

**Natural Heritage Resources and Conservation Significance of the Laramie Foothills,
Larimer County, Colorado**



A Report Prepared for The Nature Conservancy of Colorado

**by the Colorado Natural Heritage Program
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Executive Summary

In the spring of 1996 the Colorado Natural Heritage Program was contracted by The Nature Conservancy of Colorado to assess the importance of the Laramie Foothills area in northern Larimer County for conservation of biodiversity. This was done by identifying locations of natural heritage resources (rare and imperiled plants and animals, and significant natural communities) and evaluating their biodiversity significance.

The Laramie Foothills area between Fort Collins and the Wyoming state line is considered a landscape of biological significance. Rare and imperiled plant, animals, and significant natural communities occur in the area. Detailed field observations were completed to more thoroughly document the extent and overall condition of the natural heritage resources. The importance of the site in a local, regional, and global context was evaluated to determine the conservation value and priority of the Laramie Foothills. This was done by comparing occurrences of the species and natural communities at the Laramie Foothills to others in Colorado, the region (Central Shortgrass Prairie), and North America (where applicable). In this way the relative importance of the site compared to other known sites within the Central Shortgrass Prairie can be evaluated.

Ecological connectivity is an important factor in the long term viability of natural communities and species. The ecological connectivity of the Laramie Foothills with the Great Plains and the Rocky Mountains is considered one of the most important values of the site. Much of the Colorado Front Range no longer has this connectivity, due to human developments such as roads, and houses and widespread conversion to agricultural land.

The Laramie Foothills contains several significant occurrences of imperiled plants and plant communities. The best known occurrence of the plant species Bell's twinpod, which is globally imperiled, occurs at the site. Several of the mountain mahogany shrublands which occur in the Laramie Foothills are extremely limited in distribution, found mainly on the Colorado Front Range, and highly threatened. Protection of these communities will have regional or global significance. The large needle-and threadgrass - bluegrama grassland present, while geographically common, is not known to be protected in the Central Shortgrass Ecoregion.

The Laramie Foothills represent a rare opportunity where imperiled species and significant natural communities can be protected in a landscape which still has the capability of having relatively natural, functional ecological processes.

Numerous threats to the natural heritage resources exist. The most serious threats include habitat fragmentation, physical destruction of habitat, invasion of non-native species, and alteration of natural disturbance regimes.

Acknowledgments

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Introduction

In the spring of 1996 the Colorado Natural Heritage Program was contracted by The Nature Conservancy of Colorado to conduct an ecological evaluation of the Laramie Foothills area in northern Larimer County. The purpose of this evaluation was to identify locations of natural heritage resources (rare and imperiled plants and animals, and significant natural communities) and to assess the biodiversity significance of the area within the context of the Central Shortgrass Prairie Ecoregion (see Figure 1). The Laramie Foothills occur along the boundary of the Central Shortgrass Prairie ecoregion and the Southern Rocky Mountain ecoregion. Because many of the dominant vegetation types are restricted to the foothills or Great Plains the area was compared to other prairie ecosystems.

Rare and imperiled plants, animals, and significant natural communities were known to occur in the area. In-depth field surveys were completed to more thoroughly document the extent and overall condition of the known and newly identified natural heritage resources.

The relative importance of the site in a local, regional, and global biodiversity context was evaluated to determine the ecological value of the Laramie Foothills. This was done by comparing occurrences of the species and natural communities in the Laramie Foothills to others in Colorado, the Central Shortgrass Prairie Ecoregion, and North America (where applicable). Much of the comparative information was compiled from Natural Heritage Programs in Colorado and adjacent states.

Location and Site Ecological Boundaries

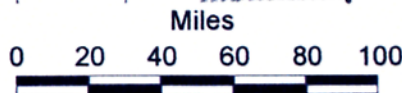
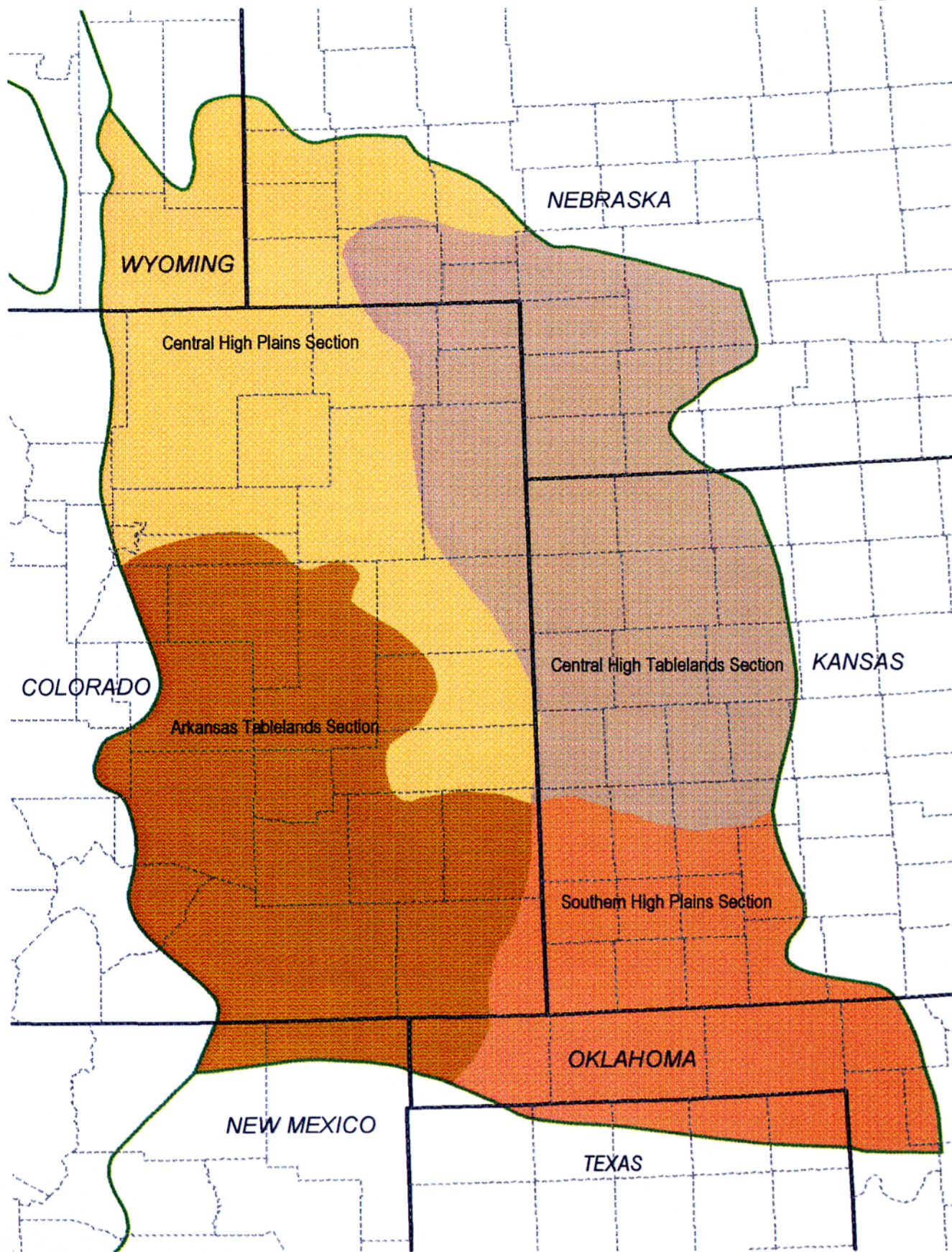
The Laramie Foothills are located on the eastern flank of the Laramie Mountains in northern Larimer County, Colorado. The site begins approximately 10 miles north of Fort Collins (near Teds Place) as a narrow band encompassing the hogbacks in the area, and widens as it continues north to the Wyoming state line.

Ecological boundaries of the site follow the outcrops of sedimentary rocks from U.S. Highway 287 near Teds Place, north and east to the edge of the Great Plains (immediately west of the Rawhide Flats), north to the Wyoming state line, west to the more contiguous montane forests near Virginia Dale, and south near Halligan Reservoir. Encompassed within the area are large grasslands, some sparse ponderosa pine (*Pinus ponderosa*) woodlands, and extensive mountain mahogany (*Cercocarpus montanus*) shrublands.

The grassland communities within the Laramie Foothills area and those to the east (the Rawhide Flats) are similar, but there are important differences. The Rawhide Flats area supports animal communities that are more common on the prairies of northeast Colorado. This is especially true of the avian community, which at Rawhide Flats includes mountain plovers, burrowing owls, chestnut-collared longspurs, ferruginous hawks, grasshopper sparrows, loggerhead shrikes, short-eared owls, and savannah sparrows. While most would agree that ecological systems are interrelated at a variety of scales, because the Rawhide Flats area is more ecologically similar to the grasslands of northeast Colorado than to the Laramie Foothills area, this was chosen as a relatively natural boundary. Successful protection of many of these grassland species would likely need to focus on areas to the east of the Laramie Foothills in Larimer and Weld counties.

Figure 1.

Central Shortgrass Prairie Ecoregion



The boundary to the west is delineated where ponderosa pine woodlands and forests become the dominant vegetation types. Successful protection of species which depend on ponderosa pine habitat likely will need to concentrate on areas outside of the Laramie Foothills. The northern boundary of the site is the Wyoming state line. Ecological boundaries probably extend to the north (especially north of the Soapstone Hills) but field surveys would be needed to accurately determine the extent. The ecological connectivity of the Laramie Foothills to the Great Plains and to the Rocky Mountains is considered to be especially important as much of this habitat along the Front Range has been highly altered by urban development and conversion to agricultural land.

Methodology

The Laramie Foothills area was known to contain natural heritage resources (rare or imperiled plants and animals and significant natural communities) and is considered a potential conservation site (or simply site) by the Colorado Natural Heritage Program. Known records of natural heritage resources and aerial photos were examined to target field surveys. Landowners were contacted to obtain permission to access targeted areas. Detailed field surveys were conducted where permission was granted to thoroughly document the extent and overall condition of the natural communities and species populations in the Laramie Foothills. The highest priorities for field survey were natural communities and globally rare species (those ranked G1-G3 by the Natural Heritage Network). Because few globally rare species occur in the area much of the field survey focused on documenting the extent and condition of the natural communities.

Once occurrences of natural heritage resources were documented preliminary conservation boundaries were delineated to identify the potential conservation site. These boundaries are delineated for the Laramie Foothills megasite and other smaller sites within the megasite (see Figure 2). The boundaries are designed as a first approximation of a geographic location where some level of conservation action is needed. These boundaries attempt to incorporate the ecological processes, such as fire, flooding, and animal movement, thought to be necessary for long term viability of the natural communities and species. Natural communities and species respond differently to various management and land use activities depending on their sensitivity and the natural conditions in which they evolved. Management which focuses on conservation of biodiversity needs to consider and simulate those conditions.

The importance of the site in a local, regional, and global context was evaluated to determine the conservation value and priority of the Laramie Foothills. This was done by comparing occurrences of the species and natural communities at the Laramie Foothills to others in Colorado, the Central Shortgrass Prairie Ecoregion, and North America (where possible and applicable). In this way the biodiversity values of the site can be compared to other sites. This information can help prioritize where conservation efforts are most needed and can be most efficient and effective.

