LARAMIE FOOTHILLS BISON CONSERVATION HERD

MANAGEMENT PLAN | 2018

+CURRENT AS OF JULY 31, 2018

EXECUTIVE SUMMARY

Less than a century ago, the American bison (*Bison bison*) was headed towards extinction. Once totaling nearly 40 million individuals, bison numbers plummeted to approximately 1,000 animals after intensive hunting pressures in the late 1800s. A few remnant populations survived, including a herd of around 25 individuals in Yellowstone National Park. In the early 1900s however, the Yellowstone herd was exposed to brucellosis—a disease caused by *Brucella abortus* bacteria that results in spontaneous abortions—and the disease gained a foothold in the population. Since then, individuals from the original Yellowstone herd have been relocated to start new herds across the United States, but many of these relocations have failed due to the detection of brucellosis in establishing populations. Today, public and private landowners, NGOs, tribal entities, and other bison supporters work diligently to conserve and manage bison, while simultaneously supporting efforts to increase genetic diversity without transferring brucellosis.

In 2015, ten plains bison were reintroduced to the shortgrass prairie at Soapstone Prairie Natural Area and Red Mountain Open Space to form the Laramie Foothills Bison Conservation Herd. The herd exists due to revolutionary research and a collaborative partnership amongst the United States Department of Agriculture Animal and Plant Health Inspection Service, Colorado State University Animal Reproduction and Biotechnology Laboratory, the City of Fort Collins Natural Areas Department (the City), and the Larimer County Department of Natural Resources (the County). This reintroduction effort represents the first-time assisted reproduction techniques—including in-vitro fertilization, embryo transfer, and artificial insemination—have been used to facilitate the creation of a new bison population using reproductive material from the genetically significant, but brucellosis-positive Yellowstone bison herd.

All ten bison share Yellowstone origins and are the result of multiple projects including a contraception vaccine study and research involving immunocontraceptives and brucellosis transmission. To date, 54[1] brucellosis-free and genetically valuable bison roam on approximately 2,700 acres in northern Colorado, contributing to the conservation and genetic integrity of the species while assisting with ecosystem management goals set forth by the City and County. Through an adaptive management approach, project partners will ensure that established goals and priorities are met and align with the proposed actions outlined in this Bison Management Plan.

1. At the time of publication.

Cover Photo | Norm Keally
This Page | Kristi Schwickerath

CONTENTS

PART I | HISTORY

Jennifer Barfield, PhD | Assistant Professor
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Larimer County Natural Resources

John Stokes | Director
City of Fort Collins Natural Areas

PART II | THE FUTURE

ACKNOWLEDGEMENTS
Project partners would like to thank the citizens of Fort Collins and Larimer County for their ongoing support of bison conservation in the Laramie Foothills.

+ All black and white bison photos and uncredited photos courtesy of Norm Keally.

PART I | HISTORY

INTRODUCTION | CONTEXT

Soapstone Prairie Natural Area (Soapstone Prairie) and Red Mountain Open Space (Red Mountain) are situated within the incredibly diverse transitional landscape of Colorado's Front Range to High Plains ecotone. Owned and managed by the City of Fort Collins Natural Areas Department (the City) and Larimer County Department of Natural Resources (the County), respectively, the two properties contribute over 37,000 acres of high quality habitat to the Laramie Foothills Mountains to Plains Conservation Area. From shortgrass prairie to foothills shrubland, wet meadow to riparian mixed forest, this corridor of protected lands is home to vibrant plant communities[2] including globally-rare species such as the Colorado butterfly plant and a fungus new to science, *Cercopemyces crocodilinus*. It also supports a rich array of wildlife including 130 species of birds as well as elk, mule deer, badgers, pronghorn, black-tailed prairie dogs, swift foxes, and black-footed ferrets (Youngberg & Panjabi, 2016; see: Context, pages 3-4).

In complement to the site's biological diversity, the cultural heritage of Soapstone Prairie and Red Mountain extends back 12,000+ years tracing an unbroken line of human habitation by nomadic Clovis, Folsom, and indigenous peoples; cattle and sheep ranchers; and present-day recreation and birding enthusiasts. Soapstone Prairie is home to the Lindenmeier Archaeological Site, a National Historic Landmark representing the largest known Folsom camp. It also preserves the legacy of the Graves Camp Rural Historic District, a historically significant working landscape designated in the National Register of Historic Places in 2016 for over a century of sheep and cattle ranching under the Warren Livestock Company. Similar cultural remnants remain at Red Mountain, including ancient engravings, numerous historic structures, and prehistoric sites featuring stone circles and groundstone scatters.

Although there is evidence of bison and human cohabitation in the fossil record dating back to pre-colonial times, free-ranging plains bison (*Bison bison*: the descendants of *Bison antiquus*) have been largely absent from the landscape of northern Colorado since the latter 1800s (Hedrick, 2009). Following centuries of subsistence hunting by indigenous peoples, bison populations were reduced to isolated pockets in the wild and commercially-managed meat and breeding stock in captivity as a result of intentional herd reduction, diseases, and forage competition with cattle (Figgs, 2008; Freese et al., 2007; Knapp et al., 1999). Under these conditions, the free-ranging days of the bison of the Laramie Foothills faded into the annals of history. With their disappearance came associated socio-cultural impacts to indigenous peoples, as well as ecological changes to the landscapes where bison once roamed.

2. Plant communities align with the U.S. National Vegetation Classification system. More information can be found at http://usnvc.org/

A RARE OPPORTUNITY | LARAMIE FOOTHILLS BISON CONSERVATION HERD

For both the City and County, conservation and a commitment to public service are at the heart of complementary missions to protect and enhance lands with natural resource, agricultural, and scenic values; provide appropriate educational and recreational opportunities; and safeguard cultural amenities. As long-term management objectives were established for Soapstone Prairie and Red Mountain, the idea to restore a bison conservation herd sprouted in the minds of land managers and researchers who envisioned an opportunity to:

- Restore a native keystone grazer to the landscape of northern Colorado;
- Improve assisted reproduction and disease management technologies;
- Provide seed stock for other developing conservation herds; and,
- Offer educational interpretation and viewing opportunities for visitors.

In pursuit of this vision, the City formalized bison ambitions in its 2007 Soapstone Prairie Natural Area Management Plan proposal to "research how a cattle-to-bison shift in the grazing regime might more closely approximate historic prairie communities" and contribute to the achievement of broader land management goals related to vegetation and wildlife habitat. The County also began evaluating the potential for bison reintroduction on a portion of the landscape, thus establishing a policy framework for the two agencies to move forward with bison conservation should the opportunity arise in the future.

Although not unprecedented internationally, the establishment of a conservation herd was a novel aspiration for the Laramie Foothills community of northern Colorado. For the idea to gain momentum, key challenges had to be addressed, namely: how to obtain brucellosis-free bison with high integrity genetics, where to reintroduce them, and how to manage the herd into the future. Potential scenarios presented themselves along the way (see: Timeline, pages 11-14), but it took a unique set of partners with complementary resources and missions to ultimately make bison reintroduction a success.

THE RIGHT PARTNERS

From disease research to land management, infrastructure to veterinary care, bison reintroduction is complex, involves multiple stakeholders, and is dependent on sustained, collaborative effort to ensure success. A feasible proposal for a bison herd

SHARED MISSIONS

CITY OF FORT COLLINS NATURAL AREAS

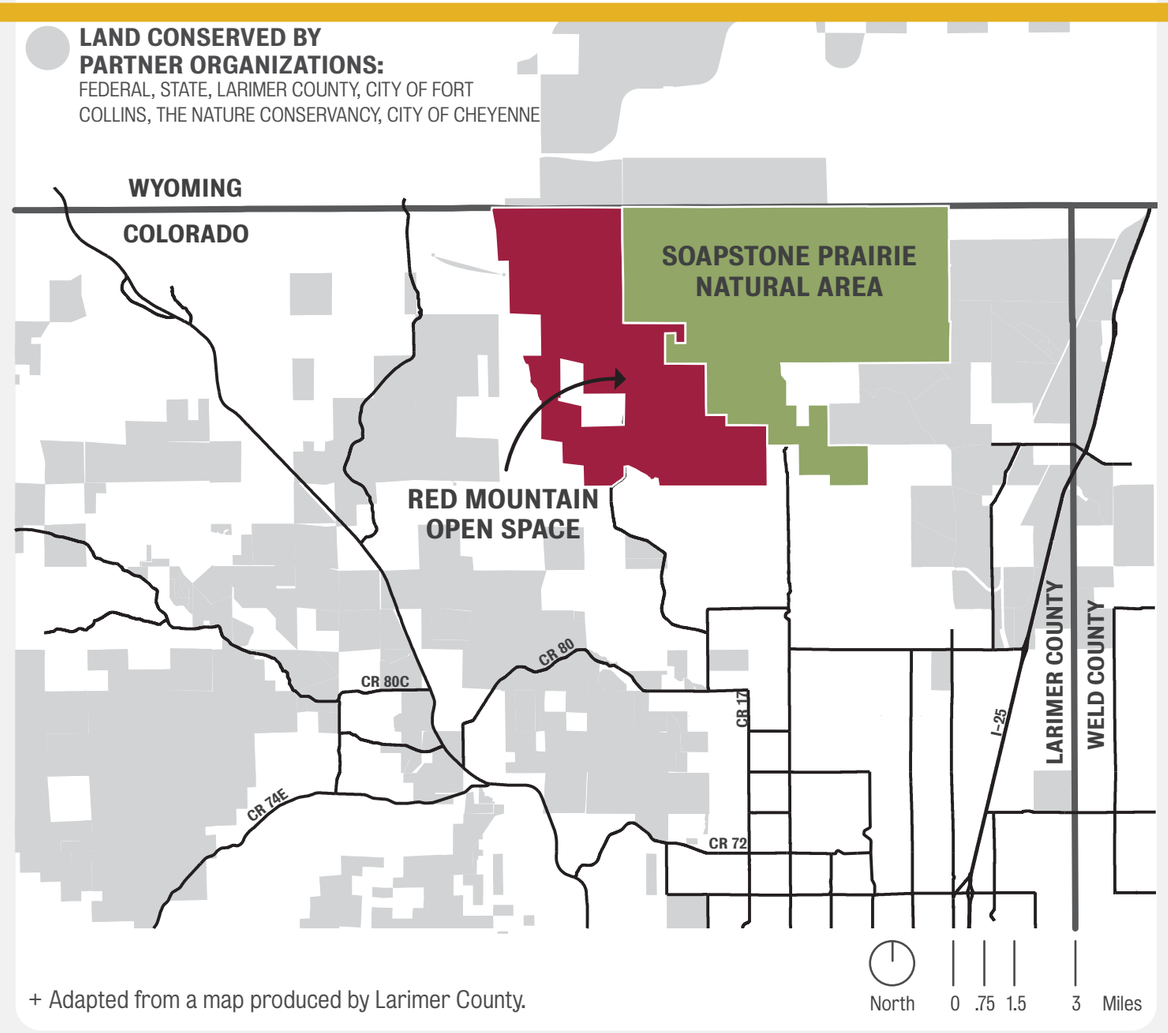
"To conserve and enhance lands with natural resource, agricultural, and scenic values, while providing meaningful education and appropriate recreation opportunities."

LARIMER COUNTY DEPARTMENT OF NATURAL RESOURCES

"To establish, protect, and manage significant regional parks and open lands providing quality outdoor recreational opportunities and stewardship of natural resource values. We are committed to fostering a sense of community and appreciation for the natural and agricultural heritage of Larimer County for present and future generations."

LARAMIE FOOTHILLS
MOUNTAINS TO PLAINS CONSERVATION AREA

LAND CONSERVED BY PARTNER ORGANIZATIONS:
FEDERAL, STATE, LARIMER COUNTY, CITY OF FORT COLLINS, THE NATURE CONSERVANCY, CITY OF CHEYENNE



+ Adapted from a map produced by Larimer County.

COMPLEX COMMUNITIES
DIVERSE VEGETATION, WILDLIFE, AND CULTURAL CONNECTIONS

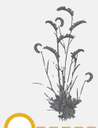
Some of the species and features found at Soapstone Prairie and Red Mountain include:

Buchlöe dactyloides | Buffalograss

Cultural Remnants
Stone circles and groundscatters

Grave's Camp Rural Historic District

Mustela nigripes | Black-Footed Ferret

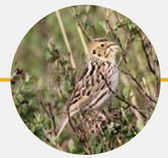


Bouteloua gracilis | Blue Grama Grass

Lindenmeier Archaelogical Site
Folsom and Clovis Points

Liatris ligulistylis | Rocky Mountain Blazing Star

Antilocapra americana | Pronghorn



Ammodramus bairdii | Baird's Sparrow
Photo | Bird Conservancy of the Rockies

Photo | Kristi Schwickerath

CONTEXT

at Soapstone Prairie and Red Mountain materialized when a shared vision, timing, and opportunity aligned for a partnership to form amongst the United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS), Colorado State University Animal Reproduction and Biotechnology Laboratory (CSU), the City, and the County.

APHIS

For decades, APHIS has partnered with state and federal agencies, animal health authorities, and livestock industries to cooperatively eradicate brucellosis (APHIS, n.d.). To date, eradication has been achieved in 48 states, and APHIS has developed and implemented a bison management plan to maintain a free-ranging herd of Yellowstone bison while eliminating exposure of cattle to potential carriers. In 2010, APHIS reached out to the Barfield Lab (see: The Barfield Lab, page 17) to express an interest in investigating mitigation strategies for brucellosis. What ensued from this discussion was revolutionary research that made it possible to preserve and transfer Yellowstone bison genetics beyond the boundaries of Yellowstone National Park (Barfield, 2014).

CSU

Since 2011, Dr. Jennifer Barfield (Assistant Professor of Reproductive Physiology at CSU) and her team have pioneered extensive research into, and use of, assisted reproductive technologies in bison. With support from APHIS, the Barfield Lab refined embryo transfer techniques developed in the commercial cattle and equine industries that have been used to successfully mitigate brucellosis in livestock. They adapted those methods, along with techniques for washing embryos, to use in bison that test positive for the disease. Their research resulted in the live births of bison calves with bloodlines made up entirely of Yellowstone genetics (see: The Barfield Lab, page 17). In 2014, a population of these calves approached eligibility for release from quarantine. Cognizant of the City's interest in establishing a conservation herd through prior conversations with APHIS, discussions commenced to assess opportunities for collaboration.

CITY + COUNTY

With the threat of brucellosis eliminated and genetic integrity secured through the work of APHIS and the Barfield Lab, bison reintroduction in the Laramie Foothills became a tangible possibility. To complement potential contributions of seed stock, handling facilities, significant experience with disease management, veterinary care, and groundbreaking reproductive research from APHIS and CSU, the City offered a dedicated conservation vision, infrastructure, and land with high quality habitat at Soapstone Prairie. To expand contiguous habitat and build upon a long history of collaborative conservation with the City, the County contributed additional lands within Red Mountain. The pooled resources of APHIS, CSU, the City, and the County provided encouraging evidence that a stable partnership could be sustained to support a bison conservation herd. A shared commitment to transfer and preserve bison genetics and expand knowledge about the effects of bison reintroduction on grassland ecology further propelled the group toward its conservation vision.

BRUCELLOSIS

As one of two free-ranging, wild populations in North America, the Yellowstone National Park bison herd retains a proportion of pre-settlement genetics that are highly valued for their diversity and lack of cattle gene introgression (Herman et al., 2014). However, the Yellowstone bison are exposed to, and many carry, *Brucella abortus*, an infectious bacterium that decreases reproductive efficiency, mainly by abortion (Bricker & Halling, 1994). Brucellosis (the disease that results from the *Brucella abortus* bacterium) remains one of the most common zoonotic diseases in the world, as there are six species within the genus *Brucella* that infect a variety of species including bison, humans, marine mammals, dogs, rodents, and camels (Corbel, 2006). While brucellosis has been aggressively targeted and eradicated in cattle and bison populations nationally, the last known reservoir of the disease persists in the bison and elk in the Greater Yellowstone Area, rendering their direct transfer out of the Park impossible. To assuage practical and political fears of disease transmission from carriers to livestock, innovation was required to develop alternative technologies and methodologies to source new conservation herds with Yellowstone bison genetics, but without brucellosis.

