Natural Heritage Inventory
of
La Sierra
Costilla County, Colorado

Colorado State University

Knowledge to Go Places

Natural Heritage Program
COLORADO

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of
La Sierra
Costilla County, Colorado

Prepared for:

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Front cover photos (clockwise from upper left): Rio Grande cutthroat trout (© Frank Weissbarth), montane grasslands and spruce-fir forest, Culebra Peak, and aspen forest (all by John Sanderson).

Executive Summary

La Sierra[1] is a ~77,000 acre landscape in the Sangre de Cristo Mountain Range of southern Colorado. It is part of the historic Sangre de Cristo Land Grant. La Sierra contains a wide variety of South Rocky Mountain ecosystems, including alpine meadows, spruce-fir and aspen forests, ponderosa pine forests, piñon-juniper woodlands, and sagebrush shrublands. Many streams traverse La Sierra and provide important habitat for imperiled Rio Grande cutthroat trout. La Sierra has been used over the past several decades for a variety of purposes, with timber harvest (until the late 1990s) and big game hunting as the most prevalent uses. Both have provided important economic benefits to the owners of the property, and both are relevant to conservation concerns. While resource use has proceeded, La Sierra has also provided important habitat for many relatively common species and ecosystems that merit increased protection in Colorado. This property is in a region dominated by private ownership. Many of the private landholdings are large and are actively practicing conservation through easements, forest restoration, and other activities. La Sierra and its diverse ecosystems are an important part of regional biodiversity. It offers good opportunities for conservation that can be implemented in conjunction with the sustainable use of the tract's natural resources.

As part of a comprehensive approach to negotiating land tenure rights on La Sierra, the Land Rights Council contracted the Colorado Natural Heritage Program (CNHP) to inventory the portion of La Sierra below treeline for areas of special biological significance. Such locations were identified by: 1) examining existing biological data for rare or imperiled plant and animal species and significant plant communities (collectively called **elements**) from the CNHP's database, and 2) conducting field surveys to search for additional locations of these elements and assessing the condition of known elements. Areas that were found to contain significant elements were delineated as "Potential Conservation Areas" (PCAs), which are described in this report. These are the areas that we believe most merit conservation protection.

Compilation of information from previous and current CNHP fieldwork has resulted in the documentation of 13 rare, imperiled, or potentially imperiled species or communities. This includes 4 new locations for plant communities, 7 locations for a fish species, one location for an avian species, and one location for a mammalian species. Ten of these locations occur in 7 Potential Conservation Areas (PCAs) profiled in this report. Conservation priorities were assigned to these areas by considering the urgency for conservation action and the greatest chance for long-term viability. These priorities are established using a ranking system that applies throughout North America. Of the 7 PCAs, 5 have *high biodiversity significance* (rank of B3). These PCAs include fair to excellent occurrences of the potentially imperiled Rio Grande cutthroat trout. The other 2 PCAs have *moderate biodiversity significance* (rank of B4). One of these is a possible hybrid occurrence of Rio Grande cutthroat, while the other is a complex of aspen forest and montane grassland.

[1] The tract we are calling "La Sierra" has been widely known as the "Taylor Ranch" for the past several decades. The new landowners (as of August 2004) have christened the ranch "Cielo Vista."

Protecting rare and imperiled species and communities is only one part of conservation-oriented management. Another important aspect is keeping common species common. This can be done by integrating conservation considerations into all aspects of land management. With this philosophy in mind, this report discusses general threats to biodiversity and management approaches that can mitigate these threats. We believe that following the guidelines herein will help the property reach its potential as a valuable conservation area in the Culebra Range and in Colorado. The single most important short-term management item for La Sierra is the stabilization of the many roads that are eroding excessively. Stabilizing the roads will reduce the amount of sediment being deposited in the streams, leading to improved conditions for aquatic species, particularly the Rio Grande cutthroat. Closing a significant percentage of the roads on the property would benefit a variety of species, but the roads must be stable before they are closed. Maintaining all roads at minimum standards of Best Management Practices will help address some of the worst problems that arise from the presence of roads.

Grazing of both wild and domestic animals on La Sierra is an important and sensitive issue. Both are important for economic reasons, and both can have significant impact on species and ecosystems. Elk are currently having a large impact on aspen forests and willow communities, where regeneration of plants is heavily impacted. The species that depend on these communities would benefit if elk numbers in the Culebra Range were reduced to levels recommended by the Colorado Division of Wildlife. Cattle can have equivalently deleterious impacts, particularly along streams. The Rio Grande cutthroat and other water-dependent species would benefit if cattle are kept out of riparian areas. Domestic sheep have a high potential to transmit disease to bighorn sheep, which are a conservation target in the Southern Rockies. The long-term prospects for the regional bighorn herd are improved if domestic sheep are not grazed on La Sierra.

Most of the ecosystems on La Sierra (aspen, grasslands, ponderosa pine, piñon-juniper, and sagebrush) historically experienced fire on short to medium return intervals. These ecosystems and the species they support are dependent on fire. We can predict with high confidence that fire will return to these ecosystems. As we have learned in the recent past fire can be very dangerous for people and for important structures. For all of these reasons, a fire management plan would benefit owners and users of the property. Fire can also be used to rejuvenate ecosystems and increase grass forage.

Overall, the size and potential of the ecosystems on La Sierra and the presence of several excellent populations of Rio Grande cutthroat attest to the conservation importance of this property. We hope this report helps direct efforts to allow the property to fulfill this potential.

It should be noted that the results presented in this report represent only a limited CNHP inventory. Since resources were not available to include the full range of biologists desired, only a single biologist worked on this project. The emphasis was on evaluating known occurrences of elements (primarily Rio Grande cutthroat) and assessing the type, size, and condition of plant communities. There was little time to search for rare plants and no effort was made to find additional locations of animals. If a full Costilla County inventory is pursued in the future, it would likely be useful to do additional work on plants and animals on La Sierra.

Recommendations

The following are CNHP's recommendations for conservation-oriented management of La Sierra.

1. Within the Potential Conservation Areas designated in this report, make conservation objectives (i.e., protection of the elements) a high priority. The "Biodiversity Significance Rank" or "B-rank" of the PCAs indicates their conservation priority relative to other sites throughout the state and country. A B-rank of 1 is of global significance. A B-rank of 5 is of general significance. Most of the PCAs in this report are ranked B3, and are designated for the Rio Grande cutthroat trout. The cutthroat is currently the most imperiled element known on La Sierra. We recommend reviewing all activities planned in and near PCAs to assess their potential impact on conservation targets.

2. Develop a road management plan that employs Best Management Practices on the entire road network. Survey the roads for sections where road erosion is severe, beginning in the watersheds where pure-strain cutthroat are present (especially Cuates, Jaroso, and Torcido Creeks). Stabilize erosion in these areas. Close as many roads as possible, but not before stabilizing them.

3. Develop and implement a fire management plan. A well-designed and implemented fire management plan will increase grass cover, improve habitat conditions for a number of native species, and decrease the possibility of a catastrophic fire that endangers property and human safety. An effective plan would include clear statements about how fire (both natural and prescribed) will be used to restore and maintain fire-dependent ecosystems, and how thinning and prescribed fires will be used in tandem to minimize risk to structures and human health. The fire plan must include clear instructions on how personnel working on the property will respond to fires started naturally by lightning strikes, and could include the option of allowing fires to burn.

4. Cooperate with the Colorado Division of Wildlife and adjacent landowners to bring the elk population down to target levels suggested by wildlife agencies. The unnaturally large numbers of elk in the region are adversely impacting aspen and willow across the area.

5. Manage domestic grazers with conservation elements in mind. Because of impacts on water quality and bank structure, domestic grazers should be restricted from riparian areas along creeks that support pure-strain populations of Rio Grande cutthroat. For the montane grasslands, cattle grazing is a compatible use if the cows are moved regularly. Developing water on these grasslands would concentrate grazers and adversely impact the grasslands. The long-term viability of the regional bighorn sheep will be higher if domestic sheep are not allowed on the property because of the high probability that the domestic sheep will transmit disease to the wild sheep.

6. Manage access to and activities in riparian and wetland areas to minimize vegetation loss, sediment deposition into streams, and bank destabilization. This is particularly important along cutthroat streams. Avoid channel re-configuration.

7. Avoid wholesale alterations to natural ecosystem types (e.g., don't plow up or hydroaxe sagebrush to plant grasslands). Where possible, return altered ecosystems to native types. When planting, use native species as much as possible.

8. Use the resources and contacts shown in Appendix B, and seek out additional resources and contacts. Many individuals and agencies are effectively integrating conservation objectives into land management. Much can be learned from other landowners in the vicinity who are trying to achieve conservation goals while managing a productive landscape.

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Acknowledgments

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Introduction

The Land Rights Council contracted with the Colorado Natural Heritage Program to conduct a natural heritage inventory of La Sierra and to provide conservation-oriented protection and management recommendations. The inventory was done only on the area below treeline (~35,000 acres), though this report includes a few comments on managing the alpine portions of La Sierra. CNHP has conducted similar inventories on public and private land throughout Colorado. In 1997, CNHP began the San Luis Valley inventory with Saguache County (Rondeau *et al.* 1998). A survey of Mineral County was conducted in 1998 (Rondeau 1999), and survey of Rio Grande and Conejos Counties was done in 1999 (Kettler *et al.* 2000). On the east side of the Culebra Range, CNHP conducted an inventory in the Upper Purgatoire River watershed, which has subsequently led to significant conservation action by The Nature Conservancy (Carpenter 1998, Schulz and Moorhead 2001) and many private parties. We hope the current work lays the foundation for future work throughout Costilla County, and possibly for a comprehensive conservation assessment of the entire Culebra Range.

This inventory was conducted using the methodology that is used by Natural Heritage Programs throughout North America. Our primary focus was to identify the locations of rare and imperiled plants and animals, and significant plant communities (rare or high quality examples of common plant communities), delineate Potential Conservation Areas (PCAs) based on these locations, assess conservation values, and systematically prioritize PCAs for conservation action. On private lands conservation actions generally include a variety of voluntary management actions and conservation easements, which may be financially advantageous to the landowner.

Locations of imperiled species and significant plant communities were identified by:

- Examining existing biological data for rare or imperiled plant and animal species, and significant plant communities (collectively called **elements)**;
- Accumulating additional existing information;
- Conducting extensive field surveys for these elements;
- Identifying Potential Conservation Areas supporting these elements and prioritizing these areas for conservation action.

Locations identified as having natural heritage significance (those places where elements have been documented) are presented in this report as Potential Conservation Areas. The aim in delineating PCAs is to identify a land area that can provide the habitat and ecological needs upon which a particular element or suite of elements depends for their continued existence. PCAs are delineated using the best available knowledge of each species's life history, understanding of site and landscape features and condition, and information about past, current, and potential future land uses.

General Study Area Description

La Sierra includes approximately 77,000 acres on the west side of the Culebra Range (part of the Sangre de Cristo Range) on the east side of the San Luis Valley in south-central Colorado (Figure 1). Elevations range from approximately 8,200 feet at the New Mexico state line to over 14,000 feet on Culebra Peak. The San Luis Valley is Colorado's largest and driest mountain valley, while its adjacent mountain ranges receive abundant rain. The diverse landscape and climate creates habitat for a variety of ecosystems. La Sierra extends from dry sagebrush and piñon-juniper woodlands at lower elevations to moist spruce-fir forests and wet alpine meadows at higher elevations. It lies within the South Rocky Mountain Ecoregion (Bailey *et al.* 1994).

A long and interesting geologic history laid the foundation for the current ecological variety. The ancient basement rocks of southern Colorado were formed during Precambrian orogenies (mountain building episodes), around 1.0 to 1.8 billion years ago (Aber 2004). From about 1 billion to 400 million years ago, shallow seas and low lying land environments dominated, and limestone, dolomite, sandstone, and shale were deposited. Beginning in the Pennsylvanian, the Ancestral Rockies were born, then largely eroded, in a location that includes the current Sangre de Cristos. During the Cretaceous period (145-65 million years ago), shallow seas again dominated, depositing limestone, shale, and chalk. From around 70 to 30 million years ago, the Laramide Orogeny formed the basic structure of the Rockies as we see them today. But the story was not yet over. In the mid-Tertiary (about 25 million years ago), the Rio Grande Rift began to form, causing the east side of the San Luis Valley to drop and creating the steep western side of the Sangre de Cristos. Around the time the rift was forming, extensive volcanic activity deposited basalt and other igneous rocks throughout the region. Though most volcanic activity was over by about 21 million years ago, some igneous extrusion was occurring as recently as 5 million years ago.

Much of this tremendous history can be seen on La Sierra. The great variety of granites and metamorphic rocks from the Precambrian time make up the heart of the Sangre de Cristos, including the Culebra Range. It is the erosional resistance of these crystalline rocks that supports the high peaks (Aber 2004). Throughout the range there are small and large pockets of the marine sedimentary rocks. At lower elevations the igneous (volcanic) rocks are prominent, such as the basalt cap on the San Pedro Mesa just west of La Sierra (Colo. DNR 1997).

La Sierra contains a wide range of typical Southern Rocky Mountain vegetation (Figure 2). Piñon-juniper woodlands (*Pinus edulis-Juniperus scopulorum*) dominate much of the lower portion of La Sierra, often with sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus* ssp.) and ponderosa pine (*Pinus ponderosa*) mixed in. In areas with appropriate soils, sagebrush and/or grasslands dominate. At slightly higher elevations the "mixed conifer" forest prevails. On north-facing slopes this forest is dominated by Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine. On south-facing slopes there is less Douglas fir and more white fire (*Abies concolor*). It is now widely understood that historically these mixed conifer forests were mostly open ponderosa pine woodlands with a prominent bunch-grass understory. In the absence of fire (due mostly to fire suppression) these forests become denser, and non-fire resistant species such as white fir can become prevalent. Engelmann spruce (*Picea engelmannii*) and subalpine fir

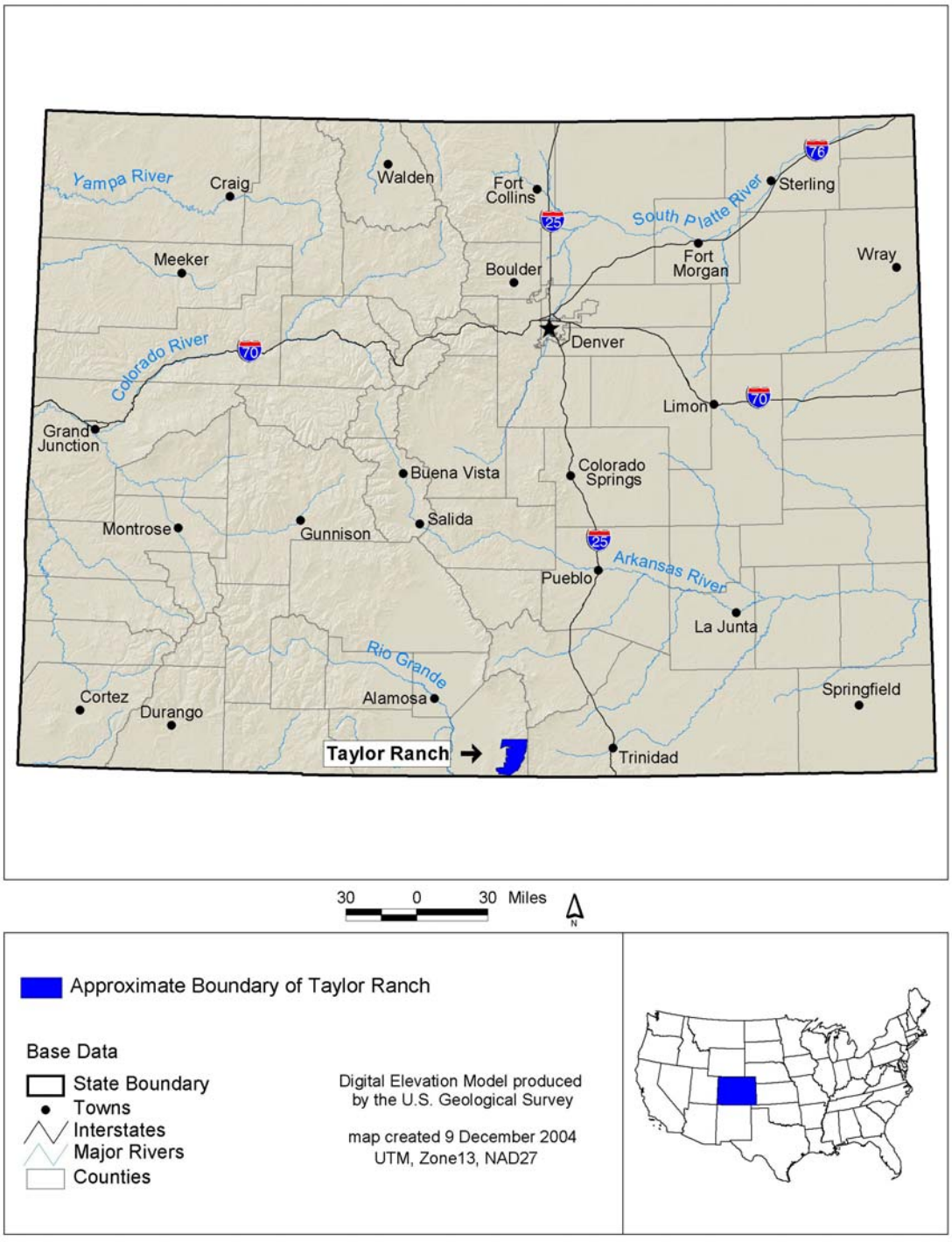

Figure 1. Location of La Sierra.

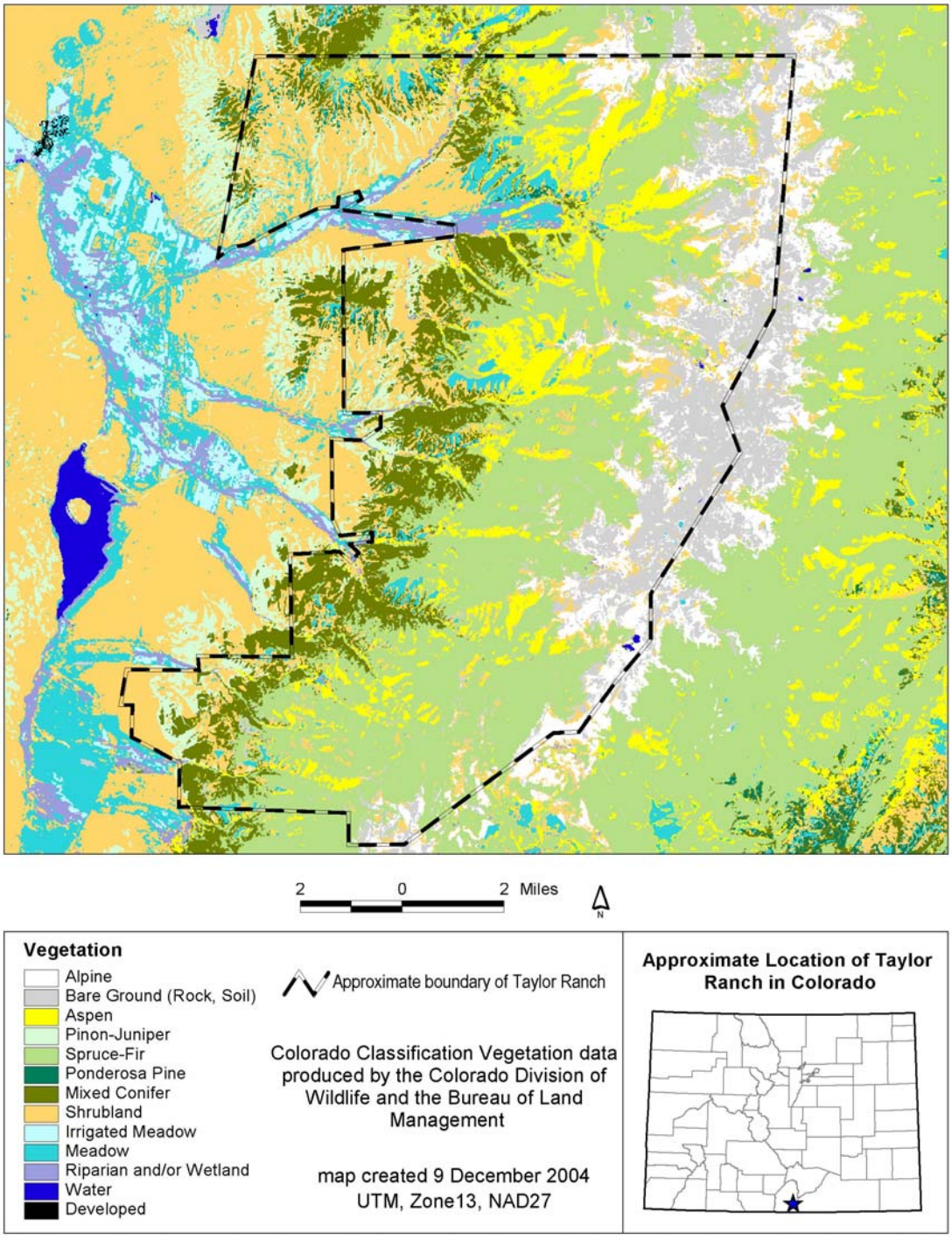

Figure 2. General vegetation patterns on La Sierra

(*Abies lasiocarpa*) are the dominant species at higher elevations. These are often mixed with considerable amounts of aspen. In the absence of fire, the conifers eventually over-top the aspen and the aspen die off. There are several stands of nearly pure aspen (*Populus tremuloides*) stands that cover in total several thousand acres of La Sierra, mostly above 8,500 feet. These pure stands of aspen are found almost exclusively on the north end of La Sierra, north of North Vallejos Creek. Extensive grasslands dominated by mountain muhly (*Muhlenbergia montana*) are a special feature of La Sierra. These are found throughout La Sierra on south-facing slopes between about 8,500-11,000 feet, but like the aspen they are most common north of North Vallejos Creek. A few dry south-facing slopes at high elevations support open bristle-cone pine (*Pinus aristata*) woodlands with a robust understory of bunch grass (e.g., *Festuca arizonica, Danthonia parryi, Muhlenbergia montana, Blepheroneuron trichocarpa*).

