BACA GRANDE BIOLOGICAL ASSESSMENT 2005

Natural Heritage Program
COLORADO

Colorado State University
Knowledge to Go Places

Prepared for:
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Cover photograph: Emergent wetland within the Baca Grande (*photo by John Sovell*)

EXECUTIVE SUMMARY

The 14,000 acres (5,665 ha) Baca Grande or "Baca" is located at the northeastern edge of the San Luis Valley up against the Sangre de Cristo Mountains, and is bordered by the Baca National Wildlife Reserve to the west, the Great Sand Dunes National Park to the south, national forest to the east, and private property to the north. This private residential development is under the oversight of the Baca Grande Property Owners Association (POA). The Crestone community desires that the Baca be developed in an environmentally friendly manner and to this end the POA and the Crestone Baca Land Trust, operating since 2001, have been working to establish conservation easements on selected parcels and to encourage property owners to consolidate lots, in order to reduce the density of residences within the Baca development.

To assist the Crestone community with its desire for environmental stewardship, the Colorado Natural Heritage Program (CNHP) was contracted by the Crestone Baca Land Trust to perform a biological assessment of the Baca. The purpose of this assessment is to identify important biological resources and assist the Land Trust with identifying focal areas for conservation action, and to offer recommendations on development that will benefit preservation of the Baca's biological resources.

The methods for assessing and prioritizing conservation needs over an area the size of the Baca are necessarily diverse. The Colorado Natural Heritage Program follows a general method that is continuously being developed specifically for this purpose. The Natural Heritage Inventory described in this report was conducted in the following several steps: all available and pre-existing information was collected at the outset of the project; a list of the rare, imperiled, and vulnerable animals and plant communities with potential to occur on the Baca was created; the entire area was searched for the target species, and sub-areas were identified for increased survey effort based on their likelihood of harboring rare or imperiled species. Additionally, input from representatives of the Land Trust and long-term residents of the Baca were incorporated into the inventory process.

During summer 2005, most every area of the Baca was visited once, and in some cases multiple times, to search for rare animals and record the type and condition of plant communities of concern present on the Baca. Survey sites were visited at the appropriate time as dictated by the seasonal occurrence (or phenology) of the individual animal species. It was essential that surveys took place during a time when the targeted animals were detectable.

The results of the Baca survey confirm that there are numerous animal species and one plant community of conservation priority within the Baca. Several uncommon and even rare species of animals (5 in all) inhabit the Baca. In all, 45 different animal species were recorded from the Baca. Other species of interest on the Baca include elk and pronghorn, which are still wide-ranging and common, but are considered important for aesthetic reasons.

We have delineated five potential conservation areas and one site of local significance on the Baca where conservation is a desirable priority (Figure 8). These areas include the riparian corridor at intermediate elevations along all four creeks passing through the Baca, which support occurrences of the vulnerable narrowleaf cottonwood and Rocky Mountain juniper Woodland plant community. Future residential development, road construction, and recreational activities in and near these occurrences run the risk of compromising the health of these unique woodlands, which are currently in fair to good condition. These riparian woodlands sustain a wealth of biological diversity including a diverse community of riparian woodland birds, which indicates that the riparian hydrology is intact and functioning. Maintaining the natural hydrology will be difficult in the face of the development occurring in the Baca, but is important if health of the riparian corridor and riparian dependent species are to be maintained. Development of the water resource potential of the Baca to meet an expanding human population will make this difficult, but not impossible. Conservation of these riparian communities is an important management priority and should be a component of any future activities on the Baca. Also included are lands supporting a population of the vulnerable *agrestis* subspecies of the northern pocket gopher, which is concentrated along the riparian corridors at lower elevation. Conservation of this population of gophers is also a management priority and should also be a component of any future activities on the Baca. Finally, there is one area that includes a wetland, which supports a diverse number of aquatic dependent animals. Protecting this wetland from future disturbance will benefit these wetland dependent animals and enhance the character of the Baca for current and future residents. In general, the lands delineated by these six areas are in fair to good condition with their natural hydrology still intact, and their plant communities are supporting an abundance of wildlife, including species of conservation priority.

Elk and pronghorn also occupy the Baca and their continued viability will require maintaining corridors of connectivity between the Baca and public lands to the east, west, and south. Large open areas must also be left undisturbed within the Baca to provide areas for the pronghorn and elk to browse and graze.

Management activities that will benefit the riparian corridor include maintenance of the natural hydrology, prevention of residential development and the placement of septic systems near streambeds, and implementation of an integrated weed management plan. Appropriate planning for residential development to avoid loss of vegetation within and near the riparian corridor and to prevent nutrient enrichment of the creeks from septic systems and residential gardens and lawns would benefit health of the riparian communities within the Baca. Currently, weeds are a moderate problem and an integrated weed management strategy should be implemented to control weeds, which have the potential to increase as increased residential development and human activity provides the opportunity for their introduction. Information in this report will help in determining the appropriate placement of areas designated for conservation action versus those more appropriate for developed activities, which should allow for realization of both the economic and ecological potential of the Baca. Realization of either one to the complete exclusion of the other would probably prove detrimental to the greater area, and can hopefully be avoided.

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INTRODUCTION

The Baca Grande, or "Baca", is a private residential development of approximately 14,000 acres (5,665 ha) near the northeast end of the San Luis Valley south of Crestone, Colorado. The subdivision is situated at the edge of the valley in the foothills of the Sangre de Cristo Mountains. The property is under multiple ownerships and its development is under the oversight of the Baca Grande Property Owners Association (POA). In the early years of the development there were approximately 10,000 lots within an area larger than the developments current size, but the original development, because of its isolated location, was failing financially. A reorganization in 1971 created its current boundary, which includes 5,500 lots covering of 14,000 acres, or 2.5 acres/lot (1 ha/lot) on average, of which about 15 percent have been developed. On lands adjacent to the Baca subdivision there are many spiritual and educational organizations that have benefited through land grants from the Manitou Foundation. The Manitou Foundation is a non-profit organization that owns pockets of property in and around the Baca. Their mission is to preserve wildlife and the natural environment; develop and support programs for youth and adults, which promote environmental awareness, earth stewardship and sustainability; and to advocate and support the preservation, teaching and practice of the world's wisdom traditions, sacred arts, ancient healing and medicinal sciences. Activities of the Manitou Foundation have created a climate of environmental stewardship in the area that is unique to such a small mountain community like Crestone. This has fostered a desire in the community's residents for an environmentally friendly development on the Baca. To this end about 4,000 acres (1,620 ha) of the subdivision has been designated as greenbelts, parks, and riding trails. In addition, the Crestone/Baca Land Trust, operating since 2001, has been working to establish conservation easements on selected parcels within the subdivision, and is currently focusing efforts on the riparian areas of Spanish and Cottonwood creeks, and their associated wetlands. One of the Land Trusts goals is to encourage property owners in the region to consolidate lots or to place conservation easements on their property to reduce density in the Baca subdivision.

Disturbances to the ecology integrity of the creeks flowing through the Baca will have indirect effects on the integrity of downstream wetlands in the Baca National Wildlife Reserve (NWF). The waters of all four creeks bisecting the Baca east to west (South Crestone, Willow, Spanish, and Cottonwood) recharge the wetlands of the Baca NWF, which borders the Baca on its western boundary. The health, integrity, and water quality of the reserve's wetlands are dependent upon the sum of activities that occur along all four creeks from their source, high in the peaks of the Sangre de Cristo Mountains, to there terminus on the reserve.

To assist the Crestone community with its desire for environmental stewardship, the Colorado Natural Heritage Program (CNHP) was contracted by the Crestone Baca Land Trust to perform a biological assessment of the Baca. The purpose of this assessment is to identify important biological resources and assist the Land Trust with identifying focal areas for conservation action, and to offer recommendations on development that will benefit preservation of the Baca's natural resources.

Natural Heritage Network Ranking System

Just as ancient artifacts and historic buildings represent our cultural heritage, a diversity of plant and animal species and their habitats represent our "natural heritage." Colorado's natural heritage encompasses a wide variety of ecosystems from tallgrass prairie and shortgrass high plains to alpine cirques and rugged peaks, from canyon lands and sagebrush deserts to dense subalpine spruce-fir forests and wide-open tundra.

These widely diversified habitats are determined by water availability, temperature extremes, altitude, geologic history, and land use history. The species that inhabit each of these ecosystems have adapted to the specific set of conditions found there. Because human influence today touches every part of the Colorado environment, we are responsible for understanding our impacts and carefully planning our actions to ensure our natural heritage persists for future generations.

Some generalist species, like house finches, have flourished over the last century, having adapted to habitats altered by humans. However, many other species are specialized to survive in vulnerable Colorado habitats; among them are Bell's twinpod (a wildflower), the greenback cutthroat trout, and the Pawnee montane skipper (a butterfly). These species have special requirements for survival that may be threatened by incompatible land management practices and competition from non-native species. Many of these species have become imperiled not only in Colorado, but also throughout their range of distribution. Some species exist in less than five populations in the entire world. The decline of these specialized species often indicates disruptions that could permanently alter entire ecosystems. Thus, recognition and protection of rare and imperiled species is crucial to preserving Colorado's diverse natural heritage.

Colorado is inhabited by some 800 vertebrate species and subspecies, and tens of thousands of invertebrate species. In addition, the state has approximately 4,300 species of plants and more than 450 recognized plant communities that represent terrestrial and wetland ecosystems. It is this rich natural heritage that has provided the basis for Colorado's diverse economy. Some components of this heritage have always been rare, while others have become imperiled with human-induced changes in the landscape. This decline in biological diversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that Wilson (1988) has compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

The need to address this loss in biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biological diversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, scientifically based approach to preserving biological diversity, Dr. Robert Jenkins of The Nature Conservancy pioneered the Natural Heritage Methodology in the early 1970s.

Recognizing that rare and imperiled species are more likely to become extinct than common species, 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 rarity or imperilment of a species, the quality of its populations, and the importance of associated conservation sites, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community realized that plant communities are equally important as individual species, this methodology has been applied to ranking and preserving rare plant communities, as well as the best examples of common communities.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. NatureServe, the umbrella organization of this international network, and its member programs are a leading source for information about rare and endangered species and threatened ecosystems. The 85 Natural Heritage Network data centers are located in each of the 50 U.S. states, 11 Canadian provinces and territories, and many countries and territories in Latin America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable conservationists and biological resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity?

Protecting biological diversity has become an important management issue for many biological resource professionals. Biological diversity at its most basic level includes the full range of species on Earth, from single-celled organisms such as bacteria and protists through the multicellular kingdoms of plants and animals. At finer levels of organization, biological diversity includes the genetic variation within species, both among geographically separated populations and among individuals within a single population. On a wider scale, diversity includes variations in the biological communities in which species live, the ecosystems in which communities exist, and the interactions between these levels. All levels are necessary for the continued survival of species and plant communities, and many are important for the well being of humans.

The biological diversity of an area can be described at four levels:

Genetic Diversity — the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species varies between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. Once lost, this unique genetic information cannot be reclaimed.

Species Diversity — the total number and abundance of plant and animal species and subspecies in an area.

Community Diversity — the variety of plant communities within an area that represent the range of species relationships and inter-dependence. These communities may be diagnostic of or even restricted to an area.

Landscape Diversity — the type, condition, pattern, and connectedness of plant communities. A landscape consisting of a mosaic of plant communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of plant communities all result in a loss of biological diversity for a region.

The conservation of biological diversity should include all levels of diversity: genetic, species, community, and landscape. Each level is dependent on the other levels and inextricably linked. In addition, and all too often omitted, humans and the results of their activities are also closely linked to all levels of this hierarchy and are integral parts of most landscapes. We at the Colorado Natural Heritage Program believe that a healthy natural environment and a healthy human environment go hand in hand, and that recognition of the most imperiled species is an important step in comprehensive conservation planning.

Colorado's Natural Heritage Program

To place this document in context, it is useful to understand the history and functions of the Colorado Natural Heritage Program (CNHP).

CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in the Colorado Division of Parks and Outdoor Recreation for 14 years, the Program was relocated to the University of Colorado Museum in 1992, and then to the College of Natural Resources (since 2005 the Warner College of Natural Resources) at Colorado State University in 1994, where it has operated since.

The multi-disciplinary team of scientists, planners, and information managers at CNHP gathers comprehensive information on the rare, threatened, and endangered species and significant plant communities of Colorado. Life history, status, and location data are incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists.

All Natural Heritage Programs house data about imperiled species and are implementing use of the Biodiversity Tracking and Conservation System (BIOTICS) developed by NatureServe. This database includes taxonomic group, global and state rarity ranks, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. BIOTICS also has an ArcView based mapping program for digitizing and mapping occurrences of rare plants, animals, and plant

communities. These rare species and plant communities are referred to as "elements of biological diversity" or simply "elements."

Concentrating on site-specific data for each element enables CNHP to evaluate the significance of each location for the conservation of biological diversity in Colorado and in the nation. By using species imperilment ranks and quality ratings for each location, priorities can be established to guide conservation action. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-planning tool.

To assist in biological diversity conservation efforts, CNHP scientists strive to answer questions like the following:

- What species and ecological communities exist in the area of interest?
- Which are at greatest risk of extinction or are otherwise significant from a conservation perspective?
- What are their biological and ecological characteristics, and where are these priority species or communities found?
- What is the species' condition at these locations, and what processes or activities are sustaining or threatening them?
- Where are the most important sites to protect?
- Who owns or manages those places deemed most important to protect, and what may be threatening the biodiversity at those places?
- What actions are needed for the protection of those sites and the significant elements of biological diversity they contain?
- How can we measure our progress toward conservation goals?

CNHP has effective working relationships with several state and federal agencies, including the Colorado Department of Natural Resources, the Colorado Division of Wildlife, the Bureau of Land Management, and the U.S. Forest Service. Numerous local governments and private entities, such as consulting firms, educators, landowners, county commissioners, and non-profit organizations, also work closely with CNHP. Use of the data by many different individuals and organizations encourages a cooperative and proactive approach to conservation, thereby reducing the potential for conflict.

The Natural Heritage Ranking System

Key to the functioning of Natural Heritage Programs is the concept of setting priorities for gathering information and conducting inventories. The number of possible facts and

observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Because biological inventories tend to be under-funded, there is a premium on devising systems that are both effective in providing information that meets users' needs and efficient in gathering that information. The cornerstone of Natural Heritage inventories is the use of a ranking system to achieve these twin objectives of effectiveness and efficiency.

Ranking species and ecological communities according to their imperilment status provides guidance for where Natural Heritage Programs should focus their information-gathering activities. For species deemed secure, only general information needs to be maintained by Natural Heritage Programs. Fortunately, the more common and secure species constitute the majority of most groups of organisms. On the other hand, for those species that are by their nature rare, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant communities. Each of these elements of biological diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than five current locations in Colorado, is ranked G5 S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1 S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table A-1.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table A-1, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Table 1. Definition of Natural Heritage imperilment ranks.

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G/S#?	Indicates uncertainty about an assigned global or state rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
G/SNR	Not yet ranked.
S#B	Refers to the breeding season imperilment of elements that are not residents.
S#N	Refers to the migratory or winter season imperilment of elements that are not residents.
SNA	Not Applicable. A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
SZN	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

Legal Designations for Rare Species

Natural Heritage imperilment 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 species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as "Sensitive," as does the Bureau of Land Management. Table A-2 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Table 2. Federal and State agency special designations for rare species.

Federal Status:	
1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)	
LE	Listed Endangered: defined as a species, subspecies, or variety in danger of extinction throughout all or a significant portion of its range.
LT	Listed Threatened: defined as a species, subspecies, or variety likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P	Proposed: taxa formally proposed for listing as Endangered or Threatened (a proposal has been published in the Federal Register, but not a final rule).
C	Candidate: taxa for which substantial biological information exists on file to support proposals to list them as endangered or threatened, but no proposal has been published yet in the Federal Register.
PDL	Proposed for delisting.
XN	Nonessential experimental population.
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: Significant current or predicted downward trends in population numbers or density. 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.
4. State Status:	
The Colorado Division of Wildlife has developed categories of imperilment for non-game species (refer to the Colorado Division of Wildlife's Chapter 10 – Nongame Wildlife of the Wildlife Commission's regulations). The categories being used and the associated CNHP codes are provided below.	
E	Endangered: those species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy, as determined by the Commission.
T	Threatened: those species or subspecies of native wildlife which, as determined by the Commission, are not in immediate jeopardy of extinction but are vulnerable because they exist in such small numbers, are so extremely restricted in their range, or are experiencing such low recruitment or survival that they may become extinct.
SC	Special Concern: those species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing "candidate species") and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

Element Occurrences and their Ranking

Actual locations of elements, whether they are single organisms, populations, or plant communities, are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. To prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the ecological quality of the occurrences whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on three factors:

Size – a measure of the area or abundance of the element's occurrence. Takes into account factors such as area of occupancy, population abundance, population density, population fluctuation, and minimum dynamic area (which is the area needed to ensure survival or re-establishment of an element after natural disturbance). This factor for an occurrence is evaluated relative to other known, and/or presumed viable, examples.

Condition/Quality – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes measures such as reproduction, age structure, biological composition (such as the presence of exotic versus native species), structure (for example, canopy, understory, and ground cover in a forest community), and biotic interactions (such as levels of competition, predation, and disease).

Landscape Context – an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the element, and connectivity. Dominant environmental regimes and processes include herbivory, hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbances. Connectivity includes such factors as a species having access to habitats and resources needed for life cycle completion, fragmentation of ecological communities and systems, and the ability of the species to respond to environmental change through dispersal, migration, or re-colonization.

Each of these factors is rated on a scale of A through D, with A representing an excellent rank and D representing a poor rank. These ranks for each factor are then averaged to determine an appropriate EO-Rank for the occurrence. If not enough information is available to rank an element occurrence, an EO-Rank of E (for extant) is assigned. EO-Ranks and their definitions are summarized in Table A-3.

Table 3. Element occurrence ranks and their definitions.

A	Excellent viability.
B	Good viability
C	Fair viability.
D	Poor viability.
H	Historic: known from historical record, but not verified for an extended period of time.
X	Extirpated: extinct within the state.
E	Extant: the occurrence does exist but not enough information is available to rank.
F	Failed to find: the occurrence could not be relocated.

Potential Conservation Areas and Sites of Local Significance

In order to successfully protect populations or occurrences, it is helpful to delineate Potential Conservation Areas (PCAs) or Sites of Local Significance (SLS). The PCAs and SLSs focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence of natural heritage significance. Potential Conservation Areas may include a single occurrence of a rare element, or a suite of rare element occurrences or significant features.

Potential Conservation Areas

The PCA is designed to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features; vegetative cover; and current and potential land uses. In developing the boundaries of a PCA, CNHP scientists consider a number of factors that include, but are not limited to:

- ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the PCA and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. The proposed boundary does not automatically recommend exclusion of all activity. Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the PCA or SLS affect the natural heritage resources and sensitive species on which the PCA or SLS is based. Please note that these boundaries are based on our best estimate of the primary area supporting the long-term survival of targeted species and plant communities. A thorough analysis of the human context and potential stresses has not been conducted. However, CNHP's conservation planning staff is available to assist with these types of analyses where conservation priority and local interest warrant additional research.

Off-Site Considerations

Frequently, all necessary ecological processes cannot be contained within a PCA or SLS of reasonable size. For example, taken to the extreme, the threat of ozone depletion could expand every PCA or SLS to include the entire planet. The boundaries described in this report indicate the immediate, and therefore most important, area to be considered for protection. Continued landscape level conservation efforts that may extend far beyond PCA and SLS boundaries are necessary as well. This will involve regional efforts in addition to

coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Potential Conservation Areas (Biological Diversity Rank)

CNHP uses element and element occurrence ranks to assess the overall biological diversity significance of a PCA, which may include one or many element occurrences. Based on these ranks, each PCA is assigned a biological diversity rank (or B-rank). See Table A-4 for a summary of these B-ranks. The SLSs are not assigned biological diversity ranks.

Table 4. Natural Heritage Program biological diversity ranks and their definitions.

B1	Outstanding Significance (indispensable): only known occurrence of an element A-ranked occurrence of a G1 element (or at least C-ranked if best available occurrence) concentration of A- or B-ranked occurrences of G1 or G2 elements (four or more G1 or G2 elements)
B2	Very High Significance: B- or C-ranked occurrence of a G1 element A- or B-ranked occurrence of a G2 element One of the most outstanding (for example, among the five best) occurrences range wide (at least A- or B-ranked) of a G3 element. Concentration of A- or B-ranked G3 elements (four or more) Concentration of C-ranked G2 elements (four or more)
B3	High Significance: C-ranked occurrence of a G2 element A- or B-ranked occurrence of a G3 element D-ranked occurrence of a G1 element (if best available occurrence) Up to five of the best occurrences of a G4 or G5 community (at least A- or B-ranked) in an ecoregion (requires consultation with other experts)
B4	Moderate Significance: Other A- or B-ranked occurrences of a G4 or G5 community C-ranked occurrence of a G3 element A- or B-ranked occurrence of a G4 or G5 S1 species (or at least C-ranked if it is the only state, provincial, national, or ecoregional occurrence) Concentration of A- or B-ranked occurrences of G4 or G5 N1-N2, S1-S2 elements (four or more) D-ranked occurrence of a G2 element At least C-ranked occurrence of a disjunct G4 or G5 element Concentration of excellent or good occurrences (A- or B-ranked) of G4 S1 or G5 S1 elements (four or more)
B5	General or State-wide Biological Diversity Significance: good or marginal occurrence of common community types and globally secure S1 or S2 species.

Protection Urgency Rank

Protection urgency ranks (P-ranks) refer to the timeframe in which it is recommended that conservation protection occur. In most cases, this rank refers to the need for a major change of protective status (for example agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to protect the area. Table A-5 summarizes the P-ranks and their definitions.

Table 5. Natural Heritage Program protection urgency ranks and their definitions.

P1	Protection actions needed immediately. It is estimated that current stresses may reduce the viability of the elements in the PCA within 1 year.
P2	Protection actions may be needed within 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA within this approximate timeframe.
P3	Protection actions may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.
P4	No protection actions are needed in the foreseeable future.
P5	Land protection is complete and no protection actions are needed.

A protection action involves increasing the current level of protection accorded one or more tracts within a potential conservation area. It may also include activities such as educational or public relations campaigns, or collaborative planning efforts with public or private entities, to minimize adverse impacts to element occurrences at a site. It does not include management actions. Situations that may require a protection action may include the following

- Forces that threaten the existence of one or more element occurrences at a PCA. For example, development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence; or timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;

- The inability to undertake a management action in the absence of a protection action; for example, obtaining a management agreement;

- In extraordinary circumstances, a prospective change in ownership or management that will make future protection actions more difficult.

Management Urgency Rank

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the PCA. This rank refers to the need for management in contrast to protection (for example, increased fire frequency, decreased grazing, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, re-routing trails, patrolling for collectors, hunters, or trespassers, etc.). Management action does not include

legal, political, or administrative measures taken to protect a potential conservation area. Table A-6 summarizes M-ranks and their definitions.

Table 6. Natural Heritage Program management urgency ranks and their definitions.

M1	Management actions may be required within one year or the element occurrences could be lost or irretrievably degraded.
M2	New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA.
M3	New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA.
M4	Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.
M5	No management needs are known or anticipated in the PCA.

The PCA Profile

The following information is summarized for each Potential Conservation Area.

Biodiversity Rank (B-rank): The overall significance of the PCA in terms of rarity of the Natural Heritage resources and the quality (condition, abundance, etc.) of the occurrences. Please see Table A-4, for rating criteria for the biodiversity ranks.

Protection Urgency Rank (P-rank): An estimate of the timeframe in which conservation protection should occur. This rank generally refers to the need for a major change of protective status (e.g., ownership or designation as a natural area). Please see Table A-5, for the definitions of the ranks.

Management Urgency Rank (M-rank): An estimate of the timeframe in which conservation management should occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (legal, political, or administrative measures). See Table A-6, for the definitions of the ranks.

Location: General location and specific road/trail directions.

Legal Description: U.S.G.S. 7.5-minute quadrangle name and Township, Range, and Section(s) if applicable.

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

Biodiversity Comments: A synopsis of the rare species and significant plant communities that occur in the PCA. A table within the PCA profile lists the element occurrences found within the PCA, their rarity ranks, the occurrence ranks, federal and state agency designations, and the last observation date. See Table A-1, for explanations of global and state imperilment ranks and Table A-2 for legal designations.

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

Protection Comments: A summary of major land ownership issues that may affect the PCA and the element(s) in the PCA.

Management Comments: A summary of PCA management issues that may affect the long-term viability of the PCA.

