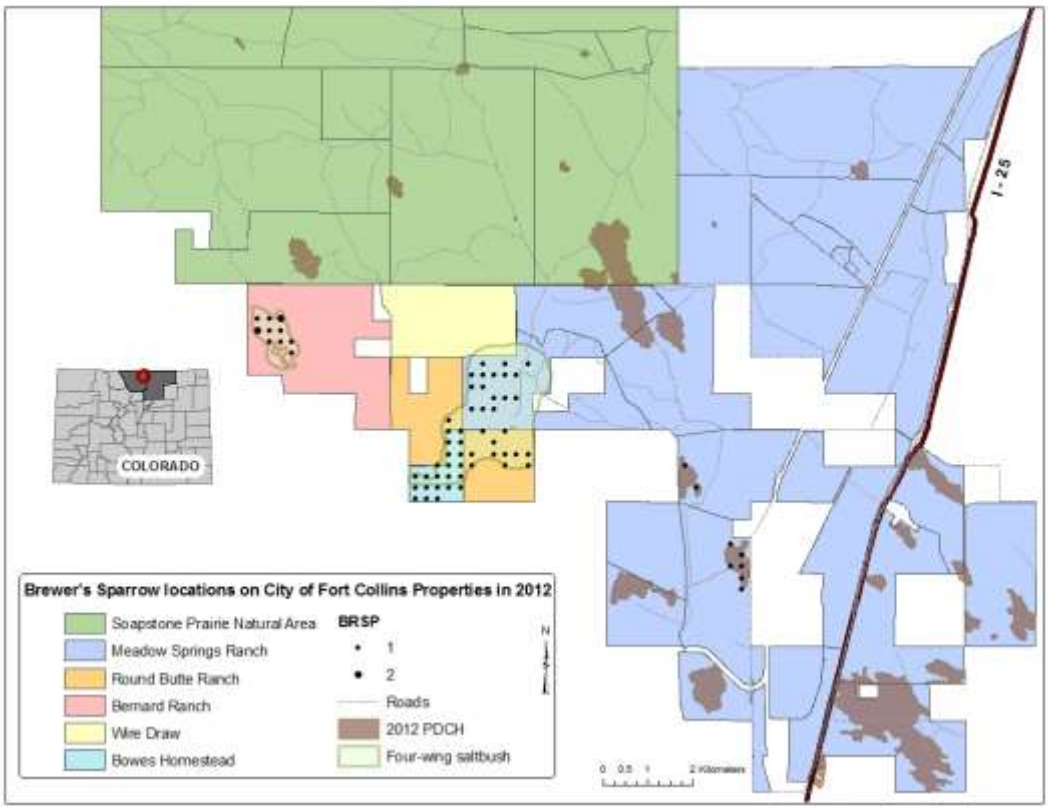
Long-billed Curlew *(Numenius americanus)*



