Natural Heritage Inventory of Monte Vista National Wildlife Refuge, Rio Grande County, Colorado

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Introduction

The Nature Conservancy, with funding from the U.S Fish and Wildlife Service, contracted the Colorado Natural Heritage Program to inventory the Monte Vista NWR for areas of special biological significance. The study was designed to document the rare or imperiled species and significant natural communities occurring on Monte Vista NWR and to provide personnel the biological information needed to effectively manage natural heritage resources found on the refuge. Wetland function and restoration potential were also assessed for the study area. Studies of this nature help to continually re-evaluate the conservation status of rare species and help to further biologist's understanding of the natural resources of Colorado.

The Monte Vista National Wildlife Refuge (NWR), located in Rio Grande County, lies in the southern part of Colorado in the western San Luis Valley. The San Luis Valley is Colorado's largest and driest (climatically) mountain valley. The San Luis Valley floor which is composed of sediments up to 30,000 feet thick with embedded clay layers and lava flows is included in the Great Plains-Palouse Dry Steppe province (Bailey and others 1994). Cool winters and cool summers characterize this study area. Climate data (Table 1) for a long-term station near the Monte Vista NWR was obtained from the Western Regional Climate Center (http://www.wrcc.dri.edu).

Table 1. Climate data from a selected weather station near the study area.

Station (approximate elevation in feet)	Avg. Annual Precipitation (in.)	Avg. Total Snowfall (in.)	Avg. Max. Temperature (degrees F)	Avg. Min. Temperature (degrees F)
Monte Vista (7760)	7.50	22.1	58.4	24.3

Agriculture, grazing, development, construction of reservoirs, water diversions, and mining have had many impacts on wetlands throughout the San Luis Valley. Fertile soils and available water for irrigation make floodplains productive areas for agriculture. Since the nineteenth century, hydrological diversions and the installation of groundwater wells have been developed for irrigation and drinking water supplies. Such activities have eliminated or altered some wetlands, and created other wetlands that are very different from those in existence prior to European settlement. The diverse wetland assemblage that occurs in parts of the San Luis Valley floor include herbaceous wetlands dominated by various sedges and rushes (e.g., *Carex utriculata*, *C. simulata*, *C. lanuginosa*, *Eleocharis palustris*, *Scirpus acutus*, and *Juncus balticus*), wetland grasses (e.g., *Calamagrostis canadensis*, *Agrostis gigantea*, *Poa pratensis*, *Glyceria grandis*, and *Beckmannia syzigachne*), and common wetland forbs (e.g., *Typha latifolia*, *Sagittaria cuneata*, *Argentina anserina*, and *Mentha arvense*) and alkaline wetlands typically dominated by broom seepweed (*Suaeda calceoliformis*), saltgrass (*Distichlis spicata*), greasewood (*Sarcobatus vermiculatus*), wiregrass (*Juncus balticus*), various bulrushes (e.g., *Scirpus pungens*, *S. maritimus*, *S. nevadensis*), alkaline sacaton (*Sporobolus airoides*), scratchgrass muhly (*Muhlenbergia asperifolia*), and occasionally, the rare slender spiderflower (*Cleome multicaulis*).

The Monte Vista NWR natural heritage inventory was conducted using the methodology that is used by Natural Heritage Programs throughout North America. Our primary focus was to

identify the locations of rare and imperiled plants and animals, and significant plant communities (rare or high quality examples of common plant communities), delineate Potential Conservation Areas (PCAs) based on these locations, assess conservation values, and prioritize specific areas for conservation efforts. Locations in the refuge with natural heritage significance (those places where elements have been documented) are presented in this report as Potential Conservation Areas. The goal of the process is to identify a land area that can provide the habitat and ecological needs upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history, in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses is used to delineate PCA boundaries.

Methods

The Colorado Natural Heritage Program follows a general methodology that is continuously being developed for the specific purpose of biological inventories such as this. The Monte Vista NWR natural heritage inventory was conducted in several steps as summarized below. Additionally, input from local experts was sought at all stages.

Collect Available Information

The Colorado Natural Heritage Program databases were updated with information regarding the known locations of species and significant plant communities within and immediately surrounding the Monte Vista NWR. A variety of information sources were searched for this information, including museum and herbaria collections at Colorado universities, as well as available literature. Information from expert interviews was also sought. Results from literature sources were incorporated into CNHP databases, in the form of either locational information or as biological data pertaining to a species in general.

Identify Rare or Imperiled Species and Significant Plant Communities with Potential to Occur on Monte Vista NWR.