Sites of Local Significance

A Site of Local Significance is a site which includes good examples of species or plant communities that are too small or whose biological or ecological significance is not great enough to be considered exemplary in a statewide context. However, they do contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant consideration at some level when planning management activities.

Sites of Local Significance are biologically significant at the local level, but do not meet CNHP's criteria for a Potential Conservation Area and are not maintained in CNHP's database (BIOTICS).

PROJECT BACKGROUND

The Baca Grande is a private residential development of approximately 14,000 acres (5,665 ha) near the northeast end of the San Luis Valley south of Crestone, Colorado. It is situated at the edge of the valley in the foothills of the Sangre de Cristo Mountains. Currently the Baca is being developed as a residential subdivision, which is under the oversight of the Baca Grande POA. At present, only about 15 percent of the subdivision is built out and the remainder is predominantly in a natural state, although the landscape is fragmented by an abundant infrastructure of roads built to facilitate the subdivision's development.

Purpose of the Project

The Colorado Natural Heritage Program (CNHP) conducted a biological assessment of the Baca during late spring and the summer of 2005. The purpose of this assessment was to identify significant biological values of the Baca (especially occurrence of species and plant communities in need of conservation) and to evaluate their health. The results of this assessment will assist the Crestone Baca Land Trust and the Baca Grande POA in evaluating potential conservation easement scenarios and in understanding how development might affect the existing biological resources of the Baca. The goals of the project included:

- identification of potential conservation targets (i.e., sensitive species and plant communities),
- evaluation of species viability and plant community integrity, and the stresses that may adversely affect viability and integrity, and
- basic conservation and management strategies for biological resources on the property.

This biological assessment identifies the conservation targets present on the Baca, and identifies the viability or integrity, stresses, and management strategies of each conservation target in relation to the specific conditions of their occurrence on the Baca.

Study Area

The Baca is located near the northeast end of the San Luis Valley south of Crestone, Colorado (Figure 1). It is situated at the edge of the valley in the foothills of the Sangre de Cristo Mountains. Elevation ranges from 7,620 feet (2,323 m) along approximately 2 miles (3.2 km) of its southwest boundary where Willow, Spanish, and Cottonwood creeks exit the Baca, to about 8,840 feet (2,694 m) near the northeast corner, where the property reaches its highest point in the Sangre de Cristo Mountains.

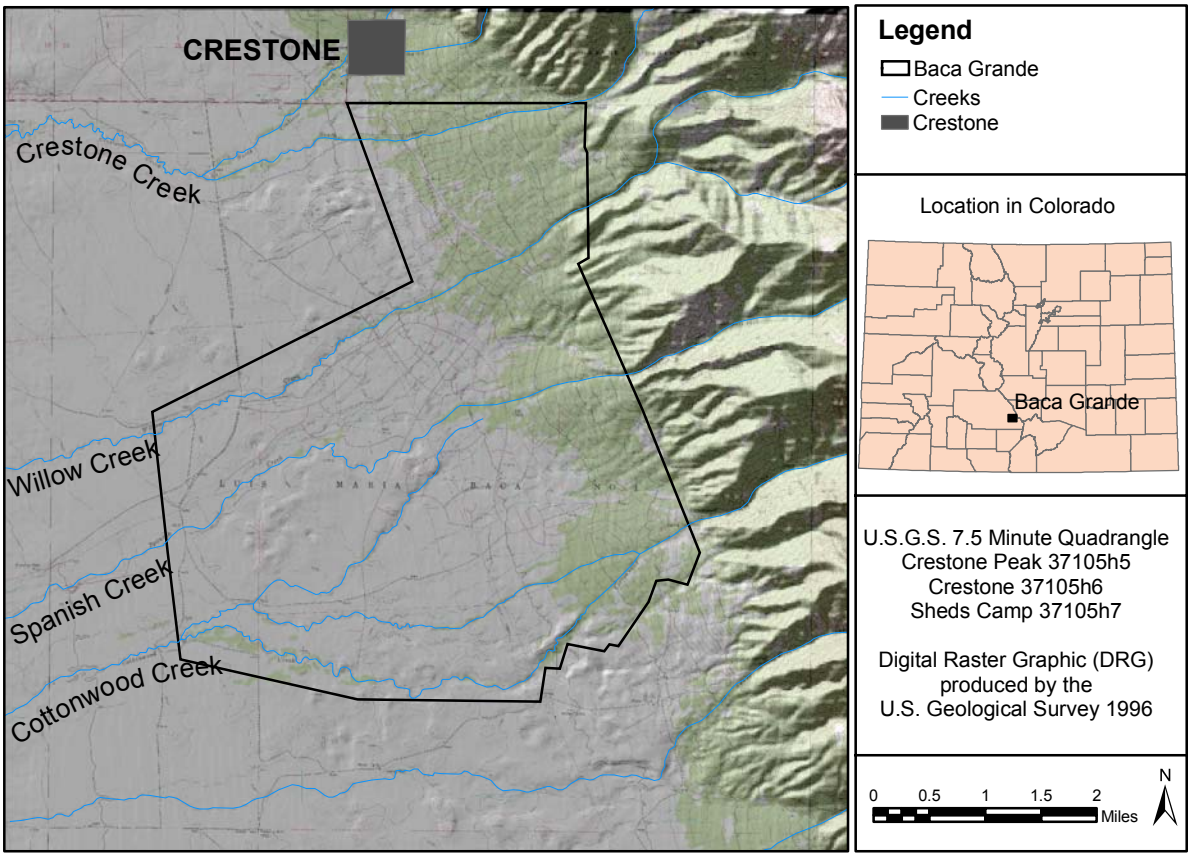


Figure 1. Location of the Baca Grande in the San Luis Valley of Saquache County, Colorado.

Ecoregion

The Baca is located within the Southern Rocky Mountain ecoregion (Figure 2) (Bailey 1994, modified by The Nature Conservancy). There is a wide range in elevation within the ecoregion, and four broad ecological zones can be distinguished across this elevation gradient. The four dominant ecological zones are Alpine, Subalpine, Upper Montane, and Lower Montane-Foothill (Merriam 1898, Gregg 1963), and the Baca includes two of these zones; the Upper Montane and the Lower Montane-Foothills zones. The Upper Montane zone is characterized by aspen forest, mixed-conifer forests, montane grasslands, mountain sagebrush shrublands, montane riparian woodlands and shrublands, and high montane lakes and streams of high-moderate gradient (Neeley 2001). The Lower Montane-Foothill zone includes Douglas-fir (*Psuedotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), shrublands, intermontane-foothill grasslands, active and stabilized sand dunes, greasewood flats and ephemeral wetlands, and foothill riparian woodland and shrublands, as well as rivers of varying size and gradient (Neeley et al. 2001). Natural disturbances acting upon the landscapes of this ecoregion include fire, hydrologic regime, herbivory, insect outbreaks, snow avalanches, and wind (Ricketts et al. 1999, Veblen 2000).

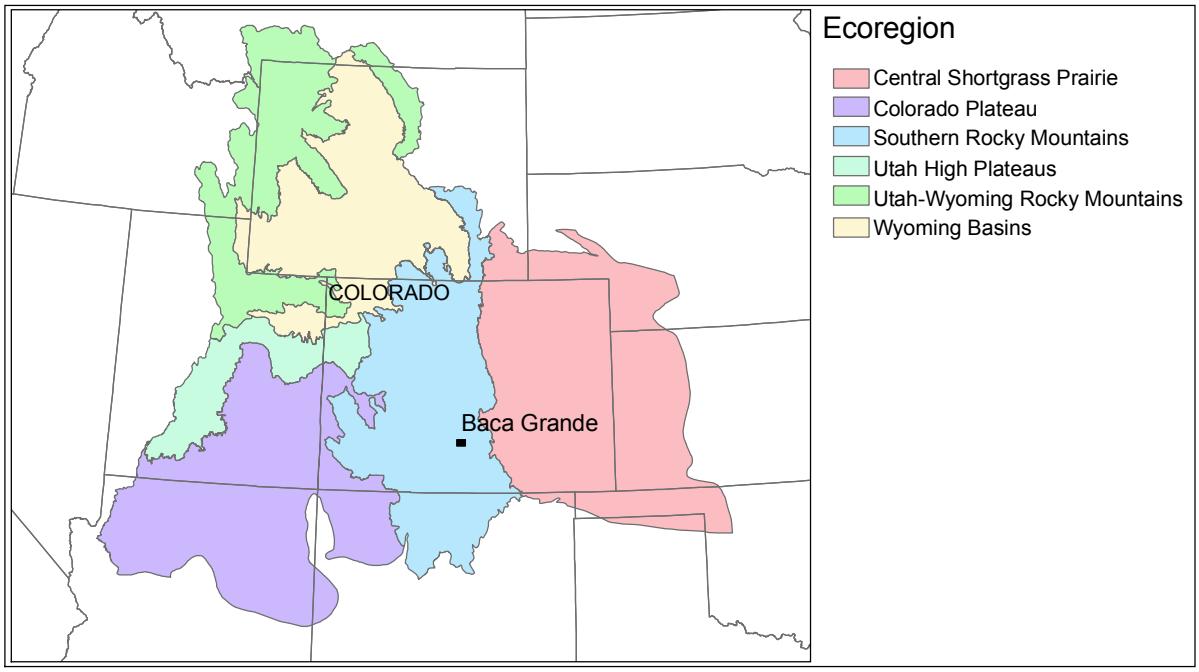


Figure 2. Ecoregions of Colorado (modified from Bailey 1994).

Hydrology

Four streams flow out of the Sangre de Cristo Mountains and cross the Baca from the northeast to the southwest. South Crestone Creek flows through the extreme north end of the Baca, and is followed in succession as one moves south by Willow, Spanish, and Cottonwood creeks (Figure 1). All of these creeks are perennial, the hydrology's of which are driven by snowmelt and periodic summer rains. Flows in these creeks peak in June at about 18 feet per cubic second (0.5 m^3/sec), decline by August to about 15 $feet^3$/sec (0.4 m^3/sec) when summer rains hold the flows steady until September, after which there is a rapid decline to a flow of about 1 $feet^3$/sec (0.03 m^3/sec) by the end of October (USGS National Water Information System Web Data 2005). Flows remain fairly steady at 1 $feet^3$/sec from November through April, at which point runoff from melting snow replenishes the creeks.

Irrigation of ranching pastures to the west of the Baca was the predominant use of the water in these creeks up until establishment of the Baca NWF. There are numerous groundwater wells and a few reservoirs and diversions that remove water from the drainages associated with the creeks in the Baca.

The Baca lies within the Closed Basin of Colorado's San Luis Valley and waters in these four creeks terminate their flows on the valley floor rather than feeding larger rivers that then exit the watershed. By virtue of the Baca's location – sharing a border with the Baca NWR to its west - modification to creek flows and water quality originating in the Baca has the potential to influence the ecology of the wetlands within the Baca NWR. Of the nine drainages feeding wetlands in the Baca NWR, four are the afore-mentioned creeks flowing across the Baca Grande.

Climate

Climate data from the Great Sand Dunes National Park weather station, approximately 15 miles southeast of the Baca, is fairly typical of Colorado's San Luis Valley. Annual precipitation ranges from 6-20 inches (15-50 cm). Most of the annual precipitation (60 to 70 percent) falls during the growing season from May through September – a pattern which is characteristic of the valley (Western Regional Climate Center 2006). Mean temperatures during July (the hottest month) are highs of 80º F (27º C) and lows of 50º F (10º C), while January (the coldest month), experiences mean highs of 35º F (2º C) and lows of 10º F (-12º C) (Western Regional Climate Center 2006).

Geology

Geologically, the Baca is defined by the San Luis Valley, which is a large fault bounded trough formed from a tear in the earths crust where the continental plate is splitting apart and drifting away forming a "rift valley" much like the great Rift Valley of Africa (Foutz 1994). A secondary influence on the geology of the area surrounding the Baca is the prevailing southwest winds blowing across the valley that pick up sand from the valley's floor. Upon reaching the base of the Sangre de Cristo Mountains these southwest winds swirl together with a southeast wind blowing across the mountains (Chronic and Williams 2002). Where the two winds swirl together the sand is deposited forming a large dune field, which was recently designated as the Great Sand Dunes National Park and Preserve. The sand sheet accompanying these dunes is quite extensive and the sand that accumulates up the sides of the Sangre de Cristo's continuously washes down from the mountains creating a sheet that underlies much of the Baca at its lower elevations. The result of this wind action is that most of the Baca's surface geology is defined by eolian deposits (wind eroded, transported, and deposited materials) that arise from Quaternary Age rocks (Figure 3). In addition, there are alluvial (sediment deposited in the bed or former bed of a river) and surficial deposits (loose, unconsolidated sedimentary deposit lying on bedrock) of the same Quaternary period. At its highest elevations, along the extreme eastern border, a small portion of the Baca is defined by metamorphic and igneous units typical of the Sangre de Cristo Mountains.

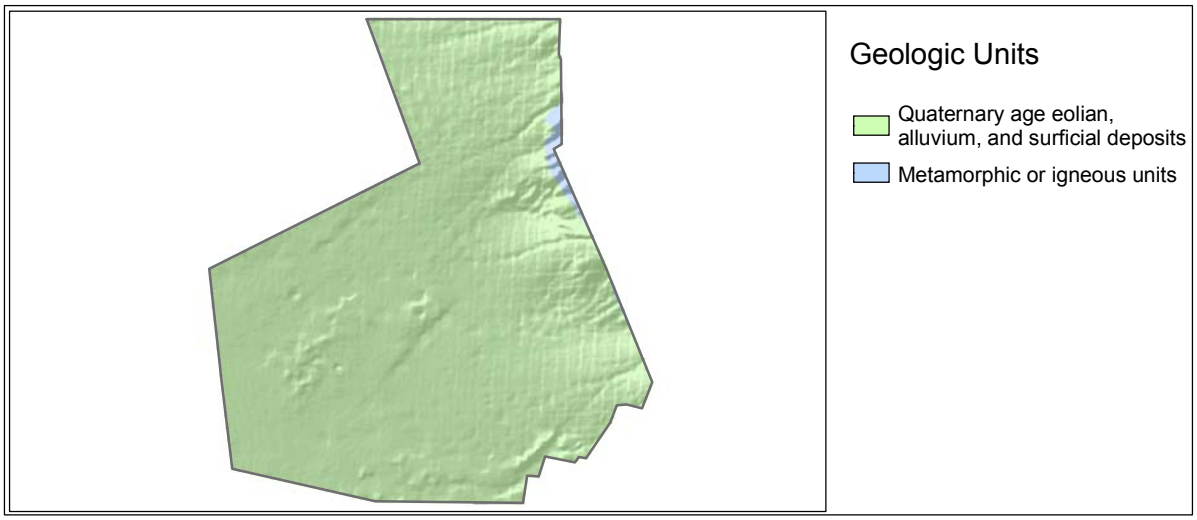


Figure 3 Generalized geology of the Baca Grande (adapted from Green 1992).

Soils

Soils on the Baca were formed from wind blown sands and at higher elevation from cobble and gravel alluvial sediments derived mainly from metamorphic and igneous rocks. Soils are characterized as sand, sandy loam, loamy sand, and cobble and stony loam (Figure 4) (U.S.D.A. Soil Conservation Service 1974). All the soils on the Baca are deep and well drained.

Figure 4. Generalized soils of the Baca Grande (U.S.D.A. Soil Conservation Service 1974).

Ecological Systems

The wide range in elevation on the property results in there being a high diversity of plant communities within the Baca. Based on NatureServe's[1] ecological systems definitions, there are 13 ecological systems present on the Baca (Figure 5). However, nearly 90% of the landcover is split between two ecological systems: the Inter-Mountain Basins Semi-Desert Shrub Steppe (56.5%) and the Southern Rocky Mountain Pinyon-Juniper Woodland (33.0%). Three other native ecological systems that occur at a rate greater than one percent of cover in the Baca include the Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Greasewood Flat, and Inter-Mountain Basins Mesic Meadow, while another seven systems are present at less than one percent of cover in the Baca (Table 1). Pinyon-juniper occurs at higher elevation in the Baca, generally above 7,800 feet (2,377 m), while semi-desert shrub dominates the cover below that elevation. The desert grassland occupies areas of intermediate elevation within the Baca, and the greasewood flats and wet meadows are present at lower elevations (Figure 5). Pinyon-juniper and semi-desert shrub are very common in western Colorado. On the Baca the rarest plant communities are members of the Rocky Mountain Lower Montane Riparian Woodland and Shrubland system.

[1] NatureServe is a non-profit conservation organization representing an international network of biological inventories—known as natural heritage programs or conservation data centers—operating in all 50 U.S. states, Canada, Latin America and the Caribbean. NatureServe and its member programs are the leading source for information about rare and endangered species and threatened ecosystems.

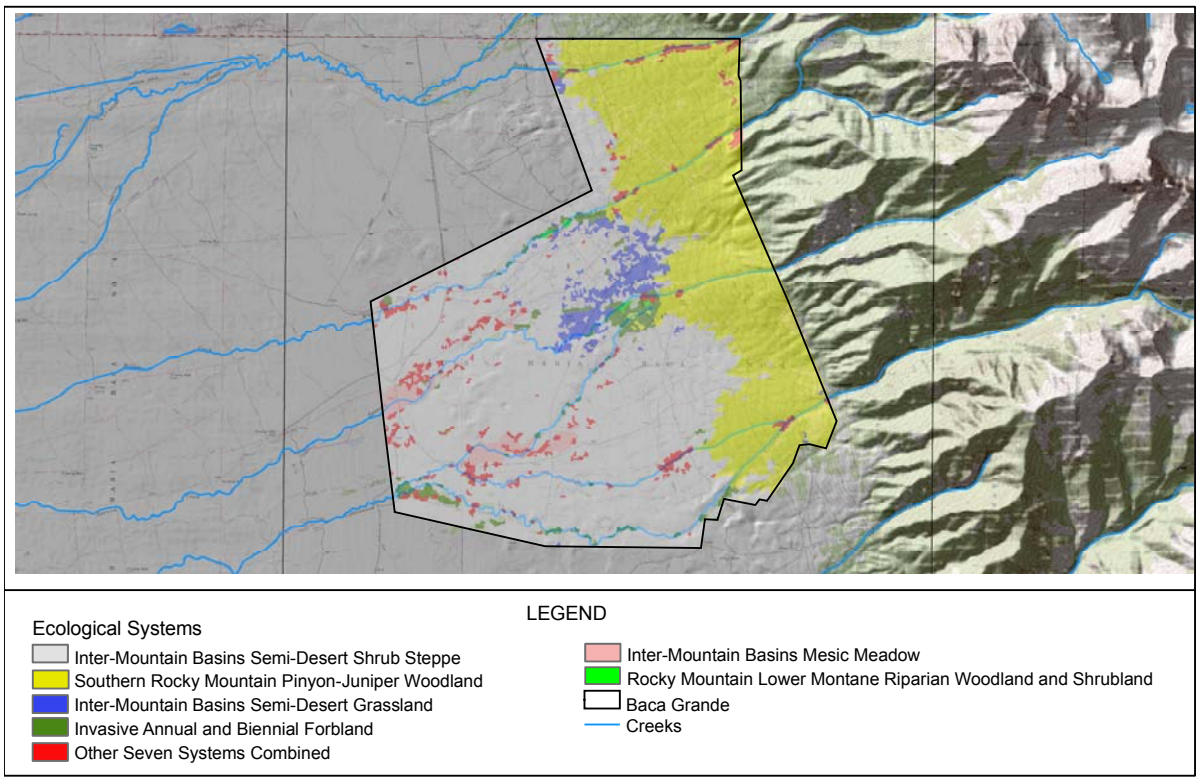


Figure 5. Ecological Systems of the Baca Grande from the USGS Gap Analysis Program (2004).

Table 7. The Ecological Systems and the approximate percent of landcover of each system in the Baca Grande.

ECOLOGICAL SYSTEM	PERCENT
Inter-Mountain Basins Semi-Desert Shrub Steppe	56.5
Southern Rocky Mountain Pinyon-Juniper Woodland	33.0
Inter-Mountain Basins Semi-Desert Grassland	2.9
Invasive Annual and Biennial Forbland	2.2
Inter-Mountain Basins Mesic Meadow	1.9
Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0.1
Other Seven Systems Combined	3.4
TOTAL	100

Land Use

In 1823 King Ferdinand VII of Spain granted 500,000 acres of property in New Mexico to Cabeza de Vaca (anglicized as Baca) for his loyalty to the crown (Abdoo 2004). Through the ensuing 12 years the family was forced from much of the land by roaming bands of Navajo Indians and the Mexican Army. Upon returning in 1835 the family found that there was a second grant being petitioned on their property for the present town of Las Vegas, New Mexico (Abdoo 2004). In 1860, with the land under U. S. jurisdiction, Congress granted five properties to Cabeza de Baca in exchange for granting the original property to the town of Las Vegas. Four of the five grants were in New Mexico and Arizona, while Grant No. 4 was in the San Luis Valley of Colorado (Abdoo 2004). The Colorado property was under the control of numerous owners from 1860 to 1962, when it was purchased by the Arizona-Colorado Land and Cattle Company (Abdoo 2004). During this period the 100,000 acre

Baca Grant No. 4 was a cattle ranch with a championship cattle rearing operation. Grant No. 4 was the only one of the five Baca Grants maintained intact for over 100 years (Abdoo 2004). In addition to ranching, mining was prevalent in the ranges of the Sangre de Cristo Mountains, which boarders the property on its east. It is estimated that 50 million dollars of precious metals have been mined from the area since 1900 (Abdoo 2004).

In 1971 sales of portions of the original 100,000 acre Grant began and a choice parcel of the ranch became what is known today as the Baca Grande (Baca). The Baca was originally planned as a resort/retirement development, but it has grown slowly and undergone a change in concept and by the late 90s was still in its early stages of development (Joseph 1996). The last few years have seen an increase in activity and development on the Baca as its remote mountain location has attracted a diverse community of peoples including retirees, second home buyers, and younger people attracted to the spiritual and environmental education organizations that have settled in the area. This diverse and unusual mix of people endeavor to create a sustainable development that is environmentally friendly with principles of land stewardship, and that will identify and preserve priority biological resources. There is a conscious effort for water, power and transportation conservation, appropriate sewage treatment, and careful consideration of community and neighborhood design (Joseph 1996).

The Baca development is managed by the Baca Grande Property Owners' Association (POA), whose purpose it is to serve the owners of property in the Baca and to operate and manage the development. The Baca is a covenanted community, with Covenants & Restrictions created by the POA in the early 70's (Joseph 1996). The development is divided into three subunits; Chalet I, Chalet II, and the Grants and as of 2004 there were 1,719 lots, 1,096 lots, and 1,365 lots, respectively, in each subunit (Abdoo 2004). Lot consolidation and conservation easements in the intervening years has, to some extent, reduced lot numbers in each subunit of the Baca. Both of the Chalet subunits occupy the pinyon-juniper zone while the Grants occupy the lower lying desert shrub zone. Lots in the two Chalets are fully developed with underground utilities, including sewers, to the lot line, while those in the Grants rely on septic systems for waste water discharge. This biological assessment was undertaken at a time when the Baca has experienced an increase in sales with over 200 lots being sold in each of the last two years. This increase in development has the potential to compromise the ecological integrity of the biological resources found in the Baca, making this assessment particularly timely.

CONSERVATION ASSESSMENT

Potential Threats to Biological Diversity in the Baca Grande

General threats that may affect biodiversity in the Baca Grande are summarized below. It is understand that the issues discussed below are often important parts of a healthy economy and contribute to the well being of our society. These "threats to biodiversity" are mentioned with the hope that good planning can minimize the impacts where critical habitat resides. All of these threats have the potential to create impacts that will stress the viability and integrity of the species and plant communities in the Baca.

Residential Development

Residential development is increasing in the Baca Grande, especially in the two Chalet subdivisions, and this is the number one threat to the biological resources on the Baca. Development creates a number of stresses, including habitat loss and fragmentation, introduction and proliferation of non-native species, fire suppression, and predation and disturbance from domestic animals (dogs and cats) (Oxley et al. 1974, Coleman and Temple 1994). Increasing human density in an area can lead to a change in the composition of wildlife populations (e.g., numbers of foxes and coyotes may increase, or number of bird species present may decrease), and may also alter movement patterns and behavior of wildlife. Loss of habitat to development is considered irreversible. Continued development within all subdivisions will also place a stress on water resources represented by the mountain streams of the area as more ground and surface water is pumped and diverted to meet the growing needs of the human population. This could result in the decline of water available to riparian plant communities having negative impacts on their continued viability.

