A Vegetation Survey and Preliminary Ecological Assessment of Valles Caldera National Preserve, New Mexico

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New Mexico Natural Heritage Program

A Vegetation Survey and Preliminary Ecological Assessment of Valles Caldera National Preserve, New Mexico[1]

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SUMMARY

With the acquisition of the Valles Caldera National Preserve (VCNP) has come the need for comprehensive biological inventories to support sound natural resources management. Fundamental components of this effort are the development of a vegetation map and associated vegetation community classification, and a preliminary assessment of the condition and regional status of these communities. Accordingly, we conducted an initial vegetation survey to help characterize the range of variation and condition among the preserve's ecosystems and to provide a foundation for the development of a high-resolution vegetation map to be used in planning and management. In 2001, we established 100 vegetation plots in the preserve's forests and grasslands that have detailed species inventories, site and tree stand characterizations, and repeat photo points. In this first year, sampling was focused on describing reference conditions in stands that had the fewest impacts from past logging and grazing or those with special biological elements. Data from these plots were used to develop a vegetation classification that conforms to the National Vegetation Classification system standards. The classification serves as an organizing tool for information on the preserve's ecosystems and for defining map units for a vegetation map to be developed in succeeding years.

We identified and described 65 plant associations that encompass high elevation sub-alpine forests, down through mixed conifer to open foothill pine woodlands, and from high montane grasslands to valley floor wetlands. This makes VCNP one the most diverse sites in the Southern Rocky Mountains Ecoregion (southern Wyoming to northern New Mexico). The montane grasslands and wetlands of the preserve are of particular importance because they are considered part of an ecosystem type that is threatened and declining on a global basis due to the impacts of grazing and development. The estimated 26,000 acres of montane grasslands along with the 1,650 acres of wetlands on the preserve represent some of the largest and highest quality occurrences in terms of ecological function and biodiversity within the ecoregion, and they potentially represent a 20% increase in acreage of montane grasslands and wetlands under protection in parks and preserves. Although of relatively high quality, long-term cattle and sheep grazing has left an imprint on these communities in terms of declines in native bunchgrasses and increases in exotic or undesirable species. These effects are further confounded by the presence of sizable elk populations on the preserve. Furthermore, past grazing impacts are also thought to be responsible for declines in aquatic habitat and the cold-water fishery within the preserve. Given this complexity, the implementation and maintenance of a scientific monitoring program that addresses the interactions among grazers and ecological processes such as fire and flooding, is critical to the restoration and long-term sustainability of these grassland and associated aquatic ecosystems.

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With respect to forests, the VCNP was subject to extensive timber harvest during the twentieth century—approximately 40,000 acres out of the 65,000 was either selectively harvested or clear-cut between 1930 and 2000. This has left a legacy of second-growth forests with a mix of altered stand conditions and an extensive logging road network with its implications for degraded hydrological regimes and erosion hazards. Yet, the remaining 25,000 acres of virgin forest still represent the some the largest and best occurrences left in the Jemez Mountains, particularly those on Redondo Peak and in the Sierra del los Valles along the eastern boundary of the preserve. These stands and associated rocky talus slopes are also home to several sensitive species including the Jemez Mountains salamander (*Plethodon neomexicanus*), Goat Peak pika (*Ochotona princeps nigrescens*), and the northern goshawk (*Accipiter gentiles*), and Sapello Canyon larkspur (*Delphinium sapellonis*). In addition, these remaining virgin forests lie in the upper watersheds of the East Fork of the Jemez River and San Antonio Creek, which form the core of the cold-watery fishery for the preserve. Accordingly, an East Fork- San Antonio Upper Watershed Protection Zone is suggested as a special management area where livestock grazing and logging would be excluded and restoration implemented scientifically on a landscape scale to improve downstream riparian wetland and aquatic conditions. In addition, the zone would secure habitat for several sensitive species and hence help avoid future conflicts in their management.

We would also suggest a special management area for the Alamo Canyon wetland complex on the west side of the preserve. The primary feature of this complex is a large grassy montane fen known as "Alamo Bog" that is unique in the Southern Rocky Mountain region. Unlike other fens in the region, this one is highly acidic as a result of sulfuric acid inputs from underlying warm springs and, over the course of 9,000-plus years, it has accumulated more than 12 feet of organic peat intermixed with sediments. In addition, the wetland complex also contains a bog birch (*Betula glandulosa*) community that is found nowhere else in New Mexico. Overall, this highly acidic and deep fen along with the bog birch make up a globally rare ecosystem type that is worthy of special management attention.

Redondo Peak is both sacred to the native people of the region and the heart of a preserve now belonging to the American people. While the enabling legislation for the VCNP set aside the lands above 10,000 ft for protection, to effectively manage this landscape for its cultural and biological values requires that the entire slope of the mountain be considered. We therefore suggest a Redondo Peak Reserve that encompasses the lower slopes of the mountain so that management, particularly of fire, can be implemented in a meaningful landscape context to ensure the long-term sustainability of the forests, montane grasslands, rare species, and the associated cultural resources of the mountain.

Overall, we suggest that management of the natural resources of the preserve would be best addressed through an ecosystem approach that recognizes the role humans play in balancing biodiversity protection with sustainable resource extraction along with recreational and scenic values. We recommend a strategy that focuses on watersheds and the reestablishment of landscape-level processes such as appropriate fire regimes and levels of grazing in a way that will ensure long-term sustainability of productivity and biodiversity.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

With establishment of the Valles Caldera National Preserve in 2000, 90,000 acres of picturesque land rich in natural resources and biodiversity came under ownership of the American people. With acquisition has come the responsibility for wise management to ensure long-term sustainability of the preserves ecosystems. As a step towards this, inventories of the preserve's animal, plant, timber, and range resources, and an assessment of their status are needed. Accordingly, we present a vegetation survey that characterizes the range of variation among the preserve's ecosystems and that provides the initial groundwork for the future development of a high-resolution vegetation map. An additional goal was to highlight the outstanding ecological attributes of the preserve along with some of the biological management issues that will likely need to be addressed in the natural resources planning process.

The vegetation survey was conducted during the summer of 2001 and was centered on establishing 100 detailed vegetation plots across the range of the preserve’s vegetation communities. Based on these plots, a preliminary vegetation classification was constructed that contains information on community species composition, abundance, and site characteristics. This classification will serve as the framework for the development a vegetation map to be built from aerial photography and satellite imagery in the second year of the project. The classification also conforms to national vegetation classification and mapping standards. This has allowed us to effectively access information from a variety of databases and literature sources about the ecology and distribution of the component communities. Using this information, we present here an overview of the vegetation pattern and ecology of the preserve along with a preliminary assessment of ecological conditions and biodiversity status (rarity) in a regional and national (and sometimes international) context. In addition, we have identified for consideration a set of special management areas that focus on sites that support species or communities of special interest, or that address the protection and restoration of ecological processes necessary for sustaining biological resources within the preserve. Our overall objective has been to provide fundamental information for effective natural resources management in a watershed and ecosystem context, and to complement and support other biological and natural resources inventories and studies.

ACKNOWLEDGEMENTS

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Photographs. Phil Tonne: Figures 8, 10, 13, 14, 15, 16, 17, 18, 20, 21, 24, 37, 41 a & c, and 42 ; Esteban Muldavin: cover photo, 9, 11, 12 ,22, 23, 26, 27, 30, 32, 38, 39, 40, 41b, 43, 48, 49; Tom. Swetnam: 34, 44, and 45; Yvonne Chauvin: 19 and 33; Elizabeth Milford 29, and J. Stewart (NM Rare Plant Council): 25.

STUDY AREA

Location and History

The Valles Caldera National Preserve (VCNP) lies in north-central New Mexico in the heart of the Jemez Mountains (Figure 1). It is bounded primarily by Santa Fe National Forest lands with smaller units of Bandelier National Monument and Santa Clara Pueblo along its eastern flank. The preserve encompasses most the original Baca Location No. 1 land grant except for the peripheral areas owned by the U.S. Forest Service (USFS), Bandelier NM and Santa Clara Pueblo. The acreage is approximately 89,000 acres (36,000 ha).

A report on the Baca compiled by the USFS (1993) provides extensive details about the history (through 1993) and resources of the preserve. Briefly, the Baca Location No. 1 was established as part of a land exchange in the 1860's between the U.S. government and the Baca family for lands near Las Vegas, NM. At the turn of the century, the parcel began to change hands and eventually was acquired in 1926 by Frank Bond, an Española, NM merchant and sheep rancher. He grazed sheep on the land until the 1940's, when a cattle operation was phased in. At the same time, major timber harvests were begun in the 1930's by New Mexico Timber Company, who had held a 99-year lease on the timber rights since 1918. Frank Bond died in 1945, but the land was managed by his descendants until 1962, when Pat Dunigan, a Texas oilman, purchased the parcel. Dunigan and his co-investors purchased the ranch with the intention of investigating its geothermal potential for electrical power. Between 1972 and 1982, geothermal leases were issued to Union Geothermal of California and upwards of 40 wells were drilled, mostly in the Alamo Creek and Redondo Creek drainages. The ranch continued to have a livestock operation, but with much lower numbers (4,000 to 6,000 head versus 12,000). Timber harvests continued until 1972 when Pat Dunigan was able to acquire the remaining timber rights from New Mexico Timber Company (following a protracted legal battle). Logging was discontinued up until Pat Dunigan's death in 1980. In the ensuing 20 years land was managed by his heirs and logging resumed along with a large livestock operation.

In April 2000, Congress passed the Valles Caldera Preservation Act (Public Law 106-248) that allowed the purchase of the land for public use. There were five purposes stipulated in the act that will have a direct impact on how the land will be managed for generations to come:

1) to authorize Federal acquisition of the Baca ranch;

2) to protect and preserve for future generations the scientific, scenic, historic, and natural values of the Baca ranch, including rivers and ecosystems and archaeological, geological, and cultural resources;

3) to provide opportunities for public recreation;

4) to establish a demonstration area for an experimental management regime adapted to this unique property which incorporates elements of public and private administration in order to promote long term financial sustainability consistent with the other purposes enumerated in this subsection; and

5) to provide for sustained yield management of the Baca ranch for timber production and domesticated livestock grazing insofar as is consistent with the other purposes stated herein

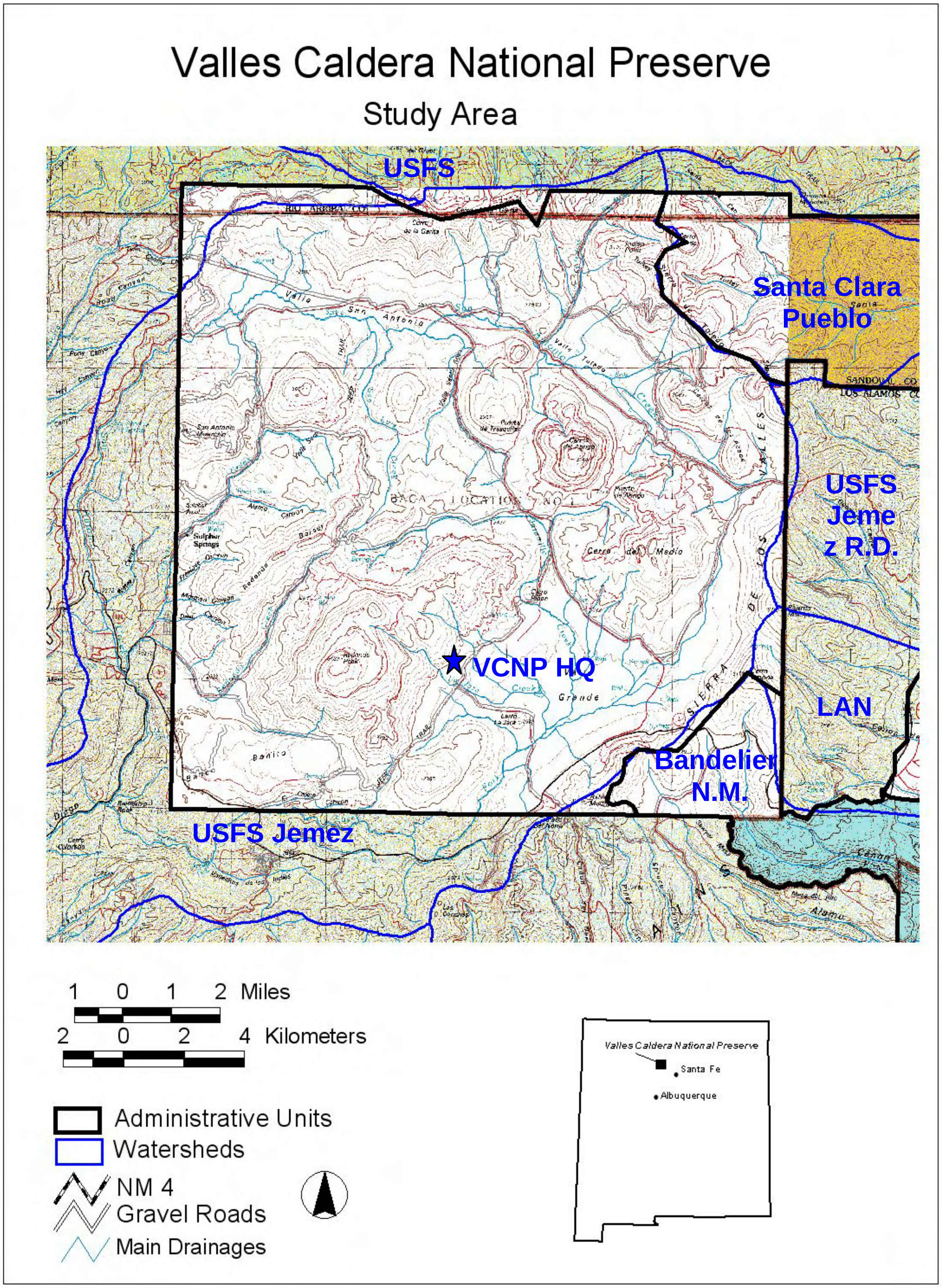

Figure 1. Valles Caldera National Preserve (VCNP) encompasses most of former Baca Location No. 1 except for areas that were distributed to Bandelier National Monument, Santa Clara Pueblo and the Coyote District of the Santa Fe National Forest.

Landscape and Climate

The dramatic landscape of the Valles Caldera National Preserve is derived from the remnants of a series of volcanic eruptions from 1,600,000 to 60,000 years ago that left behind a caldera rim of mountains that ring the preserve and several volcanic cones and domes that dominate the center (Figure 2). The intervening valleys, or in Spanish, “valles” formed after an ancient caldera lake was breached and drained. There is a 3,250-foot difference in elevation across the preserve with the lowest point at about 7,930 ft (2,440 m), near the mouth of El Cajete Canyon in the southwestern corner of the preserve. The highest point is Redondo Peak at 11,254 ft (3,430 m), with the mountains of the caldera rim averaging over 10,000 ft (3,000 m). The intervening valles range from about 8,400 ft (2,560 m) to 9,000 ft (7,740 m).

Since there are no official weather stations on or near the VCNP, the best available climate information comes from Los Alamos at 7,360 ft (2,243 m) (Table 1). The regional climate is considered semi-arid continental with the majority (60%) of the precipitation coming in the summer months in the form of convectional “monsoon” storms. The winter precipitation is primarily from snow. This overall climate scenario is modified by the high elevations and topographic variability within the VCNP. For example, the 18.4 in (46.7 cm) mean annual precipitation (MAP) reported for Los Alamos is estimated to increase to over 35 in (90 cm) at the caldera rim (Allen 1989), and snow accumulation, while minimal at Los Alamos, can be significant within the valle/mountain landscape of the preserve. Similarly, temperatures at the highest elevations of the VCNP may be anywhere from 25 to 35° F (15 to 20° C) colder than Los Alamos, and the valles are likely to be between 10 and 15° F (5 to 8° C) colder. The effect of cold-air drainage into the valle bottoms may also drive temperatures down even further.

Figure 2. Looking south from Pajarito Mountain over Valle Grande with the Sierra de los Valles of the caldera rim to the left and Redondo Peak, a volcanic dome, in the distance to the right.

Table 1. Monthly Climate Summary for Los Alamos (Station 295084) based on a period of record from 2/1/1942 to 12/31/2001.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	39.5	43.5	49.6	58.6	67.7	77.9	80.5	77.7	72.4	61.7	48.8	40.9	59.9
Average Min. Temperature (F)	18.4	21.8	26.8	33.8	42.7	51.8	55.5	53.9	48.0	37.7	26.8	19.8	36.4
Average Total Precipitation (in.)	0.88	0.73	1.08	0.99	1.25	1.38	3.05	3.77	1.81	1.54	0.94	0.97	18.39
Average Total Snowfall (in.)	12.1	9.1	10.3	4.8	0.6	0.0	0.0	0.0	0.0	2.2	4.9	11.2	55.2
Average Snow Depth (in.)	3	2	1	0	0	0	0	0	0	0	0	2	1

The Jemez Mountains are considered part of the Southern Rocky Mountains Ecoregion by Neely et al. (2001), which approximates the Southern Rocky Mountain Steppe--Open Woodland--Coniferous Forest--Alpine Meadow Province in Bailey's (1995) ecoregion classification used by the U.S. Forest Service. Alternatively, it is considered part of the Southern Rockies Ecoregion in Omernik's (1987) classification developed for the Environmental Protection Agency. For our purposes here, we have adopted the Southern Rocky Mountains Ecoregion term and delineation used by Neely et al. (2001).