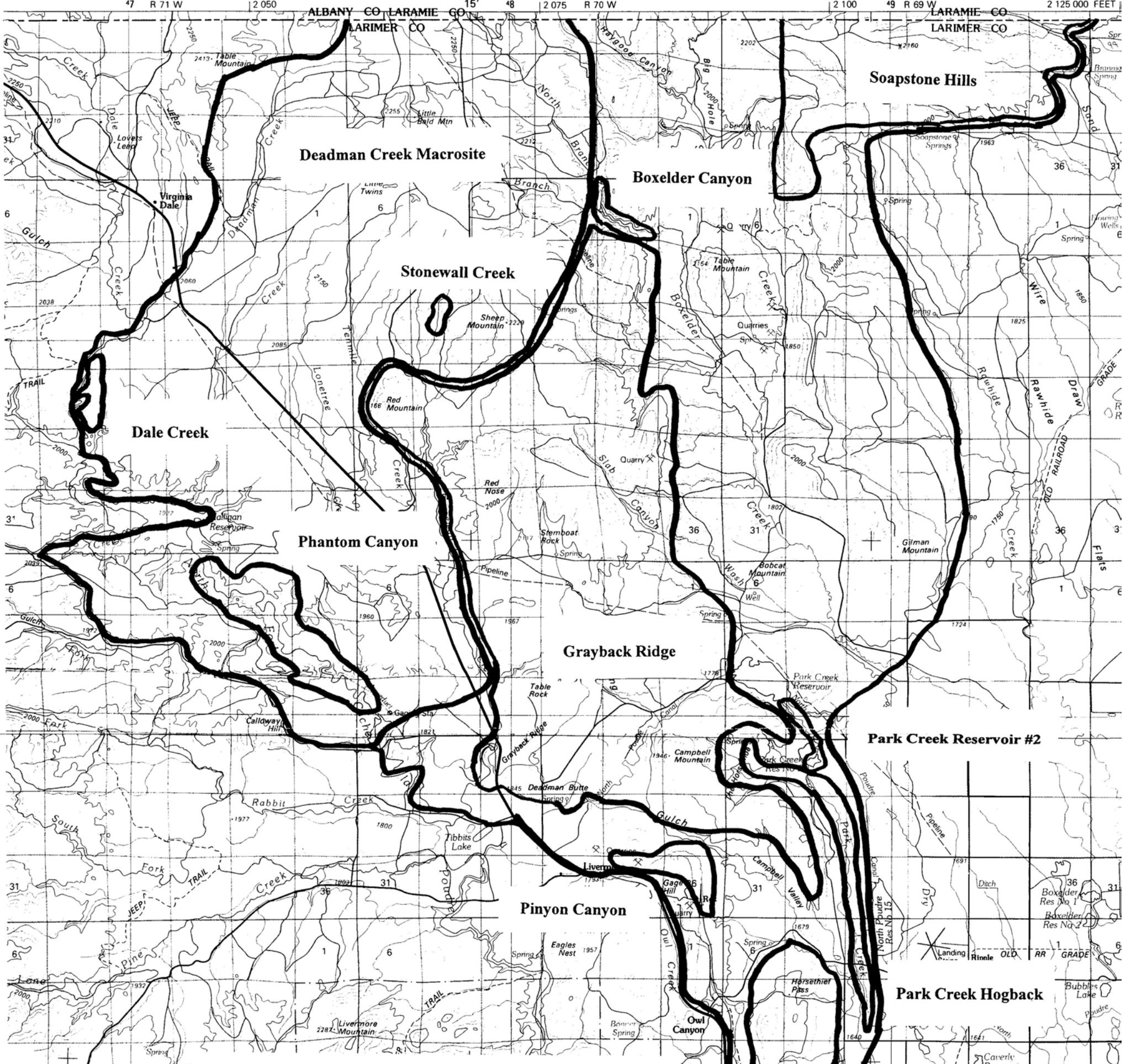
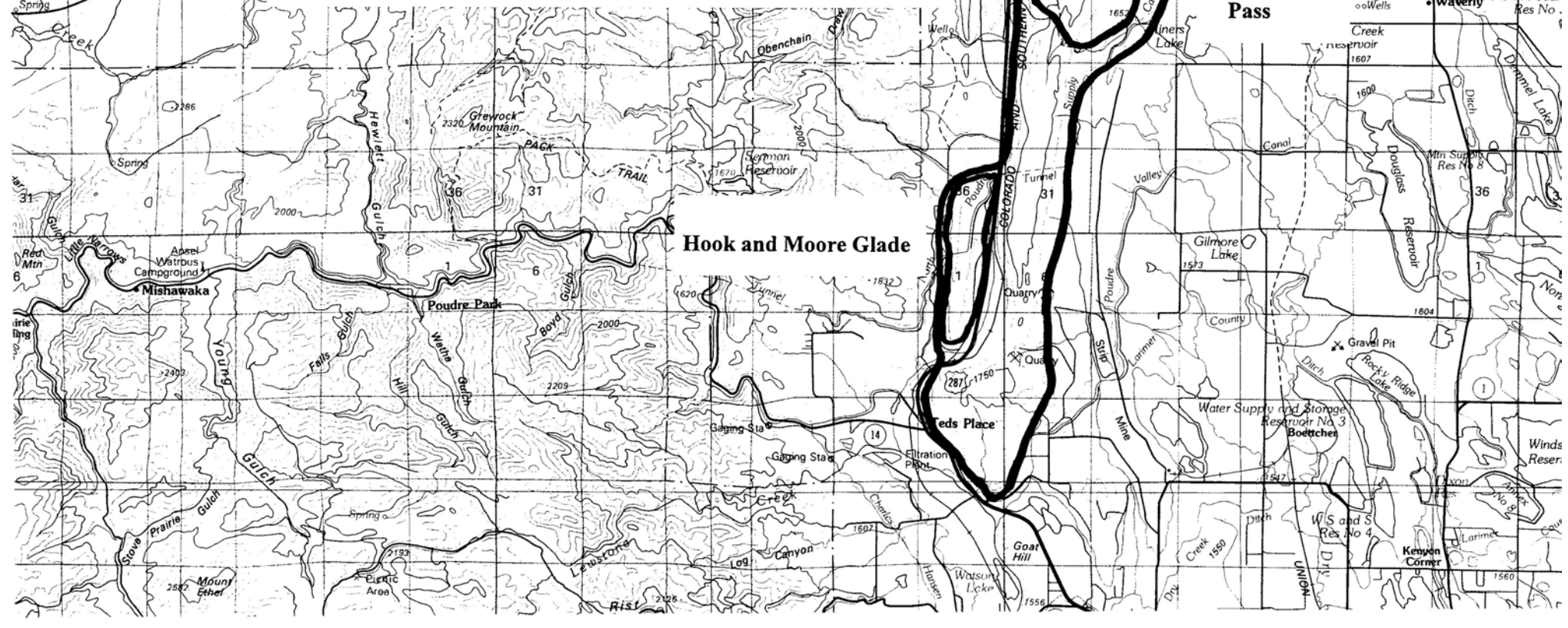


Figure 2. Map of the Laramie Foothills Megasite (outer boundary) and Sites Nested Within Its Boundary



Discussion

Connectivity

Ecological connectivity is an important factor in the long term viability of natural communities and species. Fragmented or isolated landscapes may not provide for the long-term viability of many species (Gilpin 1987). Fragmentation can result in remnant areas with only a subset of the historic natural communities (and the associated species). Therefore, loss or change through disturbance may not always be balanced by reappearance somewhere else on the landscape (Hobbs 1987). Advantages and disadvantages of corridors have both been well documented (sources in Cox *et al.* 1994 - pages 34-35; Bridgewater 1987). Long-term affects of corridors are difficult to assess because it is often impossible to define the extent of landscape factors that may influence a managed population, or to anticipate future changes that may affect populations (Cox *et al.* 1994). The ecological connectivity of the Laramie Foothills with the Great Plains and the Rocky Mountains is considered one of the most important values of the site (see Figure 3).

Connectivity to the Rocky Mountains is assured to some level by the abundance of Forest Service land to the west of the Laramie Foothills. The majority of the lands which provide the connectivity to the Great Plains are controlled by a small number of landowners. Conversion of these lands to uses not compatible with protection of biodiversity has the potential to seriously impact the connectivity and ecological integrity of the Laramie Foothills.

Landscapes of Biological Significance

Landscapes of biological significance are land units that are large enough to incorporate ecological processes and contain concentrations of rare species and/or high quality natural communities (Chaplin *et al.* 1996). These landscapes are considered an appropriate scale to involve local citizens in conservation planning. How these people view and treat the landscape will determine the long-term biological and economic viability of the landscape (Chaplin *et al.* 1996).

The Laramie Foothills Megasite is an example of a landscape of biological significance. Many species which occur in the Laramie Foothills have widespread distributions that have often been influenced by large scale natural communities and ecological processes (fire, drought, herbivory). This scale often necessitates consideration of large geographical areas and assemblages of species or natural communities - hence the designation as a megasite. The megasite is used to address conservation issues of larger scales that are not site specific (such as wide ranging species or protecting natural ecological processes). Proactive and cooperative conservation actions at a landscape level may prevent further species declines and decrease the likelihood of future agency regulatory actions.

FIGURE 3. LOOKING EAST TO THE GREAT PLAINS FROM THE SOAPSTONE HILLS.



Representativeness and Ecoregional Context

The Laramie Foothills Megasite occurs at the meeting of several ecologically distinct systems and has characteristics of all of these; the Great Plains, the foothills, and to a lesser extent, montane ecosystems. The dominant vegetation types are typical of the Great Plains or foothills of northern Colorado. The species and community occurrences were evaluated in the context of other prairie ecosystems or ecoregions, mainly the Great Plains-Palouse Dry Steppe Province mapped and described by Bailey *et al.* (1994), and McNab and Avers (1994).

The physical environment represented in the Laramie Foothills contains examples of common and uncommon environments within the Central Shortgrass Prairie and Rocky Mountain Front Range. The most important local factors influencing the distribution of the natural communities in the Laramie Foothills appear to be geology (as it affects soil development) and elevation. Similar elevational gradients, geology and soils occur along the northern Colorado Front Range, and to a lesser extent in southeast Colorado (Purgatorie River Canyon), northeast New Mexico, and in east central Wyoming (the Hartville uplift near Guernsey).

Several aspects of the physical setting however, are uncommon and not widely represented in other areas. The extent of the exposure of the sedimentary hogbacks and outcrops at the Laramie Foothills is not typical of the Colorado Front Range. In most places this transition from the plains grassland, to foothills shrublands, to montane ponderosa pine forests takes place over an area 1-3 miles wide (Marr and Boyd 1979). This transition at the Laramie Foothills takes place over an area approximately 10 miles wide and is gradual, often containing a mosaic of large patches of the characteristic natural communities (grasslands, mountain mahogany shrublands, and ponderosa pine woodlands).