Information regarding basic species and community biology including range, habitat, phenology (reproductive timing), food sources, and substrates collected in the previous step was used to refine the list of elements with potential to occur in the study area and to develop a "search image." In general, species and plant communities included in Rio Grande County are included in this list. Species or plant communities that occur only in habitats that are not present in this study area were removed from the list.
The following list (Table 2) includes those elements currently tracked by CNHP that were thought to potentially occur on Monte Vista NWR, and were therefore targeted in CNHP field inventories. The amount of effort given to the inventory for each of these elements was prioritized according to the element's rank. Globally imperiled (G1 - G3) elements were given highest priority and greatest amount of search effort, state imperiled elements (G4-G5/S1-S3) were secondary. See Appendix A for an explanation of ranks.

Table 2. Rare Species and Plant Communities Potentially Occurring on Monte Vista NWR

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
Plants				
Cleome multicaulis	Slender spiderflower	G2G3	S2S3	BLM
Sparganium eurycarpum	Giant bur-reed	G5	S2?	
Plant Communities				
Distichlis spicata	Salt meadows	G5	S3	
Sarcobatus vermiculatus / Sporobolus airoides	Saline bottamland shrublands	G3?	S3	
Birds				
Asio flammeus	Short-eared owl	G5	S2B, SZN	
Aytha valisineria	Canvesback	G5	S2B, SZN	
Egretta thula	Snowy Egret	G5	S2B, SZN	
Grus canadensis tabida	Greater sandhill crane	G5T4	S2B, S4N	
Haliaeetus leucocephalus	Bald eagle	G4	S1B, S3N	
Plegadis chihi	White-Faced Ibis	G5	S2B, SZN	FS, BLM
Podiceps nigricollis	Eared grebe	G5	S3B, SZN	

Conduct Field Surveys

Targeted Inventory Areas were visited at the appropriate time as dictated by the phenology or activity patterns of the individual elements. It is essential that surveys take place during a time when the targeted elements are 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 parts of the growing season.

The methods used in the surveys necessarily vary according to the elements that were being targeted. In most cases, the appropriate habitats were visually searched in a systematic fashion that would attempt to cover the area as thoroughly as possible in the given time. Some types of organisms require special techniques in order to capture and/or document their presence. These are summarized below:

Amphibians and Reptiles: visual, hand capture, or with aquatic nets
Mammals: visual, live traps, pitfall traps
Birds: visual or by song/call, evidence of breeding sought
Insects: aerial net
Plants and plant communities: visual, collect qualitative or quantitative composition data
Wetland plant communities: visual, collect qualitative or quantitative composition, soil, hydrological, and functions and value data

When necessary and permitted, voucher specimens were collected and deposited in university museums and herbaria.

When a rare or imperiled species or significant plant community was detected, its precise location and known extent were recorded on 1:24,000 scale topographic maps. Other data recorded at each occurrence included numbers observed, breeding status, habitat description, disturbance features, observable threats, and potential protection and management needs. This record is tracked as an *element occurrence record* or more simply an *occurrence.* The overall significance of each occurrence (relative to others occurrences of the same element) was estimated by rating the size of the population or community, the condition or naturalness of the habitat, and the landscape context in which it occurs. These factors are combined into an *element occurrence rank*, useful in refining conservation priorities. See Appendix A for more information about element occurrence ranking.

Delineate Potential Conservation Area Boundaries

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

- the extent of current and potential habitat for the elements present, considering the ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the potential conservation area and the surrounding watershed;

- maintenance of the hydrologic integrity of the groundwater, e.g., by protecting recharge zones;

- land intended to buffer the area against negative impacts of future changes in the use of surrounding lands;

- exclusion or control of invasive exotic species;

- land necessary for management or monitoring activities.

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

CNHP uses the Natural Heritage Ranking Methodology to help prioritize conservation actions by identifying those areas that have the greatest chance of conservation success for the most imperiled elements. The areas are prioritized according to their **biodiversity significance rank**, or "B-rank," which ranges from B1 (outstanding biodiversity significance, globally significant) to B5 (general or state-wide biodiversity significance). These ranks are based on the conservation ranks (imperilment or rarity) for each element and the element occurrence ranks (quality rank) for that particular location. Therefore, the highest quality occurrences (those with the greatest likelihood of long-term survival) of the most imperiled elements are the highest priority and receive the highest B-rank). See Appendix A for more details on the ranking procedure. The B1-B3 sites are the highest priorities for conservation actions.

Potential Conservation Area Profile

Profile Explanation

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

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

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

Location: General location.

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

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

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

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

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

Soils Description: Soil profile descriptions were generally conducted at each site. When these profile descriptions were found to match the mapped soil type found in the county soil surveys, then reference is only given to that particular soil series and no profile description is provided. However, if a profile description did not match the mapped soil type, then profile descriptions are presented. Classification of these soils was conducted, when possible, using *Keys to Soil Taxonomy*.

Restoration Potential: A brief summary describing the feasibility of restoring ecosystem function(s) at each site.

Wetland Functional Assessment: A summary of the functions and the proposed HGM classification and Cowardin system for the wetlands occurring within each Potential Conservation Area and Site of Local Significance. Each function is ranked (i.e., none, low, moderate, high, or exceptional) according to how well the wetland is performing each particular function.