Many streams cross La Sierra, but wetland areas are not extensive. The streams generally have narrow riparian zones which are variously dominated by aspen, willow, wet meadow and wetland plants, and occasionally conifers. Wetland areas are generally restricted to alpine areas, small spots along streams, beaver pond complexes (which are not especially abundant) and the Salazar Meadow. The wetlands generally are dominated by willows (*Salix monticola, Salix lucida, S. drummondiana, S. exigua*), sedges (*Carex* ssp.), and mesic grasses such as Canadian reedgrass (*Calamagrostis canadensis*) and tufted hairgrass (*Deschampsia cespitosa*), and a few wetland forbs (e.g., *Senecio triangularis*).

Cold winters and cool summers characterize the study area (Table 1). The higher elevations are decidedly cooler and moister, except during winter thermal inversions, which trap the coldest air at the valley floor. Precipitation decreases rapidly with decreasing elevation, from around 11 inches on the west edge of the range to about 30 inches per year on the highest peaks. Climate data for several long-term stations were obtained from the Western Regional Climate Center (http://www.wrcc.dri.edu) and the Colorado snotel site (http://www.wcc.nrcs.usda.gov/snotel/Colorado/colorado.html).

Table 1. Climate data from selected weather stations in or near the study area.

		Jauary		July	
Station (elevation in feet)	Avg. Annual Precipitation (in.)	Avg. Max. Temp. (deg F)	Avg. Min. Temp. (deg F)	Avg. Max. Temp. (deg F)	Avg. Min. Temp. (deg F)
Great Sand Dunes	11.1	35.0	9.6	80.7	50.4
Blanca	8.5	35.1	1.6	82.1	47.8
Culebra #2 (10,500')	29.9	28.2	3.3	55.2	45.8

Given its position in the heart of the Culebra Range, La Sierra is an important piece of what is shaping up to be a tremendous regional conservation effort. To the south, the 565,000 acre Vermejo Park Ranch is actively working to restore ecosystems and rare and imperiled species. To the east, the 28,000 Bar NI Ranch and several other ranches have conservation easements on them, and many are actively participating in ecosystem restoration and development of fire management plans that are based on natural (i.e., historic) fire regimes. To the north an 80,000 acre conservation easement was recently formalized for the Forbes Trinchera Ranch (Denver Business Journal, Dec 1 2004). Further north are the Great Sand Dunes National Park and Preserve and large areas owned and managed by the U.S. Forest Service. A significant portion of La Sierra is already under easement with the Rocky Mountain Elk Foundation.

The conservation potential of such a large protected area is great. With proper management that incorporates conservation principles, a wide range of species and ecosystems can be allowed to function in a largely natural manner, while providing fabulous aesthetic, open space, recreational, and hunting and fishing opportunities. This has been, and, we hope, will continue to be a great accomplishment for the property owners of this area.

Methods

The Colorado Natural Heritage Program follows a methodology for its inventories that is being continually developed and improved. The general framework of the methodology is applied to all inventories, but the specific application may employ only part of the overall CNHP capacity. The inventory of La Sierra was conducted following the steps described below. Because resources were limited for this project, the inventory focused on known locations of elements while also assessing the variety of plant communities present on La Sierra. Input from local experts was sought at all stages.

Collect Available Information

The first step in the inventory process is to gather existing information on the ecology, geology, and hydrology of the inventory area, and to review records that are already present in the Colorado Natural Heritage Program database. Geographic Information System (GIS) data layers were very important for this project. Among the data layers we obtained were vegetation, roads, creeks, US Geological Survey 7.5' topographic quads, and Digital Orthographic Quarter Quads (black and white aerial photos with 1 m resolution). From the Colorado Division of Wildlife's web site we obtained maps of distributions of wildlife species (we were particularly interested in bighorn sheep use of the area). Paper resources were also important, including the forestry management plan developed by SEC, Inc. (2001, 2002), the report on fish resources prepared by Matt Weaver (no date), and several articles and other assorted information loaned by Arnold Valdez. Ray Wrobley of SEC, Inc. loaned us a set of true color photos of the area. While in the field we also used a set of color infrared photographs.

From the CNHP Biotics database we assembled information on known element occurrences on La Sierra and throughout Costilla County, as well as Potential Conservation Areas already designated in the county. Element occurrences records and PCAs are displayed digitally in GIS data layers, and they also come with a written record. The written records include information from many sources. Those that were particularly important for this project were the fish records, which include much valuable information from the Colorado Division of Wildlife (especially John Alves), and from researchers at Colorado State University.

Using records from the CNHP database, we compiled a list of rare and imperiled species and plant communities that are known to occur, or have occurred at some time in the past, in Costilla County (Table 2). This list served as a preliminary guide to what we may expect to find on La Sierra. We can confidently say that this list does not include all of the species and plant communities of interest that occur in Costilla County. We can also say that some of these elements undoubtedly do occur on La Sierra but we don't know where, and that some of these elements almost certainly do not occur on La Sierra (e.g., Southwestern Willow Flycatcher). Of course, the biologist doing the field work kept his eyes open continuously to not only evaluate the plant communities on the project, but also to evaluate the potential for other plants and animals to occur in the study area.

Table 2. List of Known Current or Historic Elements from Costilla Counties

Scientific name	Common Name	Global rank	State rank	Federal status	Federal agency status	State status
Birds						
Amphispiza belli	Sage Sparrow	G5	S3B		USFS	
Buteo regalis	Ferruginous Hawk	G4	S3B,S4N		BLM / USFS	SC
Charadrius montanus	Mountain Plover	G2	S2B	PT	BLM / USFS	SC
Empidonax traillii extimus	Southwestern Willow Flycatcher	G5T1T2	SNA	LE	USFS	E
Haliaeetus leucocephalus	Bald eagle	G4	S1B,S3N			T
Fish						
Catostomus plebeius	Rio Grande sucker	G3G4	S3		BLM / USFS	SC
Gila pandora	Rio Grande chub	G3	S1?		BLM / USFS	SC
Oncorhynchus clarki stomias	Colorado cutthroat trout	G4T2T3	S2	LT		T
Oncorhynchus clarki virginalis	Rio Grande cutthroat trout	G4T3	S3		BLM / USFS	SC
Mammals						
Gulo gulo	Wolverine	G4	S1		USFS	E
Lynx canadensis	Lynx	G5	S1			E
Mustela nigripes	Black-footed Ferret	G1	S1			E
Perognathus flavus sanluisi	Silky Pocket Mouse subspecies	G5T3	S3			
Thomomys talpoides agrestis	Northern Pocket Gopher subspecies	G5T3	S3			
Plants						
Cleome multicaulis	Slender Spiderflower	G2G3	S2S3		BLM	
Cryptantha pustulosa	Catseye	G5TNR	S1			
Cryptantha weberi	Weber's catseye	G3	S3			
Delphinium alpestre	Colorado Larkspur	G2	S2			
Delphinium robustum	Wahatoya Creek Larkspur	G2?	S2?			
Draba grayana	Gray's Peak Whitlow-grass	G2	S2		USFS	
Hymenoxys helenioides	Intermountain Bitterweed	G3G4Q	S1			
Minuartia stricta	Rock Sandwort	G5	S1			
Neoparrya lithophila	Rock-loving Neoparrya	G3	S3		BLM	
Oxytropis parryi	Parry's Locoweed	G5	S1			
Parthenium tetraneuris	Barneby's Fever-few	G3	S3			
Stellaria irrigua	Altai Chickweed	G4?	S2			

Scientific name	Common Name	Global rank	State rank	Federal status	Federal agency status	State status
Plant communities						
Abies concolor - Picea pungens - Populus angustifolia / Acer glabrum forest	Montane Riparian Forests	G2	S2			
Carex lanuginosa herbaceous vegetation	Montane Wet Meadows	G3	S3			
Carex nebrascensis herbaceous vegetation	Wet Meadows	G4	S3			
Carex vesicaria herbaceous vegetation	Montane Wetland	G4Q	S1			
Cornus sericea shrubland	Riparian Shrubland	G4Q	S3			
Phragmites australis western North America temperate semi-natural herbaceous vegetation	Western Slope Marsh	G5	S3			
Pinus aristata / Festuca thurberi woodland	Montane Woodlands	G5	S2			
Pinus aristata / Juniperus communis woodland	Montane Woodlands	GU	S4			
Populus angustifolia / Alnus incana woodland	Montane Riparian Forest	G3	S3			
Salix exigua - Salix ligulifolia shrubland	Strapleaf Willow - Coyote Willow	G2G3	S2S3			
Salix exigua / mesic graminoids shrubland	Coyote Willow / Mesic Graminoid	G5	S5			
Salix ligulifolia shrubland	Strapleaf Willow	G2G3	S2S3			
Schoenoplectus acutus - Typha latifolia - (schoenoplectus tabernaemontani) herbaceous vegetation	Bulrush Marsh	G4	S2S3			
Schoenoplectus pungens herbaceous vegetation	Threesquare Marsh	G3G4	S3			
Sparganium eurycarpum herbaceous vegetation	Emergent Palustrine Wetlands	GU	S2			

Identify Targeted Inventory Areas

Targeted Inventory Areas (TIAs) are locations thought likely to harbor imperiled species or significant plant communities. Since it is impossible to cover every square foot of a study area, TIAs are the focus of field inventory. For La Sierra, known locations of Rio Grande cutthroat were targeted in order to evaluate the condition of the streams and the watersheds. Additional TIAs were chosen using aerial photography, topographic maps, geology maps, vegetation surveys, and personal recommendations from locals. These TIAs were based on large and potentially good occurrences of the major forest, shrub, and grassland types. Wetlands, because they are relatively rare on the property, were also targeted.

The above information was used to delineate 19 TIAs (#3 in Table 3 was eliminated) that were believed to have the best probability of harboring natural heritage elements that merit conservation attention (Table 3). These areas, illustrated on the map of Targeted Inventory Areas (Figure 3), varied in size from less than 100 acres to several thousand acres. They included most of the major habitat types in the study area.

Table 3. Targeted Inventory Areas

TIA Number	Target	Comments
1	Aspen	Largest contiguous aspen stand; few roads.
2	Spruce/fir	Large stand (1608 acres) with relatively few roads.
4	Spruce/fir and Spruce/fir/aspen mix	Large stand, but lots of roads.
5	Spruce/fir and spruce/fir/aspen mix	Large stand, but lots of roads and obvious logging.
6	Spruce/fir	Largest polygon on veg layer. Lots of logging in this area.
7	Sagebrush	Largest area of sagebrush, relatively few roads. Look for non-native species, major vegetation manipulation, and erosion.
8	Grasslands	Largest "grass dominated" area. Lies between large aspen and large sagebrush.
9	Potential wetland	On the vegetation map there is a moderate-sized polygon of "upland willow/shrub around rock." This may be unique.
10	Potential wetland	Headwaters of Torcido creek; appears to be extensive wetland among spruce/fir.
11	Potential wetland	Just below 2, north of Vallejos creek.
12	Rio Grande cutthroat	N. Vallejos; no PCA.
13	Rio Grande cutthroat	Vallejos; no PCA.
14	Rio Grande cutthroat	Alamosito; no PCA
15	Rio Grande cutthroat	San Francisco; a small record; no PCA.
16	Rio Grande cutthroat	Torcido; there is a PCA here.
17	Rio Grande cutthroat	Jaroso; there is a PCA here.
18	Rio Grande cutthroat	Cuates; there is a PCA here; very dense road concentration mid-way up watershed.
19	Shrub/grassland mosaic	Largest mosaic of xeric shrub and grassland.
20	Shrub/grassland mosaic	Another large mosaic of grassland and xeric shrub.

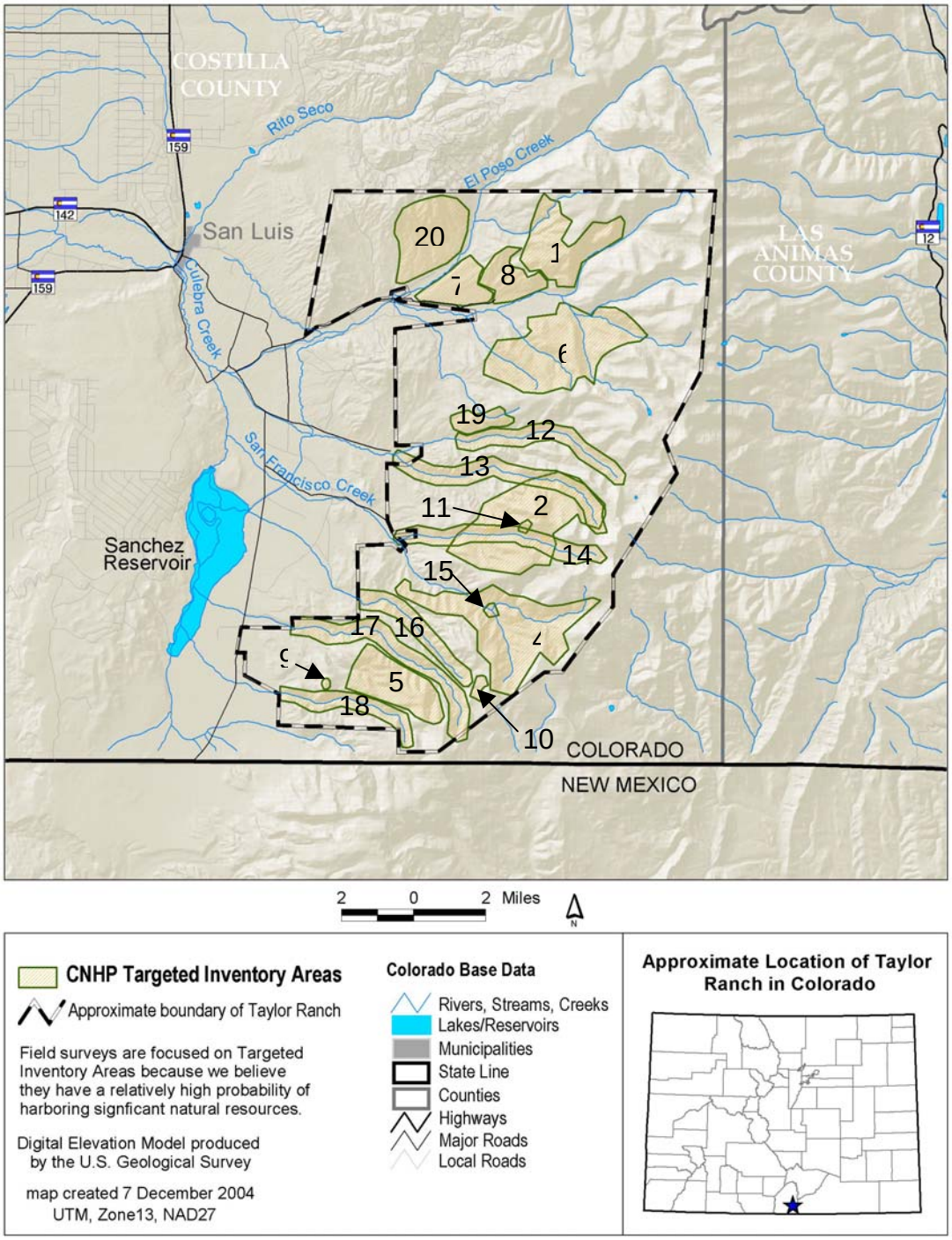

Figure 3. Targeted Inventory Areas. Numbers correspond to "TIA Number" in Table 3.

Conduct Field Surveys

We spent two weeks surveying La Sierra. The first three days were spent driving as many roads as possible and stopping regularly to walk short distances from the road. Our goal was to understand the distribution and composition of the variety of ecosystems on La Sierra. The majority of the remaining survey period was spent visiting Targeted Inventory Areas to determine if the intended target was present. If it was present, we assessed the condition of the ecosystem components that support the element.

For the significant plant communities on La Sierra, community extent, composition, landscape context, degree of disturbance, and other information were documented and entered into the CNHP database. This record is called and *element occurrence record,* or simply an *occurrence*. Each element occurrence is given an *element occurrence rank* (see Appendix A) for more information on the heritage ranking system. The location of vegetation cover plots were recorded using a Garmin 12 GPS. The full extent of the plant community was delineated on-screen using a GIS and the 1 foot resolution black and white digital orthophoto quarter quads. The rank of each occurrence was determined by comparing information known about the occurrence to other occurrences in the CNHP database and to standards that have been developed for the Southern Rocky Mountains (Rondeau 2001).

For the Rio Grande cutthroat, data about the occurrence and the occurrence rank were already recorded in the CNHP database. The emphasis of the 2004 survey was to determine the condition of the stream and the overall watershed. This assessment was summarized and entered in the appropriate records in the CNHP database. The information from the assessment was used to develop recommendations about how to protect these occurrences.

Plants were regularly collected to confirm field identifications. Collected plant specimens will be deposited in the Colorado State University herbarium or in the University of Colorado herbarium.

Delineate Potential Conservation Area Boundaries

Since the objective for this inventory was to identify and prioritize specific areas for conservation efforts, boundaries for Potential Conservation Areas were delineated. These boundaries are an estimation of the primary area needed to ensure long-term persistence of the element they contain. In order to ensure this persistence, the ecological processes that support that occurrence must remain functional. The PCA boundary is meant to include features in the surrounding landscape that provide these functions; the boundary serves as a starting point for planning long-term conservation efforts. Data collected in the field are essential to delineating such a boundary, but other sources of information such as aerial photography are also used. These boundaries are considered preliminary and additional information about the area or the element may call for alterations to the boundaries. In developing potential conservation area boundaries, we consider a number of factors that include, but are not limited to:

- the extent of current and potential habitat for the elements present;

- the ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the potential conservation area and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater, e.g., by protecting recharge zones;
- land intended to buffer the area against negative impacts of future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

The potential conservation area boundaries delineated in this report do not confer any regulatory protection, nor do they exclude all human activity. It is hypothesized that some activities may degrade the element or the ecological processes on which they depend, while others will not. The boundaries represent the best estimate of the primary area supporting the long-term survival of the targeted species or plant communities, and are presented for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that they are compatible with protection of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on our understanding of the ecological systems. A thorough analysis of the human context and potential stresses to the elements was not conducted. All land within the conservation planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels.

CNHP uses the Natural Heritage Ranking Methodology to help prioritize conservation actions by identifying those areas that have the greatest chance of conservation success for the most imperiled elements. PCAs are prioritized according to their **biodiversity significance rank**, or "B-rank," which ranges from B1 (outstanding biodiversity significance, globally significant) to B5 (general or state-wide biodiversity significance). B-ranks are based on the degree of imperilment or rarity of each element (i.e., the conservation rank) and the element occurrence ranks (quality rank) for that particular location. Therefore, the highest quality occurrences (those with the greatest likelihood of long-term survival) of the most imperiled elements are the highest priority and receive the highest B-rank. See Appendix A for more details on the ranking procedure. The sites delineated for La Sierra are ranked B3 and B4 (relative to all other sites in Colorado and the U.S.). B3 sites should be given the highest priority. B4 sites also merit protection, but are a lower priority. The sum of all the sites in this report represents the area CNHP recommends be considered for conservation actions to preserve the most significant

elements on La Sierra. The inverse of this statement is that use of the natural resources on La Sierra should generally be directed away from these conservation areas.