The Laramie Foothills site is contained in a relatively natural landscape that is for the most part undeveloped. Throughout most of the central and northern Front Range of Colorado the interface between the mountains and the plains has been highly altered and fragmented by urban development and agricultural conversion. Ecological connectivity between the plains and the mountains is therefore very limited. This is not the case in southern Wyoming or southern Colorado, however the majority of the shrub communities present at the Laramie Foothills are not represented in these areas (Bourgeron and Engelking 1994). This diverse mosaic of natural communities contained in a relatively natural and ecologically intact landscape at the Laramie Foothills is uncommon. Protection of representative examples of these natural communities would help protect numerous species. Conservation actions at this site may represent the one of the best opportunities to protect viable and ecologically functioning examples of many of the communities restricted to the Front Range.

The site encompasses good to excellent representations of several common plant and animal communities, as well as several rare species and natural communities. Less extensive examples of the common communities also occur in other parts of the Colorado Front Range, and some of the rare natural communities also occur in small, lower quality occurrences to the south of the Laramie Foothills. The landscape in these areas is also highly altered and fragmented by urban growth and conversion to agricultural lands. It is unlikely that these natural communities and species in an ecologically intact landscape like that found at the Laramie Foothills would be found in other parts of the Front Range.

The dominant grassland community in the area (*Stipa comata-Bouteloua gracilis*) is more common to the north in Wyoming, Nebraska, Montana, North Dakota, South Dakota, and into Canada. Northern Colorado appears to be the southern limit for this grassland. This community

has been somewhat impacted by livestock grazing and fire suppression across its range and no known occurrences are protected in the adjacent states or in Colorado. The occurrence in the Laramie Foothills is considered to be representative of the community.

The mosaic of shrubland communities at the site are considered highly significant. Several of the shrub communities in the Laramie Foothills occur further to the south in Boulder and Jefferson counties, but only in relatively narrow bands associated with the sedimentary rock outcrops. The Laramie Foothill site encompasses examples of many of the lower elevation mountain mahogany (*Cercocarpus montanus*) communities known from the Colorado Front Range (see Figure 4), including the best known occurrence of the mountain mahogany/New Mexico feathergrass (*Cercocarpus montanus/Stipa neomexicana*) community and one of the best occurrences of the mountain mahogany/Scribner's needle grass (*Cercocarpus montanus/Stipa scribneri*) community. The mountain mahogany/mountain muhly (*Cercocarpus montanus/Muhlenbergia montana*), mountain mahogany/Griffith's wheatgrass (*Cercocarpus montanus/Elymus lanceolata X Pseudoroegneria spicata*), mountain mahogany/needle-and-thread grass (*Cercocarpus montanus/Stipa comata*), and mountain mahogany-skunkbush/big bluestem (*Cercocarpus montanus-Rhus trilobata/Andropogon gerardii*) shrubland communities are also present but have been somewhat degraded from human activities. This condition is typical for the Front Range. Thorough inventory efforts have been completed over most of the potential range of these shrublands and it appears that high quality examples are extremely rare or possibly nonexistent in other places. Most other examples are within a landscape is highly degraded or altered.

Two grass species common in the plant communities, New Mexico feathergrass (*Stipa neomexicana*) and Scribner's needlegrass (*Stipa scribneri*), occur here at the northern extent of their natural range. The northern distribution of New Mexico feathergrass east of the continental divide is in Platte County, Wyoming (Dorn 1992), which is the location of the Hartville Uplift. The Hartville Uplift is geologically similar to the hogbacks and buttes common in the Laramie Foothills. Another species relatively common in the Laramie Foothills is Scribner's needlegrass. This species is not known to occur in Wyoming (Dorn 1992) and is more common in the Southwest United States.

Several mammals associated with rocky habitats in the Southwest U.S. reach their northern range limits between Fort Collins and Virginia Dale. These include the Mexican woodrat (*Neotoma mexicana*), northern rock mouse (*Peromyscus nasutus*), rock squirrel (*Spermophilus variegatus*), and Colorado chipmunk (*Tamias quadrivittatus*). Micro-habitat influences may create habitat conditions similar to the Chihuahuan desert habitats, especially on warm, south facing, rocky slopes. These species may have colonized the area during Holocene times, the Hypsithermal Interval, or more recently and may now be relicts in the area confined to warmer, south facing slopes (Armstrong 1996). The North Fork of the Poudre River is the northern most major tributary (and canyon) to the South Platte River. The lack of suitable habitat (steep rocky canyons) to the north may have limited the chance for these species to move further north of the Wyoming state line (Armstrong 1992).

FIGURE 4. LOOKING SOUTHEAST INTO CAMPBELL VALLEY AT SEVERAL MOUNTAIN MAHOGANY COMMUNITIES.



General Condition and Management of Major Vegetation Types

Grasslands

The grassland communities present in the Laramie Foothills are in highly variable condition. Individual parcels (of which there are many) have been, and are currently managed, in many different ways. Grazing regimes, fire, and other natural disturbances have varied effects on grassland communities which can be greatly modified during drought or above normal precipitation years (Weaver 1954). Long term grazing patterns in the Laramie Foothills have undoubtedly affected the vegetation on the grasslands. Milchunas and Lauenroth (1993) suggest that species composition between grazed and ungrazed sites is affected more by water availability and length of association with grazing, than grazing intensity. Evaluation of grazing impacts on the basis of species presence alone may be misleading because changes in species composition may be small when compared to other ecosystem functions (Weaver *et al.* 1996). Because no detailed data exist describing the historic (before European settlement) composition of the grasslands in the area we may never know what the grasslands looked like in “natural condition.”

Historically, disturbances probably did not occur every year on the same part of the grassland as it does today with some livestock grazing regimes. Bison were thought to graze some parts of the grasslands only once or twice every several years or possibly a few consecutive years followed by several years of rest. Fires, though not as frequent as in the tallgrass prairies to the east, were undoubtedly a part of the natural disturbance regime (Anderson 1990). Soil disturbance by small mammals on grasslands provides unique microhabitats and affects soil conditions, often leading to a substantial increase in plant diversity (Benedict *et al.* 1996). Small mammal burrows were observed frequently on the grasslands in the Laramie Foothills. This suggests that these animals may play an important role in the dynamics of the grassland which should be considered in management for conservation purposes.

In the Laramie Foothills, pastures have often been grazed during the same season for many years. The effects of this management regime are hard to quantify but species not resistant to grazing may have been reduced in abundance or eliminated from some parts of the grassland. With numerous landowners it may be possible to simulate the natural mosaic of heavily disturbed to lightly disturbed patches on the landscape. Historically, this mosaic was probably shifting on the landscape as bison use fluctuated. It may be difficult to reconstruct this mosaic at the scale at which it naturally occurred. On parcels where management focusing on biodiversity rather than forage production is possible, it may be desirable to manage for conditions and processes, such as species diversity and fire, that are not provided on nearby lands (Licht 1997). This may include lightly grazed and burned pastures, or pastures grazed on a rest-rotation system. Management should consider and simulate the natural disturbance regimes (frequency, intensity, variability) thought to be present before European settlement.

Shrublands

Most of the mountain mahogany shrublands in the area are in good to excellent condition at present, except the occurrences of the *Cercocarpus montanus/Stipa comata* community which were found in degraded condition. Current livestock grazing pressure within the good condition communities is light and appears to have little impact. Significant increases in grazing pressure could potentially degrade the occurrences.

Historic fire intervals are not known but fire suppression may have allowed mountain mahogany to become more dense and allowed ponderosa pine to invade former shrub dominated stands (see Culver 1997 and numerous citations within). Because of the low productivity associated with many of these mountain mahogany sites fuel buildup may be very slow.

Residential development and mining could have a serious impact on these shrublands by physically altering the habitat, fragmenting the landscape, reducing the ability to use fire as a management tool, and introducing or increasing the abundance of non-native species that are currently a minor component.

Woodlands

Within the Laramie Foothills ponderosa pine is mainly limited to rock outcrops and ravines or canyons, mainly near Phantom Canyon and north of Steamboat Rock. In general, the condition of the ponderosa pine communities is good to excellent. These communities occur more frequently and in larger stands throughout the Front Range of Colorado and into Wyoming. In some isolated stands in the Laramie Foothills a few large trees exist among the more numerous younger trees. This suggests that in the last 100-200 years ponderosa pine was not absent from the area but may be currently becoming more dense or widespread. This may be a result of fire suppression, grazing, changes in climate, or a combination of all these or other unknown factors.

Riparian communities

Riparian natural communities are generally present throughout the site but constitute a small proportion of the landscape. One occurrence of the narrow-leaf cottonwood/bluestem willow (*Populus angustifolia/Salix irrorata*) community was documented. Coyote willow (*Salix exigua*) is the most common riparian shrub in the area. While limited in extent these riparian shrublands may be important habitat for a variety of animal species. Many riparian systems in the west have been impacted by activities associated with human settlement (excessive grazing, impoundment for livestock water, irrigation, road development, etc.). The riparian areas in the Laramie Foothills are no exception. Numerous riparian areas in the site do support structurally intact communities (natural overstory species), although most have been invaded by non-native species in the understory. To support the natural range of variability for communities in the Laramie Foothills some riparian areas will need to be managed to reduce impacts from livestock disturbance, and decrease the abundance of non-native species (which could may involve grazing riparian areas at certain times of the year).

Historic Conditions

General Land Survey Records

General Land Survey Records for the area were examined at the state office of the Bureau of Land Management. Most of the survey records were from the 1860s to late 1870s. From general descriptions it appears that much of the area had been settled to some extent at that time. For example, a surveyor in 1864 comments that the area just east of Ft. Collins is said to be first rate farming land and is all occupied by settlers. There is mention of the Roberts' settlement in the survey done near Rabbit Creek in 1878. Because some level of settlement had occurred before the land surveys it should be noted that records from this time do not necessarily describe presettlement conditions.

Other factors may contribute to possible survey inaccuracies. Many of the surveyors had little training in plant identification. Many of the surveys were done in the winter making it difficult to identify many species (especially blue grama and buffalo grass). There is no mention of mountain mahogany (*Cercocarpus montanus*) in the area but common mention of sagebrush. Currently, sagebrush does not occur in the areas for which survey records were examined so it is assumed that they were referring to mountain mahogany. Near the Owl Canyon Piñon Grove a resurvey in 1867 describes the area as “land mountainous, the soil sandy, rocky and poor and the vegetation as bunchgrass and sagebrush.” In addition, “heavy growth of young cedar” is a common statement which may refer to Rocky Mountain juniper (*Juniperus scopulorum*).

In general, early surveys characterize the Laramie Foothills as either rolling prairie usually dominated by bunchgrass, bluegrass, and buffalo grass; or mountainous land (including hogbacks) that are dominated by bunchgrass and sagebrush with sparse to heavy growth of cedars and pines and some scattered piñon pine. Many of the streams in or adjacent to the foothills are described as having scattered to dense cottonwood and willows along them. The areas near the west side of the Laramie Foothills area (near Phantom Canyon and Greyrock Mountain) are described as having few pines in some cases to “dense good timber” in others. This would imply that there were some fairly dense forests or woodlands in those times. In addition, many of the surveyors mention buffalo grass as the dominant grass. It seems probable that in many cases they were actually seeing blue grama. During surveys by CNHP buffalo grass was seen only in low abundance scattered throughout the grasslands and was never observed as dominant. The owner of the Roberts Ranch, Evan Roberts, said that he thinks that there is less buffalo grass than there used to be on the ranch. Buffalo grass is thought to decrease with long-term grazing (personal communication with Ken Lair - Natural Resource Conservation Service).