Residential development can result in the loss of upland vegetation leading to more rapid water runoff, elevated stream flows, and increased erosion after rainfall events and during periods of snowmelt (Patten 1998, USDA et al. 1998). Increases in water runoff can lead to a proportional reduction in ground water recharge, leading to a lowered water table, reducing water available to riparian vegetation. Groundwater withdrawal also can cause a drop in the water table resulting in reduced stream flows and reducing the amount of water available to riparian vegetation, ultimately leading to decline and death of the vegetation (Patton 1998).

Water Development

River impoundment in the form of lakes, reservoirs, irrigation ditches, and canals can affect aquatic dependent plants and animals (Chien 1985, Friedman et al. 1998). Annual flooding is a natural ecological process that can be severely altered by the construction of dams, reservoirs, and other water diversions. These water diversions and impoundments have altered the normal high peak flows that were once a part of the natural hydrological regimes of the rivers and their tributaries. These periodic floods are necessary for continued viability of most riparian vegetation. For example, many plants, including cottonwood trees,

reproduce primarily with flooding events (Rood and Mahoney 1993). As plant composition changes in response to alterations in the flooding regime, the composition of the aquatic and terrestrial fauna may also change. Groundwater pumping and the diversion of surface flows occur in some riparian areas of the Baca and such activities have the potential to increase with population growth and consequent increases in water demand.

In addition to impoundment, rivers have also been altered by stream bank stabilization projects (e.g., channelization) (Rosgen 1996). Most streams and rivers are dynamic and inherently move across the land. Stabilizing or channelizing stream banks forces the river to stay in one place and often leads to changes in riparian ecology. It is also well known that different plant communities require different geomorphologic settings. For example, point bars are required for some species of willows to regenerate, terraces are required for mature cottonwood/shrubland forests, and old oxbow reaches may eventually provide habitat for many wetland communities. By stabilizing a river, the creation of these geomorphic settings is often eliminated. Thus, the plant communities that require such fluvial processes are no longer able to regenerate or survive while at the same time the establishment of non-native species is promoted. In general, the cumulative effects from dams, reservoirs, and channelization on plant communities have caused a gradual shift from diverse multi-aged riparian woodlands to mature single-aged forest canopies.

Many wetlands not associated with fluvial processes have been altered by irrigation practices, water diversions, and groundwater withdrawals. Many historical wetlands, such as seeps and springs, have been lost or altered due to water "development" projects, such as water diversions or impoundments. The number of species supported by a manmade pond with minimal edge habitat is generally less than the number supported by an extensive intact seep and spring, wetland, or naturally occurring pond.

Non-native Species

Although non-native species are mentioned repeatedly as stresses in the above discussions, because they may be introduced through so many activities, they are included here as a general threat as well. Non-native plants or animals can have wide-ranging impacts. Non-native plants can increase dramatically under the right conditions and dominate a previously natural area (e.g., scraped roadsides). This can generate secondary effects on animals (particularly invertebrates) that depend on native plant species for forage, cover, or propagation. Effects of non-native fishes include competition that can lead to local extinctions of native fishes and hybridization that corrupts the genetic stock of the native fishes. Native fish populations downstream of the Baca in the Baca NWF could be adversely impacted by the introduction of any non-native fishes into the creeks within the Baca. Some non-native species of concern observed in the Baca include whitetop (*Cardaria draba*), Canada thistle (*Cirsium arvense*), Kentucky bluegrass (*Poa pratensis*), and smooth brome (*Bromus inermis*).

Roads

There is a complex, dense network of roads throughout most of the Baca Grande due primarily to past designs on residential development within the Baca. Expansion of the existing road network will detrimentally affect the biodiversity of the Baca. Roads are associated with a wide variety of impacts to plant communities, including invasion by non-native plant species, increased depredation and parasitism of bird nests, increased impacts of pets, fragmentation of habitats, erosion, pollution, and road mortality (Noss et al. 1997).

Road networks crossing landscapes can increase erosion and alter local hydrological regimes. Runoff from roads may impact local vegetation *via* contribution of heavy metals and sediments. Road networks interrupt the linear continuity of plant communities (e.g. woodland canopy cover along a riparian zone), and therefore fragment landscapes for large mammals like coyote (*Canus latrans*) and bobcat (*Lynx rufus*).

Effects on wildlife can be attributed to road avoidance and mortality due to vehicular collisions (roadkill). Traffic noise appears to be the most important variable in road avoidance, although visual disturbance, pollutants, and predators moving along a road are alternative hypotheses as to the cause of avoidance (Forman and Alexander 1998). Songbirds appear to be sensitive to remarkably low noise levels, even to noise levels similar to that of a library reading room (Reijnen et al. 1995).

Recreation

Different types of recreation (e.g., motorized versus non-motorized activities), typically have different effects on ecosystem processes. All-terrain vehicles can disrupt wildlife and fragment habitat for native resident species, and ATVs have also been identified as a vector for the invasion of non-native plant species (Campbell and Kriesch 2003).

Non-motorized recreation, mostly hiking but also some mountain biking, presents a different set of issues (Cole and Knight 1990, Knight and Cole 1991; Miller et al. 1998, 2001). Wildlife behavior can be significantly altered by repeat visits of hikers or bicyclists. Trail placement should consider the range of potential impacts on the ecosystem. Considerations include minimizing fragmentation by leaving large undisturbed areas of wildlife habitat where possible (Colorado Department of Natural Resources 1998). Miller et al. (1998) found lower nest survival for grassland birds adjacent to trails; they also found that grassland birds were more likely to nest away from trails with a zone of influence approximating 250 feet (75 m). Riparian zones are highly desirable areas within which to develop trail routes and impacts to native vegetation (mainly trampling) in these areas can be high. Trails can also act as corridors for introduction and dispersal of non-native plants.

Fragmentation and Edge Effects

Edges are simply the outer boundary of an ecosystem that abruptly grades into another type of habitat (e.g., edge of a riparian woodland adjacent to a rabbitbrush shrubland) (Forman and Godron 1986). Edges are often created by naturally occurring processes such as floods, fires, and wind. Edges can also be created by human activities such as roads, trails, timber

harvesting, agricultural practices, and rangeland management. Human induced edges are often dominated by plant and animal species that are adapted to disturbance. As the landscape is increasingly fragmented by large-scale, rapid anthropogenic conversion, these edges become increasingly abundant in areas that may have had few "natural" edges. The overall reduction of large landscapes jeopardizes the existence of specialist species, may increase non-native species, and may limit the mobility of species that require large landscapes or a diversity of landscapes for their survival (e.g., large mammals or migratory waterbirds).

Recommended Conservation Strategies

Conservation Strategies can be classified as three major types:

1. Land protection accomplished through conservation easements, land exchanges, long term leases, acquisition, or government regulation;

2. Management of the land influenced so that significant resources are protected; and

3. Public education about the significant ecological values of the Baca to engender support for land use decisions that protect these values.

The first step in facilitating any of the conservation strategies suggested above is to identify the significant elements of biodiversity and their locations in the Baca. This report and the accompanying GIS data provide information necessary for this first step. The next step is to use this information to make conservation decisions. The Potential Conservation Areas and Sites of Local Significance descriptions within this report provide protection and management suggestions for most areas identified during the inventory. However, some general recommendations for conservation of biological diversity in Baca are given here.

1. Develop and implement a plan for protecting the Potential Conservation Areas and Sites of Local Significance profiled in this report. The PCAs aand SLS in this report provide a basic framework for implementing a comprehensive conservation program. The sites, because they have biological significance, are in need of priority attention. Consider incentive-based programs such as purchasing development rights or outright purchase from willing owners of land for significant sites that are in need of protection. Support local organizations, such as the Baca Crestone Land Trust, in purchasing or acquiring conservation easements for protection of biological diversity or open space. Explore opportunities to form partnerships to access state and federal funding for conservation projects, such as those offered through the Colorado Division of Wildlife. Continue to promote cooperation among local entities to preserve the Baca's biodiversity. Encourage community leaders to institutionalize consideration of significant biological resources in land use planning.

2. Use this report in the review of proposed activities in or near Potential Conservation Areas and Sites of Local Significance to determine whether or not activities adversely affect elements of biodiversity. All of the PCAs and the SLS presented contain elements of biodiversity of state or global significance. The biodiversity represented

by these sites and their locations should be a consideration of planners and biologists when making land use decisions on the Baca.

Certain land uses on or near a site may affect the element(s) present there. Range-restricted species may be especially vulnerable to habitat destruction, while wetland and riparian areas are particularly susceptible to impacts from off-site activities if the activities affect water quality or hydrologic regimes. In addition, cumulative impacts from many small changes can have effects as profound and far-reaching as one large change. As proposed land use changes are considered, they should be compared to the maps presented herein (also available in GIS format). If a proposed project has the potential to impact a site, planning personnel should contact persons, organizations, or agencies with the appropriate biological expertise for input in the planning process. The Colorado Natural Heritage Program routinely conducts site-specific environmental reviews and should be considered a valuable resource. To contact CNHP's Environmental Review Coordinator call (970) 491-7331. Other key partners, such as the Colorado Division of Wildlife, can be valuable resources as well, particularly in evaluating potential impacts to biological resources not tracked by CNHP (e.g., game species).

3. Recognize the importance of larger, contiguous plant communities.
While the PCAs and the SLS identified in this report contain known locations of significant elements of biological diversity, protection of large areas in each vegetation type, especially where these are connected, may ensure that species that have not yet been located are not lost. Work to protect large blocks of land in each of the major vegetation types in the Baca, and avoid fragmenting large natural areas unnecessarily with roads, trails, etc. Although large migrating animals like pronghorn (*Antilocapra americana*) and elk (*Cervus elaphus*) are not tracked by CNHP as rare species, they are part of our biological diversity, and their needs for winter range and access to protected corridors to food and water should be taken into consideration. Fragmentation of the landscape also affects smaller animals and plants, opening more edge habitats and introducing exotic species. Encourage cluster developments that designate large common areas for preservation of plant communities, as an alternative to scattering residences over the landscape with a house on each 35-acre parcel. Work with developers early in the planning process to educate them about the benefits of retaining natural areas. Locate trails and roads to minimize impacts on native plants and animals. See Foreman et al. (2003) and Forman and Alexander (1998) for an excellent review of the literature on the ecological effects of roads. See *Planning Trails with Wildlife in Mind* published by the State Trails Program (Colorado Department of Natural Resources 1998) for suggestions regarding planning trails with minimum impacts to wildlife.

4. Increase efforts to protect biodiversity by promoting cooperation and incentives among landowners, pertinent government agencies, and non-profit conservation organizations. Involve all stakeholders in land use planning. The long-term protection of biological diversity in the Baca will be facilitated by the cooperation of the POA, private landowners, businesses, government agencies, and non-government organizations. Efforts to provide stronger ties among federal, state, local, and private interests involved in the protection or management of natural lands will increase the chance of success. By developing incentives that encourage biodiversity considerations in land-use planning, the

likelihood of conserving biodiversity should increase. Such incentives will make planning for conservation a higher priority for private and public entities.

5. Promote wise management of the biodiversity resources that exist within Potential Conservation Areas and Sites of Local Significance. Development of a site-specific conservation plan is a necessary component of the long-term protection of a PCA or SLS. Because some of the most serious impacts to ecosystems are at a large scale (e.g., altered hydrology, residential encroachment, and non-native species invasion), considering each area in the context of its surroundings is critical. Several organizations and agencies are available for consultation in the development of conservation plans, including the Colorado Natural Heritage Program, the Colorado Division of Wildlife, the Natural Resources Conservation Service, The Nature Conservancy, and various academic institutions. With the current rate of population growth in the Baca, rare and imperiled species and plant communities will likely decline if not given appropriate protection or management attention.

Coordinate with managers of public parks or other public lands that support sensitive biological resources. Engage local citizens, groups, and organizations (e.g., schools, the Manitou Foundation) in assisting with management and monitoring projects on public lands. Make a concerted effort to involve individual landowners in conservation dialogue, as applicable.

6. Stay informed and involved in public land management decisions. On three of its sides, the Baca Grande is surrounded by federal public lands including the Great Sand Dunes National Park and Preserve, the Baca National Wildlife Reserve, or U.S. National Forest property. Encourage protection for the most biologically significant sites by implementing within the Baca Grande compatible management activities designated in National Park Service Plans and U.S. Fish and Wildlife Service Plans.

7. Continue inventories and monitoring where necessary, including inventories for species that cannot be surveyed adequately in one field season and continue inventories on lands that CNHP could not access in 2004. Because some species are ephemeral or migratory, completing an inventory in one field season is often difficult. Despite the best efforts during one field season, it is likely that some elements were not documented during the survey. Thus, it is recommended that this report and the data included within it serve as a guide for subsequent surveys of the Baca Grande.

8. Continue to take a proactive approach to weed and exotic species control. Recognize that weeds affect native plant communities and other plant and animal species. Discourage the introduction and/or sale of non-native species that are known to significantly impact natural areas. These include, but are not limited to, exotic, invasive species such as tamarisk (*Tamarix* spp.), yellow toadflax (*Lanaria dalmatica*), and Canada thistle (*Cirsium arvense*), and non-native fish species. Further, natural area managers, public agencies, and private landowners should be encouraged to remove these species from their properties. Enforce the use of weed-free forage on horse trails. Encourage the use of native species for revegetation and landscaping efforts. Ideally, seed should be locally harvested. This includes any seeding done on POA road right-of-ways. The Colorado Natural Areas

Program has published a book entitled *Native Plant Revegetation Guide for Colorado* that describes appropriate species to be used for revegetation. This resource is available on the World Wide Web at http://www.parks.state.co.us/home/publications.asp#CNAP.

9. Encourage public education functions and publications. A significant early step in the process of conserving biodiversity is educating local citizens and other stakeholders on the value that such areas offer the public. As described in this report, the Baca is rich in animal and plant diversity. Conveying the value and function of these habitats and the species that inhabit them to the public can generate greater interest in conserving lands. Conducting forums or presentations that highlight the biodiversity of the Baca should increase awareness of the uniqueness of the habitats within the development. Similarly, providing educational pamphlets or newsletters that explain why these areas are so valuable can increase public interest and support for biodiversity conservation. Consider developing a community conservation website to provide information on biological resource, biological diversity, and conservation opportunities in the Baca. Enlist the assistance of local media in public education efforts.

10. Develop and implement comprehensive program to address loss of wetlands. In conjunction with the information contained in this report, information regarding the degree and trend of loss for all wetland types (i.e., salt meadows, emergent marshes, riparian forests, seeps/springs, etc.) should be sought and utilized to design and implement a comprehensive approach to the management and protection of the Baca's wetlands. Encourage and support statewide wetland protection efforts such as CDOW's Wetlands Program. Support of research efforts on wetlands to aid in their conservation is encouraged. Education on the importance of wetlands could be implemented through local agencies. Encourage communication and cooperation with landowners regarding protection of wetlands in the Baca.

11. Develop and implement a fire management and mitigation strategy for the riparian corridors. Few data are available on the natural frequency of fire in riparian ecosystems; however, fire was highly variable and depended on site-specific fuels and conditions (Dwire and Kauffman 2003). In lower montane riparian corridors fires are presumably uncommon due to the high moisture content of riparian soils and vegetation, and the low frequency of lightning strikes in low-lying drainages and valley bottoms where riparian areas occur (Joy 1996). Historically, in lower montane riparian woodlands low intensity surface fires occurred about once every 25 to 50 years (Dwire and Kauffman 2003) and consequently, compared to hydrology, fire is less important to these riparian systems. Although it is the least vigorous sprouter of all the cottonwood species (Schier and Campbell 1976), narrowleaf cottonwood (*Populus angustifolia*) probably resprouts following light intensity fires (Hansen et al. 1988) and mature narrowleaf cottonwood trees may resist fire, but young trees are probably killed by fire (Culver 1997), and older trees are commonly killed by even relatively cool fires which wound trees and facilitate the onset of heartwood decay (Myers and Buchman 1984). Consequently, fire should not be used as a management tool on sites where the maintenance of bottomland hardwoods is a management objective (Culver 1997). However, when fire removes competing conifers, thins the overstory, allows more light penetration, and exposes the mineral soil, it allows cottonwood seeds to establish

if soil moisture is adequate. In areas where conifers are taking over the riparian corridor, if fire does not occur the cottonwoods may be lost (Gruell 1980). The thinning of junipers in areas where dense juniper stands have taken over the narrowleaf cottonwood and Rocky Mountain juniper (*Juniperus scopulorum*) woodland will help maintain the cottonwoods. Also, the thinning of shrub cover and young juniper, where dense stands of shrubs and junipers exist in the understory of the riparian woodland, will help to reduce fuel loads and remove ladder fuels that could result in the loss of larger cottonwoods and junipers in the event that a fire does occur. This would also open areas where young cottonwoods could regenerate if soil moisture is adequate.

METHODS

The natural heritage inventory described in this report was conducted in several steps summarized below. Additionally, input from representatives of the Crestone Baca Land Trust and long time residents of the Baca was incorporated into the inventory process.

Collect Available Information

The Colorado Division of Wildlife provided data on elk and pronghorn. In addition, the scientific literature was searched for information on species' life history and locations of occurrence. These data were entered into CNHP databases and used to identify areas of potential habitat.

Identify Rare or Imperiled Species and Ecological Systems with Potential to Occur at the Baca Grande

The information collected in the previous step was used to refine a list of potential species and plant communities, and to refine our search areas (Table 8). In general, species and plant communities previously recorded from Saguache County were included in the list. Species and plant communities preferring habitats that are not found on the Baca were removed from the list. In all, 24 species and nine plant communities were identified as potentially occurring on the Baca. These species and plant communities were considered to be a priority for inventory because of their conservation status (G1 to G3 or S1 to S3) (see Natural Heritage Network Ranking System), and/or because they are known to occur in areas that are subject to various development pressures, such as hydrological alterations and conversion to residential uses. In addition, the plant communities on the Baca were assessed for condition and viability because of their importance in maintaining integrity of the animal community, and integrity of surface and ground water flows.

Table 8. Species and plant communities of concern with potential to occur in the Baca Grande.

SCIENTIFIC NAME	COMMON NAME	PRIORITY RANK
Amphibians		
Rana pipiens	northern leopard frog	G5S3
Birds		
Accipiter gentiles	northern goshawk	G5S3B
Amphispiza belli	sage sparrow	G5S3B
Aquila cheysacros	golden eagle	G5S3S4B
Egretta thula	snowy egret	G5S2B
Glaucidium gnoma	northern pygmy-owl	G4S3B
Haliaeetus leucocephalus	bald eagle	G4S1B
Himantopus mexicanus	black-necked stilt	G5S3B
Plegadis chihi	white-faced ibis	G5S2
Fish		
Gila pandora	Rio Grande chub	G3S1?

Table 8. Species and plant communities of concern with potential to occur in the Baca Grande.

SCIENTIFIC NAME	COMMON NAME	PRIORITY RANK
Catostomus plebeius	Rio Grande sucker	G3G4S1
Insects		
Amblyscirtes simius	simius roadside skipper	G4S3
Cicindela theatina	San Luis Dunes tiger beetle	G1S1
Euphilotes rita coloradensis	rita dotted-blue	G3G4T2T3S2
Libellula nodisticta	hoary skimmer	G4S1
Oeneis alberta	Alberta arctic	G4S3
Polites rhesus	rhesus skipper	G4S2S3
Pyrgus xanthus	xanthus skipper	G3G4S3
Stinga morrisoni	Morrison's skipper	G4G5S3S4
Mammals		
Perognathus flavescens relictus	plains pocket mouse subspecies	G5T2S2
Perognathus flavus sanluisi	silky pocket mouse subspecies	G5T3S3
Spermophilus tridecemlineatus blanca	thirteen-lined ground squirrel subspecies	G5T3S3
Tadarida brasiliensis	Brazilian free-tailed bat	G5
Thomomys talpoides agrestis	northern pocket gopher subspecies	G5T3S3
Plants		
Cleome multicaulis	slender spiderflower	G2G3S2S3
Plant Communities		
Festuca arizonica-Muhlenbergis Montana	Montane Grasslands	G3S2
Picea pungens/Alnus incana	Montane Riparian Forests	G3S3
Populus angustifolia Sand Dune	Narrowleaf Cottonwood Sand Dune Forest	G1S1
Populus angustifolia-Juniperus scopulorum	Montane Riparian Forest	G3S3
Salix geyeriana/Carex aquatilis	Montane Willow Carr	G3S3
Salix geyeriana/Carex utriculata	Geyer's Willow/Beaked Sedge	G5S3
Salix monticola/Carex aquatilis	Montane Riparian Willow Carr	G3S3
Salix monticola/Mesic Graminoid	Montane Riparian Willow Carr	G3S3
Sarcobatus vermiculatus/Distichlis spicata	Saline Bottomland Shrublands	G4S2

Identify Targeted Inventory Areas

Given the moderate size of the Baca, we were able to search most all of the area for the target species. Sub-areas, identified as target inventory areas (TIAs), were identified for increased survey effort based on their likelihood for harboring rare or imperiled species. Sub-areas were those areas presumed to have highest quality habitats based on aerial photographs, geology maps, vegetation surveys, personal recommendations from knowledgeable local biologists and residents, and numerous roadside surveys by our field scientists. Targeted inventory areas visited by field biologists are displayed on Figure 6.

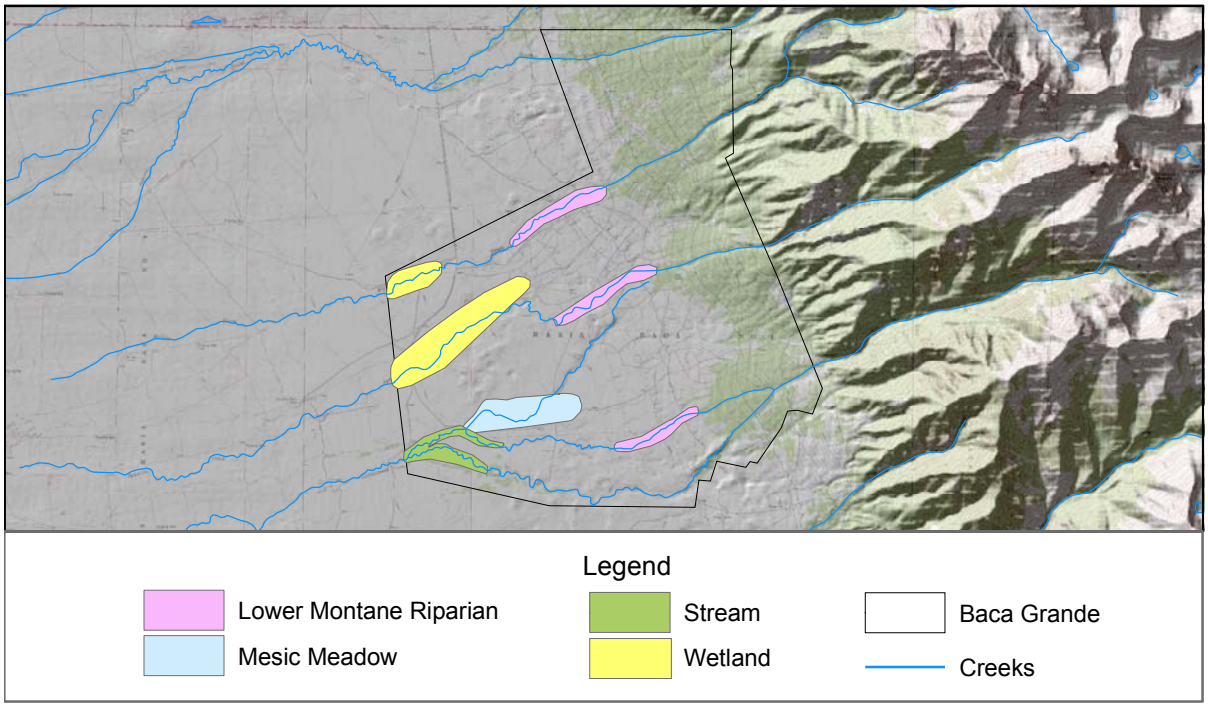


Figure 6. Target inventory areas on the Baca Grande.

Conduct Field Surveys

Survey sites were visited at appropriate times, as dictated by the seasonal occurrence (or phenology) of the individual species. It was essential that surveys took place during a time when the targeted species were detectable. For instance, breeding birds cannot be surveyed outside of the breeding season, and plants are often not identifiable without flowers or fruit, which are only present during certain times of the year.

Survey methods varied according to the species for which surveys were conducted. In most cases, the appropriate habitats were visually searched in a systematic fashion to cover the area as thoroughly as possible in the given time. Some types of organisms require special techniques to document their presence. Species that require methods other than visual search were:

- Amphibians: visual observation and capture using aquatic dip nets;
- Mammals: live traps;
- Birds: visual observation or identification by song or call; and
- Fish: capture using aquatic dip nets.