THE RIGHT CONDITIONS

PASTURE DESIGN PROCESS

After potential partners and contributions were identified, existing conditions were assessed to advance collective understanding of the capacity of the land, infrastructure, and resources at Soapstone Prairie and Red Mountain to support bison reintroduction. Since the two properties were sustainably managed for cattle grazing in the decades prior, suitability analyses were focused less on forage availability and more on the following priorities to identify potential locations for the Phase I bison pasture:

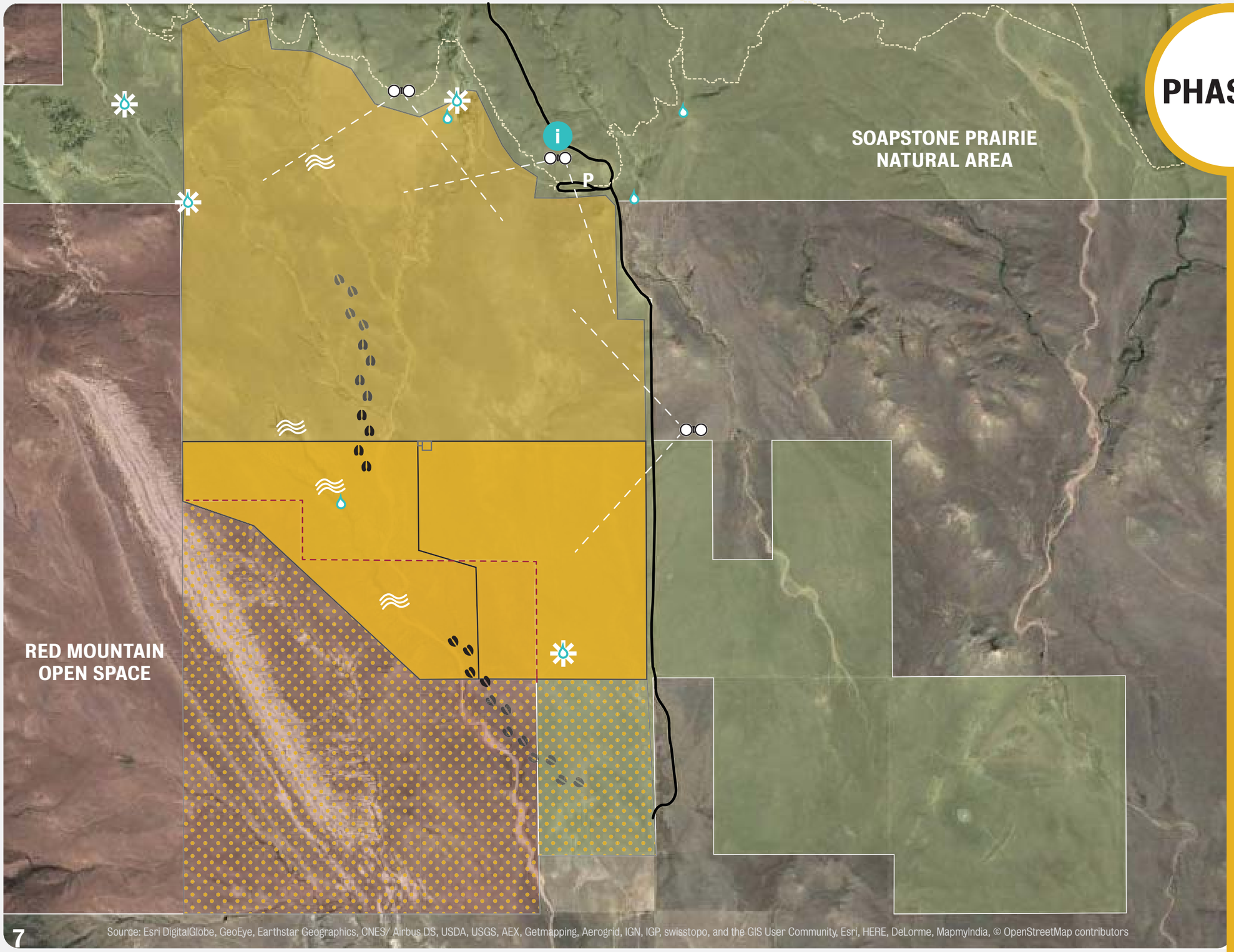
- Utilize existing infrastructure;
- Avoid recreation conflicts;
- Minimize impacts to existing grazing leases;
- Create safe opportunities for public viewing; and,
- Consider the feasibility of contiguous expansion in subsequent phases.

When evaluated holistically, these constraints revealed a 1,000-acre tract of land spanning Soapstone Prairie and Red Mountain with naturally occurring surface water, geographic separation from current grazing operations, no existing trails, safe viewing opportunities from the main access road, and the ability to support future expansion (see: Phasing, pages 7-8).

To ensure that vegetative health and forage quality could be maintained throughout the proposed reintroduction zone, stocking rates were calculated using traditional livestock stocking calculations commonly accepted in the field of range management (Holchek et al., 1994). A conservative utilization rate of 33% was applied to secure ample forage for resident wildlife and provide year-round forage for bison even in average drought conditions. Initial stocking rates identified approximately 30 bison (27 cows and 3 bulls equivalent) as a sustainable rate for the Phase I pasture.

INFRASTRUCTURE

Although sufficient resources existed to support bison reintroduction in the Phase I pasture, it was determined that existing infrastructure at Soapstone Prairie and Red Mountain would be inadequate for bison, and "fencing, watering tanks, and sorting facilities would all need to be upgraded" (Figgs, 2008). To bring infrastructure up to bison reintroduction standards, several on-site improvements preceded the proposed bison release in 2015.



PHASING

PHASE I

~1,000 acres:
750 Soapstone Prairie
250 Red Mountain

- Fencing + water improvements completed in 2015.

PHASE II

~1,700 acres at Soapstone Prairie

- Fencing improvements completed December 2017; pasture opened to bison in 2018.

POTENTIAL EXPANSION

From 500 (feasible) to 1,450 (aspirational) acres could be added south of the Phase I pasture.

WINDMILLS

SURFACE WATER

STOCK TANKS

PUBLIC PARKING

MAIN ACCESS ROAD

TRAILS

VIEWING OPPORTUNITIES

INTERPRETIVE SIGNAGE

POTENTIAL CONTIGUOUS PASTURE

North 0 500 1,000 2,000 Feet

Fencing
To ensure that the proposed Phase I pasture was both wildlife friendly and secure, City and County staff and volunteers removed approximately three miles of existing fencing, upgraded one mile of cattle fencing, and installed five and a half miles of new fencing that is robust enough for bison, yet still meets the "wildlife friendly" specifications developed by Colorado Parks and Wildlife (see: Appendix A: Fencing Specification | Colorado Park and Wildlife).

Water
Although the Phase I pasture was sited to take advantage of naturally occurring surface water at various draws and arroyos, three existing wells were modified for use in the bison pasture to establish a stable year-round source.

SUSTAINABLE FUNDING

In preparation for bison reintroduction, scientists at CSU, APHIS, and Denver Zoo secured research funding "to establish a genetically diverse, brucellosis-free herd of bison with Yellowstone genetics;" continue to study the use of assisted reproductive technologies; assess the effects of bison on grassland wildlife and land health; and, document the human health benefits and social effects of bison reintroduction for visitors and stakeholders (Barfield, 2014). Funds provided the research team with the opportunity to evaluate vegetation conditions prior to and following bison reintroduction. They also allowed project partners to begin collaborating to "develop an interdisciplinary model for species reintroduction that integrates the scientific tools necessary to address the socio-ecological and disease management complexities of plains bison reintroduction in the American West" (Barfield, 2014). Funding through the City and County's dedicated sales tax, additional grants, private donations, and significant in-kind contributions from all invested partners helped ensure that no single contributor shouldered mobilization costs alone. These funding sources also allowed infrastructural improvements to advance in preparation for the anticipated arrival of bison.

FROM ASPIRATION TO ACTION | INTERGOVERNMENTAL AGREEMENT

In March of 2015, an Intergovernmental Agreement (IGA) was developed amongst the partners to clarify goals and responsibilities and serve as the foundational document for the collaboration. The IGA gave the project the stability to transition from idea, through mobilization, to implementation. The document outlines the following roles (among other duties):

- The City and County are to provide land, grazing management, resources, vegetation monitoring, and maintenance;
- CSU is to own the bison and provide all necessary care, associated supplies, and supplemental feed; monitor the herd; capture escaped bison; perform non-City/non-County fund administration; and,
- APHIS is to provide seed stock, disease monitoring, and testing to ensure that bison remain brucellosis-free.

All partners are called upon to support ongoing research and develop funding sources with City and County contributions limited to use on Soapstone Prairie and Red Mountain and not to exceed those of other partners. Ongoing research is identified as a priority, and partners agree to consider incoming proposals and collaborative opportunities to develop funding sources to support the herd. The full terms and conditions of the IGA are elaborated in Appendix B.

LAUNCH | RELEASE

Confident in the capacity of the team and land to support a conservation herd—and with a solid framework for action established by the IGA—reintroduction plans continued to move forward leading up to a community bison release on November 1, 2015. In preparation for the event, Phase I infrastructural improvements were completed to reroute the first two miles of the Cheyenne Rim Trail (in anticipation of future expansion), modify fencing, and secure water resources (see: Phasing, pages 7-8). An Emergency Response Plan was also developed to identify roles and responsible parties in the event of water and forage shortages, significant weather events, wildfire, infrastructural damage, escape, disease, death, or livestock intermingling. The full plan is attached as Appendix C.

On the research end of the spectrum, a CSU graduate student collected baseline data at Soapstone Prairie and Red Mountain from May-November 2015 using vegetation transects, grazing exclosures, bird surveys, and remotely triggered wildlife cameras to determine vegetation composition, bird and mammal densities, and habitat use before the release. A summary of these findings is included in Appendix D.

To promote public awareness and community participation, news of the bison project and upcoming release were shared through all available channels at the City, County, and CSU. Relationships were fostered with members of the Crow Nation (Montana), CSU's Native American Cultural Center, and local leaders of indigenous peoples who provided prayers, songs, drumming, and blessings leading up to, and during, the release event on November 1. Due to overwhelming interest from the public (and spatial constraints at Soapstone Prairie and Red Mountain), a pre-release event was held at the National Wildlife Research Center (CSU Foothills Campus) to accommodate approximately 300 invested members of the community.

On November 1, 2015 (National Bison Day and the first day of Native American History Month), over 200 guests comprised of tribal nations, dignitaries, and bison lovers of all ages gathered at Soapstone Prairie to welcome ten bison back to the shortgrass prairie after 100+ years of absence from this ecosystem. The seven cows, two yearling heifers, and one five-month old bull that were released became the founding members of the Laramie Foothills Bison Conservation Herd.

From left to right: Solomon Little Owl of the Crow Nation, Dr. Jennifer Barfield (CSU), and Matt McCollum (APHIS) at the bison release.

POST LAUNCH | CONTINUED GROWTH AND RESEARCH

Since the 2015 release, project partners continue to monitor, care for, and grow the herd; provide opportunities for education and community involvement; research the ecosystem effects of bison reintroduction on-site; and seek out ongoing funding and partnership opportunities to expand research and infrastructural capacity. These achievements and milestones are tracked in the Timeline on pages 11-14.

APHIS

2002
48 states become brucellosis free.

2004
Bison that migrated from Yellowstone in 1997 and were kept for research in Idaho are transferred to CSU's Foothills Campus.

2007–2009
Johne's outbreak thwarts potential bison partnership between the City and APHIS.

2010
AHPIS reaches out to the Barfield Lab to express an interest in investigating mitigation strategies for brucellosis.

CSU: THE BARFIELD LAB

2007
Jen Barfield arrives at CSU and begins studying reproduction in domestic animals, especially cattle.

2011
Collaborative research commences with APHIS.

Wildlife Conservation Society arranges for a group of female bison from the American Prairie Reserve to be sent to CSU's Animal Reproduction and Biotechnology Laboratory facility in Fort Collins, CO to serve as recipients of fertilized embryos from a herd of genetically pure bison managed by APHIS.

2012
First bison born using Yellowstone bison as embryo donors.

2014
Six bison born that test negative for brucellosis and have Yellowstone genetics. Their eligibility for release prompts broader conversation with the City about bison reintroduction at Soapstone Prairie.

One Health Catalyst Grant secured in partnership with APHIS and Denver Zoo to study assisted reproductive technologies, assess human dimensions, and analyze the ecological effects of reintroduced bison.

LARIMER COUNTY

2004
Larimer County purchases Red Mountain Open Space.

2007
Red Mountain Open Space Resource Management and Implementation Plan completed.

2009
Red Mountain opens to the public.

CITY OF FORT COLLINS

2004
City of Fort Collins purchases major holdings of Soapstone Prairie.

2009
Soapstone Prairie Mangement Plan Volumes I + II discuss potential introduction of bison in the future.

Soapstone Prairie opens to the public.

IGA

Intergovernmental Agreement developed and signed by APHIS, CSU, City of Fort Collins, and Larimer County.

2015
Denver Zoo, in partnership with CSU, completes year one visitor study to examine the human dimensions of reintroduced bison.

Baseline research completed.

Service learning projects completed to improve and prepare Phase I pasture for future bison.

RELEASE!

Ten bison released at Soapstone Prairie on November 1 to celebrate National Bison Day, the first day of Native American History month, and the launch of the Laramie Foothills Bison Conservation Herd.

Of those released, three resulted from reproductive research; the other seven were born under the care of APHIS.

Diverse members of the public, national media outlets, dignitaries, and tribal leaders attend.

First educational programs offered to the public around the bison release.

2016

Six bison calves born naturally during the first year.

One disease-free bull with Yellowstone genetics introduced to the herd at Soapstone Prairie and Red Mountain.

With oversight from APHIS and the Barfield Lab, ten cleaned embryos are transferred into bison cows.

Monitoring and evaluation continue to track vegetation changes and human dimensions.

2017

Eleven bison calves born naturally during the second year bringing the herd up to 36 individuals.

Seven bison transferred from APHIS and released: four calves and three cows.

A bull from the original group of ten is transferred to the Minnesota Zoo.

APHIS leadership disbands the WiLDIT group and effectively pulls out of the IGA.

~6.4 miles of old cattle fence removed by staff and volunteers to prepare for the Phase II pasture.

Phase II is completed bringing the total bison pasture up to 2,700 acres.

2018

The first bulls born at Soapstone Prairie and Red Mountain are scheduled for transfer.

Bison released into the Phase II pasture.

Bison Management Plan completed.

PART II | THE FUTURE

Following a successful release and establishment period, partners agreed that a formalized Bison Management Plan was warranted to guide decision making as the herd and partnership continue to evolve over the next 10-15 years. Although an adaptive approach will direct management decisions, the Bison Management Plan will provide a solid framework to ensure that proposed actions are in alignment with established objectives and priorities.

PROJECT OBJECTIVES

Moving forward, objectives put forth in the IGA, past management plans, and study designs will continue to be prioritized while allowing new opportunities to be explored. The following have been identified as key project objectives:

- Establish and sustain a genetically diverse and brucellosis-free bison herd with Yellowstone genetics;
- Advance the science of assisted reproductive technologies in wildlife conservation;
- Assess how a cattle-to-bison shift in the grazing regime impacts ecosystems at Soapstone Prairie and Red Mountain and contributes to the achievement of broader land management goals;
- Support new or growing conservation herds across the country by providing individuals from the Laramie Foothills Bison Conservation Herd;
- Demonstrate to other managers, scientists, and policymakers that a new approach to the science and practice of bison reintroduction can be widely applied (Barfield, 2014);
- Develop and deliver high quality educational programming and outreach to engage the public in bison conservation; and,
- Explore opportunities for co-managed bison and cattle grazing.

PHASING + INFRASTRUCTURE

As funding, opportunity, and staff capacity allow, new handling facilities will be developed and infrastructure will be updated to support the herd, ongoing research, and public engagement. As herd management is refined, additional acreage may be expanded beyond Phases I and II. The phasing map found on pages 7-8 tracks expansions and infrastructure improvements to date.

FACILITIES

At present, bison care is coordinated out of APHIS's handling facilities at the National Wildlife Research Center (CSU Foothills Campus). However, APHIS will no longer be a project partner moving forward, and CSU has acquired ownership of the handling facilities to continue disease management, monitoring, and research. As the herd continues to grow, the facilities at the CSU Foothills Campus will become impractical for future use due to the complexities associated with the capture and transport of large numbers of bison. To minimize animal stress, promote safe handling, and increase efficiency, on-site handling facilities will need to be designed and developed at Soapstone Prairie and Red Mountain within the next one-to-three years. Any proposals for such facilities will adhere to CSU's Institutional Animal Care and Use Committee (IACUC) Policies and Guidelines and will incorporate design recommendations from Dr. Temple Grandin (an international expert on humane animal handling) and other experts to pursue best practices for animal care and handling. Further, any proposed design will be thoroughly vetted to assess potential impacts associated with habitat fragmentation, wildlife disturbance, and/or viewshed encroachment. To maintain a light footprint, temporary structures may be considered to facilitate safe handling seasonally while minimizing permanent development.

THE HERD

SIZE | COMPOSITION | GENETIC DIVERSITY

Forage availability, landscape (spatial) constraints, maintenance of genetic diversity, and management limitations suggest that a herd of approximately 75-100 bison could be supported on the existing 2,700 acre bison pasture at Soapstone Prairie and Red Mountain (see: Phasing, pages 7-8). As the herd approaches 100 individuals, management will seek to achieve outcomes that are characteristic of free-ranging bison while accounting for the constraints of a fenced population dependent on active care.

For reasons of safety and to mimic natural tendencies, a 1:25 bull-to-cow ratio will guide management decisions related to herd composition.[3] In pursuit of this predominantly female distribution, bulls will be rotated through the herd and sent to other conservation herds, and cows will age in place at Soapstone Prairie and Red Mountain. Considering the carrying capacity and spatial boundaries of the pasture, lack of natural predators, and reproductive success of the herd, individual bison may need to be transferred to other conservation projects should population numbers push beyond the established herd cap of 100 individuals. In the event of overabundance, the IGA (see: Appendix B) includes a hierarchy of how to divest all or part of the herd, favoring donation as seed stock or sale to private producers over sale for slaughter; the latter will only be considered once all other options are exhausted.

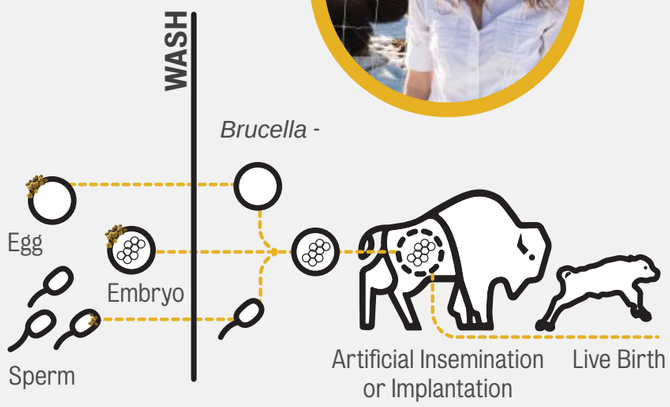
Since the Laramie Foothills Bison Conservation Herd cannot reproduce through chance encounters with other populations, the herd will be supplemented with new individuals, and natural and assisted breeding will be pursued to maintain genetic diversity over time. To minimize potential conflicts associated with introductions, groups composed of bison that interact frequently, have established relationships, or are from the same cohort will be introduced together. When bison are assessed for transfer to other conservation herds, observed relationships and herd dynamics will be considered to minimize stress or isolation. Only in rare circumstances will bison be separated from one another or moved in or out of the herd individually. As the herd changes and grows, splits or the formation of subgroups will be carefully monitored and management decisions will be adjusted accordingly.