Historic Aerial Photos

Historic aerial photos of the area from 1938, 1941, 1963, 1984 were examined at the Natural Resources Conservation Service office in Fort Collins. The photo scale was 1:20,000.

Prairie dog towns may have been more common in the past in the area. In the 1938 and 1963 photos a fairly large prairie dog town was located just east of North Poudre Reservoir No. 15. In the 1963 photo this town appeared to cover an entire section (640 acres). Today there is evidence of a prairie dog town in the Horseshoe that is not currently occupied. The prairie dog town in the Horseshoe may have been part of the town east of the reservoir. It is unknown if the prairie dogs were poisoned, shot, or eliminated by the plague. Photos from 1941 show what may have been a fairly large (.5 mile X 1.25 miles) prairie dog town south of Steamboat Rock. Currently there is a small (< 5 acres) town in that area.

In the 1941 photos most of the stream channels in the area appear to be wide, sandy bottomed, already downcut, and nearly devoid of riparian vegetation. It should be noted that these photos were taken not long after the drought of the 1930s. Channel entrenchment was difficult to assess using these photos but major changes were not observed in the Horseshoe and Campbell Valley areas.

Stream down-cutting and movement of the cuts further upstream in the Laramie Foothills area has been a concern for many people familiar with the area. When comparing the 1938 and 1984 photos, it doesn't appear that the stream channel geomorphology has changed significantly in Campbell Valley. Between 1938 and 1984 downcutting of a stream in the Horseshoe appears to have moved upstream approximately 75 to 125 feet. Most of the streams were downcut at the time of the early photos. Geologists think that the downcutting may be normal but possibly

slightly accelerated by grazing impacts in the late 1800s (personal communication to John Stokes from Stanley Schuman).

There has been much discussion on the “natural” extent of forests and woodlands at lower elevations along the Front Range. Both General Survey Records and photos from 1941 would suggest that ponderosa pine woodlands or forests were not completely absent from the Laramie Foothills area at those times. Comparison of aerial photos from 1941 and 1984 shows that ponderosa pine has increased dramatically in some areas, but in some places it was already present (e.g. north of Steamboat Rock). In 1941, there appear to be 10-20 ponderosa pine trees on the saddle at the south end of Steamboat Rock. Photos from 1984 show nearly the same number.

Interpretation of Survey Records and Historic Aerial Photos

Survey records and aerial photos should be interpreted with caution. Settlement and historic overstocking of the range may have significantly altered the landscape before descriptions were available. The role of climatic fluctuations in the last 100+ years is unclear but could have played an influential part in changing vegetation patterns on the landscape. The rapid changes on the prairie from the effects of drought and wet cycles have been well documented by Weaver (1954) and others. Native Americans’ impact on the landscape probably changed dramatically with the use of horses brought to North America by the Spanish. Our view of how the landscape is “supposed to look” is probably only a short-term view of an ecosystem that was historically very dynamic. Currently, we can only hypothesize about how the presettlement disturbance regimes affected the vegetation and the landscape.

Distribution, Protection Issues, Threats, and Population Trends Relating to Species and Natural Communities Occurring in the Laramie Foothills

The following species have been documented from the Laramie Foothills. In general, the distribution information was taken from GIS coverage compiled for the Great Plains from the state Natural Heritage Programs. Occurrence ranks and survey dates were unknown for occurrences outside of Colorado, and for some occurrences documented by other researchers. Threats and trend data are generally taken from a variety of sources summarized in the Characterization Abstracts in the Biological and Conservation Datasystem (BCD) at CNHP. Global rarity and state rarity ranks are indicated for those states that track the elements. Species which are considered “watchlisted” (S3S4) are not actively tracked in the database. Instead, information is accumulated and stored in manual files in the event that future trends suggest that the species need to be more closely monitored.

Birds

Aquila chrysaetos (golden eagle)* G5 - Fifteen occurrences (active nesting sites) have been documented in the Great Plains portion of Colorado (S3S4), 10 in Kansas (S1), and 80 in Nebraska (S3). The Oklahoma Biological Survey ranks the species S2. There are 5 A-ranked occurrences in the Central Shortgrass Ecoregion in Nebraska. This species is watchlisted in Colorado.

Dolichonyx oryzivorus (bobolink) G5 - Eleven occurrences have been documented in the Great Plains of Colorado (S3), 3 in Kansas (S1), 1 in Wyoming (S3). Most occurrences in Colorado

are considered historic (information is greater than 5 years old). Breeding bird surveys indicate significant declines in recent decades, particularly in central North America (Sauer and Droege 1992).

Empidonax minimus (least flycatcher) G5 - Four occurrences have been documented in Colorado (S1), but only the location at the Laramie Foothills is documented with precise locational information. This species has significantly increased in abundance in western Northern America in the recent decades (Sauer and Droege 1992).

Invertebrates

Callophrys mossii schryveri (Schryver's elfin butterfly) G4T3 - Twenty-two occurrences have been documented in Colorado (S2S3). Most occurrences in the state are considered historic (information is greater than 10 years old). Much of the habitat for this species is being impacted along the Front Range by fragmentation.

Fish

Etheostoma exile (Iowa darter) G5 - Over 50 occurrences are documented in Colorado (S3), most of which are considered historic (information is more than 5 years old) There are many unranked occurrences in other states. This species may have never been common in Colorado (CNHP 1997) but occurs east to New York and Canada. Habitat alterations such as dewatering, channelization, and increased pollution are considered the most predominant threats.

Etheostoma nigrum (Johnny darter) G5 - More than 70 occurrences have been documented in Colorado (S3S4), 59 in Nebraska (S3), and 7 in Wyoming. This species is considered more common than previously thought and is now watchlisted in Colorado.

Mammals

Plecotus townsendii pallescens (pale lump-nose bat) G4T4 - Currently there are about 35 occurrences in Colorado (S2). The regional distribution is was not compiled for this project.

Significant animal species searched for but not located in the Laramie Foothills

Charadrius montanus (mountain plover) - The habitat in the Laramie Foothills is probably marginal for mountain plovers. In general it is thought that most of the grasslands in the Laramie Foothills are more of a mixed grass type that is of taller stature than that normally inhabited by plovers. This species prefers relatively flat prairie with short grasses such as those grazed heavily or utilized by prairie dogs. Several prairie dog towns are present but may be too small for use by the plovers.

Zapus hudsonius preblei (Preble's subspecies of the meadow jumping mouse) - Extensive trapping was conducted in the riparian shrublands along Stonewall Creek (760 trapnights) but no individuals were captured.

Tympanuchus phasianellus jamesi (plains sharp-tailed grouse) - This species was historically present in the area (Cooke 1897), but probably in low numbers. Colorado Division of Wildlife personnel indicate that there is limited chance for successful re-introduction here because habitat conditions are marginal.

Natural Communities

Mountain mahogany/Griffith's wheatgrass (*Cercocarpus montanus/Elymus lanceolata X Pseudoroegneria spicata*) G4 - In Colorado (S3) 4 occurrences have been documented on the East slope, and 5 on the West Slope, most of which are in poor condition (Element Occurrence ranks of C or D). Griffith's wheatgrass is essentially a rhizomatous hybrid of bluebunch wheatgrass and may fill a similar role. This community has only been documented in northeast Colorado but will be considered a phase of the more common mountain mahogany/blue bunch wheatgrass (*Cercocarpus montanus/Pseudoroegneria spicata*) community that occurs in Utah, Wyoming, and on the Western Slope in Colorado. No occurrences are known to be protected on the East Slope.

Mountain mahogany/mountain muhly (*Cercocarpus montanus/Muhlenbergia montana*) GU - Little is known about the distribution or rarity of this community. It has only been documented from Larimer County and the San Isabel National Forest (Johnston 1987).

Mountain mahogany-skunkbush/big bluestem (*Cercocarpus montanus-Rhus trilobata/Andropogon gerardii*) G2G3 - This community has only been documented from the Front Range of Colorado but may be somewhat more common than occurrence data suggest. Only 5 occurrences have been documented (S2S3). The most extensive occurrences are around Horsetooth Reservoir in Larimer County. A small occurrence exists in the Laramie Foothills at the Horsethief Pass site.

Mountain mahogany/needle-and-thread grass (*Cercocarpus montanus/Stipa comata*) G2 - Twenty occurrences have been documented in Colorado (S2) of which only about one-quarter are considered good quality (Element Occurrence ranks of A or B). This community is locally common along the Colorado Front Range but nearly all occurrences have been heavily degraded by invasion of non-native species (especially cheatgrass - *Bromus tectorum*) as is the case with the occurrences at the Laramie Foothills. Several occurrences are physically protected by local open space departments on the Front Range but none are known to be managed to reduce the impacts of non-native species on this shrubland.

Mountain mahogany/ New Mexico feathergrass (*Cercocarpus montanus/Stipa neomexicana*) G2G3 - This community is known to occur in northeast Colorado and in small stands in east central Wyoming and southeast Colorado. Eleven occurrences have been documented in Colorado (S2S3). The only high quality occurrences (Element Occurrence ranks of A or B) are in the Laramie Foothills at the Grayback Ridge and Park Creek Hogback sites. These are the best condition and largest known. These occurrences also represent much of the natural variation within the community. This variation ranges from the sparsely vegetated stands on shale at the Park Creek Hogback site, to more "typical" examples near the Campbell Valley and Grayback Ridge (see Figure 5), to the densely vegetated stands with ponderosa pine invading north of Steamboat Rock. Most of the potential habitat in Colorado has been searched but only roadside surveys have been conducted in Wyoming. The community is not expected to occur in New Mexico as one-seed juniper (*Juniperus monosperma*) is the common overstory species with New Mexico feathergrass in northern New Mexico (personal communication with Esteban Muldavin - New Mexico Natural Heritage Program).

Mountain mahogany/Scribner's needlegrass (*Cercocarpus montanus/Stipa scribneri*) G3/S3 - This community is only known from Colorado (S3). Four occurrences have been documented. This community occupies very steep, rocky slopes and is expected to be somewhat more common than occurrence data currently suggest, hence the S3 rank. The occurrence at the Laramie Foothills (in the Grayback Ridge site), while relatively small, is typical for this community and is one of the best known (see Figure 5). There is one occurrence on Boulder County Open Space property.

Rocky Mountain juniper/mountain mahogany (*Juniperus scopulorum/Cercocarpus montanus*) G2/S2 - Three occurrences of this community have been documented in Colorado (S2). The occurrence in the Laramie Foothills (in the Deadman Creek site) is one of the best documented but other high quality occurrences are expected to exist. Little is known about this community which has only been documented from the Roosevelt National Forest (Johnston 1987). It is suspected that this community is more common than existing data suggest, but because it generally occurs near the lower elevational limits of Forest Service land, it has probably been overlooked.