When a rare species was discovered, its precise location and known extent of occupied habitat was recorded with a global positioning system (GPS) unit. Other data recorded for each occurrence include numbers observed, breeding status, habitat description, disturbance features (e.g., residential development, damming or diversion of natural water flows, and presence of invasive plant species), observable threats, and potential protection and management needs.

Identify Conservation Needs and Opportunities

Once the biological inventory has identified species, plants, and plant communities in the study area, it is necessary to interpret these data from a conservation planning standpoint. In order to do this, CNHP has developed methods to delineate the local geographic areas that are necessary to maintain long-term persistence of the species and plant communities of interest. Potential Conservation Areas (PCAs) are delineated to focus attention on species and plant communities of highest conservation priority at global and statewide levels (see The Natural Heritage Ranking Method for details on PCA methods). In addition, Sites of Local Significance (SLSs) are identified in order to emphasize biological resources that are not among the highest priorities for conservation at a statewide level, but are nonetheless very significant to supporting species at the local level. SLSs contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant conservation consideration.

Delineate Potential Conservation Areas

Finally, since the objective for this inventory is to prioritize specific areas for conservation efforts, Potential Conservation Area (PCA) boundaries were delineated. The goal of the PCA is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features; vegetative cover, and current and potential land uses. In developing the boundaries of a PCA, CNHP scientists consider a number of factors that include, but are not limited to:

- ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the PCA and surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. **The proposed boundary does not automatically recommend exclusion of all activity.** Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the PCAs affect the biological resources and sensitive species on which the PCA is based. **Please note that these boundaries are based on our best estimate of the primary area supporting the long-term survival of targeted species and plant communities. A thorough analysis of the human context and potential stresses has not been conducted.** However, CNHP's conservation planning staff is available to assist with these types of analyses where conservation priority and local interest warrant additional research.

RESULTS AND DISCUSSION

Numerous animals and a plant community of conservation priority are present on the Baca. Altogether

- five animals that are rare, imperiled or globally vulnerable within the state of Colorado, and
- multiple occurrences of one plant community that is globally imperiled

have been documented in the Baca (Table 9).

Occurrences of these five animals and this rare plant community were concentrated near riparian areas on the Baca (Figure 7). Two specimens of the northern pocket gopher (*Thymomys talpoides agrestis*) were collected from the Baca during this assessment, while trapping efforts were unsuccessful in eight areas where fresh sign of pocket gopher digging was observed (Figure 7). The *agrestis* subspecies of the northern pocket gopher is the only species of pocket gopher found on the Baca (Fitzgerald 1994), making all eight unsuccessfully trapped locations probable occurrences of the *T. t. agrestis* subspecies.

This survey identified an additional 42 common animal species, resulting in a total observation of 47 animals on the Baca (Table 10). In addition, six more common plant communities were identified in the Baca (Table 10). There were five Potential Conservation Areas (PCA) and one Site of Local Significance (SLS) developed from data collected during this survey (Figure 8, Table 11). These PCAs and the SLS can be used to prioritize and evaluate conservation needs within the Baca. Important findings include the discovery of healthy examples of the same globally imperiled plant community (*Populus angfustifolia-Juniperus scopulorum* woodland) along the Cottonwood Creek, South Crestone Creek, Spanish Creek, and Willow Creek riparian corridors; the moderately sized population of the globally vulnerable northern pocket gopher; and a moderately sized wetland located where Spanish Creeks leaves the Baca and enters the Baca NWR that supports a rich diversity of rare and common animals including shorebirds, bats, and amphibians.

Table 9. The animals and a plant community of concern observed in the Baca Grande during summer 2005.

Element	Common Name	Global Rank	State Rank	Federal and State Status
ANIMALS				
Birds				
Accipiter gentilis	northern goshawk	G5	S3B, SZN	BLM, FS
Charadrius montanus	mountain plover	G2	S2B	BLM, FS, SC
Phalaropus tricolor	Wilson's phalarope	G5	S4B, S4N	
Mammals				
Tadarida brasiliensis	Brazilian free-tailed bat	G5	S1	
Thomomys talpoides agrestis	northern pocket gopher *agrestis* subspecies	G5T3	S3	

Table 9. The animals and a plant community of concern observed in the Baca Grande during summer 2005.

Element	Common Name	Global Rank	State Rank	Federal and State Status
PLANT COMMUNITIES				
Populus angfustifolia- Juniperus scopulorum woodland	Montane Riparian Forest	G2G3	S2	

Table 10. Common animals and plant communities observed in the Baca Grande during summer 2005.

Element	Common Name	Global Rank	State Rank	Federal and State Status
ANIMALS				
Amphibians				
Ambystoma tigrinum	tiger salamander	G5	S5	
Pseudacris triseriata	chorus frog	G5	S5	
Birds				
Agelaius phoeniceus	red-winged blackbird	G5	S5	
Anas crecca	green-winged teal	G5	S5B, S4N	
Bubo virginianus	great horned owl	G5	S5	
Buteo jamaicensis	red-tailed hawk	G5	S5B, S5N	
Colaptes auratus	northern flicker	G5	S5	
Contopus sordidulus	western wood-pewee	G5	S5	
Corvus brachyrhynchos	American crow	G5	S5	
Dendroica coronata	yellow-rumped warbler	G5	G5	
Gallinago delicata	Wilson's snipe	G5	S5	
Gymnorhinus cyanocephalus	pinyon jay	G5	S5	
Icterus bullockii	Bullock's oriole	G5	S5	
Oreoscoptes montanus	sage thrasher	G5	S5	
Passerculus sandwichensis	savannah sparrow	G5	S4B	
Petrochelidon pyrrhonota	cliff swallow	G5	S5B	
Pica hudsonia	black-billed magpie	G5	S5	
Poecile gambeli	mountain chickadee	G5	S5	
Sialia currucoides	mountain bluebird	G5	S5	
Spizella breweri	Brewer's sparrow	G5	S4B	
Sturnella neglecta	western meadowlark	G5	S5	
Tachycineta bicolor	tree swallow	G5	S5	
Tachycineta thalassina	Violet-green swallow	G5	S5	
Troglodytes aedon	house wren	G5	S5	
Turdus migratorius	American robin	G5	S5	
Xanthocephalus xanthocephalus	yellow-headed blackbird	G5	S5	
Zenaida macroura	mourning dove	G5	S5	
Fish				
Pimephales promelas	fathead minnow	G5	S5	
Insects				
Papilio rutulus	western tiger swallowtail	G5	S5	
Plebejus lupini	lupine blue	G5	S5	

Table 10. Common animals and plant communities observed in the Baca Grande during summer 2005.

Element	Common Name	Global Rank	State Rank	Federal and State Status
Pontia protodice	checkered white	G4	4	
Vanessa cardui	painted lady	G5	S5B	
Mammals				
Antilocapra americana	pronghorn	G5	S4	
Cervus elaphus	American elk	G5	S5	
Dipodomys ordii	Ord's kangaroo rat	G5	S5	
Lasiurus cinereus	hoary bat	G5	S5	
Microtus pennsylvanicus	meadow vole	G5	S5	
Myotis ciliolabrum	western small-footed bat	G5	S4	
Neotamias minimus	least chipmunk	G5	S5	
Odocoileus hemionus	mule deer	G5	S5	
Peromyscus maniculatus	deer mouse	G5	S5	
Sciurus aberti	Abert's squirrel	G5	S5	
PLANT COMMUNITIES				
Eleocharis palustris	Emergent Wetland	G5	S4	
Ericameria Nauseosa Shrubland	Rubber Rabbitbrush Shrubland	G5	S5	
Juncus balticus Herbaceous Meadow	Western Slope Wet Meadows	G5	S5	
Pinus edulis - Juniperus scopulorum Woodland [Provisional]	Foothills Pinyon-Juniper Woodland	GU	SU	
Populus angustifolia/Ericameria nauseosa Woodland	Montane Riparian Forest	GU	SU	
Populus tremuloides/Mixed Shrub	Montane Riparian Forest	GU	SU	

Table 11. Baca Grande Potential Conservation Areas.

Potential Conservation Area	Protection Urgency Rank	Management Urgency Rank
B2: Very High Biodiversity Significance		
Cottonwood Creek-Western Sangres	P2	M2
Spanish Creek	P2	M2
B3: High Biodiversity Significance		
South Crestone Creek	P2	M2
Willow Creek Cottonwood-Riparian Woodland	P2	M2
B4: Moderate Biodiversity Significance		
Baca Grande and Reserve	P2	M2
Sites of Local Significance		
Spanish Wetlands	NA[1]	NA

[1] NA – not applicable.

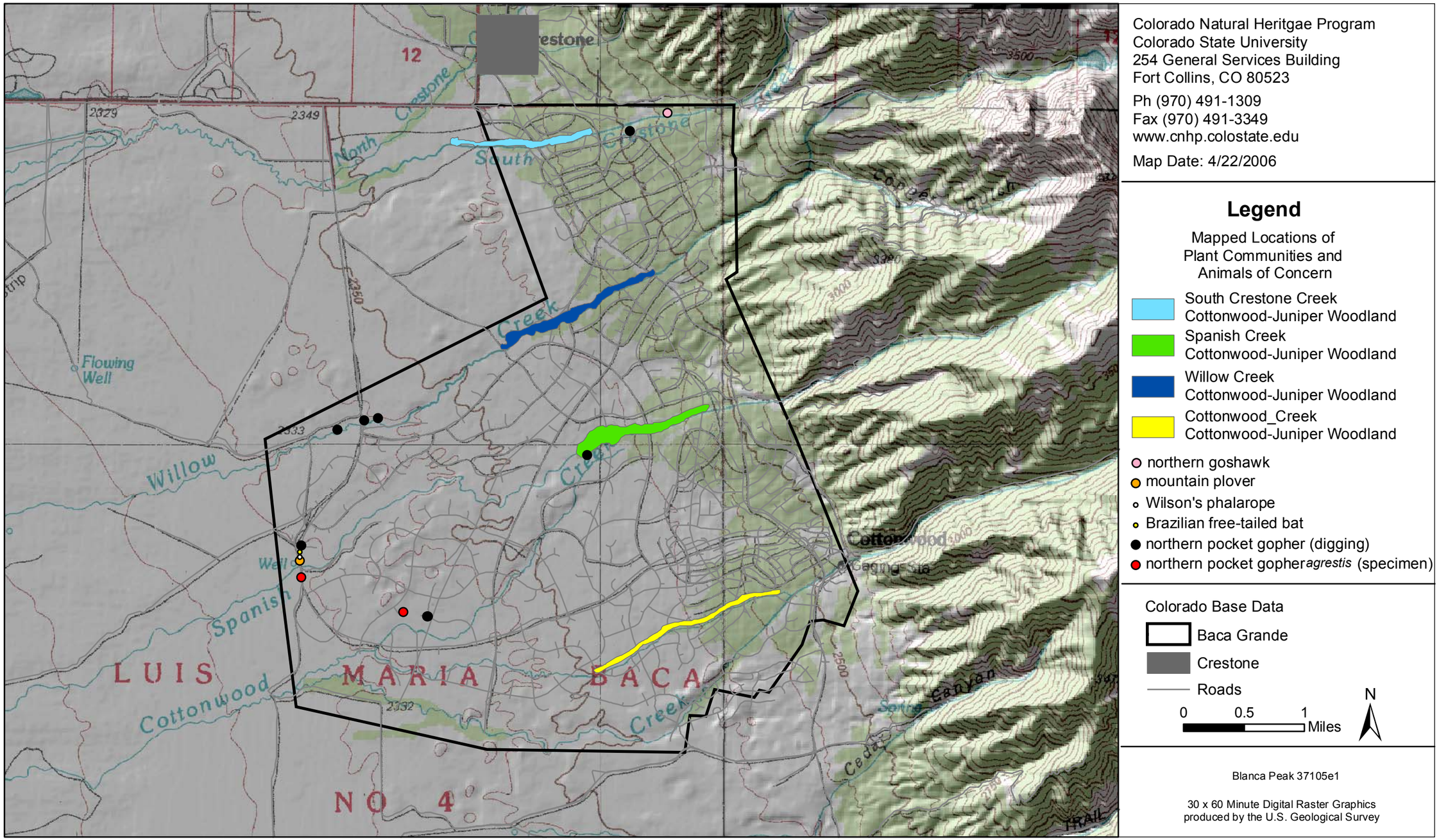
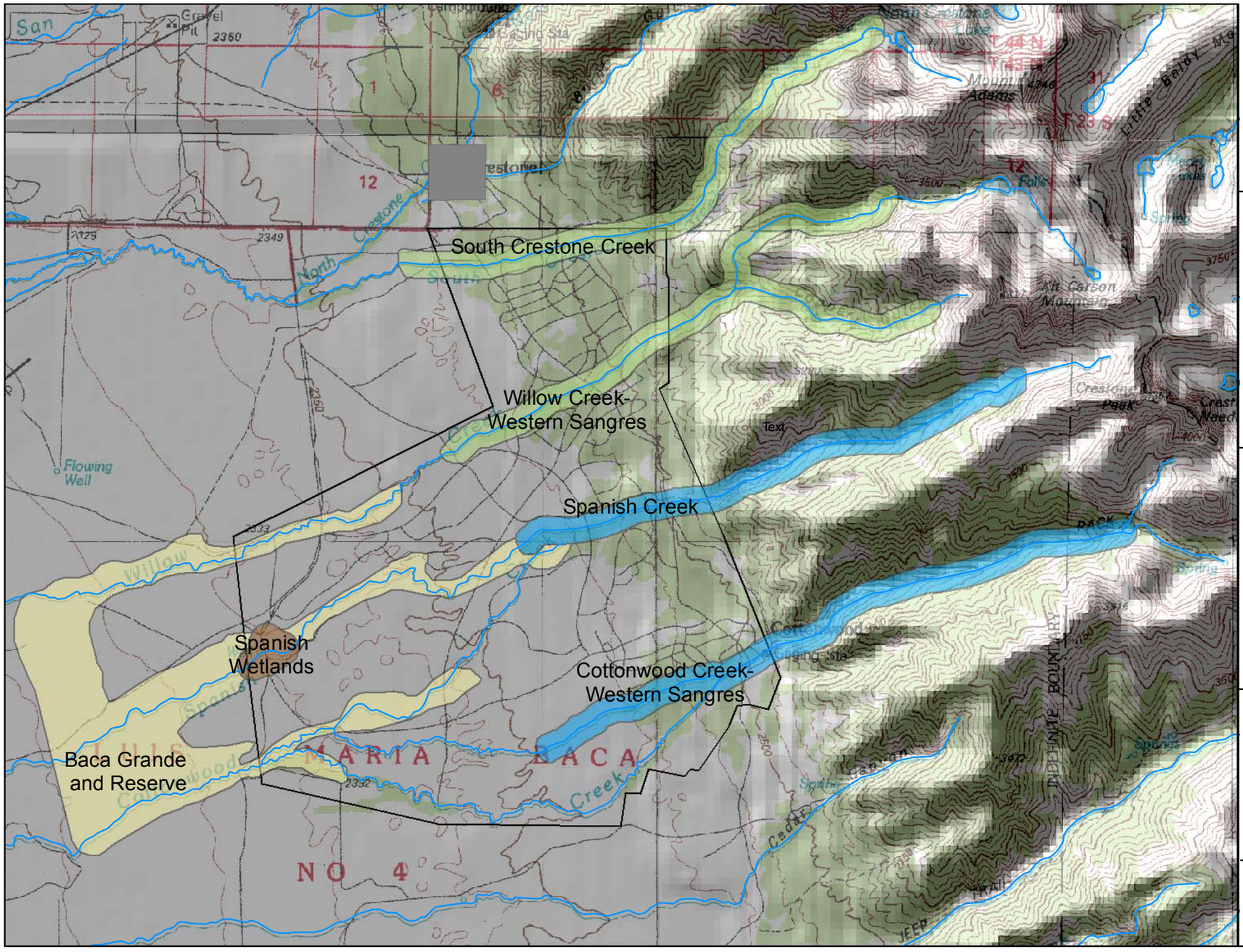


Figure 7. The location of occurrence for 5 animals and multiple occurrences of a plant community of concern documented at the Baca Grande.



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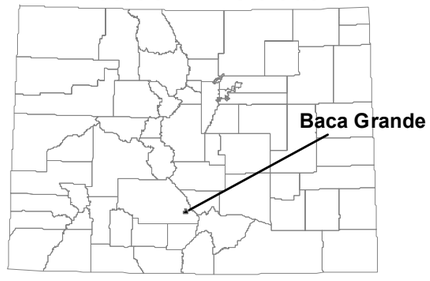
Map Date: 5/18/2006

Legend

CNHP Potential Conservation Areas (PCAs) by Biodiversity Significance Rank and Sites of Local Significance (SLS)

- B2: Very High Biodiversity Significance
- B3: High Biodiversity Significance
- B4: Moderate Biodiversity Significance
- Site of Local Significance

Location in Colorado



Colorado Base Data

- Baca Grande
- Crestone
- Creeks
- Roads

0 1 2 Miles

N

Blanca Peak 37105e1
Canon City 38105a1
30 x 60 Minute Digital Raster Graphics
produced by the U.S. Geological Survey

Figure 8. The location of Potential Conservation Areas and the Site of Local Significance on the Baca Grande (please note that sensitive species and plant communities may also exist outside of PCA or SLS boundaries).

Highlights: Globally and/or Statewide Rare, Imperiled or Vulnerable Plant Communities and Animals

Narrowleaf Cottonwood – Rocky Mountain juniper Woodland (*Populus angustifolia- Juniperus scopulorum* Woodland)

The narrowleaf cottonwood and Rocky Mountain juniper woodland community is imperiled (S2) in Colorado where there are only 38 recorded occurrences (Figure 9), and is globally imperiled (G2G3). This community has only been documented in Colorado, north-central Wyoming and northern New Mexico, and it may occur in Utah (NatureServe 2006). Cottonwood-juniper woodlands occur on both sides of the continental divide in Colorado, between 5,725 and 7,875 feet (1,740-2,400 m) (NatureServe 2006). In Saguache County, there are eight known occurrences of this community and four of these are in the Baca. Newly-mapped occurrences of this plant community are found along all four creeks (South Crestone, Willow, Spanish and Cottonwood) that cross the Baca. Within the Baca this plant community is found in four PCAs (Table 12).

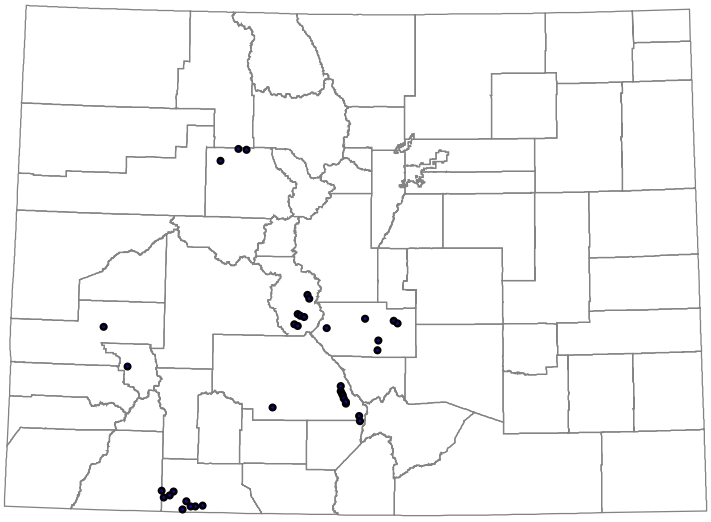


Figure 9. Distribution of the narrowleaf cottonwood – Rocky Mountain juniper woodland community in Colorado.

Cottonwood-Juniper dominated riparian areas occur along lower foothill streams with perennial to intermittent stream flows. Total biomass and canopy cover is usually low. The association is characterized by an open canopy of narrowleaf cottonwood and Rocky Mountain juniper, often with graminoids growing in the understory (Photo 1). The species composition and percent cover is variable and depends on aspect, elevation, and stream flow, in addition to the degree of disturbance by recreational use and livestock grazing.

Table 12. Baca Grande PCAs supporting narrowleaf cottonwood – Rocky Mountain juniper woodland.

Potential Conservation Area	Biodiversity Rank
Cottonwood Creek-Western Sangres	B2
Spanish Creek	B2
South Crestone	B3
Willow Creek-Western Sangres	B3

Photo 1. Understory of a narrowleaf cottonwood – Rocky Mountain juniper woodland.

Brazilian free-tailed bat (*Tadarida brasiliensis*)

In Colorado, the Brazilian free-tailed bat (*Tadarida brasiliensis*) is extremely rare (S1) with only 17 recorded occurrences (Figure 10). However, this bat is common globally (G5) occurring throughout the southern U. S., Mexico, Central America, and throughout much of South America (NatureServe 2006). In Saguache County, there are only three records for Brazilian free-tailed bat populations and one of these records is from this assessment of the Baca. The one SLS within the Baca supports this bat (Table 13) (Figure 8).

The Brazilian free-tailed bat commonly roosts in caves and mines and is very social, with nursery colonies of 10 to 20 million individuals (CDOW 2006a). A colony in Colorado at the Orient Mine in Saguache County has an estimated population of as many as 250,000 individuals, and is the largest colony in Colorado (CDOW 2006a). The bats recorded from the Baca were probably foraging individuals from the Orient Mine, making this wetland an important source of food and water for this colony. The Brazilian free-tailed bat is migratory and travels south to Mexico and Central America for the winter. Predators of this bat include owls, kestrels (*Falco sparverius*), various hawks, raccoons (*Procyon lotor*), skunks (*Mephitis mephitis*) and snakes. Populations of the Brazilian free-tailed bat are thought to be in decline; a decline apparently caused by disease, pesticide poisoning, and human disturbance of nursery colonies (CDOW 2006a). This species feeds on flying insects including moths, flying ants, and beetles and will often fly considerable distances to favorite feeding areas (NatureServe 2006), and it deserves continued respect, study and protection.

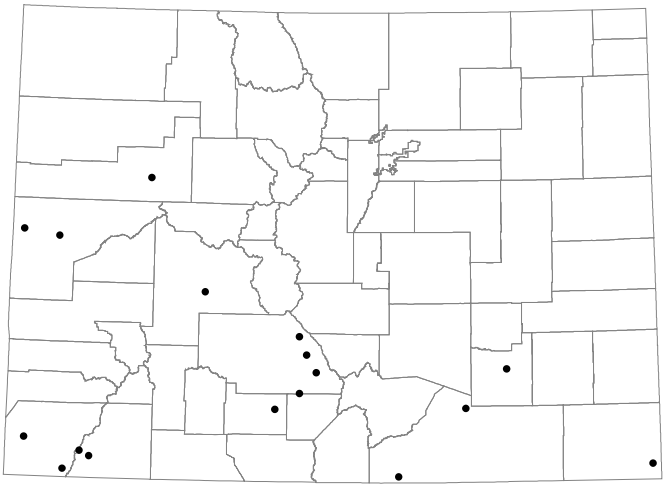


Figure 10. Distribution of the Brazilian free-tailed bat in Colorado

Table 13. The Baca Grande SLS supporting the Brazilian free-taield bat.

Site of Local Significance	Biodiversity Rank
Spanish Wetlands	Not Applicable

Photo 2. Brazilian free-tailed bat.

Mountain Plover (*Charadrius montanus*)

In Colorado, mountain plover (*Charadrius montanus*) occur in South Park, on the eastern plains, and in the San Luis Valley (Figure 11). There are 115 records of this globally imperiled (G2) bird in CNHP's BIOTICS database, but more occurrences are discovered annually. Mountain plover are globally imperiled (G2) with a restricted breeding range that includes Montana, Wyoming, Colorado, New Mexico, and the Texas Panhandle north to Nebraska. It is estimated that the population in Colorado includes a high percentage of the total breeding population, with the Pawnee National Grasslands representing 10 to 20 percent of the total breeding population, and with another 40 to 50 percent of the breeding population in southeastern Colorado (Nature Serve 2006). The one SLS within the Baca supports this bird (Table 14) (Figure 8). The breeding range of this species has undergone a dramatic long-term contraction, both in Colorado (Andrews and Righter 1992) and throughout the western Great Plains (Graul and Webster 1976). Breeding Bird Survey data indicate a significant decline of 3 percent per year in the continental population during the period 1966 to 2004 (Sauer et al. 2005). Once widely distributed in eastern Colorado (Sclater 1912, Bailey and Niedrach 1965), the mountain plover underwent a dramatic range reduction due to loss of habitat, as native prairie was converted to cropland (see refs. in Andrews and Righter 1992). Additional threats to mountain plover and their habitat include gas, oil, and mineral extraction activities, livestock grazing and spring plowing (the timing and extent), collisions with motor vehicles, and recreational activities (Underwood 1994). Breeding mountain plover occupy open habitats with low-growing vegetation, especially shortgrass prairie of blue grama grass and buffalo grass (Graul 1975, Graul and Webster 1976, Knopf and Miller 1994). In grasslands where vegetation grows taller than approximately three inches, mountain plover use intensively grazed areas (Graul and Webster 1976, Knopf 1996), prairie dog towns (Knowles et al. 1982, Knowles and Knowles 1984, Olson and Edge 1985, Shackford 1991), and fallow or recently plowed agricultural fields (Shackford 1991, Shackford et al. 1999).