Results

This inventory documented a number of biologically significant elements found throughout the Monte Vista NWR. Fourteen elements of concern at sixteen locations and several animal species imperiled in Colorado were documented, including a large population of the globally imperiled spider flower (*Cleome multicaulis*) and the state imperiled Giant Bur Reed (*Sparganium eurycarpum*). Large tracts of land dominated by such species as greasewood (*Sarcobatus vermiculatus*), saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and rabbitbrush (*Chrysothamnus* spp.) support speculations that these species dominated in the San Luis Valley prior to European settlement.

Although the natural hydrology has been altered at Monte Vista NWR, all of the elements occurring within the site are supported by the current hydrologic management practices of the refuge. Sedge meadows (*Carex simulata*, *C. atherodes*, and *Scirpus pungens*) and emergent marshes (*Scirpus maritimus*, *S. acutus*, *Eleocharis palustris*, *Typha latifolia*, and *Sparganium eurycarpum*) are supported by seepage from ditches, canals and ponds which supplement natural ground water discharge. Also, open water supports floating/submergent species (*Ranunculus aquatilis* and *Potamogeton* spp.). Within the refuge, nine significant wetland plant communities occur.

In this report, we profiled 1 Potential Conservation Area (PCA) which encompases the boundaries of Monte Vista NWR. Priorities are assigned to PCAs by considering the urgency for conservation action (areas with the more rare or imperiled elements) and the greatest chance for long-term viability (largest, best condition populations). We identified the biodiversity rank of Spring Creek at Greenie Mountain Potential Conservation Area as "B2" (of very high significance). This site supports good examples of globally imperiled, globally vulnerable and state vulnerable plant species, as well as good examples of abundant widespread plant communities. Excellent occurrences of waterbirds and an excellent example of a globally vulnerable mouse sub-species are also supported at this site.

This area is described in the following pages and, where possible, management and protection recommendations are provided. Identification and protection of this area will serve as an important step in preserving the natural heritage of the refuge.

All of the data collected are housed and maintained in the Biological and Conservation Data System (BCD) at the Colorado Natural Heritage Program. Moreover, a geographic information system (GIS) coverage has been created for the Potential Conservation Areas. This coverage can be provided to the Monte Vista NWR upon request.

Spring Creek at Greenie Mountain Potential Conservation Area

Biodiversity Rank: B2 (Very high significance)
This site supports good examples of a plant species imperiled on a global scale and a state vulnerable plant species, fair to good examples of three plant communities vulnerable on a global scale, six good examples of widespread to abundant plant communities, five excellent occurrences of waterbirds, and one excellent example of a mouse sub-species vulnerable on a global scale.

Protection and Management Issues: The majority of the site lies within the Monte Vista National Wildlife Refuge (the remaining portion is located on private land) and currently has adequate protection. However, any alterations in the current hydrological regime could potentially affect the elements. Also of concern are current populations of non-native species, whitetop (*Cardaria* spp.) and Canada thistle (*Cirsium arvense*).

Biodiversity Rank Justification: This site contains 14 elements of concern at 16 locations. The large population of the globally imperiled slender spiderflower (*Cleome multicaulis*) found throughout the site is the primary reason for the high biodiversity rank. The slender spiderflower has a global range from southern Wyoming to central Mexico. In spite of its large range, populations of this plant have decreased dramatically in the last 100 years, especially in the southwestern states. No occurrences of this species have been documented in New Mexico or Arizona since the 1940's. There are some occurrences in Texas and Mexico while Wyoming only has one. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. There are approximately 35 occurrences of this species in Colorado. Slender spiderflower is limited by very specific habitat requirements including moist alkaline soils and some form of soil disturbance. These discriminating habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

In addition to the slender spiderflower, a population of the state imperiled giant bur-reed, which is mainly found on the eastern plains and in the San Luis Valley, is also supported by the site. Nine significant wetland plant communities were located at this site: small flowered sedge wet meadow (*Carex simulata*), two types of salt meadows (*Distichlis spicata* and *Distichlis spicata*-(*Scirpus nevadensis*)), three types of emergent marsh (*Eleocharis palustris*, *Scirpus acutus*, *S. maritimus*), two types of wet meadows (*Juncus balticus* var. *montanus* and *Scirpus pungens*), and saline bottomland shrublands *(Sarcobatus vermiculatus*/*Sporobolus airoides*).

Several animal species imperiled in Colorado are also represented at this site: two bird species, Snowy Egret (*Egretta thula*) and White-faced Ibis (*Plegadis chihi*) and one imperiled mammal subspecies, the silky pocket mouse (*Perognathus flavescens sanluisi*). Other state imperiled bird species that are known to use the site include the short-eared owl (*Asio flammeus*) and the Greater Sandhill Crane (*Grus canadensis tabida*).