Geology

The Jemez Mountains lie at the intersection of the Jemez lineament and the Rio Grande rift (Figure 3). The Jemez lineament is a chain of volcanic centers extending from Arizona to Colorado, and the Rio Grande rift is a crack in the earth's crust extending from the Rocky Mountains of central Colorado to Chihuahua, Mexico. This geologic interface was the site of a series of volcanic events related to tectonic movements, including two massive explosions leading to the formation of the Toledo and Valles Calderas at 1.61 and 1.23 million years ago, respectively (Spell et al. 1993). The Toledo eruption ejected an estimated 396 km^3 of rock and ash, while the Valles eruption produced about 292 km^3. By comparison, Mt. Saint Helens erupted 25 km^3 and Krakatoa 18 km^3 of new material.

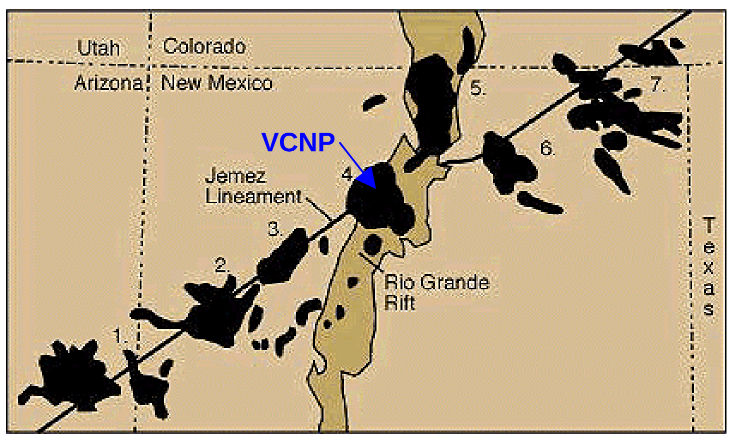

Figure 3. Miocene to Holocene volcanic fields and the Jemez lineament: 1. Springerville; 2. Zuni-Bandera 3; Mount Taylor; 4. Jemez Mountains; 5. Taos; 6. Ocate; and 7. Raton-Clayton (from Ander et al. (1981).

The remnant caldera rim is comprised of a chain of peaks and domes that include the Sierra del los Valles along the eastern flank of the preserve and Cerro de la Garita along the northeasterly boundary (Figure 4). The mountains are primarily made up of Otowi (Qbo) and

Tshirege members (Qbt) of the Bandelier Tuff, Cerro Toledo Rhyolite (Qct), the Tischcoma formation (Tt), and the Paliza Canyon Formation (Tpa) (Table 2). The Bandelier Tuff was deposited in a sheet 30 to 900 ft (9 to 275 m) thick in the Jemez Mountains and beyond, forming the upper walls of San Diego Canyon, and dominating the geology of Bandelier National Monument to the southeast of the preserve.

Within the caldera rim, the formation of the prominent landforms was primarily by resurgence of the caldera floor and intrusion through faults. The more recent Valles eruption was followed by the collapse of the caldera, and subsequently by the formation of multiple intra-cauldron lakes (Gardner et al. 1996), and now represented by Tuffaceous Lake Sediments (Qls). There was a later resurgence of the caldera floor that formed the classic domal uplift of Redondo Peak (Qbt). A series of rhyolitic domes resulted when molten rock squeezed up through faults in a regular sequence along the ring fracture that had formed during the caldera collapse (Valle Grande Member – Qvvf). Eight domes were formed between 1.1 and 0.5 million years ago: Cerro del Medio (the oldest), Cerro La Jara, Cerros del Abrigo, Cerro Santa Rosa, Cerro San Luis, Cerro Seco, San Antonio Mountain, and South Mountain (the youngest). The most recent events were the El Cajete pumice (Qvec) eruption and the Banco Bonito (Qvbb) obsidian flow, both occurring within the last 60,000 years. The slopes of the valles are dominated by older quaternary alluvial fan (Qf) deposits from the surrounding mountains forming alluvial fans and fan piedmonts that lead down to recent alluvial fill (Qal) in the valley bottoms.

The drainages of San Antonio Creek and the East Fork of the Jemez River come together at the head of San Diego Canyon, and San Diego Canyon represents the only drainage outlet from the Valles Caldera. The head of this canyon occurs at the lowest lip of the caldera rim and is thought to represent the point where the caldera was breached because of overflow from a lake generated by displacement of a growing resurgent dome of Redondo Peak (Smith and Bailey 1963). There is evidence for this in the lake sediments that thin against the resurgent dome and are associated with hydromagmatic tuffs (Gardner et al. 1996).

Soils

The soils to some degree mirror the geology of the VCNP (Figure 5). There are some 20 soil series that are components of 19 soil mapping units that have been mapped for the preserve as part of the Natural Resources Conservation Service, Sandoval County Soil Survey (Table 3). The soils fall into two large groups: forest and grassland soils. The forest soils are primarily mountain soils (Andisols, Alfisol and Inceptisol soil orders) and are derived from the volcanic rocks and gravel (rhyolites and andesites, with some dacites and latites, tuffs and pumices) along with some windblown deposition. These soils tend to be very rocky with loamy textures in the matrix. The grassland soils are mostly Mollisols that have developed in the volcanic alluvium of the alluvial fans and piedmonts, or in recent water-deposited sediments of the valley bottoms. They are usually deeper and have rich organic material accumulations in the top layers along with fine textures and little rock accumulation.

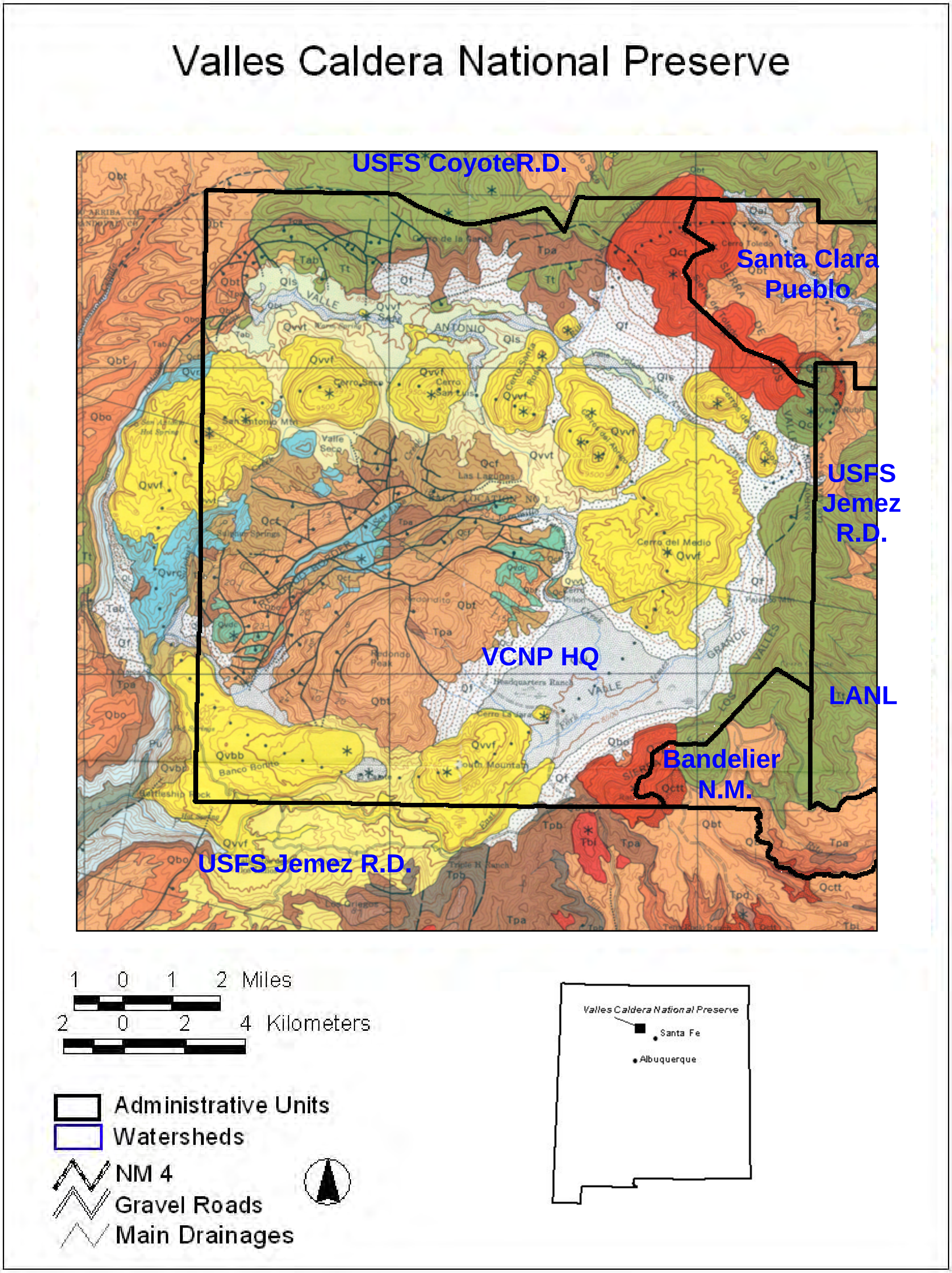

Figure 4. Geology of the Valles Caldera National Preserve as mapped by Smith et al. (1970). See Table 2 for map unit descriptions.

Table 2. Geologic map units of Smith et al. (1970) that occur on the Valles Caldera National Preserve (see Figure 4 for map).

Map Unit	Map Unit Name	Description
Qvbb	Banco Bonito Member	(100-500 ft). Thick flow of porphyritic obsidian containing phenocrysts of quartz, sanidine, plagioclase, biotite, hornblende, and pyroxene.
Qal	Alluvium	(0-100(?) ft). Silt, sand, and gravel; mainly deposits of recent streams.
Qf	Fan Deposits	(0-100(?) ft). Coarse sand and gravel; mainly deposits of transient streams with steep gradients.
Qbo	Otowi Member	(0-600+ ft). Nonwelded to densely welded ash-flow deposits, characteristically containing abundant accidental lithic inclusions. As mapped includes 0-30 ft of basal, bedded, air-fall pumice. (Guaje Pumice Bed).
Qct	Cerro Toledo Rhyolite	Volcanic domes; mainly gray lithoidal rhyolite, commonly lithophysal, and subordinate obsidian, containing small sanidine and rare quartz phenocrysts.
Qctt	Cerro Toledo Rhyolite	Rhyolite tuffs and tuff braccias (0-200+ ft); includes hoy avalanche deposits from Rabbit Mountain center.
Qls	Tuffaceous Lake Sediments	(0-100+ ft). Thin-bedded clay, silt, and sand deposited in lakes within the Valles Caldera; commonly contain fossil leaf and other plant remains; interbedded with tuffs of the Valle Grande Member of the Valles Rhyolite.
Qvvf	Valle Grande Member (volc.domes and flows)	Volcanic domes and flows (200-2,500 ft). Predominantly porphyritic rhyolites containing major phenocrysts of quartz and sanidine with lesser plagioclase, biotite, hornblende, and pyroxene.
Qvvt	Valle Grande Member (tuffs)	Bedded rhyolite tuffs and tuff breccias (0-500(?) ft).
Qvdc	Deer Canyon Member	Rhyolite dome-flow, associated breccias, and bedded tuffs (25-100ft). Predominantly coarsely porphyritic lithoidal rhyolite typically containing abundant phenocrysts of sanidine and bi-pyramidal quartz.
Qcf	Caldera Fill	(0-2,500 + ft) coarse breccia, gravel, sand and silt deposited within the Valles Caldera. Predominantly volcanic detritus but locally contains large blocks of Paleozoic limestone and red sandstone. Some coarse breccia units represent landslide deposits from the caldera walls. Includes early-formed caldera lake sediments and some pyroclastic deposits.
Qbt	Tshirege Member	(50-900+ ft). Nonwelded to densely welded ash flow deposits, characteristically containing sparse to abundant cognate inclusions of hornblende-rich quartz-latite pumice, and sparse accidental lithic inclusions. As mapped includes 3-12 ft of basal, bedded, air-fall pumice. (Tsankawi Pumice Bed).
Tt	Tschicoma Formation	(0-3,000+ ft). Predominately coarsely porphyritic dacite, rhyodacite, and quartz latite containing pyroxene, hornblende, biotite, plagioclase, and occasionally quartz phenocrysts. Thick massive flows and domes. Associated pyroclastics mapped as part of the Puye Formation.
Tpa	Paliza Canyon Formation (andesitic)	Mainly hypersthene-augite andesites and subordinate olivine-bearing basaltic andesites. Flows, flow breccias, tuff breccias, and dikes, undivided (0-2,000 ft). As mapped includes some gravels of the Cochiti Formation.
Tab	Abiquiu Tuff of Smith	(0-1,200+ ft). Mainly white to light-gray tuffaceous sand and conglomerate; includes basal gravel member (60-300 ft), composed of Precambrian crystalline rock types, and a thin (5-25 ft) chert bed (Pedernal Chert Member of Church and Hack, 1939). The Abiquiu west of La Grulla Plateau consists only of the basal gravel and chert. Includes tuffaceous sediments of questionable correlation at the mouth of Santa Fe Creek Canyon.

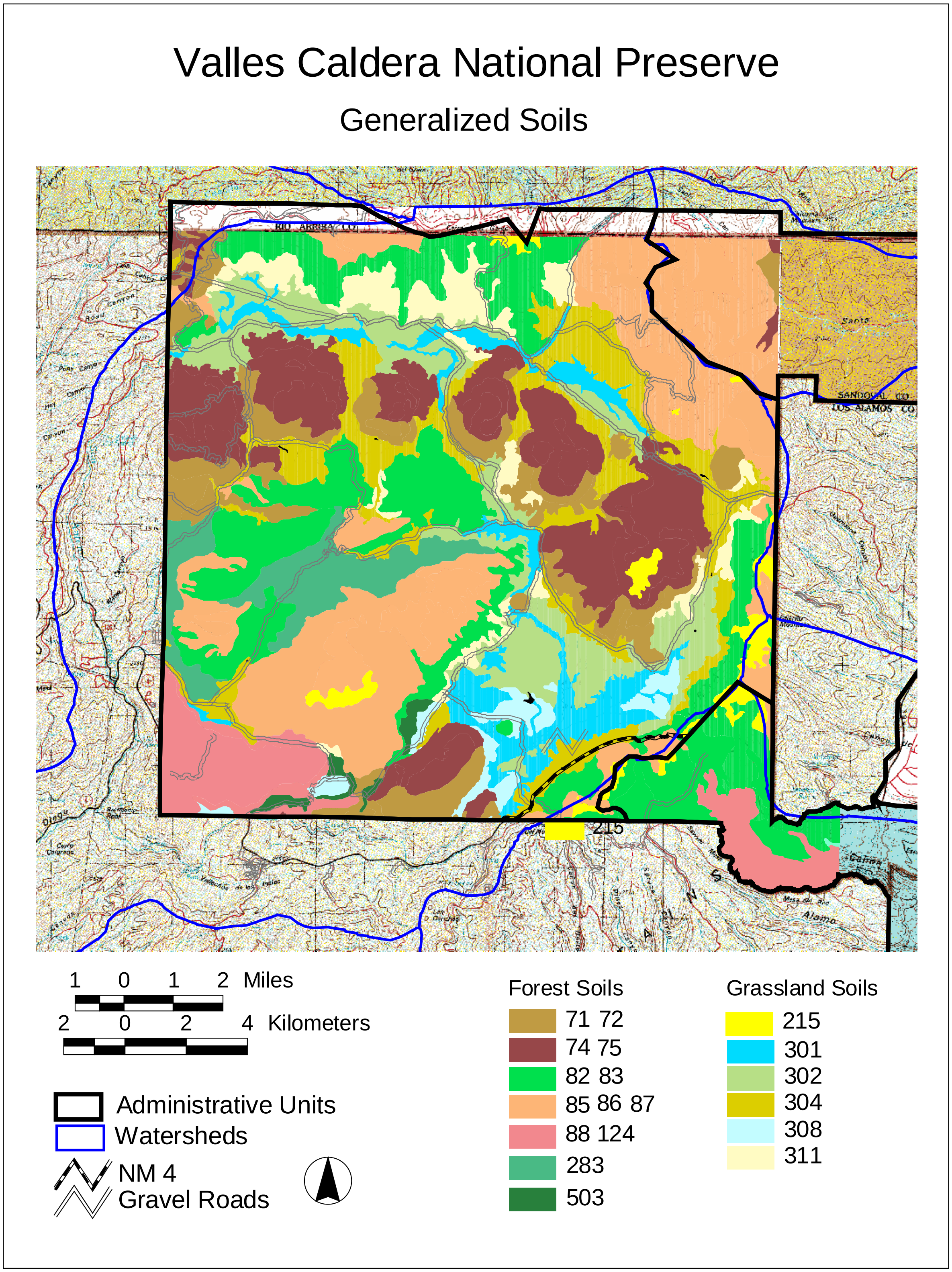

Figure 5. Generalized soils map of the Valles Caldera National Preserve based on the Natural Resources Conservation Service Soil Survey for Sandoval County (NRCS no date). See Table 3 for soil map unit descript

Table 3. Soil Map Units of the Valles Caldera Nation Preserve as defined and mapped by the Natural Resources Conservation Service as part of the Soil Survey of Sandoval County.