Mountain muhly-needle and thread grass (*Muhlenbergia montana-Stipa comata*) G2 - Four occurrences have been documented in Colorado (S2). One occurrence of this community is documented from the Laramie Foothills. Little is known about this community which had previously only been documented from the nearby Roosevelt National Forest (Johnston 1987), but it is suspected that it may be more common than existing data suggest.

FIGURE 5. THE MOUNTAIN MAHOGANY/NEW MEXICO FEATHERGRASS (TOP) AND MOUNTAIN MAHOGANY/SCRIBNER'S NEEDLEGRASS COMMUNITIES (BOTTOM).



Narrow leaf cottonwood/bluestem willow (*Populus angustifolia/Salix irrorata*) GU - Little is known about the distribution or rarity of this community. It is suspected that most occurrences have been invaded by non-native species in the understory as is typical of most lower elevation riparian communities.

Needle-and-thread grass - blue grama (*Stipa comata-Bouteloua gracilis*) G5 - Only 6 occurrences have been documented in Colorado (S2S3) but it is likely that it is more common than data currently suggest. The condition of this community in Colorado and range-wide is highly variable. The Laramie Foothills contain small but excellent condition examples of this community, as well as large occurrences that have been more heavily altered by livestock grazing (but are presumed to be restorable).

A similar plant community (*Stipa comata-Bouteloua gracilis-Carex filifolia* - G5) which occurs in several northern Great Plains states and Canadian provinces, is considered synonymous with the *Stipa comata-Bouteloua gracilis* community. In Kansas, it is estimated that there are 5-10 occurrences, mostly 1000 acres or less, in variable condition. No occurrences are known to be protected in Kansas (personal communication with Chris Lauver - KS Biological Survey)

This community is also common in Wyoming. At the landscape scale the general condition is thought to be good with little impact from exotic species, but some impact from fire suppression and long-term seasonal grazing. No occurrences are known to be protected in Wyoming (personal communication with George Jones - WY Natural Diversity Database)

This community also occurs in Montana, Manitoba, and Saskatchewan. Specific data were not compiled for these areas but impacts and threats are expected to be similar to the other states. It is unknown if there are any protected occurrences in these areas.

It appears that this plant community has been impacted by various human activities for many years throughout much of its range including the Laramie Foothills. The most prevalent threats are overgrazing and agricultural conversion. The most noticeable impact is the increase in native weedy species. Currently non-native species do not appear to pose a great threat to the grassland in the area. Smaller parcels have been less impacted in recent times (i.e. the grassland just east of Phantom Canyon). The specific impacts of historic season long livestock grazing and fire suppression are little understood. Research addressing these impacts would be valuable for the long-term management.

Plants

Aletes humilis (Larimer aletes) G2G3 - This species is thought to be endemic to Colorado (S2S3) but may occur in southern Wyoming. Thirty-six occurrences have been documented in Colorado, most of which are high quality (Element Occurrence ranks of A or B). Several occurrences are known within the site (see Figure 6). Population trends for this species at 2 sites have been stable over the last five years (personal communication with A. Carpenter and T. Schulz - The Nature Conservancy of Colorado). Because of its habitat, usually steep slopes and cliffs, it is thought to be somewhat naturally protected. Populations are protected at The Nature Conservancy's Phantom Canyon and Cap Rock preserves.

Physaria bellii (Bell's twinpod) G2 - This species is only known from the Front Range of Colorado (S2), mainly on a narrow band of the Niobrara shale from Jefferson County north to Larimer County. Twenty-seven occurrences have been documented. Approximately two-thirds

of these occurrences are low quality or historic (Element Occurrence Rank of C, D, or H). The best known (and largest) population of this species is located within the Park Creek Hogback site (see Figure 6). This species is naturally rare and highly threatened by human activities. The predominant threats to this species are road construction and maintenance, and mining.

Potentilla ambigens (southern Rocky Mountain cinquefoil) G3 - Seven occurrences have been documented in Colorado (S1S2). One occurrence is known from the Air Force Academy, but it is unknown if protection is addressed in management plans for the facility. One occurrence is known from the Laramie Foothills at the Deadman Creek Macrosite.

Potentilla effusa var. *rupincola* (Rocky Mountain cinquefoil) G3G5T2 - Twenty-five occurrences have been documented in Colorado (S2), about half of which are low quality or historic (element Occurrence ranks of C, D, or H). One occurrence is known from the Laramie Foothills at the Phantom Canyon site. Its habitat may offer some natural protection (steep cliffs or shelves on cliffs).

FIGURE 6. LARIMER ALETES (TOP) AND BELL'S TWINPOD (BOTTOM).



Table 1. Occurrences of rare and imperiled plants and animals and significant natural communities known to occur in the Laramie Foothills Study Area. Occurrence ranks are noted. A question mark (?) indicates that an occurrence rank was not assigned.

Scientific Name	Common Name	Occr. Rank	Global Rank	State Rank	Fed. Status	State Status	Fed. Sens.
Birds							
<i>Dolichonyx oryzivorus</i>	bobolink	C	G5	S3B,SZN			
<i>Empidonax minimus</i>	least flycatcher	?	G5	S1B,SZN			
Invertebrates							
<i>Callophrys mossii schryveri</i>	Schryver's elfin	?	G4T3	S2S3			
Fish							
<i>Etheostoma exile</i>	Iowa darter	?	G5	S3		SC	
Mammals							
<i>Plecotus townsendii pallescens</i>	Pale lump-nose bat	?	G4T4	S2			FS
Communities							
<i>Cercocarpus montanus/ Elymus lanceolata X Pseudoroegneria spicata</i>	foothills shrubland	C	G4	S3			
<i>Cercocarpus montanus/ Elymus lanceolata X Pseudoroegneria spicata</i>	foothills shrubland	D	G4	S3			
<i>Cercocarpus montanus/ Muhlenbergia montana</i>	foothills shrubland	C	GU	S2			
<i>Cercocarpus montanus - Rhus trilobata/Andropogon gerardii</i>	foothills shrubland	C	G2G3	S2S3			
<i>Cercocarpus montanus/Stipa comata</i>	mixed foothill shrublands	C	G2	S2			
<i>Cercocarpus montanus/Stipa comata</i>	mixed foothill shrublands	C	G2	S2			
<i>Cercocarpus montanus/Stipa comata</i>	mixed foothill shrublands	CD	G2	S2			
<i>Cercocarpus montanus/Stipa comata</i>	mixed foothill shrublands	D	G2	S2			
<i>Cercocarpus montanus/Stipa neomexicana</i>	foothills shrubland	A	G2G3	S2S3			
<i>Cercocarpus montanus/Stipa neomexicana</i>	foothills shrubland	B	G2G3	S2S3			
<i>Cercocarpus montanus/Stipa scribneri</i>	foothills shrubland	B	G3	S3			
<i>Juniperus scopulorum/ Cercocarpus montanus</i>	foothills juniper woodlands	B	G2	S2			
<i>Muhlenbergia montana-Stipa comata</i>	montane grasslands	BC	G2	S2			
<i>Populus angustifolia/Salix irrorata</i>	Foothills cottonwood riparian forests	C	GU	SU			
<i>Stipa comata- Bouteloua gracilis</i>	montane grasslands	A	G5	S2S3			

Plants							
<i>Aletes humilis</i>	Larimer aletes	A	G2G3	S2S3			FS
<i>Aletes humilis</i>	Larimer aletes	A	G2G3	S2S3			FS
<i>Physaria bellii</i>	Bell's twinpod	A	G2	S2			
<i>Pellaea atropurpurea</i>	purple cliff-brake	H	G5	S2S3			
<i>Potentilla ambigens</i>	southern Rocky Mountain cinquefoil	C	G3	S1S2			
<i>Potentilla effusa</i> var. <i>rupicola</i>	Rocky Mountain cinquefoil	B	G3G5T2	S2			
<i>Solidago ptarmicoides</i>	prairie goldenrod	H	G5	S2S3			

Conclusions

The Laramie Foothills, because of the imperiled species and natural communities it contains, was determined to have very high significance for the protection of biodiversity. The site includes the best known occurrences of several natural heritage resources including the mountain mahogany/New Mexico feathergrass community; the mountain mahogany/Scribner's needlegrass community; and the plant Bell's twinpod. The site also contains two excellent occurrences of the plant Larimer aletes. Long-term persistence of these communities and species will be affected by actions within the Laramie Foothills.

The landscape in which these natural heritage resources occur is unusual for the Colorado Front Range. Several of these natural heritage resources occur only along the Front Range from Jefferson County north to Larimer County, an area that has historically, and is currently being highly impacted by urban and agricultural development. The Laramie Foothills site is relatively undeveloped and still maintains ecological connectivity to the Rocky Mountains and the Great Plains. This is not the case with most of the Colorado Front Range. The Colorado Natural Heritage Program considers the Laramie Foothills as one of the last intact landscapes where these natural communities and species occur, and where many of the natural ecological processes are still intact and functioning (or restorable). Functioning natural ecological processes not only help to insure the long-term viability of the imperiled communities and species, but may also help prevent those that are currently common from becoming imperiled in the future..

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Appendix

Vegetation Mapping

A generalized vegetation map for the Laramie Foothills is included as a supplement to this report. Mapping was done using aerial photo interpretation with field verification over much of the area. Only broad vegetation types were mapped because of the difficulty of mapping the complex mosaic of plant associations occurring within the types. Within each vegetation type there could be one or many plant associations and small inclusions of other associations too small to map independently. Mapping units are described below along with the plant associations that are commonly associated.

Grasslands - approximately 60,000 acres

Needle-and-thread grass-blue grama (*Stipa comata-Bouteloua gracilis* or *Stipa comata-Bouteloua gracilis-Carex filifolia*.)

Mountain muhly-needle-and-thread grass (*Muhlenbergia montana-Stipa comata*)

Shrublands - approximately 42,000 acres

mountain mahogany/New Mexico feathergrass (*Cercocarpus montanus/Stipa neomexicana*)

mountain mahogany/needle-and-thread grass (*Cercocarpus montanus/Stipa comata*)

mountain mahogany/Scribner's needle grass (*Cercocarpus montanus/Stipa scribneri*)

mountain mahogany-skunkbush/big bluestem (*Cercocarpus montanus-Rhus trilobata/Andropogon gerardii*)

mountain mahogany/mountain muhly (*Cercocarpus montanus/Muhlenbergia montana*)

mountain mahogany/Griffith's wheatgrass (*Cercocarpus montanus/Elymus lanceolata x Pseudoroegneria spicata*)

Riparian communities

Riparian natural communities are generally present throughout the site but constitute a small proportion of the landscape and were not delineated on maps.

Pinus ponderosa Woodlands - approximately 10,000 acres

Extensive ponderosa pine forests or woodlands are not common in the Laramie Foothills site. Most stands are very small or intermixed with mountain mahogany shrublands and are not considered significant enough to track as occurrences of elements of biodiversity. The following plant associations are represented in some of these small patches: Mixed ponderosa pine/mountain mahogany stands were included here.

ponderosa pine/King's spikefescue (*Pinus ponderosa/Leucopoa kingii*)

ponderosa pine/sedge (*Pinus ponderosa/Carex* spp.)

ponderosa pine/mountain muhly (*Pinus ponderosa/Muhlenbergia montana*)

Importance for Animal Groups

The following section lists animal species which the site could potentially support (using the rough estimates of area in each major habitat presented above).