The identification of PCAs within the study area does not suggest that other areas merit no conservation efforts. In fact, the landscape beyond a PCA is often critical to the long-term persistence of the elements in the PCA. Also, the broader landscape also should be managed where possible in a manner that allows the natural ecological processes to continue. By managing common landscapes well, common species and ecosystems will remain common. As a positive consequence, expensive, high-priority conservation action will not be required for them. We believe that common landscapes can be managed in an ecologically sensitive manner while still using them to meet the needs of the landowners and other users.

Results

Thirteen element occurrence records have been documented for La Sierra (Table 4). Seven of these records are Rio Grande cutthroat, four are plant communities, one is a bird, and one is a mammal. The mammal record (a subspecies of northern pocket gopher) is an imprecise historic record from a museum specimen that suggests this element may still be present on La Sierra. The bird record (a sage sparrow) is also imprecise; it may or may not actually occur on La Sierra. Unfortunately, intensive, species-specific searches were beyond the resources of this project.

Seven Potential Conservation Areas were delineated based on the element occurrences (Figure 4, Table 5). Six of these were delineated for populations of the Rio Grande cutthroat trout. These PCAs merit the most protection effort. The seventh PCA was delineated for a mosaic of aspen forest and montane grasslands in a matrix of spruce-fir forest. This mosaic includes three element occurrences. These occurrences are regionally significant because they are relatively large and in fair to good condition. They have been highlighted because they represent a less-common ecosystem matrix that supports a different set of species than occur in the other ecosystems that dominate La Sierra (for more details, see the description of the PCA below). Four element occurrences (the northern pocket gopher subspecies, the sage sparrow, the bristlecone pine occurrence, and the record of the Rio Grande cutthroat on San Francisco Creek) were not included in PCAs. These records were either too imprecise (the former two) or not a high enough priority (the latter two) to merit development of PCAs. However, management actions on the range should consider potential impacts on these occurrences.

We begin the results section with a summary of element occurrence records and PCAs. Before profiling the PCAs, we present a section on threats to biodiversity and general management guidelines. These threats and guidelines apply to the entire property, not just PCAs. We end the report with profiles of the PCAs themselves.

Table 4. Element occurrence records on La Sierra.

Scientific name	Common name	Location	EO Rank	Global element rank	State element rank	Federal status	Federal agency status	State status	Comments
Fish									
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	Alamosito Creek, headwaters to confluence with San Francisco Creek.	C	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: A. At risk: no barrier present, brown trout present.
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	Cuates Creek, headwaters to Sanchez Reservoir (Ventero Creek)	A	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: A. Irrigation ditches exists as barrier in lower reaches of creek. No non-native fish present.
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	South Vallejos Creek, headwaters to confluence with North Vallejos.	C	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: A. At risk: no barrier present; brown trout and brook trout present.
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	North Vallejos Creek, headwaters to ~1.8 miles above confluence with South Vallejos.	C	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: B+ (possibly hybridized with rainbow trout). At risk: no barrier present; brook trout and rainbow trout present.
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	Jaroso Creek, headwaters to Sanchez Reservoir.	A	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: A. Secure, barrier present (man-made, dry conditions); no non-native fish present (brook trout observed in 1995, but not in 1996).
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	Torcido Creek, headwaters to Sanchez Reservoir.	A	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: A. Secure, above a known barrier (dry conditions), no non-native fish present.
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	San Francisco Creek, near confluence with El Fragoso Creek	H	G4T3	S3	none	FS/BLM	SC	Historic wild population. Purity: A. EO Rank is historic because data are more than 7 years old. Population is considered low stability because of the presence of brown trout. There is a barrier (culvert).

Scientific name	Common name	Location	EO Rank	Global element rank	State element rank	Federal status	Federal agency status	State status	Comments
Birds									
Amphispiza belli	Sage Sparrow	South of Sanchez Reservoir, overlapping the west edge of La Sierra.	H	G5	S3B	none	none		This record is from the 1997 Colorado Breeding Bird Atlas. Lives almost exclusively in shrublands, especially sagebrush.
Mammals									
Thomomys talpoides ssp. *agrestis*	Northern pocket gopher subspecies	Somewhere near Culebra Creek.	H	G5T3	S3	none	none	SC	This record is from a museum specimen of a collection made in 1912, indicating that this species is possibly present, but no sampling has been done in the recent past.
Plant communities									
Muhlenbergia montana	Montane grasslands	On south-facing slopes above North Vallejos Creek.	B	G3G4	S2?	none	none	none	First records of this type of grassland in the CNHP database.
Muhlenbergia montana	Montane grasslands	On north-facing slopes above Culebra Creek.	C	G3G4	S2?	none	none	none	First records of this type of grassland in the CNHP database.
Pinus aristata/Festuca arizonica	Montane woodlands	On the ridge between Jaroso Creek and Cuates Creek.	B	G4	S3	none	none	none	Likely more patches of this present on La Sierra.
Populus tremuloides / Juniperus scopulorum forest	Aspen / common juniper woodlands	From North Vallejos Creek to the slopes north of El Poso Creek on land north of the property boundary.	C	G4	S4	none	none	none	Possibly the largest group of aspen stands in the Culebra Range.

Table 5. Potential Conservation Areas on La Sierra.

Potential Conservation Area	Biodiversity Rank
B3 sites (high biodiversity significance)	
Cuates Creek	B3
Jaroso Creek	B3
Torcido Creek	B3
Alamosito Creek	B3
South Vallejos Creek	B3
B4 sites (moderate biodiversity significance)	
North Vallejos Creek	B4
Culebra Creek Montane Complex	B4

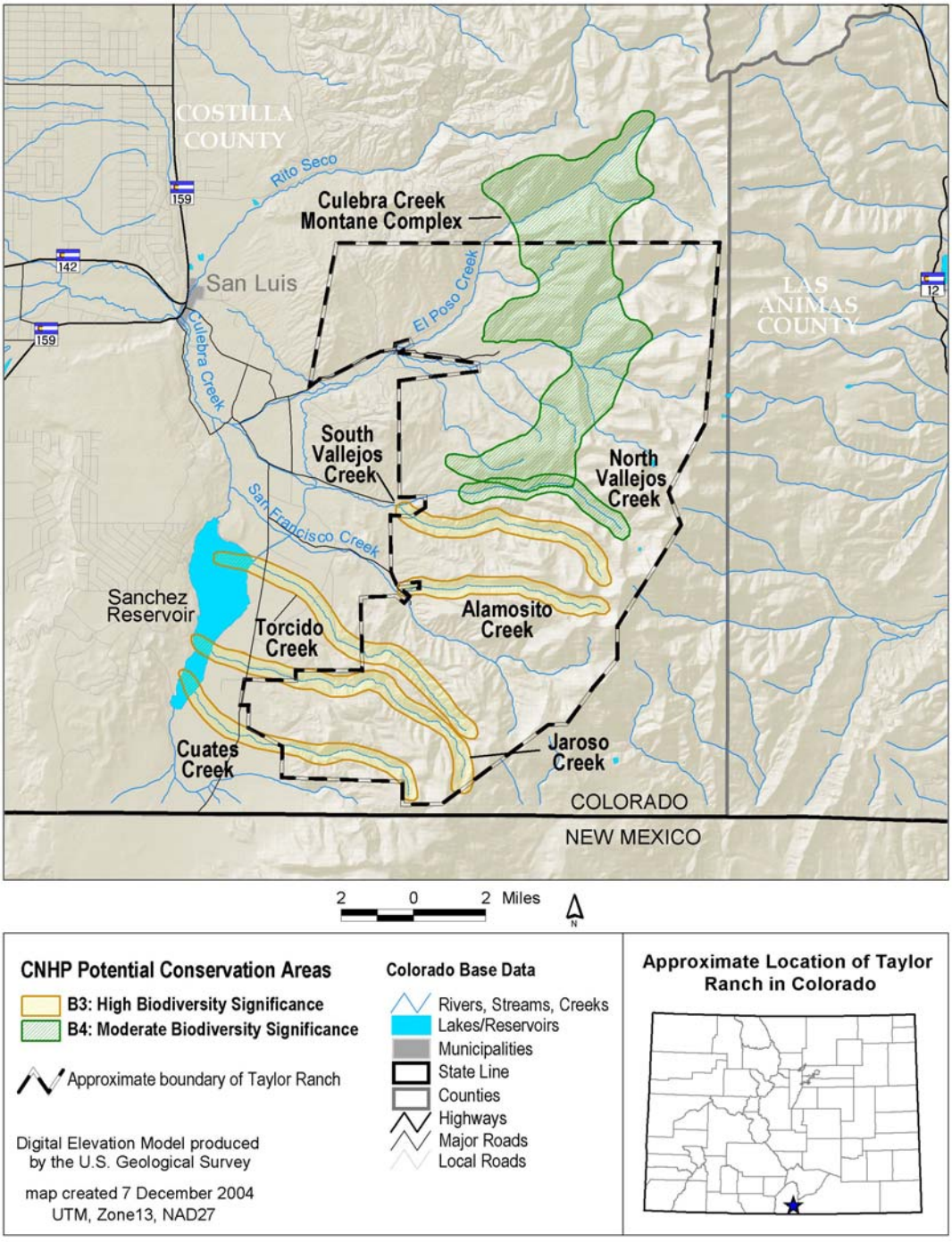

Figure 4. Potential Conservation Areas on La Sierra.

Major Threats to Biodiversity and General Management Guidelines

Major Threats to Biodiversity

Known threats to a specific species or site are discussed below and are, in most cases, identified in the Potential Conservation Areas profiles. In addition to specific threats, there are threats that may not be problematic at the site at this time but could be in the future. The following sections briefly discuss some of the threats of greatest concern. These threats should be kept in mind while developing management plans for La Sierra or when contemplating specific activities.

General management guidelines are closely allied to threats, because threats can be exacerbated or mitigated by management actions. Following the discussion of general threats is a section that presents some of the most important management considerations for developing a conservation-oriented approach to managing La Sierra.

Roads

Roads have many negative ecological impacts (Ecological Society of America 1999). Among the impacts of roads are:

- *Degradation of water quality.* Roads contribute sediment to water bodies which can degrade water quality and damage aquatic life. Roads are dumping very significant amounts of sediment into most of the streams on La Sierra. This sediment is unnaturally filling beaver ponds and clogging trout spawning beds. (It is also affecting irrigation efforts on the lands below La Sierra.)
- *Interruption of hydrologic systems.* Roads can inhibit and redirect surface and groundwater flows. For example, toward the top of Alamosito Creek a road through a willow-dominated wetland has disrupted groundwater flow, harming the shrubs. Lower down on the Alamosito the road has become channelized so that water flows down the road in large flows rather than being more dispersed across the land in small, natural overland flowpaths.
- *Biological invasions.* Roads enable the spread of non-native, invasive, and sometimes noxious plants and animals. Far and away the densest concentrations of weeds on La Sierra are along and near roads. Also, roads allow anglers access to remote streams. These anglers may unwittingly be transporting fish pathogens that could harm Rio Grande cutthroat populations.
- *Habitat fragmentation.* Roads create open edges to forests which can make forest species more vulnerable to disturbances such as windthrow, pest epidemics, and nest parasitism. "Edge" habitats have been promoted by past forest management plans because they are favored by elk and deer (SEC, Inc. 2001, 2002), but it must be recognized that what is positive for some species may be detrimental to others. A balanced, conservation-minded management plan considers all of the impacts.
- *Fire.* Most fires are caused by people, and over half of these begin in the vicinity of roads. Fire is a natural process that we believe should be incorporated back into the La

Sierra management plan, but the frequency and timing of fires plays an important role in how the landscape responds. Also, roads impact the way in which fire spreads across the landscape, which affects the ecosystem response.

- *Vehicle and occupant noise*. Noise from vehicles and vehicles occupants may affect the distribution of wildlife populations.

In our view, dealing with the problems caused by the extraordinary network of roads on La Sierra should be one of the highest management priorities. High erosion areas should be identified and stabilized, particularly in the Cuates, Jaroso, and Torcido watersheds, which support the best occurrences of the Rio Grande cutthroat.

Most of the minor roads across La Sierra should be closed. Roads with slopes greater than 10%, on highly erodable soils, or immediately adjacent to streams could all be priorities for closure. Roads will close naturally over time if windthrown trees are allowed to remain across the road. However, roads *must* be stabilized before they are closed. If roads cannot be closed, highly erodable roads should be access-limited, because more traffic inevitably brings more erosion.

Stabilization of roads includes the use of proper grading, water bars, drain dips, properly installed culverts, and other techniques described in Best Management Practices (BMPs) for Colorado (Colorado Timber Industry Association and Colorado State Forest Service 1998; available by calling 970-491-6303). Planting vegetation on the road is also an important part of stabilization. Using native seed mixes for such plantings would entail less risk to native ecosystems. Names of two suppliers of native seed are provided in Appendix B. They will be able to provide recommendations for seed mixes. The Colorado Native Plant Society website (http://carbon.cudenver.edu/~shill/conps.html) provides additional information on using native plants along with a list of vendors, as does the Colorado Natural Areas Program (1998; contact info in Appendix B)

Non-native Species

Effects of non-native species on an important conservation target on La Sierra is most clear in the case of the Rio Grande cutthroat trout, the only trout that is native to these streams. All three of the commonly stocked non-native trout—rainbow, brown, and brook trout—have deleterious effects on the cutthroat. All three are aggressive competitors, often out-competing the natives for food and spawning habitat. Rainbows present an additional challenge to native cutthroats. They interbreed with the cutthroat, altering the genetic makeup of the natives (Figure 5). Both of these processes have decreased the range of Rio Grande cutthroat in Colorado to less than 1% of their historic distribution.

Although not currently a problem, native fish can also be impacted by non-native pathogens against which they have few defenses. Pathogens can be spread by several means: stocking of fish, movement of infected fish into uninfected waters, and even use of equipment that has been immersed in infected waters.

Figure 5. A "cutbow" hybrid created when a rainbow bred with a cutthroat. Photo copyright Frank Weissbarth.

Non-native plants or animals can have wide-ranging impacts. Non-native plants can increase dramatically under the right conditions and essentially dominate a previously natural area. For example, on scraped roadsides across La Sierra, especially at lower elevations and on the main north-south road, weedy non-natives abound. This can generate secondary effects on animals (particularly invertebrates) that depend on native plant species for forage, cover, or propagation. Cheatgrass (*Bromus tectorum*), smooth brome (*Bromus inermis*), and crested wheatgrass (*Agropyron cristatum)* are hardy grasses from Eurasia that survive in dry habitats and are very difficult to control. The latter two have been widely planted on La Sierra. While these species may have positive impacts for a small set of species, they may have negative impacts on a range of native species that would otherwise depend on the plants that have been displaced. In addition to changing food resources, these grasses can completely change fire dynamics in these ecosystems, causing changes in fire frequency, the intensity of fires, and patterns in which fires burn. We recommend considering restoring areas dominated by these species with appropriate native species.

Non-native weeds are not currently a major problem on La Sierra, but they do deserve some attention. In 2004, the most commonly seen weed was Canada thistle (*Cirsium arvense*), although it is generally not abundant. Because its distribution is limited, control in the near future is recommended, before the plant has an opportunity to become more widespread. For more information on the most problematic non-native weeds (i.e., those considered "noxious" weeds) and their control, contact the local extension office or the Colorado Department of Agriculture. A list of noxious weeds is available on the Colorado Department of Agriculture web site. (See Appendix B for contact information and web address.) The spread of noxious weeds can be limited by using only certified weed-free hay; by making certain cattle coming onto the property have been recently fed only weed-free hay; by inspecting cattle being moved onto the property for weed seeds caught on their exterior; and by eliminating roads that often serve as conduits for weeds.

Fragmentation and Edge Effects

"Edge" areas are zones of sharply contrasting habitats or landscapes (Schwarz *et al.* 1993). Edges are often created by naturally occurring processes such as floods or fires and will recover naturally over time. Edges can also be created by human activities, such as when forests are cut and roads are built. Edges are often dominated by plant species that are adapted to disturbance and are more common and widespread. These areas often attract high numbers of generalist species. As our global landscape has become increasingly fragmented by large-scale, rapid anthropogenic conversion, edges have become abundant. Elk and deer are generalist species. They typically do well in the types of habitats present on La Sierra, which have abundant edges

due to widespread logging and roads. This fact is widely recognized, and creating edges are a main focus of the forestry management plans prepared by SEC, Inc. (2001, 2002).

While edges benefit generalists, they are disadvantageous to specialists. The overall reduction of large landscapes further jeopardizes the very existence of some specialists. Wolverines (likely extirpated in Colorado), goshawks, pine martens, lynx, many birds, and many other species require large areas of intact forest. These species are at a tremendous disadvantage when edges are as abundant as they are on La Sierra.

Recreation

Over the past several decades, recreation on La Sierra has been very limited. It is anticipated that this will continue to be the case. There may be one exception, however: Culebra Peak. We believe it would be perfectly acceptable to make more access to Culebra Peak available to individuals and groups who love to climb 14ers, but ecological issues surrounding the peak should be approached properly. The impact of additional traffic is a major concern, especially around the "4-way" intersection, where soils are particularly erodable and much erosion is currently evident. These roads should be stabilized and well-maintained if they are to receive additional traffic.

On the peak itself, alpine plants and plant communities are often particularly sensitive to trampling by numerous hikers (Spackman *et al.* 1996). The best way to deal with this situation is to survey for rare or sensitive species, then to design a trail that avoids these species. It is best if hikers take a consistent, marked route up the peak. We suggest that if the peak will be opened to additional climbers that it is done with guidance from the Colorado 14ers Project, which is trying to protect Colorado's high peaks. Contact information is included in Appendix B.

Hydrological Modification

River impoundment in the form of lakes and reservoirs, and water diversions such as irrigation ditches or canals can affect aquatic dependent plants and animals (Chien 1985). Impoundments and diversions alter flow patterns. Natural flow patterns are important for structuring channels and for many ecological functions such as given breeding cues to aquatic organisms and facilitating the establishment of willows and cottonwoods. Impoundments and diversions can also have direct impacts on aquatic organisms. In extreme cases, species of concern such as the Rio Grande cutthroat are spilled onto irrigated fields when protective screens are not in place. We discourage modification of stream channels and flow regimes, including on-stream impoundments and diversions.

Development of Structures and Subdivision of Land

It is not anticipated that La Sierra will be subdivided and developed, but the subject merits mention. Development creates a number of stresses, including habitat loss and fragmentation, introduction of non-native species, fire suppression, and often the introduction of domestic predators (dogs and cats) (Oxley *et al.* 1974, Coleman and Temple 1994). La Sierra currently has been heavily impacted of road building and logging, but these effects, while important, are

not as severe and long-lasting as building homes on small lots. Progress toward protection of native species in the region would be dealt a severe blow if significant portions of La Sierra were subdivided.

Mining and drilling

Mining has been a traditional industry in Colorado for over a century and a half. Pressures to develop energy resources have increased dramatically in recent years. Poorly planned or managed operations of this type have the potential for tremendous and immediate adverse impact on biodiversity and can continue having an impact for decades after the activity has ceased. Because of the natural heritage value of La Sierra, we discourage future mining or drilling on the property. If these activities are to be pursued, planning can and should be done to accommodate conservation objectives.

Incompatible Livestock Grazing

Domestic livestock grazing, a traditional industry of rural Colorado, has left a broad, often subtle, and sometimes extreme impact on the landscape. Historic livestock grazing probably had a large influence on the composition of non-forested communities in the area (USDA Forest Service 1996). As early as 1820, there were records of cattle being brought into the San Luis Valley. By the close of the century, and through the early part of the 20th century, there were high numbers of livestock. It appears that by 1929, stocking rates started declining dramatically due to documented overuse of the resource (USDA Forest Service 1996).