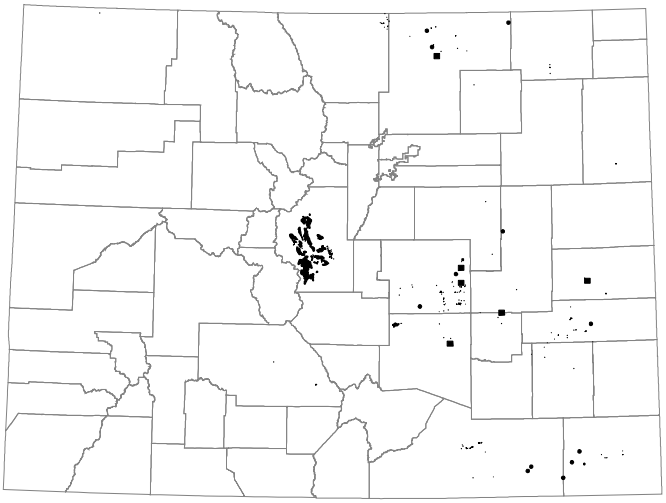


Figure 11. Distribution of the mountain plover in Colorado.

Table 14. The Baca Grande SLS supporting the mountain plover.

Site of Local Significance	Biodiversity Rank
Spanish Wetlands	Not Applicable

Photo 3. Mountain plover.

Northern Goshawk (*Accipiter gentiles*)

In Colorado, northern goshawk (*Accipiter gentiles*) occur throughout the western half of the state (Figure 12). There are 359 records of this state vulnerable (S3B) raptor in CNHP's Observation Database. Northern goshawk are demonstrably secure (G5) with a global distribution that extends from northern Mexico to Alaska and which includes most of Canada and the northern U. S. This goshawk record from the Baca is of a nesting goshawk within the riparian corridor of South Crestone Creek towards the eastern boundary of the Baca (Figure 7). Trends for this species are difficult to determine because data are lacking. In the western U. S., it is believed that clearcut logging of old-growth forests, fire suppression, and catastrophic fire are causing declines in northern goshawk populations (NatureServe 2006). However, data to support this decline is inconclusive (Kennedy 1997) and BBS data indicates an increase of 1.55 percent per year between 1966 and 2004 (Sauer et al. 2005). This species requires large blocks of forest for nesting and foraging (Kingery 1998) and nesting birds will reuse the same territory year after year and sometimes reuse the same nest. Pairs typically have one or more alternate nests within the same territory and may desert one nest and then return to it in a later year (Kingery 1998). Human disturbances around nesting sites may upset breeding goshawks causing them to abandon their nest (Kingery 1998).

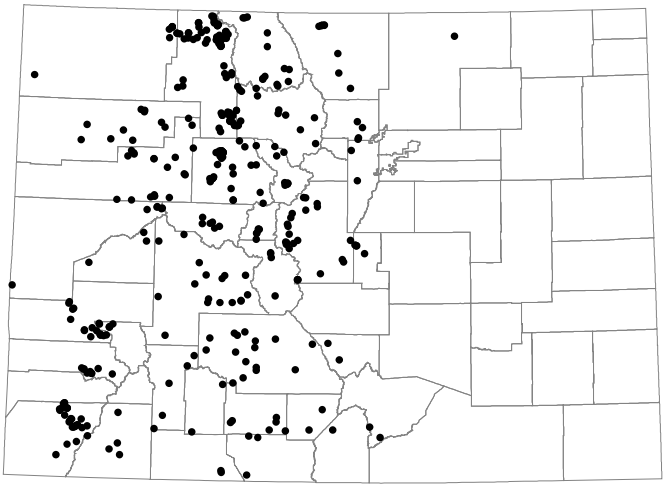


Figure 12. Distribution of the northern goshawk in Colorado.

Photo 4. Northern Goshawk.

Northern Pocket Gopher (Thomomys talpoides agrestis)

There are nine subspecies of northern pocket gopher (*Thomomys talpoides*) found in Colorado (Fitzgerald et al. 1994). Subspecies *T. t. agrestis* is endemic to the San Luis Valley (Figure 13). There are six records of this state vulnerable (S3) subspecies in CNHP's BIOTICS database. The *T. t. agrestis* subspecies is also globally vulnerable (G5T3). Northern pocket gophers occur over much of the northern Great Plains from southern Canada south to northern New Mexico and Arizona. The *T. t. agrestis* subspecies is narrowly distributed in the San Luis Valley, north and east of the Rio Grande (Armstrong 1972). Fresh diggings of this subspecies are sparsely scattered along the lower riparian areas of the Baca (Figure 7). There is one PCA within the Baca supporting this animal (Table 15) (Figure 8). The PCA offers an outstanding opportunity to support the continued viability of this population of the *T. t. agrestis* subspecies by preserving suitable habitat in its present state (e.g., free of surface disturbance from recreation, or residential and commercial development). The Baca appears to supply all of this subspecies' ecological requirements, including a large enough area of suitable habitat with proper soils, drainage, soil moisture content, and forage availability. There are no recent population studies of this subspecies, but field observations suggest that it may be stable at several sites in the San Luis Valley (C.A. Pague, unpubl. data). Land-use conversion could have negative impacts on the viability of this subspecies.

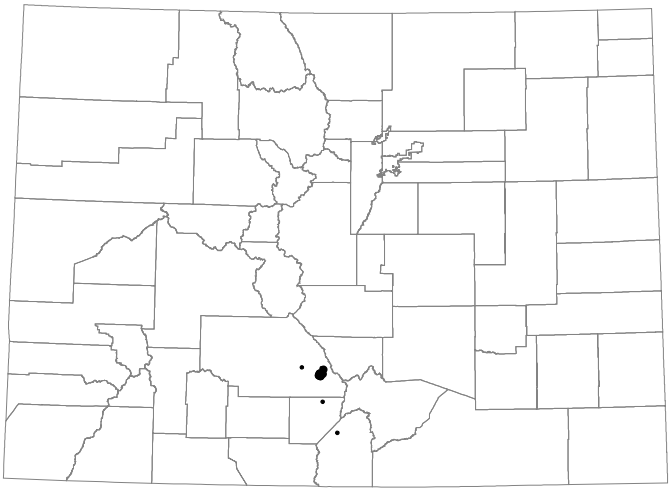


Figure 13. Distribution of the northern pocket gopher *agrestis* subspecies in Colorado.

Table 15. The Baca Grande PCA supporting the mountain plover.

Potential Conservation Area	Biodiversity Rank
Baca Grande and Reserve	B4

Photo 5. A northern pocket gopher (*Thomomys talpoides*) crosses the snow in Rocky Mountain National Park. Photo courtesy of the National Park Service.

Wilson's Phalarope (*Phalaropus tricolor*)

In Colorado, breeding occurrences of Wilson's phalarope occur throughout the state, and they are apparently secure with 25 breeding sites recorded statewide (Kingery 1998) (Figure 14). Wilson's phalarope is globally secure (G5) and ranges from coastal British Columbia and northern Alberta, south to central California and east to Kansas, with populations around the Great Lakes and in New Brunswick and Nova Scotia (McAlpine et al. 1988, AOU 1998). A male and female pair was observed within the SLS developed for the Baca (Table 16) (Figure 8). This bird is reported to be in decline because of the loss and degradation of wetlands. Wilson's phalarope nest on the ground in shallow freshwater and saline ponds, marshes and wet meadows (AOU 1998). It is important that both seasonal and semipermanent wetlands be protected to provide suitable habitat during both wet and dry years (Colwell and Oring 1988). In addition, wet-meadow areas near deeper wetlands should be protected during the breeding season so that adults can move young from nests to brooding areas without needing to travel overland for long distances, which exposes both adult and young birds to a greater chance of predation.

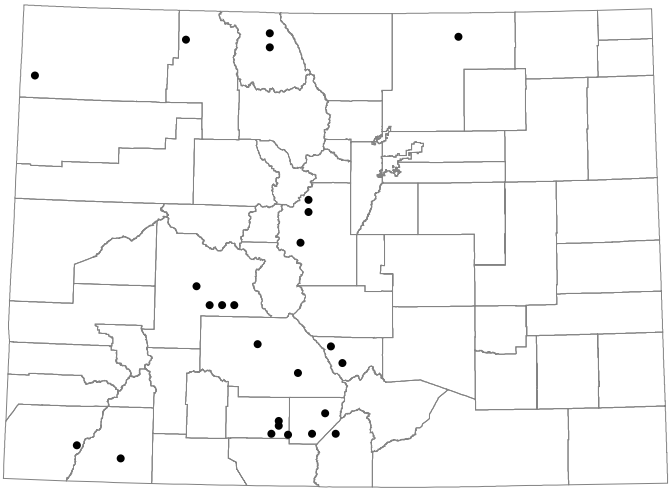


Figure 14. Distribution of Wilson's phalarope in Colorado (after Kingery 1998).

Table 16. The Baca Grande PCA supporting Wilson's phalarope.

Potential Conservation Area	Biodiversity Rank
Spanish Wetlands	Not Applicable

Photo 6. Wilson's phalarope.

Other Highlights

Ungulate Populations

Evidence of elk was common throughout the Baca including heavy grazing of willows at the Spanish Wetland SLS and an abundance of scat observed in the Spanish Meadows, an open grass meadow south of the Spanish Creek Cottonwood and Juniper Woodland PCA. In addition, pronghorn were also observed on the Baca, with lone individuals as well as groups of a few to more than 5 individuals spread throughout the Baca. Species activity maps from the Colorado Division of Wildlife (2006b) indicate that portions of the Baca below 8,600 feet (2620 m) in elevation are severe winter range for elk (Figure 15). Severe winter range is defined as those areas where 90% of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten. In addition, pronghorn winter range overlaps the Baca at elevations below 8,000 feet (2,438 m) (Figure 15). If elk and pronghorn are to remain viable at the Baca, then large undisturbed areas for browsing and grazing should be maintained, and undisturbed corridors between the Baca and the Baca NWF to the west, the Great Sand Dunes National Park and Preserve to the south, and the U. S. National Forest to the east should be maintained. This will require that the Crestone community work with partners and neighbors to preserve movement corridors in a natural state - a difficult task given pressures of development being exerted on the area.

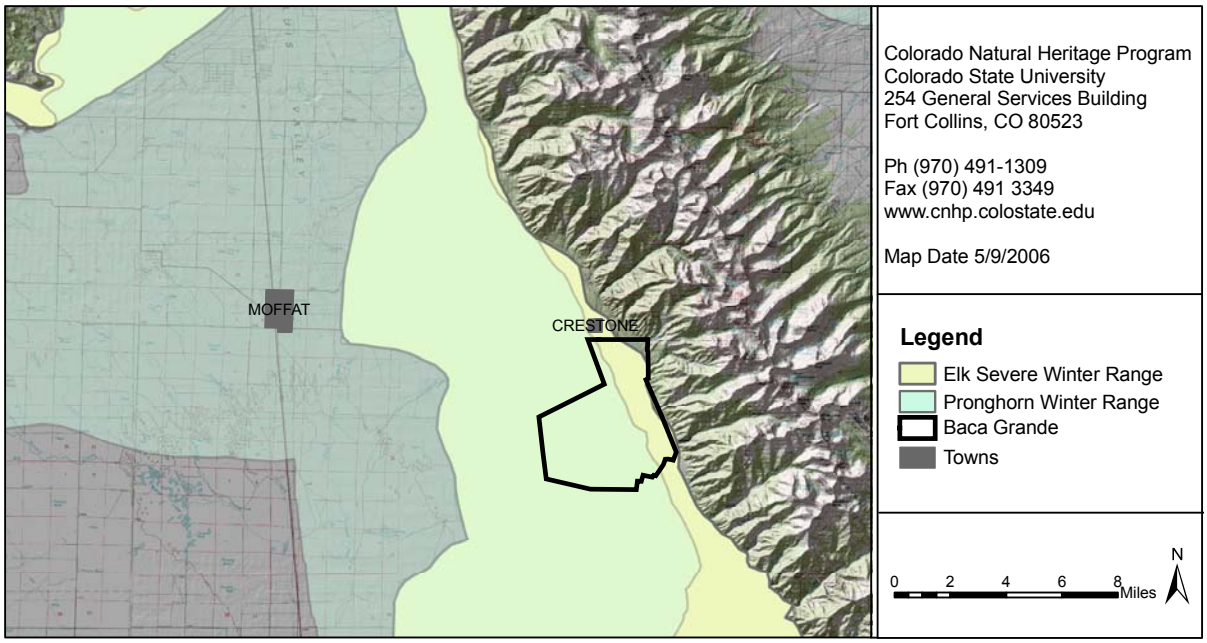


Figure 15. Elk severe winter range and pronghorn winter range in the area of the Baca Grande (after CDOW 2006b).

Photo 7. Pronghorn on the Baca Grande.

Fish Populations

Seining was performed to survey the fish community in Cottonwood, Spanish, and Willow creeks and the only fish recorded was the fathead minnow (*Pinephales promelas*) (Table 10). However, during the summer of 2005 a new population of the Rio Grande chub (*Gila pandora*) was recorded in the Baca NWR just downstream of the Baca in a ditch associated with South Crestone Creek by the Colorado Division of Wildlife. In addition to the chub, a population of the Rio Grand sucker (*Catostomus plebeius*) was also recorded from the same locale. The Rio Grande chub and Rio Grande sucker are globally vulnerable (G3 and G3G4 respectively) and state extremely rare (S1? and S1, respectively) fishes, which are listed as species of concern by the State of Colorado and are on the Forest Service sensitive species list. The Rio Grande chub is also on the Bureau of Land Management sensitive species list.

Protection of the riparian corridor associated with South Crestone Creek from residential development and nutrient enrichment will help to maintain the downstream water quality and benefit these rare fish populations.

Potential Conservation Area and Sites of Local Significance Profiles

The four Baca PCAs and one SLS documented in this report are profiled in this section. The PCAs are organized in descending order, most important to least important, according to their Biodiversity Rank (e.g., B2 to B4). Each PCA profile includes the following information:

Biodiversity Rank (B-rank): The overall significance of the PCA in terms of rarity of the biological resources and the quality (condition, abundance, etc.) of their occurrences. Please see Table 4 for rating criteria for the biodiversity ranks.

Protection Urgency Rank (P-rank): An estimate of the timeframe in which conservation protection should occur. This rank generally refers to the need for a major change of protective status (e.g., ownership or designation as a natural area). Please see Table 5 for the definitions of the ranks.

Management Urgency Rank (M-rank): An estimate of the timeframe in which conservation management should occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (legal, political, or administrative measures). See Table 6 for the definitions of the ranks.

Location: General location and specific road/trail directions.

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

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

Biodiversity Comments: A synopsis of the rare species and significant plant communities that occur in the PCA. A table within the PCA profile lists the element occurrences found within the PCA, their rarity ranks, the occurrence ranks, federal and state agency designations, and the last observation date. When the same element is listed more than once in the table, it is because there are multiple element occurrences of that element within the PCA. Where there is more than one element occurrence in the PCA, the occurrence(s) of primary of concern is in boldface in the table. See Table 1 for explanations of global and state imperilment ranks and Table 2 for legal designations.

Boundary Justification: Justification for the location of the preliminary conservation planning boundary delineated in this report, which includes all known occurrences of biological resources and, in some cases, adjacent lands required for their protection.

Protection Comments: A summary of major land ownership issues that may affect the PCA and the element(s) in the PCA.

Management Comments: A summary of PCA management issues that may affect the long-term viability of the PCA.

In addition, one Site of Local Significance (SLSs) was identified in order to emphasize biological resources that are not among the highest priorities for conservation at a statewide level, but are

nonetheless significant for supporting species at the Baca Grande. SLSs contribute to the character of the local area and the local diversity of plants and communities present, and therefore warrant conservation consideration. The SLS designated on the Baca Grande harbors important ecological resources for animals of conservation priority, and requires specific management activities to maintain ecosystem health and the health of the species it supports. Occurrence of the biological resources highlighted within these PCAs and the SLS are not restricted to within the site boundary. Rather, the area of habitat required to support the highest quality occurrences of these resources on the Baca are delineated by the boundaries.

B2 Potential Conservation Areas

Cottonwood Creek-Western Sangres

Biodiversity Rank: B2 (Very high biodiversity significance)
This PCA supports a good (B-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* woodland) and an excellent ranked (A-ranked) occurrence of a globally vulnerable (G3?) plant community (*Psuedotsuga menziesii/Betula occidentalis* woodland).

Protection Urgency Rank: P2 (High urgency)
There is an outstanding opportunity to eliminate the threats to the riparian woodlands of Cottonwood Creek if action is taken over the next five years to appropriately manage residential development within the Baca Grande.

Management Urgency Rank: M2 (High urgency)
The riparian community within the PCA will benefit from management designed to maintain the natural hydrology, prevent excessive residential development, and control weeds.

Location: This PCA is located on the Baca Grande development, south of Crestone in the San Luis Valley of Colorado. The eastern side of the PCa is where the Camino Baca Grande road crosses Cottonwood Creek.

Legal Description:
U.S.G.S. 7.5-minute quadrangle: Crestone

Size: 931 acres (377 ha) **Elevation:** 7,700 – 11,320 feet (2,347 – 3,450 m)

General Description: This PCA starts in the upper subalpine region of the Sangre de Cristo Mountains near the mouth of Cottonwood Creek and extends downstream along the creek to where juniper no longer occurs in the riparian corridor. At the upper reaches of the PCA there is an excellent example of a Douglas fir (*Psuedotsuga menziesii*) and water birch (*Betula occidentalis*) woodland. This community is located at the entrance to a moderately wide canyon with granite walls and it is in pristine condition without non-native species. The only threat appears to be recreational use, mainly hiking. As the stream grade becomes more gradual at about 8,100 feet (2,470 m), changes in geomorphology causes increased meandering of the creek, creating habitat upon which a narrowleaf cottonwood and Rocky Mountain juniper woodland has become established. This mature community seems to be undergoing some regeneration of cottonwood, particularly within areas where the recent drought has resulted in cottonwood die-off. However, very few young juniper are present. The cover of native plants within the PCA is extensive.

At the lowest elevations of the PCA the adjacent upland is comprised of grassland that includes western wheatgrass (*Pascopyrum smithii*), muhly (*Muhlenbergia* sp.), and blue grama (*Chondrosum gracile*). There are patches of rabbitbrush (*Ericameria nauseosa*)

scattered within this grassland at the edges of the riparian woodland. Moving upstream, the adjacent landscape includes pinon pine (*Pinus edulis*) and Rocky Mountain juniper in the middle third of the PCA and at higher elevations in the subalpine zone there is a mixed conifer and deciduous forest and shrubland that includes Douglas fir, white fir (*Abies concolor*), blue spruce (*Picea pungens*), Engelmann spruce (*Picea englemannii*), quaking aspen (*Populus tremuloides*), water birch, Rocky Mountain maple (*Acer glabrum*), and mountain spray (*Holodiscus dumosus*). Some pinon pine and ponderosa pine occur at this elevation.

The current condition of the riparian woodland is good. There is a high percentage of cover of native plant species within the riparian woodland and at present there is little land use within the riparian corridor itself. The interaction of the stream with its floodplain is currently intact and undisturbed by channelization or structures such as houses, and there are few upstream water retention structures (e.g. reservoirs). There is also good regeneration of cottonwood along the creek in areas of recent cottonwood die-off. The PCA is within the Baca Grande subdivision and the potential for disturbance from increased residential development is high, which could increase sedimentation in the creek and fragmentation of the riparian corridor. Also, nutrient enrichment within the creek from septic systems has the potential to increase with additional development, and enrichment may already be causing algal blooms as evidenced by the abundant algae observed in this creek, and which occur in all creeks of the Baca mainly at lower elevation. In addition, increasing water demand associated with development may require more diversion of surface and groundwater, impacting the hydrology of the riparian woodland as well as downstream wetlands on the Baca NWR. Water is already being drawn from two pumping stations on the creek (Photo 5) and an increasing human population on the Baca Grande will add additional stress to the system.

Photo 8. A water storage facility along Cottonwood Creek and a well (insert) that is pumping groundwater from along the creek.

There are no reservoirs in the drainage upstream of the occurrence, however, there is one diversion present on the stream. The natural flood regime appears intact, but where three roads bisect the creek bank stability is compromised as indicted by the unvegetated banks. In other areas of the PCA the streambank is covered by stabilizing plant growth.

The soils within this area are defined by the sandsheet that underlies the eastern portion of the San Luis Valley and which formed from the prevailing southwest winds that blow across the valley. Consequently, soils of the PCA include sandy loams and loamy sand.

Biodiversity Comments: This PCA supports a good (B-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* forest) and an excellent ranked (A-ranked) occurrence of a globally vulnerable (G3?) plant community (*Psuedotsuga menziesii/Betula occidentalis* forest). These two plant communities represent unique assemblages of plant species, and each community occurs at fewer than 40 locations each, in Colorado. Conservation of these two types of plant communities where ever they occur in Colorado, and elsewhere, is important to sustaining the unique plant assemblages associated with them and the animals they support.

The boundary of this PCA includes the riparian zone, floodplain, and some upland habitats of the upper half of Cottonwood Creek. The waters of this creek assist with recharging the wetlands of the Baca NWR, which borders the Baca on its western boundary. The health, viability, and water quality of the wetlands on the Baca NWR are dependent upon the nine creeks supplying their water. Protection of the riparian corridor along Cottonwood Creek will help to maintain the quality of the wetlands on the reserve.

Table 17. Natural Heritage element occurrences at the Cottonwood Creek-Western Sangres PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
***Populus angfustifolia-Juniperus scopulorum* woodland**	**Montane Riparian Forest**	**G2G3**	**S2**	**None**	**None**	**None**	**B**	**7/20/05**
Psuedotsuga menziesii/Betula occidentalis	Montane Riparian Forest	G3?	S3	None	None	None	A	6/29/1997

*EO = Element Occurrence
Note: Bold type indicates the primary element occurrence(s) upon which the Biodiversity rank is based.

Boundary Justification: The boundary was developed using orthophoto[1] quads and distribution information from field surveys identifying the extent of both the narrowleaf cottonwood – Rocky Mountain juniper and Douglas fir – water birch woodlands. The PCA includes the length of Cottonwood Creek, buffered by 656 feet (200 m) (Larsen et al. 2006, Spackman and Hughes 1995) on each side, from the lowest point of the cottonwood-juniper

[1] Digital orthophoto quads are photo maps that combine the image characteristics of an aerial photograph with the geometric qualities of a map, and which allow for the measurement of true distances.

woodland to an area upstream in the Sangre de Cristo Mountians. The area within the PCA should be managed to protect the long-term integrity of the floodplain and the sources of both surface and groundwater recharge and flow, which are responsible for supplying water to the riparian plant community. This boundary also includes the upstream slopes of the riparian corridor outside of the Baca, and this area should also be managed to protect against disturbances within the boundary.

Protection Comments: There is an opportunity to eliminate the threats to the riparian woodlands of Cottonwood Creek if action is taken to appropriately manage residential development within the Baca Grande. The PCA includes property representing many owners, but the entire development is managed by the Baca Grande Property Owners Association (POA). Residents of the Crestone community, and the members of the POA, are interested in developing the Baca Grande in an environmentally friendly manner. Developing conservation easements on any parcels within 656 feet (200 m) of Cottonwood Creek within the PCA would benefit riparian biological function, as would covenants prohibiting development within this 656 foot buffer (Larsen et al.2006, Spackman and Hughes 1995)

Management Comments: The riparian community within the PCA would benefit from management designed to maintain the natural hydrology, prevent development, and control weeds. Important management considerations include appropriate planning of residential development to avoid loss of vegetation within the PCA that can increase sedimentation and fragment the native plant community, proper regulation of septic systems to avoid nutrient enrichment, and maintenance of the natural hydrology to promote the health of the native riparian plant community. Also important, will be the development of landscaping guidelines that restrict non-native species, which can escape residential gardens and dominate native plant communities, and areas of turfgrass that require intensive irrigation and fertilization. Logging or development along slopes of the creek at higher elevation will increase erosion and runoff, which will compromise the health of riparian communities and wetlands at lower elevations along the creek.