MU #	Map Unit Name	Soil Series	Soil Taxonomic Classification
	FOREST SOILS		
71	Palon cobbly sandy loam, 15 to 35 percent slopes	Palon	Psammentic eutroboralfs, loamy-skeletal, mixed
72	Palon very cobbly sandy loam, 35 to 65 percent slopes	Palon	Psammentic eutroboralfs, loamy-skeletal, mixed
74	Origo-Pavo association, 5 to 35 percent slopes	Origo	Psammentic cryoboralfs, loamy-skeletal, mixed
		Pavo	Cryic paleborolls, fine-loamy, mixed
75	Origo very cobbly sandy loam, 35 to 65 percent slopes	Origo	Psammentic cryoboralfs, loamy-skeletal, mixed
82	Calaveras loam, 15 to 35 percent slopes	Calaveras	Dystric eutrochrepts, loamy-skeletal, mixed, frigid
83	Calaveras-Rubble Land association, 35 to 60 percent slopes	Calaveras	Dystric eutrochrepts, loamy-skeletal, mixed, frigid
		Rubble Land	
85	Redondo coarse sandy loam, 15 to 35 percent slopes	Redondo	Typic cryoboralfs, loamy-skeletal, mixed
86	Redondo cobbly coarse sandy loam, 35 to 80 percent slopes	Redondo	Typic cryoboralfs, loamy-skeletal, mixed
87	Redondo-Rubble Land association, 35 to 80 percent slopes	Redondo	Typic cryoboralfs, loamy-skeletal, mixed
		Rubble Land	
88	Totavi-Jemez-Rock Outcrop association, 0 to 15 percent slopes	Jemez	Mollic eutroboralfs, fine-loamy, mixed
		Rock Outcrop	
		Totavi	Vitrandic haploborolls, ashy
124	Rock Outcrop	Rock Outcrop	
283	Mirand-Alanos complex, 5 to 40 percent slopes	Alanos	Typic eutroboralfs, clayey-skeletal, mixed
		Mirand	Mollic eutroboralfs, fine, mixed
503	Cajete-Cypher association, 8 to 50 percent slopes	Cajete	Mollic vitrandepts, ashy-skeletal, frigid
		Cypher	Lithic ustochrepts, loamy-skeletal, mixed, frigid
	GRASSLAND SOILS		
215	Ess-Rock Outcrop complex, 5 to 45 percent slopes	Ess	Argic cryoborolls, loamy-skeletal, mixed
		Rock Outcrop	
301	Vastine-Jarola silt loams, 0 to 5 percent slopes	Jarola	Typic argialbolls, fine-loamy, mixed, frigid
		Vastine	Typic endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed, frigid
302	Tranquilar-Jarmillo complex, 1 to 8 percent slopes	Jarmillo	Pachic haploborolls, coarse-loamy, mixed
		Tranquilar	Typic argialbolls, very-fine, montmorillonitic, frigid
304	Cosey-Jarmillo association, 2 to 20 percent slopes	Cosey	Typic paleborolls, loamy-skeletal, mixed
		Jarmillo	Pachic haploborolls, coarse-loamy, mixed
308	Cajete gravelly loam, 0 to 8 percent slopes	Cajete	Mollic vitrandepts, ashy-skeletal, frigid
311	Cosey-Tranquilar-Calaveras association, 5 to 20 percent slopes	Calaveras	Dystric eutrochrepts, loamy-skeletal, mixed, frigid
		Cosey	Typic paleborolls, loamy-skeletal, mixed
		Tranquilar	Typic argialbolls, very-fine, montmorillonitic, frigid

Flora and Fauna Studies

Because the VCNP had been privately held for so long, there have been very few biological surveys up until the present. Osborn (1996) conducted a comparative floristic study between Redondo Peak and Mount Taylor that included a plant species list and brief descriptions of the major vegetation zones. Whitford and Ludwig (1975) conducted a detailed inventory of the Redondo Peak area as part of a survey during the geothermal exploration days of the Baca. They presented a vegetation classification and vegetation map of spruce-fir, mixed conifer and grasslands types. They documented eight plant associations (habitat types) with plot data that have been integrated into the VCNP vegetation classification and database (see Table 6). They also conducted mammal, amphibian and bird surveys and provided an analysis of conditions during that period in the Baca's history.

The USFS (1993), in its report on the potential government purchase of the Baca, provided a broad overview of the natural resources as well as the history and the economics of the site. Based on forest inventories from the early 1980's, they estimated that of the 94,812 acres then in the Baca, about 25% or 24,000 acres (9,700 ha) were in grassland, 70% or 65,000 acres were in forest(ponderosa pine at 7,700 acres (7,150 ha); spruce-fir at 12,100 acres (4,900 ha); and mixed conifer at 35,700 acres (14,500 ha)). Only 1% of the landscape was in aspen. The remaining 5% was ascribed to rock outcrop, rubble fields and scrub. At that time, they estimated that nearly 60% of the forest lands had been logged.

With acquisition, new surveys and ecological studies among several animal and plant groups have been initiated by several organizations. See the VCNP web site for information on specific studies (http://www.vallescaldera.gov/).

METHODS

Field Sampling

Vegetation sampling was designed to capture as wide a variety of vegetation types as possible within the limited time frame available for sampling (July 15 to September 15, 2001). The goal was to establish 100 plots among both forest and grassland communities with a concentration on describing reference conditions with minimal disturbances from logging and grazing (in subsequent years, sampling will be targeted at post-logging communities for mapping purposes). To help in planning and for optimizing the distribution of sample points, the preserve was delineated into a set of operational sampling zones that roughly follow major watershed boundaries (Figure 6). Because of the current emphasis on grassland and wetland management at the preserve, 60% of the plots were allocated to grasslands and wetlands, and the remaining 40% to forest and woodlands.

We used 1991 color infrared stereo aerial photography as an aid in establishing plot locations in areas of low disturbance, and homogenous vegetation and habitat (Figure 7). Plots were established in large stands of vegetation representative of the typical vegetation at a site. Plots were generally 400 m^2 and square, but occasionally other sizes were used to fit the structure of a community, especially along drainages where vegetation stands conform to the channel shape. A list of all vascular plant species, stratified by lifeform (tree, shrub, subshrub, grass and forb layers) was compiled and cover estimated for each species using a modified Domin-Krajina Scale (Table 4). See Appendix A for examples of sampling forms. In addition, the NMNHP field survey handbook is provided in the Data Addendum.

Plant voucher specimens were collected to confirm field identifications as necessary and are housed at the University of New Mexico Herbarium. Specimens were identified to lowest level possible given the material at hand and names assigned according to the PLANTS database (USDA-NRCS 2002). A species list derived from the plot data is provided in Appendix B. Discrepancies in names between our list and those of Ron Hartman's concurrent botanical survey have been noted based on his preliminary report provided to the VCNP.

Site attributes included slope percent, aspect, slope shape, surface rock type, and ground cover (percent rock, gravel, bare soil and litter), along with detailed narratives on species composition and site conditions. On forest plots, the largest trees of the dominant species were radial increment cored where possible to determine approximate ages of establishment (cores were taken only from Douglas-fir, ponderosa pine, limber pine, blue spruce and Engelmann spruce and are archived at NMNHP). Cored trees were also measured for height and diameter at core height and breast height (DBH). Within each plot, all trees were counted in two-inch-diameter classes up to 20 inches. Above 20 inches, individual trees were measured for their DBH. Trees below 2 inches were also broken into two height classes: those above breast height and those below (see forms in Appendix A).

All plots were monumented in the center with one-meter-long iron rebar stakes and tagged with oblong durable aluminum tags with the plot number, project and date etched on each and then attached with 1.5 mm iron wire. For aesthetic reasons, the stakes in grasslands were pounded down to nearly ground level. Those in forest plots extend at least 0.5 m above the ground and are covered with a meter of white PVC pipe to make them more easily visible under forest conditions. A list of all plots, their location and vegetation classification is provided in Appendix C.

All vegetation, tree and site data were entered into a Microsoft Access 2000 database and quality controlled through error checking computer routines and manual read-backs. The complete records for all plots are provided in the Data Addendum. Each record contains the comprehensive documentation of the plot location, dimensions, vegetation composition, tree stand structure, site characteristics, vegetation classification, and photo points. In addition, the computerized ASCII dataset and database are provided on a separate data CD.

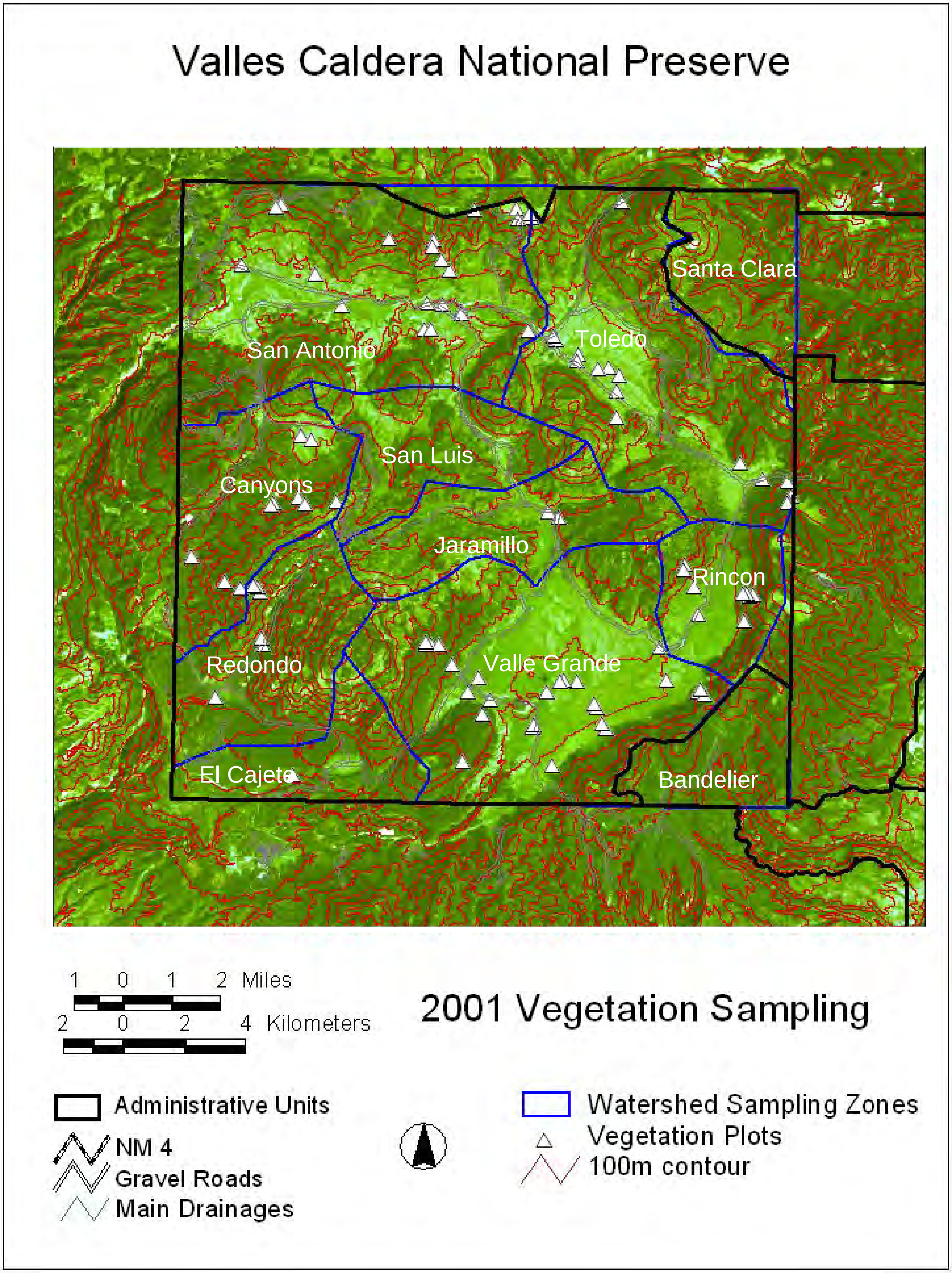

Figure 6. Distribution of vegetation plots established in 2000 per watershed sampling zones. See Data Addendum for exact plot locations and how they are classified. Base: Thematic Mapper (TM) imagery

Table 4. Modified Domin-Krajina Vegetation Cover Scale from Mueller-Dombois and Ellenberg (1974). Cover Class is the scalar value assigned in the field; Percent Canopy Cover is the range of cover the class represents; m^2/ 400 m^2 is the actual area represented by the cover class within the 400m^2 plot; and Midpoint % Cover is the midpoint canopy cover value used in data analysis.

Cover Class	Percent Canopy Cover	m^2 / 400 m^2	Midpoint % Cover
+0	[Undefined]	[Outside plot]	[0.001]
+	<.05	<0.04 m	0.01
1	<0.1	≥ 0.04 & < 0.5	0.05
2	<1	≥ 0.5 & < 4	0.5
3	1 – 4	≥ 5 & < 20	2.5
4	5 – 10	≥ 20 & < 40	7.5
5	10 - 25	≥ 40 & <100	17.5
6	25 - 33	≥ 100 & <132	29.0
7	33 - 50	≥ 132 & <200	41.5
8	50 - 75	≥ 200 & <300	62.5
9	> 75	≥ 300 m	87.5

Table 5. U.S. National Vegetation Classification physiognomic-floristic hierarchy for terrestrial vegetation (Grossman et al. 1998) with a supplemental Alliance Group level.

Level	Primary Basis for Classification	Example
Class	Growth form and structure of vegetation	Shrubland
Subclass	Growth form characteristics, e.g., leaf phenology	Deciduous Shrubland
Group	Leaf types, corresponding to climate	Cold-deciduous Shrubland
Formation	Additional physiognomic and environmental factors	Temperate Cold-deciduous Shrubland
Alliance Group	*Regional floristically and environmentally related Alliances*	*Rocky Mountain Montane Deciduous Scrub*
Alliance	Dominant/diagnostic species of the uppermost or dominant stratum	Mountain Mahogany (*Cercocarpus montanus)*
Plant Association (Plant Association)	Additional dominant/diagnostic species from any stratum	Mountain Mahogany/New Mexico Muhly (*Cercocarpus montanus/Muhlenbergia pauciflora*)

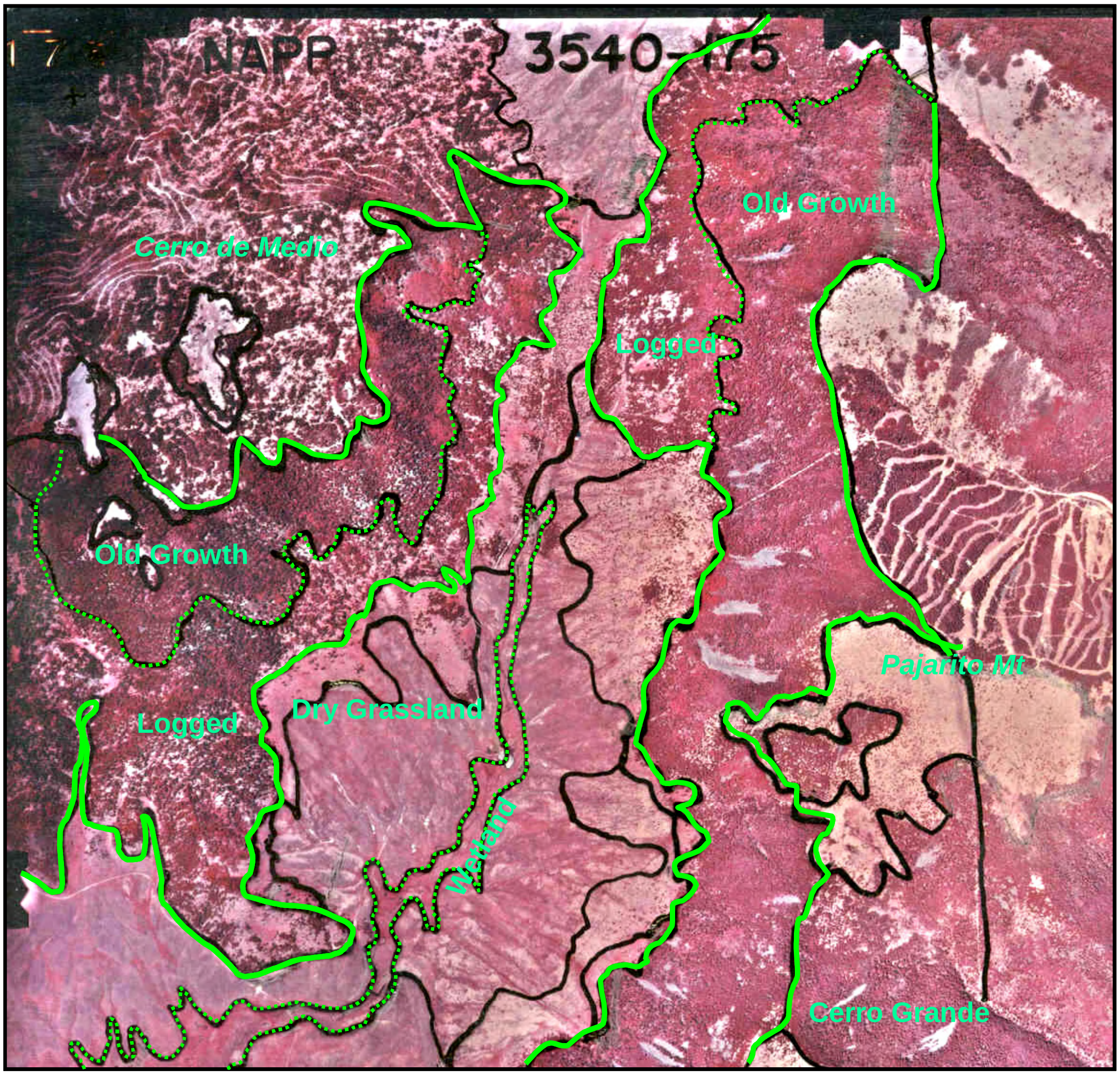

Figure 7. False-color infrared 1991 aerial photography from the National Aerial Photography Program (NAPP) at approximately 1:24,000 scale was used to map out broad vegetation types and conditions on the VCNP and to help design the sampling strategy.