3. This number is subject to change based on actual herd size.

HEALTH | REPRODUCTION

The Laramie Foothills Bison Conservation Herd exists as a result of revolutionary research realized by the Barfield Lab with support from APHIS. Bison calves have been successfully born through artificial insemination, embryo transfer, and in-vitro fertilization, and subsequently released at Soapstone Prairie and Red Mountain (see below). This lab-to-prairie reintroduction represents the first-time assisted reproduction has been used to create a new bison population from a genetically significant, but disease-positive herd (Barfield, 2014). Over the next 10-15 years, project partners will continue to support research by Dr. Barfield and her team to test and refine methods of producing genetically diverse and brucellosis-free offspring. Specifically, the research team hopes to improve the efficiency of the techniques and seeks to reach a point where new genetics are not required annually, allowing the herd to be self-sustaining without intervention.

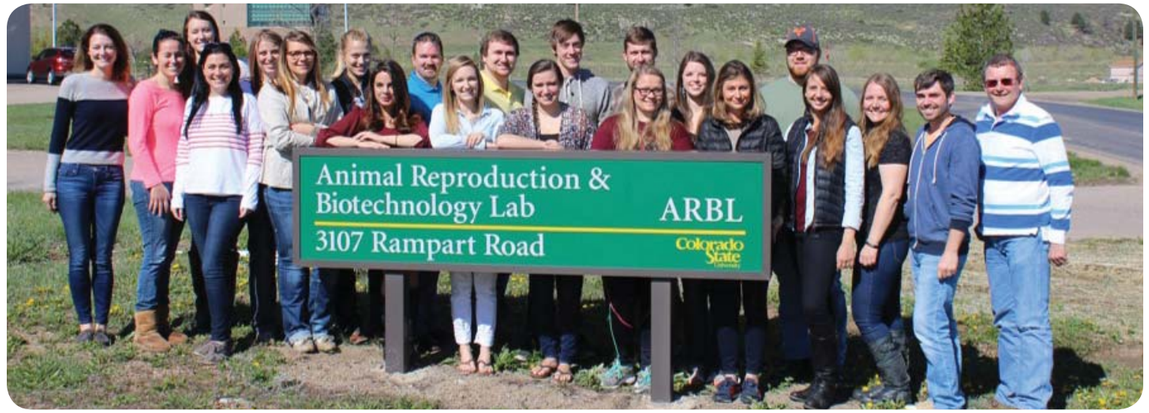
While this research has direct implications for the herd at Soapstone Prairie and Red Mountain, it also offers an alternative to the cull or quarantine programs employed at a national scale to mitigate brucellosis in Yellowstone bison. When used in combination with natural mating, assisted reproductive technologies have the potential to preserve valuable Yellowstone genetics and mitigate disease transmission beyond the Laramie Foothills (Barfield, 2014). Ultimately, the offspring of these techniques may serve as critical source bison for new conservation herds on state, federal, and tribal lands.



THE BARFIELD LAB
BRUCELLOSIS MITIGATION

The assisted reproduction research conducted by the Barfield Lab focuses on producing offspring with Yellowstone genetics through a process where embryos from *Brucella* positive bison are "cleaned" of the disease through a washing process and transferred into *Brucella* negative cows (Barfield, 2014). The Laramie Foothills Bison Conservation Herd is a result of these techniques, and some individuals were born from cows that were artificially inseminated or implanted with cleaned embryos.

Above: Researcher at the Barfield Lab; Dr. Jennifer Barfield. Photos courtesy of CSU.



Above: Dr. Barfield (far left) with students and lab members at the CSU Foothills Campus Animal Reproduction and Biotechnology Lab. Photo courtesy of CSU.

DISEASE MANAGEMENT

Although brucellosis has been successfully eradicated in the United States (with the exception of the Yellowstone bison and elk populations), disease management still plays a critical role in bison conservation (APHIS, n.d.). To ensure that the Laramie Foothills Bison Conservation Herd continues to test negative for brucellosis, routine check-ups and vaccinations occur annually, and any introduced bison are vaccinated before they are released at Soapstone Prairie and Red Mountain. Due to rigorous quarantine procedures and Dr. Barfield's embryo transfer research, brucellosis has not been found in the Laramie Foothills Bison Conservation Herd to date. Moving forward, assisted reproductive methods will continue to be used to mitigate any potential for brucellosis contamination. Other disease management strategies will also be employed including spatial and/or temporal separation between cattle and bison.

While there are no documented cases of plague outbreak among bison, *Yersinia pestis* bacteria can affect a host of mammals through its transmission by fleas. City staff will continue the annual application of deltamethrin insecticide and sylvatic plague vaccine on prairie dog colonies to mitigate plague. However, since the Phase II bison pasture includes an active prairie dog colony that incurs occasional plague infestation, monitoring will occur to ensure that no bison are affected by the disease during plague outbreaks. If deemed necessary, certain areas of the pasture may be closed to bison to prevent potential transmission.

Although documented cases of rabies in bison are also rare, a bison at the CSU Foothills Campus was infected as recently as 2012 (Rhyan et al., 2013). To manage this potential threat, the team will continue to conduct routine disease checks, vaccinate for rabies, mitigate any potential for disease transmission, and document and address any signs of irrational behavior and/or potential symptoms observed in the herd.

Other diseases that could affect the bison herd, such as Johne's disease, malignant catarrhal fever, and bovine tuberculosis, will continue to be monitored, and appropriate actions will be taken to prevent and mitigate potential outbreaks or fatalities.

EYES ON THE HERD

Since the release in 2015, the safety and wellbeing of the herd have been routinely monitored through visual scans. Since 1,700 acres were added during the Phase II pasture expansion, alternative surveillance options (including potential new technologies) will be explored to improve the efficiency of routine checks in the future.

In addition to daily bison checks, an Emergency Response Plan (ERP) was created prior to the 2015 release to address emergency situations and safeguard both the bison and the community. Moving forward, the ERP will continue to be implemented and periodically reviewed to adapt to changes in management (see: Appendix C).

INTERVENTION

In the event of sickness or injury, humane treatment will be administered; however, intervention will be avoided unless required by extenuating circumstances. Careful monitoring, in-field examinations, vaccinations, and antibiotics (if minor infection is suspected) will be the primary preventative methods utilized to safeguard the wellbeing of the herd.

Should a sick or injured animal be rejected by the herd, the individual will be evaluated for relocation to a new herd or transferred to the CSU Foothills Campus facility. While the project involves many invested partners, the final jurisdiction for treatment or intervention resides with CSU, as they own the bison (City of Fort Collins et al., 2014). If a bison dies from an unknown cause, the team will perform an in-field assessment or transfer the individual to the CSU College of Veterinary Medicine teaching hospital for evaluation. In either scenario, a necropsy will be performed to determine the cause of death and ensure it is not brucellosis related. If the cause of death can be determined and is not deemed to be disease related, the individual will be left in the pasture to decompose naturally. Measures may be taken to relocate the individual if it is within public view.

Currently, no handling facilities or recovery stalls exist at Soapstone Prairie or Red Mountain to treat sick or injured animals. As the herd continues to grow, on-site handling facilities will become essential for continued care. Potential improvements to address this need are discussed on pages 15-16.

ECOSYSTEM HEALTH

CATTLE AND BISON GRAZING

Understanding how native (e.g., bison) and non-native grazers (e.g., cattle) influence prairie ecosystems remains an important conservation research topic at Soapstone Prairie and Red Mountain (Barfield, 2014). While bison are no longer the predominant grazer of the shortgrass prairie, grazing does play a crucial role in maintaining ecosystem health and landscape heterogeneity. At Soapstone Prairie and Red Mountain, both bison and cattle grazing contribute to the achievement of vegetation management goals, although the existing bison population is not sizable enough to drive significant landscape change at the scale required for successful management.

For domesticated cattle, Folsom Grazing Association and the City, as well as a private local rancher and the County, have worked together to create grazing leases that mimic ecological disturbance regimes to manage Soapstone Prairie and Red Mountain as working landscapes. At present, decisions concerning stocking rates, grazing rotations, and the carrying capacity of the land are derived from a combination of traditional ranching metrics and ecological assessments. Moving forward, grazing areas will continue to be monitored and managed to support

Above: Cattle drive at Soapstone Prairie. Photo courtesy of Folsom Grazing Association.

heterogeneity in vegetation composition and structure. Grazing plans may be modified in response to environmental conditions, such as poor vegetative health or limited forage availability, to adjust the duration and number of cattle grazing at Soapstone Prairie and Red Mountain.

For bison, the City and County are responsible for determining grazing management actions. As outlined in the IGA, project staff will continue to "collaboratively develop an annual written 'Grazing Plan' for the Properties, which will include stocking rates, animal unit months ('AUMs') for each pasture, and grazing rotation plans" (2014). Future management decisions will conform to the terms of the IGA and adapt to findings associated with ongoing monitoring of vegetation and wildlife responses to bison and cattle grazing.

BISON STOCKING RATE

The Phase II bison pasture (see: Phasing, pages 7-8) shares similar soil and forage production rates as the Phase I bison pasture; therefore, the same stocking rates were utilized to estimate the carrying capacity of the Phase II pasture. In all instances, stocking rates will respond to actual resource availability and herd conditions while working towards a partnership goal of 75-100 bison.

To complement stocking rate caps, an adaptive pasture rotation strategy will be employed to promote a diversity of vegetation communities and encourage interaction among shortgrass prairie vegetation and wildlife such as grassland birds, prairie dogs, and pronghorn. Through rotation based on seasonality, variation in grazing intensity, and targeted species interactions, management will seek to achieve heterogeneity in vegetation composition and structure.

MONITORING AND ASSESSMENTS

Ongoing assessments will be made to better understand how temporal and spatial shifts between cattle and bison grazing support vegetation management goals to increase heterogeneity and trend towards reference plant communities identified at Soapstone Prairie and Red Mountain by the National Resources Conservation Service. These assessments will look at changes in composition, forage production, and consumption over time using a variety of methods such as photopoint monitoring, range exclosures, production clippings, and vegetation transects. Forage estimates may be adjusted in response to incoming data and analyses, and any indication of continual habitat degradation will prompt consideration of alternative vegetation management practices.

WILDLIFE INTERACTIONS

Soapstone Prairie and Red Mountain conserve high quality shortgrass prairie, foothills shrubland, and diverse riparian areas providing critical habitat for an abundance of native wildlife. As such, management decisions related to pasture expansion, infrastructure, and grazing will take a "wildlife first" approach to prioritize the conservation of ecological communities found in the Laramie Foothills.

To conserve avian wildlife, targeted grazing and other management techniques will be utilized to improve vegetation structure and composition. From varying grazing intensity to fencing exclosures, different strategies will be employed to establish and maintain a highly diverse mosaic of habitat types. In doing so, species like McCown's longspurs and mountain plovers will have access to both the short nesting and tall forage grass they depend upon for survival (Youngberg & Panjabi, 2016).

To safeguard avian breeding habitats within the bison pasture, regular monitoring will be conducted to assess potential impacts to nesting areas. Although no known threats are anticipated with the Phase II bison pasture expansion, any changes on the ground will be carefully tracked to ensure sensitive areas remain protected. If significant impacts are observed, certain areas of the pasture may close seasonally.

Beyond avian species, Soapstone Prairie and Red Mountain represent critical wintering habitat for wildlife such as elk, mule deer, and pronghorn. Bearing in mind that there is a substantial difference in the amount of browse consumed by wildlife than by cattle or bison, approximately 70% of the forage in the pasture remains for wildlife grazing (Fusaro, 2008a; Fusaro, 2008b). While concerns regarding interspecific competition do not exist, vegetation trends and pasture productivity will continue to be monitored, and if degradation is observed, modifications to management practices will be considered, especially during the winter season.

Livestock fencing can negatively affect movement corridors for elk, mule deer, and pronghorn, but is necessary to contain the bison herd for pasture management. Although the fencing utilized to secure the bison pasture was specifically designed to be wildlife friendly (see: Appendix A), movement of migrating ungulates and other species will continue to be monitored to assess potential impacts associated with bison fencing. To assist with this monitoring, and complement on-site observations, wildlife cameras or other tracking devices may be installed along fence lines. Observed conflicts or perceived threats to safe passage will be mitigated, and modifications and repairs to existing fencing will occur as needed.

The Phase II expansion of the bison pasture envelopes roughly 200 acres of an active prairie dog colony which provides habitat for other grassland wildlife including the black-footed ferret, McCown's longspur, mountain plover, and swift fox; all endangered or species of concern (Youngberg & Panjabi, 2016). During the annual application of deltamethrin insecticide and sylvatic plague vaccine on prairie dog colonies—as well as the biannual black-footed ferret monitoring—short-term relocations to other pasture zones may be considered to move bison away from treated areas and address human safety concerns related to working near the herd. These short-term actions will support ongoing research and assessment of ecological or behavioral changes among species.

PUBLIC ENGAGEMENT

The Laramie Foothills Bison Conservation Herd continues to gain popularity with an invested public and momentum in the conservation community. Educational programming, volunteer service learning, and original research opportunities will continue to be offered to provide residents with an open window into the lives of bison at Soapstone Prairie and Red Mountain. These programs and public engagement opportunities will take a passive stance in order to manage the herd with limited human contact. By assuming a passive role, bison conservation will be supported in a way that minimizes human interactions, reduces safety concerns, and raises public awareness about the successes and challenges facing the herd.

At present, the herd is visually accessible to the public from March to November when Soapstone Prairie and Red Mountain are open; however, the herd's whereabouts change daily, and suitable vantages are limited making viewing opportunities random and infrequent (see: Phasing, pages 7-8, Viewing Opportunities). The rerouted Cheyenne Rim Trail, Phase II pasture expansion, and growth of the herd may create additional opportunities to see the bison at close proximity, but challenging terrain and greater room to roam may make such encounters rare. In the next 10-15 years, tours and technology may be developed to help make the herd more visually accessible, although intensive promotion is not a management priority.

With the rerouted trail and potential for close encounters with the herd, public safety will always remain a priority. To minimize potential conflicts, fencing will be properly maintained and recreation will be adapted or terminated if activities pose a risk to human or bison safety (Natural Areas Department, 2007). Should either be compromised, the City and County reserve the right to close portions of Soapstone Prairie and Red Mountain to the public per the IGA.

Currently, the Cheyenne Rim Trail is designated for mixed-use, allowing biking, hiking, and horseback riding. While impacts are not anticipated, recreational activities may be limited or single-use designations may be applied if activities are shown to be disruptive to the herd. Seasonal closures of the Cheyenne Rim Trail may also occur during calving season if bison exhibit aggressive behaviors or if the public induces negative responses in bison (City of Fort Collins et al., 2014). To better understand the social and recreational impacts of the herd, visitation and visitor perceptions of bison may be evaluated as needed.

EDUCATIONAL PROGRAMMING + OUTREACH

In addition to viewing opportunities and recreation, numerous educational programs related to bison have been provided prior to, and since the 2015 release. Moving forward,

popular education programs will continue to be offered and new programming may be developed to bolster community support for bison conservation.

Project partners continue to seek out opportunities to connect a diverse public to the bison. While there are limited indigenous peoples currently affiliated with the initiative, there is interest in collaborating on "Science, Technology, Engineering, Mathematics" (STEM) education, internships, and other projects in the future. Increasing accessibility to bison research and finding new ways to celebrate cultural connections to the herd will remain an ongoing priority.

CHALLENGES + OPPORTUNITIES

The success of the Laramie Foothills Bison Conservation Herd can be attributed to the strength of the collaborative partnership, enthusiasm of staff and researchers, and investment of an engaged public. While the growth of the herd is indicative of a strong foundation for future success, uncertainties exist, especially related to the sustained involvement of partners and challenges associated with long-term management including staffing changes, political will of various partner organizations, available resources, and funding. The agreements outlined in the IGA and an adaptive approach will serve as guides for navigating future trials and opportunities.

To address challenges as they arise and achieve the conservation objectives set forth in this plan, an open dialogue will be maintained and management strategies will be adapted to reflect an evolving understanding of the role bison play in the greater ecosystems of Soapstone Prairie and Red Mountain. From habitat diversification to disease management, reproductive research to public engagement, project partners are committed to securing the long-term viability of both the project and the herd. To play a valuable role in bison conservation beyond the Laramie Foothills, the City, the County, and CSU will actively seek out opportunities to share findings, bison, and a replicable partnership model with the broader conservation community.