From ground surveys it is clear that the historic channel of Cottonwood Creek actually lies to the south of the current channel. A diversion structure redirects water from this historic channel into a channel to the north where the cottonwood riparian forest is found (Photo 9). Wildlife signs, including observation of animals and scat suggest that the historic channel is still the preferred route for large ungulates including elk. Cottonwood and juniper also occur along this channel, but decades of water diversion have left the woodland in a degraded state with less abundant cover of trees than would occur with a more natural flow of water. Whether to open the diversion structure and allow more natural flows into the historic channel is a matter of debate for the local community, the Baca Grande POA, and the local water district administrator. It would be useful for the interested partners to determine if the current channel is natural, if so did water flow in both channels at one time, if not then why is the water being diverted, and who has ownership of the water rights. Once this is known a discussion on whether the continued diversion of this water is a valid use of the resource may be warranted. Ultimately, the best restoration action for Cottonwood Creek would be to restore flows to the historic channel with regulated flows through the diversion (i.e. the north

channel). Modifying the flow in the south channel to simulate historic flows is the best restoration strategy. Research and modeling suggest that the hydrologic characteristics important to health of the vegetation include how long flood waters extend into the spring, the fraction of the growing season that experiences elevated flows, the average groundwater level, and the water level fluctuation gradient (Leyer 2005, Toner and Keddy 1997). Consequently, sustaining flood waters into the spring for as long as possible and elevating flows through part of the growing season, followed by pulses of water to mimic the rain events of the summer monsoon season will help restore the south channel of Cottonwood Creek. Such a flow control will replenish groundwater flows to the riparian vegetation and simulate the natural water level fluctuation gradient of the stream, which is associated with the spring runoff and the summer monsoons (Figure 16). The confirmed reliance of riparian cottonwoods on adjacent stream flow emphasizes the importance of sufficient instream flows for the conservation and restoration of riparian cottonwoods (Wilms et al. 1998).

Photo 9. The diversion structure which is forcing water from the historic south channel of Cottonwood Creek into its north channel and the decree from the State of Colorado Division of Water Resources noting the closure of the structure on 22 May 2005 (insert).

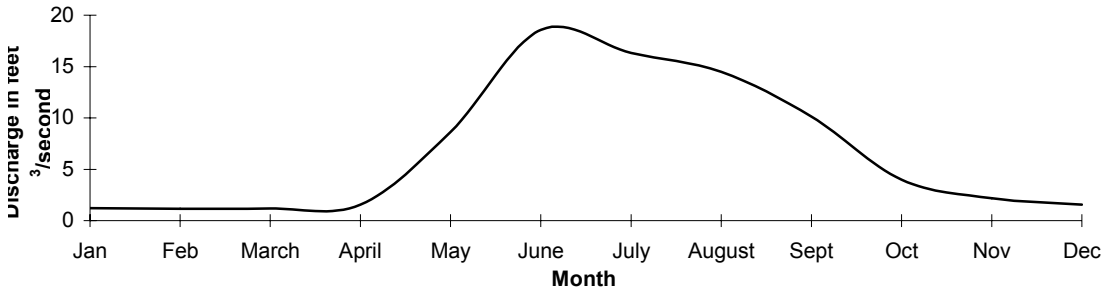


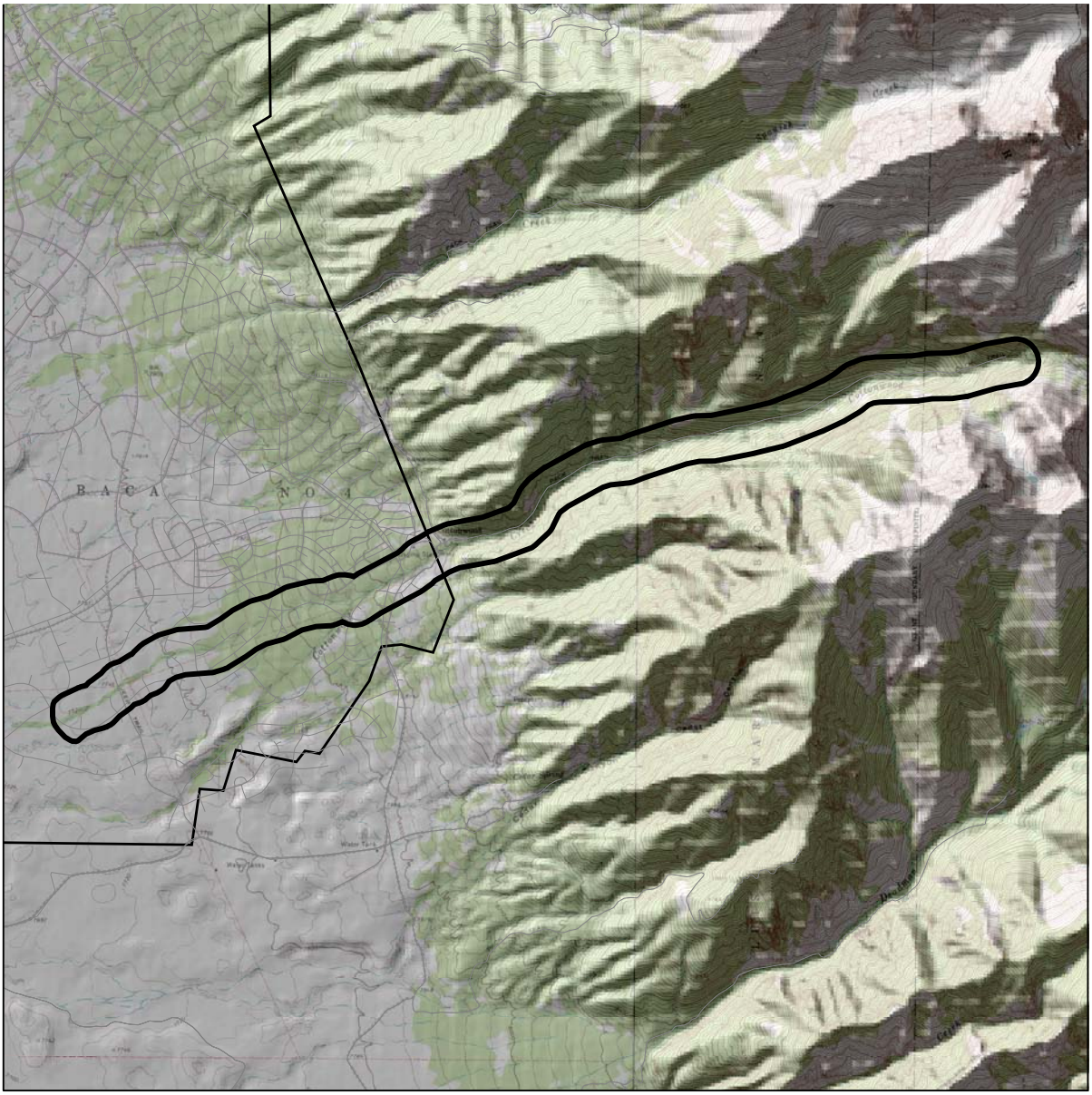
Figure 16. Mean monthly stream flow for Cottonwood Creek near Crestone, Colorado from 1967-1970 (USGS National Water Information System Web Data 2005).

If it is decided to increase flows to the historic channel, the important considerations associated with maintenance of flows in the north channel, where the PCA is located, include maintaining downstream flow schedules through the diversion that (1) retain occasional spring flooding, (2) taper off rather than abruptly drop, and that (3) provide some pulses of flow throughout the summer if enough water is available (Rood and Mahoney 1990).

Increased surface water runoff from developed areas can cause channelization and the loss of stream meanders and riffle and pool complexes. Channelization eliminates barren bars upon which cottonwood regeneration can occur and causes a loss of habitat for amphibians, fish, and aquatic invertebrates. Water quality and survival of aquatic animals is compromised by excessive runoff that causes erosion and increased sedimentation, and by nutrient enrichment from septic systems and fertilization of lawns in developed areas. Increases in surface water runoff and groundwater pumping can decrease groundwater recharge, which lowers alluvial water tables and can negatively impact riparian vegetation. All of these alterations compromise the survival of native plant species adapted to the dynamic patterns of surface and groundwater flow, and favors establishment of non-native plants. Inappropriate management of residential development leading to such alterations will compromise the integrity of the riparian woodlands. A specific concern for the Baca is that increased residential water use will deplete water resources causing a die-off of the riparian plant community. This problem will be magnified during periods of drought and the riparian plant community will be less resilient to the natural die-off of trees associated with extreme drought events because less water will be available to stimulate plant regeneration once the drought ends (Photo 10).

Currently, Canada thistle and the non-native grasses Kentucky bluegrass and smooth brome are a moderate threat to cottonwood-juniper woodland, and an integrated weed management strategy should be implemented to control these non-natives. Weeds have the potential to increase as residential development provides the opportunity for their introduction. Because the use of many pesticides is restricted within riparian zones, and care should be taken to ensure that the method of application is designed to avoid adverse impacts to native species.

Photo 10. Cottonwood die-off, possibly attributable to the 2002 drought, along Cottonwood Creek within the Cottonwood Creek-Western Sangres PCA. Because the riparian system is still functioning, numerous young cottonwoods were observed regenerating within the understory of this die-off.



0 0.25 0.5 0.75 1 Miles

N

Colorado Natural Heritage Program
Colorado State University
254 General Services Building
Fort Collins, CO 80524

www.cnhp.colostate.edu

Map Date: 4/28/2005

Legend

PCA Boundary

Baca Grande

Roads

Crestone 37105-H6
Crestone Peak 37105-H5

7.5 Minute Digital Raster Graphic produced by the U.S. Geological Survey

Location at the Baca Grande

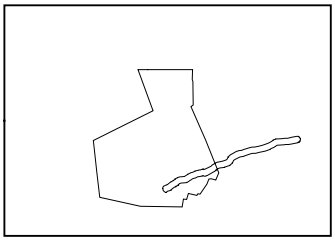


Figure 17. Cottonwood Creek-Western Sangres Potential Conservation Area. B2: Very High Biodiversity Significance.

Spanish Creek

Biodiversity Rank: B2 (Very high biodiversity significance)
This PCA supports a good (B-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* Woodland).

Protection Urgency Rank: P2 (High urgency)
There is an outstanding opportunity to eliminate the threats to the riparian woodlands of Cottonwood Creek if action is taken over the next five years to appropriately manage residential development within the Baca Grande.

Management Urgency Rank: M2 (High urgency)
The riparian community within the PCA will benefit from management designed to maintain the natural hydrology, prevent excessive residential development, and control weeds.

Location: This PCA is located on the Baca Grande development, south of Crestone in the San Luis Valley of Colorado. The eastern side of the PCA is where the Camino Baca Grande road crosses Spanish Creek.

Legal Description:
U.S.G.S. 7.5-minute quadrangle: Crestone

Size: 779 acres (315 ha) **Elevation:** 7,760 – 11,647 feet (2,365 – 3,550 m)

General Description: This PCA starts in the upper subalpine region of the Sangre de Cristo Mountains near the mouth of Spanish Creek and extends downstream along the creek to where juniper no longer occurs in the riparian corridor. As the stream grade becomes more gradual, at about 8,120 feet (2,475 m), changes in geomorphology causes increased meandering of the creek, creating habitat upon which a narrowleaf cottonwood and Rocky Mountain juniper woodland has become established. The lowest elevations of this PCA demarcate the point at which the juniper ceases to remain a part of this riparian community. Although, the regeneration of cottonwoods and juniper is less than expected, cover of native plants within the PCA is extensive. The herbaceous understory within the cottonwood-juniper woodland is comprised of western wheatgrass, Baltic rush (*Juncus balticus*), numerous *Carex* species, and a forb component that is dominated by starry false lily of the valley (*Maianthemum stellatum*). Patches of the non-native grasses Kentucky blue grass and smooth brome are common in adjacent uplands and within the understory of the riparian woodland.

At the lowest elevations of the PCA the adjacent upland is comprised of grassland that includes western wheatgrass, muhly, and blue grama. There are patches of rabbitbrush scattered within this grassland at the edges of the riparian woodland. Moving upstream, the adjacent landscape includes pinon-juniper in the middle third of the PCA and at higher elevations in the subalpine zone there is a mixed conifer and deciduous forest and shrubland

that includes Douglas fir, white fir, blue spruce, Engelmann spruce, quaking aspen, Rocky Mountain maple, and mountain spray.

The current condition of the riparian woodland is good. There is a high percentage of cover of native plant species within the riparian woodland. There is little land use within the riparian corridor itself and the continuity of the corridor is intact. The interaction of the stream with its floodplain is currently intact and undisturbed by channelization or structures such as houses, and there are no upstream water retention structures (e.g. reservoirs). Native vegetation along the streambank affords a high degree of bank stabilization throughout most of the PCA except for in a few places, where disturbances associated with construction of bridges crossing the creek have left the banks relatively unvegetated. There is also good regeneration of cottonwood along the creek in areas of recent cottonwood die-off. The PCA is within the Baca Grande subdivision and the potential for disturbance from increased residential development is high. Disturbance would increase sedimentation and nutrient enrichment in the creek, and fragment the riparian corridor. Also, nutrient enrichment within the creek from septic systems has the potential to increase with additional development, and enrichment may already be causing algal blooms as evidenced by the abundant algae observed in this creek, and which occur in all creeks of the Baca mainly at lower elevation.. In addition, increased water demand to support the human population resulting from development will require more diversion of surface and groundwater and will impact the hydrology of the riparian woodland as well as downstream wetlands on the Baca NWR.

The natural flood regime appears intact, but where three roads bisect the creek bank stability is compromised as indicted by the unvegetated banks. In other areas of the PCA the streambank is covered by stabilizing plant growth.

The soils within this area are defined by the sandsheet that underlies the eastern portion of the San Luis Valley and which formed from the prevailing southwest winds that blow across the valley. Consequently, soils of the PCA include sandy loams and loamy sand.

Biodiversity Comments: This PCA supports a good (B-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* woodland). This plant community represents a unique assemblage of plant species, and occurs at fewer than 40 locations in Colorado. Conservation of this plant community where ever it occurs in Colorado, and elsewhere, is important to sustaining the unique plant assemblage associated with it and the animals it supports.

The boundary of this PCA includes the riparian zone, floodplain, and some upland habitats of the upper half of Spanish Creek. The waters of this creek assist with recharging the wetlands of the Baca NWR, which borders the Baca on its western boundary. The health, viability, and water quality of the wetlands on the Baca NWR are dependent upon the nine creeks supplying their water. Protection of the riparian corridor along Cottonwood Creek will help to maintain the quality of the wetlands on the reserve.

Table 18. Natural Heritage element occurrences at the Spanish Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
***Populus angfustifolia-Juniperus scopulorum* woodland**	**Montane Riparian Forest**	**G2G3**	**S2**	**None**	**None**	**None**	**B**	**11/12/05**

*EO = Element Occurrence

Note: Bold type indicates the primary element occurrence(s) upon which the Biodiversity rank is based.

Boundary Justification: The boundary was developed using orthophoto quads and distribution information from field surveys identifying the extent of the narrowleaf cottonwood – Rocky Mountain juniper woodland. The PCA includes the length of Spanish Creek, buffered by 656 feet (200 m) (Larsen et al. 2006, Spackman and Hughes 1995) on each side, from the lowest point of the cottonwood-juniper woodland to an area upstream in the Sangre de Cristo Mountians. The area within the PCA should be managed to protect the long-term integrity of the floodplain and the sources of both surface and groundwater recharge and flow, which are responsible for supplying water to the riparian plant community. This boundary also includes the upstream slopes of the riparian corridor outside of the Baca, and this area should also be managed to protect against disturbances within the boundary.

Protection Comments: There is an opportunity to eliminate the threats to the riparian woodland of Spanish Creek if action is taken to appropriately manage residential development within the Baca Grande. The PCA includes property representing many owners, but the entire development is managed by the Baca Grande Property Owners Association (POA). Residents of the Crestone community, and the members of the POA, are interested in developing the Baca Grande in an environmentally friendly manner. Developing conservation easements on any parcels within 656 feet (200 m) of Spanish Creek within the PCA would benefit riparian biological function, as would covenants prohibiting development within this 656 foot buffer (Larsen et al. 2006, Spackman and Hughes 1995).

Management Comments: The riparian community would benefit from management designed to maintain the natural hydrology, prevent development, and control weeds. Important management considerations include appropriate planning of residential development to avoid loss of vegetation within the PCA that can increase sedimentation and fragment the native plant community, proper regulation of septic systems to avoid nutrient enrichment, and maintenance of the natural hydrology to promote the health of the native riparian plant community. Also important, will be the development of landscaping guidelines that restrict non-native species, which can escape residential gardens and dominate native plant communities, and areas of turfgrass that require intensive irrigation and fertilization. Logging or development along slopes of the creek at higher elevation will increase erosion and runoff, which will compromise the health of riparian communities and wetlands at lower elevations along the creek.

There is a diversion on Spanish Creek that redirects flow from the historic channel into a drainage, which flows south and eventually joins Cottonwood Creek. Maintaining flows in the historic channel is the most beneficial management strategy for assuring the integrity of the Spanish Creek riparian corridor. Allowing some flow into the diversion would benefit the current riparian woodland along this channel. However, restoring an ecologically meaningful level of flow through the diversion presents difficult challenges because the hydrology of the historic channel should not be compromised, which may require eliminating all flow through the diversion during drought years. Important considerations associated with diversion of flows, besides the above concerns stated for the historic channel, include maintaining downstream flow schedules through the diversion that (1) retain occasional spring flooding, (2) taper off rather than abruptly drop, and that (3) provide some pulses of flow throughout the summer if enough water is available (Rood and Mahoney 1990).

Increased surface water runoff from developed areas can cause channelization and the loss of stream meanders and riffle and pool complexes. Channelization eliminates barren bars upon which cottonwood regeneration can occur and causes a loss of habitat for amphibians, fish, and aquatic invertebrates. Water quality and survival of aquatic animals is compromised by excessive runoff that causes erosion and increased sedimentation, and by nutrient enrichment from septic systems and fertilization of lawns in developed areas. Increases in surface water runoff and groundwater pumping can decrease groundwater recharge, which lowers alluvial water tables and can negatively impact riparian vegetation. All of these alterations compromise the survival of native plant species adapted to the dynamic patterns of surface and groundwater flow, and favors establishment of non-native plants. Inappropriate management of residential development leading to such alterations will compromise the integrity of the cottonwood-juniper woodland. A specific concern for the Baca is that increased residential water use will deplete water resources causing a die-off of the riparian plant community. This problem will be magnified during periods of drought and the riparian plant community will be less resilient to the natural die-off of trees associated with extreme drought events because less water will be available to stimulate plant regeneration once the drought ends.

Currently, Canada thistle and the non-native grasses Kentucky bluegrass and smooth brome are a moderate threat to cottonwood-juniper woodland, and an integrated weed management strategy should be implemented to control these non-natives. Weeds have the potential to increase as residential development provides the opportunity for their introduction. Because the use of many pesticides is restricted within riparian zones, and care should be taken to ensure that the method of application be designed to avoid adverse impacts to native species.

Photo 11. Cottonwood and juniper along Spanish Creek within the Spanish Creek PCA.

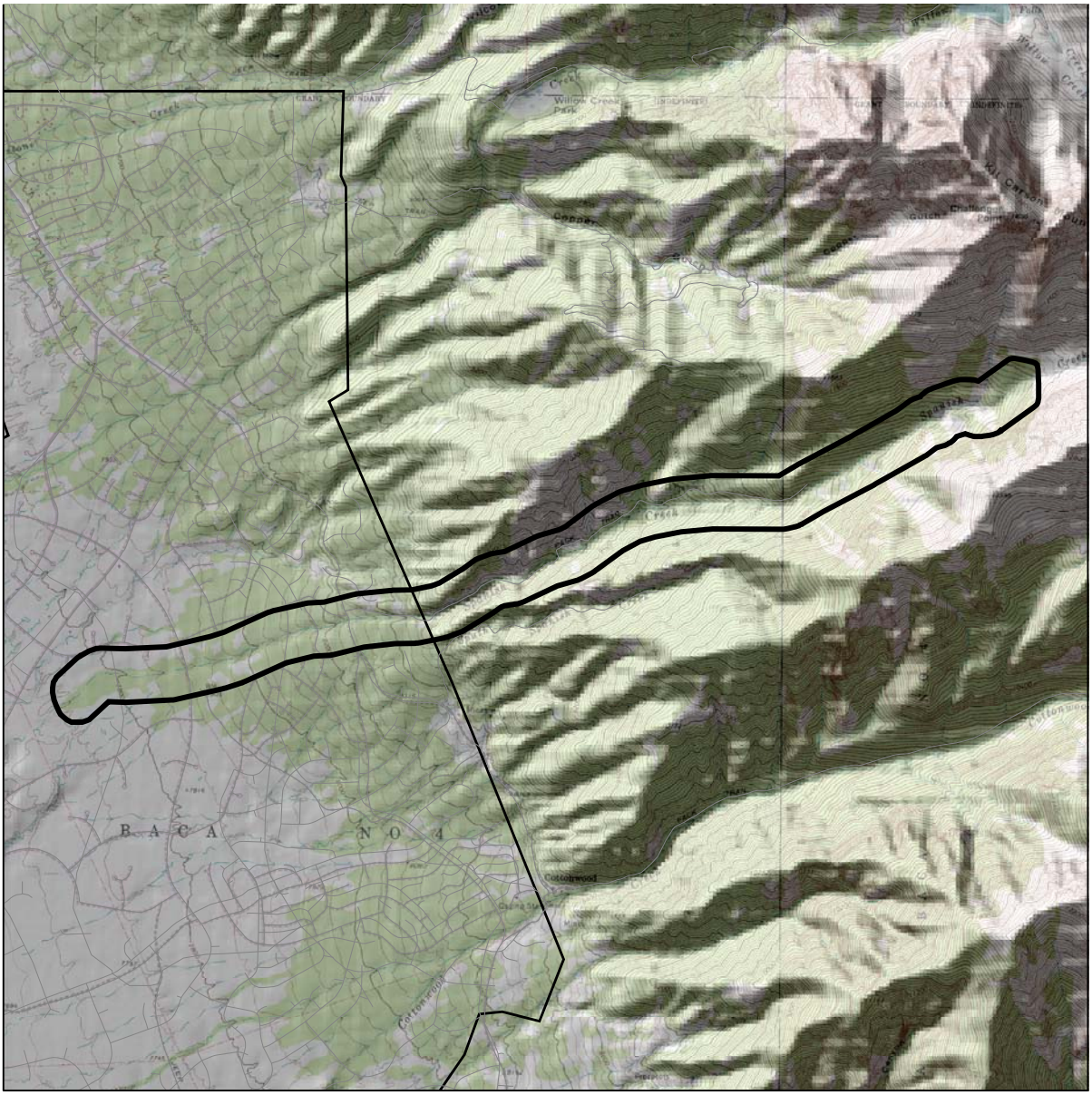


Figure 18. Spanish Creek Potential Conservation Area.
B2: Very High Biodiversity Significance.

B3 Potential Conservation Areas

South Crestone Creek

Biodiversity Rank: B3 (High biodiversity significance)
This PCA supports a fair (C-ranked) occurrence of a globally imperiled (G2G3) plant community *(Populus angustifolia-Juniperus scopulorum* Woodland).

Protection Urgency Rank: P2 (High urgency)
There is an outstanding opportunity to eliminate the threats to the riparian woodlands of South Crestone Creek if action is taken over the next five years to appropriately manage residential development within the Baca Grande.

Management Urgency Rank: M2 (High urgency)
The riparian community within the PCA will benefit from management designed to maintain the natural hydrology, prevent excessive residential development, and control weeds.

Location: This PCA is located on the Baca Grande development, south of Crestone in the San Luis Valley of Colorado. The midpoint of the PCA is where the Camino Baca Grande road crosses South Crestone Creek at the town park.