For each plot, a site-quality assessment form was filled out that numerically scored an occurrence on a set of stand and landscape factors that include among others: exotic species encroachment; stand structure modifications due to logging, browsing or fire, etc.; erosion hazards; fire and hydrological regime alterations; stream channel degradation; landscape fragmentation and road impacts. Scores range between 1.0 and 4.0, where 4.0 is a very high quality site that has received minimum human-caused impacts. A score around 3.0 is a good site that will require mostly passive management to improve quality. Stands around 2.0 are significantly altered and will likely need active management to improve conditions. Scores below 2.0 are sites that have undergone significant degradation and are not restorable without intensive management (see Appendix A for an example of the field form).

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Repeat photo points were established on all of the forest plots and approximately half of the grassland sites (all plots have at least one reference photograph, barring exposure problems). At each photo point, four photographs were taken from a tripod over the rebar monument in each of the major slope directions (upslope, downslope, and across the slope in each direction). The compass direction and focal length of each shot was logged for future reference. Most photographs were taken on Ektachrome 200 slide film. All slides have been annotated and are provided in the Data Addendum along with a list of photopoint GPS locations and associated photopoint data. All original photopoint slides are provided in the Data Addendum, and a subset were scanned as image .jpeg files and placed on a separate data CD along with a selection of landscape and other shots of interest.

Analysis

To develop a preliminary classification of vegetation communities on the VCNP, the plot data was subjected to multivariate cluster analysis (Ludwig and Reynolds 1988) and standard tabular comparison techniques (Mueller-Dombois and Ellenberg 1974). The cluster analysis was performed using SAS (1990) CLUSTER procedure using the flexible-beta strategy with the beta coefficient set at –0.25. All species were used, and abundance scalar values were converted to percent cover mid-point values. The resulting classification dendrograms are provided in the Data Addendum. The dendrograms provided the foundation for the vegetation classification that was then refined by tabular comparison where plots were grouped into vegetation units following the hierarchy and protocols of the International Classification of Ecological Communities and U.S. National Vegetation Classification System (Grossman et al. 1998), which is the U.S. geographic data standard (Table 5). In general, each plot was classified into an Alliance based on dominant or indicator species, and then to a particular Plant Association (PA) based on codominance and/or other groups of differential species. Phases of associations were assigned as necessary to further define the character of the plant community.

Since the National Vegetation Classification (NVC) is intended to be part of a universal international system, it, by design, lacks regional categories such as "Spruce-Fir Zone " or "Rocky Mountain Montane Coniferous Forest," which are part of regional and state classifications such as Brown et al. (1998), Dick-Peddie (1993) or the U.S. Fish and Wildlife Gap Analysis Project classification for New Mexico (Thompson et al. 1996). These regional "biomes" or "zones" are essentially floristically based and can be very useful for general analysis and planning. They conceptually reflect regional knowledge of broad vegetation types and serve as effective categories for communication among scientists, managers and the public in the Southwest. NMNHP, as part of the development of the statewide New Mexico Plant Community Classification, has incorporated the regional biome concept as a supplemental "Alliance Group" level in Table 5 between the Formation and Alliance of the NVC. It is based on the Gap classification Level IV with some modifications, which in turn draws upon Dick-Peddie (1993) and Brown et al. (1998).

Plant Associations are the fundamental unit of classification. Ecologists use the concept of plant association to help describe and recognize patterns in the way vegetation occurs in the landscape. By grouping land areas based on the ability to support similar associations, general management observations and recommendations can be made for each grouping. In the past 30 years, resource managers have found that the classification of vegetation into plant associations has provided insight and ability to predict vegetation changes in response to various disturbance processes. In addition, plant associations are used to define mapping unit components in the mapping process—providing the information link between vegetation spatial distribution and its ecology.

With respect to the ecological assessment, we conducted a regional analysis of ecosystem rarity using databases from the Natural Heritage Network (or NatureServe) along with information from literature sources, particularly the U.S. Forest Service habitat type papers. The heritage network under NatureServe evaluates status of biological elements, either species or natural communities, using a ranking system that considers rarity, vulnerability and imperilment (Grossman et al. 1998). The ranking system is used by all network data centers including the New Mexico Natural Heritage Program (NMNHP), as well as by various government agencies and other organizations to support the planning of conservation strategies.

Each plant association on the VCNP has a global and state status rank. Global element ranks are based on factors such as rarity; quality, condition and viability; size; and identifiable threats that face the community. Each element is assigned a single global (G) rank to indicate its relative degree of imperilment on a five-point scale (e.g., 1 = critically imperiled because of extreme rarity, 5 = demonstrably secure). The primary criteria for ranking community elements is the number of occurrences (the number of known distinct localities) and extant acreage. Also of importance are the size of the geographic range, trends in distribution, and the number of already protected occurrences. However, the emphasis remains on the number of occurrences, such that ranks are, in effect, an index of known biological rarity. State ranks are similar, but the evaluation is based on ranges and distributions within New Mexico.

In addition, using individual element rarity ranks to evaluate the importance of various natural communities and species occurrences on the VCNP, we utilized a suite of information on species and ecosystem rarity as developed as part of a multi-agency ecological assessment of the Southern Rocky Mountains Ecoregion led by The Nature Conservancy (Neely et al. 2001). This assessment included information not only on the status of individual species and natural communities, but also on their distribution and level of protection within particular sites in the region. The data was generated from expert workshops, inventories and landscape-scale models in cooperation with the U.S. Forest Service, Bureau of Land Management, Colorado Division of Wildlife, Colorado Natural Heritage Program, Natural Resource Ecology Laboratory, New Mexico Natural Heritage Program, and Wyoming Natural Diversity Data Base. We addressed local conditions using the site quality ranks scored for each plot (described above in Field Methods), geographic information system (GIS) analysis and mapping. Using aerial photo interpretation we mapped out the amount of logged versus unlogged forest habitat (Figure 7), and we used available GIS layers such as the road grid and installations to evaluate the degree of landscape fragmentation in a given watershed.

RESULTS

A Vegetation Survey of the Valles Caldera National Preserve

When compared to other high elevation sites of the southern Rocky Mountains and Colorado Plateau, the vegetation of the VCNP is diverse. In the first year of sampling on the preserve, we described 65 plant associations (PAs) that range from high elevation sub-alpine forests to foothill open pine woodlands, and from high montane grasslands to valley floor wetlands. Thirty-one of these are provisional associations that have not been described elsewhere (any association documented by less than five plots is considered provisional). Based on information from surrounding areas (USFS 1997; DeVelice et al. 1986), there are potentially upwards of 100 plant associations that may occur on the preserve. Hence, the vegetation classification presented here should be considered preliminary pending additional sampling in the second year of the project. Currently, most of the plant associations are documented with anywhere from one to six plots, and these provide the foundation for our understanding the ecology and status of these communities on the preserve (see the Data Addendum for detailed quantitative data on individual plant associations). In the following we summarize the information on composition, structure and environments of these communities in two main sections: 1) forests and woodlands of the mountain slopes, and 2) grasslands and herbaceous wetlands of the valles (Figure 8).

Figure 8. The Valle Grande presents the typical landscape of the VCNP where grasslands dominate the lower alluvial slopes and valley floor, while various forest types cloak the surrounding volcanic hills and mountains.

Table 6. A preliminary vegetation classification for the Valles Caldera National Preserve. Only the alliance groups, alliances and plant associations (Pas) are shown from the National Vegetation Classification hierarchy (see Table 5 for definitions). Provisional types known only from the VCNP are indicated with a "§", while an "*" refers to those associations described by Whitford and Ludwig (1975), but have not been confirmed again on the VCNP. All other associations have been previously described elsewhere and are part of the National Vegetation Classification (Anderson et al.1998). Species codes for the associations are provided in brackets followed by the common name.

FORESTS, WOODLANDS, AND SHRUBLANDS

Rocky Mountain Spruce-Fir Forest

***Abies lasiocarpa* Alliance** (Subalpine Fir)

Abies lasiocarpa/*Vaccinium myrtillus* PA [ABILAS/VACMYR] (Subalpine Fir/Whortleberry)

***Picea engelmannii* Alliance (Engelmann Spruce)**

Picea engelmannii/Carex foenea PA [PICENG/CARFOE] (Engelmann Spruce/Dryspike Sedge)

Picea engelmannii/Danthonia parryi PA [PICENG/DANPAR] (Engelmann Spruce/Parry Danthonia)

Picea engelmannii/Erigeron eximius PA [PICENG/ERIEXI] (Engelmann Spruce/Sprucefir Fleabane)

* *Picea engelmannii*/*Moss* PA [PICENG/Moss] (Engelmann Spruce/Moss)

* *Picea engelmannii*/*Vaccinium myrtillus* PA [PICENG/VACMYR] (Engelmann Spruce /Whortleberry)

Rocky Mountain Mixed Conifer Forest

***Abies concolor* Alliance (White Fir)**

Abies concolor/*Jamesia americana* PA [ABICON/JAMAME] (White Fir/Cliffbush)

Abies concolor/*Vaccinium myrtillus* PA [ABICON/VACMYR] (White Fir/Whortleberry)

Abies concolor-Pseudotsuga menziesii/*Acer glabrum* PA [ABICON-PSEMEN/ACEGLA] (White Fir-Douglas-fir/ Rocky Mountain Maple)

* *Abies concolor-Pseudotsuga menziesii*/*Bromus ciliatus* PA [ABICON-PSEMEN/BROCIL] (White Fir-Douglas-fir/Fringed Brome)

§ *Abies concolor-Pseudotsuga menziesii*/*Festuca Thurberi* PA [ABICON-PSEMEN/FESTHU (White Fir-Douglas-fir/Thurber fescue

Abies concolor-Pseudotsuga menziesii/*Juniperus communis* PA [ABICON-PSEMEN/JUNCOM] (White Fir- Douglas-fir/Common Juniper)

Abies concolor-Pseudotsuga menziesii/*Mahonia repens* PA [ABICON-PSEMEN/MAHREP] (White Fir-Douglas-fir/ Oregongrape)

* *Abies concolor-Pseudotsuga menziesii*/*Quercus gambelii* PA [ABICON-PSEMEN/QUEGAM] (White Fir- Douglas-fir/ Gambel Oak)

***Abies concolor–Populus tremuloides* Alliance (White Fir- Quaking Aspen)**

§ *Abies concolor-Populus tremuloides/Acer glabrum* PA [ABICON-POPTRE/ACEGLA] (White Fir-Quaking Aspen/Rocky Mountain Maple)

***Picea pungens* Alliance (Blue Spruce)**

Picea pungens/*Carex foenea* PA [PICPUN/CARFOE] (Blue Spruce/Dryspike Sedge)

Picea pungens/*Erigeron eximius* PA [PICPUN/ERIEXI] (Blue Spruce/Sprucefir Fleabane)

***Pseudotsuga menziesii* Alliance (Douglas-fir)**

Pseudotsuga menziesii/*Acer glabrum* PA [PSEMEN/ACEGLA] (Douglas-fir/Rocky Mountain Maple)

Pseudotsuga menziesii/*Jamesia americana* PA [PSEMEN/JAMAME] (Douglas-fir/Cliffbush)

Pseudotsuga menziesii/*Mahonia repens* PA [PSEMEN/MAHREP] (Douglas-fir/Oregongrape)

Pseudotsuga menziesii-Pinus flexilis/Trisetum spicatum PA [PSEMEN-PINFLE/TRISPIM] (Douglas-fir-Limber Pine/ Rocky Mountain Trisetum)

§ *Pseudotsuga menziesii/Vaccinium myrtillus* [PSEMEN/VACMYR] (Douglas-fir/Whortleberry)

***Pinus flexilis* Alliance (Limber Pine)**

Pinus flexilis /Juniperus communis PA [PINFLE/JUNCOM] (Limber Pine/Common Juniper)

Rocky Mountain Aspen Forest

***Populus tremuloides* Alliance (Quaking Aspen)**

Populus tremuloides/*Festuca thurberi* PA [POPTRE/FESTHU] (Quaking Aspen/Thurber Fescue)

Populus tremuloides/*Thalictrum fendleri* PA [POPTRE/THAFEN] (Quaking Aspen/Fendler Meadowrue)

Table 6 (continued). A preliminary vegetation classification for the Valles Caldera National Preserve.

Rocky Mountain Montane Riparian Woodland

***Picea pungens* Temporarily Flooded Alliance (Blue Spruce)**

§ *Picea pungens/Alnus incana/Hydrophyllum fendleri* PA [PICPUN-ALNINC/HYDFEN] (Blue Spruce-Thinleaf Alder/Fendler Waterleaf]

* *Picea pungens/Alnus incana/Poa pratensis* PA [PICPUN-ALNINC/POAPRA] (Blue Spruce-Thinleaf Alder/Kentucky Bluegrass]

Rocky Mountain Ponderosa Pine Forest and Woodland

***Pinus ponderosa* Alliance (Ponderosa Pine)**

§ *Pinus ponderosa*/*Danthonia parryi* PA [PINPON/DANPAR] (Ponderosa Pine/Parry Danthonia)

Pinus ponderosa/*Festuca arizonica* PA [PINPON/FESARI] (Ponderosa Pine/Arizona Fescue)

Pinus ponderosa/*Juniperus communis* PA [PINPON/JUNCOM] (Ponderosa Pine/Common Juniper)

Pinus ponderosa/*Quercus gambelii/Arizona Fescue* PA [PINPON/QUEGAM/FESARI] (Ponderosa Pine/Gambel Oak/Arizona fescue)

Pinus ponderosa/*Ribes leptanthum/ Carex inops* ssp. *heliophila* PA [PINPON/RIBLEP/CARINOH] (Ponderosa Pine/Trumpet Gooseberry/Sun Sedge)

Rocky Mountain Pinyon-Juniper Woodland

***Pinus edulis* Alliance (Pinyon Pine)**

Pinus edulis/Quercus gambelii PA [PINEDU/QUEGAM] (Pinyon Pine/Gambel Oak)

Rocky Mountain Montane Shrubland

***Quercus gambelii* Alliance (Gambel Oak)**

Quercus gambelii/*Carex inops* ssp. *heliophila PA* [QUEGAM/CARINOH] (Gambel Oak/Sun Sedge)

§ *Quercus gambelii/Holodiscus dumosus* PA [QUEGAM/HOLDUM] (Gambel Oak/Rockspirea)

§ *Quercus gambelii/Poa pratensis* PA [QUEGAM/POAPRA] (Gambel Oak/Kentucky Bluegrass)

Quercus gambelii/*Robinia neomexicana* PA [QUEGAM/ROBNEO] (Gambel Oak/New Mexico Locust)

Rocky Mountain Montane Riparian Shrubland

***Betula glandulosa* Seasonally Flooded Alliance (Bog Birch)**

§ *Betula glandulosa*/*Carex aquatilis/ Lycopodium annotinum* PA [BETGLA/CARAQU/LYCANN] (Bog Birch/Water Sedge/Stiff Clubmoss)

GRASSLANDS and WETLANDS

Rocky Mountain Montane Grasslands

***Blepharoneuron tricholepis* Alliance (Pine Dropseed)**

§ *Blepharoneuron tricholepis-Juncus balticus* PA [BLETRI-JUNBAL] (Pine Dropseed-Baltic Rush)

§ *Blepharoneuron tricholepis-Koeleria macrantha* PA [BLETRI-KOEMAC] (Pine Dropseed-Prairie Junegrass

§ *Blepharoneuron tricholepis-Muhlenbergia montana* PA [BLETRI-MUHMON] (Pine Dropseed-Mountain Muhly)

§ *Blepharoneuron tricholepis-Muhlenbergia wrightii* PA [BLETRI-MUHMON] (Pine Dropseed-Mountain Muhly)

***Danthonia parryi* Alliance (Parry Danthonia)**

§ *Danthonia parryi*- *Festuca arizonica* PA [DANPAR-FESARI] (Parry Danthonia-Arizona fescue)

§ *Danthonia parryi*- *Festuca thurberi* PA [DANPAR-FESTHU] (Parry Danthonia -Thurber fescue)

§ *Danthonia parryi*- *Poa pratensis-Potentilla hippiana* PA [DANPAR-POAPRA-POTHIP] (Parry Danthonia-Kentucky Bluegrass-Woolly Cinquefoil)

Table 6 (continued). A preliminary vegetation classification for the Valles Caldera National Preserve.