When repeatedly grazed, many plant species will respond in a predictable manner. Plants that are more palatable can be reduced or eliminated over time, while other less palatable plants may increase in abundance. Often, non-native plants increase in abundance significantly under heavy disturbance such as frequent, high intensity livestock grazing. Depending on grazing practices and local environmental conditions, impacts can be moderate and largely reversible (slight shifts in species composition), or severe and nearly irreversible (extensive gullying, introduction of non-native forage species). Stresses due to sediment deposition and water quality changes from incompatible grazing practices are more difficult to judge, but they may be detrimental to aquatic biota (Gifford *et al.* 1975). Some of these effects are currently obvious along El Poso Creek. Native herbaceous plants in the woodlands along this creek have been virtually eliminated. In some areas stream banks are badly sloughing and depositing sediments into the creek. "Sacrificing" some stream sections may be the chosen course of action, but as often as possible, bank structure and robust native vegetation along streams should be the goal.

Cattle have traditionally been grazed in many areas of La Sierra. Currently cattle are being grazed in the Salazar Meadow and along El Poso Creek. The large meadow south of Vallejos Creek, which has been converted from sagebrush to largely non-native grasses, is another area that appears very amendable to grazing. Some areas should not be grazed, particularly the riparian areas of creeks that support the Rio Grande cutthroat, especially Cuates, Jaroso, and Torcido Creeks. Many studies demonstrate reduced trout populations related to habitat loss and degradation caused by livestock grazing (e.g., Behnke 1992). The montane grasslands identified in this report can be grazed, but they should not be grazed season-long, i.e., cattle grazed on

these meadows should be moved frequently throughout the season. We discourage the further development of springs or wells, and we also discourage the transport of water to currently dry montane grasslands dominated by native species (i.e., the grasslands in the Culebra Creek Montane Complex PCA).

In watersheds where cattle are grazed, even when cutthroat are not present, it would still be beneficial to restrict access to the immediate riparian area. A buffer 25-50 ft wide along all streams would benefit aquatic organisms, fisheries, water quality, riparian vegetation, and animals such as songbirds that typically require healthy riparian vegetation. Usually such a buffer is maintained by running a fence along the stream. Cattle are watered by pulling water out of the stream into a stock tank outside the fence. Alternatively, small portions of the creek can be left unfenced for cattle to access the creek. The NRCS in Alamosa can provide advice for these types of riparian protection projects (see Appendix B for contact information).

General Management Guidelines

Timber Management

Timber on La Sierra has been poorly managed for the past four decades. Vast areas of large trees were indiscriminately highgraded (i.e., all the big, healthy trees were taken, with few left to provide seed). Huge amounts of slash and debris remain on the forest floor and in piles at landings, significantly increasing fuel loads in the forest. Forest structure, which is very important to many native species, has been dramatically altered. Formerly closed-canopy forests that have been opened are experience large amounts of blowdown. In addition to further increasing fuel loads, freshly downed trees offer habitat to many forest pathogens that may then spread to healthy trees. The impacts of the extensive road network were addressed above. Besides altering habitat and ecological processes (such as runoff, sedimentation, etc.), logging operations that are not carefully planned and executed can also physically destroy imperiled plant populations and plant communities. The good news is that there is abundant regeneration occurring in most of the cutover forests. However, this regeneration can also bring problems with it, including overly-dense forests prone to intense fires.

SEC, Inc. (2001, 2002) produced a forest management plan for La Sierra. This plan presents a wealth of useful information about managing these forests. The plan does a very good job of addressing the primary goals of the landowner at the time the plan was created, primarily maintenance of elk habitat and, secondarily, avoidance of wildfire.

We suggest using this plan as a launching point for a more conservation-oriented management plan for the property. Rather than focusing solely on maximizing elk habitat, we would prefer to see the focus moved to maintaining natural functioning ecosystems. For example, fire can destroy trees, but it is vital to maintaining certain ecosystems, particularly aspen forests and ponderosa pine woodlands. Expanses of old forests with large trees and no roads are critical to many species, suggesting that some percentage of La Sierra should be set aside as no-cut, roadless areas (the San Francisco Creek watershed was in this condition less than 20 years ago). Much of the advice on forest insects and pathogens is important and useful, but it should also be recognized that most of these insects and pathogens are native species and for millennia have

been part of western forests. Insects and pathogens damage and sometimes kill trees, but they also have a role in creating a diversity of habitats. It is widely believed that naturally functioning forests (including a diversity of ages, fire regimes, etc.) are more resilient to insect and pathogen outbreaks.

One exciting possible element of a forest management plan could include timber harvest with a goal of ecosystem restoration. This is particularly true in the ponderosa pine forests, which historically were likely much more open on average than they are now. Small trees can be removed from these areas for poles, firewood, and pulpwood while also improving the health of the remaining ponderosa pine. The same may be true for the piñon-juniper woodlands. This work should not be done indiscriminately, but should be based on an understanding of the history of these forests in the region. Scott Chase at the Vermejo Park Ranch and Ryan Boggs of The Nature Conservancy have both spent considerable effort studying these issues, and have expressed willingness to provide advice about these efforts (see Appendix B for contact info).

Fire Management

We believe in one basic pre-supposition about forests in Colorado: they *will* burn. It is only a matter of how and when. For several reasons—human safety, preservation of assets including natural resources, and to improve the health of ecosystems—a fire management plan is essential.

Fire is a natural ecological process that has been suppressed since the turn of the century (USDA Forest Service 1996). Some of the forested zones, especially ponderosa pine are adapted to frequent fires of low-intensity. These fires reduce competition and prepare natural seedbeds (USDA Forest Service 1996). Large ponderosa pines are fire resistant, and typically were not harmed by these low-intensity fires. The trees that survived fires were typically healthier and insect and pathogen resistant because they had fewer competitors for resources. Not allowing natural fires to burn in these forests allows the more shade-tolerant, fire-intolerant species such as white fir and Douglas-fir to move into ponderosa pine sites. The relatively closed canopy of these mixed forests decreases the understory vegetation—primarily bunch grasses—that serve as important ungulate forage. Additionally, the increased fuel loading from dense regeneration and natural dead-and-down accumulation predisposes the site for high-intensity fires, which can be extremely damaging (USDA Forest Service 1996). Frequent, low-intensity fires tend to keep the accumulated fuel load at a moderate level.

All of the non-alpine ecosystem types on La Sierra—grassland, sagebrush, piñon-juniper, ponderosa pine, aspen, and spruce-fir—historically experienced fire as a natural ecosystem process. Some of these ecosystems, e.g., aspen and bristlecone pine, are very much dependent on fires for their continuance on the landscape. Certain ecosystems (ponderosa pine, sagebrush, grasslands, and some piñon-juniper) burned regularly, with a fire-return intervals of 15-50 years. In some areas, some of these ecosystems burned at moderate (50-200 year) intervals. This may be particularly true for some piñon-juniper stands. Spruce-fir typically burned at very long intervals, from 200-500 years. Typically, the more frequently an ecosystem burns, the lower the intensity of the fire. In such cases, many of the major plants survive the fire. This is especially true in ponderosa pine. In ecosystems that burn rarely, fires can be very intense and large stands of mature trees can be completely destroyed. In the case of spruce-fir, destroyed stands are often

replaced in the short term by aspen, adding to the diversity of the landscape. Over time conifers re-colonize these aspen stands. The conifers, which live longer than aspen, eventually grow taller than the aspen, shade the aspen out, and finally return the forest to a conifer forest.

We believe strongly that a fire management plan should be developed for La Sierra. A primary reason for this is simply to know that when a fire breaks out, personnel working on the property know how to respond to the fire. Even a simple plan may protect structures and ensure that people are not put at risk. We would like to see the fire management plan go beyond these necessities to include incorporating fire into management and improvement of the variety of ecosystems on the property.

A fire management plan should be multi-faceted. It should be based largely on historic fire patterns in the area. This information can be gained through detailed scientific studies, and it can also be gained anecdotally by interviewing individuals who have long experience with ecosystems in the area. As with the timber management plan, the fire plan should be based on specific objectives for different parts of La Sierra. Some areas may be allowed to burn. Other areas may receive prescribed burns. Still other areas may be kept from burning. Firewood collection should, to the degree possible, be concentrated near structures and other valuable assets or where safety is a concern.

We want to issue one large caveat with respect to the use of fire as a management tool, which may be obvious: it should be done with care and with guidance from professionals. Fire can harm people, structures, and even the species and communities we are trying to protect. As with timber management, Ryan Boggs of The Nature Conservancy and Scott Chase of Vermejo Park Ranch will provide advice on gathering information about fire history and on developing goals for a variety of ecosystem types. The San Luis Valley office of The Nature Conservancy and the National Park Service are currently completing an environmental assessment of the role of fire on the Great Sand Dunes National Park and on the adjacent Medano-Zapata Ranch. This assessment likely will contain much useful information applicable to La Sierra. Another valuable resource for developing landscape-level goals (i.e., how should the different forest types look, and how should they be distributed across the landscape) is the Fire Regime Condition Class tool developed collectively by several federal land management agencies. Information about this tool can be found on the web; the web site info is in Appendix B.

Fisheries Management

Fisheries on La Sierra are an important natural resource. Culebra Creek and other creeks provide anglers opportunities to catch trout, including the native Rio Grande cutthroat trout. Several streams support high-quality populations of the cutthroat, which is possibly La Sierra's most imperiled species.

For streams in general, we recommend these management actions to protect aquatic species, including trout:

- Minimize sedimentation to streams. This is particularly important with respect to roads, as discussed above. Sediment degrades water quality and fouls spawning beds.

- Allow for healthy stream banks and robust riparian vegetation. These mitigate high temperatures, provide shelter, and support the aquatic food web by cycling nutrients and organic material into the stream.
- Except to protect Rio Grande cutthroat, do not place structures into streams that inhibit movement along the stream. For example, if a culvert must be placed in a stream, it should be done in a manner that allows movement past the culvert. On the other hand, if properly done, culverts can serve as movement barriers that protect cutthroat populations. (Consult with John Alves at the Colorado Division of Wildlife for information on stream structures that do not impair fish travel and barriers that do). Such barriers to upstream movement should be built on all streams containing cutthroat (contact John Alves and/or Scott Miller about locations). Permanent dams, even those with a spillway, should be avoided. Beaver activity, including dams, should not be inhibited, and may even be encouraged. Beaver ponds trap sediments and increase both aquatic and wetland habitat diversity.
- Do not allow introduction of non-native trout into streams that support cutthroat.
- Natural flow patterns (i.e., timing and amount of water flowing in the stream) should not be altered. Both impoundments and diversions negatively impact flow patterns.

As mentioned elsewhere in this report, our greatest concern is for the Rio Grande cutthroat trout[2]. This native species has diminished to less than 10% of its historic range globally, and in Colorado it is present in less than 1% of its historic range (Alves 1996). Populations of this trout continue to be threatened by the factors that led to its diminution, including the introduction and spread of non-native trout, habitat degradation related to livestock grazing, water diversion, and development. The cutthroat is also threatened by natural stochastic and demographic factors (against which reduced population have lost much of their capacity to respond), poor habitat quality, and pathogens such as whirling disease.

Protection of the Rio Grande cutthroat in Colorado recently became more crucial because New Mexico has outlawed the used of piscicides (chemicals that kill fish). Putting chemicals in streams is never desirable, but it is often the best option for restoring populations of the cutthroat. There is no point in restoring cutthroat to streams already dominated by non-native cutthroat which, at best, will out compete them, and, at worst, will hybridize with them and alter their genetic makeup. When used properly, piscicides can be safe and useful, but they must be used with care.

The vast majority of remaining cutthroat populations are isolated from one another (Alves 1998, USFWS 1998). This is true on La Sierra, where the best populations of cutthroat are isolated from each other by irrigation ditches, dry streambeds, and Sanchez Reservoir. Lack of connectivity between populations precludes genetic interchange and ensures that as populations are extirpated by anthropogenic factors, natural disturbance, or demographic stochasticity, there will be no individuals to recolonize habitat. The small size and isolation of the few remaining populations places the subspecies at risk.

[2] Much of the information in this section is from Greenwald 2002.

Also mentioned elsewhere, road-building and logging, by altering the hydrology of watersheds, is well documented to be deleterious to fish and other aquatic life forms (Eaglin and Hubert 1993). Roads and logging increase surface runoff, sedimentation and debris avalanches, and destroy riparian vegetation. Additionally, roads require in-stream structures, such as culverts and bridges, that remove aquatic habitat and/or are barriers to fish. Of all these effects, stream sedimentation from erosion and debris avalanches is the most harmful to native trout. Increased sediments in the stream environment reduce dissolved oxygen, raises stream temperature, and can bury or cement trout spawning beds making reproduction impossible (Cooper 1965). Degraded habitat may give non-native trout a competitive advantage over native trout (Behnke 1979, Griffith 1988).

Because of the small size and high elevation of most cutthroat streams, much of the habitat occupied by the subspecies is marginal, with steep gradients, few deep pools and cold summer water temperatures. This is clearly seen on La Sierra where the cutthroat streams flow at only a few cubic feet per second, whereas the streams dominated by non-native trout flow at several times that discharge rate. Since virtually all remaining Rio Grande cutthroat populations exist in isolated streams, the potential for loss of any of these populations to catastrophic disturbance or environmental stochasticity (i.e. drought, flood, cold winter resulting in anchor ice) and for an accumulation of such losses over time is very great.

Fishing can and has had an impact on populations of Rio Grande cutthroat trout. We believe it would be prudent to restrict access to at least portions of the cutthroat streams. Mere access to streams can harm populations by, for example, unintentionally introducing pathogens into a stream. Where fishing is allowed, catch-and-release should be encouraged for cutthroat. Where non-native species co-exist with the cutthroat, unlimited take of the non-natives (rainbow, brown, and brook trout) should be encouraged to reduce the impact of the non-natives on the cutthroat. Live bait should be prohibited in cutthroat streams because it may introduce unwanted species.

We think that Matt Weaver's report on fisheries on the property is generally well-done and on target, particularly with respect to the Rio Grande cutthroat. For many of the reasons listed above, we support Matt Weaver's recommendations for restoring cutthroat to streams where they do not currently live. It would be great to have several connected streams all supporting genetically pure cutthroat and free of non-natives. Restoring the fish is not a pretty or simple process. All non-natives must be removed from the stream, and a barrier must be in place to restrict re-invasion of the stream by non-natives from lower stretches of the stream. Although we support re-introduction, we cannot over-emphasize that protection of existing pure-strain populations is the highest priority as well as being the easiest step for protection of this species. We do not agree with Mr. Weaver's suggestions for in-channel stream modifications, particularly on the three best cutthroat streams (Cuates, Jaroso, and Torcido), because we can't be certain of the long-term effects of such modifications.

We strongly encourage working with John Alves of the Colorado Division of Wildlife and Scott Miller of the US Fish and Wildlife Service on protecting, and possibly restoring, cutthroat populations. Personnel on the Vermejo Ranch also have considerable experience in these endeavors. Contact information is included in Appendix B.

Wildlife Management

La Sierra supports important game and non-game wildlife resources, including healthy populations of several predators. The large mammals that concern us most are elk and sheep. Populations of predators are also a long-term concern.

It is wonderful to experience the abundance of elk on La Sierra, particularly in the fall when bulls are bugling. Elk are also highly valued by hunters, and for the commercial hunts that can be run on La Sierra. However, it is apparent to a trained eye that elk numbers are very high in the area. The most obvious sign of excessively high numbers are strong browse lines on willow stands, and in some areas the nearly complete destruction of willows (Figure 6). It is nearly certain that a closer look would reveal reduced to non-existent regeneration of these plants. The same type of effect is likely present in the aspen stands. In areas where elk numbers are too high, regeneration of aspen can be virtually halted (Larsen and Ripple 2003).

The age-structure, productivity, and resistance of these browsing-sensitive vegetation types would be improved if there were fewer elk on the property. Since these vegetation types are extremely important to certain groups of species (e.g., songbirds), reducing elk numbers would improve the prospects for the dependent non-game populations. Reducing elk numbers is also consistent with the Colorado Division of Wildlife's goals for the Culebra Range, where elk numbers are considered as much as 40% higher than what is preferable for the long-term health of the herd and the ecosystems that support them (C. Wagner, pers. comm.. to J. Sanderson). We would like to think that the size of the elk herd could be reduced in a manner consistent with the production of large bulls for hunters visiting La Sierra. In theory, reduced herd size along with the forest restoration activities described above would increase forage available to the remaining elk. We recognize, however, that reducing herd size is a matter that must be addressed on a regional scale. We therefore encourage the landowners and users to work with the Colorado Division of Wildlife (contact info in Appendix B) and with adjacent landowners to accomplish elk herd objectives.

Bighorn sheep present different concerns. Populations of bighorn sheep in the Southern Rocky Mountains are at only about 2% to 8% of their sizes at the time of European settlement (Singer 1995). Causes for the rapid decline from 1870 through 1950 included unregulated harvesting, excessive grazing of livestock on rangelands, and diseases transmitted by domestic sheep (Stohlgren no date). Bighorn sheep populations are still vulnerable, primarily because of diseases transmitted from domestic sheep. The Colorado Division of Wildlife recommends that no domestic sheep graze within 40-50 miles of a herd of bighorn sheep (C. Wagner, pers. comm. to J. Sanderson). In order to protect the herd of bighorn sheep that uses a significant portion of La Sierra (Figure 7), we suggest that domestic sheep not be grazed anywhere on the property.

Figure 6. A willow stand with an strong elk browse line (left), and another willow stand where all of the older stems are dead.

Finally, a word about predators. Locals we spoke to on La Sierra attest to healthy populations of some major predators, including black bear and mountain lion. It's worth noting, however, that at least two major predators that were historically present in this area—grizzly bears and wolves—are now absent. Wolves in particular can have an important effect on the structure of ecosystems (Smith *et al.* 2003). At Isle Royal where wolves restored themselves over 50 years ago, wolves completely eliminated coyotes and influenced the moose populations. The changes in moose populations, which included changes in the dynamics of population numbers as well as foraging patterns, had important implications for forest growth and composition. Similar effects are occurring in Yellowstone National Park (Smith *et al.* 2003). Predators such as wolves have an important role to play in maintaining the historic range of variability of South Rocky Mountain ecosystems, including those in the Culebra Range. There is abundant evidence that wolves will arrive in Colorado without human intervention in the relatively near future. When they do arrive, we encourage land managers, ranchers, and other residents to figure out a way to co-exist with these predators. Stories of successful co-existence now abound in the Northern Rockies, and we believe these successes can be repeated in Colorado.

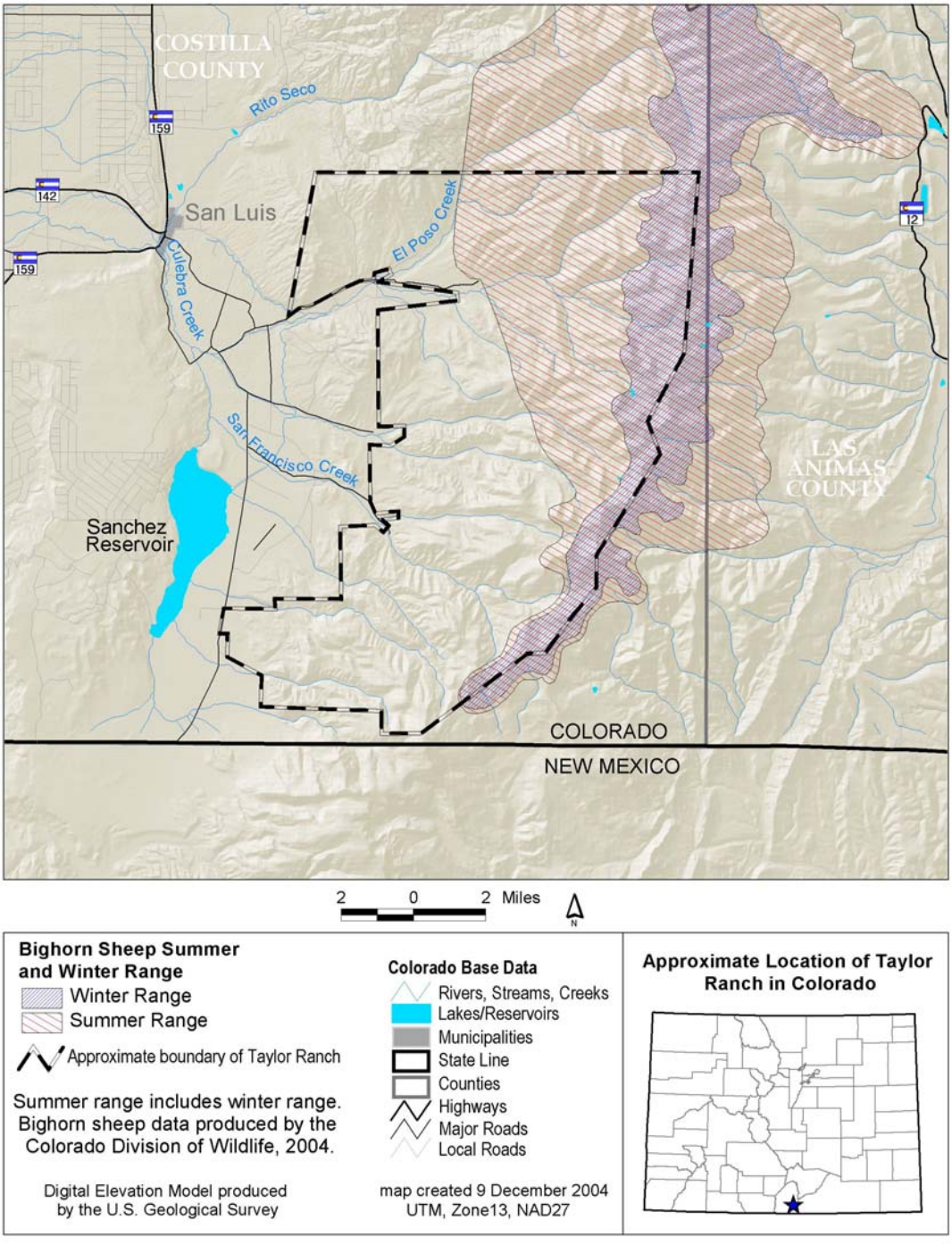

Figure 7. Bighorn sheep winter and summer range on La Sierra (source: Colorado Division of Wildlife).