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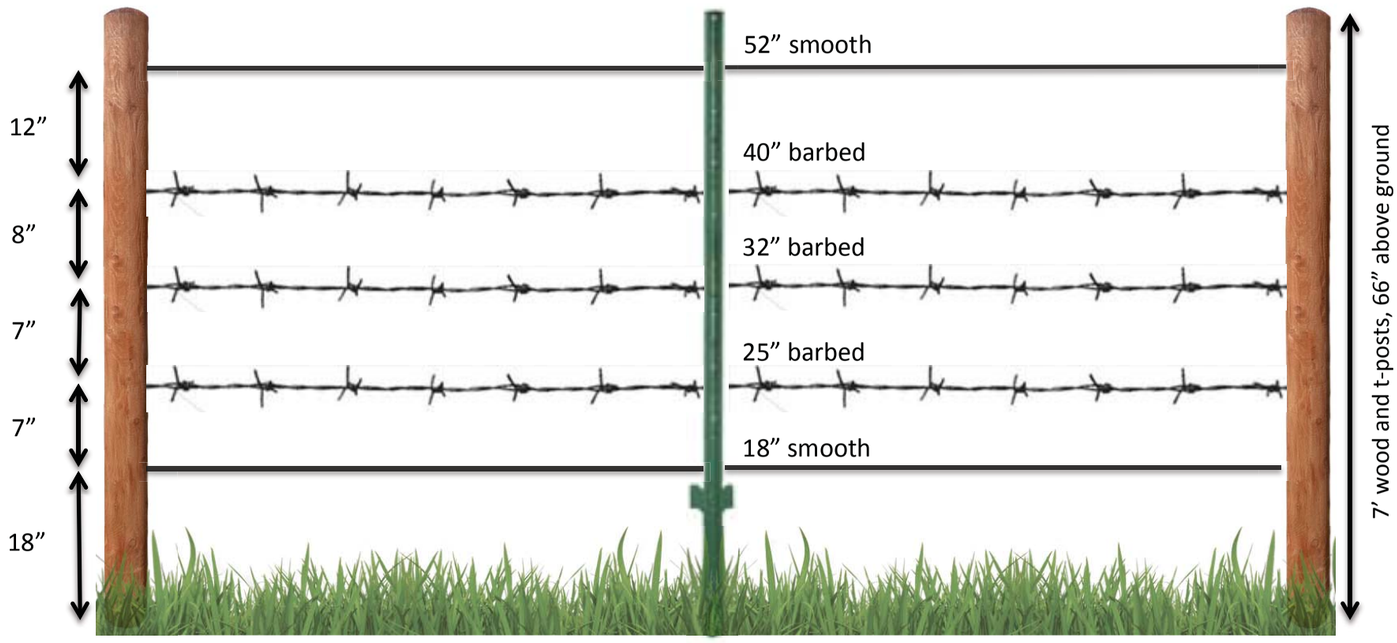
Fencing Design Specs

Soapstone/Red Mountain Bison Pasture

City of Fort Collins Larimer County Colorado State University USDA-APHIS



- CPW Wildlife Fencing Standards
- Galvanized 12 ½ ga smooth wire
- Galvanized 14 ga barbed wire
- 9 ga 1 ½ in staples
- 7’ tall, 5” diameter wooden posts
- Standard t-post (1.33 lbs./ft)
- H-braces @ 800 ft spacing or significant change w/ 8’ tall, 6” posts
- 60” tall rough stock rodeo gates

APPENDIX B: INTERGOVERNMENTAL AGREEMENT

INTERGOVERNMENTAL AGREEMENT
FOR GRAZING OF BISON
AT SOAPSTONE PRAIRIE AND RESERVOIR RIDGE NATURAL AREAS
AND RED MOUNTAIN OPEN SPACE

THIS INTERGOVERNMENTAL AGREEMENT ("Agreement"), dated 3/24/15, 2015, is entered into by and between THE CITY OF FORT COLLINS, COLORADO, a municipal corporation ("City"), LARIMER COUNTY, COLORADO ("County"), THE BOARD OF GOVERNORS OF THE COLORADO STATE UNIVERSITY SYSTEM ACTING BY AND THROUGH COLORADO STATE UNIVERSITY, ON BEHALF OF THE ANIMAL REPRODUCTION AND BIOTECHNOLOGY LAB ("CSU"), and THE UNITED STATES DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE VETERINARY SERVICES ("APHIS"), and will be effective on the date last signed below ("Effective Date"). The City, County, CSU and APHIS are referred to herein individually as a "Party" and collectively as the "Parties."

RECITALS

A. Pursuant to a separate agreement between them, CSU and APHIS are collaborating on a program to investigate the use of assisted reproductive techniques as a brucellosis mitigation strategy for North American Bison (the "Project").

B. The majority of the Project work will be conducted at CSU facilities in Fort Collins, and the animals involved will be owned by CSU.

C. The City and County are the owners of certain properties, situated in the County of Larimer, State of Colorado, commonly known as the Soapstone Prairie Natural Area and the Reservoir Ridge Natural Area (City owned), and Red Mountain Open Space (County owned) (together, the "Properties"), and the City and County are willing to make portions of these properties available as grazing land for bison involved in the Project.

D. Bison are listed in the Soapstone Management Plan as a species that the City's Natural Areas Department (NAD) would like to reintroduce to Soapstone. The Project would also benefit the City by providing native grazing animals for grassland management and creating a unique wildlife viewing opportunity for the public.

E. CSU will collaborate with the City and County to conduct surveys that evaluate the impact that bison have on grassland health. This will include non-invasive research conducted by graduate students from CSU, and will also provide opportunities for citizen volunteers to be involved in the Project.

F. Use of the Properties for the Project will also benefit the public by supporting important work in bison genetics, disease mitigation and management, and the implementation of new techniques in the reproductive sciences to help conserve an iconic grassland species.

NOW, THEREFORE, the parties agree as follows:

1. Term and Termination. The term of this Agreement will begin on the Effective Date and continue until termination of the Project. Any Party may also terminate this Agreement at any time on no less than six (6) months advance written notice to the other Parties.

2. Funding.

(a) CSU, APHIS, the City and the County will collaborate to develop funding sources ("Project Funds") to pay for the construction, maintenance and repair of bison fencing, bison handling facilities, water development, and other necessary grazing and grazing management infrastructure, and herd maintenance needs on the Properties, including but not limited to veterinary care and supplemental feed. Funding provided by the City and County will not exceed the amount of funding provided by other partners in the project and will only be used for expenses on the Properties. The City and County are not obligated to provide funding for the Project.

(b) Non-City or County Project Funds will be held and administered by CSU or CSU's designee, and possibly through the CSU Foundation, which can accept tax-deductible donations to be made to the Project.

(c) The City has agreed to provide and install bison fencing on the Properties at a value of up to Forty Thousand Dollars ($40,000) in matching funds for initiation of the Project on the Properties.

3. Construction of Improvements.

(a) While the initial bison fencing will be installed by the City, other parties may want to place other improvements on the Properties from time to time. No improvements may be placed on any of the Properties by CSU or APHIS without the prior express written approval of the owner of such Property. The City and County will review and approve the location and design of any improvements proposed to be constructed on their respective Properties for the Project, including bison fencing and other grazing infrastructure. Any proposed improvements must be submitted to the owner of the property for its review at least sixty (60) days in advance of the proposed installation. The City and County will, in their reasonable sole discretion, approve or deny any requests for improvements. If a request is denied, the City and/or County will provide CSU and APHIS with a written response with the reason for the denial of approval. The construction of all such improvements on City-owned Properties may need to be contracted through the City's purchasing process, or as otherwise approved by the City's Director of Purchasing and Risk Management.

(b) The City and/or County agree to install signage at the entrance to the Properties that are being used for bison grazing with appropriate information about the Project and bison safety. The Parties shall confer on the type and nature of all such signage.

4. City and County Rights and Responsibilities.

(a) The City and County will provide a portion of the Properties for year-round grazing purposes for the Project, and hereby grant to CSU, APHIS and to each other a license to enter on their respective Properties for the purpose of carrying out the obligations of the parties under this Agreement.

(b) On or about March 1 of each year, commencing in 2015, the City, County and CSU will collaboratively develop an annual written "Grazing Plan" for the Properties, which will include stocking rates, animal unit months ("AUMs") for each pasture, and grazing rotation plans. If the City, County and CSU have not agreed upon a Grazing Plan by May 1 of each year, the City and County will determine the Grazing Plan for that year and provide CSU and APHIS with a written copy of the Grazing Plan..

(c) The parties acknowledge that the City and County currently have cattle grazing programs on Soapstone and Red Mountain and that they intend to maintain those programs. Further, the City may initiate a grazing program on Reservoir Ridge and may, in its sole discretion include the property in this Agreement.

(d) Notwithstanding paragraph 4(b) above, if the City or County determines that the grazing conditions on its respective Property warrant it, whether such conditions are caused by drought, pestilence, insect infestation or any other circumstance beyond the City and County's control, the City or County may reduce the agreed-upon number of AUMs per year on its Property to that number it determines is appropriate under the then-existing grazing conditions. If favorable grazing conditions exist, and the City or County determines that conservation objectives will not be negatively impacted by additional grazing, the City or County may increase the numbers of AUMs per year on its property to a number it determines is appropriate under the then-existing grazing conditions.

(e) In addition to grazing land, the City and County (or their designees) will coordinate with each other to provide the following on the Properties:

(1) Access to existing water sources for livestock;
(2) Grazing management, including monitoring of forage use, water availability and range conditions to determine if changes are needed, and reporting any necessary actions to Jennifer Barfield (910-354-8061 or Jennifer.Barfield@colostate.edu) at CSU;
(3) Periodic herd monitoring including reporting any problems or changes to CSU (contact: Jennifer Barfield or main ARBL office at 970-491-3456); and
(4) Periodic inspection, maintenance and repair of fencing, water developments, and other grazing infrastructure during normal working hours.

(f) The City and County agree to allow research by CSU faculty and students on the Properties with the approval of the City and/or County. A written summary of the proposed research project must be submitted to the City and/or County for their review and approval at least 30 days prior to the initiation of the study.

5. CSU Rights and Responsibilities.

(a) All bison placed on the Properties will be owned by, and be the responsibility of, CSU. CSU will provide veterinary care, reproductive services, veterinary supplies, and supplemental feed for the animals as needed. All supplemental feeding will be conducted in predetermined locations on the Properties approved in advance in writing as part of the Grazing Plan, and all hay shall be certified "weed free" by a certifying body acceptable to the City and County in their sole discretion. CSU will monitor the animals on a regular basis and will respond promptly to any reports from the City or County of sick or injured animals, escaped animals, or needed changes in stocking or rotation dates based on changed conditions on the Properties. CSU will be responsible for gathering and/capturing any escaped bison.

(b) CSU will administer the Project Funds (see section 2a and 2b) to reimburse reasonable costs for labor and materials for maintenance and repair work on fencing, water developments, and other infrastructure. CSU will reimburse the City or County within thirty (30) days of receipt of a detailed invoice describing the work performed. Estimates for these costs will be provided to CSU for approval prior to the initiation of the work, except in an emergency. In the case of an emergency repair or similar situation, the City or County may proceed with the work and provide invoices for the repair to CSU as soon as reasonably possible.. If Project Funds are depleted and the parties agree that certain maintenance or repair work is necessary and should be performed, CSU may agree to reimburse the cost of such materials provided that the City and County provide the labor for such maintenance or repair work from other sources.

(c) CSU may use the Properties for bison grazing purposes only. This Agreement does not allow for any other private or commercial uses, hunting, shooting, trapping or poisoning of wildlife, or control of prairie dogs.

(d) In consideration of the use of the Properties for grazing, CSU agrees to use best efforts so that any animals that are no longer needed for the Project will be disposed of in priority as follows:

(1) Provided as "seedstock" to other public conservation herds;
(2) Sold to private producers, provided all proceeds from such sale are used to support the Project;
(3) Donated to the City and/or County, subject to the City's or County's acceptance of the donation in its discretion;
(4) If other options are exhausted, the animals may be sold to slaughter, provided all proceeds from such sale are used to support the Project; or

(5) If the Project has been terminated or the herd is completely eliminated through slaughter, the proceeds of any sale will be donated to the City and County to reimburse each party for expenses associated with the Project. Once the City and County are fully reimbursed, the remaining funds can be used by CSU to cover Project expenses. Any funds remaining may be donated to the American Bison Society or similar American bison conservation organization.

(e) CSU, in cooperation with the City and County, will conduct studies on how bison grazing impacts prairie ecosystem health. In addition, faculty and students from various colleges will conduct non-invasive research approved by the City and/or County. Participation by other organizations in these studies, such as the Denver Zoo will be managed through CSU. All organizations participating in studies on the Properties must be approved by the Property owner, and approval will be at the Property owner's sole discretion.

6. APHIS Responsibilities. APHIS will provide the "seedstock" bison for the Project and will provide disease monitoring on a regular basis for all Project animals. APHIS will provide testing to ensure that bison remain brucellosis free.

7. Education and Outreach. The parties will collaborate on education and outreach programs related to the Project. All parties will be acknowledged on printed materials, press releases and other materials developed about the Project. Peer-reviewed, scholarly publications will acknowledge all parties but will not give authorship unless individuals provided significant contributions to experimental design, data collection, or data analysis of the published study.

8. Use and Condition of the Properties.

(a) CSU and APHIS acknowledge that the Properties are open to the public. The City and County reserve the right to close all or any portion of the Properties to the public at any time. The City and County also reserve the right to perform management activities on the Properties, and to make alterations, changes and additions to the land and improvements that make up the Properties, at any time.

(b) Neither CSU nor APHIS shall permit or allow the use of the Properties by: (1) the general public, except for members of the public using the Properties in accordance with the City of Fort Collins Code and Natural Areas regulations and policies, and Larimer County Natural Resources Regulations, or (2) any persons other than CSU and APHIS's employees or agents, who are permitted to occupy or use the Properties only to the extent required to carry out the purposes of this Agreement.

(c) Only licensed vehicles are allowed on the Properties and must remain on established roads. Unlicensed vehicles are prohibited, except that ATVs used for animal management activities may be used on or off established roads, but only with the express written permission of the City or County, as applicable, keeping such use to an absolute minimum and only during dry conditions unless such use is necessary due to an emergency situation.

(d) CSU and APHIS acknowledge and agree that the City and County have not made, do not make, and specifically negate and disclaim any representations, warranties, or guarantees of any kind whether expressed or implied, oral or written, past, present, or future, concerning the Properties and; (i) the value, nature, quality, or condition of the Properties, including, without limitation, the water, soil, and geology of the Properties; (ii) the suitability of the Properties for any and all activities and uses which the parties may conduct thereon including the grazing of livestock; (iii) the compliance of or by the Properties or their operation with any laws, rules, ordinances, regulations of any applicable governmental authority or body; (iv) the manner or quality of the construction or materials, if any, incorporated into the improvements located on the Properties; (v) the manner, quality, state of repair or lack of repair of the improvements located on the Properties; or (vi) any other matter with respect to the Properties and the improvements located thereon. Specifically, the City and County have not made, do not make and specifically disclaim any representations regarding compliance with any environmental protection, pollution, or land use laws, rules, regulations, orders, or requirements, including solid waste, as defined by the U.S. Environmental Protection Agency regulated at 40 C.F.R., Part 261, or the disposal or existence, in or on the Properties, of any hazardous substance, as defined by the Comprehensive Environmental Response Compensation and Liability Act of 1980, as amended, and regulations promulgated thereunder.

9. Special Conditions.

(a) Winter/Off Season. CSU, the City and the County acknowledge that access to some or all of the Properties may be difficult in the winter months. CSU, the City and the County agree to use best efforts to monitor bison health, supplemental feed and water needs on the Properties on a regular basis using the resources of CSU, the City and County as available for each Property.

(i) Soapstone Prairie Natural Area. Soapstone has a resident ranch manager that is employed by the grazing tenant on the Property. The City will request that the ranch manager monitor the above needs during his/her regular working hours, even during the period of time that the area is closed to the public. However, the parties acknowledge that the grazing tenant and its ranch manager are not employees or agents of the City and are under no obligation to provide these services. CSU will provide additional support to monitor the animals if the ranch manager is not available and advance notice is provided to CSU by the City.

(ii) Red Mountain Open Space and Reservoir Ridge Natural Areas. CSU, the City and County will agree upon a winter monitoring plan for these two properties prior to the introduction of bison into these areas.

(b) Calving Season. The bison calving season is from April 1st – July 31st of each year. During this period, visitor access may need to be restricted for public safety, or, at a minimum, additional signage and information may need to be provided to visitors of the Properties. The Parties agree to collaborate to provide this restricted access when warranted.

10. Communications. The Parties agree to collaborate in advance on any press release, media statement, adjacent landowner communication or promotion related to the use of the Property for the Project. Also, the Parties acknowledge that, in the event of an emergency concerning the Property and the Project, they will use their best efforts to coordinate with each other on any public communications; however, coordinating such communications in advance may not be practicable. In addition, the Parties agree to collaborate on their fund raising and communications for the Project.

11. Liability and Insurance.

(a) To the extent permitted by applicable law, each party will be responsible for its own negligent acts or omissions and that of its officers, employees, agents and contractors. Neither the City nor the County will be liable to CSU, APHIS or each other for any livestock injuries or deaths, regardless of cause, incurred in connection with grazing on the Properties under this Agreement, unless such injuries or deaths result from a negligent act or omission of the City or County. Any liability of the City, County, CSU, or their officers and employees is subject to all the defenses, immunities, and limitations of the Colorado Governmental Immunity Act (Section 24-10-101, et seq.) and to any other defenses, immunities, and limitations to liability available under the law.

(b) During the term of this Agreement, CSU, at its sole cost and expense, must procure, pay for, and keep in full force and effect a comprehensive policy of general liability insurance and insuring CSU in an amount not less than One Million Dollars ($1,000,000.00), which may also be provided through self-insurance, covering bodily injury, including death to persons, personal injury, and property damage liability arising out of a single occurrence. Such coverage must include, without limitation, the insured's' liability for property damage, bodily injuries, and death of persons in connection with the keeping of CSU's bison on the Properties (including acts or omissions of CSU or of its officers, employees, or agents), and protection against liability for non-owned and hired automobiles. Such coverage must also include automobile liability insurance. All such policies of insurance must name CSU as an insured and name the City and County as additional insureds. CSU shall provide the City and County with notice of cancellation within 30 days. CSU will provide certificates of insurance to the City and the County as evidence of insurance. Notwithstanding the notice period in paragraph 1, if CSU's insurance is cancelled the City and/or County may immediately terminate this Agreement and require removal of the animals from the Properties.

(c) All Project work conducted on the Properties, including movement of animals from outside Colorado onto the Properties, must comply with all applicable laws, regulations and other legal requirements.

12. Default. If any party defaults in its obligations under the terms of this Agreement, a non-defaulting party may give the defaulting party written notice specifying the nature of the default. If the defaulting party has not cured the default within thirty (30) days, or, for a default reasonable requiring more than 30 days to effect a cure, has not commenced a cure within 30 days and pursued it with diligence, then the non-defaulting party may terminate this Agreement and/or pursue all available remedies at law or in equity.

13. Termination. Upon termination of this Agreement:

(a) All bison must be removed from the Properties unless CSU agrees to donate, and the City or County agrees to accept, some or all of the animals.

(b) Upon termination of the Project, CSU will remove surface fixtures, equipment and other improvements installed on the Properties for the Project, except for the fencing, to the extent requested by the City and County. CSU must consult with the Property owner in advance of any such removal, and the City or County may in its sole discretion require CSU to leave some or all improvements in place, provided that CSU shall be allowed to remove all portable handling facilities from the Properties. If CSU removes improvements from the Properties, CSU shall restore the Properties to a condition comparable to their condition prior to the removal activities.