Legal Description:
U.S.G.S. 7.5-minute quadrangle: Crestone

Size: 850 acres (344 ha) **Elevation:** 7,740 – 11,890 feet (2,360 – 3,625 m)

General Description: This PCA starts in the upper subalpine region of the Sangre de Cristo Mountains near the mouth of South Crestone Creek and extends downstream along the creek to where juniper no longer occurs in the riparian corridor. As the stream grade becomes more gradual, at about 8,120 feet (2,475 m), changes in geomorphology causes increased meandering of the creek, creating habitat upon which a narrowleaf cottonwood and Rocky Mountain juniper woodland has become established. This mature community seems to be undergoing some regeneration of the cottonwood overstory, particularly within areas where the recent drought has resulted in cottonwood die-off. However, very few young Juniper are present. The cover of native plants within the PCA is extensive and the herbaceous understory within the cottonwood-juniper woodland is comprised of grasses, sedges, and forbs. However, the non-native Kentucky blue grass is common both in adjacent uplands and within the understory of the riparian woodland. The lowest elevations of this PCA demarcate the point at which the juniper ceases to remain a part of the riparian community.

At the lowest elevations of the PCA the adjacent upland is comprised of grassland that includes western wheatgrass, muhly, and blue grama. There are patches of rabbitbrush scattered within this grassland at the edges of the riparian woodland. Moving upstream, the adjacent landscape includes pinon-juniper in the middle third of the PCA and at higher elevations in the subalpine zone there is a mixed conifer and deciduous forest and shrubland

that includes Douglas fir, white fir, blue spruce, Engelmann spruce, aspen, Rocky Mountain maple, and mountain spray.

The current condition of the riparian woodland is fair. Although, there is a high percentage of cover of native plant species within the riparian woodland, there is also a great deal of land use both within, and adjacent to, the riparian corridor itself. In the west half of the PCA, where there is a condominium development along the creek, and channeling of the creek at this development has restricted the interaction of the creek with its floodplain. Also, where land use is occurring, disturbances associated with that use has left the banks relatively unvegetated, compromising the stability of the streambank. The PCA is within the Baca Grande subdivision and the potential for disturbance from increased residential development is high. Disturbance would increase sedimentation and nutrient enrichment in the creek, and fragment the riparian corridor. Also, nutrient enrichment within the creek from septic systems has the potential to increase with additional development, and enrichment may already be causing algal blooms as evidenced by the abundant algae observed in in this creek, and which occur in all creeks of the Baca mainly at lower elevation. In addition, increased water demand to support the human population resulting from development will require more diversion of surface and groundwater and will impact the hydrology of the riparian woodland as well as downstream wetlands on the Baca NWR.

There is one reservoir in the drainage upstream of the PCA, but only 10-15% of the drainage basin above the PCA drains to the reservoir. There are pumpimg stations drawing water from within the occurrence reducing water available to the riparian zone. The natural flood regime appears intact, but the bank stability is compromised where three roads bisect the creek and where a condominion has been developed at the west end of the PCA. In these areas of disturbance the banks are relatively unvegetated. In other areas of the PCA the streambank is covered by stabilizing plant growth.

The soils within this area are defined by the sandsheet that underlies the eastern portion of the San Luis Valley and which formed from the prevailing southwest winds that blow across the valley. Consequently, soils of the PCA include sandy loams and loamy sand.

Biodiversity Comments: This PCA supports a fair (C-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* woodland). This plant community represents a unique assemblage of plant species, and occurs at fewer than 40 locations in Colorado. Conservation of this plant community where ever it occurs in Colorado, and elsewhere, is important to sustaining the unique plant assemblage associated with it and the animals it supports.

The boundary of this PCA includes the riparian zone, floodplain, and some upland habitats of the upper half of South Crestone Creek. The waters of this creek assist with recharging the wetlands of the Baca NWR, which borders the Baca on its western boundary. The health, integrity, and water quality of the wetlands on the Baca NWR are dependent upon the nine creeks supplying their water. Protection of the riparian corridor along Cottonwood Creek will help to maintain the quality of the wetlands on the reserve.

Table 19. Natural Heritage element occurrences at the South Crestone Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
***Populus angfustifolia-Juniperus scopulorum* woodland**	**Montane Riparian Forest**	**G2G3**	**S2**	**None**	**None**	**None**	**C**	**7/22/05**

*EO = Element Occurrence

Note: Bold type indicates the primary element occurrence(s) upon which the Biodiversity rank is based.

Boundary Justification: The boundary was developed using orthophoto quads and distribution information from field surveys identifying the extent of the narrowleaf cottonwood – Rocky Mountain juniper woodland. The PCA includes the length of South Crestone Creek, buffered by 656 feet (200 m) (Larsen et al., Spackman and Hughes 1995) on each side, from the lowest point of the cottonwood-juniper woodland to an area upstream in the Sangre de Cristo Mountians. The area within the PCA should be managed to protect the long-term integrity of the floodplain and the sources of both surface and groundwater recharge and flow, which are responsible for supplying water to the riparian plant community. This boundary also includes the upstream slopes of the riparian corridor outside of the Baca, and this area should also be managed to protect against disturbances within the boundary.

Protection Comments: There is an opportunity to eliminate the threats to the riparian woodland of South Crestone Creek if action is taken to appropriately manage residential development within the Baca Grande. The PCA includes property representing many owners, but the entire development is managed by the Baca Grande Property Owners Association (POA). Residents of the Crestone community, and the members of the POA, are interested in developing the Baca Grande in an environmentally friendly manner. Developing conservation easements on any parcels within 656 feet (200 m) of Spanish Creek within the PCA would benefit the riparian biological function, as would covenants prohibiting development within this 656 foot buffer (Larsen et al. 2006, Spackman and Hughes 1995).

Management Comments: The riparian community would benefit from management designed to maintain the natural hydrology, prevent development, and control weeds. Important management considerations include appropriate planning of residential development to avoid loss of vegetation within the PCA that can increase sedimentation and fragment the native plant community, proper regulation of septic systems to avoid nutrient enrichment, and maintenance of the natural hydrology to promote the health of the native riparian plant community. Also important, will be the development of landscaping guidelines that restrict non-native species, which can escape residential gardens and dominate native plant communities, and areas of turfgrass that require intensive irrigation and fertilization. Logging or development along slopes of the creek at higher elevation will increase erosion and runoff, which will compromise the health of riparian communities and wetlands at lower elevations along the creek.

Increased surface water runoff from developed areas can cause channelization and the loss of stream meanders and riffle and pool complexes. Channelization eliminates barren bars upon which cottonwood regeneration can occur and causes a loss of habitat for amphibians, fish, and aquatic invertebrates. Water quality and survival of aquatic animals is compromised by excessive runoff that causes erosion and increased sedimentation, and by nutrient enrichment from septic systems and fertilization of lawns in developed areas. Increases in surface water runoff and groundwater pumping can decrease groundwater recharge, which lowers alluvial water tables and can negatively impact riparian vegetation. All of these alterations compromise the survival of native plant species adapted to the dynamic patterns of surface and groundwater flow, and favors establishment of non-native plants. Inappropriate management of residential development leading to such alterations will compromise the integrity of the cottonwood-juniper woodland. A specific concern for the Baca is that increased residential water use will deplete water resources causing a die-off of the riparian plant community. This problem will be magnified during periods of drought and the riparian plant community will be less resilient to the natural die-off of trees associated with extreme drought events because less water will be available to stimulate plant regeneration once the drought ends.

Thinning of cottonwoods within the Town Park has resulted in the loss of trees along the edges of the woodland in the vicinity of the park and has reduced the continuity of the woodland along the creek (Photo 12). Thinning of hazardous trees within a town park is an acceptable form of mitigation, but thinning of mature trees should not be a general management activity within the riparian woodland outside the park boundary. In this type of riparian woodland the trees hold the greatest conservation value. Removing the forest overstory will impact soil moisture, plant community structure, cover for animals, and species diversity.

Currently, Canada thistle and the non-native grasses Kentucky bluegrass and smooth brome are a moderate threat to cottonwood-juniper woodland, and an integrated weed management strategy should be implemented to control these non-natives. Weeds have the potential to increase as residential development provides the opportunity for their introduction. Because the use of many pesticides is restricted within riparian zones, care should be taken to ensure that the method of application be designed to avoid adverse impacts to native species.

Photo 12. Thinning of cottonwood at the town park along South Crestone Creek within the South Crestone Creek PCA.

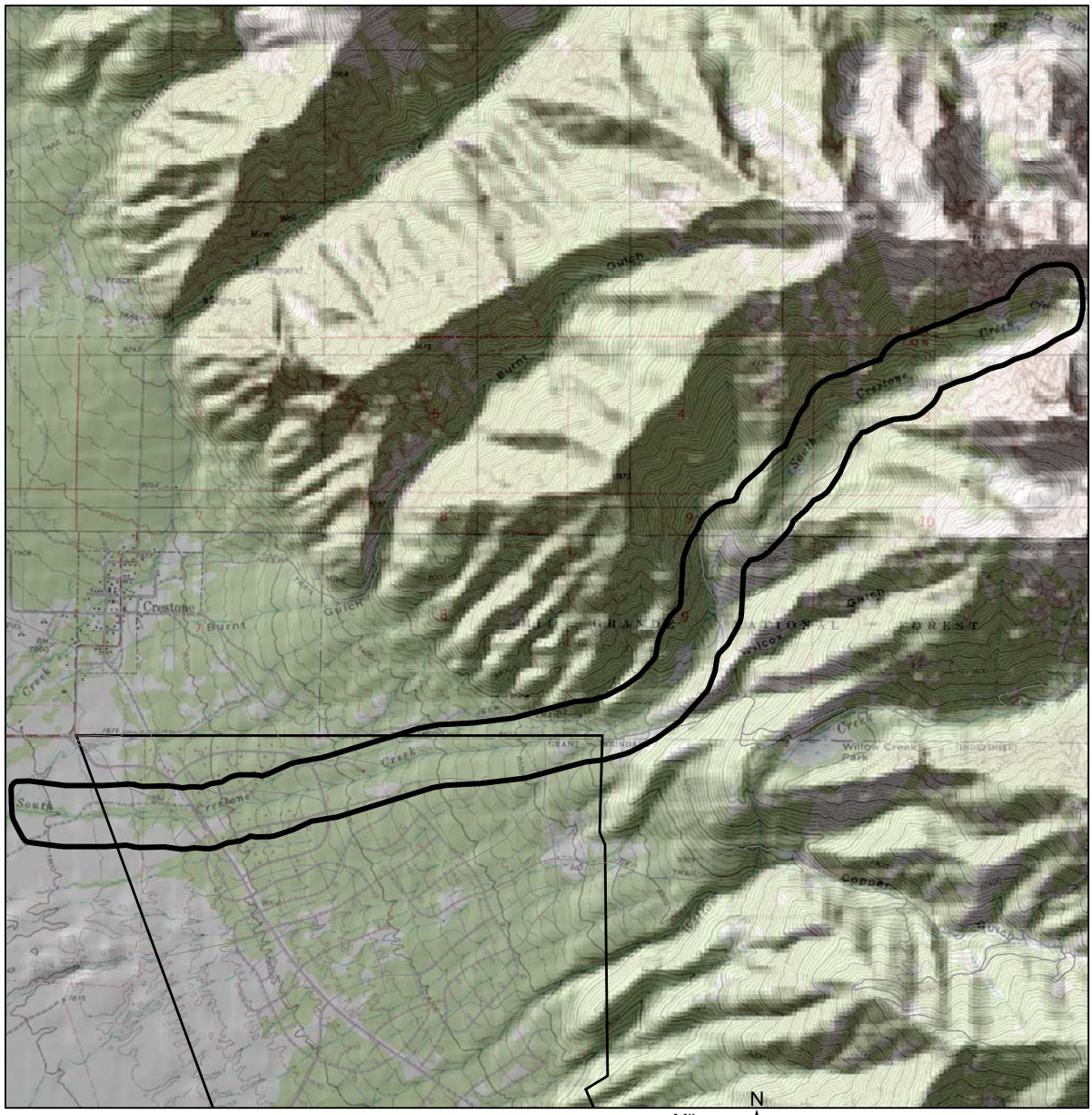


Figure 19. South Crestone Creek Potential Conservation Area.
B3: Very High Biodiversity Significance.

Willow Creek Western Sangres

Biodiversity Rank: B3 (High biodiversity significance)
This PCA supports a fair (C-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* Woodland).

Protection Urgency Rank: P2 (High urgency)
There is an outstanding opportunity to eliminate the threats to the riparian woodlands of Willow Creek if action is taken over the next five years to appropriately manage residential development within the Baca Grande.

Management Urgency Rank: M2 (High urgency)
The riparian community within the PCA will benefit from management designed to maintain the natural hydrology, prevent excessive residential development, and control weeds.

Location: This PCA is located on the Baca Grande development, south of Crestone in the San Luis Valley of Colorado. The northeastern side of the PCA is where the Camino Baca Grande crosses Willow Creek.

Legal Description:
U.S.G.S. 7.5-minute quadrangle: Crestone

Size: 1,093 acres (442 ha) **Elevation:** 7,780 – 11,480 feet (2,371 – 3,500 m)

General Description: This PCA starts in the upper subalpine region of the Sangre de Cristo Mountains near the mouth of Willow Creek and extends downstream along the creek to where juniper no longer occurs in the riparian corridor. As the stream grade becomes more gradual, at about 8120 feet (2475 m), changes in geomorphology causes increased meandering of the creek, creating habitat upon which a narrowleaf cottonwood and Rocky Mountain juniper woodland has become established. Although, the regeneration of cottonwood and juniper is less than expected, cover of native plants within the PCA is extensive and the herbaceous understory within the cottonwood-juniper woodland is comprised of grasses, sedges, and forbs. However, the non-native Kentucky blue grass is common both in adjacent uplands and within the understory of the riparian woodland.

At the lowest elevations of the PCA the adjacent upland is comprised of grassland that includes western wheatgrass, muhly, and blue grama. There are patches of rabbitbrush scattered within this grassland at the edges of the riparian woodland. Moving upstream, the adjacent landscape includes pinon-juniper in the middle third of the PCA and at higher elevations in the subalpine zone there is a mixed conifer and deciduous forest and shrubland that includes Douglas fir, white fir, blue spruce, Engelmann spruce, aspen, Rocky Mountain maple, and mountain spray. Some pinon pine and ponderosa pine occur at this elevation

The current condition of the riparian woodland is fair. Although, there is a high percentage of cover of native plant species within the riparian woodland, there is also a great deal of land

use both within, and adjacent to, the riparian corridor itself. In the west half of the PCA there is a riding stable along the creek, and channeling of the creek at the location of the stable has restricted the interaction of the creek with its floodplain. Stability of the streambank is compromised in spots where the stable intercepts the creek and where three roads cross the creek, all of which breaks the continuity of the riparian corridor within the PCA. In these areas of disturbance the banks are relatively unvegetated, compromising the stability of the streambank. In other areas of the PCA the streambank is covered by stabilizing plant growth. The drainage upstream of the PCA is without reservoirs, nor are there any surface water diversions on the creek, and the natural flood regime appears intact. The PCA is within the Baca Grande subdivision and the potential for disturbance from increased residential development is high. Disturbance would increase sedimentation and nutrient enrichment in the creek, and fragment the riparian corridor. Also, nutrient enrichment within the creek from septic systems has the potential to increase with additional development, and enrichment may already be causing algal blooms as evidenced by the abundant algae observed in in this creek (Photo 13), and which occur in all creeks of the Baca mainly at lower elevation. In addition, increased water demand to support the human population resulting from development will require more diversion of surface and groundwater and will impact the hydrology of the riparian woodland as well as downstream wetlands on the Baca NWR.

The soils within this area are defined by the sandsheet that underlies the eastern portion of the San Luis Valley and which formed from the prevailing southwest winds blowing across the valley. Consequently, soils of the PCA include sandy loams and loamy sand.

Photo 13. Abundant algal blooms in Willow Creek at the west end of the Grants subdivision that are uncharacteristic of a clear mountain stream, and which may indicate a response to nutrient enrichment from runoff attributable to septic systems, roads, and landscape fertilizer use within the riparian corridor.

Biodiversity Comments: This PCA supports a fair (C-ranked) occurrence of a globally imperiled (G2G3) plant community (*Populus angustifolia-Juniperus scopulorum* woodland). This plant community represents a unique assemblage of plant species, and occurs at fewer than 40 locations in Colorado. Conservation of this plant community where ever it occurs in Colorado, and elsewhere, is important to sustaining the unique plant assemblage associated with it and the animals it supports.

The boundary of this PCA includes the riparian zone, floodplain, and some upland habitats of the upper half of Willow Creek. The waters of this creek assist with recharging the wetlands of the Baca NWR, which borders the Baca on its western boundary. The health, integrity, and water quality of the wetlands on the Baca NWR are dependent upon the nine creeks supplying their water. Protection of the riparian corridor along Cottonwood Creek will help to maintain the quality of the wetlands on the reserve.

Table 20. Natural Heritage element occurrences at the Willow Creek Western Sangres PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
***Populus angfustifolia-Juniperus scopulorum* woodland**	**Montane Riparian Forest**	**G2G3**	**S2**	**None**	**None**	**None**	**C**	**7/22/05**

*EO = Element Occurrence

Note: Bold type indicates the primary element occurrence(s) upon which the Biodiversity rank is based.

Boundary Justification: The boundary was developed using orthophoto quads and distribution information from field surveys identifying the extent of the narrowleaf cottonwood – Rocky Mountain juniper woodland. The PCA includes the length of Willow Creek, buffered by 656 feet (200 m) (Larsen et al., Spackman and Hughes 1995) on each side, from the lowest point of the cottonwood-juniper woodland to an area upstream in the Sangre de Cristo Mountians. The area within the PCA should be managed to protect the long-term integrity of the floodplain and the sources of both surface and groundwater recharge and flow, which are responsible for supplying water to the riparian plant community. This boundary also includes the upstream slopes of the riparian corridor outside of the Baca, and this area should also be managed to protect against disturbances within the boundary.

Protection Comments: There is an opportunity to eliminate the threats to the riparian woodland of Willow Creek if action is taken to appropriately manage residential development within the Baca Grande. The PCA includes property representing many owners, but the entire development is managed by the Baca Grande Property Owners Association (POA). Residents of the Crestone community, and the members of the POA, are interested in developing the Baca Grande in an environmentally friendly manner. Developing conservation easements on any parcels within 656 feet (200 m) of Spanish Creek within the PCA would benefit the riparian biological function, as would covenants prohibiting development within this 656 foot buffer (Larsen et al. 2006, Spackman and Hughes 1995).

Management Comments: The riparian community would benefit from management designed to maintain the natural hydrology, prevent development, and control weeds. Important management considerations include appropriate planning of residential development to avoid loss of vegetation within the PCA that can increase sedimentation and fragment the native plant community, proper regulation of septic systems to avoid nutrient enrichment, and maintenance of the natural hydrology to promote the health of the native riparian plant community. Also important, will be the development of landscaping guidelines that restrict non-native species, which can escape residential gardens and dominate native plant communities, and areas of turfgrass that require intensive irrigation and fertilization. Logging or development along slopes of the creek at higher elevation will increase erosion and runoff, which will compromise the health of riparian communities and wetlands at lower elevations along the creek.

Increased surface water runoff from developed areas can cause channelization and the loss of stream meanders and riffle and pool complexes. Channelization eliminates barren bars upon which cottonwood regeneration can occur and causes a loss of habitat for amphibians, fish, and aquatic invertebrates. Water quality and survival of aquatic animals is compromised by excessive runoff that causes erosion and increased sedimentation, and by nutrient enrichment from septic systems and fertilization of lawns in developed areas. Increases in surface water runoff and groundwater pumping can decrease groundwater recharge, which lowers alluvial water tables and can negatively impact riparian vegetation. All of these alterations compromise the survival of native plant species adapted to the dynamic patterns of surface and groundwater flow, and favors establishment of non-native plants. Inappropriate management of residential development leading to such alterations will compromise the viability and integrity of the cottonwood-juniper woodland. A specific concern for the Baca is that increased residential water use will deplete water resources causing a die-off of the riparian plant community. This problem will be magnified during periods of drought and the riparian plant community will be less resilient to the natural die-off of trees associated with extreme drought events because less water will be available to stimulate plant regeneration once the drought ends (Photo 14).

Currently, Canada thistle and the non-native grasses Kentucky bluegrass and smooth brome are a moderate threat to cottonwood-juniper woodland, and an integrated weed management strategy should be implemented to control these non-natives. Weeds have the potential to increase as residential development provides the opportunity for their introduction. Because the use of many pesticides is restricted within riparian zones, care should be taken to ensure that the method of application be designed to avoid adverse impacts to native species.

Photo 14. Cottonwood die-off along Willow Creek within the Willow Creek Western Sangres PCA. Because the riparian system is still functioning, numerous young cottonwoods were observed regenerating within the understory of this die-off.

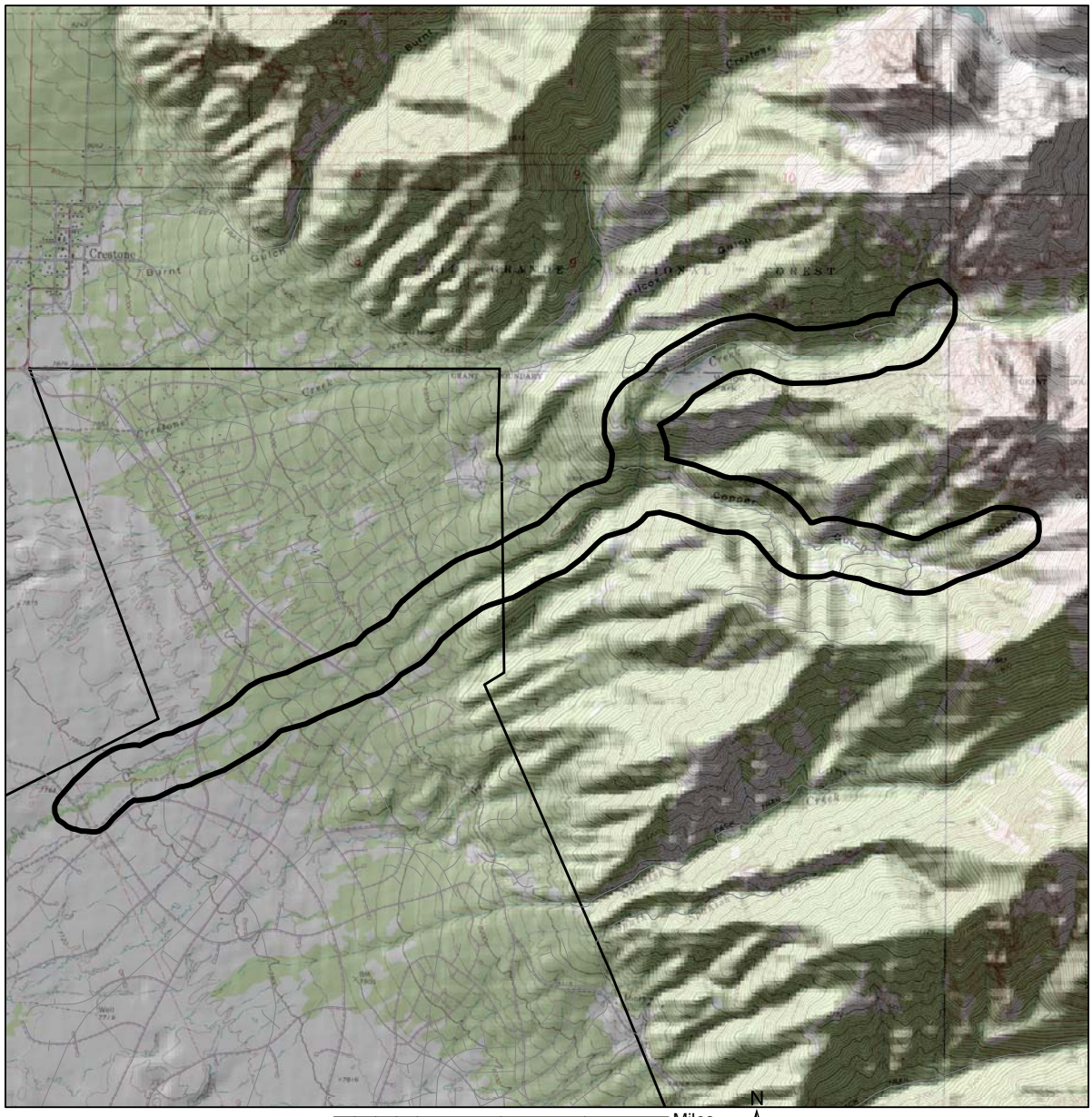


Figure 20. Willow Creek Western Sangres Potential Conservation Area.
B2: Very High Biodiversity Significance.

B4 Potential Conservation Areas

Baca Grande and Reserve

Biodiversity Rank: B4 (Moderate biodiversity significance)
This PCA supports a fair (C-ranked) occurrence of a globally vulnerable subspecies (G5T3); the northern pocket gopher (*Thomomys talpoides agrestis*).