***Festuca arizonica* Alliance (Arizona Fescue)**

Festuca arizonica-Blepharoneuron tricholepis PA [FESARI-BLETRI] (Arizona Fescue-Pine Dropseed)
§ *Festuca arizonica-Bouteloua gracilis* PA [FESARI-BOUGRA] (Arizona Fescue-Blue Grama)
Festuca arizonica- Muhlenbergia montana PA [FESARI-MUHMON] (Arizona Fescue-Mountain Muhly)

***Festuca thurberi* Alliance ((Thurber Fescue)**

§ *Festuca thurberi-Stipa lettermannii* PA [FESTHU/STILET] (Thurber Fescue-Letterman Needlegrass)

Rocky Mountain Wet Meadows and Wetlands

***Deschampsia cespitosa* Alliance (Tufted Hairgrass)**

§ *Deschampsia cespitosa-Carex aquatilis* PA [DESCES-CARAQU] (Tufted Hairgrass-Water Sedge)
§ *Deschampsia cespitosa-Carex foenea* PA [DESCES-CARFOE] (Tufted Hairgrass-Dryspike Sedge)
Deschampsia cespitosa-Carex microptera PA [DESCES-CARMIC] (Tufted Hairgrass-Smallwing Sedge)
§ *Deschampsia cespitosa-Carex utriculata* PA [DESCES-CARUTR] (Tufted Hairgrass- Northwest Territory Sedge)
§ *Deschampsia cespitosa-Glyceria borealis-Carex aquatilis* PA [DESCES-GLYBOR-CARAQU] (Tufted Hairgrass-Northern Mannagrass-Water Sedge)
§ *Deschampsia cespitosa-Potentilla hippiana* PA [DESCES-POTHIP] (Tufted Hairgrass-Woolly Cinquefoil)

***Carex aquatilis* Alliance (Water Sedge)**

Carex aquatilis-Carex utriculata PA [CARAQU-CARUTR] (Water Sedge-Northwest Territory Sedge)

***Carex utriculata* Alliance (Northwest Territory Sedge)**

§ *Carex utriculata-Carex microptera* PA [CARUTR-CARMIC] (Northwest Territory Sedge-Smallwing Sedge
§ *Carex utriculata –Juncus longistylis* PA [CARUTR-JUNLON] (Northwest Territory Sedge-Longstyle Rush)

***Carex pellita* Alliance (Woolly Sedge)**

Carex pellita-Eleocharis palustris PA [CARLAN-ELEPAL] (Woolly Sedge-Common Spikerush)

***Eleocharis palustris* Alliance (Common Spikerush)**

§ *Eleocharis palustris-Rorip*pa *sphaerocarpa* PA [ELEPAL-RORSPH] (Common Spikerush-Roundfruit Yellowcress)

***Juncus balticus* Alliance (Baltic Rush)**

§ *Juncus balticus-Agrostis gigantea PA* [JUNBAl-AGRGIG] (Baltic Rush-Redtop)
§ *Juncus balticus-Carex foenea* PA [JUNBAL-CARFOE] (Baltic Rush-Dyspike Sedge)
§ *Juncus balticus-Deschampsia cespitosa* PA [JUNBAL-DESCES] (Baltic Rush-Tufted Hairgrass)
§ *Juncus balticus-Poa pratensis* PA [JUNBAL-POAPRA] (Baltic Rush-Kentucky Bluegrass)

***Glyceria borealis* Alliance (Northern Mannagrass)**

Glyceria borealis/monotypic PA [GLYBOR-MONTYP] (Northern Mannagrass-Monotypic Stand)

AQUATIC VEGETATION

***Sparganium angustifolium* Alliance Vegetation (Naarrowleaf Burreed)**

§ *Sparganium angustifolium-Potamogeton nodosus* PA [SPAANG-POTNOD](Narrowleaf Burreed-Longleaf Pondweed)

Forest, Woodland, and Shrubland Communities

The forests and woodlands of the VCNP can be categorized into three broad zones that traverse the elevation gradient of the mountain slopes (Figure 9). At the highest elevations (9,000 to 11,250 ft; 2,740 m to 3,430 m) are spruce-fir forests dominated by Engelmann spruce (*Picea engelmannii*) and corkbark fir (*Abies lasiocarpa* var. *arizonica*). Mixed Conifer forests are generally found below 10,000 ft (3,050 m) and are usually codominated by a combination of firs and pines: Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), blue spruce (*Picea pungens*), southwestern whitepine (*Pinus strobiformis*), limber pine (*Pinus flexilis*), and ponderosa pine (*Pinus ponderosa*). Sites that have been burned or logged within the spruce-fir or mixed conifer zones are often dominated by aspen, or, on warmer sites, Gambel oak (*Quercus gambelii*) scrub. On warmer aspects below 9,000 ft, mixed conifer gives way to ponderosa pine forests and woodlands that commonly border the grasslands of the valles. There are also small occurrences of pinyon pine (*Pinus edulis*) woodlands within the ponderosa pine zone.

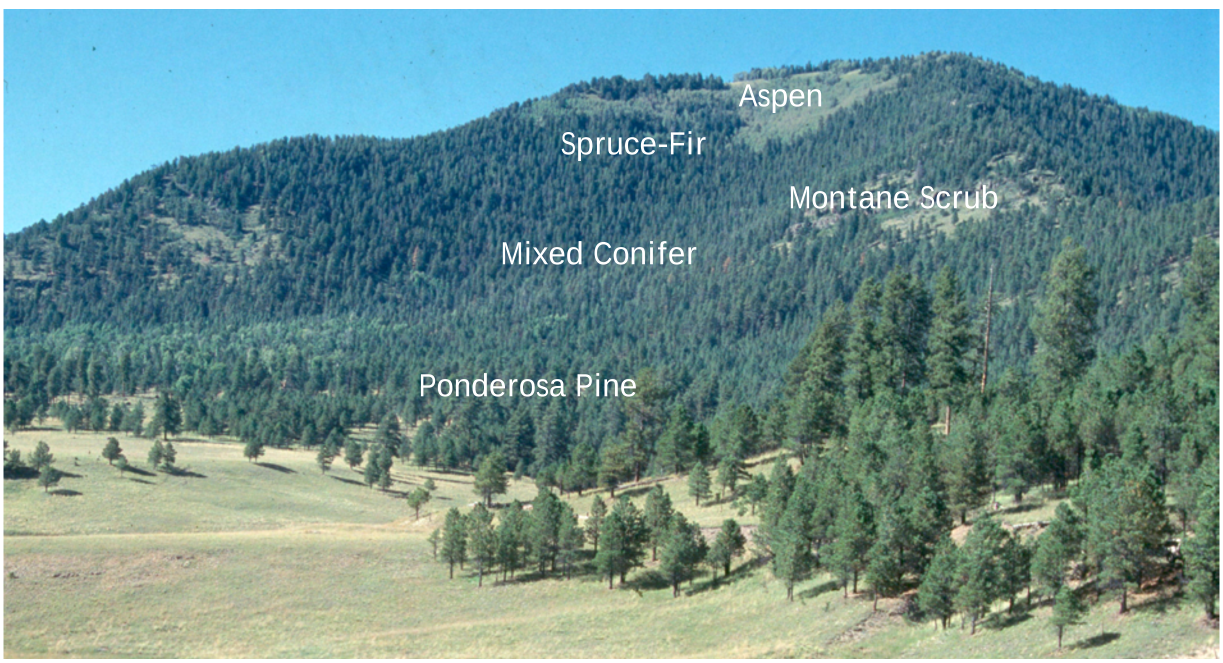

Figure 9. The typical distribution of forest zones in the VCNP as shown along the northern rim of Valle San Antoni

Spruce-Fir Forests

Spruce-fir forests are a major element in the VCNP forest ecosystem; they cloak much of the upper slopes and ridgelines along the caldera rim and on Redondo Peak. This very cold forest type is also referred to as Rocky Mountain Subalpine Conifer Forest (Brown et al. 1998; Dick-Peddie1993; Thompson et al. 1996), and is primarily found on the Origo and Redondo soils (see Table 3 and Figure 5). Either Engelmann spruce and/or corkbark fir can dominate, typically forming dense closed canopies with shady understories (Figure 10). Both species are widely distributed throughout the mountains of the western United States and Canada, but on the VCNP they are near their southern limit, with only a handful of sites occurring further south in New Mexico and Arizona (corkbark is actually a southern variant of subalpine fir and is known only from the Southwest). Of the two trees, Engelmann spruce is the longer-lived species, and in general reaches maturity at between 250 and 300 years, with individuals known to live as long as 500 to 600 years. In "old-growth" stands of the VCNP, the oldest trees so far measured were between 185 and 200 years, and had heights approaching 115 ft (35 m) and diameters over 28 in (73 cm).

Figure 10. An example of the Corkbark Fir/Wortleberry PA along the northern caldera rim near Garita gate. Both corkbark fir and Engelmann spruce occur in the canopy, but corkbark fir dominates the reproduction. Note the accumulation of woody debris after more than 200 years without fire.

Corkbark fir is shorter-lived (250 to 300 years maximum) and tends to be restricted to more mesic and colder sites. Hence, corkbark fir is less common on the VCNP than Engelmann spruce, but it can still be the dominant or codominant in some stands because of differences in seedling establishment and shade tolerance between the two species. For optimal germination and establishment, Engelmann spruce requires a mineral seedbed or shallow duff layer, and light to moderate shade—conditions found most commonly after a fire or other disturbance. In contrast, corkbark fir seedlings can become established on a continuing basis without disturbance in heavy shade on a variety of substrates, including mineral soils, duff, litter and logs (although mineral seedbeds and light duff layers are also the most favorable). As a result, corkbark fir seedling and saplings often outnumber spruce in older, low-disturbance stands. They are also more shade tolerant, which allows them to persist for longer periods in the understory while waiting for an opportunity to grow into the canopy as overstory trees die (corkbark fir saplings can be over 50 years old and still be no taller than three feet (1 m)). Once "released" from the shady conditions, firs can grow into canopy gaps to reach heights around 100 ft (30 m). Yet, they are prone to disease and pests and seldom live beyond 250 years (the oldest tree sampled so far on the VCNP was approximately 125 years old and 90 ft (27 m) tall)[2].

[2] For more information on these species see: http://www.fs.fed.us/database/feis/plants/tree/

Neither tree is fire resistant; both are generally killed in fires, even by low-intensity ones. But this trait is in keeping with the pre-settlement fire regimes where stand replacement fires occur at relatively long intervals of anywhere from 30 to 250 years or more (Kipfmueller and Baker 2000; Abolt 1997; Arno 1980; Touchan et al. 1996; Grissino-Mayer et al. 1995). Unlike lower elevation forests, the impact of fire suppression has apparently been minimal in some spruce-fir sites, particularly at high elevations (Bogan et al. 1998; Sherriff et al. 2001), or the fire regime is just beginning to extend beyond the historical range of variability after 100 years of suppression (Abolt 1997; Kipfmueller and Baker 2000). The long return intervals between fires are primarily a function of increased moisture at high elevations that naturally suppresses fire. This leads to slow accumulation of high fuel loads and fuel beds that tend to be irregular, with large amounts of needle litter accumulating under the narrow crowned trees. This combination of long-term fuel accumulation and heterogeneous fuel patterns tends to promote highly destructive stand-destroying fires. These concentrated, slow-burning fuels usually produce flames high enough to reach the low-growing, lichen-draped branches and start crown fires. Although these are commonly whole-tree crown fires, surface fires can also cause high mortality as they burn slowly through the fine fuels that collect at the base of mature trees and girdle their thin-barked boles (Bradley et al. 1992).

The occasional mature tree that survives fire in a moist protected pocket and trees adjacent to burned areas provide seeds to colonize burned sites. Given the right combination of available seed, moisture and somewhat protected seedbeds, Engelmann spruces or corkbark firs may immediately reproduce prolifically and develop more or less even-aged, tall conifer stands within 100 years following fires (unless aspen take over the site first). On drier sites at lower elevations, fire frequencies tend to increase and both Engelmann spruce and corkbark fir become less prevalent and are replaced by more fire-adapted species such as Douglas-fir, limber pine or southwestern white pine along with aspens as the forests grade into the mixed conifer zone (Arno 1980).

Wildlife, particularly large ungulates such as elk and deer, are known to use the spruce-fir zone in the southern Rockies extensively for both forage and cover (Alexander 1987), but information on such activity is limited on the VCNP. According to Whitford and Ludwig (1975), elk, particularly bull elk, used the higher elevations of Redondo Peak for summer browse and grazing. Krantz (2002) reported that elk browse was extensive throughout the forests of the VCNP in 2001, but specific use in the spruce-fir zone was unclear.

Six plant associations have been identified among spruce-fir forests on the VCNP, five of which belong to the **Engelmann Spruce Alliance** (see Table 6). This alliance is defined not only by the dominance of Engelmann spruce in the canopy but also by strong reproduction in the understory (Figure 11). Corkbark fir is usually a minor element or absent. In contrast, in the **Corkbark Fir Alliance** (represented by one association on the VCNP), corkbark fir either dominates the canopy or codominates it with Engelmann spruce along with having abundant and successful reproduction (Figure 10).

Among the five Engelmann spruce plant associations (PA), the Engelmann Spruce/Parry's Oatgrass PA was found in the most exposed conditions on northerly slopes and ridges on the borders with montane meadows at elevations above 10,000 ft (3,000 m). This association is characterized by an open canopy of Engelmann spruce and scattered limber pine, and a grassy understory dominated by Parry's oatgrass (*Danthonia parryi*) with occasional bunches of Thurber fescue (*Festuca thurberi*) and Arizona fescue (*Festuca arizonica*). There was also an assortment of forbs (15 species) commonly associated with montane meadows. This association may represent the invasion of montane grasslands by spruce as a function of fire suppression during the twentieth century (Allen 1989). Dyer and Moffett (1999), using historical photography, reported a similar invasion of spruce-fir in high elevation grasslands on Sierra Blanca in south-central New Mexico. This association has not been reported elsewhere in the Southwest, and it may be transitory pending reestablishment of natural fire regimes on the VCNP.

Also occurring on the ridges and upper slopes was the Engelmann Spruce/Dryspike Sedge PA, which is characterized by a moderately closed canopy of mixed-aged spruces; corkbark fir is absent. The understory is relatively low in cover (7 to 10%), mesic and dominated by dryspike sedge (*Carex foenea*) and an assortment of forbs, many of which are more prevalent in adjoining forest associations. Although this association might be found near montane meadows, the understory composition and the presence of Engelmann spruces in many size classes in a closed canopy suggests that this does not likely represent an invasion of montane meadows, and it is likely that it occurs on a forest soil type (an Alfisol) such as the Redondo soil series. Whitford and Ludwig (1975) reported an Engelmann Spruce/Moss PA from the upper elevations of Redondo Peak that is a similar closed canopy forest, but the understory was very depauperate with a scattering of grasses and forbs.

The most common spruce-fir associations on the VCNP are the Engelmann Spruce/Forest Fleabane PA, Engelmann Spruce/Whortleberry PA and Corkbark Fir/Whortleberry PA. The latter two occur primarily on upper slopes and drier sites. The understory is distinctly dominated by the low-lying subshrub whortleberry (*Vaccinium myrtillus*), with only a few scattered forbs or grasses. The Engelmann Spruce/Forest Fleabane PA is usually found on lower slopes under more mesic conditions that lead to the development of a richer herbaceous layer that often exceeds 30% cover, while shrub cover is minimal. Forest fleabane (*Erigeron eximius*) is usually the dominant forb, but it is the overall rich complement of mesic forbs that is characteristic, e.g., strawberry (*Fragaria vesca*), Canadian white violet (*Viola canadensis*), fringed brome (*Bromus ciliatus*), and northern bedstraw (*Galium boreale*). All three of these associations are widely distributed in the Southwest and into the southern Rocky Mountains (Moir and Ludwig 1979; DeVelice et al. 1986; Fitzhugh et al. 1987; Muldavin et al. 1996).

Figure 11. An example of the Engelmann Spruce/Forest Fleabane PA along the caldera rim north of Pajarito Mountain. Spruce dominates the reproduction and canopy.

Quaking Aspen Forests

Figure 12. Young aspen stand in the northwestern corner of preserve. Note the marks from elk chewing on the lower portions of the trucks.

Quaking aspen (*Populus tremuloides*) is a major successional species following fire in spruce-fir and mixed conifer forests (Figure 12). Aspen is a clonal species that most commonly reproduces by root sprouting. Following fires (and other disturbances such as logging), aspens can vigorously resprout and can come to dominate a site for decades, even centuries (Bradley et al. 1992). Aspen regeneration is particularly strong on severely burned sites, but may be controlled to some degree by preferential elk and deer browsing in those areas (Bailey and Witham 2002). Although some aspen forests are known to be self-perpetuating, conifers will typically regain a site in the absence of fire and with adequate conifer seed sources (DeVelice et al. 1986).