14. Notices. Any notice or other communication given by any party to another relating to this Agreement must be hand-delivered or sent by registered or certified mail, return receipt requested, or by overnight commercial courier, addressed to such other party at its respective addresses set forth below; and such notice or other communication will be deemed given when so hand-delivered or three (3) business days after so mailed, or the next business day after being deposited with an overnight commercial courier:

If to the City:

Natural Areas Department
City of Fort Collins
Attn: Natural Areas Director
P.O. Box 580
Fort Collins, CO 80522

With a copy to:

City Attorney's Office
City of Fort Collins
P.O. Box 580
Fort Collins, CO 80522

If to the County:

Larimer County Natural Resources Department
1800 S. County Road 31
Loveland, CO 80537

If to CSU:

Animal Reproduction and Biotechnology Lab
Attn: Department Head
Colorado State University
Fort Collins, CO 80523

With a copy to:
Office of the General Counsel
Colorado State University System
01 Administration Building
0006 Campus Delivery
Fort Collins, CO 80523

If to APHIS:

Animal and Plant Health Inspection Service
Veterinary Services, Office of the Deputy Administrator
Washington, DC 20250

15. Obligations Subject to Appropriation. The obligations of the City and of the County to commit or expend funds after calendar year 2014 are subject to and conditioned upon the annual appropriation of funds sufficient and intended to carry out said obligations by the Fort Collins City Council and the Larimer County Board of County Commissioners, respectively, in the City and County's sole discretion. If the City Council or Board of County Commissioners do not appropriate funds necessary to carry out any such obligations, the City or County will notify the other parties promptly of such non-appropriation. If such non-appropriation results in a material impairment of CSU or APHIS's rights hereunder, such party may terminate the lease, with no further recourse against the City or County, by providing thirty (30) days written notice to the City and or County. If neither party exercises this termination right within sixty (60) days of receiving the City's or County's notice of said non-appropriation, then each such party waives its right to terminate this Agreement pursuant to this section.

16. General Provisions.

(a) Words of the masculine gender include the feminine and neuter gender; and when the sentence so indicates, words of the neuter gender refer to any gender. Words in the singular include the plural and vice versa.

(b) This Agreement is to be construed according to its fair meaning and as if prepared by all parties hereto and is deemed to be and contain the entire understanding and agreement between the parties hereto. There shall be deemed to be no other terms, conditions, promises, understandings, statements, or representations, expressed or implied, concerning this Agreement unless set forth in writing and signed by the parties hereto.

(c) This Agreement cannot be modified or assigned except in writing signed by all parties.

(d) Subject to the provisions hereof, the benefits of this Agreement and the burdens hereunder inure to and are binding upon the parties hereto and their respective heirs, administrators, successors, agents and permitted assigns.

(e) This Agreement will be governed by and its terms construed under the laws of the State of Colorado. Any judicial proceedings commenced by a party to enforce any of the obligations, covenants, and agreements contained herein, must be commenced in the Larimer County District or County Courts or the Federal Courts in Denver, Colorado.

(f) Nothing contained herein is deemed or should be construed by the parties nor by any third party as creating the relationship of principle and agent, a partnership or a joint venture between the parties, or an employment relationship between the parties.

(g) This Agreement is made for the sole and exclusive benefit of the City, County, CSU and APHIS, their successors and assigns, and it is not made for the benefit of any third party.

(h) The City and County reserve the right to grant to any third party such easements and rights-of-way as they each may desire over, across, and under portions of the Properties and to lease all or any portion of the Properties to any other third party so long as such easements, rights-of-way, and leases do not unreasonably interfere with the rights of CSU or APHIS as provided in this Agreement.

(i) If any term or condition of this Agreement is held to be invalid by final judgment of any court of competent jurisdiction, the invalidity of such a term or condition, will not in any way affect any of the other terms or conditions of this Agreement, provided that the invalidity of any such term or condition does not materially prejudice any party in their respective rights and obligations under the valid terms and conditions of this Agreement.

(j) To the extent necessary to carry out all of the terms and provisions hereof, the said terms, obligations, and rights set forth herein survive and will not be affected by the expiration or termination of this Agreement.

(k) No party will be deemed in violation of this Agreement if prevented from performing any of its respective obligations hereunder by reason of strikes, boycotts, labor disputes, embargoes, shortage of energy or materials, acts of God, acts of public enemies, acts of superior governmental authorities, weather conditions, rights, rebellions, sabotage, or any other circumstances for which it is not responsible or that are not within its control.

THE CITY OF FORT COLLINS, COLORADO
a Municipal Corporation

Date: 03/24/15

By: Karen Weitkunat
Karen Weitkunat, Mayor

ATTEST:
Wanda Nelson
City Clerk

CITY OF FORT COLLINS SEAL COLORADO

APPROVED AS TO FORM:
D. Daller
Assistant City Attorney

LARIMER COUNTY, COLORADO

By: Linda Hoffmann
Linda Hoffmann, County Manager

APPROVED AS TO FORM:
Stacy 1-15-15
County Attorney

THE BOARD OF GOVERNORS OF THE COLORADO STATE UNIVERSITY SYSTEM, ACTING BY AND THROUGH COLORADO STATE UNIVERSITY

Date: 1-30-15

By: _____
Amy L. Parsons
Vice President for University Operations

Approved:

Date: 1-30-15

By: _____
Dr. Thomas Hansen, Director
Animal Reproduction and Biotechnology Laboratory

Legal Review:

Date: 1/30/15

By: _____
Jason L. Johnson
Deputy General Counsel
Colorado State University System

USDA
United States Department of Agriculture

Animal and Plant Health Inspection Service

Veterinary Services

1400 Independence Ave, SW

Washington, DC 20250

Date: 2/6/15

_____
John R. Clifford
Chief Veterinary Officer
USDA

APPENDIX C: EMERGENCY RESPONSE PLAN

EMERGENCY RESPONSE PLAN
FOR GRAZING OF BISON
AT SOAPSTONE PRAIRE AND RESERVOIR RIDGE NATURAL AREAS
AND RED MOUNTAIN OPEN SPACE

A herd of bison owned by Colorado State University (CSU) with disease management provided by the United States Department of Agriculture Animal and Plant Health Inspection Service Veterinary Services (APHIS) was released onto a portion of Soapstone Prairie Natural Area (Soapstone) and Red Mountain Open Space (Red Mountain) in the fall of 2015.

There is currently 1,000 acres that makes up phase one of the bison pasture. The pasture is split in half by a fence line running north and south creating the East pasture and the West Pasture. At this point in time, CSU or USDA does daily welfare/water checks for the bison on T, TH, FRI, SAT and SUN. Natural Areas staff is responsible for daily checks on Monday and Wednesday of each week. A small group of staff from CSU, USDA, CFC and LCNR with access to the bison has been included on a rolling email to coordinate daily checks and communicate about day to day findings.

A few individual bison may be kept on Reservoir Ridge Natural Area as well – a separate Emergency Response Plan will be drafted for that site. The following Emergency Response Plan outlines the responsibilities of the parties involved (CSU, City of Fort Collins, Larimer County and APHIS) and the steps to occur in case of the following emergency events:

Water Shortage

- The City and County (Landowners) will provide access to existing water sources within bison pastures for livestock and monitor water availability.
- In the event that existing water sources are insufficient or become unavailable, CSU will be responsible for hauling water to the bison. The Landowners will work to make existing water sources available as soon as possible if mechanical failures cause the water to become unavailable.
- Water may be hauled from other parts of the Properties subject to water availability and permission being granted by the Landowners.
- The Landowners will maintain existing water infrastructure including normal wear and tear. If water infrastructure is destroyed or damaged by bison or another emergency situation, the Landowners will coordinate and perform repairs of water infrastructure and submit invoices for reimbursement to CSU per the IGA.

Forage Shortage

- The Landowners will be responsible for grazing management, including drafting an annual grazing plan and setting stocking rate, and monitoring range condition and forage utilization.
- If it is determined that the bison need additional feed or nutritional supplements, CSU will be responsible for providing feed or supplements and distributing it to the animals for the duration of the need. The Landowners may help with distribution as staffing allows.
- Hay and other feed needs to be certified "weed free" and certification tags made available to Landowners upon request.
- Feed may be stored on-site at a location approved by the Landowners.
- Feed and supplements shall be provided in a dispersed manner to lessen impacts of concentrated feeding on range condition.

Significant Weather

If a significant weather event is known to be heading toward the Properties, the following pre-emptive steps should be taken:

- Feed should be stored on site at an approved location. The amount of feed should be sufficient to feed all bison for as long as weather conditions may prevent the bison from foraging (e.g. blizzard conditions). CSU is responsible for hauling feed to Soapstone/Red Mountain. The Landowners may help with distribution as staffing allows.
- Equipment should be available on-site or brought on-site sufficient to facilitate feeding or any other management needs during the weather event. This includes front-end loaders, ATVs, etc. If the Landowners have sufficient equipment on-site, it can be used. If equipment isn't available, CSU will be responsible for providing it.
- CSU is responsible for having equipment sufficient to access the Properties from Fort Collins. In a heavy snowfall event this may be a high clearance four-wheel drive vehicle. If a road is washed out by a flood or other event, an ATV may be needed. The Landowners will partner on providing equipment subject to availability.
- In the event of a large rain storm, bison should be moved into the eastern pasture if possible. It may be necessary to leave the bison in the eastern pasture for the duration of the flash flood season. The bison will be moved by CSU and USDA staff, assisted by City and County staff if available.
- In the event of a large snow storm and/or during the winter season, bison should be moved into the western pasture to provide cover.

After a large storm event, the following steps should be taken:

- Refrain from driving within the pasture if it is muddy or damage would be caused, unless an emergency situation requires access and city/county staff are consulted.
- Reach the bison as soon as personal safety is secured and access to the property is safe.
- On a weekday during open season for Soapstone/Red Mountain (7am-5pm; Mar 1 –Nov 30), City staff will check the status of the bison and the condition of the fence.
- If City staff is not onsite at Soapstone/Red Mountain, CSU will check the status of the bison and the condition of the fence.
- If the fence is undamaged, the gate between the east and west pasture can be reopened.
- If the fence is damaged and/or if bison escape their pasture see below.

Fence Damage

- The Landowners are responsible for periodic inspection, maintenance and repair of fencing, and other grazing infrastructure during normal working hours.
- In the case of an emergency repair or similar situation, the Landowners may proceed with the work and provide invoices for the repair to CSU as soon as reasonably possible.
- Sufficient fencing materials will be kept on-site to quickly repair a small break in the fence.

Escaped Bison

- The Landowners and CSU will periodically check on the bison. If it is determined that one or more has escaped, the call tree below should be utilized.
- CSU will be responsible for gathering and/capturing any escaped bison and returning them to their pasture. City and County staff will assist when available.
- An escaped bison response plan will be shared via letter with adjacent landowners providing contact information. If applicable, the communication leads for each party will work on a coordinated response for press releases, etc.

Wildfire

- Any wildfire observed that may threaten the bison should be reported using 911 and then the call tree below should be utilized.
- Defensive fire protection measures will be completed if time allows and the bison are confined to the corral.
- In the event of a wildfire in the bison pastures, quick assessment of fence damage and forage availability will need to be completed. In the case of significant damage bison may need to be moved to other pastures or transported back to the CSU foothills campus until repairs can be made

Injuries, Illness and Disease

- The City, County and CSU will periodically check on the bison. If it is determined that one or more is injured or ill, the call tree below should be utilized immediately.
- CSU and USDA will provide veterinary care and disease management, reproductive services, veterinary supplies, and supplemental feed for the animals as needed.

Cattle or Bison Intermingling

- If it is observed or suspected that cattle or bison from other herds have made their way into the Laramie Foothills herd pastures, utilize the call tree below and notify the cattle or bison's owner if known.
- If possible, record any tags or identifying brands/etc. of the animal for future identification.

Sheep in Close Proximity

- Due to the risk of contraction of malignant catarrhal fever from domestic sheep, bison should be kept as far as possibly from domestic sheep.
    - If domestic sheep are observed within a mile of the bison pasture, the Call Tree below should be immediately used.

General

- For any applicable emergency, the Call Tree should be utilized to coordinate response and public response, if needed.
- Respond quickly to phone calls.
- Avoid driving in muddy conditions if at all possible.
- Keep law enforcement informed.
- Following an emergency response, ensure that all partners were notified of the emergency, how it was handled and if/when it was/will be resolved.

Contact List and Call Tree

It will be essential to contact the appropriate parties that need to be involved for a specific emergency.

For any emergency, please contact EACH of the following points of contact for partner agencies FIRST:

City of Fort Collins Point of Contact

- Daylan Figgs, Land and Water Program Manager
- (970)416-2814, (970) 217-5968 (cell) and dfiggs@fcgov.com

Larimer County Point of Contact

- Meegan Flenniken, Resource Program Manager
- (970)619-4562, (970) 231-1536 (cell) and mflenniken@larimer.org

CSU Point of Contact

- Jennifer Barfield, PhD – CSU Department of Biomedical Sciences
- (970) 491-8934, (910) 354-8061 (cell) and Jennifer.barfield@colostate.edu

USDA Point of Contact

- Matt McCollum, Biologist – Wildlife Livestock Disease Investigations Team USDA APHIS
- (970) 266-6233, (970) 222-1600 (cell) and matt.mccollum@aphis.usda.gov

If the above contacts cannot be reached, and for *specific* emergencies also contact:

- Contact all Point Of Contacts listed in the previous section, plus:
    - Justin Scharton, Environmental Planner (City Backup POC)
        - (970)221-6213, (970)222-8933 (cell) and jscharton@fcgov.com

- Justin Fredrickson, Soapstone Technician (City Backup POC)
  - (970)416-2527, (970)631-6931(cell) and jfredrickson@fcgov.com
- Travis Rollins, Natural Resource Specialist- Larimer County (County Backup POC)
  - (970) 498-5622; (970)227-3296 (cell) trollins@larimer.org
- Kristin Powell, Senior Ranger – City of Fort Collins
  - (970)218-4683
- Steve Gibson, District Manager - Larimer County
  - (970) 498-5621 (office), (970)214-8819 or sgibson@larimer.org
- Zach Cook, Ranger - Larimer County – (Zach lives in the area)
  - (970)218-0867 or zcook@larimer.org
- Nancy Howard, District Wildlife Manager - Colorado Parks and Wildlife
  - (970)217-1471 and nancy.howard@state.co.us
- Zoe Shark, Community Relations Manager – City of Fort Collins Natural Areas
  - (970)221-6311 and zshark@fcgov.com
- Coleman Cornelius, Director of Communications – CSU College of Veterinary Medicine and Biomedical Sciences
  - (970) 491-6023 and coleman.cornelius@colostate.edu
- Teddy Parker-Renga, Community Relations Specialist
  - (970) 619-4561 or parkertp@larimer.org
- John and Brenda Barkley– Folsom Grazing Assn. Ranch Managers at Soapstone
  - (719)337-2051 or (719)836-4833
- Charles Rogers, Platte River Power Authority Rawhide Bison Manager –
  - (970)229-5616 or rogersc@prpa.org

Other important contacts:
Wellington Fire Dept. – (970) 568-3232
Larimer Dispatch Non-Emergency – (970) 416-1985
Larimer County Sheriff's Office – (970) 498-5100
Larimer County Search and Rescue – Request through Larimer County Dispatch (970) 416-1985
Wyoming Highway Patrol - (307) 777-4321
Laramie County Sheriff's Office - (307) 633-4700
City of Cheyenne Police - (307) 637-6500
DWM Colorado Parks and Wildlife – (970) 472-4300
Steve Gibson Senior Ranger Larimer County - (970) 214-8819
Zach Cook Ranger Larimer County - (970) 218-0867
Travis Rollins District Manager Larimer County - (970) 227-3296
Eldon Ackerman – (970)222-2563
Willie Altenburg - (970) 568-7792
Meadow Springs Ranch– Jason Graham (970) 221-6921
Duck Creek Grazing Association – (307) 256-6908
Rick Gallegos- (970) 568-7758
Jim Gallegos - (970) 420-3580
Butch and Judy Bernard – (970)568-4320

APPENDIX D: KATE WILKINS | RESEARCH SUMMARIES

Kate Wilkins, PhD candidate
Graduate Degree Program in Ecology
Department of Fish, Wildlife, and Conservation Biology
Colorado State University

Research Summary: May 2015-May 2016

Introduction

The plains bison (*Bison bison*), along with natural fire, were instrumental in helping shape North America's Great Plains. The local extinction of keystone species, such as bison, can have important consequences for species diversity and ecosystem processes. Bison reintroduction to northern Colorado (Soapstone Prairie Natural Area and Red Mountain Open Space) could provide the means to restore grassland function and quality for birds and other animals. To our knowledge, this is the first study evaluating the before and after effects of bison reintroduction on grassland birds, mammals, and vegetation in northern Colorado.

Most research on the ecological effects of bison reintroduction has focused on changes in grassland composition and structure, with little emphasis on the wildlife species that rely on prairie ecosystems. My project helps fill these gaps in our understanding of grassland ecology and conservation by comparing bird, mammal, and vegetation communities before and after bison reintroduction and between cattle and bison-grazed sites. This research has the following objectives:

1) Evaluate the effects of bison reintroduction on Colorado grassland bird and mammal habitat use, species interactions, and vegetation composition and structure

2) Determine whether non-native grazers (e.g. cattle) serve the same ecological function as native species (e.g. bison) in creating viable habitat for bird and mammal species

Methods

Baseline data were collected on Soapstone Prairie Natural Area (SPNA) and Red Mountain Open Space (RMOS) from May-November 2015, prior to bison reintroduction. Post-reintroduction data will be collected from May-November 2016 and 2017. I am using bird surveys (point counts) and remotely triggered wildlife cameras to assess changes in bird and mammal habitat use and density in response to the reintroduction of bison. A grid of 20 bird point count stations and 20 wildlife cameras have been evenly distributed at each of the following three sites: the bison reintroduction site (RMOS and SPNA), an adjacent cattle-grazed site on RMOS with similar topographic characteristics, and an ungrazed site (not grazed by bison or cattle) on SPNA. I am also using a Daubenmire frame and modified Robel pole to collect data on vegetation composition and structure (respectively) within 50 m of each point count and wildlife camera.