Table 3. Natural Heritage element occurrences at Spring Creek at Greenie Mountain PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
Cleome multicaulis	Slender spiderflower	G2G3	S2S3	BLM	B
Sparganium eurycarpum	Giant bur-reed	G5	S2?		B
Plant Communities					
Carex simulata	wet meadow	G3	S3		B
Distichlis spicata	Salt meadows	G5	S3		B
Distichlis spicata-(Scirpus nevadensis)	Salt meadows	G4	S?		B
Eleocharis palustris	Spikerush emergent wetland	G5	S4		B
Juncus balticus var. *montanus*	Western slope wet meadows	G5	S5		B
Sarcobatus vermiculatus/ Sporobolus airoides	Saline bottomland shrublands	G3?	S3		B
Scirpus acutus	Hardstem bulrush emergent wetland	G5	S3?		B
Scirpus maritimus	Alkali bulrush emergent wetland	G4	S2		B
Scirpus pungens	Common threesquare emergent wetland/wet meadow	G3G4	S3		B
Birds					
Asio flammeus	Short-eared owl	G5	S2B, SZN		
Egretta thula	Snowy Egret	G5	S2B, SZN		A
Egretta thula	Snowy Egret	G5	S2B, SZN		A
Grus canadensis tabida	Greater sandhill crane	G5T4	S2B, S4N		
Plegadis chihi	White-Faced Ibis	G5	S2B,	FS, BLM	A

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
			SZN		
Plegadis chihi	White-Faced Ibis	G5	S2B, SZN	FS, BLM	A
Vertebrates					
Perognathus flavus sanluisi	Silky pocket mouse subsp.	G5T3	S3		A

*EO=Element Occurrence. Multiple listings represent separate locations.

Location: Approximately 5 air miles southeast of Monte Vista in Rio Grande County. Much of the refuge is only open to the public by special permission from the refuge manager.
U.S.G.S. 7.5-min. quadrangle: Homelake, Monte Vista, Waverly, and Fulcher Gulch
Legal Description: T37N, R07E S 1, 11, 12, 13, 14
T37N, R08E S 1-12, 17, 18
T37N, R09E S 5, 6
T38N, R08E S 25, 26, 27, 28, 29, 30, 31, 32, 33
T38N, R09E S 29, 30, 31, 32
Elevation: 7,580-7,800 ft. Approximate Size: over 15,000 acres.

General Description: This site contains a diverse assemblage of open water, emergent marsh, saline wet meadows, peatland, riparian communities, and some uplands. Historically, much of the site received flow from Spring Creek and possibly from groundwater discharge. The natural hydrology of the site has been altered due to groundwater pumping and water diversions for local irrigation and for habitat management on the Monte Vista National Wildlife Refuge (Refuge). Remnants of a large fen occur near the headwaters of Spring Creek. Most of the Refuge's cultural resources occur in this area suggesting that the site used to support large populations of wildlife and was a predominant feature on the landscape (Mike Blenden - pers. comm.). The fen is almost entirely dry, as the series of springs have not exhibited flow since the late 1970's due to the development of large wells in the area. The remaining portion of the PCA is heavily managed for waterbird use. Water is conveyed via numerous ditches and canals to waterbird management units to inundate these areas during seasonal use. Spring Creek has also been channelized for much of its length through the site.

Although the hydrology within the PCA does not likely represent natural historic conditions, current hydrologic management supports all of the elements found at the site. For instance, seepage from canals, ditches, and ponds supplement natural groundwater discharge is supporting sedge meadows (*Carex simulata*, *C. atherodes*, and *Scirpus pungens*) and emergent marshes (*Scirpus maritimus*, *S. acutus*, *Eleocharis palustris*, *Typha latifolia*, and *Sparganium eurycarpum*) whereas open water areas within the habitat management units support floating/submergent species (*Ranunculus aquatilis* and *Potamogeton* spp.).

It has been speculated that much of the refuge, prior to European settlement, was dominated by greasewood (*Sarcobatus vermiculatus*), saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and rabbitbrush (*Chrysothamnus* spp.). There are still some very