Potential Conservation Area Profiles

This section presents the Potential Conservation Areas we have delineated on La Sierra. These are the areas we believe most merit conservation attention. This first page describes the format of the PCA profiles.

Biodiversity Rank: B# (Level of significance)
The relative global significance of the Potential Conservation Area (referred to as a **site** in the following discussions) in terms of the imperilment of the Natural Heritage resources and the quality (condition, size, landscape context) of the occurrences.

Protection and Management:
Short summary of the land ownership and protection status. Management issues, which could affect the elements, are discussed.

Biodiversity Rank Justification: A synopsis of the imperiled species and significant plant communities that occur within the potential conservation area. A table within the profile lists each element occurrence found in the site, global and state ranks of these elements, the occurrence ranks and federal and state agency special designations. See Appendix A for explanations of ranks.

Location: General location.

Legal Description: U.S.G.S. 7.5-minute Quadrangle name and Township Range Section(s).

General Description: A brief narrative picture of the topography, vegetation, and current use of the potential conservation area. Common names are used along with the scientific names.

Boundary Justification: Justification for the location of the potential conservation area boundary delineated in this report, which includes occurrences of natural heritage resources and, in some cases, adjacent lands required for their protection.

Protection and Management Comments: More detailed information on protection and management issues at the site is presented. Formal protection status refers to areas designated as a Research Natural Area, Area of Critical Environmental Concern, special management area, National Wildlife Refuge etc., land under a private conservation easement, or areas where the elements of concern are specifically addressed in a management plan.

Potential threats are discussed in general terms. In many cases, these threats are not currently an issue, but they do have the potential to become an issue in the future. Occasional monitoring of the sites would help identify changing threats, and allow proactive management before the elements of concern are impacted. Knowledgeable biologists should be consulted to recommend appropriate monitoring intervals.

B3 Potential Conservation Areas

Cuates Creek

Biodiversity Rank: B3 (High significance)
The site supports an excellent (A-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Cuates Creek is historic and native (i.e., not stocked) and genetically pure.

Protection and Management: The abundance of sediment-rich runoff from the extensive network of logging roads in this watershed is likely impacting the stream and its inhabitants. We recommend that the road network be surveyed for rapidly eroding areas, and that these areas be stabilized immediately. Impacts of roads on streams can be largely avoided by not building new roads within 50 ft of the stream and by using Best Management Practices on all roads. Maintaining a 50 ft buffer along the stream in which domestic cattle are not grazed will help maintain water quality and stream bank structure. Avoiding timber harvests within 0.25 mile of the stream will also help maintain water quality. A barrier to upstream movement of non-native fish species should be built at a location that will prevent non-native incursions into the cutthroat population.

Biodiversity Rank Justification: The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, this subspecies occupies less than 1% of its former range (Alves 1996), and wild, genetically pure populations are especially imperiled. Protection of Colorado's remaining historic, genetically pure populations has become particularly crucial since New Mexico has recently disallowed the use of piscicides (chemicals that kill fish) that are necessary for re-establishing cutthroat populations[3].

Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout. It is also important that populations of the Rio Grande cutthroat exist that do not have co-occurring populations of brown or brook trout (which often out compete cutthroat) or rainbow trout (which both out compete and interbreed with cutthroat, creating hybrids instead of the original subspecies).

[3] General comments about the status, management, and protection of the Rio Grande cutthroat included in this PCA apply to all PCAs with Rio Grande cutthroat.

The site supports an excellent (A-ranked) occurrence of this globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Cuates Creek is historic and native (i.e., not stocked), and it is genetically pure (i.e., they have not interbred with rainbow trout or other subspecies of cutthroat trout). There have been no non-native trout recorded in Cuates Creek.

Table 6. Natural Heritage element occurrences at Cuates Creek PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki ssp. *Virginalis*	Rio Grande cutthroat trout	G4T3	S3	none	A

*EO=Element Occurrence

Location: From San Luis (Costilla County, Colorado) drive east to county road 21, then turn south. Continue to where Cuates Creek crosses the road. The site extends from Sanchez Reservoir (Ventero Creek) to the headwaters of Cuates Creek, with a 0.25 mile buffer on each side of the stream. The headwaters can be reached by entering the "Cielo Vista Ranch" (with permission only) via the south headquarters, which are on Cuates Creek.

U.S.G.S. 7.5-min. quadrangles: La Valley, Sanchez Reservoir
Elevation: 8,300-11,600 ft Approximate Size: 2,270 acres

General Description: This Potential Conservation Area spans from the subalpine through the montane zone onto the flat valley floor. The creek is on average steep (11% grade) and narrow, with an average flow of only a few cubic feet per second. The site flows through mainly spruce-fir then mixed conifer forests with varying amounts of aspen mixed in. Riparian areas tend to have proportionally higher amounts of aspen. Along the creek there are several to many small stands of willow (especially *Salix drummondiana* but also *S. planifolia* at higher elevations and *S. lucida, S. geyeriana*, and *S. monticola* in the montane zone) with an understory including *Deschampsia caespitosa, Calamagrostis canadensis*, and *Senecio triangularis*.

There are currently few beaver in Cuates Creek. Beaver activity (e.g., building dams, harvesting trees) should not be inhibited since they generally contribute to riparian habitat and diversity. Along Cuates Creek beaver may be particularly valuable when their ponds retain sediment that has run off from logging roads.

Alves (2004) estimates that there are approximately 28 lbs of cutthroat per acre and 254 fish per mile in the creek. The population is stable and secure. Some artificial barriers occur in the lower portion of the drainage where the creek is diverted into irrigation ditches and the main stem frequently becomes dry. No other fish have been documented in the creek (Alves 2004, surveyed in 2000).

Boundary Justification: The boundary incorporates an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the Rio Grande cutthroat. The site includes the area that has the most immediate and direct impact on the creek.

The boundary as drawn indicates the minimum area that should be considered for any conservation management plan. The entire watershed above the site also impacts the creek, particularly by contributing runoff to the creek. Although the entire watershed is not within the primary boundary, any activity in the watershed (e.g., logging, road building) should be assessed for its potential impact on the Rio Grande cutthroat.

Protection and Management Comments: La Sierra is privately owned, and the new owners (as of August 2004) have expressed interest in managing for conservation values. However, rights for local residents to certain resources on La Sierra (related to the original Sangre de Cristo Mexican Land Grant) have been confirmed by the Colorado Supreme Court; the full extent of these is still being defined. Activities of all parties using the land should be reviewed for potential impacts on the Rio Grande cutthroat.

An extensive network of logging roads is contributing excessive amounts of sediment to the streams. Numerous studies have shown that increased surface runoff and decreased slope stability caused by road building and logging increases sediment production and the likelihood of major landslides (e.g., Amaranthus *et al.* 1985, Megahan and Kidd 1972). In fact, a major landslide occurred on North Vallejos Creek as a result of improper road building. Increased sediments in the stream environment reduce dissolved oxygen, raise stream temperature, and can bury or cement spawning beds making reproduction impossible (Cooper 1965). Degradation of habitat from logging, roads or other factors likely also gives non-native trout a competitive advantage over native trout (Behnke 1979, Griffith 1988).

All roads should be maintained according to Best Management Practices for Colorado (Available from the Colorado State Forest Service—see Appendix B for contact information). The entire road network should be surveyed for high erosion areas, and these areas should be treated (water bars, planting with native vegetation, closing the roads) as soon as possible. As many roads as possible should be closed, but it must be insured that they are stable before they are closed. Otherwise, they will continue to dump sediment into the stream. Roads within 50 ft of the stream should be particularly well maintained. The road along Cuates Creek just above the south Ranch headquarter is very close to the stream and should be given special attention to avoid erosion and sediment deposition into the river. Locations where roads cross the creek should be given high priority to ensure they are stable and not eroding excessively.

Future timber harvest, even for thinning or restoration work, should carefully follow Best Management Practices to avoid additional stream degradation. Harvests within the 0.25 mile stream buffer should be minimized. Timber harvest should not occur within 50 feet of the creek. Cattle grazing should also be avoided within 50 feet of the stream. Cattle can have a very deleterious effect on stream banks (which fish need for shelter), streambed substrates (needed for spawning), and water quality.

The artificial barriers mentioned above inhibit movement of non-native fish up Cuates Creek. However, there is no guarantee that these barriers will always remain in place. It is recommended that the best, most secure portion of the cutthroat population in Cuates Creek be protected by constructing a high-quality barrier at a location recommended by John Alves (Colorado Division of Wildlife) and Scott Miller (US Fish and Wildlife Service).

Cuates Creek is not particularly amenable to fishing because it is narrow and, in many places, heavily vegetated. It also has a low base flow, around 2-3 cubic feet per second. Nonetheless, if fishing is done in Cuates Creek, the small but secure Rio Grande cutthroat population suggests that the fishing should be catch and release only.

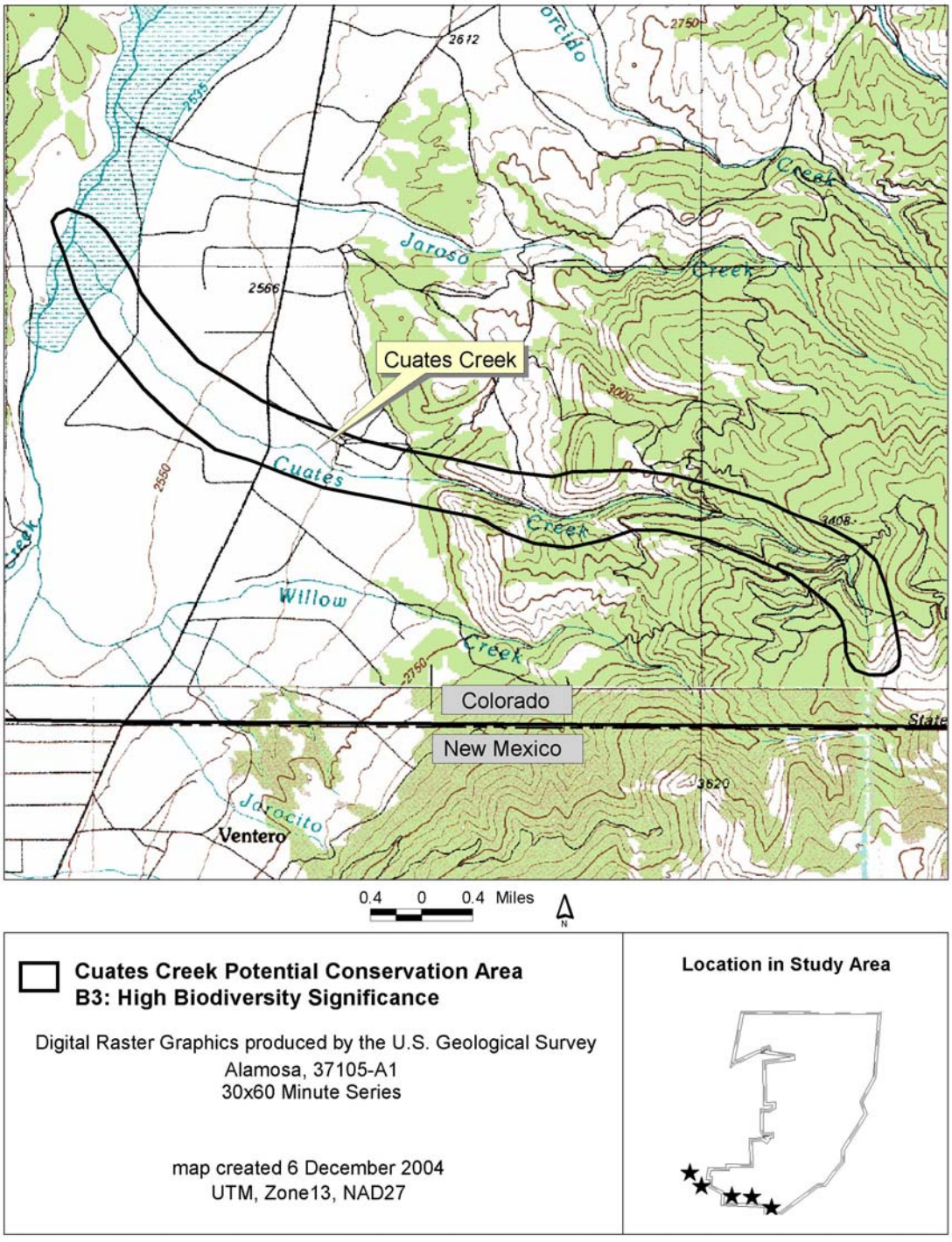

Figure 8. Cuates Creek Potential Conservation Area.

Jaroso Creek

Biodiversity Rank: B3 (High significance)
The site supports an excellent (A-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Jaroso Creek is historic and native (i.e., not stocked) and genetically pure.

Protection and Management: The abundance of sediment-rich runoff from the extensive network of logging roads in this watershed is likely impacting the stream and its inhabitants. We recommend that the road network be surveyed for rapidly eroding areas, and that these areas be stabilized immediately. Impacts of roads on streams can be largely avoided by not building new roads within 50 ft of the stream and by using Best Management Practices on all roads. Maintaining a 50 ft buffer along the stream in which domestic cattle are not grazed will help maintain water quality and stream bank structure. Avoiding timber harvests within 0.25 mile of the stream will also help maintain water quality. A barrier to upstream movement of non-native fish species should be built at a location that will prevent non-native incursions into the cutthroat population.

Biodiversity Rank Justification: The site supports an excellent (A-ranked) occurrence of this globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Jaroso Creek is historic and native (i.e., not stocked), and it is genetically pure (i.e., they have not interbred with rainbow trout or other subspecies of cutthroat trout). Brook trout were found in Jaroso Creek in 1995, but no non-native trout have been found in Jaroso Creek in subsequent surveys. However, Weaver (no date) indicates that there are brook trout below "Jaroso Meadow."

Table 7. Natural Heritage element occurrences at Jaroso Creek PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	G4T3	S3	none	A

*EO=Element Occurrence

Location: From San Luis (Costilla County, Colorado) drive east to county road 21, then turn south. Continue to where Jaroso Creek crosses the road. The site extends from Sanchez Reservoir (Ventero Creek) to the headwaters of Jaroso Creek, with a 0.25 mile buffer on each side of the stream. The headwaters can be reached by entering the "Cielo Vista Ranch" (with permission only) via the south headquarters, which are on Cuates Creek, then heading south one drainage to Jaroso Creek. Logging roads can easily be followed to the headwaters of the creek.

U.S.G.S. 7.5-min. quadrangles: La Valley, Sanchez Reservoir
Elevation: 8,300-12,000 ft Approximate Size: 2,950 acres

General Description: This Potential Conservation Area is along a creek that is on average steep and narrow, with an average flow of only a few cubic feet per second. The site spans from the subalpine to montane zones, flowing through mainly spruce-fir then mixed conifer forests with varying amounts of aspen mixed in. The spruce-fir forests at the headwaters of Jaroso Creek are very heavily cut over (Figure 9, left). Several roads constructed on the highly erodable soils of this area are excessively steep and eroding severely. One spot in particular (Figure 9, right, NAD27 UTM Zone 13 E474855 N4096567) should be addressed quickly to avoid additional erosion.

Beaver activity (e.g., building dams, harvesting trees) is scattered along Jaroso Creek. This activity should not be inhibited since it generally contributes to riparian habitat and diversity. Beaver may be particularly valuable when their ponds retain sediment that has run off from logging roads.

Alves (2004, pers. comm. to J. Siemers) estimated that there are approximately 63 lbs/acre of fish in the creek, which is considerably higher than Cuates Creek. The population is stable and secure. Some artificial barriers occur in the lower portion of the drainage where the creek is diverted into irrigation ditches and the main stem frequently becomes dry. No other fish have been documented in the creek (Alves 2004, pers. comm. to J. Siemers).

Figure 9. Upper Jaroso Creek showing extensive logging and residual debris (left) and severe erosion of the road and sediment deposition into creek (right).

Boundary Justification: The boundary incorporates an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the Rio Grande cutthroat. The site includes the area that has the most immediate and direct impact on the creek.

The boundary as drawn indicates the minimum area that should be considered for any conservation management plan. The entire watershed above the site also impacts the creek, particularly by contributing runoff to the creek. Although the entire watershed is not within the primary boundary, any activity in the watershed (e.g., logging, road building) should be assessed for its potential impact on the Rio Grande cutthroat.

Protection and Management Comments: Brook trout have been found in the lower portions of Jaroso Creek in some years, but not in others. It appears that brook trout may be limited to below the main north-south road, where a culvert acts as a (weak) barrier to upstream movement (Weaver no date). Another round of sampling should be done above this road to determine if brook trout are still absent. If so, the road culvert should be improved to be a more secure barrier.

Jaroso Creek has a base flow of only about 4 cubic feet per second (Weaver no date) and, like the other creeks in the area, is generally narrow and heavily vegetated. This makes fishing challenging, but it should be kept that way on this creek. The creek should not be "improved" for fishing, because such actions may in fact cause as much harm as good to the overall population. Fishing in Jaroso Creek should be catch and release.