We have described two associations of the **Quaking Aspen Alliance** from the upper elevations of the VCNP (>8,900 ft; 2,700 m). The Aspen/Meadow Rue PA is the most common and is characterized by closed canopies of aspen with few, if any, conifers codominating. The understory is typically a luxuriant herbaceous cover represented by a wide variety of mesic forbs and grasses such as meadow rue (*Thalictrum fendleri*), stickywilly bedstraw (*Galium aparine*), strawberry, violet, geranium (*Geranium richardsonii*, *G. caespitosum*), deer sedge (*Carex rossii),* and fringed brome (*Bromus ciliatus*). Kentucky bluegrass (*Poa pratensis*), an exotic and invasive rhizomatous grass species, can dominate the understory. A Kentucky Bluegrass Phase of the association has been described where the Kentucky bluegrass exceeds 25% cover (it can exceed 60%). This association has been reported widely in the Rocky Mountains from Canada to the Southwest. Mueggler and Campbell (1986) suggest that bluegrass-dominated types are some of the poorest among aspen communities in terms of wildlife habitat because of low plant species diversity.

In contrast, the Quaking Aspen/Thurber Fescue PA is dominated by native grasses and sedges including Thurber fescue, fringed brome, junegrass (*Koeleria micrantha*), and dryspike sedge (*Carex foenea*). Forb richness is lower than in the previous association and more representative of meadows with species such as vetch (*Vicia americana),* pea (*Lathyrus* spp.), and bluebell bellflower (*Campanula rotundifolia*). As Allen (1984) and Karmarkova et al. (1988) have pointed out, the understory composition suggests that this aspen association may represent an invasion of a montane meadow grassland by trees (our sample stand graded into montane meadow at the top of the slope and is analyzed in detail by Allen (1984)). Although relatively uncommon, this association has been reported elsewhere in Colorado (Hess and Alexander 1986; Karmarkova et al. 1988).

Mixed Conifer Forest

The middle elevations of the VCNP are dominated by mixed conifer forests composed of various admixtures of conifers (Douglas-fir, white fir, blue spruce, southwestern white pine, limber pine, and ponderosa pine) along with scattered aspens. This forest type is also referred to as Rocky Mountain Upper Montane Conifer Forest (Brown et al. 1998; Dick-Peddie1993; Thompson et al. 1996). On the VCNP, mixed conifer forests primarily occur on rocky soils of the Palon, Pavo, Origo and Calaveras soil series.

Figure 13. A White Fir-Douglas-fir/Forest Fleabane PA in Deer Canyon in the southwest corner of the preserve.

Which tree species will dominate a stand is a function of site conditions and disturbance history (particularly fire). Cooler, more mesic sites tend to be dominated by white fir and blue spruce. White fir and blue spruce are similar to corkbark fir and Engelmann spruce in that they are extremely shade tolerant, but intolerant of fire. In contrast, Douglas-fir is less shade tolerant, but has a greater fire resistance and drought tolerance. Hence, it tends to be favored over white fir or blue spruce on drier sites with the potential for higher fire frequency. But with the cessation of natural fire during the twentieth century, both white fir and blue spruce have become more prevalent, sometimes dominating sites that would normally support Douglas-fir or even pines for the long term. Ponderosa pine, with its shade intolerance and the highest fire resistance of the group, is typically an early successional species following fire in the mixed conifer forests. Later, as the ponderosas mature, the Douglas-firs will replace them in the canopy. Sometimes, however, they become established at the same time and codominate the regenerating forest. Without fire and with adequate seed sources, blue spruce and white fir will eventually replace both Douglas-fir and ponderosa, particularly on the more mesic sites (where fire is less likely). Southwestern white pine or limber pine are found scattered throughout the mixed conifer zone, but they seldom dominate except on very dry, rocky sites.

We have classified the mixed conifer communities of the VCNP into three forest alliances (White Fir, Douglas-fir, Blue Spruce) and one woodland alliance (Limber Pine) based on canopy dominance and tree reproduction status in the understory (Table 2). Associations clearly dominated by one tree species, both in the canopy and in the reproduction, are put into the respective tree Alliance. In addition, we have identified a White Fir – Quaking Aspen Alliance where conifers and the broadleaf deciduous trees codominate.

The **White Fir Alliance** is either dominated by white fir or codominated by white fir and Douglas-fir (as indicated in the association name) with both species actively reproducing in the understory (Figure 13). Although less shade tolerant than white fir, Douglas-fir is the longer lived of the two, which may be partly responsible for the dynamic balance between the two in stands (on the VCNP the oldest white fir we measured was approximately 160 years and the oldest Douglas-fir 225 years). Blue spruce is an occasional sub-canopy associate, but seldom a codominant. Ponderosa pine can be present, but usually only as old and large individuals left from an earlier stage of forest development. The alliance extends from about 8,800 ft (2,700 m) to 9,880 ft (3,000 m).

Eight associations have so far been identified for the White Fir Alliance with a variety of understories and canopy structures. The White Fir/Forest Fleabane (*Abies concolor/Erigeron eximius*) PA has a rich and often luxurious undergrowth dominated by mesic forbs and grasses that include, beside forest fleabane, woodland strawberry, Canadian white violet, fringed brome, and Ross sedge. Sites are typically cool, northerly mid to lower slopes down to elevations of 8,800 ft (2,700 m). In drier upper slope positions this association grades into those dominated by shrubs and subshrubs. Specifically, the White Fir/Whortleberry Association PA dominated by subshrubs such as whortleberry and myrtle boxleaf (*Paxistima myrsinites*), and the White Fir-Douglas-fir/Common Juniper PA dominated by taller shrubs such as common juniper (*Juniperus communis*), and mountain ninebark (*Physocarpus monogynus*). Alternatively, these upslope sites can be dominated by the White Fir-Douglas-fir/Creeping Barberry PA where both shrub and herbaceous cover are minimal. This association is typified by scattered individuals of creeping barberry (*Mahonia repens*) and myrtle boxleaf, and a low overall species richness. The sparse understory may result from a combination of dense overstory canopies and dry shallow soils. In contrast, the White Fir-Douglas-fir/Thurber Fescue PA has a distinctive grassy understory similar to the montane grasslands on which it is known to border.

On the steepest mid slopes of the caldera the terrain often becomes a jumble of boulders and cobbles reflecting relatively stable, overgrown talus slopes or rock fields (felsenmeers). Cool sites, such as north-facing draws and slopes, commonly support the White Fir-Quaking Aspen/Rocky Mountain Maple PA. Fivepetal cliffbush (*Jamesia americana*), Rocky Mountain maple (*Acer glabrum)* typically dominate a conspicuous tall shrub layer that can have additional shrubs such as rockspirea (*Holodiscus dumosus*), trumpet gooseberry (*Ribes leptanthum*), gooseberry currant (*Ribes montigenum*), whortleleaf snowberry (*Symphoricarpos oreophilus*), and Fendler's brickellbush (*Brickellia fendleri*). We have also identified a White Fir-Quaking Aspen/Rocky Mountain Maple PA in similar habitats but where quaking aspen and white fir codominate in the canopy (technically this association is part of the **White Fir-Quaking Aspen Alliance**). The aspens are typically large, mature individuals of 100 years or more, and are likely remnants from a period when aspens dominated the site following a fire (or logging). Whitford and Ludwig (1975) also identified a White Fir-Douglas-fir/Gambel Oak Association of north-facing lower slopes of Valle Seco that had a significant quaking aspen component.

In the **Douglas-fir Alliance**, white-fir is absent or is represented by only seedlings and saplings (typically in cooler microsites within stands). Among the five plant associations we have identified for the Douglas-fir Alliance, four have close analogs in the White Fir Alliance: the Douglas-fir/Rocky Mountain Maple PA, Douglas-fir/Five-petal Cliffbush PA, Douglas-fir/Creeping Barberry, and Douglas-fir/ Whortleberry PA (Figure 14). The main difference is the lack of white fir in the canopy and perhaps a tendency for somewhat warmer site conditions. In addition, we have identified a Douglas-fir-Limber Pine/Rocky Mountain Trisetum Association of high exposed ridgelines (>9500 ft; 2,930 m). Under these dry conditions, the canopies are moderately open (50%), and the understory is typically grassy and dominated by Rocky Mountain trisetum (*Trisetum montanum*), deer sedge (*Carex rossii*), and fringed brome (*Bromus ciliatus*), along with a scattering of forbs.

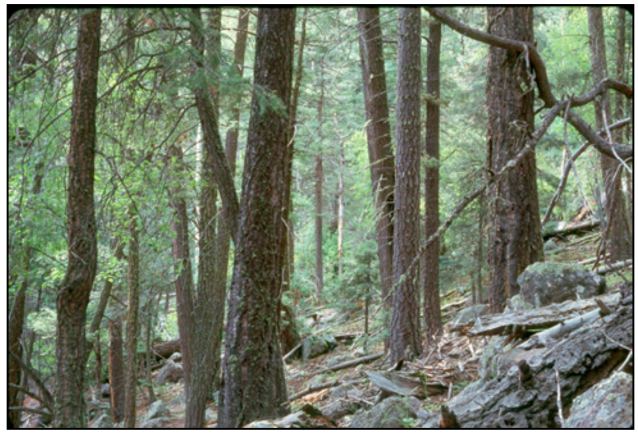

Figure 14. Douglas-fir/Rocky Mountain Maple PA along the boulder strewn slopes of the San Antonio Rim.

On the driest and rockiest ridgeline sites Douglas-fir drops out, leading to the relatively uncommon situation where limber pine dominates an open woodlands (Figure 15). We have so far identified one association from the **Limber Pine Alliance**—the Limber Pine/Common Juniper PA, which has a similar herbaceous layer to the Douglas-fir-Limber Pine/Rocky Mountain trisetum PA but with a shrub layer dominated by common juniper. Southwestern white pine (*Pinus strobiformis*) is closely related to limber pine and the Jemez Mountains mark the transition zone between the two species. Hence, southwestern white pine, a somewhat taller tree, may replace limber pine in some stands on the preserve.

Figure 15. Limber Pine/Common Juniper PA on the eastern slope of Cerro del Medio.

The **Blue Spruce Alliance,** although relatively common on the VCNP, is usually restricted to northern exposures of lower slopes and along the edges of the grasslands. We have identified two associations: the forb-rich Blue Spruce/Forest Fleabane PA and the graminoid-dominated Blue Spruce/Dryspike Sedge PA. Although both of these associations can form mature stands on mesic lower mountain slope sites, they occur most commonly as dense-canopied "blue spruce fringes" along the borders of the VCNP valle grasslands (Figure 16). These fringes are narrow (<30 m wide) and, perhaps because of moisture conditions and the heavier clay mollisol soils of the grasslands, do not seem to be significantly actively encroaching further into the valle grasslands (in contrast to ponderosa pine woodlands—see woodland ecological assessment below). Whitford and Ludwig (1975) also identified a Blue Spruce-Douglas-fir/Sparse PA of lower mountain slopes.

Figure 16. An example of a relatively young blue spruce fringe forest bordering montane grasslands in Valle San Antonio (left photo). Right photo from inside the same stand shows the sparse understory as a function of the dense canopy.

Ponderosa Pine Forests and Woodlands

Ponderosa pine forests and woodlands represent the lowest and warmest zone of the forests on the VCNP. Ponderosa pine (*Pinus ponderosa* var. *scopulorum*) is a fire and drought tolerant tree represented by the three-needled Southwestern race on the VCNP. While the species and race are known to reach heights of over 150 ft (45 m) and ages up to 742 years (Swetnam and Brown1992), the trees tend to decline after 350 years (Moir and Dieterich1988). On the VCNP, the tallest trees measured so far were about 100 ft (30 m) and about 200 years old (see Data Addendum).

Figure 17. The multi-age structure of trees is apparent in this stand of the Ponderosa Pine/Arizona Fescue PA located along the lower-slope of the Valle San Antonio rim.

Fire has played an important role in shaping the structure and composition of ponderosa pine forests and woodlands. Because ponderosa pine is highly fire tolerant (Bradley et al. 1992) and drought tolerant, it often occupies sites that are drier and that have higher natural fire frequencies than those of the mixed conifer zone (DeVelice et al. 1986; Allen and Peet 1990; Touchan et al. 1996). In the past, low-intensity fires would burn through ponderosa pine stands every 8 to 15 years, removing competing understory vegetation and woody debris (Weaver 1951; Cooper 1960; Mehl 1992; Swetnam and Baisan 1996; Touchan et al. 1996). Savanna woodlands with their high grass cover were likely to have the most frequent ground fires, while forests tend to occur on steeper, rocky slopes with less “fine fuels,” hence fire return intervals were likely longer. After fires, the shade-intolerant seedlings become established in open areas, usually in pulses correlated to favorable precipitation years (Mast et al 1997; Mast el al. 1998; Savage et al. 1995). The other conifers (white fir, Douglas-fir, etc.) are less drought and fire tolerant and at a disadvantage on these sites. Hence, either they fail to become established or are removed by subsequent surface fires, leading to forest stands dominated by ponderosa (with even-aged tree groups embedded in the stands depending on recruitment pulses).

We have identified five associations from the **Ponderosa Pine Alliance** that occur along lower mountain slopes and at the interface to valle grasslands (Figure 17). The Ponderosa Pine/Parry’s Oatgrass PA and Ponderosa Pine/Arizona Fescue PA are open forests and woodlands with grassy understories dominated by either Parry’s oatgrass or Arizona fescue along with Thurber fescue, prairie junegrass, and Kentucky bluegrass. There is also a variable complement of grassland-related forbs such as bluebell bellflower (*Campanula rotundifolia*), Fendler's sandwort (*Arenaria fendleri*), Rocky Mountain iris (*Iris missouriensis*), hairy goldenaster (*Heterotheca villosa*), yarrow (*Achillea millefolium*) and nodding onion (*Allium cernuum*). Shrubs are minor or absent.

The Ponderosa Pine/Trumpet Gooseberry/Sun Sedge PA occurs further upslope and has a similar complement of grassland forbs and grasses, but it also has a conspicuous shrub element dominated by trumpet gooseberry, and Woods' rose (*Rosa woodsii*). The herbaceous layer is dominated by sun sedge *(Carex inops* ssp. *heliophila*) and Kentucky bluegrass. This association has not been reported elsewhere.

The Ponderosa Pine/Common Juniper PA represents a transition from ponderosa pine to the mixed conifer zones and is known from the lower toe slopes of Redondo Peak. While the canopy is dominated by ponderosa pine, there is little ponderosa reproduction. Instead, white fir, Douglas-fir, and blue spruce are prevalent, suggesting that fire suppression is once again leading to the slow transformation of a ponderosa pine woodland to a mixed conifer forest. Common juniper is well represented and characteristic in the shrub layer (in some cases it may be more abundant due to fire suppression). There are still several grassland forbs in the understory such as bluebell bellflower, Rocky Mountain iris, and yarrow, but grassland dominants such as Parry's oatgrass and Arizona fescue are absent. This association is not widely reported in New Mexico and is more common in the northern Rockies (Anderson et al. 1998).

In contrast to the previous two associations, the Ponderosa Pine/Gambel Oak/Arizona Fescue PA is not linked directly to valle grasslands. Rather, it occurs along slopes of the southern flank of Redondo Peak and Redondo Border and in the rolling terrain of Banco Bonito (and occasionally along the caldera rim). Whitford and Ludwig (1975) were the first to describe this association on the VCNP and they noted that the Gambel oak (*Quercus gambelii*) shrub component seemed underrepresented relative to other sites in the Southwest. Arizona fescue is also poorly represented, but both the low cover of Gambel oak and fescue may be due to increased tree canopy due to fire suppression or simply the dryness of the sites. It is particularly in this association that fire suppression has led to increased densities of younger ponderosa pines, forming dense "dog-hair" stands that significantly increase the hazard of crown fires (see Preliminary Ecological Assessment-Forest and Woodlands below).

Pinyon-Juniper Woodland

There are isolated occurrences of pinyon-juniper woodland represented by the **Pinyon Pine Alliance** in the southwest quadrant of the preserve. Pinyon woodlands are at their upper elevation limits on the VCNP, and are likely to be found only in small pockets on dry southerly slopes and rock outcrops. We identified a Pinyon Pine/Gambel Oak Association in Freelove Canyon on a steep, severely eroding south-facing slope at about 8,400 ft (2,590 m). The canopies of both pinyon and Gambel oak were low and there were only a few scattered grasses and forbs. Although rare on the VCNP, this type is common elsewhere in the Jemez Mountains and the Southwest.

Montane Shrublands

The upland montane shrublands of the VCNP are represented by the four associations from the **Gambel Oak Alliance** that are commonly associated with post-fire or logging of ponderosa, Douglas-fir or white fir forests (Bradley et al. 1992). This is particularly true for the Gambel Oak-New Mexico Locust PA that is known from lower-elevation (8,500 ft; 2,625 m) southerly slopes in the canyon country of the southwest quadrant of the preserve. Both Gambel oak and New Mexico locust (*Robinia neomexicana*) resprout after moderate to severe fires and are clonal species that can be long-lived on a site. Shrub cover can approach 100% and also include common chokecherry (*Prunus virginiana*) and gooseberry currant. With the dense shrub cover, the herbaceous layer is sparse and low in diversity.

The Gambel Oak/Sun Sedge PA has a more open shrub canopy and a grassy understory dominated by more relatively xeric species such as sun sedge along with mountain muhly (*Muhlenbergia montana*) and blue grama (*Bouteloua gracilis*). It occupies exposed southern aspects of upper slope and ridge line positions—drier and warmer conditions that favor scrub species such as mountain mahogany (*Cercocarpus montanus*) and cacti such as kingcup cactus (*Echinocereus triglochidiatus*). On the VCNP, it is known from Freelove Canyon at about 8,300 ft (2,560 m) and has not been previously reported in New Mexico (but it is known from Colorado).