large tracts of land dominated by such species within the site. Exact species composition varies with the degree of soil moisture and salinity. For example, in areas where seasonal soil moisture is high, salt crusts may develop on the soil surface, limiting species composition to those tolerable of saline and/or alkaline soils. This occurs when the soil solution (soil water and its constituents (nutrients, salts, etc.)) becomes concentrated due to evaporation. This increase in concentration limits the solubility of calcium sulfate, calcium carbonate, and magnesium carbonate, which, as evaporation increases, eventually precipitate out of the soil solution and form salt crusts. This process also increases the proportion of soluble sodium in the soil solution, thus creating a saline soil environment (United States Salinity Laboratory Staff 1954). Often areas with thick salt crusts are void of any vegetation, however pickleweed (*Salicornia rubra*) is sometimes found in these areas and is the most saline tolerant species in the area. However, no pickleweed was located at this site. Broom seepweed (*Suaeda calceoliformis*), saltgrass, and Nevada bulrush (*Scirpus nevadensis*) occupy slightly less saline areas. Decreasing salinity and moisture allows greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*), and Baltic rush (*Juncus balticus*) to establish. Thus, a consistent pattern of species distribution is conspicuous on the landscape: the lowest areas of saline bottomland meadows and shrublands were typically void of vegetation; saltgrass occupied bands of slightly less saline soils whereas Baltic rush and greasewood occurred on sporadic knolls. Slender spiderflower was typically found growing around the base of these knolls, occupying a very narrow band between the more saline saltgrass community and the less saline areas of Baltic rush and greasewood. Near the northeastern edge of the site, a large stand of greasewood and alkali sacaton occupies slightly drier areas than those dominated by greasewood and Baltic rush.

In addition to Spring Creek, it has also been suggested that Cat Creek and potentially Rock Creek used to flow through portions of what is now the Refuge and that most natural wetlands probably occurred along these drainages (Mike Blenden - pers. comm.). Examples of which species these wetlands may have been comprised of can still be found along Spring Creek, where the creek has not been channelized. A nice example of this occurs just east of where Spring Creek crosses CO Highway 15. Here, the creek exhibits a slow, meandering flow allowing productive stands of sedges (*Carex* spp.), rushes (*Juncus* spp.), and slough grass (*Beckmannia syzigachne*) to establish across a relatively broad floodplain. Early explorers who came to the Valley in the late 1800's noted that the Alamosa River, which is just south of this site, was a sinuous, marshy stream with cottonwoods and willows only occurring in periodic patches (Essington 1996). Early records also indicate that marshy areas along the Conejos River were more frequent than they are today (Essington 1996).

This area along Spring Creek, although small in extent, may best represent what freshwater marshes were like in the western portion of the San Luis Valley prior to European settlement.

Boundary Justification: The boundary is drawn to encompass the ecological processes believed necessary for long term viability of the majority of the elements. The source of Spring Creek (the historic fen) is captured to ensure natural surface water flow through the site and also to allow future restoration efforts of the fen. Much of the Refuge was encompassed in order to provide rare and imperiled bird species the area, and ability to move freely in this area to find necessary resources. This also provides many source areas for seed

dispersal for the plant and plant community elements. Such areas are extremely important to buffer long-term population fluctuations of the elements. Although the boundary does encompass the source of surface water input to the site, it is difficult to account for areas that contribute groundwater discharge. Thus, it is important to note that any changes in the current status of groundwater pumping and water diversions from water bodies that recharge groundwater would likely affect the elements (both positively and negatively depending on the element). Also, although the silky pocket mouse occurrence is encompassed within this site, it should be noted that site boundaries were not drawn to account for the ecological processes necessary for the viability of this element

Protection and Management Comments: The site is mostly within the boundaries of the Monte Vista National Wildlife Refuge. A small portion of the site occurs on privately owned land. No development threats are foreseen in the immediate future, however the private lands have no formal protection.

Changes in water management could impact the integrity of the elements on this site. In addition, whitetop (*Cardaria* spp.) and Canada thistle (*Cirsium arvense*), introduced and highly aggressive species, are found within the site occupying wet meadows and irrigated areas.

Soils Description: Soils types are variable within this site, however most are derived from alluvium material and have high alkalinity. Alamosa, Arena, and Hooper are the most common soil series found in association with the wetland plant communities at this site (USDA 1980b). The Alamosa is a Fine-loamy, mixed, frigid Typic Argiaquolls. The Arena is a Fine-loamy, mixed, frigid Aquentic Durorthids. Both of these soils are poorly drained and were formed in loamy alluvium in old floodplains. The Hooper is a Clayey over sandy or sandy-skeletal, montmorillonitic, frigid Typic Natrargids (USDA 1980b). The Hooper is well drained and was also formed in alluvium on old floodplains. Soil profile descriptions were found to match mapped soil types except for a small fen, dominated by short beaked sedge, found along Spring Creek (just west of County Rd. 3E). This area had a dense fibric mat of peat overlying highly sapric material. These organic horizons appear to have formed above an impermeable layer. The water table depth was found to be at the soil surface.

Soil Profile (perched wetland) – Histic Cryaquolls
Oi – 22 inches to12, fibric
Oa – 12 inches to 0; highly sapric with substantial graininess
C – 17 inches to ?; extremely hard surface; no sample was taken
pH of soil water in the soil pit was 7.8.