Birds:

Estimated home range or density information for species that were confirmed or probable breeders on the Roberts Ranch is summarized. Information was taken mainly from Birds of North America (BNA) series and from estimates of abundance from Hallock (1996).

red-tailed hawk - home range up to 163 ha BNA
nighthawk - 28-33 ha BNA
broad-tailed hummingbird - 1-6.7 km home range from nest, density 1.2 /ha
northern flicker - density in wooded habitat in winter 3-5/ha
least flycatcher - breeding density in open woodland 1.4-1.7 pairs/ha BNA
horned lark - 58/ha high plains in winter BNA
cliff swallow - range before nesting 2-15 km, nesting range 1.5-6 km, postnesting 50-185 km
gray catbird - .1 pair/ha upland shrub
lark bunting - 5-40 pairs/sq. km in Palouse Prairie BNA
savannah sparrow - .7-2.3 pairs/ha in grasslands in the summer, 4-30 individuals winter,
grasshopper sparrow .25 territories/ha native prairie
western meadowlark - greatest densities in Great Plains roughlands and High Plains
American goldfinch - home range summer > 1 km, density .78-12 nests/ha BNA

The following birds were not documented in the area but could potentially occur in the Laramie Foothills.

mountain plovers - home range 21-56 ha, density 2-5 birds/sq. km in shortgrass BNA
burrowing owls - home range .14-4.8 sq. km
loggerhead shrike - 1 pair/1.6-10 km BNA

1996 Breeding Bird Species of Laramie Foothills Megasite. Based on information compiled by Dave Hallock for The Nature Conservancy

<u>Common Name</u>	<u>Latin Name</u>	<u>Habitat</u>	<u>Abund.</u>	<u>Status</u>	<u>density or home range comments</u>
Habitat Codes: S - Shrubland ; G - Grassland; R - Riparian; C - cliffs, rock outcrops; W - Ponderosa Woodlands; P - Ponds, streams; M - Wet Meadows					
Abundance Codes: 1: one breeding pair; 2: 2-10 breeding pairs; 3: 11-100 breeding pairs; 4: 101-1000 breeding prs.; 5: >1000 breeding prs.					
Breeding Status Codes: Po - Possible Breeder; Pr - Probable Breeder; Cf - confirmed breeder					
* = <u>general nesting habitat</u>					
<u>Anseriformes</u>					
Green-winged Teal	<i>Anas crecca</i>			2 Po	6-70 ha during nesting (F. McKinney in BNA, No.193)
Mallard	<i>Anas platyrhynchos</i>			2 Cf	
Common merganser	<i>Mergus merganser</i>			1 Po	NIA
(1): Usually nesting species of the west slope of Colorado, they breed east of the divide along the Poudre River. Could be migrants; seen in May but not June.					
<u>Falconiformes</u>					
Turkey Vulture	<i>Cathartes aura</i>	C*, G, S	"1 - 2"	Po	NIA
<u>Accipitridae</u>					
Red-tailed Hawk	<i>Buteo jamaicensis</i>	R*, C*, S, G		2 Cf	mean home range spring: male 163 ha, female 85 ha. summer: 117 ha male and female (Peterson 1979 in BNA, No. 52. 1993.)
Golden Eagle+	<i>Aquila chrysaetos</i>	C*, G, S		1 Cf	NIA
<u>Falconidae</u>					
American Kestrel	<i>Falco sparverius</i>	R*, G, S		2 Cf	NIA
Prairie Falcon+	<i>Falco mexicanus</i>	C*, G, S		1 Cf	NIA
<u>Charadriiformes</u>					
Killdeer	<i>Charadrius vociferous</i>	G*, M*, P, R		2 Cf	NIA
<u>Scolopacidae</u>					
Spotted Sandpiper	<i>Actitis macularia</i>	P*		2 Po	NIA
Common Snipe	<i>Gallinago gallinago</i>	M*, R*		2 Cf	NIA
Wilson's Phalarope	<i>Phalaropus tricolor</i>	P*		2 Po	nest fidelity: 100m to 1Km from nest site. density: 0-40 prs possible on 40 ha ephemeral wetland. (Colwell 1986 in BNA, No. 83. 1994.)
<u>Columbidae</u>					
Rock Dove	<i>Columba livia</i>	C*	"2-3"	Po	11.4 - 30.8 indiv./sq. Km in urban areas. (BNA, No.13, 1992)
Mourning Dove	<i>Zenaida macroura</i>	R*, S*, W*, G		3 Cf	nest fidelity: males: 0.8 - 7.8 Km range from site; females: 0.8 - 5.3 Km from nest.
<u>Stridiformes</u>					
Great Horned Owl	<i>Bubo virginianus</i>	R*		2 Po	NIA
<u>Caprimulgiformes</u>					
Common Nighthawk	<i>Chordeiles minor</i>	R*, S*, W*, G	"2 - 3"	Cf	density: 1 male/33.6 ha. home range 28.34 ha natural field (Wedgewood 1973 in BNA)
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	S*, W*, G		2 Po	fidelity to breeding site. radio tagged birds rarely travel more than 500m away from nest site (BNA, No. 32. 1992)

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Abundance Codes: 1: one breeding pair; 2: 2-10 breeding pairs; 3: 11-100 breeding pairs; 4: 101-1000 breeding prs.; 5: > 1000 breeding prs.					
Breeding Status Codes: Po - Possible Breeder; Pr - Probable Breeder; Cf - confirmed breeder					
* = <u>general nesting habitat</u>					
<u>Apodiformes</u>					
White-throated Swift	<i>Aeronautes saxatalis</i>	C*	3 Po	NIA	home range suggested as 1 - 6.7 Km from nest site. density: approx. ave. 1.1 bird per ha. (variance from feeder/natural flower - difficult to est.) (BNA, No. 16, 1992.)
(2): Possible breeder, but colonies are usually obvious and none were seen. This is fairly low in elev. for nesting (except for Pawnee Grassland colony.)					
<u>Trochilidae</u>					
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	R*,S*	2 Cf		home range: 0.8 - 7.9 Km. from nest site. Density: 2 pairs/ 5 Km. of river shoreline. (Brooks and Davis. 1987 in BNA, No.84 1994).
Belted Kingfisher	<i>Ceryle alcyon</i>	R*	2 Po		home range: 0.8 - 7.9 Km. from nest site. Density: 2 pairs/ 5 Km. of river shoreline. (Brooks and Davis. 1987 in BNA, No.84 1994).
<u>Piciformes</u>					
Northern Flicker	<i>Melanerpes erythrocephalus</i>	R*	3 Pr		density in wooded habitat (winter): 2.77 - 4.72 individuals/hectare (BNA, No. 166. 1995)
<u>Passeriformes</u>					
Western Wood-Pewee	<i>Contopus sordidulus</i>	R*	"2 - 3"	Pr	NIA
Least Flycatcher+?	<i>Empidonax minimus</i>	R*	1 Cf		breeding density in open woodland habitat approx. 1.4-1.7 pairs/hectare (BNA, No. 99. 1994)
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	R*, C*	2 Po		NIA
Say's Phoebe	<i>Sayornis saya</i>	S*	3 Pr		NIA
Western Kingbird	<i>Tyrannus verticalis</i>	R*	2 Po		0.5 nests/hectare in open grassland (BNA, No. 227. 1996)
Eastern Kingbird	<i>Tyrannus tyrannus</i>	R*	2 Po		NIA
<u>Aluauidae</u>					
Horned Lark	<i>Eremophila alpestris</i>	G*	4 Cf		58.4 individuals/hectare (high plains in winter): Return to breeding site: 65% return in Colorado study. (BNA, No. 195. 1995)
<u>Hirundinidae</u>					
Tree Swallow	<i>Tachycineta bicolor</i>	R*	"2 - 3"	Po	density: dependent upon nest site availability. Home range: 60 Km non-nesting. male: 4-5 Km during nesting. female: 2-3 Km during nesting. (BNA, No.11, 1992)
Violet-green Swallow	<i>Tachycineta thalissina</i>	C*	3 Cf		NIA
N. Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	P*	2 Po		density: dependent upon nest site availability. Home range: during nesting approx. 1000 meters. (BNA, No.234, 1996)
Bank Swallow	<i>Riparia riparia</i>	P*	2 Po		NIA
Cliff Swallow	<i>Hirundo pyrrhonota</i>	C*	4 Cf		density: dependent on nest site availability. range: before nesting, 2-15 Km. nesting range: 1.5 - 6 Km post-nesting range: 50 - 185 Km. (BNA, No. 149. 1995)
Barn Swallow	<i>Hirundo rustica</i>	P*	"2 - 3"	Cf	NIA
(3): Cliff swallows are colonial nesters. A colony exists on Spring Gulch just north of CR 80 and along Spring Gulch south of Campbell Mountain.					

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Abundance Codes: 1: one breeding pair; 2: 2-10 breeding pairs; 3: 11-100 breeding pairs; 4: 101-1000 breeding pairs; 5: > 1000 breeding pairs.					
Breeding Status Codes: Po - Possible Breeder; Pr - Probable Breeder; Cf - confirmed breeder					
* = <u>general nesting habitat</u>					
Black-billed Magpie	<i>Pica pica</i>	S*,R*	3 Cf	NIA	
Common Raven	<i>Corvus corax</i>	C*, G, S	2 Po	NIA	
Black-capped Chickadee	<i>Parus atricapillus</i>	R*	2 Po		Home range: (winter) 5.7 - 38.9 ha. flock ranges: av. 14.5 ha. breeding density (varies): 0.15 - 0.25 pairs/hectare (BNA, No. 39, 1993)
Rock Wren	<i>Salpinctes oboleus</i>	C*	3 Pr	NIA	
Canyon Wren	<i>Catherpes mexicanus</i>	C*	2 Po		home range: territorial around nest during breeding. No distance or density data.
House Wren	<i>Troglodytes aedon</i>	R*,S*	3 Pr	NIA	
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	S*	3 Cf		Home range: (breeding) 4 ha. around breeding core area of 0.4 ha. (winter) 8.8 ha. density: (pinyon-juniper woodland) 45 individuals/ sq. Km. (BNA, No. 23, 1992.)
Mountain Bluebird	<i>Sialia currucoides</i>	W*	2 Cf		Home range: few data, no radio tracking completed. density: cavity nester. nesting site dependent.
Veery+	<i>Catharus fuscescens</i>	R*	"1 - 2" Pr		home range: few data. density: habitat dependent - dense understory preferred. no hard number data available.
American Robin	<i>Turdus migratorius</i>	R*	3 Cf	NIA	
Gray Catbird+	<i>Dumetella carolinensis</i>	R*,S*	"2 - 3" Pr		home range: not reported. density: (varied, habitat dependent) 0.1 pairs/ha. (upland shrub) - 1.0 pairs/ha. (6-8 yr. old aspen stand) - 7.4 pairs/ha. (MI dense shrubland) (BNA, No. 167, 1995)
Northern Mockingbird	<i>Mimus polyglottos</i>	S*,W*	3 Pr		home range: year round resident, territorial. density: populations very local in distribution and densities vary greatly. (BNA, No. 7, 1992)
Sage Thrasher	<i>Oreoscoptes montanus</i>	S*	2 Po	NIA	
European Starling	<i>Sturnus vulgaris</i>	R*,S,G	3 Cf		home range: year round resident for breeding and foraging. travel large distances to forage. density: 10-20 pairs/sqr. Km.
Warbling Vireo	<u>Passeriformes</u> <i>Vireo gilvus</i>	R*	2 Pr	NIA	
Virginia's Warbler	<i>Vermivora virginiae</i>	S*,W*	2 Po	NIA	
Yellow Warbler	<i>Dendroica petechia</i>	R*	3 Cf	NIA	
Common Yellowthroat	<i>Geothlypis trichas</i>	R*	2 Po	NIA	