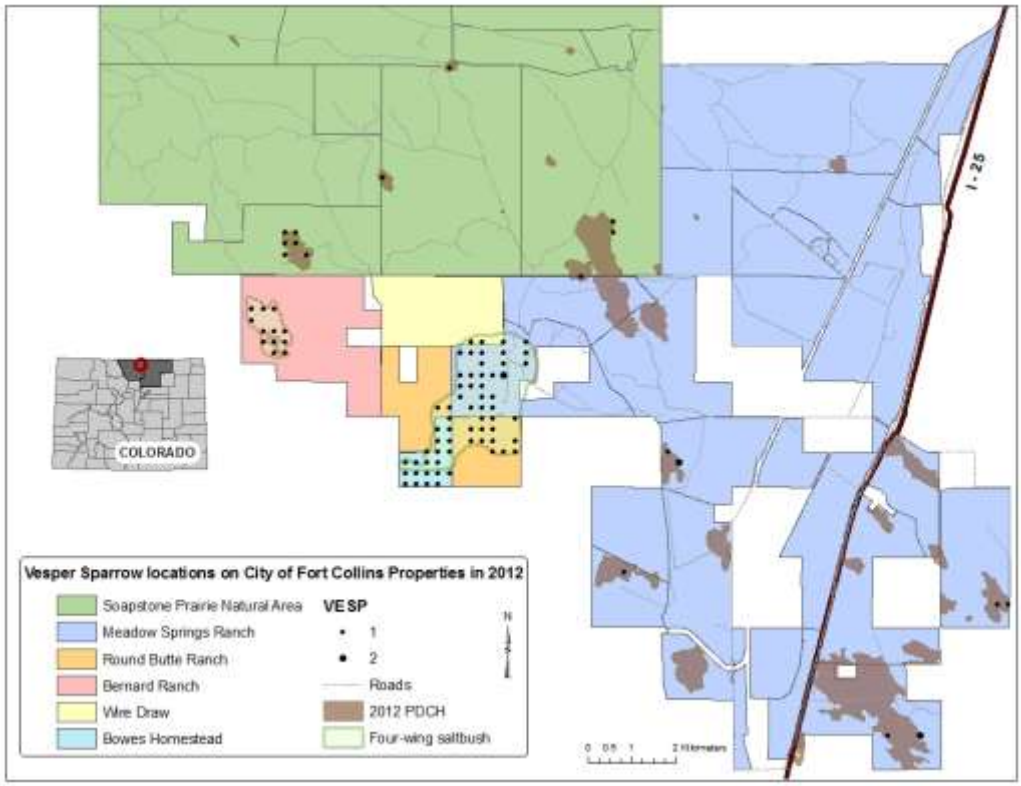
Burrowing Owl *(Athene cunicularia)*



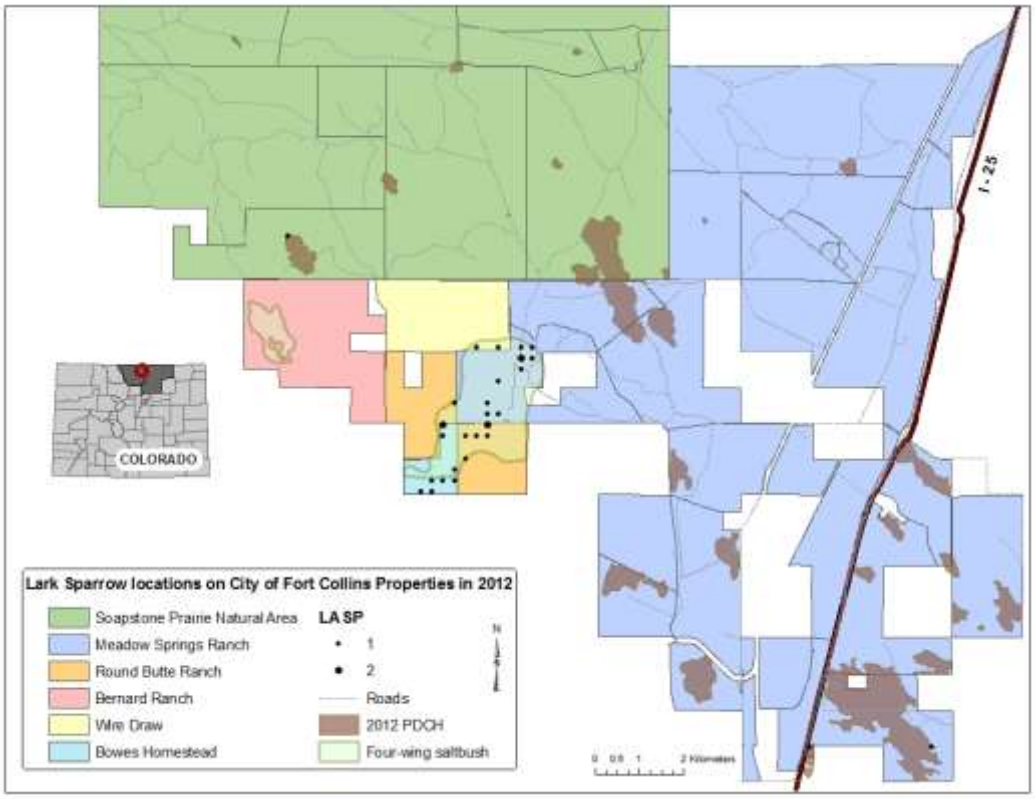
Loggerhead Shrike *(Lanius ludovicianus)*