Figure 18. The Gambel Oak/Sun Sedge PA is common on southwesterly slopes of Freelove Canyon.

The Gambel Oak/Kentucky Bluegrass PA is a similar, but more mesic, grass-dominated type. It has been found in Alamo Canyon on southerly slopes at around 8,750 ft (2,00 m). The grass layer is dominated by Kentucky bluegrass with an assortment of other mesic species such as fringed brome, prairie junegrass, and slender wheatgrass (*Elymus trachycaulus*). The prevalence of the exotic Kentucky bluegrass suggests possible grazing impacts in the past. The forb component is also well represented by many species that are common in mixed conifer and ponderosa pine forests, e.g., Fendler's meadowrue, pineywoods geranium and alpine false springparsley (*Pseudocymopterus montanus*). This association has not been described elsewhere.

The Gambel Oak/Rockspirea Association is known from higher elevations of the caldera rim country of Valle San Antonio (9,400 ft; 2,900 m). It is a shrubby analog of the White Fir or Douglas-fir/Cliffbush associations and occurs on stabilized rocky scree slopes and rock outcrops. Along with rockspirea there is a variety of shrubs that include cliffbush, wax currant (*Ribes cereum*), mountain mahogany, and Fendler's brickellbush. It also has not been previously described.

Montante Riparian Forests and Shrublands

Figure 19. Blue Spruce/Thinleaf Alder/ Fendler's Waterleaf PA along La Jara Creek.

Woody riparian habitats on the VCNP are mostly restricted to mountain stream drainages associated with Redondo Peak and the canyons to the west of Redondo Border in the southwestern portion of the VCNP. For example, in the upper reach of La Jara Creek that drains the east flank of Redondo Peak we have identified a riparian Blue Spruce/Thinleaf Alder/Fendler's Waterleaf PA (Figure 19). Blue spruce forms a moderate overstory with a sub-canopy of thinleaf alder (*Alnus incana* ssp. *tenuifolia*), and a very diverse herbaceous layer of over 40 grasses and forbs. Many these are obligate or facultative wetland species such as Canada reedgrass (*Calamagrostis canadensis*), Fendler's waterleaf (*Hydrophyllum fendleri*), seep monkeyflower (*Mimulus guttatus*), Columbian monkshood (*Aconitum columbianum*), and Fendler's cowbane (*Oxypolis fendleri*). Whitford and Ludwig (1975) described a similar Blue Spruce/Thinleaf Alder/Kentucky Bluegrass Association from streamside terraces along Redondo Creek where blue spruce along with other conifers occupy the lower slopes and terraces adjacent to the streams, and where the undergrowth is distinctively grassy. There are also sites where the conifers have either been removed or have died out leaving scattered thinleaf alder thickets along the streams adjacent to drier terraces that support grassy meadows dominated by Kentucky bluegrass.

Figure 20. The Bog Birch/Water Sedge/Club Moss PA in the Alamo Canyon fen complex. Note that the bog birch in the foreground is heavily browsed, presumably by deer and elk. Blue spruces are typically stunted or have died.

A special Bog Birch/Water Sedge/Stiff Clubmoss PA has been identified as part of the fen complex in Alamo Canyon (see Potential Special Management Areas below). Although bog birch (*Betula glandulosa*) is prevalent in the Rocky Mountains and northward, this is the only known location for it in New Mexico (Figure 20). Along with bog birch and water sedge (*Carex aquatilis*), this association is typified by a high cover of club moss (*Lycopodium annotinum*) that forms mats in the water channel. Other obligate wetland species that are present include tufted hairgrass (*Deschampsia cespitosa*), rough bentgrass (*Agrostis scabra*), and Canada reedgrass (*Calamagrostis canadensis*). The association lies at about 8,680 ft (2,650 m) along a low gradient portion of Alamo Creek adjacent to a large fen dominated by tufted hairgrass. Blue spruces are also present along the margins of the occurrence (although their vigor is much reduced).

Grasslands and Wetlands

The grasslands of the VCNP fall into two broad categories: 1) Montane Valley Grasslands dominated by upland grasses and forbs; and 2) Montane Wet Meadows and Wetlands of valley bottoms dominated by facultative and obligate wetland grass and grass-like (graminoid) species.

Montane Grasslands

Montane Valley Grasslands make up the majority of the grasslands on the VCNP, covering over 26,000 acres (10,500 ha) and dominating the expansive lower elevation valles (Figure 21). They are also found at higher elevations along the caldera rim and in small interior mountain valleys (Figure 22). Despite their seemingly high abundance on the VCNP, montane grasslands are relatively uncommon in New Mexico. Other than in the Jemez Mountains, they are found only at the highest elevations of the Sangre de Cristo Mountains along with scattered occurrences in the Sacramento Mountains and in the Gila (Potter and Foxx 1981; Baker 1983; Allen 1984; Dick-Peddie 1993; Moir 1967).

Figure 21. In the valles of the VCNP, Arizona fescue commonly dominates the upper slopes, while pine dropseed and Arizona fescue often codominate the lower slopes and

On the VCNP we have identified five Montane Grassland alliances based on relative dominance, i.e., the **Parry's Oatgrass, Thurber Fescue, Arizona Fescue, Pine Dropseed (*Blepharoneuron tricholepis*), and Kentucky Bluegrass Alliances**. Besides the dominant grasses, these alliances are typified by the presence of meadow species such as Fendler's sandwort, bluebell bellflower, Parry's bellflower (*Campanula parryi*), yarrow, beautiful fleabane (*Erigeron formosissimus*), heartleaf buttercup (*Ranunculus cardiophyllus*), yellow owlclover (*Orthocarpus luteus*), woolly cinquefoil (*Potentilla hippiana*), and Rocky Mountain iris. Overall, they are highly diverse communities, with over 125 species of grasses and forbs recorded so far on the VCNP (see Appendix D).

Figure 22. Thurber fescue and Parry's oatgrass typically dominate the higher interior montane valleys such as this one in Canada Bonita along the eastern rim of the VCNP.

We have limited information on the dominant species of these grasslands. With respect to Arizona fescue, most of our ecological understanding comes from research on Idaho fescue (*Festuca idahoensis*), a closely related species that is a dominant of montane grasslands from Colorado northward to Montana (Anderson et al. 1998; Mueggler and Stewart 1980; Zouhar 2000). Accordingly, Arizona fescue, like Idaho fescue, is probably one of the more favored forage species for domestic livestock, elk, and deer. Thurber fescue is less favored because it is coarser and less palatable, but it is still considered a fair forage grass (particularly in the spring). Grazing pressure tends to reduce both Thurber fescue and Arizona fescue, and Thurber fescue has been largely eliminated from many sites it once occupied (Turner and Paulsen 1976). Lastly, Parry's oatgrass is less palatable and hence less impacted by grazing, and it may even be increasing as grazing pressure displaces the fescues. Under heavy grazing the exotic Kentucky bluegrass will displace both fescues and Parry's oatgrass, and its dominance in these associations is usually an indicator of severe historic grazing practices (Dick-Peddie 1993; Uchytil 1993; Moir 1967).

Although pine dropseed is a common native dominant or codominant in the VCNP grasslands, there has been little research about its ecology. Based on our observations of habitat conditions on the preserve, it seems to favor lower slope sites, possibly finer soils, and occurs in areas that had heavy grazing disturbance in the past (particularly as one approaches stock tanks). More information is needed on its habitat relationships and dynamics.

The high mountain montane grasslands (>9,500 ft; 2,930 m) of the VCNP are commonly dominated by Parry's Oatgrass associations (Figure 22) and associated with Ess soils (Figure 5, map unit 215). There is the Parry's Oatgrass/Thurber Fescue PA in which the two respective codominants can approach 70 to 90% canopy cover. Arizona fescue or other grasses may be present, but they are clearly subordinate. The Parry's Oatgrass/Arizona Fescue PA also occurs in these ridge and mountain valley sites, but under seemingly drier conditions. The combined cover of Arizona fescue and Parry's oatgrass in this association can exceed 80%, and the combination of grass and forb cover can approach 100%. The only shrub of note is shrubby cinquefoil (*Pentaphylloides floribunda*), which under certain conditions increases with grazing (Mueggler and Stewart 1980), yet it is also considered a favored browse species of elk and may be impacted by the high elk numbers on the preserve. Both associations are highly diverse assemblages, with over 50 species of grasses and forbs recorded so far in each.

Both of these associations are also prevalent in the lower elevation valles of the preserve where they occupy the upper piedmont slopes along the forest and woodland edges (particularly on Cosey soils—soil map unit 304 in Figure 5). In addition, in small drainages of the eastern piedmont in the Valle Grande we identified an unusual Thurber Fescue/ Letterman's Needlegrass Association codominated by Letterman's needlegrass (*Stipa lettermannii*) and where Parry's oatgrass is absent (while being present in the adjacent sites). Further down the slopes on Jaramillo, Trasquilar and Cajete soils (map units 302 and 308), both Parry's Oatgrass and Thurberi fescue diminish and Arizona fescue becomes the dominant (Figure 21). We have identified three Arizona fescue plant associations that tend to separate out by aspect and geomorphology. The Arizona Fescue/Mountain Muhly PA is found on northerly facing slopes, while the Arizona Fescue/Blue Grama PA tends to be on southerly slopes. The Arizona

Fescue/Pine Dropseed PA occurs along the lower piedmont slopes and on the mid-valley benches and terraces where it often grades into pine dropseed-dominated types. It is here that pine dropseed associations often prevail (Pine Dropseed/June Grass, Pine Dropseed/Mountain Muhly, and Pine Dropseed/Spike Muhly associations). The benches or terraces (remnants of ancient alluvial fans, stream terraces, and lake bed sediments) lie just above the valley floor and represent both the lowest topographic position of the upland grasslands and where Montane Valley Grasslands meet Montane Graminoid Wet Meadows and Wetlands that occur on the current floodplain of the valley floor (see below).

For several of the above associations we have identified Kentucky bluegrass phases where bluegrass reaches anywhere from 10 to 50% cover, suggesting significant impacts from past livestock grazing. We have a Kentucky Bluegrass/Woolly Cinquefoil PA of benches and valley bottom terraces where almost all native grass species are absent or uncommon. Kentucky bluegrass also appears to be particularly abundant in pine dropseed types, further supporting the concept that pine dropseed may be a co-increaser with Kentucky bluegrass with grazing (alternatively, abundant pine dropseed may represent an intermediate recovery phase following severe grazing).

Montane Wet Meadows and Wetlands

Figure 23. The complexity of wet meadows and wetlands is evident in this view across the Valle Grande. Each color represents a different wetland species dominant.

Montane Wet Meadows and Wetlands occur throughout the lowland valleys (Figure 23), commonly adjacent to perennial streams of the valley bottoms (Figure 24), but also along seeps, springs and creeks in the uplands. These diverse communities—142 species have been recorded so far—are dominated by facultative and obligate wetland graminoid species, mostly sedges (*Carex* sp.) and rushes (*Juncus* sp.). We have identified 15 obligate and 13 facultative wetland species as defined by the national wetlands species list (U.S. Fish and Wildlife Service 1988). In addition, most of these communities are on sites subject to periodic flooding, or where the soils can become saturated at some point during the year in most years (most of the wet meadows and wetlands are associated with hydric Vastine soils—soils map unit 301). Accordingly, these communities would likely be considered jurisdictional wetlands under federal rules (Federal Interagency Committee for Wetland Delineation 1989). Woody perennial species such as willows, alders and water birch are absent or very rare. Whether this is a function of hydrological and soil conditions or past overgrazing is an open question. These wet meadows correspond to the Sedge Wet Meadows of Whitford and Ludwig (1975) and Montane Meadows of Barnes (2002).

We have classified these wet meadows into 17 plant associations among eight **Wet Meadow and Wetland alliances** based on dominance and indicator value. The alliances are **Tufted Hairgrass** (*Deschampsia cespitosa*), **Northwest Territory Sedge** (*Carex utriculata*), W**ater Sedge** (*Carex aquatilis*), **Woolly Sedge** (*Carex pellita*), **Common Spikerush** (*Eleocharis palustris)*, **Baltic Rush** (J*uncus balticus*), **Northern Mannagrass** (*Glyceria borealis*), and **Kentucky Bluegrass**.

Figure 24. A typical wet meadow/wetland along San Antonio Creek represented here by the Tufted Hairgrass - Northwest Territory Sedge Association. Note the lack of woody riparian species.

Northwest Territory sedge, water sedge, woolly sedge, and smallwing sedge (*Carex microptera*) are a set of similar species that form an operational functional group of tall coarse sedges growing near or adjacent to the stream channels and springs of the VCNP. They are difficult to differentiate morphologically (except when flowering) and their habitat seems similar: frequently flooded sites with saturated or near saturated soils. They typically form dense, sometimes wide bands of 10 m or more along perennial channels. They are important to stream function because they serve to stabilize the banks and shade the channel.

Spikerush-dominated communities typically occur in close association with sedge communities, but along low bars and beaches within the active channels and at the interiors of spring wetlands. In contrast, Baltic rush and tufted hairgrass associations are typically found away from the channel on slightly higher ground than either the sedges or spikerushes (although sometimes these can also be found directly adjacent to the active channel). Overbank flooding still can occur but not necessarily on an annual basis, and ground water and snowmelt may be more important, leaving soils saturated for long periods with standing water at or near the surface. Grazing may favor Baltic rush over tufted hairgrass, and with overuse, wet meadows can shift to the exotic Kentucky bluegrass and a mixture of exotic and/or weedy forbs. Accordingly, we have identified a Kentucky Bluegrass Alliance, and in many cases we have identified a separate Kentucky Bluegrass Phase for associations that have been subject to long-term grazing.

Northern mannagrass communities are associated with shallow pond and lake edges, and in the case of the VCNP, stock tanks. Northern mannagrass is a native, perennial, hydrophytic grass of cold temperate climates. Soils remain saturated during the growing season, but can dry out late in the season (Muldavin et al. 2000)

Plants and Animals of Note

Rare Species

While the VCNP was privately held there were few floral and faunal surveys, let alone ones targeted at rare plants and animals. Whitford and Ludwig (1975) in their survey of biota and vegetation of Redondo Peak and its surroundings noted some sensitive species (see below), but a comprehensive survey has been lacking. With federal acquisition, new surveys have been initiated for select taxonomic groups, but more will be needed to develop the full picture of biodiversity on the preserve necessary for effective management, especially with respect to those rare species currently or historically known to occur on the preserve and in the neighboring mountains (Table 7).

Among rare plants, *Delphinium sapellonis*, or Sapello Canyon larkspur, is the only sensitive plant species recorded from the VCNP (Figure 25). It is known from high elevation forests in the Sierra de los Valles along the eastern boundary of the preserve. This is a New Mexico endemic found only in the Jemez, Sangre de Cristo, and Sandia Mountains, and is listed by the state of New Mexico as a "Species of Concern."[3]

Figure 25. Sapello Canyon larkspur (*Delphinium sapellonis*).

Bog birch (*Betula glandulosa*), although a somewhat common species at higher latitudes of the U.S. and Canada, is found in New Mexico only on the VCNP (in the Alamo Canyon wetland complex on the west side of the preserve—see Figure 20).

With respect to animals, the most important sensitive species are the Jemez Mountains salamander (*Plethodon neomexicanus*), Goat Peak pika (*Ochotona princeps nigrescens*), bald eagle (*Haliaeetus leucocephalus*), and the northern goshawk (*Accipiter gentiles*), all known to occur in the VCNP. The first two are endemic to the Jemez Mountains, and the bald eagle and northern goshawk are occasional breeders and migrants from northern latitudes. These three species were formerly considered federal candidate species-Category 2 under the Endangered Species Act, but when that designation was dropped from the Act, they became commonly referred to now as "Former Species of Concern." At the state level, the Jemez Mountains salamander is considered "threatened" by the New Mexico Department of Game and Fish Department (NMDGF), and all three species are at least considered "Imperiled" on a global or statewide basis (G2 or S2 rank) by the New Mexico Natural Heritage Program.

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[3] For further information see the New Mexico Rare Plant Technical Council description at http://nmrareplants.unm.edu/reports/delsap.htm

Table 7. Species of note for the Valles Caldera National Preserve that are either known from the preserve or in the surrounding mountains. ESA = Endangered Species Act status where FSOC refers to former species of concern or Category 2 species. SEN. or T or E refers to Sensitive, Threatened or Endangered designations of the US Forest Service and the New Mexico Department of Game and Fish. G-rank and S-rank refer to the New Mexico Natural Heritage Program (NMNHP) rarity rankings (see Methods).

Common Name	Scientific Name	VCNP	ESA	USFS	State	NMNHP G-rank	NMNHP S-rank
American marten	Martes americana			Sen.	T	G4G5	S2
Bald eagle	Heliaeetus leucocephalus	X	T		T	G4	S1B,S3N
Big free-tailed bat	Nyctinomops macrotis		FSOC	Sen.		G5	S2
Black swift	Cypseloides niger				Sen.	G4	S1B,S2N
Boreal owl	Aegolius funereus			Sen.	T	G5	S1B,S1N
Goat peak pika	Ochotona princeps nigrescens	X	FSOC	Sen.	Sen.	G5T1	S1?
Jemez Mountains salamander	Plethodon neomexicanus	X	FSOC	Sen.	T	G2	S2
Mexican spotted owl	Strix occidentalis lucida			T	Sen.	G3	S2
Northern leopard frog	Rana pipiens	X		Sen.		G5	S4
Northern goshawk	Accipiter gentiles	X	FSOC	Sen.	Sen.	G5	S2B,S2N
Peregrine falcon	Falco peregrinus	X		Sen.	T	G4	S2
Preble's shrew	Sorex preblei					G4	S1
Rio Grande chub	Gila Pandora				Sen.	G3	S3
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	X		Sen.	Sen.	G4T3	S2
Rio Grande sucker	Catostomus plebeius			Sen.		G3G4	SE3
Spotted bat	Euderma maculatum		FSOC	Sen.	T	G4	S3
Wrinkled marshsnail	Stagnicola caperata			Sen.	E	G5	S1?