Restoration Potential: Hydrologic restoration of Spring Creek Fen and potentially restoring natural meanders to Spring Creek are long-term projects that the Refuge would like to implement (Mike Blenden pers. comm. Jan. 11, 2000). True restoration of hydrology in this area would entail capping or stopping production of numerous wells located in the area to reestablish natural groundwater flow to the series of springs. As this is likely not feasible, restoration may occur via water diversions to a recharge area thereby returning flow to the springs. This would artificially restore hydrology and would enhance functions such as wildlife habitat, plant community diversity, and stop further degradation (decomposition) of

the remaining organic soils at Spring Creek Fen. Restoring natural meanders to Spring Creek would also increase the abundance of native wetland plant communities and increase functions such as sediment/shoreline stabilization, flood attenuation and storage, and sediment/nutrient/toxicant retention and removal. Restoring natural meanders to Spring Creek would require some type of hydrological enhancement/restoration of Spring Creek Fen, since the latter serves as the headwaters of Spring Creek. A nice reference reach for channel restoration exists along Spring Creek just east of Colorado Highway 15. In this area, the creek still exhibits what is believed to be its natural meandering pattern. This area could provide a reference for calculating target meander geometry patterns and other morphological characteristics necessary for channel restoration (Federal Interagency Stream Restoration Working Group 1998).

Wetland Functional Assessment for the Spring Creek at Greenie Mountain PCA:

Proposed HGM Class: Mineral Soil Flats. Subclass: F1. (Includes saline wet meadows and shrublands).
Cowardin System: Palustrine. Subsystem: Emergent and Scrub/Shrub.

Table 4. Wetland functional assessment for mineral soil flat wetlands at the Spring Creek at Greenie Mountain PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	Doesn't flood via overbank or in-channel flow.
Sediment/Shoreline Stabilization	N/A	Doesn't occur along a natural surface drainage.
Groundwater Discharge/ Recharge	High	All of these wetlands on the site are supported by groundwater discharge as indicated by saturated areas during the dry season and the accumulation of salt crusts on the soil surface.
Dynamic Surface Water Storage	Low	There are no extensive areas of open water in these wetlands, most are saturated.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	The wetlands likely receive return water from agricultural fields, hay meadows, and rangeland, and fine textured soils are present, however, some areas are sparsely vegetated and very little ponded water is found in these areas. The latter two limit the capability of these wetlands to perform this function.
Biological Functions		
Habitat Diversity	Moderate	The wetland site consists of salt meadows and saline shrublands with no open water.
General Wildlife Habitat	Moderate	Avocets, avocet nests w/eggs, White-faced ibis, a marsh hawk, and a few butterflies were observed in the area. Coyotes are also likely users of the area.
General Fish/Aquatic Habitat	N/A	Doesn't occur along a natural surface drainage.
Production Export/Food Chain Support	Low	Sparse growth of vegetation (due to saline/alkaline soils), low habitat and species diversity, and ephemeral surface water limits the export of organic matter and nutrients. The site does, however provide food chain support for some species (avocets, and potentially the San Luis Valley sand hills skipper, which uses saltgrass as a host plant).
Uniqueness	Moderate	Salt meadows and saline bottomland shrublands were likely more prevalent in Rio Grande and Conejos counties than they currently are due to conversion to agricultural lands and hay meadows.

Proposed HGM Class: Depression. Subclass: D2. (Wetlands are either permanently flooded (open water areas) or semi-permanently flooded (emergent marshes).
Cowardin System: Palustrine. Subsystem: Emergent and Aquatic Bed.

Table 5. Wetland functional assessment for depressional wetlands at the Spring Creek at Greenie Mountain PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	Do not flood via overbank or in-channel flow.
Sediment/Shoreline Stabilization	N/A	Do not occur along a natural surface drainage.
Groundwater Discharge/ Recharge	Moderate	Seeps and groundwater discharge support most of these wetlands, however some are supported by managed water regimes and seepage from such areas. Thus, it is difficult to discern how much is natural groundwater discharge versus seepage from waterbird management units, hence the moderate rating.
Dynamic Surface Water Storage	High	There are extensive areas of open water in these wetlands. Whether from a natural origin or not, large quantities of water can be retained in these wetlands.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	These wetlands likely receive return water from agricultural fields, hay meadows, and rangeland, extensive areas of open water are in the area, and vegetation cover is high.
Biological Functions		
Habitat Diversity	High	Emergent and aquatic bed vegetation occur in these areas with open water areas.
General Wildlife Habitat	High	Avocets, White-Faced Ibis, Wilson's Phalaropes, various duck species, Greater Sandhill Cranes, Common Snipe, and a weasel-like mammal were observed in the area. High plant species diversity likely supports diverse invertebrate populations.
General Fish/Aquatic Habitat	N/A	Doesn't occur along a natural surface drainage.
Production Export/Food Chain Support	High	Plant species diversity is high, vegetation cover is high, permanent and semi-permanent water is present, and organic soil horizons are present in many of these areas. All these attributes provide for excellent food chain support and exportation of various organic substrates.
Uniqueness	Low	These freshwater wetlands are common throughout the area.