Protection Urgency Rank: P2 (High urgency)
There is an outstanding opportunity to eliminate the threats to this population of *T. t. agrestis* if action is taken over the next five years to manage development of the Baca Grande subdivision.

Management Urgency Rank: M2 (High urgency)
Current activities within the PCA have no potential to degrade the viability of the *T. t. agrestis* population. However, residential development would eliminate suitable habitat, may kill individual gophers, and could increase mortality of gophers due to harassment and predation from house pets.

Location: This PCA is within both the Baca Grande development and the Baca NWR, south of Crestone in the San Luis Valley of Colorado. On the Baca Grande take Camino Baca Grande to south on Camino Real, to west on Heather Road, to south on Birch Road.

Legal Description:
U.S.G.S. 7.5-minute quadrangles: Crestone and Sheds Camp

Size: 11,024 acres (4460 ha) **Elevation:** 7,054 - 7,875 feet (2,150 - 2400 m)

General Description: The PCA lies on the floor of the San Luis Valley and includes the riparian areas associated with Willow, Spanish, and Cottonwood creeks, and their floodplains. The PCA lies at distances of from one to over six miles from the base of the Sangre de Cristo Mountains. There are old inactive and fresh active diggings of a subspecies of the northern pocket gopher (*Thomomys talpoides agrestis*) sparsely scattered throughout the PCA. The sandy loam to loamy sand soils, forage availability represented by adequate cover of vegetation, and seasonal inundation of the floodplain along the riparian corridors are ecological components important to viability of the pocket gopher population.

Other animals observed within the PCA included pronghorn, red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), Wilson's phalarope, green-winged teal (*Anas crecca*), Wilson's snipe (*Gallinago delicate*), mountain plover, hoary bat (*Lasiurus cinereus*), Brazilian free-tailed bat, western small-footed bat (*Myotis ciliolabrum*), chorus frog (*Pseudacris triseriata*), tiger salamander (*Ambystoma tigrinum*), and an unidentified toad.

The area within the PCA is a complex mix of vegetation types that includes sedge meadows of Baltic rush, common spikerush (*Eleocharis palustris*), and other sedges; greasewood (*Sarcobatus vermiculatus*) flats; herbaceous grassland dominated by blue grama, and which also includes needle-and-thread grass (*Hesperostipa comata*), purple threeawn (*Aristida purpurea*) and Indian ricegrass (*Achnatherum hymenoides*); narrowleaf cottonwood galleries; and shrub/grass rangeland with the aforementioned grasses interspersed between scattered rabbitbrush.

The soils within this area are defined by the sandsheet that underlies the eastern portion of the San Luis Valley and which formed from the prevailing southwest winds that blow across the valley. Consequently, soils of the PCA include sands, sandy loam, and loamy sand.

In general, the PCA has a moderate amount of weeds, and there are scattered patches dominated by smooth brome and Kentucky bluegrass. The noxious weeds whitetop and Canada thistle are scattered, and infrequent within parts of the PCA.

Biodiversity Comments: This PCA supports a fair (C-ranked) occurrence of a globally vulnerable subspecies (G5T3); the northern pocket gopher (*Thomomys talpoides agrestis*). The *agrestis* subspecies is recorded from only six locales in CNHPs BIOTICS database, although, it is probably more widespread than current records indicate. Preservation of this animal where ever it occurs in Colorado and New Mexico is important to the conservation of this unique subspecies of the northern pocket gopher.

The boundaries of this PCA follow the riparian zone, floodplains, and some upland habitats surrounding three creeks flowing from the Sangre de Cristo Mountains and that cross the Baca Grande. These three creeks assist with recharging the wetlands of the Baca NWR, which borders the Baca on its western boundary. The health, integrity, and water quality of the wetlands on the Baca NWR are dependent upon the nine creeks supplying their water. Protection of the riparian corridors of these three creeks will help to maintain the quality of the wetlands on the reserve, where populations of *T t. agrestis* may also occur.

Table 21. Natural Heritage element occurrences at the Baca Grande and Reserve PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Thomomys talpoides agrestis	**northern pocket gopher *agrestis* subspecies**	**G5T3**	**S3**	**None**	**None**	**None**	**C**	**7/19/05**

*EO = Element Occurrence

Note: Bold type indicates the primary element occurrence(s) upon which the Biodiversity rank is based.

Boundary Justification: These boundaries were developed using orthophoto quads and distribution information from field survey results identifying both active and inactive diggings of pocket gophers. From some of these active sites specimens of *T. t. agrestis* were collected. The geographic distribution of pocket gophers in Colorado indicates that only *T. t. agrestis* occur within the area of this PCA.

The boundary includes habitat suitable for the northern pocket gopher as dictated by the soil conditions, and the presence of grassland and semidesert shrubland located at the edge of the riparian floodplain. The PCA's boundary extends for two miles beyond the western boundary of the Baca Grande to include territory within the Baca NWR that was also surveyed. Digital orthophoto guads and digital soil maps suggests that suitable habitat for the pocket gopher may extend even further to the west of the current boundary, but this should be confirmed through ground surveys.

Protection Comments: There is an opportunity to eliminate the threats to this population of *T. t. agrestis* if action is taken to manage development of the Baca Grande subdivision. Residents of the Crestone community, and the members of the POA, are interested in developing the Baca Grande in an environmentally friendly manner. Developing conservation easements on any parcels where pocket gophers and pocket gopher activity were observed would benefit the population, as would covenants prohibiting development within the boundary. Portions of the PCA outside of the Baca Grande are protected within the Baca NWR.

Management Comments: Current activities within the PCA have no potential to degrade the viability of the *T. t. agrestis* population. However, residential development would eliminate suitable habitat, may kill individual gophers, and could increase pocket gopher mortality due to harassment and predation by house pets.

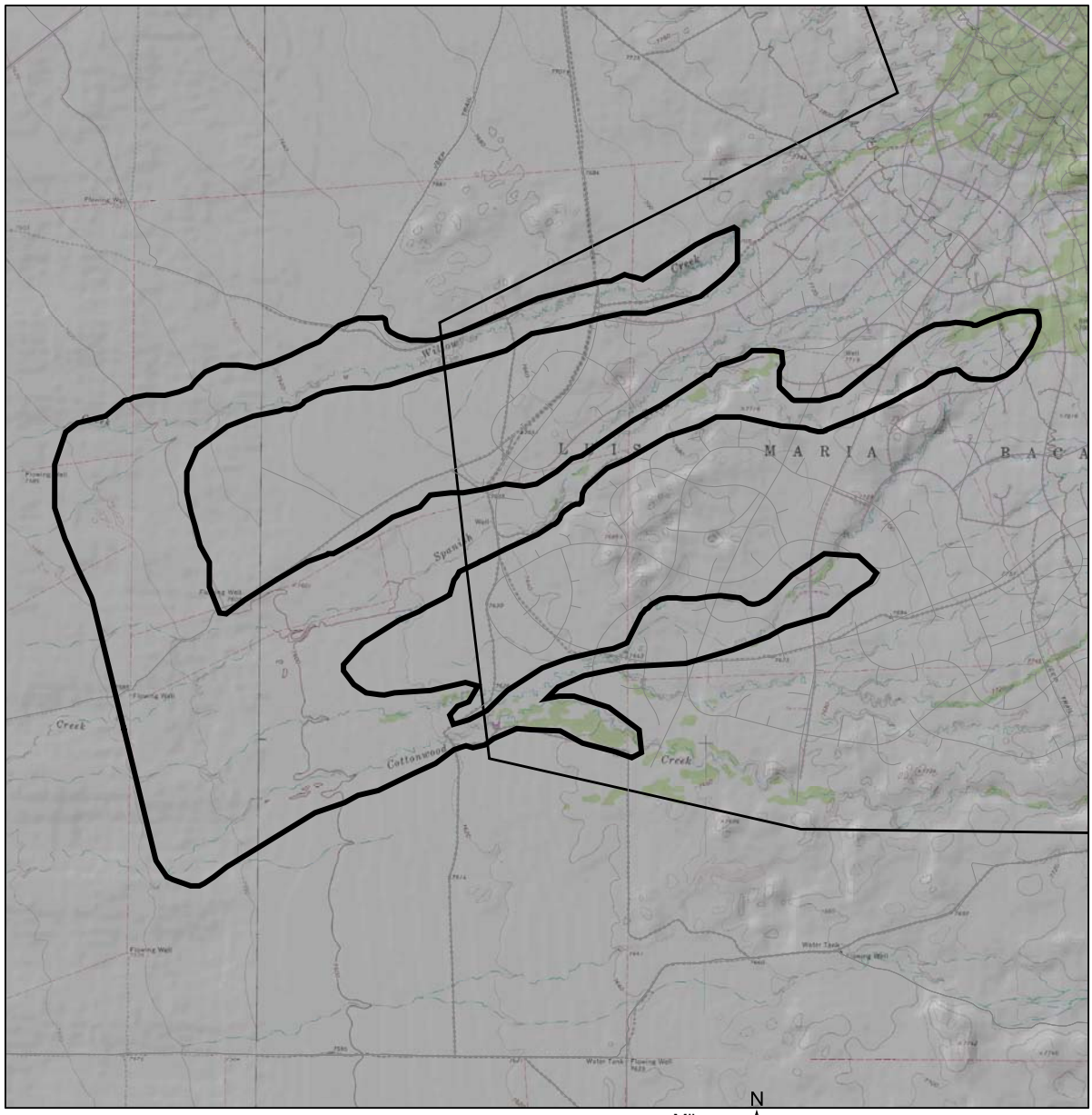
If this area is protected as open space then proper trail routing and management will be required to prevent disturbance from recreational users. All of the ecological requirements of *T. t. agrestis* including a large enough area of suitable habitat with proper soils, drainage, soil moisture content, and forage availability are represented within the PCA, and viability of this population of *T. t. agrestis* could be maintained indefinitely through preservation of this area.

In summary, the important management considerations include planning appropriately for residential development to avoid loss of pocket gophers and suitable gopher habitat, and proper development of any open space within this PCA with appropriate placement of recreational trails and management of house pets to prevent pocket gopher mortality and disturbance. Northern pocket gophers persist in areas with recreational trail use and it is not necessary to eliminate all recreation from areas occupied by pocket gophers, rather proper management to mitigate any potential adverse effects of recreation is necessary.

Photo 15. Fresh pocket gopher diggings from which a specimen of the northern pocket gopher *agrestis* subspecies was collected within the Baca Grande and Reserve PCA.

Photo 16. Fresh pocket gopher diggings.

Photo 17. Old, inactive pocket gopher digging.



Colorado Natural Heritage Program
Colorado State University
254 General Services Building
Fort Collins, CO 80524

www.cnhp.colostate.edu

Map Date: 4/28/2005

Legend

PCA Boundary

Baca Grande

Roads

Crestone 37105-H6
Sheds Camp 37105-H7

7.5 Minute Digital Raster Graphic produced by the U.S. Geological Survey

Location at the Baca Grande

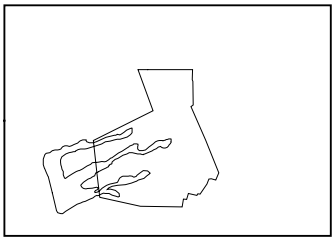


Figure 21. Baca Grande and Reserve Potential Conservation Area.
B4: Very High Biodiversity Significance.

Sites of Local Significance

Spanish Meadows

Location: This SLS is within the Baca Grande development south of Crestone in the San Luis Valley of Colorado. On the Baca Grande take Camino Baca Grande to south on Camino Real, to west on Heather Road, to north on Camino del Rey.

Legal Description:
U.S.G.S. 7.5-minute quadrangles: Crestone

Size: 120 acres (49 ha) **Elevation:** 7,625 - 7,645 feet (2,324 - 2330 m)

General Description: The Spanish Wetlands SLS is located at the point where Spanish Creek exits the Baca and enters the Baca NWR. Groundwater and spring runoff, which results from melting snow and rain, fills a natural wetland that appears to be bisected by the Camino Del Rey road berm. It appears that the road berm causes more water to amass in the wetland, behind the berm, than might accumulate under more natural conditions (Photo 18). However, it can not be ruled out that the current size of the wetland is its historical size. The wetland and surrounding area is rich in plant and animal life with numerous species of concern recorded here including Mountain Plover (*Charadrius Montana*), Wilson's phalarope (*Phalaropus tricolor*), the Brazilian free-tailed bat (*Tadarida brasiliensis*), and the northern pocket gopher *agrestis* subspecies (table 22). The slender spiderflower (*Cleome malticaulis*) has also been reported at this SLS by local residents, but was not recorded by CNHP biologists during this assessment. (Table 22). All of the shorebirds observed here were using the wetland for foraging, no nesting was observed, and the Brazilian free-tailed bats were probably foraging individuals from the colony at the Orient Mine, approximately 20 miles (32 km) north of the wetland. These bats probably forage intermittently at this wetland during the spring and summer throughout the period of time that it holds surface water. Other common species observed at the wetland included two amphibians, the western chorus frog (*Pseudacris triseriata*) and tiger salamander (*Amblystoma tigrimum*). The wetland is dominated by Baltic rush while stands of wolly sedge (*Carex pellita*) are common throughout the wetland and the community can be characterized as a *Juncus balticus* Herbaceous Meadow (Baltic Rush Western Slope Wet Meadows) (Table 22).

The current condition of the wetland is fair. There is a great deal of algae present in the wetland, which indicates an elevated level of nutrient enrichment, possibly attributable to runoff from septic systems, roads, and landscape fertilizer use. The SLS is within the Baca Grande subdivision and the potential for disturbance from increased residential development is high. Disturbance would increase the problem of nutrient enrichment already observed in the wetland and would also increase sedimentation. In addition, increased water demand to support the human population resulting from development will require more diversion of surface and groundwater. This might decrease the water available to the wetland below volumes currently necessary to support the plant and animal life now present.

Non-native plant species including whitetop, Canada thistle, Kentucky blue grass, smooth brome, dandelions (*Taraxacum officinale*), and meadow foxtail (*Alopecurus pratensis*) are present.

The SLS boundary was drawn to encompass the entire extent of the wetland at high water in early spring with a buffer of 656 feet (200 m) to protect the biological functions of the wetland plant community and to prevent nutrient enrichment from septic systems placed to close to the wetland (Larsen et al., Spackman and Hughes 1995).

Table 22. Natural Heritage element occurrences at the Spanish Wetland SLS.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Animals								
Charadrius montanus	mountain plover	G2	SZN	None	SC	None	NA[2]	7/20/2005
Phalaropus tricolor	Wilson's phalarope	G5	S4N	None	None	None	E	6-13-2005
Tadarida brasiliensis	Brazilian free-tailed bat	G5	S1	None	None	None	NA	7/20/2005
Thomomys talpoides agrestis	northern pocket gopher *agrestis* subspecies	G5T3	S3	None	None	None	C	7/19/05
Plants								
Cleome multicaulis[1]	slender spiderflower	G2G3	S2S3	None	None	BLM	NA	
Plant Communities								
Juncus balticus Herbaceous Meadow	Baltic Rush Western Slope Wet Meadows	G5	S5	None	None	None	C	6/29/2005

[1] This plant was not observed by CNHP biologists during this assessment, but the plant has been reported by local residents.

[2] NA = element occurrence rank is not applicable because the observation is not of a tracked variety (i.e. SZN or a watchlisted species) or the observation was not made by a CNHP biologist.

Protection Comments: The central area of the SLS is managed by the Baca Grande POA and is within the Baca development. Parcels of private property line the wetland within the Baca while a small portion west of the Camino Del Rey road is protected within the Baca NWR. Residents of the Crestone community and the members of the POA are interested in developing the Baca Grande in an environmentally friendly manner. Public education regarding wetland ecology may encourage efforts toward conservation. Developing conservation easements and establishing covenants prohibiting development on any parcels within the SLS would help maintain and enhance the quality of the wetland.

Management Comments: This wetland would benefit from management designed to maintain the natural hydrology, prevent development, and control weeds. Important management considerations include appropriate planning of residential development to avoid loss of vegetation within the SLS that can increase sedimentation and fragment the native plant community, proper regulation of septic systems to avoid nutrient enrichment, and maintenance of the natural hydrology to promote the health of the native wetland plant

community. Also important, will be the development of landscaping guidelines that restrict non-native species, which can escape residential gardens and dominate native plant communities, and areas of turfgrass that require intensive irrigation and fertilization.

Currently, weeds are a moderate threat to the PCA and an integrated weed management strategy should be implemented to control weeds and their eradication before invasion becomes overwhelming is recommended. Weeds have the potential to increase as residential development provides the opportunity for their introduction. The continued introduction of non-native species will require ongoing monitoring and removal. Controlling weed invasion on uplands is also suggested.

Because the use of many pesticides is restricted within wetlands, care should be taken to ensure that the method of application be designed to avoid adverse impacts to native species.

Photo 18. The Spanish Wetlands SLS in mid-June of 2005 (the berm formed by the Camino Del Rey roadway is in the background).

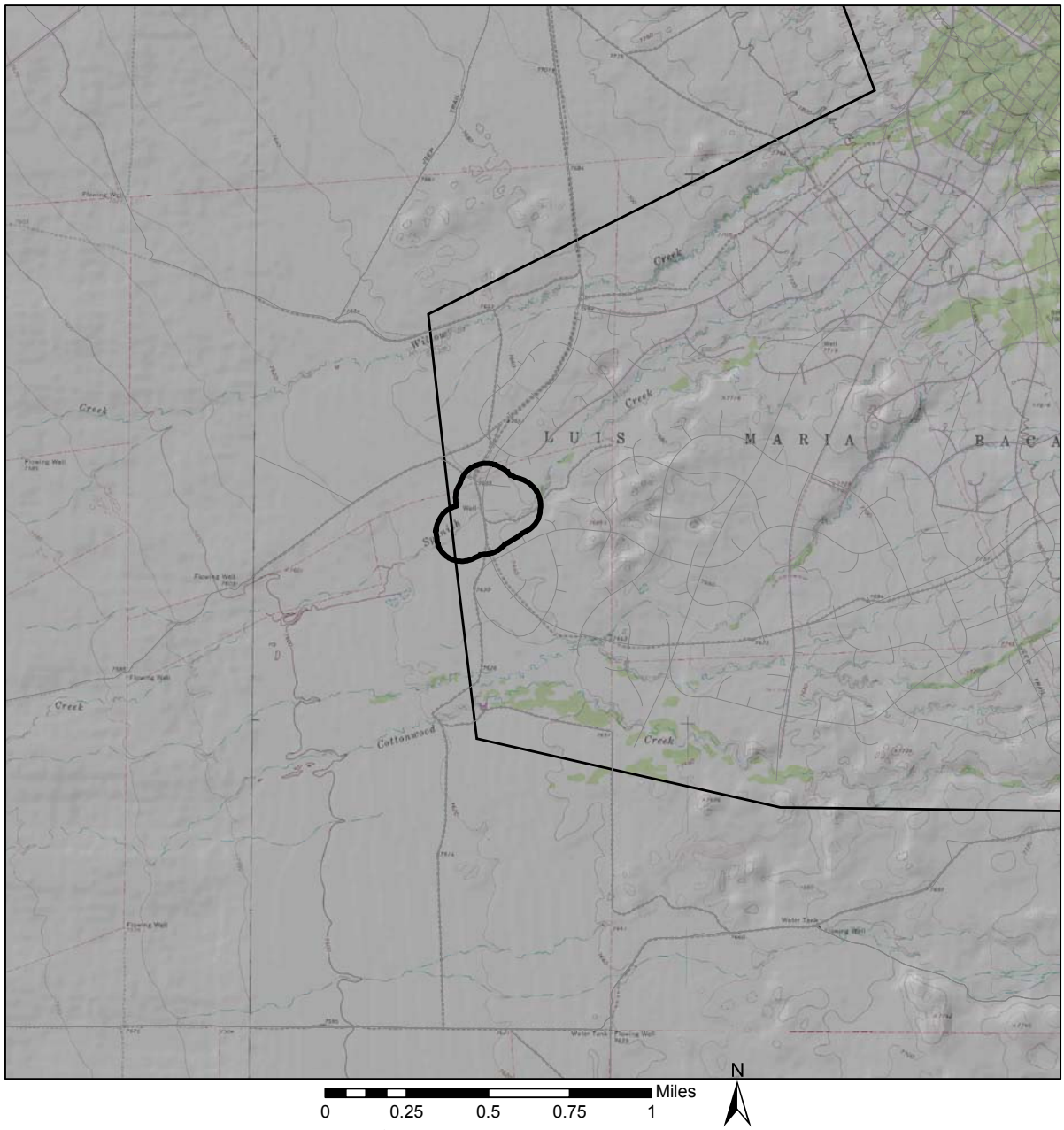


Figure 22. Spanish Wetland Site of Local Significance.

CONCLUSIONS

The Baca is an incredible landscape with a diverse community of animals, plant, and plant communities. Over 50 animal and plant communities were documented from the Baca during this assessment, and five of the animals and one plant communities are highlighted in this report because of their importance as targets of conservation.

At lower elevations, all four creeks passing through the Baca support occurrences of the vulnerable narrowleaf cottonwood-Rocky Mountain juniper woodland plant community. Future residential development, road construction, and recreational activities in and near these occurrences run the risk of compromising the health of these unique woodlands, which are currently in fair to good condition. Within the Baca, the riparian communities along the entire extent of all four creeks support a native overstory and a ground cover of both native and non-native plants, which sustain a wealth of biological diversity including a diverse community of riparian woodland birds. Such diversity suggests that the riparian hydrology is mostly intact and functioning. Maintaining the natural hydrology will be difficult in the face of the development occurring in the Baca, but is important if health of the riparian corridor and riparian dependent species are to be maintained. Development of the water resource potential of the Baca to meet an expanding human population will make this difficult, and require careful management. Conservation of these riparian communities should be an important management priority and a component of any future activities on the Baca.

A population of the globally vulnerable northern pocket gopher is concentrated along the riparian corridors. Conservation of this population of gophers should also be a management priority and a component of any future activities on the Baca. Pronghorn and elk currently occupy the Baca, but their continued viability will require maintaining large corridors of connectivity between the Baca and public lands to the east, west, and south. Large open areas must also be left undisturbed to provide areas for the pronghorn and elk to browse and graze.

A wetland at the point where Spanish Creek exits the Baca and flows into the Baca NWR supports a diverse number of aquatic dependent animals including amphibians, bats, and shorebirds. Protecting this wetland from future disturbance will benefit these wetland dependent animals and enhance the character of the Baca for current and future residents.

The major sources of stress to the biological resources identified during this assessment include residential development, water development, non-native plants, and to a lesser extent recreation. For the most part, the impacts resulting from recreation can be alleviated through proper placement of trails and management of recreational users. Other management actions can be implemented to help manage the impacts of the other sources of stress.

Management activities that will benefit the riparian corridor include maintenance of the natural hydrology, prevention of residential development and the placement of septic systems within the riparian corridor, and implementation of an integrated weed management plan. Restricting the number of residences within the Baca to numbers that the water resource can

support without depleting ground and surface water flows to the riparian corridor and downstream wetlands is important. If flows are depleted to levels below those needed to sustain these woodlands and wetlands, then they will be lost. Appropriate planning of residential development to avoid loss of vegetation within and near the riparian corridor will prevent increased sedimentation of the creeks and fragmentation of the native riparian plant community. Setbacks of 646 feet (200 m) from streambeds should be maintained to prevent nutrient enrichment of the creeks from septic systems and residential lawns and gardens, and to protect riparian biological function (Larsen et al., Spackman and Hughes 1995). Also important, will be the development of landscaping guidelines that restrict non-native species, which can escape residential gardens and dominate native plant communities, and areas of turfgrass that require intensive irrigation and fertilization. In addition, logging or development along the slopes of all the riparian corridors at higher elevation will increase erosion and runoff, which will compromise the health of riparian communities and wetlands at lower elevations along the creek.

Currently, weeds are a moderate problem and an integrated weed management strategy should be implemented to control weeds. Weeds have the potential to increase as increased residential development and human activity provides the opportunity for their introduction. Because the use of many pesticides is restricted within riparian zones, care should be taken to ensure that the method of application be designed to avoid adverse impacts to native species. The Nature Conservancy's web site on invasive species (http://tncweeds.ucdavis.edu/index.html) or http://www.invasivespecies.gov/ provide information on the control and eradication of non-native species.

Proper management combined with the appropriate placement of areas designated for conservation action should allow for realization of both the ecological and economic potential of the Baca. Information contained in this report will help to accomplish both conservation of the target elements and economic development in the Baca. Realization of either goal to the complete exclusion of the other would probably prove detrimental, and a balance of uses will increase the value of both.

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