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Abundance Codes: 1: one breeding pair; 2: 2-10 breeding pairs; 3: 11-100 breeding pairs; 4: 101-1000 breeding prs.; 5: > 1000 breeding prs.					
Breeding Status Codes: Po - Possible Breeder; Pr - Probable Breeder; Cf - confirmed breeder					
* = <u>general nesting habitat</u>					
Western Tanager	<i>Piranga ludoviciana</i>	<u>Emberizidae</u> S*, W*	2 Po	NIA	
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	<u>Emberizidae</u> Cardinalinae R*	"2 - 3"	Pr	range: few data available density: breeding habitat may limit reproductive opportunities and regulate population (BNA, No. 143. 1995)
Lazuli Bunting	<i>Passerina amoena</i>	R*, S*, W*	"2 - 3"	Pr	range: few data available. density: (breeding) 5 -40(Palouse prairie) pairs/sqr. Km dependent on habitat quality. (BNA, No. 232. 1996)
Green-tailed Towhee	<i>Papilo chlorurus</i>	<u>Emberizidae</u> Emberizinae S*	4 Pr	NIA	
Rufous -sided Towhee	<i>Pipilo erythrophthalmus</i>	S*	4 Pr	NIA	
Brewer's Sparrow	<i>Spizella breweri</i>	S*	4 Cf	NIA	
Vesper Sparrow	<i>Poocetes gramineus</i>	G*, S*	"4 - 5"	Cf	
Lark Sparrow	<i>Chondestes grammacus</i>	S*, G*	4 Pr	NIA	
Lark Bunting	<i>Calamospiza melanocorys</i>	G*	2 Po	NIA	
Savannah Sparrow+?	<i>Passerculus sandwichensis</i>	M*	"2 - 3"	Pr	range: breeding may occur w/in 50 - 300m of previous year's site. density: 0.7 pairs - 2.3 pairs/ha. in grassland sites (summer) 4.0 - 30 individuals /ha. (winter). (BNA, No. 45, 1993.)
Grasshopper Sparrow+	<i>Anmodramus savannarum</i>	G*	"3 -4"	Pr	home range: No information. density: 0.25 territories/ha. (native prairie)
Song Sparrow	<i>Melospiza melodia</i>	R*, P*	3 Pr	NIA	
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	<u>Emberizidae</u> Icterinae R*, P*	3 Cf	NIA	
Western Meadowlark	<i>Sturnella neglecta</i>	G*, S*	4 Pr		home range: breeding return within 1-1.6 Km of former breeding area. density: greatest densities reported in Great Plains roughlands and High Plains. (BNA, No. 104, 1994.)
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	R*, S*, G*	3 Cf	NIA	
Common Grackle	<i>Quiscalus quiscula</i>	R*	2 Po		home range: no info. density: highest densities in eastern U.S. (Delaware, Maryland, Kentucky) (BNA, No. 271. 1997.)
Brown-headed Cowbird	<i>Molothrus ater</i>	S*, R*, G*	"3 - 4"	Pr	home range (breeding): 8.58 ha. to 68 ha. (commute to feeding areas 2.1 - 6.7 Km away.)
Northern Oriole	<i>Icterus galbula</i>	R*	2 Pr	NIA	5.5 - 7.8 individuals /ha. (habitat dependent) (BNA, No. 47, 1993)
House Finch	<i>Carpodacus mexicanus</i>	<u>Fringillidae</u> R*	"2 - 3"	Cf	home range: return to same area to breed well documented. density: info for numbers / unit area unavailable. (BNA, No. 46. 1993.)
Lesser Goldfinch	<i>Caduelis psaltria</i>	R*, S*	"2 - 3"	Pr	NIA
American Goldfinch	<i>Caduelis tristis</i>	R*	3 Pr		home range: (summer) food sorties > 1 Km. females stay in immediate vicinity. density: .78 nest - 12 nests/ ha (habitat dependent) (BNA, No. 80. 1993)

(4): Present in shrublands mixed with juniper and/or ponderosa pine.

(5): Could not confirm on second trip in June. Birds observed in late May could have been migrants.

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Common Name

Latin Name

Habitat

Abund.

Status

density of home range comments

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Breeding Status Codes: Po - Possible Breeder; Pr - Probable Breeder; Cf - confirmed breeder
 NIA = no information on density or home range available

* = general nesting habitat

Other Potential Breeders

Common Name

Latin Name

Habitat

Abund.

Status

Peregrine Falcon

Falconiformes

Falconidae

C

NIA

Falco peregrinus

Charadriiformes

Charadriidae

Mountain Plover

Stridiformes

Stridiidae

G (short-grassed prairie)

home range: (breeding) 300 meters/day (average of 21.5 - 56.6 ha.) density: 2.0 birds - 4.7 birds/sqr. Km (shortgrass prairie) (BNA, No. 211, 1996)

Barn Owl

Tyto alba

C,R

home range: 717 Ha.; max. distance from roost 5.6 Km density: 2.2 - 5.1 pairs /sqr Km (varies w/prey abundance) (BNA, No. 1 1992)

Eastern Screech-Owl

Otus asio

R

Northern Pygmy-Owl

Glaucidium gnoma

R

Burrowing Owl+

Athene cunicularia

G (prairie dog colonies)

home range: 0.14 - 4.81 sqr. Km density: endangered throughout much of its range. (BNA, No. 61. 1993)

Lewis' Woodpecker

Melanerpes lewis

R,W

NIA

Red-headed Woodpecker

Melanerpes erythrocephalus

R

NIA

Downy Woodpecker

Picoides pubescens

R

NIA

Hairy Woodpecker

Picoides villosus

R,W

NIA

Caissin's Kingbird

Passeriformes

Tyrannidae

S (6)

NIA

Tyrannus vociferans

(6) Alex Cringan saw pair in 1992

Scrub Jay

Aphelocoma coerulescens

S, W

NIA

American Crow

Corvus brachyrhynchos

S, R

NIA

Bushtit

Psaltriparus minimus

S

NIA

Cedar Waxwing

Bombycilla cedorum

R, S

NIA

Loggerhead Shrike

Lanius ludovicianus

S, R

home range: NIA density: 1 pair/ 1.6 - 10 Km (habitat/hnest avail. dependent) (BNA, No.231, 1996)

Yellow-breasted Chat

Icteria virens

S, R

NIA

Indigo Bunting

Passerina cyanea

R

home range: NIA density: 2.8 - 3.8 pairs/ 10 ha. (habitat dependent) (BNA, no. 4. 1996)

Lazuli-Indigo Hybrid

Passerina amoena X cyanea

R

home range: NIA density: 5.0 - 40 pairs/ Sqr Km (habitat dependent) (BNA, no. 232. 1996)

Emberizidae Parulinae

Emberizidae Cardinalinae

Mammals:

The Laramie Foothills site in itself potentially supports viable populations of most mammals (assuming appropriate habitat in fair condition) except for the largest and/or most widely ranging species such as mountain lion, black bear, wolf, badgers, bobcat, pronghorn. Hundreds to thousands of moles, cottontail rabbits, chipmunks, ground squirrels, prairie dogs, gophers, meadow mice, silky mice, kangaroo rats, pack rats, voles, skunks, otter, mule deer, and elk could be supported on the site.

Threats

Human Alteration of the Landscape

Human alteration and development of the landscape has taken many forms in Larimer County. An area historically dominated by agricultural use, development generally took the form of sparse buildings and roads, plowed fields, fences, and water diversions and impoundments. These developments significantly altered the landscape but retained large areas of open spaces that were sparsely inhabited by humans and still supported many of the native plants and animals. Today, while a significant agricultural economy remains, residential and commercial development increasingly dominates land use in Larimer County and presents new challenges to the protection of biological diversity.

Residential and Commercial Development

Although currently a minor impact on the landscape at the Laramie Foothills, residential development is increasing in the area. A direct effect of residential and commercial development is typically the total alteration of the natural habitat where buildings, roads, parking lots, and other infrastructure are built. While affecting a relatively small percentage of Colorado's landscape, these effects may have devastating consequences when placed in habitats that are limited in extent. Hogbacks, wetlands and riparian areas are habitats that are typically at risk, but other habitats may be so reduced by widespread alterations that only non-viable remnants remain. Similarly, habitats and sites that support rare or imperiled species are by their nature limited in extent. Without protection from wholesale alteration these species and habitats may be totally eliminated.

The indirect effects that result from the increase in human density and the accompanying increase in development structures (including buildings, roads, and fences) exceed the direct habitat destruction in the percentage of the landscape affected (see Knight *et al.* 1995).

Human disturbances often affect natural interactions between species and between individuals, resulting in the alteration of animal communities and changing the number and types of species present (Knight and Gutzwiller 1995). The effects of these disturbances, including noise, human presence, and security lights, can be particularly acute when they occur in or near critical or sensitive habitats.

The effects of non-native plant and animal species are well known and discussed at greater length below. Since native species are rarely used in landscaping and erosion control, and many non-native species spread as a result of soil disturbance, developments can act as sources for non-native species dispersal to adjacent areas (Harty 1986).

Habitat fragmentation, a subject also presented separately in this report, is a major effect of rural development. Roads and fences can create significant barriers to dispersal for both large animals such as pronghorn and smaller ones such as rodents and even butterflies. Furthermore,

these same barriers may also act as corridors for dispersal of other species including non-native plants and animals (Schonewald-Cox and Beuchner 1993 and references therein). Increased mortality from roads also affects certain species.

Increased densities of domestic cats and dogs generally occur as human population density increases. Free roaming cats are known to consume large numbers of native rodents and songbirds (Parmalee 1953, Eberhard 1954, Jones and Coman 1981, Liberg 1984, Churcher and Lawton 1987). Aside from population effects to these animals directly, especially those which are rare or imperiled, native small-to-medium-sized predators, such as raptors, coyotes, and bobcats, may also be affected by reduced availability of prey (George 1974, Triggs *et al.* 1984).

Lastly, increased rural development is likely to restrict landscape level processes such as fire, disease, predation, and movement of animals, processes which are integral to the maintenance of the entire spectrum of biological diversity (Knight *et al.* 1995) and an important value of the Laramie Foothills.

Agriculture

The ecological effects of the landscape alterations that result from agricultural land uses are varied and controversial. In recent years, conservation biologists have paid special attention to this problem and have come closer to understanding the detrimental as well as desirable effects of agricultural practices. Although these activities have affected a small percentage of the land within the Laramie Foothills, significant impacts to native species could be expected, especially along riparian areas.