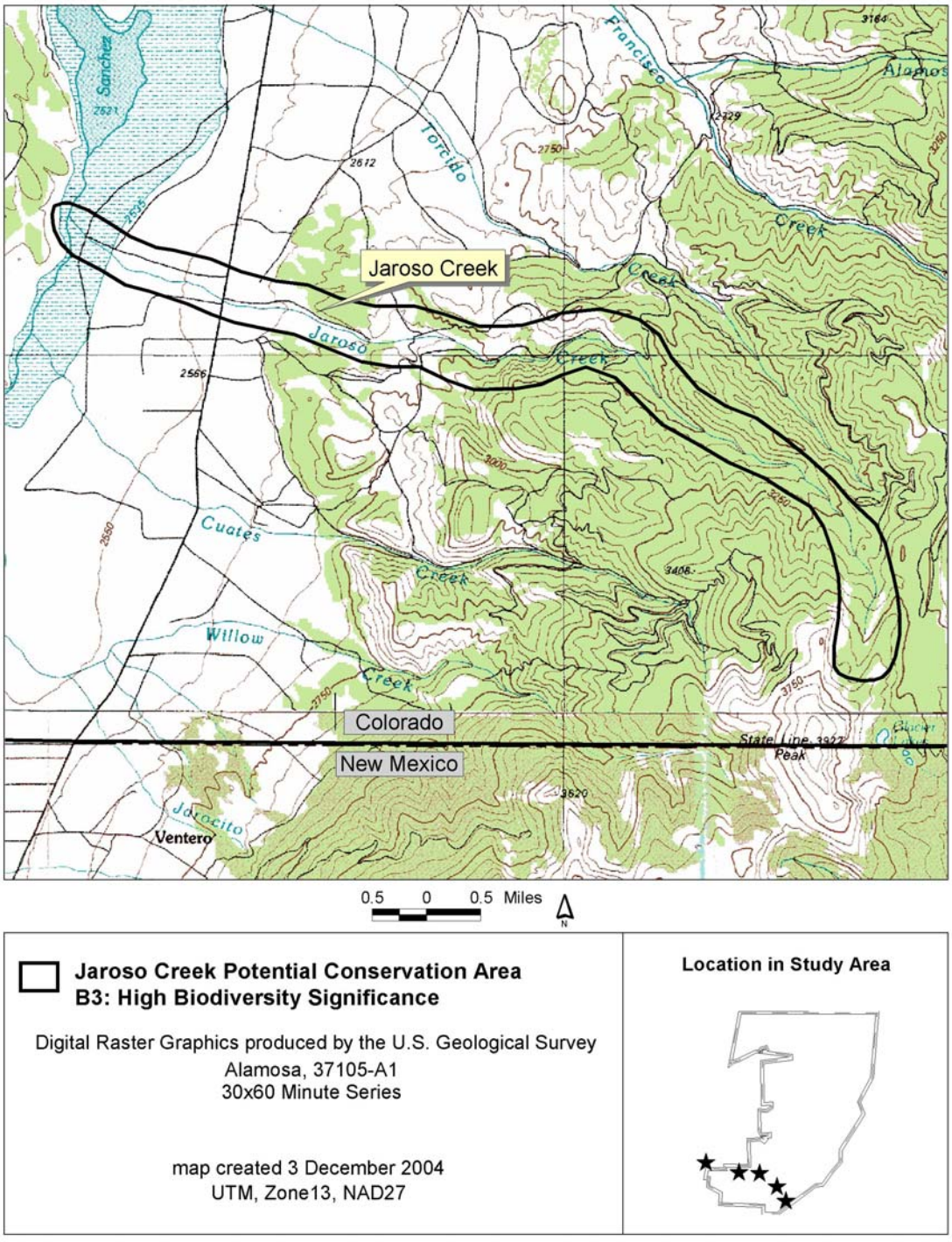

Figure 10. Jaroso Creek Potential Conservation Area.

Torcido Creek

Biodiversity Rank: B3 (High significance)
The site supports an excellent (A-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Torcido Creek is historic and native (i.e., not stocked) and genetically pure.

Protection and Management: The abundance of sediment-rich runoff from the extensive network of logging roads in this watershed is likely impacting the stream and its inhabitants. We recommend that the road network be surveyed for rapidly eroding areas, and that these areas be stabilized immediately. Impacts of roads on streams can be largely avoided by not building new roads within 50 ft of the stream and by using Best Management Practices on all roads. Maintaining a 50 ft buffer along the stream in which domestic cattle are not grazed will help maintain water quality and stream bank structure. Avoiding timber harvests within 0.25 mile of the stream will also help maintain water quality. A barrier to upstream movement of non-native fish species should be built at a location that will prevent non-native incursions into the cutthroat population.

Biodiversity Rank Justification: The site supports an excellent (A-ranked) occurrence of this globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Torcido Creek is historic and native (i.e., not stocked), and it is genetically pure (i.e., they have not interbred with rainbow trout or other subspecies of cutthroat trout). There have been no non-native trout recorded in Torcido Creek.

Table 8. Natural Heritage element occurrences at Torcido Creek PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	G4T3	S3	none	A

*EO=Element Occurrence

Location: From San Luis (Costilla County, Colorado) drive east to county road 21, then turn south. Continue to where Torcido Creek crosses the road. The site extends from Sanchez Reservoir (Ventero Creek) to the headwaters of Torcido Creek, with a 0.25 mile buffer on each side of the stream. The headwaters can be reached by entering the "Cielo Vista Ranch" (with permission only) via the south headquarters, which are on Cuates Creek. Torcido Creek is two watersheds south of Cuates Creek.

U.S.G.S. 7.5-min. quadrangles: La Valley, Sanchez Reservoir
Elevation: 8,300-11,200 ft Approximate Size: 2,860 acres

General Description: This Potential Conservation Area spans from the subalpine through the montane zone onto the flat valley floor. The creek is on average steep and narrow, with an average flow of only a few cubic feet per second. From its headwaters, Torcido Creek flows through mainly spruce-fir then mixed conifer forests with varying amounts of aspen mixed in. The site extends out onto the flat agricultural lands east of Sanchez Reservoir. Along the creek there are several to many small stands of willow, but generally not very extensive wetlands.

Figure 11. Cut over spruce-fir forest in the headwaters area of Torcido Creek.

There are currently few beaver in Torcido Creek. Beaver activity (e.g., building dams, harvesting trees) should not be inhibited since it generally contributes to riparian habitat and diversity. Along Torcido Creek beaver may be particularly valuable when their ponds retain sediment that has run off from logging roads.

Alves (2004, surveyed in 2003) estimates that there are approximately 554 cutthroat/mile and 46 lbs/acre in the creek. The population is stable and secure. Some artificial barriers occur in the lower portion of the drainage where the creek is diverted into irrigation ditches and the main stem frequently becomes dry. No other fish have been documented in the creek (Alves 2004, surveyed in 2003).

Boundary Justification: The boundary incorporates an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the Rio Grande cutthroat. The site includes the area that has the most immediate and direct impact on the creek.

The boundary as drawn indicates the minimum area that should be considered for any conservation management plan. The entire watershed above the site also impacts the creek, particularly by contributing runoff to the creek. Although the entire watershed is not within the primary boundary, any activity in the watershed (e.g., logging, road building) should be assessed for its potential impact on the Rio Grande cutthroat.

Protection and Management Comments: The watershed of Torcido Creek has been widely cut over, particularly in the headwaters area (Figure 11). The road network that supported this logging should be assessed for high erosion areas. Where spruce-fir has been greatly thinned, trees are regularly blown over. The natural closing of roads by this process is encouraged, but only after the roads have been stabilized to prevent future erosion.

Torcido Creek is not particularly amenable to fishing because it is narrow and, in many places, heavily vegetated. It also has a low base flow, around 2-3 cubic feet per second. Nonetheless, if fishing is done in Torcido Creek, the high quality of the Rio Grande cutthroat population suggests that the fishing should be catch and release only.

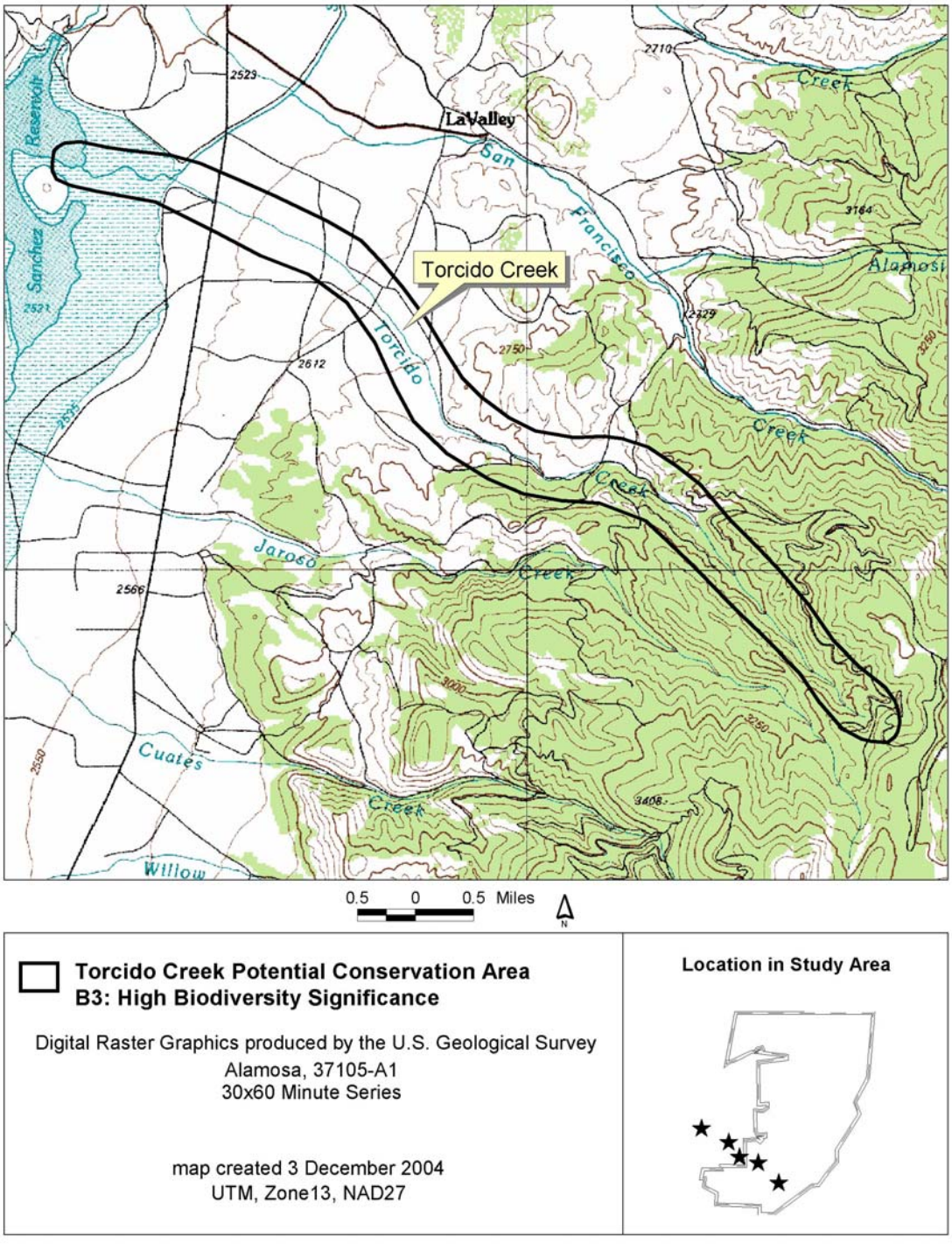

Figure 12. Torcido Creek Potential Conservation Area.

Alamosito Creek

Biodiversity Rank: B3 (High significance)
The site supports a fair (C-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. Although an occasional non-native brown trout has been found in the stream, and no barrier to prevent further incursions of non-natives exists, this site is ranked B3 because the Rio Grande cutthroat population is historic and native (i.e., not stocked), genetically pure, and largely free of non-natives.

Protection and Management: The abundance of sediment-rich runoff from the extensive network of logging roads in this watershed is likely impacting the stream and its inhabitants. We recommend that the road network be surveyed for rapidly eroding areas, and that these areas be stabilized immediately. Impacts of roads on streams can be largely avoided by not building new roads within 50 ft of the stream and by using Best Management Practices on all roads. Maintaining a 50 ft buffer along the stream in which domestic cattle are not grazed will help maintain water quality and stream bank structure. Avoiding timber harvests within 0.25 mile of the stream will also help maintain water quality. There are currently no barriers to movement of additional non-native trout into Alamosito Creek. It is recommended that a barrier be built using the culvert above the confluence with San Francisco Creek on La Sierra's main north-south road.

Biodiversity Rank Justification: The site supports a fair (C-ranked) occurrence of this globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in Alamosito Creek is historic and native (i.e., not stocked), and it is genetically pure (i.e., they have not interbred with rainbow trout or other subspecies of cutthroat trout). The population is considered only a fair occurrence of this species because some brown trout (a strong competitor) have been found in the creek, and there are no barriers to keep other non-natives from moving up the creek.

Table 9. Natural Heritage element occurrences at Alamosito Creek PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	G4T3	S3	none	C

*EO=Element Occurrence

Location: From San Luis (Costilla County, Colorado) drive east to Chama, then up Culebra Creek to the north entrance to the "Cielo Vista Ranch." Drive south (with permission) on the ranch's main north-south road to where the road crosses the Alamosito (~8 miles). The site extends upstream to the headwaters from where the main north-south road crosses the creek.

U.S.G.S. 7.5-min. quadrangles: La Valley, Culebra Peak
Elevation: 8,840-12,240 ft Approximate Size: 1,820 acres

General Description: This Potential Conservation Area spans from the subalpine through the montane zone onto the flat valley floor. The creek is on average steep (11% grade) and narrow, with an average flow of only a few cubic feet per second.

Alves (2004) estimates that there are approximately 98 cutthroat/mile and 18 lbs/acre in the creek. The population is considered only a fair quality occurrence, however, since there are brown trout present in the stream and there are no barriers inhibiting additional incursions into the creek. Genetically pure Rio Grande cutthroat have been found in San Francisco Creek, which is below Alamosito Creek, but not since 1996 (Harig and Fausch 1996).

Boundary Justification: The boundary incorporates an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the Rio Grande cutthroat. The site includes the area that has the most immediate and direct impact on the creek.

The boundary as drawn indicates the minimum area that should be considered for any conservation management plan. The entire watershed above the site also impacts the creek, particularly by contributing runoff to the creek. Although the entire watershed is not within the primary boundary, any activity in the watershed (e.g., logging, road building) should be assessed for its potential impact on the Rio Grande cutthroat.

Protection and Management Comments: Logging roads on Alamosito Creek are causing problems at both the headwaters and toward the west boundary of La Sierra. At the headwaters there is not only erosion and sediment deposition into the stream, but also roads have crossed wetlands and altered they hydrologic regime, causing damage to the vegetation in these wetlands (Figure 13, left). Lower down, a small distance above San Francisco Creek, erosion from the road is so great that it is leaving very large deposits of sediment immediately next to the creek (Figure 13, right). Among these road sections, the eroding areas are the highest priority. Stabilizing this erosion would benefit the aquatic species in the stream, including cutthroat.

Figure 13. Sickly willows at the headwaters of Alamosito Creek where a road bisected a wetland (left), and large sediment deposit on the immediate edge of the creek (right).

Alamosito Creek is not particularly amenable to fishing because it is narrow and, in many places, heavily vegetated. It also has a low base flow, around 2-3 cubic feet per second. Nonetheless, if fishing is done in Alamosito Creek, keeping non-native species should be encouraged without limit in order to reduce competition with the cutthroats, while catch and release should be the rule for cutthroat.

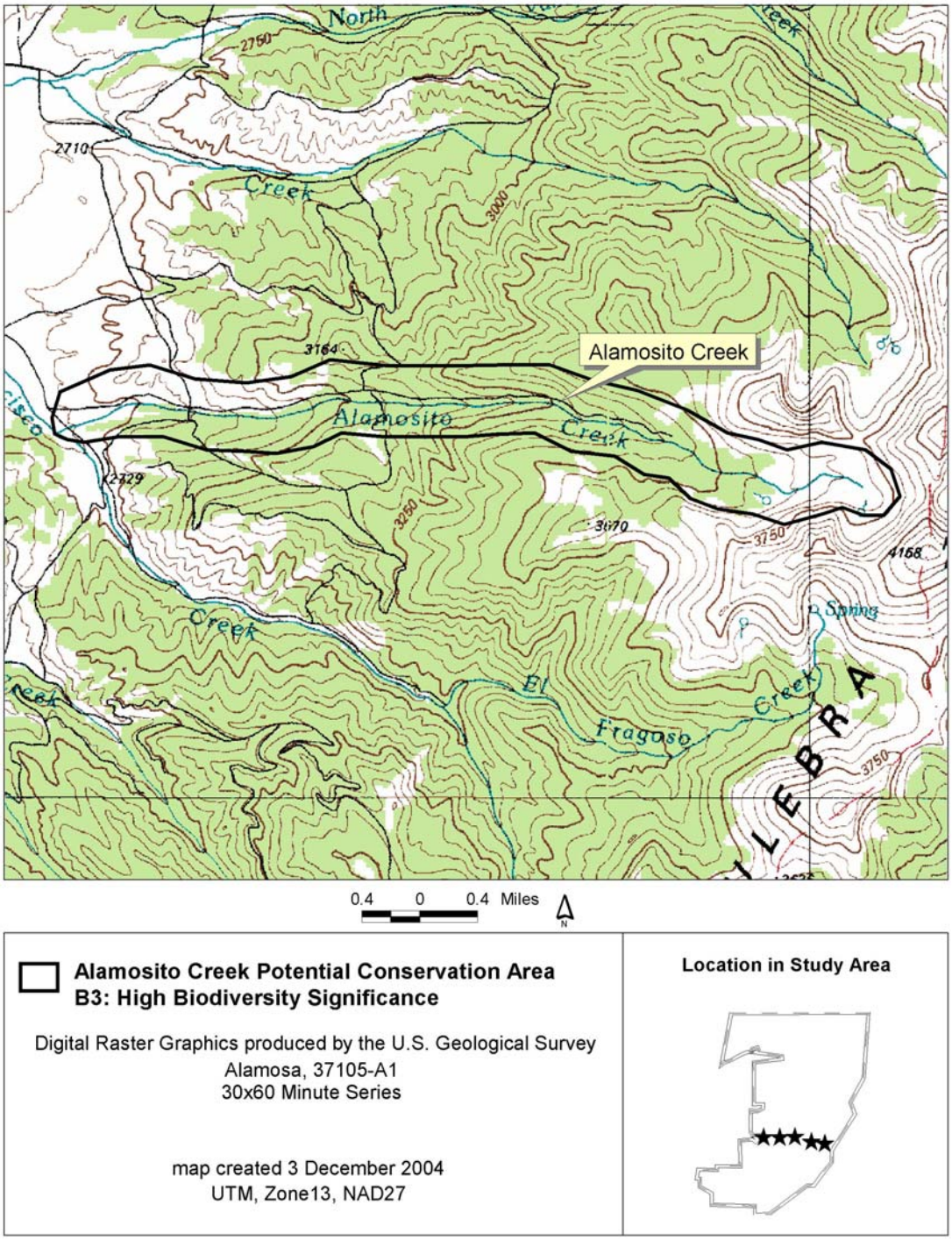

Figure 14. Alamosito Creek Potential Conservation Area.

South Vallejos Creek (Vallejos Creek No. 2)

Biodiversity Rank: B3 (High significance)
The site supports a fair (C-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. Although there are non-native brown and brook trout present and no barrier to prevent further incursions of non-natives, this site is ranked B3 because the Rio Grande cutthroat population is historic and native (i.e., not stocked) and it is genetically pure.

Protection and Management: The abundance of sediment-rich runoff from the extensive network of logging roads in this watershed is likely impacting the stream and its inhabitants. We recommend that the road network be surveyed for rapidly eroding areas, and that these areas be stabilized immediately. Impacts of roads on streams can be largely avoided by not building new roads within 50 ft of the stream and by using Best Management Practices on all roads. Maintaining a 50 ft buffer along the stream in which domestic cattle are not grazed will help maintain water quality and stream bank structure. Avoiding timber harvests within 0.25 mile of the stream will also help maintain water quality. A barrier should be built to prevent additional incursions of non-natives into the Vallejos Creek system. Eliminating non-natives should be considered.

Biodiversity Rank Justification: South Vallejos Creek supports a genetically pure and historic population of the Rio Grande cutthroat trout (*Oncorhynchus clarki* ssp. *virginalis*). Alves (2004, survey done in 1999) estimates that there are approximately 258 fish/mile and 31 lbs/acre in the creek. The population is considered only a fair quality occurrence, however, since there are brown trout and brook trout present in the stream and there are no barriers inhibiting additional incursions into the creek.

Table 10. Natural Heritage element occurrences at South Vallejos Creek PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	G4T3	S3	none	C

*EO=Element Occurrence

Location: From San Luis (Costilla County, Colorado) drive east to Chama, then up Culebra Creek to the north entrance to the "Cielo Vista Ranch." Drive south (with permission) on the ranch's main north-south road to where the road crosses the South Vallejos Creek (~4 miles). In 2004, this creek was well-labeled. The site extends from the confluence of South Vallejos Creek and North Vallejos Creek upstream to the headwaters of South Vallejos Creek. Note that in CNHP records and Colorado Division of Wildlife records, South Vallejos Creek is often referred to as "Vallejos Creek #2." On the USGS 7.5' quad, it is labeled "Vallejos Creek."

U.S.G.S. 7.5-min. quadrangles: La Valley, Culebra Peak
Elevation: 8,680-12,200 ft Approximate Size: 2,245 acres

General Description: South Vallejos Creek supports a genetically pure and historic population of the Rio Grande cutthroat trout (*Oncorhynchus clarki* ssp. *virginalis*). Alves (2004, pers. comm.. to J. Siemers; survey done in 1999) estimates that there are approximately 258 fish/mile and 31 lbs/acre in the creek. The population is considered only a fair quality occurrence, however, since there are both brown and brook trout present and there are no barriers inhibiting additional incursions of non-native fish into the creek.

Boundary Justification: The boundary incorporates an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the Rio Grande cutthroat. The site includes the area that has the most immediate and direct impact on the creek.