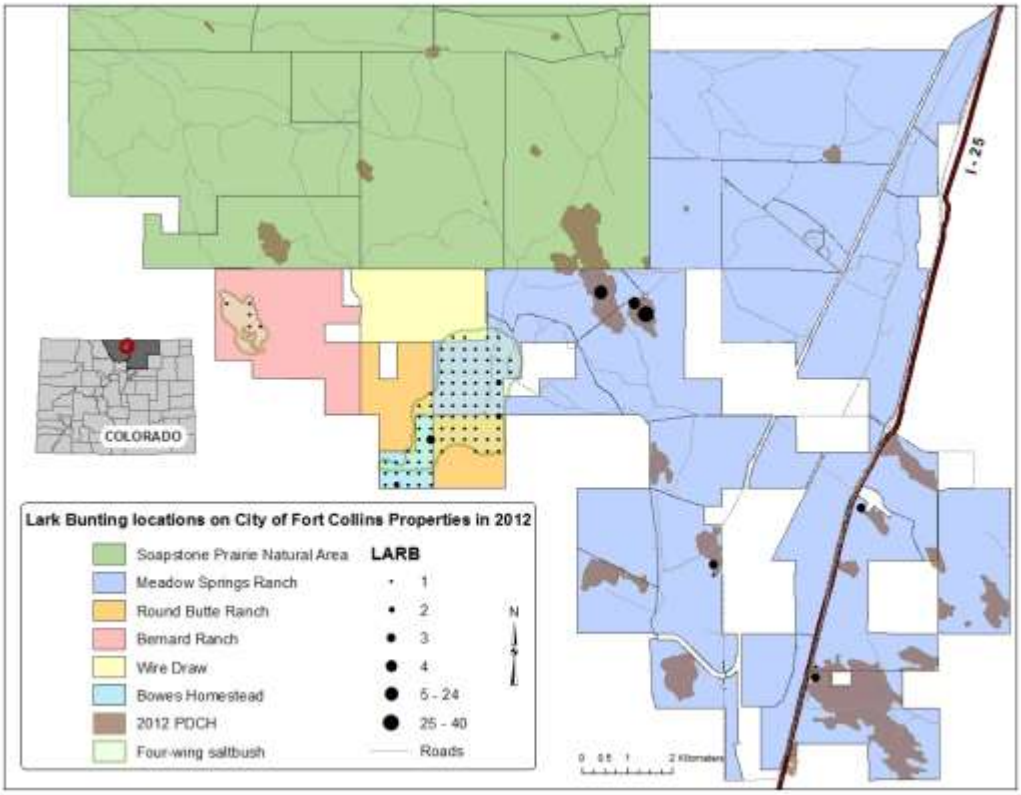
Brewer's Sparrow *(Spizella breweri)*



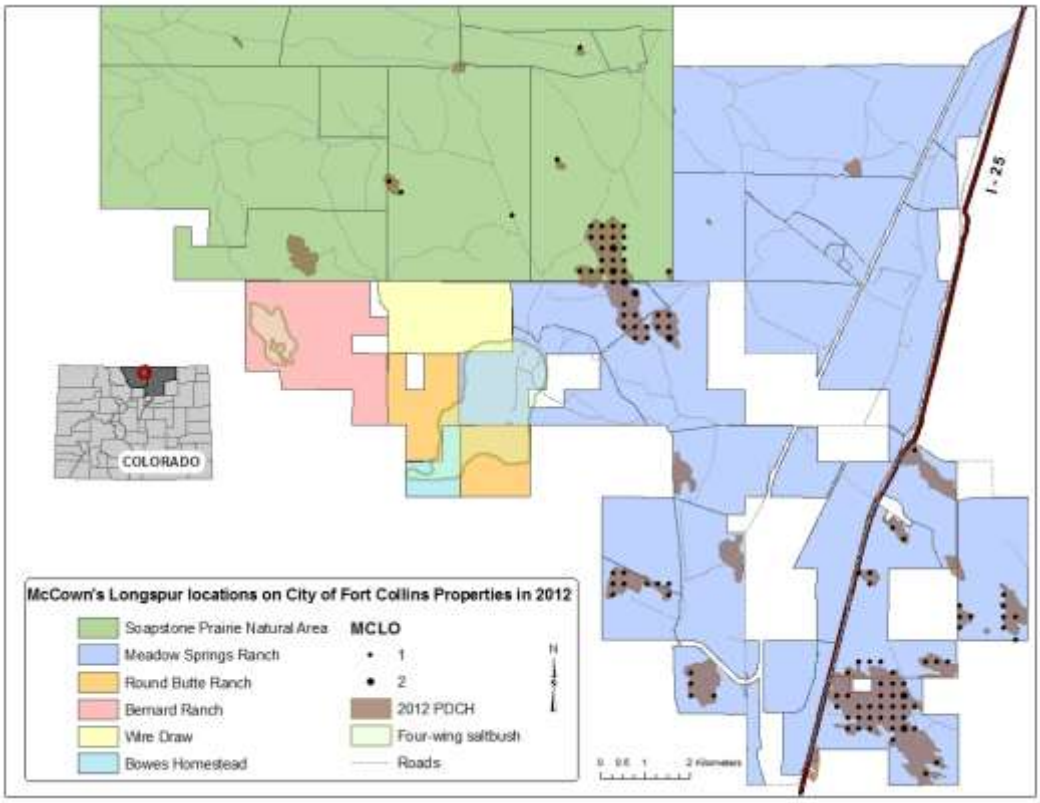
Vesper Sparrow *(Pooecetes gramineus)*



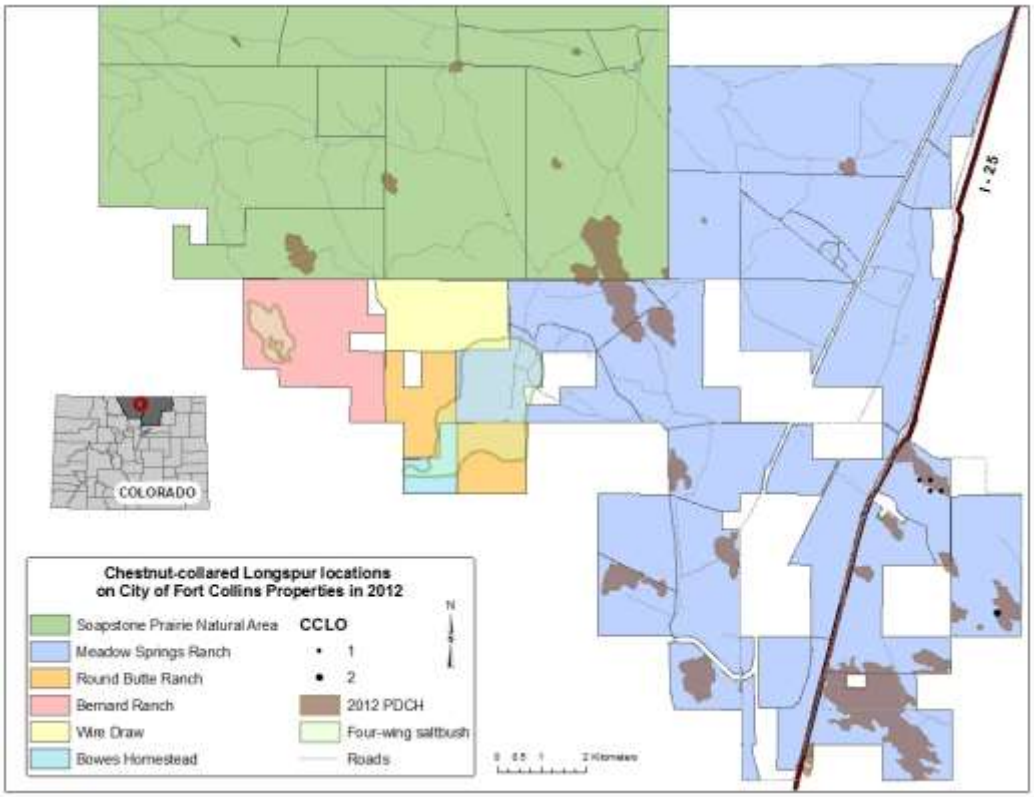
Lark Sparrow *(Chondestes grammacus)*



Lark Bunting *(Calamospiza melanocorys)*



McCown's Longspur *(Rhynchophanes mccownii)*



Chestnut-collared Longspur *(Calcarius ornatus)*