Agricultural land in and around the Laramie Foothills is concentrated along major streams and rivers (mostly for hay production). Native natural communities in these areas are often completely replaced with monotypic stands of hay or crop species. This destroys the natural vegetation within the field, and also has the effect of fragmenting formerly continuous habitat in the area. The extent of native grasslands throughout North America has been seriously reduced since European settlement, as have many individual species that use the grasslands (Sampson and Knopf 1994). Fragmentation, especially of grasslands, has separated populations of many prairie species into isolated sub-populations. In many cases, even if protected individually, these sub-populations may not insure long-term survival of the species (Gilpin 1987). About 25% of the area in the Central High Plains Section (about one-half of the eastern plains of Colorado) is used for irrigated and dry agriculture (Bailey *et al.* 1994; McNab and Avers 1994).

Livestock production in the Laramie Foothills is the most prevalent land use and has significant effects on the natural ecosystems. The physical structure of environments is often changed by livestock grazing, altering habitats for the organisms that occur there. Fleischner (1994) concludes that improper livestock grazing can affect all major attributes of ecosystems. Native plant diversity and densities are typically decreased by heavy grazing, and indirect effects can have profound impacts on animal populations including birds, small mammals, reptiles, and fish. The result is an alteration of native species composition. Fundamental ecosystem functions such as plant succession can also be disrupted by preventing seedling establishment of certain species.

The effects of improper grazing in arid or semi-arid climates such as Colorado are most severe in riparian areas (Fleischner 1994). The ecological importance of riparian areas for various wildlife, including many species that are rare or imperiled, is well documented (Johnson *et al.* 1977, Brode and Brury 1984, Laymon 1984, Johnson 1989).

Non-native Species

Invasion of non-native plants and animals is one of the greatest threats facing native habitats and the conservation of biological diversity (Primack 1993, Soulé 1990). Such invasive species can have a number of impacts on natural systems (Bratton 1982, DeLoach 1991, Harty 1986, Hester 1991). Non-native organisms that become established in natural areas often displace the native plants and animals, altering the composition of native communities (Bock and Bock 1988), and affecting any other organisms that may have relied on these native communities. In some cases, the species being displaced are rare or imperiled plants and animals (Moore and Keddy 1988).

Most invasive non-native species are adapted to habitats that have been disturbed in some way, therefore the greatest impacts tend to occur in areas that have experienced the greatest landscape modification (White *et al.* 1993). This disturbance can take the form of soil removal, severe livestock grazing, changes in the hydrologic regime, adjacent forest clearance, mining, fire suppression, and many others.

The origins of non-native plants and animals in Larimer County are varied. Many plants have been brought to this continent for use as garden and landscaping ornamentals, but have since "escaped" and established themselves in the wild. In fact, many non-native plants are recommended to gardeners on the basis of their "hardiness" or their adaptability to our local environments. Recent trends in "xeriscaping" are certainly needed and well intentioned, but many of the plants used in such plans are in fact hardy non-native plants, some of which may establish wild populations.

Certain agricultural practices have also resulted in large scale non-native plant introductions. Pasture "improvements" involved seeding with various non-native grasses meant to increase the forage value for domestic livestock. The results are large areas dominated by a few non-native grasses and very few natives. Additionally, cultivated hay is rarely composed of native grasses. Hay fields are typically monocultures of non-native grasses which, aside from displacing the former grassland or wetland, serve as a source of seeds for invasion of surrounding areas. These hay grasses, and any other weeds that may grow in the hay fields, are also spread by livestock and appear to quickly invade certain areas (especially riparian areas).

Another group of species that can have similar impacts as non-native species are those native species that take over an area when the historic natural conditions are changed. Baltic rush (*Juncus balticus*) and Nebraska sedge (*Carex nebrascensis*) are two species that dominate meadows after other native species are eliminated by heavy grazing. Cattail (*Typha latifolia* and *Typha angustifolia*) are two species that often dominate wetlands that have been disturbed by construction, where soil has been exposed and then flooded. While cattail occurs in the area naturally, wetlands dominated by these species are increasing in abundance at the expense of other wetland types. In terms of species diversity, cattail marshes are not considered an acceptable replacement for other wetland types.

Non-native Plant Species in Wetlands and Riparian Areas

Non-native plant species have the potential to radically alter the nature of our riparian and wetland areas. Some noxious weeds that cause problems in wetlands and riparian areas, such as Canada thistle (*Cirsium arvense*) and leafy spurge (*Euphorbia esula*), are so well established that there is little we can do to control them except in small, targeted areas. Preventing widespread establishment of a noxious species is usually the best way to avoid costly,

deleterious consequences in the future, i.e., prevention is the best medicine. Coordinated efforts to control weeds are needed. It often does no good to control weeds on one property while a seed source exists on an adjacent property.

Fragmentation

By using natural resources, building towns and cities and their suburbs, and creating new agricultural land, humans gradually create patches of natural habitats within human dominated landscapes. Conservation biologists term this breaking up of natural habitats "fragmentation." Some scientists consider fragmentation one of the greatest threats to biological diversity (Noss and Cooperrider 1994). Wilcove *et al.* (1986) describe fragmentation as 1) a decrease of a habitat type, and 2) breaking up of remaining habitat into smaller, more isolated pieces. Currently, the greatest mechanism of fragmentation in Larimer County and the most immediate threat to the ecological integrity of the Laramie Foothills is rural housing development and concurrent road and highway development.

Roads that accompany housing development often act as barriers to animals, especially small animals, and may encourage the spread of weedy plant species along them. There may also be significant faunal mortality due to roads, especially where animals formerly used the area where the road now exists. Fences may also act as barriers to animals, especially species like pronghorn that in most cases, do not jump over them.

Fragmentation is a process that occurs through many means, and usually occurs over several months, years, or decades. The fragmentation process may not result in immediate loss of plants, animals, and natural communities from an area, but an area may experience gradual turnover of plant and animal species. In some cases the results of fragmentation are not seen for several years as species gradually leave or die off within a fragment. The fragment size and surrounding landscape greatly influence the impacts on living things within the fragment and the time until effects are seen.

Small patches of natural habitat, such as those created by large scale suburban development or large scale conversion of land to agriculture, will be unable to support plants and animals dependent on large areas of contiguous habitat. These small fragments may also experience a change in species composition, supporting more "weedy" plant and generalist animal species. While the number of species may remain the same, small habitat fragments surrounded by suburban or agricultural development will likely experience species turnover which results in a loss of less common species and increases in common and pest plants and animals.

Large habitat fragments are less vulnerable to complete change in species composition. However, even a large habitat area can experience loss of native, habitat specific plants and animals, especially on its edges. Intensive development at the edges of even a large natural area may cause changes in the species able to survive within the natural area.

Fragmentation threatens the significant natural features of the Laramie Foothills. Only concerted and well informed development and conservation planning are likely to save the remaining high quality natural areas. The negative effects of fragmentation can be reduced by: concentrating housing and road development, leaving some areas relatively free from such pressures; planting only native species in lawns and gardens; leaving large buffers of open space around nature preserves, and discouraging the building of roads within these buffers; planning for large fragments as opposed to small ones; and educating local residents about impacts of fragmentation on the natural world.

Domestic Predators

Domestic cats (*Felis catus*) are naturally inclined to hunt and, as most cat owners know, often hunt small birds and rodents. Scientific evidence supports this notion and has demonstrated that small mammals and songbirds constitute a large proportion of the diet of free-ranging domestic cats (Parmalee 1953, Eberhard 1954, Jones and Coman 1981, Liberg 1984, Churcher and Lawton 1987). In fact, domestic predators such as cats have been implicated in the local extirpation and extinctions of songbirds and small mammals (Emlen 1974, Holler *et al.* 1989, Scott and Morrison 1990). Cats can have additional negative impacts on natural ecosystems, if not by eliminating certain prey species, then by reducing prey numbers to such an extent as to compete with native predators such as raptors (George 1974, Triggs *et al.* 1984)..

The threat posed by these domestic predators is believed to be proportional to the number of cats present in a given area. Coleman and Temple (1993) demonstrated that most free-ranging domestic cats in rural areas are associated with non-farm rural residences. Although farm residences typically support a higher number of cats per household, the higher densities of non-farm rural housing results in a higher number of cats in an area. In some areas cat density was found to equal that of native predators, and in certain instances exceeded the number of native predators by several fold. This suggests that rural development may present an indirect, but serious threat to some bird and small mammal species.

Hydrologic Modifications

Natural areas and their constituent plant and animal species often depend on an intact hydrologic regime to persist. Many of the rare and imperiled species and significant natural communities in Larimer County depend upon a natural hydrologic regime. Changes in hydrology and related changes in water quantity, quality, and periodicity threaten many natural areas across the United States, and high quality natural areas in the Laramie Foothills.

Human induced modification of the hydrologic regimes often change the quantity, place, and timing of natural water flow. Activities at one place can impact areas many miles downstream. Modifications to hydrology are caused by water diversions or removal, groundwater depletion, vegetation removal and subsequent stream channelization, dam building, and housing and road construction.

Water diversion and removal from natural streams often affects water flow downstream. These activities often cause formerly perennial streams to run intermittently. Fish species that depend on having water throughout the year are not able to survive these hydrologic modifications even if they take place many miles upstream. A reduction in water flow often causes the entire drainage to dry up. Plants and animals that depend on year round moisture usually disappear from these drainages. Wells usually do not remove water directly from a naturally wet area, but it may lower the water table sufficiently to cause ephemeral aquatic habitats to be eliminated. Lowering the water table eventually has the same effect as direct water removal. Perennial streams may run intermittently, and the plant and animal species associated with them are not able to survive. Vegetation removal from riparian areas from grazing, agriculture, or residential and commercial development often changes the natural water flow. Water flows much more quickly across the surface causing greater erosion rates. This in turn changes habitats dependent on water. Wetlands associated with streams often disappear as groundwater levels decrease, and species that depend on them in turn disappear.

Alteration of Natural Fire Regimes

Fire suppression has drastically altered natural systems and, in many areas, increased the chance of catastrophic wildfire. Fires were frequent components in the natural disturbance regime of most grasslands and ponderosa pine (*Pinus ponderosa*) woodlands (Mehl 1992). Fire promotes patch dynamics and enhances community diversity on a large spatial scale (Collins 1990). Anderson (1990) contends that fires were common in most grasslands although more common in eastern North American grasslands than in arid western grasslands. Grasslands along the Front Range in general have been invaded by ponderosa pine woodlands. Fire suppression and intense grazing (which reduces competition from grasses) are often cited as reasons for the expansion.

Simulating natural fire regimes may be necessary in some areas. Goals for fire management, possibly species-specific goals, should be developed before a fire management plan is implemented. In some cases disturbance from fires may provide the opportunity for non-native species to increase in dominance. Frequent fires in tallgrass prairie have been shown to reduce the diversity of butterflies and moths (Swengel and Swengel 1995) and burning all of the butterfly habitat in one year could potentially extirpate populations (Moffat and McPhillips 1993).