The boundary as drawn indicates the minimum area that should be considered for any conservation management plan. The entire watershed above the site also impacts the creek, particularly by contributing runoff to the creek. Although the entire watershed is not within the primary boundary, any activity in the watershed (e.g., logging, road building) should be assessed for its potential impact on the Rio Grande cutthroat.

Protection and Management Comments: Because of current uncertainty about the purity of the cutthroat population in North Vallejos Creek, mixing between North and South Vallejos Creek should be avoided. This could be done by constructing a barrier upstream of the confluence with North Vallejos Creek, most reasonably at the culvert where the main north-south road crosses South Vallejos Creek (in fact, the culvert there is likely already acting as a barrier, but it may need improvement). In the future, if the North Vallejos Creek cutthroat population is found to be genetically pure and if rainbow are eliminated, a barrier could be built at some point below the confluence of the two creeks. Note: John Alves is currently doing genetic tests on tissue from fish from all of the creeks on La Sierra. Results from these tests should be obtained as soon as they are available.

A culvert has blown out on South Vallejos Creek a small distance above the confluence with Rito Agua Azul. If this culvert is restored, it should be done in a manner that does not inhibit fish movement, and so that the crossing does not allow additional sediment flow into the creek. If the road above the former crossing is to be abandoned, it should be assured that the roads higher up in the watershed are stable and not rapidly eroding.

South Vallejos Creek is not particularly amenable to fishing because it is narrow and, in many places, heavily vegetated. It also has a low base flow, around 3 cubic feet per second (Weaver no date). Nonetheless, if fishing is done in South Vallejos Creek, it is recommended that the cutthroat fishery be catch and release. On the other hand, keeping non-native trout should be encouraged to reduce the competition with the cutthroat.

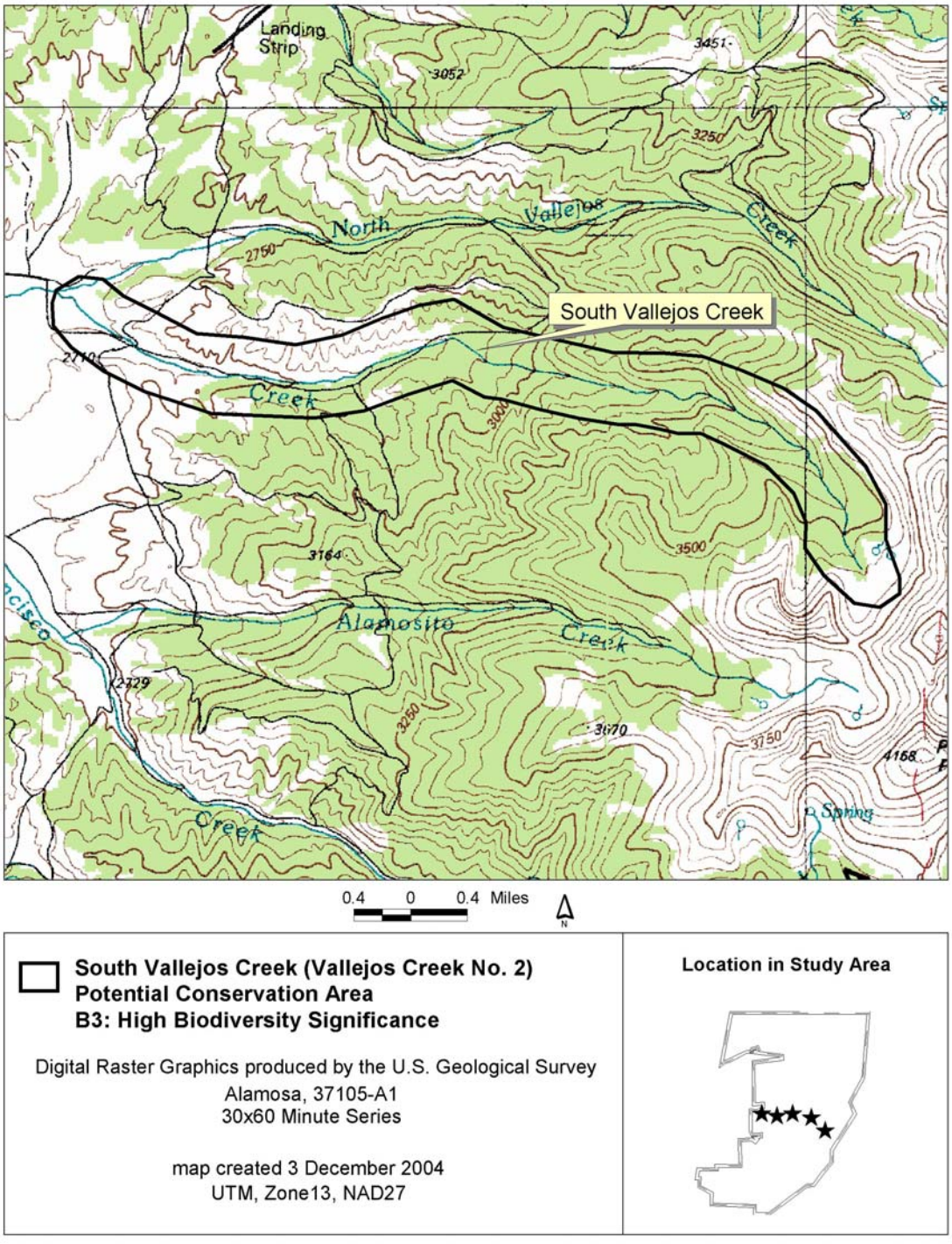

Figure 15. South Vallejos Creek Potential Conservation Area.

B4 Potential Conservation Areas

Culebra Creek Montane Complex

Biodiversity Rank: B4 (Moderate significance)
This site is drawn for a good (B-ranked) and fair (C-ranked) occurrence of a globally vulnerable (G3G4) and possibly state rare or imperiled (S2?) montane grassland (*Muhlenbergia montana*). This site also includes a fair (C-ranked) occurrence of an apparently globally secure (G4) but regionally noteworthy aspen/common juniper forest (*Populus tremuloides* / *Juniperus communis*)

Protection and Management: Aspen forests, and to some extent montane grasslands, are maintained by fire. A fire management regime that supports natural composition and distribution of aspen should be developed. The over-abundance of elk on La Sierra appears to be inhibiting aspen regeneration. Elk numbers should be reduced to levels suggested by the Colorado Division of Wildlife. Roads are common throughout the aspen forest and frequent in the grassland. Roads transport weeds, alter fire regimes, and disrupt animal movement patterns. As many of these roads as possible should be closed, but only after stabilizing areas prone to erosion. Heavy grazing could alter the structure and composition of the montane grasslands. Domestic grazers on these grasslands should be regularly moved and should be maintained in relatively low density. Water resources should not be developed on these grasslands because they would cause overstocking, and that would overly impact the native structure and function of the grasslands.

Biodiversity Rank Justification: This site contains a good (B-ranked) occurrence of a state-rare grassland, and a fair occurrence of a regionally significant aspen forest. The site is noteworthy because this is among the largest examples of this type of forest in the Sangre de Cristo Range, and because of the extensive grasslands. The grasslands—dominated by mountain muhly—are the first and largest examples of this type recorded in the CNHP database for Colorado. The grasslands have few non-native species. The aspen stands have few to no conifers, so they will persist on the landscape much longer than the mixed spruce-fir-aspen forests to the south.

The aspen ecosystem is rich in number and species of animals, especially in comparison to associated coniferous forest types. Aspen forests are important for several species, including the flammulated owl, hairy woodpecker, Williamson's sapsucker, warbling vireo, purple martin, red-naped sapsucker, and long-tailed vole (Neely *et al.* 2001). Most aspen forests are maintained by fire, and the pure stands of aspen on La Sierra show abundant evidence of fire. Less frequent fires in aspen forest have lead to old stands with little regeneration that are more susceptible to diseases and browsing by elk (Knight 1994), and aspen forests have generally declined throughout the Southern Rockies.

Montane grasslands also have a particular suite of species associated with them, including birds and invertebrates. These grasslands are well-used by elk and sheep.

Table 11. Natural Heritage element occurrences at Culebra Creek Montane Complex PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants Communities					
Muhlenbergia montana	Montane grasslands	G3G4	S2?	n/a	B
Muhlenbergia montana	Montane grasslands	G3G4	S2?	n/a	C
Populus tremuloides / Juniperus scopulorum forest	Aspen / common juniper woodlands	G4	S4	n/a	C

*EO=Element Occurrence

Location: This site extends from North Vallejos Creek on the south to the slopes above El Poso Creek on the north. From San Luis drive east to Chama, then up Culebra Creek. The aspen that can be seen from Culebra Creek form much of the site. The grasslands seen from Culebra Creek are also part of the site. The site also extends out of sight, to the north and south.

U.S.G.S. 7.5 minute quadrangles: El Valle Creek, La Valley, Taylor Peak, Trinchera Peak, Ojito Peak
Elevation: 9,000-12,000 ft. Approximate Size: 16,970 acres

General Description: The site is a complex of aspen forest and montane grassland in a larger matrix of spruce-fir forest. The montane landscape is crossed by several streams, some of which pass through steep valleys. A wide range of elevations, slopes, and aspects are represented in this site. The grasslands occur on what appear to be the driest south-facing slopes. The aspen forests are also primarily south-facing, but they cover more aspects, are mostly above the grasslands, and they extend to higher elevations. Few aspen have been cut.

The site has an extensive network of roads that were used to cut large trees in the spruce-fir forest, and nearly all of the spruce-fir stands have been moderately to heavily cut. Despite the logging, this site has great restoration potential and is valuable because it is a large tract of land under single ownership. Also, the site occurs in a region where extensive landscapes have been protected, from the Vermejo Park Ranch on the south through the Great Sand Dunes National Park, the Medano-Zapata Ranch, and US Forest Service land to the north. To the east are the Bar NI Ranch (under conservation easement) and several other large parcels with some level of protection.

Boundary Justification: The site contains the forest and grassland elements of concern plus the matrix forests and the streams that occur between the aspen stands and grasslands. Including some matrix community allows for shifting vegetation and for ecosystem processes, namely fire.

Protection and Management Comments: Roads are present in an extensive network through this site. Roads can allow weed transport, present a barrier to species movement, and alter fire

dynamics (among other effects). Several roads are actively eroding. As many roads as possible should be stabilized and closed as soon as possible.

Though the aspen forests contain abundant evidence of fire, fire has been absent from this landscape for many years. A pro-active fire management plan should be developed for this site (and for the entire property).

Elk herds in the Culebra Range area (Division of Wildlife Data Analysis Unit E-33) are approximately 40% higher than desirable (C. Wagner, CDOW, pers. comm. to J. Sanderson). The over-abundance of elk may be inhibiting aspen regeneration (and it is also inhibiting willow regeneration in small wetland areas in the aspen forest).

Cattle grazing is a compatible use of montane grasslands and aspen forests, but it should be done carefully. Cattle can transport weeds and dramatically alter structure and composition of native species. On these grasslands, herds should be kept below typical densities, and they should be moved regularly. Concentrated herds should not be left in one area for long. An essential characteristic of these grassland ecosystems is their aridity. We discourage the development of water resources for these areas because more water would cause excessive concentration of grazers (both elk and cattle).

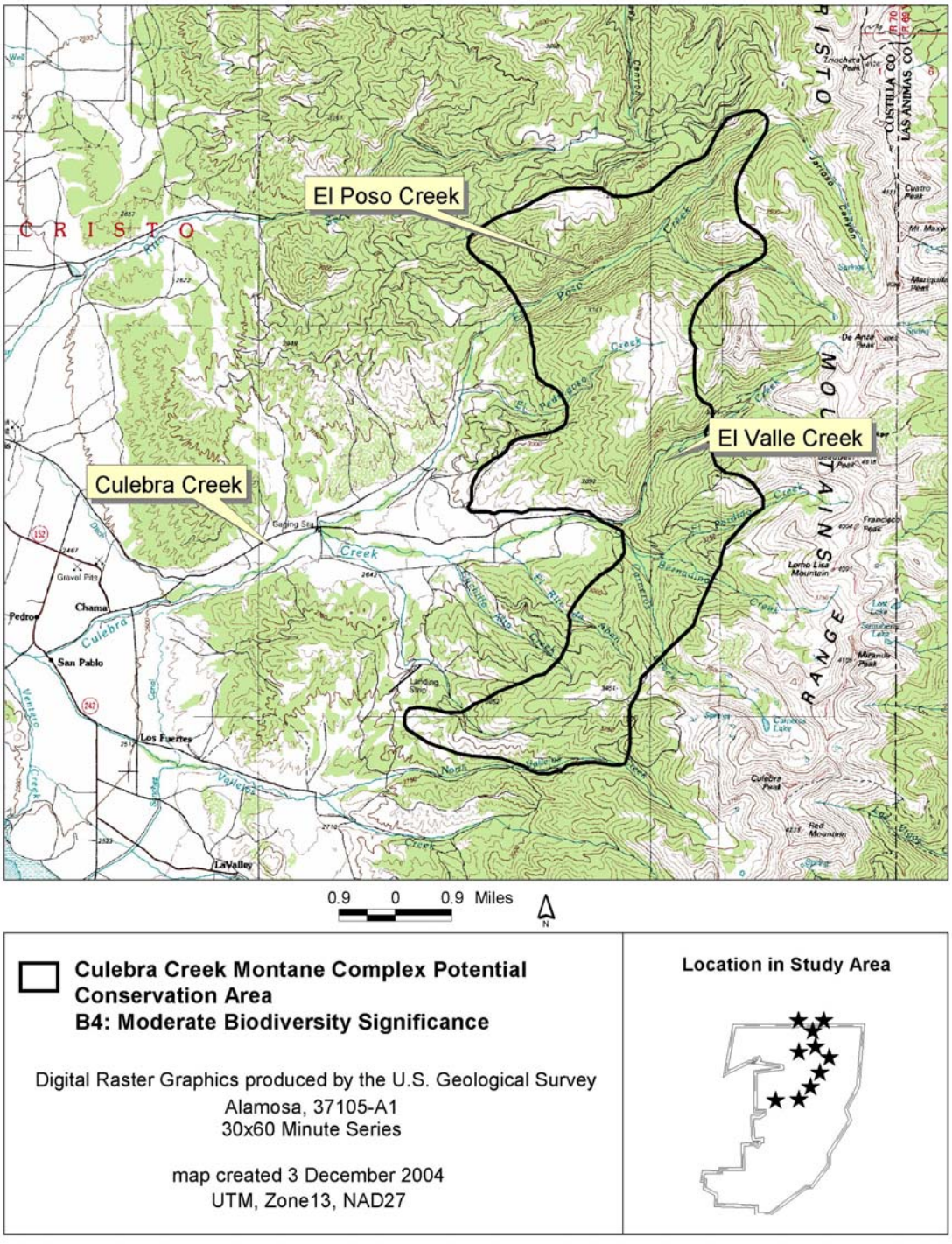

Figure 16. The Culebra Creek Montane Complex Potential Conservation Area.

North Vallejos Creek

Biodiversity Rank: B4 (Moderate significance)
The site supports a fair (C-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. Unlike the other Rio Grande cutthroat sites, this one has a rank of B4 because the fish may not be pure strain cutthroat. Brown trout and rainbow trout may be present.

Protection and Management: The abundance of sediment-rich runoff from the extensive network of logging roads in this watershed is likely impacting the stream and its inhabitants. We recommend that the road network be surveyed for rapidly eroding areas, and that these areas be stabilized immediately. Impacts of roads on streams can be largely avoided by not building new roads within 50 ft of the stream and by using Best Management Practices on all roads. Maintaining a 50 ft buffer along the stream in which domestic cattle are not grazed will help maintain water quality and stream bank structure. Avoiding timber harvests within 0.25 mile of the stream will also help maintain water quality. A barrier should be built to prevent additional incursions of non-natives into the Vallejos Creek system. Eliminating non-natives should be considered.

Biodiversity Rank Justification: The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, this subspecies occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled.

The site supports a fair (C-ranked) occurrence of a globally vulnerable (G4T3/S3) subspecies. The population of Rio Grande cutthroat in North Vallejos Creek is historic and native (i.e., not stocked), but it may not be genetically pure. John Alves from the Colorado Division of Wildlife is currently doing genetic tests to determine the purity ranking of this population. These results should be sought as soon as they are available. Meanwhile, North Vallejos Creek should be isolated from South Vallejos Creek. Also, there are non-native brook trout present in North Vallejos Creek, and there also may be brown trout and rainbow trout.

Table 12. Natural Heritage element occurrences at North Vallejos Creek PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki ssp. *virginalis*	Rio Grande cutthroat trout	G4T3	S3	none	C

*EO=Element Occurrence

Location: From San Luis (Costilla County, Colorado) drive east to Chama, then up Culebra Creek to the north entrance to the "Cielo Vista Ranch." Drive south on the ranch's main north-south road (with permission only) to where the road crosses the North Vallejos Creek (~3.75 miles). The lower end of the site begins a short distance up the creek from this point, and the

upper end of the site is at the headwaters of the creek. Note that in CNHP records and Colorado Division of Wildlife records, North Vallejos Creek is often referred to as "Vallejos Creek."

U.S.G.S. 7.5-min. quadrangles: La Valley, El Valle Creek, Taylor Ranch, Culebra Peak
Elevation: 8,960-12,080 ft Approximate Size: 1,670 acres

General Description: The watershed of North Vallejos Creek is different from the cutthroat streams to the south for a couple of reasons. The vegetation along the creek and on the south side of the creek is similar to those other watersheds. It spans the subalpine to montane zones, and consists largely of mainly spruce-fir then mixed conifer forests with varying amounts of aspen mixed in. However, on the south side of the watershed there are large montane grasslands and relatively pure aspen forests. The Culebra Creek Montane Complex PCA, which includes these montane grasslands and aspen forests, abuts the Vallejos Creek PCA. Also, the upper reaches of Vallejos Creek are very steep and narrow, and they are inaccessible by vehicle. The vegetation in this upper zone is in particularly good condition. The North Vallejos Creek watershed is also different because it is the only watershed with a massive slope failure due to faulty road construction. This slope failure dumped large amounts of sediment into the creek, and it has not yet been adequately stabilized.

North Vallejos Creek supports an historic population of Rio Grande cutthroat that is at risk (1999 survey; there is no barrier, and brook trout and rainbow trout are present; Alves 2004). It is not certain if the cutthroat in North Vallejos Creek are pure strain (Alves 1998, Alves 2004 pers. comm. to J. Sanderson), and there may be rainbow trout in North Vallejos Creek, so mixing between North and South Vallejos Creek should be avoided. The type and condition of vegetation in the North Vallejos Creek watershed, particularly in the upper reaches, suggest this could be a good conservation site, yet for the moment action on North Vallejos Creek is not yet as high of a priority as the creeks to the south (South Vallejos through Cuates) because of questions about genetic purity and the presence of rainbow. In the future, if the North Vallejos Creek cutthroat population is found to be genetically pure and if rainbow are eliminated, a barrier could be built at some point below the confluence of the North Vallejos and South Vallejos Creeks. Note: John Alves is currently doing genetic tests on tissue from fish from all of the creeks on La Sierra. Results from these tests should be obtained as soon as they are available.

There are currently beaver in North Vallejos Creek. Beaver activity (e.g., building dams, harvesting trees) should not be inhibited since they generally contribute to riparian habitat health and diversity. Along North Vallejos Creek beaver may be particularly valuable when their ponds retain sediment that has run off from logging roads. Beaver dams may also be acting as a barrier to additional movement of non-native trout into cutthroat habitat.

Boundary Justification: The boundary incorporates an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the Rio Grande cutthroat. The site includes the area that has the most immediate and direct impact on the creek.

The boundary as drawn indicates the minimum area that should be considered for any conservation management plan. The entire watershed above the site also impacts the creek, particularly by contributing runoff to the creek. Although the entire watershed is not within the primary boundary, any activity in the watershed (e.g., logging, road building) should be assessed for its potential impact on the Rio Grande cutthroat.

Protection and Management Comments: La Sierra is privately owned, and the new owners (as of August 2004) have expressed interest in managing for conservation values. However, rights for local residents to certain resources on La Sierra (related to the original Sangre de Cristo Mexican Land Grant) have been confirmed by the Colorado Supreme Court; the full extent of these is still being defined. Activities of all parties using the land should be reviewed for potential impacts on the Rio Grande cutthroat.