Data Summary

Birds

I completed a total of 300 bird surveys from May-June 2015 at the point count stations (n = 60) distributed across the bison-grazed, cattle-grazed, and ungrazed sites. In those visits, I had 1,666 bird detections, which included 35 species total. Across all sites, the most common species included Meadowlarks (*Sturnella neglecta*) (n= 523), Lark Buntings (*Calamospiza melanocorys*) (n= 240 detections), Vesper Sparrows (*Pooecetes gramineus*) (n= 236 detections), Horned Larks (*Eremophila alpestris*) (n= 231 detections), and Grasshopper Sparrows (*Ammodramus savannarum*) (n= 202 detections) (see Figure 1 for raw detections of bird species with more than 5 detections by site). I also detected and recorded the vocalizations of a Baird's Sparrow (http://www.xeno-canto.org/299348) at Soapstone Prairie Natural Area in early May, but did not have any detections of this rare species thereafter.

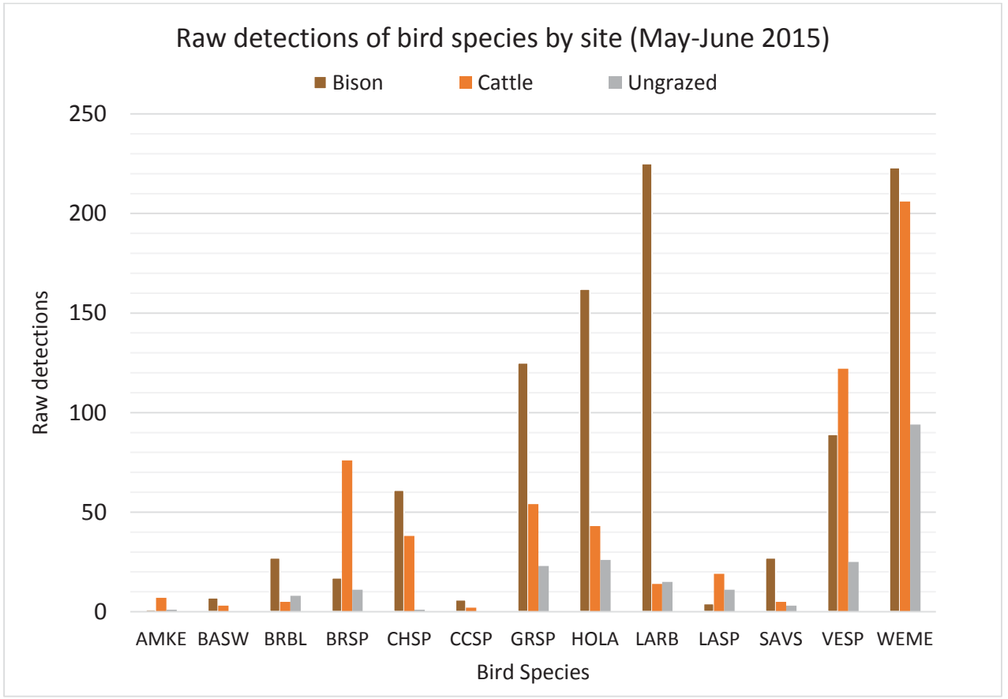


Figure 1. Detections of bird species with more than 5 detections by site from May-June 2015. Codes for bird species follow protocols from Bird Conservancy of the Rockies, and are as follows: **AMKE-** American Kestrel; **BASW**- Barn Swallow; **BRBL**- Brewer's Blackbird; **BRSP**- Brewer's Sparrow; **CHSP**- Chipping Sparrow; **CCSP**- Clay Colored Sparrow; **GRSP**- Grasshopper Sparrow; **HOLA**- Horned Lark; **LARB**- Lark Bunting; **LASP**- Lark Sparrow; **SAVS**- Savannah Sparrow; **VESP**- Vesper Sparrow; **WEME**- Western Meadowlark. *Detections do not yet reflect detection probability.

Wildlife

The wildlife cameras were in operation for 154 days from May-November 2016. Although I have yet to process all 174,111 photos, the cameras, thus far, have 3,827 wildlife detections, and 70% of photos have been processed. Across all sites, these detections include 1,508 mule deer (*Odocoileus hemionus*), 1,485 pronghorn (*Antilocapra americana*), 626 elk (*Cervus canadensis*), 84 black-tailed jack rabbits (*Lepus californicus*), 81 coyote (*Canis latrans*), 37 cottontail rabbits (*Sylvilagus sp.*), 1 white-tailed jackrabbit, and 1 bobcat (*Lynx rufus*). These detections do not yet include detection probability.

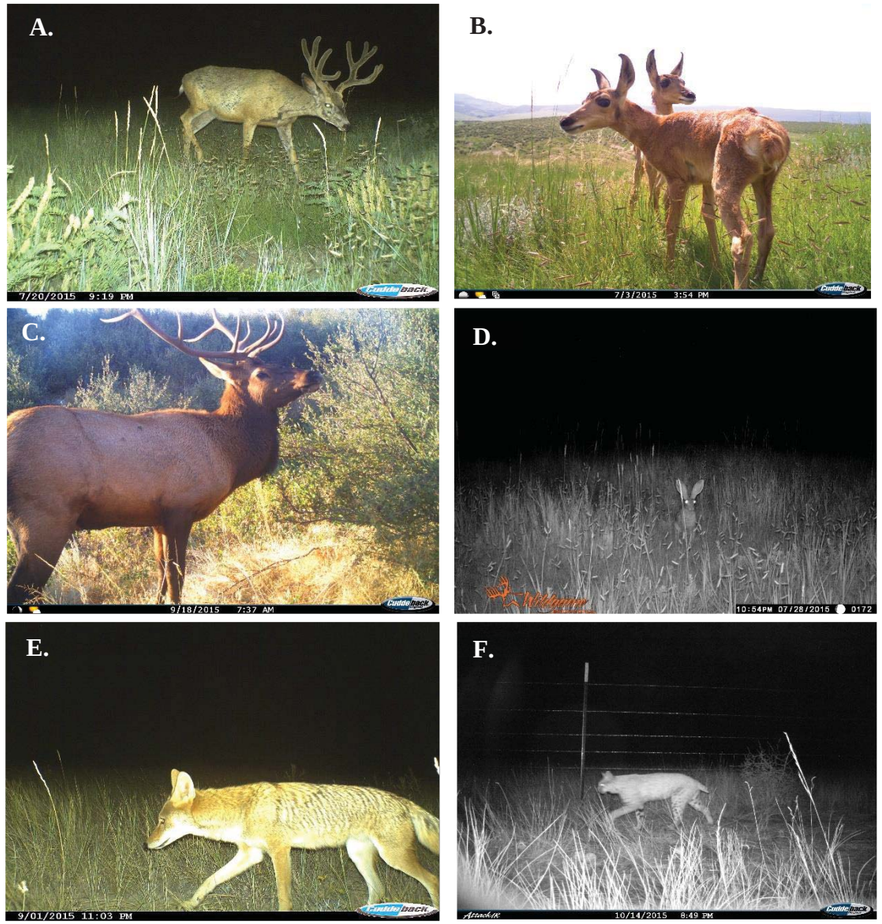


Figure 2 (A.-F.). Photos collected from wildlife cameras at bison, cattle, and ungrazed sites at SPNA and RMOS from May-November 2015. Photos include the following: a. Mule deer; b. Pronghorn fawns; c. Bull elk; d. Black-tailed jackrabbit; e. Coyote; d. Bobcat.

Vegetation

I conducted a total of 120 vegetation transects from June-July 2015. Sampling the transects revealed 29 grass species, 6 rush and sedge species, 47 forb species, and 11 sub-shrub and shrub species. Dominant grasses across all sites included Western Wheatgrass (*Pascopyrum smithii*), Blue Grama (*Bouteloua gracilis*), and Needle and Thread grass (*Hesperostipa Comata*). Dominant forbs and sub-shrubs included Short's Milkvetch (*Astragalus shortianus*) and Prairie Sagewort (*Artemesia frigida*). To assess biomass at each site, I used a formula developed by the USDA's Agricultural Research Service to assess biomass (kg/ha) in shortgrass prairie systems from visual obstruction readings (in cm) made with the modified Robel pole. The formula is as follows:

$$\text{Standing biomass} = 263.7 * \text{mean VOR}$$

I report biomass for cool (Figure 3) and warm (Figure 4) season grasses separately. At the bison reintroduction site, the main species that contributed to cool season grass biomass (3241 kg/ha ± 129 SE) included Squirreltail (*Elymus elymoides*) and Columbia needlegrass (*Achnatherum nelsonii*). Warm season grass biomass (925 ± 61) at the bison reintroduction site mainly included Blue grama (*Bouteloua gracilis*) and Purple threeawn (*Aristida purpurea*).

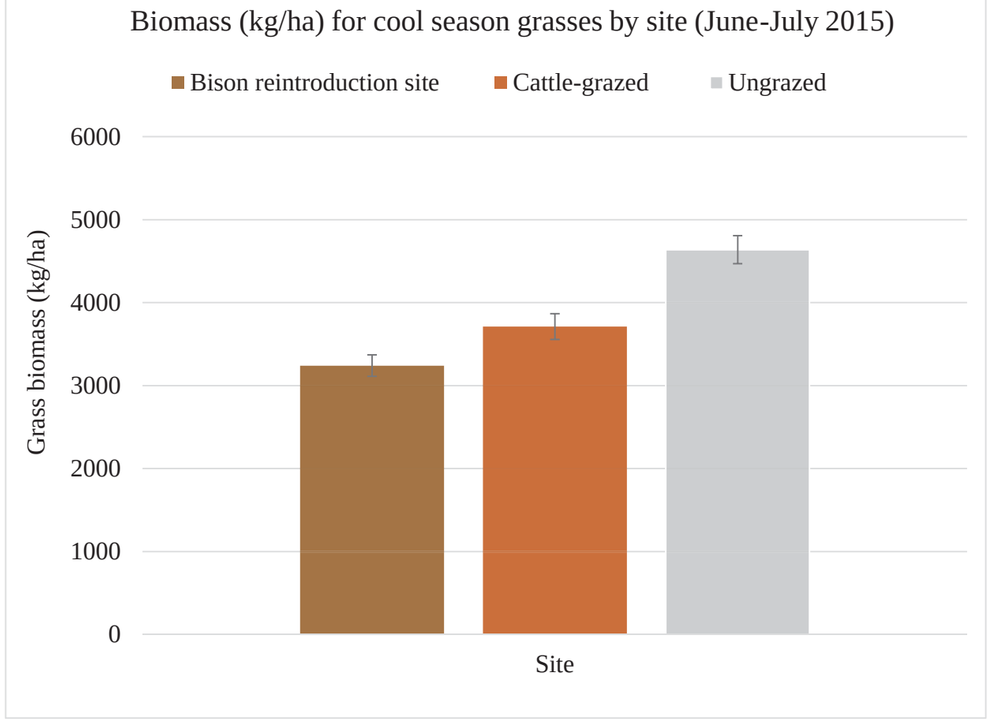


Figure 3. Cool season grass biomass (kg/ha) with standard error (SE) bars by site for the bison reintroduction, cattle grazed, and ungrazed sites.

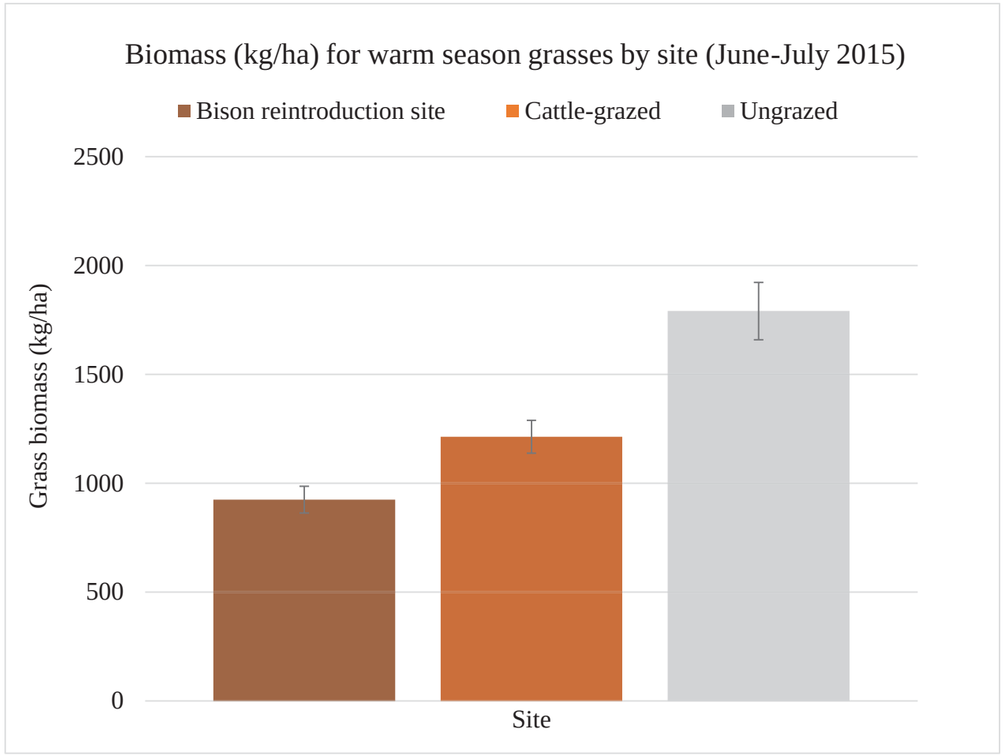


Figure 4. Warm season grass biomass (kg/ha) with standard error (SE) bars by site for the bison reintroduction, cattle grazed, and ungrazed sites.

For the cattle site, biomass (3711 kg/ha ± 306 SE) for cool season grasses included mainly Sleepy grass (Achnatherum robustum), Slender wheatgrass (*Elymus trachycaulus*), and Columbia needlegrass (*Achnatherum nelsonii*). The species that contributed most to warm season grass biomass (1213 kg/ha ± 75) included Tumblegrass (*Schedonnardus paniculatus*) and Purple threeawn (*Aristida purpurea*).

Purple threeawn (*Aristida purpurea*), Blue gramma (*Bouteloua gracilis*), and Mat muhly (*Muhlenbergia richardsonii*) mainly contributed to warm season grass biomass (1791 ± 132) at the ungrazed site. The core species associated with cool season grass biomass (4638 kg/ha ± 331 SE) at the ungrazed site included Columbia needlegrass (*Achnatherum nelsonii*), Dropseed (*Sporabulus cryptandrus*), and Western wheatgrass (*Pascopyrum smithii*).

Next Steps

The bison were reintroduced to SPNA and RMOS on November 1, 2015. Thus, May-November (2016 and 2017) I will use the same research methods to collect the post bison reintroduction data at SPNA and RMOS. I will also begin data analysis to compare bird and mammal occupancy and vegetation characteristics before and after bison reintroduction, as well as between bison, cattle, and ungrazed sites.

ECOLOGICAL AND SOCIAL CONSEQUENCES OF BISON REINTRODUCTION IN COLORADO

RESEARCH SUMMARY (2015-2017)

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INTRODUCTION

Plains bison (Bison bison), along with natural fire regimes, were instrumental in shaping North America's Great Plains (Samson et al. 2004). The prairies that form the Great Plains store carbon (DeLuca & Zabinski 2011), support biodiversity (Schulte et al. 2017), and help reduce run off from agricultural pollutants (Schulte et al. 2017). These services have been lost over time due to industrial agriculture and the large-scale loss of native grazing animals (DeLuca & Zabinski 2011). As a keystone species that directly and indirectly affects grassland ecosystems, bison could help restore these services. Bison alter plant community composition (Knapp et al. 1999; Towne et al. 2005), change soil nutrient cycling (Frank & Evans 1997), and cause shifts in bird species richness (Griebel et al. 1998), bird abundance (Powell 2006), and small mammal abundance (Matlack et al. 2001). Despite their critical contributions to land and wildlife health, bison have been nearly extirpated from North America. The plains bison currently occupy 1% of their historic range (Hedrick 2009), with very few populations persisting outside of Yellowstone National Park. Some researchers suggest that the range contraction of bison has rendered them ecologically extinct (Freese et al. 2007), meaning they no longer serve the same foundational role in grassland ecosystems.

An often controversial approach to counter the loss of species, such as bison, involves introducing non-native species to replace the ecological role of functionally extinct species (Seddon et al. 2014). Whether non-native species can serve as proxies for extinct or rare native species without causing negative ecological effects (Caro & Sherman 2009, Ricciardi & Simberloff 2009) is a particularly relevant question in North American grasslands. Cattle have largely replaced bison as large grazing animals in these ecosystems (Knapp et al. 1999; Towne et al. 2005; Fuhlendorf et al. 2010; Kohl et al. 2013). Previous research has demonstrated that cattle and bison can interact differently with grassland ecosystems. Bison tend to graze across larger areas than cattle (Kohl et al. 2013) and prefer grasses (Plumb & Dodd 1993; Knapp et al. 1999), while cattle graze both grasses and shrubs and spend more time at sites with woody vegetation (Allred 2011). Yet despite potential differences in grazing between the two species, it is feasible that cattle can be managed to achieve similar conservation outcomes as bison (Fuhlendorf et al. 2010). This idea is supported by a meta-analysis that found grazing intensity and evolutionary history of grazing serve as primary drivers affecting plant species composition and above ground net primary production (Milchunas & Lauenroth 1993). Whether or not cattle can serve as an ecological proxy for bison may depend on abiotic and biotic characteristics of the site, as well as historic and ongoing management practices (Fuhlendorf 2010).

While researchers consider the merits of cattle as proxies for bison, popular and political interest in restoring plains bison is rapidly gaining momentum across the United States (Isenberg 2000). As charismatic, native mega-herbivores of the American west, bison are an ideal species for advancing cross-disciplinary understanding of refaunation. These grazers are popular with the public, and could serve as a flagship species or focal species for grasslands conservation (Walpole & Leader-Williams 2002). Understanding how flagship species are perceived by local communities and other stakeholders is critical to mitigating potential human-wildlife conflicts that could emerge as result of reintroduction (Douglas & Veríssimo 2013). To date, there are still relatively few studies that examine the effects of species reintroductions on visitors to reintroduction sites, and that document the realities of co-existence with reintroduced charismatic species for local communities (Seddon et al. 2007). Social factors, such as human attitudes and perceptions of reintroductions, only account for 4% of the 454 papers in the reintroduction literature reviewed from 1990 to 2005 (Seddon et al. 2007). Thus, expanding both the ecological and human dimensions of refaunation will be critical to achieving successful species reintroductions and recovery of ecosystem processes.