Proposed HGM Class: Riverine. Subclass: R3. (Channelized stream whose herbaceous, rather than woody, species dominate the banks and floodplain).
Cowardin System: Palustrine. Subsystem: Emergent.

Table 6. Wetland functional assessment for the riverine wetland (Spring Creek) at the Spring Creek at Greenie Mountain PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	Low	Lack of woody vegetation, unrestricted outlet, and decreased flood volumes/frequency (due to water diversions, groundwater pumping, and channelization) impair the ability of this area to attenuate and store floodwaters. Restoration may improve the ability to perform this function.
Sediment/Shoreline Stabilization	High	Although Spring Creek has been channelized, it has not been severely incised. Emergent vegetation is growing within the channel and on the stream banks.
Groundwater Discharge/ Recharge	High	Inputs from irrigation water, seepage from waterbird management units, and natural groundwater discharge likely make Spring Creek a gaining stream.
Dynamic Surface Water Storage	N/A	Flooding is due to stream flows and not groundwater.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	Inputs from irrigation water and seepage from waterbird management units likely contribute excess nutrient loads as indicated by the extensive mats of algae occasionally encountered within the stream channel. High vegetation cover and fine textured soils provide many potential pathways for nutrient and toxicant transformation. The presence of the algal mats, however, suggests that the wetland areas are not able to retain or remove enough of the excess nutrient load to avoid eutrophication problems.
Biological Functions		
Habitat Diversity	High	The wetland site consists of emergent and aquatic bed habitats with some open water areas.
General Wildlife Habitat	High	Cattle Egrets were observed along the stream channel and marsh hawks were observed hunting in the area. Also, an unknown Rail (Sora?) was heard but could not be identified. Coyotes and other small mammals likely use the stream and adjacent floodplain for food/cover.
General Fish/Aquatic Habitat	Low to Moderate	Did not observe any fish. Adequate stream flow and plenty of vegetative cover suggest potential fish habitat. However, extensive mats of algae were observed within the stream channel, which may indicate eutrophication is occurring.
Production Export/Food Chain Support	High	High vegetative cover both within the stream channel and on adjacent floodplain areas contribute to organic matter export. These areas also likely support a diverse invertebrate population thereby providing food chain support.
Uniqueness	Moderate	The reach of Spring Creek near CO Hwy. 15, where the stream has not been channelized and is upstream from major water diversions, is very unique. This area probably best represents what many streams in the Valley looked like prior to European settlement. The remaining stretch of Spring Creek has very little unique value due to the multitude of disturbances it has suffered.

FIGURE 1. SPRING CREEK AT GREENIE MOUNTAIN PCA.