An extensive network of logging roads is contributing excessive amounts of sediment to the streams. Numerous studies have shown that increased surface runoff and decreased slope stability caused by road building and logging increases sediment production and the likelihood of major landslides (e.g., Amaranthus *et al.* 1985, Megahan and Kidd 1972). In fact, a major landslide occurred on North Vallejos Creek as a result of improper road building. Increased sediments in the stream environment reduce dissolved oxygen, raise stream temperature, and can bury or cement spawning beds making reproduction impossible (Cooper 1965). Degradation of habitat from logging, roads or other factors likely also gives non-native trout a competitive advantage over native trout (Behnke 1979, Griffith 1988).

All roads should be maintained according to Best Management Practices for Colorado (Available from the Colorado State Forest Service—see Appendix B for contact information). The entire road network should be surveyed for high erosion areas, and these areas should be treated (water bars, planting with native vegetation, closing the roads) as soon as possible. As many roads as possible should be closed, but it must be insured that they are stable before they are closed. Otherwise, they will continue to dump sediment into the stream. Roads within 50 ft of the stream should be particularly well maintained. The road along North Vallejos Creek just above La Sierra is very close to the stream and should be given special attention to avoid erosion and sediment deposition into the river. Locations where roads cross the creek should be given high priority to ensure they are stable and not eroding excessively.

If the North Vallejos Creek population of cutthroat is found to be pure strain, and if there are no rainbow trout in the Creek, a fish barrier is justified below the confluence with South Vallejos Creek. However, if there are rainbow present, mixing between the North and South Vallejos Creek populations should be avoided.

Future timber harvest, even for thinning or restoration work, should carefully follow Best Management Practices to avoid additional stream degradation. Harvests within the 0.25 mile stream buffer should be minimized. Timber harvest should not occur within 50 feet of the creek.

Cattle grazing should also be avoided within 50 feet of the stream. Cattle can have a very deleterious effect on stream banks (needed for shelter), streambed substrates (needed for spawning), and water quality.

Fishing on North Vallejos Creek should allow unlimited take of non-native brown, brook, and rainbow trout. For the cutthroat, a catch and release policy should be followed.

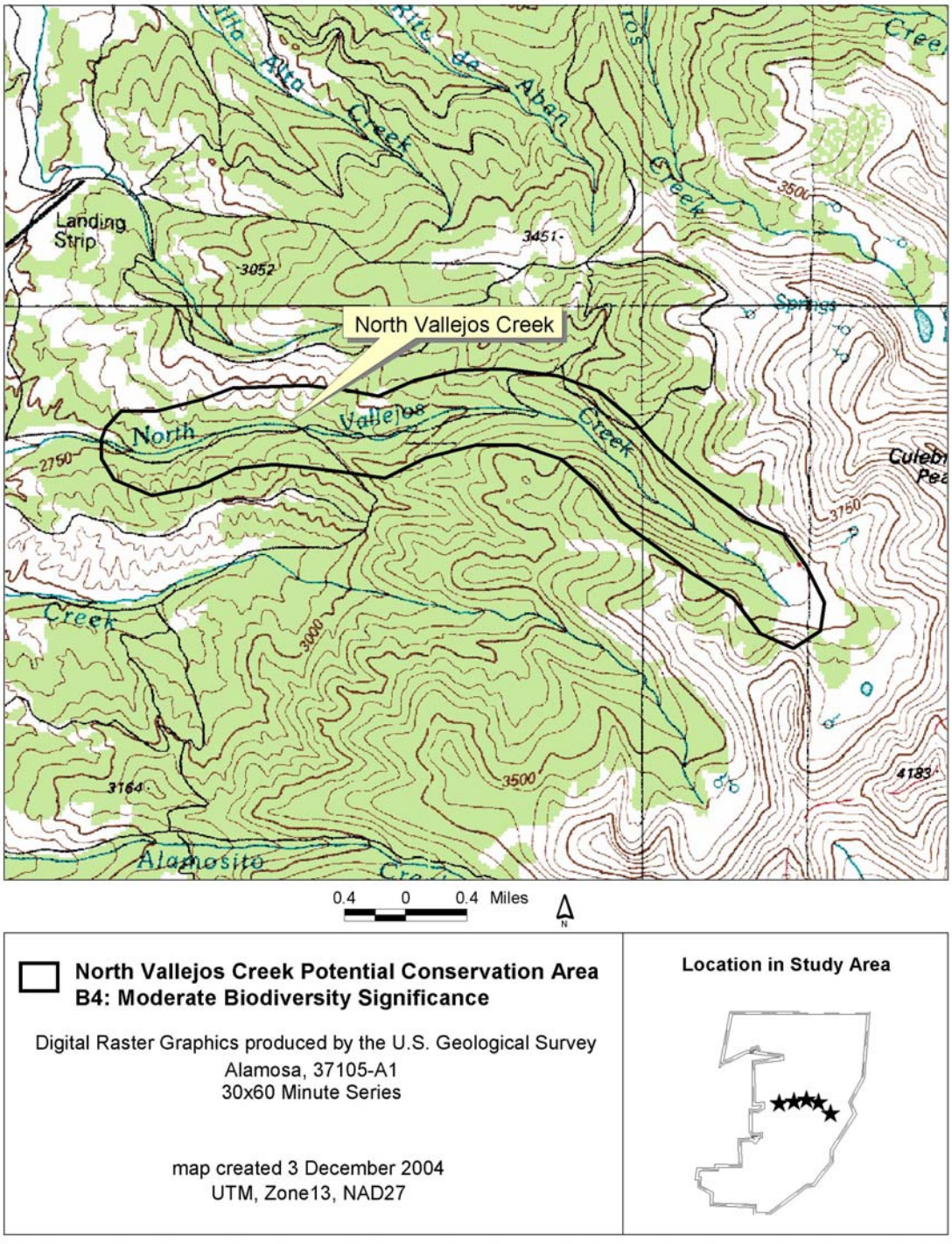

Figure 17. North Vallejos Creek Potential Conservation Area.

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Appendix A. The Natural Heritage Ranking System

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. It also enables conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

Recognizing that rare and imperiled species are more likely to become extinct than common ones, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is scientifically based upon the number of known locations of the species as well as its biology and known threats. By ranking the relative rareness or imperilment of a species, the quality of its populations, and the importance of potential conservation areas, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community began to realize that plant communities are equally important as individual species, this methodology has also been applied to ranking and preserving imperiled plant communities as well as the best examples of common communities.

At its most basic level, the Natural Heritage ranking structure is composed of a three-tiered hierarchy: 1) elements, 2) element occurrences, and 3) Potential Conservation Areas (PCAs). For each tier, there is a ranking system which facilitates comparison among the components of that tier. This system is designed to identify and prioritize land-based (or water-based) conservation opportunities with the ultimate goal of protecting all species by targeting the habitats they need to survive. By operating at different scales, the system is useful for assessing conservation needs from a variety of perspectives.

Elements

In order to conserve biodiversity, it is first necessary to identify which biological components must be actively protected to ensure their long-term survival. Species and subspecies (or other intraspecific categories) are obvious places to start. Lists of species known to occur in the area of interest are assembled because they represent key targets for conservation.

This can be problematic for groups of organisms that are poorly known. In some cases, the majority of species have not yet been discovered by science (e.g., nematodes, mites, or in some remote corners of the world, even some vertebrates). For this reason we are interested not only in species, but also in the systems that support them. We use plant communities as surrogate targets for conservation where detailed species information is lacking, or where the communities themselves have unique qualities. Thus, natural heritage programs maintain lists of plant communities as well. Species, subspecies, and plant communities, then, are the fundamental units of biological diversity which are suitable as targets of conservation and inventory. We refer to these as *elements of natural diversity*, or simply *elements*.

Element Imperilment Ranks

A key feature of Natural Heritage methodology is a ranking system for identifying which elements are more imperiled than others. Recognizing that elements occurring in few places are, in general, more vulnerable to extinction than those occurring in many places, species and natural communities are first evaluated in terms of relative rarity or imperilment. The primary criteria used in this process are estimated number of known locations, number of individuals overall, and size of the range (or abundance of habitat).

Some elements, though, are more vulnerable than others for extrinsic reasons such as loss or degradation of habitat, overcollection, or displacement by exotic species. Species that are common or widely distributed may be imperiled by a variety of factors. To address this, assessments of rarity are modified by information on population trends, threats, and number of locations already protected.

All of these factors – number of locations, number of individuals, range, trends, threats, and number of protected locations – taken together result in the overall *conservation rank (rarity or imperilment)*. Two imperilment ranks are assigned for each element to indicate the level of rarity or imperilment: first across its natural geographic range (the *global rank*); and second within the state or sub-national unit (the *state rank*). Global and state imperilment ranks are presented in Tables 5a and 5b, respectively.

Both ranks are based on a scale of 1-5 as follows:

1 - critically imperiled or extremely rare (generally five or fewer occurrences);
2 - imperiled or very rare (usually six to 20 occurrences);
3 - vulnerable, very rare or found in a restricted range (21-100 occurrences);
4 - common and apparently secure;
5 - demonstrably secure.

Interpreting Imperilment Ranks

Global ranks set the highest conservation priorities, while state ranks are used in discerning state or regional priorities. For example, an element with a rank of G3/S2 should receive higher conservation priority than an element with a rank of G5/S1 because the first element is more vulnerable throughout its range (indicated by its G-rank). Together, the global and state ranks provide an instant picture of an element's relative degree of rarity or imperilment at two scales. For example, the lynx, which is thought to be secure in northern North America but is known from less than 5 current locations in Colorado, is ranked G5S1. A plant known at the rock-loving neoparrya, which is known only from Colorado, from less than 50 locations, is ranked a G3S3. Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1S1.

When ranking migratory elements, it is necessary to distinguish between breeding, non-breeding, and resident populations. A "B" following the state rank (e.g., S1B) indicates that the rank

applies only to the status of breeding occurrences. An "N" following the state rank (e.g., S1N) refers to the nonbreeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Biological information is extremely dynamic and demands a data system that is continually updated. All element ranks are periodically updated as new information is obtained. A complete listing of the Natural Heritage global and state ranks is provided in Tables 5a and 5b. The most updated lists of ranks for Colorado are published annually and made available on the Internet (address: www.cnhp.colostate.edu).

Table 13. Definition of Colorado Natural Heritage Imperilment Ranks.

Global imperilment ranks are based on the range-wide status of a species. State imperilment ranks are based on the status of a species within an individual state. State and Global ranks are denoted, respectively, with an "S" or a "G" followed by a character. **These ranks should not be interpreted as legal designations.**

G1/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
G2/S2	Imperiled globally/state because of rarity (6 to 20 occurrences), or because of other factors making it demonstrably very vulnerable to extinction throughout its range.
G3/S3	Vulnerable through its range/state or found locally in a restricted range (21 to 100 occurrences).
G4/S4	Apparently secure globally/state, though it might be quite rare in parts of its range, especially at the periphery.
G5/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
GX	Presumed extinct.
G#?	Indicates uncertainty about an assigned global rank.
GU/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
GH/SH	Historically known, but not verified for an extended period.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These species or subspecies are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not permanent residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state, but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Notes: Where two numbers appear in a state or global rank (e.g., S2S3), the actual rank of the element falls between the two numbers.
represents rank (1-5)

Natural Heritage ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare or imperiled species receive legal protection (other than the protection provided to all wildlife). Legal status under the federal Endangered Species Act is designated by the U.S. Fish & Wildlife Service (USFWS). Designations of endangered or threatened species under the Colorado Non-game and Endangered or Threatened Species Conservation Act are made by the Colorado Division of Wildlife. In addition, the U. S. Forest Service and the Bureau of Land Management maintain “sensitive species lists” that provide some legal protection on the lands owned or managed by the respective agencies. CNHP provides information to these and other agencies to aid in the identification of priorities for conservation action, including legal protection. However, it is the intention of the Natural Heritage system to identify conservation needs and stimulate conservation action before protection under endangered species laws becomes a necessity.

Table 14. Federal and State Agency Special Designations.

Federal Status:

1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)

LE Endangered; species or subspecies formally listed as endangered.

E(S/A) Endangered due to similarity of appearance with listed species.

LT Threatened; species or subspecies formally listed as threatened.

P Proposed Endangered or Threatened; species or subspecies formally proposed for listing as endangered or threatened.

C Candidate: species or subspecies for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as "S")

FS Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.

b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as "S")

BLM Sensitive: those species found on public lands, designated by a State Director, that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.

State Status:

1. Colorado Division of Wildlife

E Endangered

T Threatened

SC Special Concern

Element Occurrences

Once the most vulnerable elements of natural diversity have been identified and ranked, it is important to document where they are located if conservation activities will be pursued. A discrete location where a species or plant community occurs is recognized as an *element occurrence*. The element occurrence is a fundamental building block for targeted conservation action; it represents a conservation unit.

Element Occurrence Ranks

In order to prioritize element occurrences for a given species, an *element occurrence rank* (EO-Rank) is assigned according to the estimated viability or probability of persistence at that site. These element occurrence ranks help prioritize among occurrences of a particular element so that conservation efforts can be focused on the occurrences with the greatest chance of long-term viability, optimizing chances for conservation success.

The EO-Rank is based on 3 factors:

> **Size** – a quantitative measure of the area and/or abundance of an occurrence such as area of occupancy, population abundance, population density, or population fluctuation.
>
> **Condition** – an integrated measure of the quality of biotic and abiotic factors, structures, and processes within the occurrence, and the degree to which they affect the continued existence of the occurrence. Components may include reproduction and health, development/maturity for communities, ecological processes, species composition and structure, abundance of non-native species, and physical or chemical factors.
>
> **Landscape Context** – an integrated measure of the quality of biotic and abiotic factors, and processes surrounding the occurrence, and the degree to which they affect the continued existence of the occurrence. Components may include landscape structure and extent, genetic connectivity, and condition of the surrounding landscape.

Each of these factors is rated on a scale of A through D, with A representing excellent and D representing poor ratings. These factors are then averaged to determine an appropriate EO-Rank for the occurrence. If there is insufficient information available to rank an element occurrence, an EO-Rank is not assigned. Possible EO-Ranks and their appropriate definitions are as follows:

A Excellent estimated viability.
B Good estimated viability.
C Fair estimated viability.
D Poor estimated viability.
E Viability has not been assessed but the element is presumed extant.
F Failed to find
H Historically known, but not verified for an extended period of time.
X Extirpated

Potential Conservation Areas

As stated previously, the element occurrence is the fundamental conservation unit. But to accomplish conservation, we must protect the lands and waters that elements need to persist. The occurrence represents the location of a species or natural community, but ecological processes and patterns support the occurrence. To conserve an occurrence then, it is necessary to focus attention on the land area that supports those ecological processes and patterns. We call such an area a *Potential Conservation Area.* Potential Conservation Areas (PCAs) may be designed to encompass suites of species co-occurring in an ecologically connected landscape. In this way, conservation efforts that protect a site are actually protecting an ecological system containing the targeted elements, not merely an occurrence of a single element.

After the identification of PCAs, some method for prioritization is needed. *Biodiversity significance ranks* are generated primarily from the imperilment of the element(s) contained within the boundaries (i.e., the global and state imperilment ranks), and then modified by the quality of the occurrences (i.e., the element occurrence rank). Biodiversity significance ranks

indicate relative significance of the loss should a particular PCA be destroyed or irretrievably degraded. For example, loss of a PCA that contains the only known example of a species or natural community could result in extinction. It would therefore be assigned the highest priority rank (e.g., B1). Another PCA may contain an occurrence of a globally common species that occurs at the margin of its range just inside the state boundary. The loss of such a PCA should be avoided, but conservation practitioners would still be left with many additional sites for the protection of that species, and so the PCA is ranked as a much lower biological priority.

Biodiversity Significance Ranks are based on an inverse scale of 1-5 as outlined below. PCA characteristics, which justify the rank, include, but are not limited to, those listed.

B1 – **Outstanding Significance.** The only known occurrence of any element, the highest quality occurrence of any G1 element, or a concentration of A- or B-ranked G1 or G2 elements.

B2 – **Very High Significance.** One of the only outstanding occurrences of any plant community, lower quality occurrences of any G1 element, good occurrences of a G2 element, excellent occurrences of a G3 element.

B3 – **High Significance.** Lower quality occurrences of a G2 element, good occurrences of a G3 element, excellent occurrence of any plant community.

B4 – **Moderate Significance.** Lower quality occurrences of a G3 element, good occurrences of any plant community, high quality or only known occurrence of a globally common S1 element, excellent occurrence of a globally common S2 element.

B5 – General or Local Conservation Interest

Appendix B: Contacts and Resources

General

Land Rights Council
Arnold Valdez, Project Director/Planner
P.O. Box 57
401 West Church Place
San Luis, Colorado 81152
tel. 719-672-1019
fax 719-672-1049
landright@earthlink.net

Cielo Vista Ranch
Mr. Bobby Hill, Co-owner
4900 County Rd. 7
Weston, CO 81091
tel. 254-897-7881

Cielo Vista Ranch
Mr. Richard Welch, Co-owner
P.O. Box 7
Chama, CO 81126-0070
(719) 206-2835

Fish and Wildlife

Chuck Wagner (Elk, sheep, and other wildlife)
Colorado Division of Wildlife
Alamosa, CO
719-587-6905

John Alves (Rio Grand cutthroat)
Colorado Division of Wildlife
Alamosa, CO
719-587-6907
john.alves@state.co.us

Scott Miller
US Fish & Wildlife Service
Monte Vista, CO
719-852-0128

Jim Baker/Scott Chase

Vermejo Park Ranch
505-445-3097

Forest and Fire Management

Colorado State Forest Office
Alamosa, CO
719-589-2271
www.colostate.edu/Depts/CSFS/
BMPs for Colorado can be requested at: csfs@lamar.colostate.edu

Fire Range Condition Class (descriptions of historic fire regimes, modeling tools, and more)
www.frcc.gov

Ryan Boggs (works in the Upper Purgatoire watershed)
The Nature Conservancy
(719) 742-5752
rboggs@tnc.org

Ernst Strenge (developed fire portion of Environmental Assessment for Great Sand Dunes National Park and Preserve and the The Nature Conservancy's Medano/Zapata Ranch)
(719) 378-2356 x12
ernststrenge@hotmail.com

Rich Larsen/Scott Chase
Vermejo Park Ranch
505-445-3097

Re-vegetating with Native Plants

Colorado Natural Areas Program (Native Plant Re-vegetation Guide for Colorado)
1313 Sherman St., Room 618
Denver, CO 80203
303-894-2580
rob.billerbeck@state.co.us
parks.state.co.us

Colorado Native Plant Society (list of native seed suppliers)
P.O. Box 200
Fort Collins, Colorado 80522
http://carbon.cudenver.edu/~shill/conps.html

Rocky Mountain
Native Plants Company

3780 Silt Mesa Road
Rifle CO. 81650
Phone (970)625-GROW (4769)
Fax (970)625-FARM (3276)
E-Mail: native@rmnativeplants.com

Western Native Seed
P.O. Box 188, Coaldale, CO 81222
(719) 942-3935
info@westernnativeseed.com

Weeds

Costilla County Extension Office
San Luis, CO
719-672-3663

Eric Lane
Colorado Department of Agriculture
Noxious Weed Program
700 Kipling Street, Suite 4000
Lakewood, CO 80215-8000
303-239-4182
www.ag.state.co.us

The noxious weed list and rules are available at:
http://www.ag.state.co.us/DPI/weeds/statutes/weedrules.pdf

Management of Alpine Areas

John Giordanengo
Restoration Manager
Colorado Fourteeners Initiative
710 10th St., Suite 220
Golden, CO 80401
303.996.2760
john@14ers.org
www.14ers.org

Riparian Area Management

Karma Anderson

District Conservationist
Natural Resources Conservation Service
121 Main Street
San Luis, Colorado 81152
719-672-3673

General Botany

Colorado Flora: Eastern Slope, Third Edition
by William A. Weber, Ronald C. Wittman
University Press of Colorado
(this is the definitive guide to Colorado's plants, but it requires some technical knowledge)

Illustrated Keys to the Grasses of Colorado
by Janet Wingate
Wingate Consulting
(a very useful and comprehensive key to Colorado's grasses)

Flora of the San Juans: A Field to the Mountain Plants of Southwestern Colorado
by Susan Komarek
Kivak I Press
(a relatively easy to use guide to common plants of Southern Colorado)

Colorado Native Plant Society (general information on botany, plus a source of plant references for Colrado)
P.O. Box 200
Fort Collins, Colorado 80522
http://carbon.cudenver.edu/~shill/conps.html