Recent bison reintroductions to shortgrass prairie in Colorado and New Mexico offer the opportunity to explore whether bison and cattle have similar potential to maintain or restore habitat quality for grassland birds and other animals, while also catalyzing the public to engage in grassland conservation efforts. Ten bison were reintroduced to a shortgrass prairie site in northern Colorado in 2015 and this herd grew to 54 animals by 2018. Sixty bison were reintroduced to Rio Mora National Wildlife Refuge in New Mexico in 2009 and have grazed continuously to the present. Bison were reintroduced to northern Colorado as part of an effort to restore historic, native animal communities on Soapstone Prairie Natural Area and Red Mountain Open Space (City of Fort Collins Natural Areas Program 2007). In addition, these bison are part of a larger effort to mitigate disease (e.g., brucellosis) while preserving the unique genetic lineage of the Yellowstone bison herd. In northern New Mexico, bison were reintroduced to Rio Mora National Wildlife Refuge to help restore grassland habitat and as cultural resource for local Native American tribes, who help to manage the herd (U.S. Fish and Wildlife Service 2012a). Prior to bison reintroduction, cattle grazed both sites for more than 100 years (U.S. Fish and Wildlife Service 2012b), and cattle continue to graze most of the pasture surrounding the bison-grazed areas in both states. Our research also offers an opportunity to understand if ecological and social effects are evident at the early stages of bison reintroduction. Our specific research questions include:

1) How does bison reintroduction in Colorado alter grassland bird density and habitat use, mammal habitat use, and plant composition and structure?

2) How does bison reintroduction alter visitor place attachment to grasslands in Colorado?

3) How do bison and cattle affect bird density and plant composition and structure in Colorado and New Mexico?

METHODS

To assess response of birds, mammals, plants and recreationists to bison reintroduction and to compare bison and cattle's effects on birds and plants, we used bird surveys (point counts), remotely triggered wildlife cameras, vegetation transects, and visitor surveys. We collected data in Colorado and New Mexico (Figure 1) before bison reintroduction (2015) and after the bison reintroduction (2016-2017). To collect the data, we established bird point count

stations in Colorado and New Mexico and wildlife cameras in Colorado at sites with bison and cattle, and sites infrequently grazed by bison or cattle (reference sites). We also used a Daubenmire frame and modified Robel pole to collect data on vegetation composition and structure (respectively) at each point count and wildlife camera.

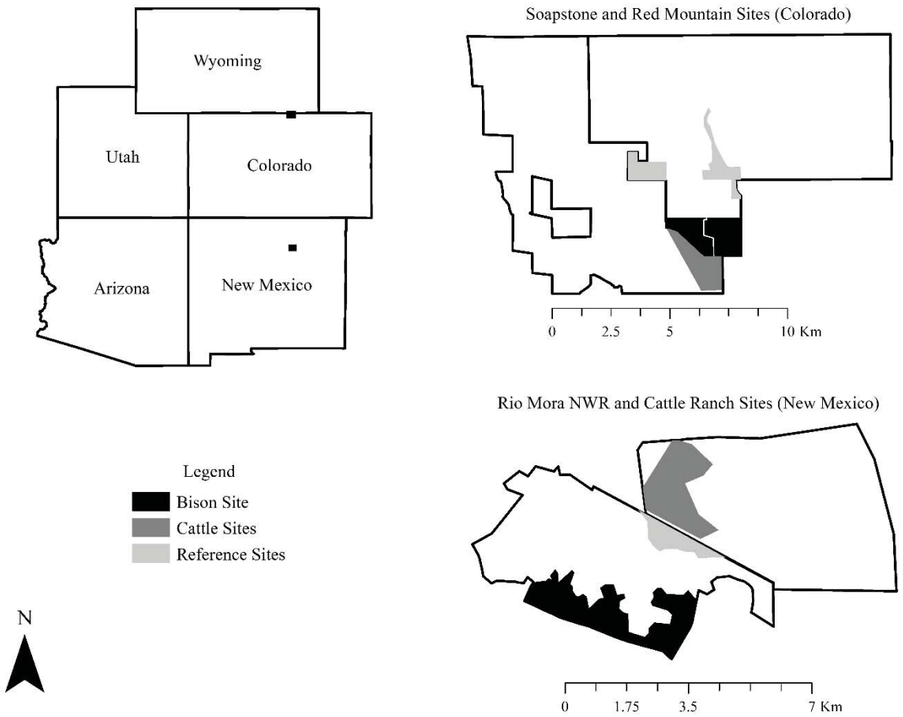

Figure 1. Study areas in Colorado and New Mexico

To better understand how bison reintroduction in Colorado affected people's connection to grasslands, we implemented a mixed-methods approach of a survey followed by open-ended questions (Borrie et al. 2002). We intercepted visitors at the only public entrance gate to Soapstone on Saturdays and Sundays during peak visitation months before (2015) and after bison reintroduction (2016). We first gave visitors a place attachment survey that asked participants how much they agreed or disagreed with a series of four statements, such as "I feel very attached to Soapstone Prairie Natural Area" and "I want to spend more time in grasslands like Soapstone Prairie Natural Area". The average score of these four statements provided an overall measure of place attachment, or the level of connection people feel for a certain space. We followed the place attachment survey with two questions, "Is Soapstone important to you" and, "If yes, why". These follow-up questions provided more context for understanding people's connections to bison and the ability of bison to make people more aware of grasslands and grassland conservation efforts. These questions were designed to help elucidate to what extent charismatic species serve as a flagships in conservation awareness (Walpole & Leader-Williams 2002; Smith & Sutton 2008).

RESULTS

Effect of Bison Reintroduction on Bird Density and Habitat Use (Colorado)

Across all sites and years in Colorado, we observed 50 species of birds (Table 1). For bird species with sufficient detections for analysis, we report densities (Horned Lark, Western Meadowlark, Vesper Sparrow) and habitat use (Grasshopper Sparrow, Lark Sparrow, Brewer's Blackbirds; Figure 2).

Table 1. List of 50 bird species at the bison and reference sites at Soapstone Prairie Natural Area and Red Mountain Open Space in Colorado. *Indicates obligate grassland birds as listed in Vickery et al. 1999 ** Indicates facultative grassland birds as listed in Vickery et al. 1999

Common name	**Scientific name**	**Banding codes**
American Goldfinch	*Spinus tristis*	AMGO
American Kestrel **	*Falco sparverius*	AMKE
American White Pelican	*Pelecanus erythrorhynchos*	AWPE
Baird's Sparrow*	*Ammodramus bairdii*	BAIS
Bank Swallow	*Riparia riparia*	BANS
Barn Swallow	*Hirundo rustica*	BARS
Black-capped Chickadee	*Poecile atricapillus*	BCCH
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN
Brown-headed Cowbird **	*Molothrus ater*	BHCO
Brewer's Blackbird **	*Euphagus cyanocephalus*	BRBL
Brewer's Sparrow	*Spizella breweri*	BRSP
Brown Thrasher	*Toxostoma rufum*	BRTH
Broad-tailed Hummingbird	*Selasphorus platycercus*	BTLH
Bullock's Oriole	*Icterus bullockii*	BUOR
Clay-colored Sparrow **	*Spizella pallida*	CCSP
Chipping Sparrow	*Spizella passerina*	CHSP
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW
Common Grackle	*Quiscalus quiscula*	COGR
Cooper's Hawk	*Accipiter cooperii*	COHA
Common Nighthawk **	*Chordeiles minor*	CONI
Common Raven	*Corvus corax*	CORA
Double-crested Cormorant	*Phalacrocorax auritus*	DCCO

Common name	Scientific name	Banding codes
Eastern Kingbird **	*Tyrannus tyrannus*	EAKI
European Starling	*Sturnus vulgaris*	EUST
Great Blue Heron	*Ardea herodias*	GBHE
Grasshopper Sparrow*	*Ammodramus savannarum*	GRSP
Green-tailed Towhee	*Pipilo chlorurus*	GTTO
Horned Lark*	*Eremophila alpestris*	HOLA
Lark Bunting*	*Calamospiza melanocorys*	LARB
Lark Sparrow **	*Chondestes grammacus*	LASP
Loggerhead Shrike **	*Lanius ludovicianus*	LOSH
Mourning Dove **	*Zenaida macroura*	MODO
Northern Mockingbird	*Mimus polyglottos*	NOMO
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS
Ring-billed Gull	*Larus delawarensis*	RBGU
Rock Wren	*Salpinctes obsoletus*	ROWR
Red-tailed hawk	*Buteo jamaicensis*	RTHA
Red-winged Blackbird **	*Agelaius phoeniceus*	RWBL
Say's Phoebe **	*Sayornis saya*	SAPH
Savannah Sparrow*	*Passerculus sandwichensis*	SAVS
Spotted Towhee	*Pipilo maculatus*	SPTO
Tree Swallow	*Tachycineta bicolor*	TRES
Vesper Sparrow*	*Pooecetes gramineus*	VESP
Violet-green Swallow	*Tachycineta thalassina*	VGSW
Western Kingbird **	*Tyrannus verticalis*	WEKI
Western Meadowlark*	*Sturnella neglecta*	WEME
Western Scrub-Jay	*Aphelocoma californica*	WESJ
Western Tanager	*Piranga ludoviciana*	WETA
Wilson's Snipe	*Gallinago delicata*	WISN OR WSNP
Yellow-rumped Warbler	*Setophaga coronata*	YRWA

There was no strong or consistent effect of bison reintroduction on bird density or habitat use (Figure 2). Horned Lark and Vesper Sparrow densities remained constant over time at both the bison and reference sites (Figure 2). In addition, Western Meadowlark densities and habitat use for Lark Sparrows and Brewer's Blackbirds did not change at the bison site relative to the reference site over the study period (Figure 2). Grasshopper Sparrow habitat use increased slightly in the bison site over time, but the top model for this species did not include a site by year interaction.

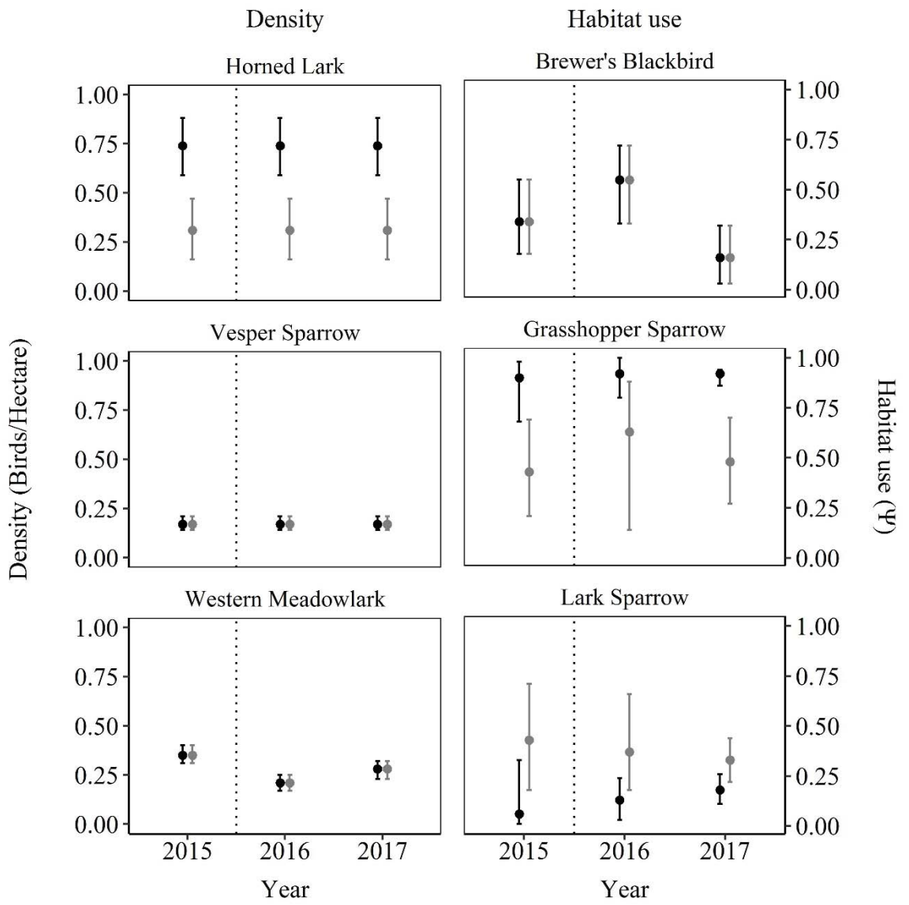

Figure 2. Density (left axis) and habitat use (right axis) of grassland birds at bison (black), and reference sites (gray) before (2015) and after (2016-2017) bison reintroduction.

Effects of Bison Reintroduction on Mammal Habitat Use (Colorado)

Across all sites and years, we observed 14 species of mammals (Table 2). The species or taxa with a sufficient number of detections for occupancy analyses included mule deer, pronghorn, coyote (*Canis latrans*), and lagomorphs: black-tailed jackrabbits (*Lepus californicus*), white-tailed jackrabbits (*Lepus townsendii*), and desert cottontails (*Sylvilagus audubonii*).

Table 2. List of mammal species at the bison and reference sites at Soapstone Prairie Natural Area and Red Mountain Open Space in Colorado.

Common name	Scientific name
American Badger	*Taxidea taxus*
American Black Bear	*Ursus americanus*
American Elk	*Cervus canadensis*
Black-tailed Jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
Desert Cottontail	*Sylvilagus audubonii*
Coyote	*Canis latrans*
Mountain Lion	*Puma concolor*
Mouse	*Unknown species*
Mule deer	*Odocoileus hemionus*
Pronghorn	*Antilocapra americana*
Thirteen-lined Ground Squirrel	*Ictidomys tridecemlineatus*
White-tailed deer	*Odocoileus virginianus*
White-tailed Jackrabbit	*Lepus townsendii*

Bison reintroduction did not affect habitat use of coyote or pronghorn, and models with site by year interactions for colonization and extinction probabilities did not converge for any species. We observed a decreasing trend in habitat use for lagomorphs and mule deer at the bison site compared to the reference site (Figure 3), and mule deer extinction probabilities were higher at the reference site compared to the bison site (Appendix 2).

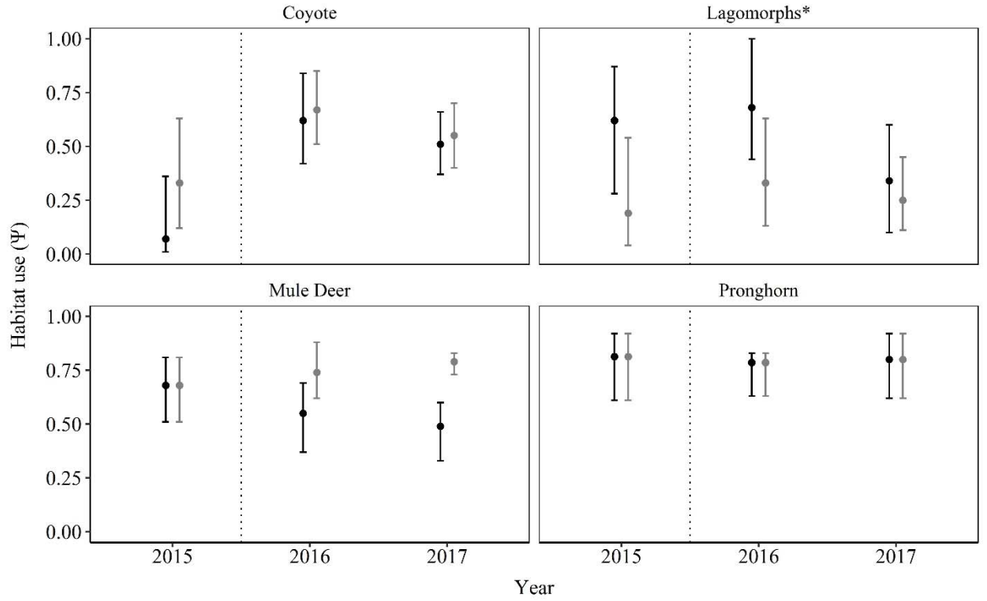

Figure 3. Habitat use for coyote, lagomorphs, mule deer, and pronghorn at bison (black) and reference (gray) sites before (2015) and after (2016-2017) bison reintroduction. *Lagomorphs include Black-tailed Jackrabbits, White-tailed Jackrabbits, and Cottontail rabbits.

Effects of bison reintroduction on plant community characteristics (Colorado)

We documented 19 grass species, 40 species of forbs, and 14 shrub species at bison and reference sites. Cover for bare ground was significantly higher in the bison site compared to the reference site and declined over time in both sites. The cover and height of forbs, warm and cool season grasses, and shrubs did not differ significantly in the bison site after bison reintroduction (Figure 4).

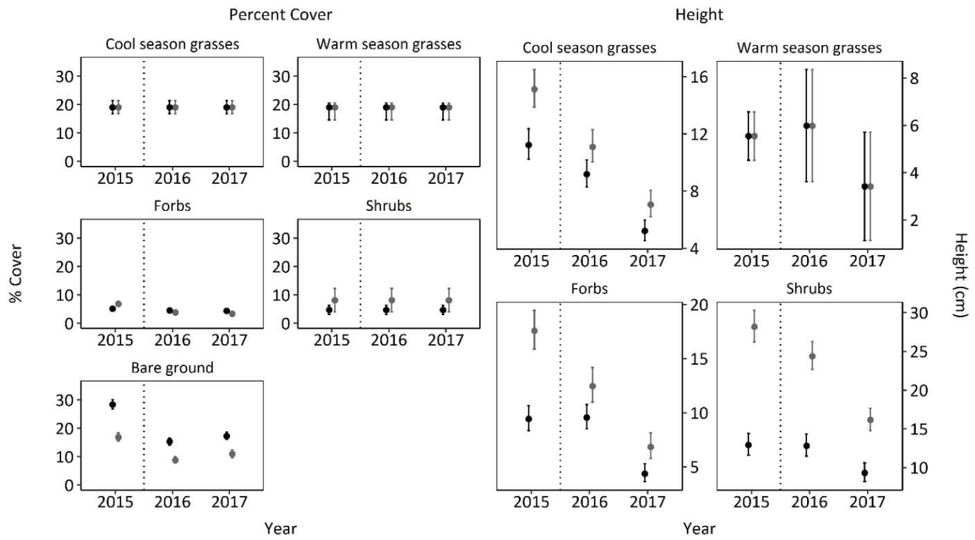

Figure 4. Percent cover and height by year and vegetation type at bison-grazed (black) and reference (gray) sites. The vertical dotted line separates the years before (2015) and after (2016-2017) bison reintroduction.