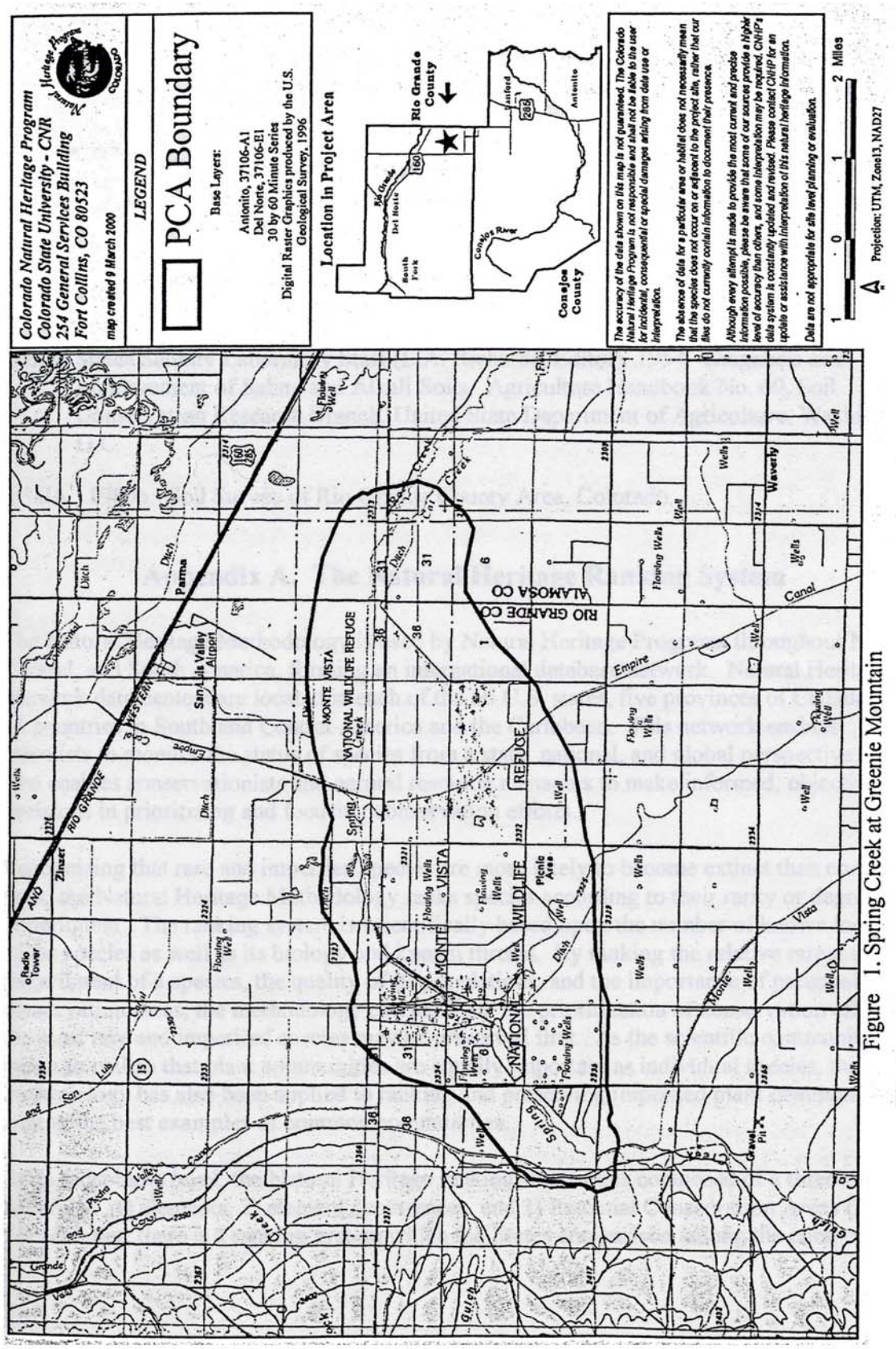

Figure 1. Spring Creek at Greenie Mountain

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Appendix A. The Natural Heritage Ranking System

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

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

At its most basic level, the Natural Heritage ranking structure is composed of a three-tiered hierarchy: 1) elements, 2) element occurrences, and 3) Potential Conservation Areas (PCAs). For each tier, there is a ranking system which facilitates comparison among the components

of that tier. This system is designed to identify and prioritize land-based (or water-based) conservation opportunities with the ultimate goal of protecting all species by targeting the habitats they need to survive. By operating at different scales, the system is useful for assessing conservation needs from a variety of perspectives.

Elements

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

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

Element Imperilment Ranks

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

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

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

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

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

Interpreting Imperilment Ranks

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

When ranking migratory elements, it is necessary to distinguish between breeding, non-breeding, and resident populations. A "B" following the state rank (e.g., S1B) indicates that the rank applies only to the status of breeding occurrences. An "N" following the state rank (e.g., S1N) refers to the nonbreeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

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

Table 7. Definition of Colorado Natural Heritage Imperilment Ranks.

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

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

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

Natural Heritage ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare or imperiled species receive legal protection (other than the protection provided to all wildlife). Legal status under the federal Endangered Species Act is designated by the U.S.

Fish & Wildlife Service (USFWS). Designations of endangered or threatened species under the Colorado Non-game and Endangered or Threatened Species Conservation Act are made by the Colorado Division of Wildlife. In addition, the U. S. Forest Service and the Bureau of Land Management maintain "sensitive species lists" that provide some legal protection on the lands owned or managed by the respective agencies. CNHP provides information to these and other agencies to aid in the identification of priorities for conservation action, including legal protection. However, it is the intention of the Natural Heritage system to identify conservation needs and stimulate conservation action before protection under endangered species laws becomes a necessity.

Table 8. Federal and State Agency Special Designations.

Federal Status:

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

LE Endangered; species or subspecies formally listed as endangered.

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

LT Threatened; species or subspecies formally listed as threatened.

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

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

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

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

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

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

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

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

State Status:

1. Colorado Division of Wildlife

E Endangered

T Threatened

SC Special Concern

Element Occurrences

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

Element Occurrence Ranks

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

The EO-Rank is based on 3 factors:

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

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

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

Potential Conservation Areas

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

After the identification of PCAs, some method for prioritization is needed. *Biodiversity significance ranks* are generated primarily from the imperilment of the element(s) contained within the boundaries (i.e., the global and state imperilment ranks), and then modified by the quality of the occurrences (i.e., the element occurrence rank). Biodiversity significance ranks indicate relative significance of the loss should a particular PCA be destroyed or irretrievably degraded. For example, loss of a PCA that contains the only known example of a species or natural community could result in extinction. It would therefore be assigned the highest priority rank (e.g., B1). Another PCA may contain an occurrence of a globally common species that occurs at the margin of its range just inside the state boundary. The loss of such a PCA should be avoided, but conservation practitioners would still be left with many additional sites for the protection of that species, and so the PCA is ranked as a much lower biological priority.

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

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

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

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

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

B5 – General or Local Conservation Interest