Effects of bison reintroduction on visitor place attachment

We intercepted 243 people before bison reintroduction (2015) and 525 people after bison reintroduction (2016). Our response rate was 75% (n=184) in 2015 and a 56% (n=302) in 2016. We surveyed approximately the same ratio of women to men in 2015 (74%) and 2016 (76%), and most were in the age range of 36-55 in both years (49% in 2015 and 45% in 2016). Most respondents (81% in 2015 and 85% in 2016) were local to the area. In both years, the majority of visitors identified as Caucasian (94%) and had either bachelors or graduate degrees (40%).

Of the people who responded "yes" to taking the survey, all completed the place attachment in 2015 and 2016. Visitors had significantly higher place attachment scores after the bison reintroduction (Figure 5). In addition, a higher percent of people agreed that they felt at home in Soapstone and wanted to spend more time in grasslands like Soapstone after the bison reintroduction. For the open-ended question, "Why is Soapstone important to you?", around 95% of visitors in 2015 (n=174) and in 2016 (n=286) said Soapstone was important to them and explained why. The top ten themes (Figure 6) that emerged from responses were similar between years, but several themes shifted, including "Historical Significance" emerging as a main theme in 2016, and more people citing the "Importance of Protecting Open Space" in 2016 compared to 2015.

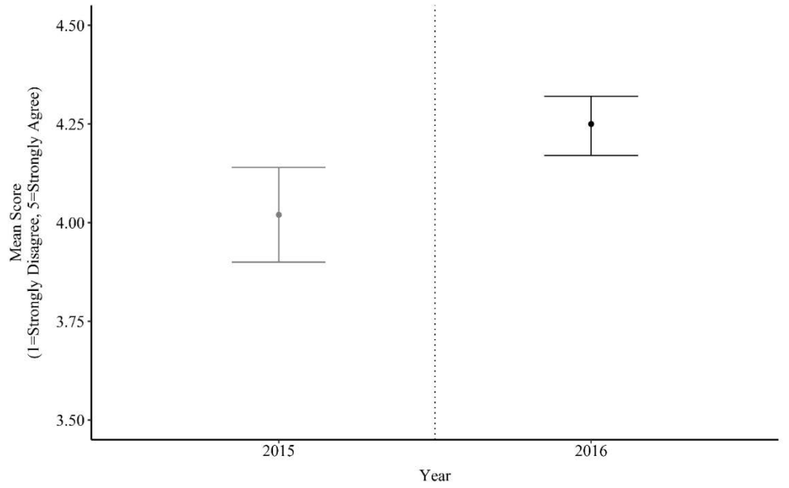

Figure 5. Mean score with confidence intervals for "place attachment" of visitors to Soapstone Prairie Natural Area on a scale of 1-5 (1 ="Strongly Agree" and 5 = "Strongly Disagree") before (2015) and after (2016) bison reintroduction. This index was calculated from a series of questions on a survey administered to visitors to Soapstone Prairie Natural Area.

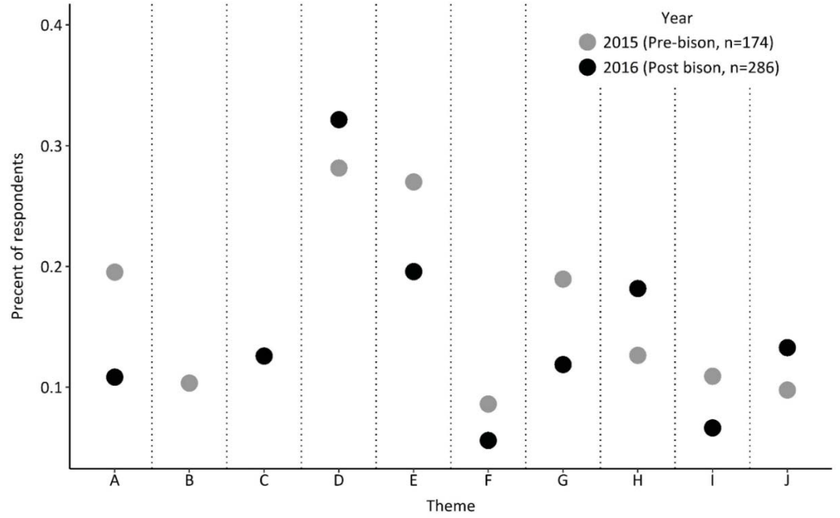

Figure 6. Percent respondents (number of respondents within each theme/total number of respondents) of themes before (2015) and after (2016) the bison reintroduction at SPNA in response to the open-ended question, "Why is Soapstone Prairie important to you?" (A. An uncrowded place to get away, B. Close and convenient, C. Historical significance, D. Important to protect open space, E. Nature preservation or conservation, F. Place to enjoy nature or the outdoors, G. Recreation asset, H. Undisturbed or undeveloped, I. Unique place, J. Wildlife)

Effects of bison and cattle on bird density and habitat use (Colorado and New Mexico)

We found that grassland bird responses to bison and cattle grazing were not uniform across species or study areas. In both Colorado and New Mexico, bison and cattle grazed sites supported higher densities of Horned Larks compared to reference sites (Figure 7). However, bison-grazed sites in Colorado supported higher densities of Horned Larks compared to cattle and reference sites, while in New Mexico, bison and cattle sites supported equal densities of Horned Larks, with too few individuals to estimate density on the reference site. Furthermore, cattle grazed sites in Colorado and New Mexico supported higher densities of Vesper Sparrows compared to bison sites. In Colorado, Vesper Sparrow density at the cattle-grazed site was significantly different from both the bison and reference sites, while in New Mexico, Vesper Sparrow density in the cattle site differed significantly from the bison site. Western Meadowlark densities in Colorado were higher at the bison and cattle sites compared to the reference site, yet equal among all sites in New Mexico. Based on overlapping confidence intervals, we report no significant differences in habitat use for Lark Sparrows or Grasshopper Sparrows at the Colorado study area (Figure 8).

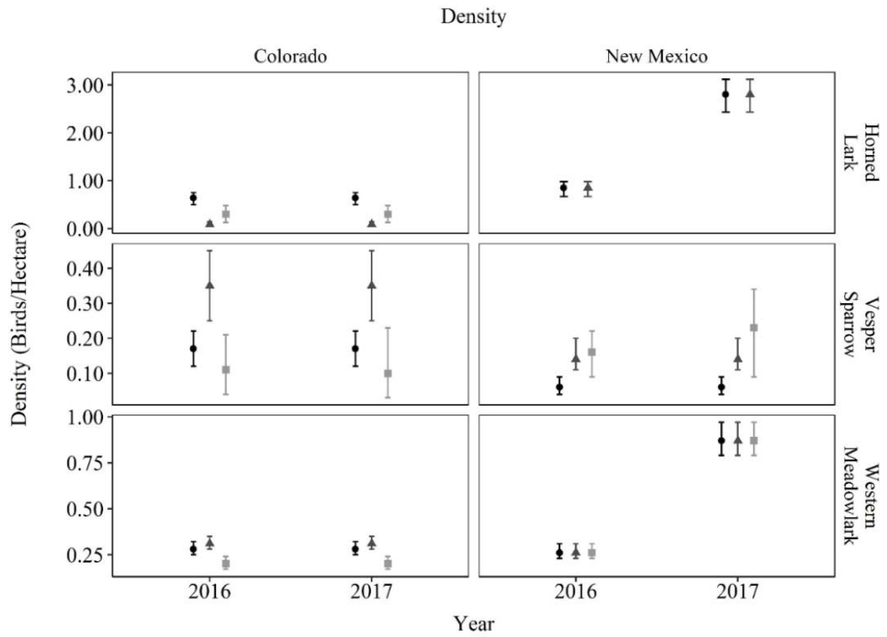

Figure 7. Density estimates for grassland birds in Colorado and New Mexico at sites grazed by bison (black circle), cattle (dark gray triangle), and ungrazed reference sites (light gray square). There were insufficient observations to estimate density at the reference site for Horned Larks in New Mexico.

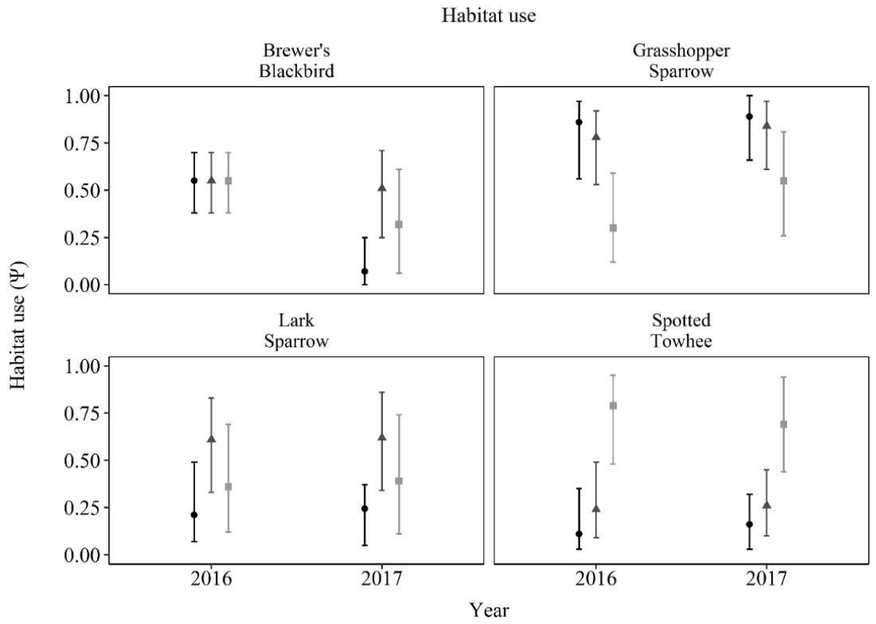

Figure 8. Density and habitat use estimates for obligate and facultative grassland birds in Colorado at sites grazed by bison (black circle), cattle (dark gray triangle), and ungrazed reference sites (light gray square).

Habitat use by Brewer's Blackbirds also did not vary among site types in 2016, but in 2017 Brewer's Blackbird habitat use was significantly higher in the cattle site compared to the bison site, but not compared to the reference site. We noted a trend of higher habitat use for Grasshopper Sparrows in the bison and cattle grazed sites compared to the reference site. In addition, we saw a trend of higher habitat use by Lark Sparrows in the cattle site compare to the bison and reference sites. The reference site supported significantly higher densities of Spotted Towhees compared to either the bison or cattle sites.

Effects of bison and cattle on plant cover, height, and communities (Colorado and New Mexico)

Based on overlapping confidence intervals, we measured no significant differences in the percent cover and height (Figure 7) or in community composition (Figure 8) of plants among bison, cattle, and reference sites in Colorado or New Mexico. However, we observed several interesting trends. In Colorado, the cattle site had higher percent cover of forbs compared to the bison or reference sites, and the percent cover of shrubs was higher at the reference site compared to the bison or cattle sites. In both Colorado and New Mexico, bison and cattle sites had higher bare ground cover compared to reference sites. In New Mexico, the cattle site had a higher percent cover of warm season grasses, while the bison site had higher percent cover of both shrubs and bare ground compared to the cattle and reference sites.

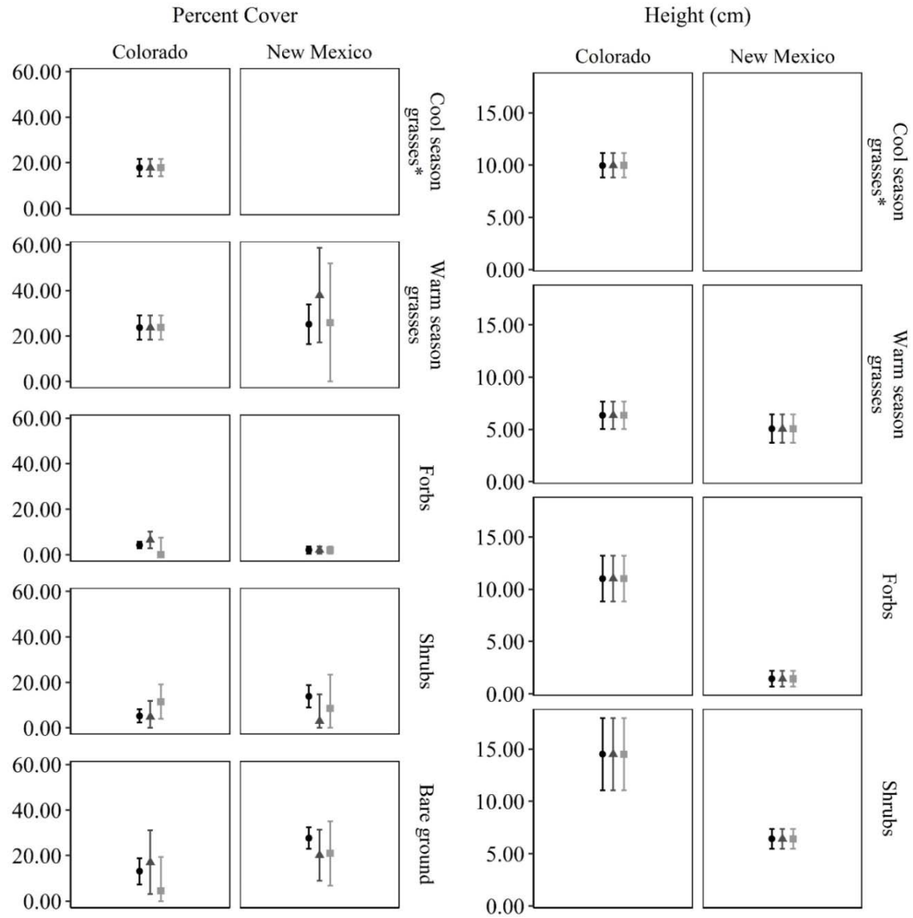

Figure 7. Vegetation cover and height estimates in 2016 at bison (black dot), cattle (dark gray triangle), and reference (light gray square) sites in Colorado and New Mexico. *Cool season grasses were not present at the sites in New Mexico.

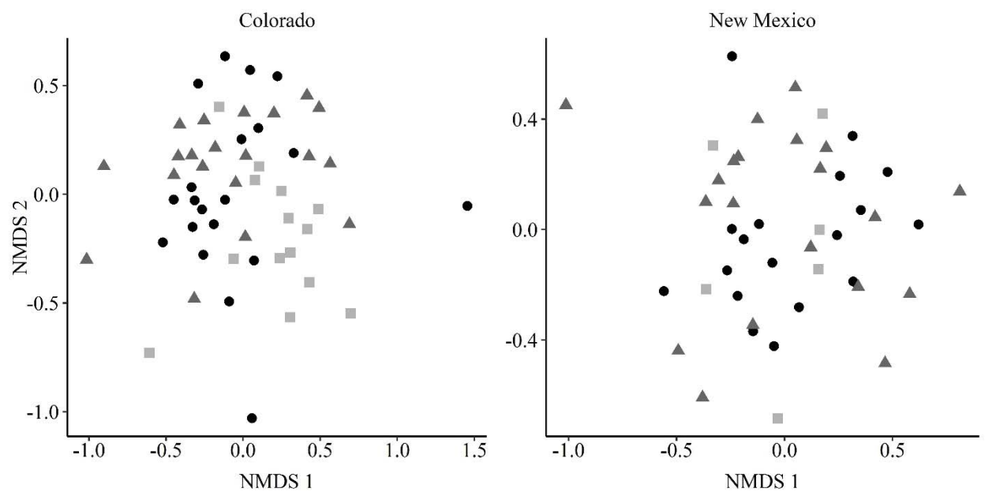

Figure 8. Plant community composition and dispersion based on Nonmetric Multidimensional Scaling (NMDS). We collected plant data in 2016 at bison (black dot), cattle (dark gray triangle), and reference (light gray square) sites in Colorado (composition difference: 0.26) and New Mexico (composition difference: 0.20).

CONCLUSION

In the two years following the reintroduction of bison to shortgrass prairie, we found that obligate and facultative grassland bird densities and habitat use did not change. Bison reintroduction also did not strongly affect habitat use by coyote, lagomorphs, mule deer, or pronghorn. We did find some support for a decrease in the percent cover and height of cool season grasses, forbs, and bare ground, and a slight increase in the percent cover of warm season grasses as a result of bison reintroduction. Although we observed few ecological effects, we documented significant increases in human visitor attachment to the grassland after reintroduction, with people more frequently emphasizing the importance of protecting open spaces with bison on the landscape. These findings could be an indication of the largely untapped potential for bison reintroduction to catalyze the conservation of grasslands, which remains one of the world's most threatened biomes.

In addition, we found that bird densities and habitat use varied among bison, cattle, and ungrazed reference sites in Colorado and New Mexico, but the direction and magnitude of these differences was species-dependent. In Colorado, where bison were reintroduced shortly before our study, one grassland bird species occurred more frequently at the bison grazed site, three species were more prevalent at the cattle grazed site, and habitat use for another species was similar in bison and cattle sites, but less prevalent in ungrazed grasslands. At the New Mexico site, where bison have been established for nearly a decade, the density of one obligate grassland bird was higher in the cattle grazed site, and another species occurred in higher densities in both bison and cattle grazed sites compared to reference sites. These differences in bird density and habitat use are only partially explained by plant height and cover; we found few differences in grass and forb cover and only marginal differences in shrub cover and height among sites. Our

findings suggest that low intensity grazing by either cattle and bison improve habitat quality for most common bird species in our shortgrass prairie study areas.

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