The endemic Jemez Mountains salamander occupies moist mixed conifer and spruce-fir forest habitats of low disturbance. Typically, these forests have developed on the old, stabilized talus slopes or rock fields (felsenmeers) associated with volcanic cones and the caldera rim. The salamanders live underground, beneath rocks and among the woody debris of the forest floor. The main threats to the species are logging and road building which disrupt the structure of the talus slope habitat. In addition, with the shady canopy gone following logging (or large stand replacement fires), sites dry out, possibly leading to adverse changes in habitat. On the VCNP there are several records from interior mountains as well as along the rim (Whitford and Ludwig 1975; Bruce Christman, NMDGF pers. com.). Based on the historic record, the VCNP harbors the center of distribution for the species (NM Endemic Salamander Team 2000). New surveys by the NMDGF are underway to determine the current distribution of the species and to further evaluate its habitat needs.

The Goat Peak pika is also known from the high-elevation felsenmeer slopes of the VCNP (usually above 10,000 ft; 3,000 m). This subspecies of the American pika is known only from the Jemez Mountains and has the center of its distribution on the VCNP and neighboring mountains to the north. Pikas directly inhabit the rock fields and adjacent forest edges (Halfner and Sullivan 1995).

Northern goshawks are typically winter migrants from northern latitudes, but are occasionally known to nest in high elevation forest in New Mexico and Arizona. All indications are that this is a declining species that has been significantly impacted by timber harvest and riparian area degradation (see Kennedy 1997 and Reynolds 1992 for an in-depth analysis). On the VCNP, two northern goshawks were sighted in 2002 along the northern rim of the caldera by NMNHP staff. Although no nest was located, they may possibly be nesting in the area. They are likely taking advantage of the remaining virgin mixed conifer and spruce-fir forest habitats of the VCNP to forage and possibly breed. In addition, migrating bald eagles use VCNP, especially before streams freeze (Johnson 2002).

There are several other species of note that were either historically present on the preserve or are currently found there or in the surrounding mountains. These species are listed in Table 7 and further information about them along with the Jemez Mountains salamander, Goat Peak pika and northern goshawk can be found at:

NMDGF BISON-M web site at http://www.cmiweb.org/states/
New Mexico Natural Heritage Program at http://nmnhp.unm.edu/.
NatureServe at http://www.natureserve.org/explorer/.

Other Animals and Plants of Interest

Active Gunnisons prairie dog (*Cynomys gunnisonii*) towns were common throughout the valle grasslands of the preserve. Some towns had been abandoned, possibly from historical control practices or sylvatic plague, while others were active and appeared to be growing. Prairie dogs are considered a "keystone" or "critical-link" species in montane grasslands because the heterogeneity and associated biodiversity they bring to the landscape mosaic. They not only provide habitat for other species but are also a major prey species. Hence, aggressive control measures in the past have lead to disruption of ecosystem processes and trophic relationships. Control measures have also been so successful regionally that prairie dogs are now considered to be in decline and in need of special management attention to conserve colonies where possible (and avoid listing as a federal T & E species).

Beavers (*Castor canadensis*) are another keystone species that were present until recently on the VCNP, with old beaver dams known on Indian Creek, Sulfur Creek, and the west side of Redondo Peak. These animals play an important role in the stream systems they inhabit, both in terms of vegetation dynamics and stream morphology. Beaver dams trap sediment and reduce stream turbidity while creating important fish habitat and actually enhancing riparian vegetation over the long term (Simino 2001). But trapping during the nineteenth and into the twentieth century led to significant declines in the state. In the 1930s, when it was realized that beavers were vital components of proper watershed management, live trapping and restocking of the animals began, with a concerted effort by NMDGF between 1947 and 1958 (Berghofer 1967). With respect to the VCNP, Simino recommended that beavers be reintroduced into the preserve's streams as part of an effort to restore the riparian zones, enhance stream functioning and improve fish habitat.

We have compiled an informal checklist of birds based on sightings by Jackie Smith, orthnithologist with the NMNHP, during the vegetation survey. The list is provided in the Data Addendum.

Preliminary Ecological Assessment

Forests and Woodlands

Outstanding Features

Although nearly 40,000 of the VCNP's 65,000 acres of forested lands have been harvested for timber in one form or another over the past 100 years, the remaining 25,000 acres of virgin forest still represent some of the largest and best occurrences left in the Jemez Mountains (Figure 28). The largest stands are in the Sierra de los Valles that lie along the eastern rim of the caldera from Cerro Grande to just north of Pipeline Road (zones 8a, b, & c; Figure 28). These stands are also adjacent to other old growth stands on U.S. Forest Service lands to the east between the VCNP and Los Alamos, and together they represent the largest contiguous block of virgin forest remaining in the Jemez Mountains (despite the losses that occurred in the May 2000 Cerro Grande Fire). Among these stands are found the range of forest communities known to the VCNP—ponderosa pine to mixed conifer to spruce-fir along with aspen groves (Figure 26). In addition, there are relatively intact high montane grasslands and meadows found within the forest matrix (e.g., Canada Bonito, a USFS Research Natural Area that is partially on the VCNP (see Figure 22).

Figure 26. West slope of Pajarito Mountain; only the lower ponderosa pine forest have been entered for timber harvest. Aspens at mid-slope are over 255 years old (Margolis et al. 2001). Note the spread of ponderosa pine into the upper Valle Grande.

Along the western boundary in the "canyons" area, the watersheds of Mormon Canyon, Deer, Free Love, and Alamo canyons, and the southern end of Redondo Border are largely intact (Zone 3). They support a mosaic of mixed conifer and ponderosa pine forests, aspen glades, and montane scrub (Figure 27). Near the summit of Redondo Peak some large stands of old growth Engelmann Spruce-Corkbark Fir forest remain, but logged areas are interspersed among undisturbed sites (Zone 4). Similarly, on San Antonio Mountain (Zone 2) some extensive stands of mixed conifer forests remain abutting the clear-cuts.

Figure 27. Looking south over the Jemez River valley from Redondo Border. The nearby north slopes of mostly virgin forests are those of Mormon and Deer Canyon. The foreground is a recently burned patch of Gambel oak that is resprouting.

Valles Caldera National Preserve

Road Network and Virgin Forest Zones

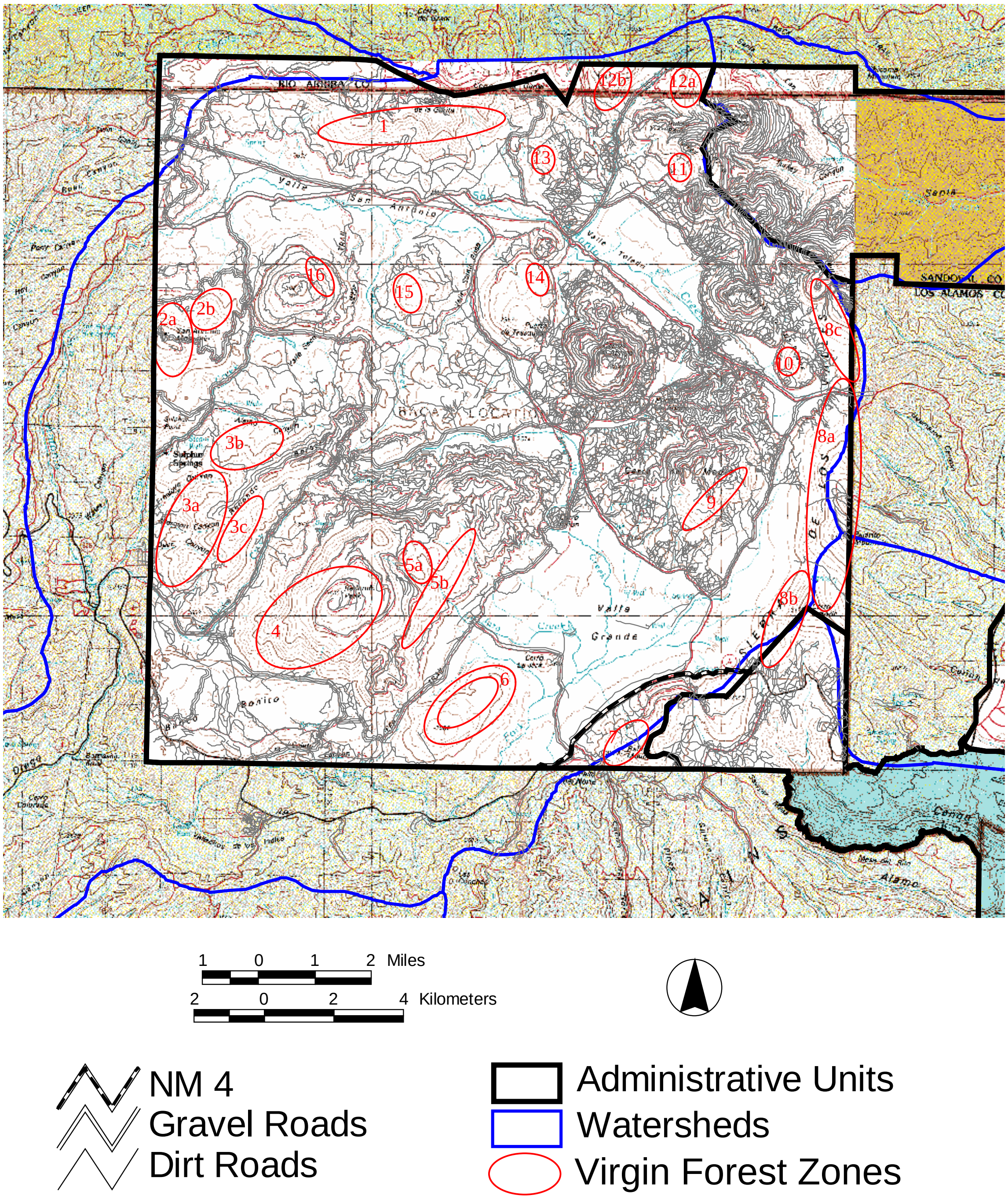


Figure 28. The logging road network of the VCNP versus virgin forest zones that have not been entered for timber harvest. See text for zone descriptions.

One of the larger occurrences of virgin mixed conifer forest on the VCNP occurs at mid elevations along the north rim of Valle San Antonio (Zone 1; see Figure 9). These mostly Douglas-fir-dominated stands are found on the steepest and rockiest slopes where logging was not mechanically feasible (nor economical). Similarly, there are remnant stands of old growth on other steep, inaccessible slopes such as along the southeast face of Cerro del Medio (Zone 9), the slopes (but not the top) of South Mountain (Zone 6), and along the mid-slopes of the eastern flank of Redondo Peak (Zone 5).

There are other smaller remnant patches on Cerro Seco (Zone 16), Cerro San Luis (Zone 15), Cerro Trasquilar (Zones 13 &14), in the Upper reaches of Rito de los Indios (Zone 12), Sierra de Toledo (Zone 11), Cerros de los Posos (Zone 10), and on the southeast slope of Rabbit Mountain (Zone 7). Most of these stands were not harvested because they were either too young at the time or had tree species compositions of low economic value (white fir, spruce, subalpine fir, limber pine and southwestern white pine).

In contrast, because of their accessibility along lower slopes, almost all of the ponderosa pine forests and woodlands on the VCNP were either selectively or clear-cut logged. The best example of a remnant old ponderosa pine stand is found in the headquarters pasture of Valle Grande (Figure 29). Currently called the “History Grove,” this open stand was protected from harvest by previous owners for aesthetic reasons. Surprisingly, even in its altered state, such an old growth pine stand is a rarity today in the Jemez Mountains.

Figure 29. Remnant stand of old growth belonging to the Ponderosa Pine/Arizona Fescue Association in the headquarters pasture; also known as the “Sherwood Forest.”

Management Issues

The primary issues with respect to forests and woodlands of VCNP concern the impacts of logging activities and fire suppression during the twentieth century on forest health. The logging history of VCNP has altered the stand structure and successional sequences in the mixed conifer forest (Figure 30). In the early period of logging (pre-1963), most of the ponderosa pine forests and much of the accessible mixed conifer forest type was selectively cut for Douglas-fir and

Figure 30. The lower west slope of Redondo Peak is an example of the patchwork of forest stands altered by past logging.

ponderosa pine, i.e., “high graded” for the most merchantable timber at the time (see USFS 1993). As a result, many of the stands were left dominated by less desirable timber species such as white fir and limber pine, and aspen commonly grew into the gaps left by the removed trees (although younger “leave-tree” Douglas-fir could also infill). This has led to extensive areas of modified forest stands with various admixtures of conifer species and aspen in various stages of development along with some unusual understory compositions and structures.

In a middle period from 1963 to 1972 timber harvest was primarily by clear-cutting, using a jammer logging system that requires building a high-density road system to access the trees (Figure 31). The jammer method is considered a poor logging practice because it results in the highest level of road disturbance and fragmentation of any logging system and, as Stone (1973) suggests, roads may contribute greater than 90 percent of the sedimentation problems associated with logging operations. As result, a dense network of logging roads was installed over much of Redondo Border, the northern end of Redondo Peak, Cerro del Medio, Cerros del Abrigo, Sierra de Toledo, and Cerros de los Posos. This has significantly altered the hydrological patterns of these mountains, and likely continues to be a source of soil erosion and low productivity today (the roads themselves have little or no vegetation or conifer regeneration).

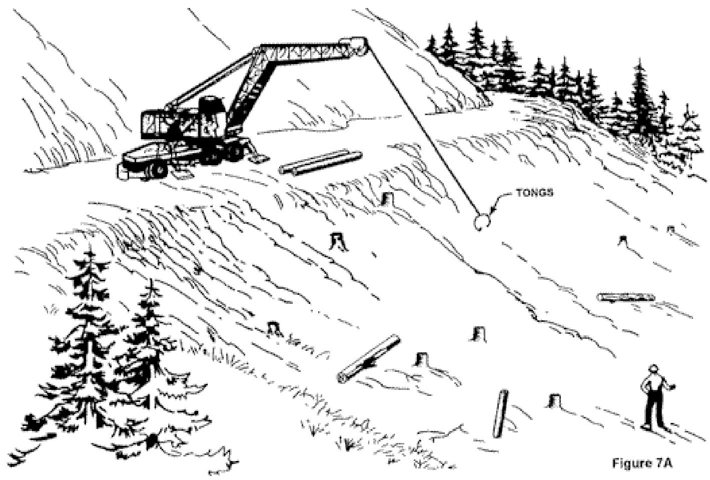


Figure 31. Because of its short reach downslope to capture logs, the jammer logging system requires a high density of near-parallel roads, often within 100 m of each other. [Drawing: OSHA 2002]

While the effects on sites selectively logged earlier in the twentieth century are beginning to be ameliorated as these stands develop closed canopies, such is not the case for the middle period. The high-density network of roads established during the 1960s have broken the forests up into narrow, linear patches that has led to increased tree windthrow and dieoff from exposure, and altered natural fire patterns. Post-logging vegetation ranges from open fields and shrublands (Figure 32) to fragmented stands of aspen, white fir and southwestern white pine along with scattered ponderosa and Douglas-fir

Figure 32. An area harvested in the 1980s along the west slope of Redondo Border.

"leave" trees (Figure 33). As a side bar, conifer reproduction is often poor, and seedling stock plantings may be required to restore these forests (aerial seeding at this late date is unlikely to be successful). The fragmentation has also likely affected wildlife habitat quality through loss of forage and cover and modified migration patterns.

Figure 33. Example of a high-graded stand on Redondo Border harvested for the most merchantable timber, usually leaving behind trees less than 10 inches in diameter.

Apparently, no logging occurred during the later portion of the tenure of James P. Dunigan from ca. 1970 to 1980 — allowing for some watershed stabilization (USFS 1993). But following his death in 1980, logging resumed up until government acquisition in 2000. During this last period much of San Antonio Mountain, Cerro del Seco, Cerro de San Luis, Cerros del los Trasquilar and portions of Redondo Border and Redondo Peak were harvested by selective and clear-cutting methods using the old logging roads and adding new ones. The last harvest occurred on South Mountain just before government acquisition, fragmenting one of the largest remaining stands of old growth on the VCNP.

A limited rehabilitation of the logging road system should be considered to encourage conifer regeneration on the roads themselves and to control erosion in some areas. The caveat is that manipulating some roads may do more harm than good, i.e., many roads, while lacking conifers, are relatively stable and "fixing" them may cause more erosion than if they were left alone. Hence, any rehabilitation plan should be supported by detailed upland hydrological and soils studies, as well as biological analysis to target desired future conditions for restored areas.

The other major issue in forest health of the VCNP is fire suppression during the twentieth century. As Keane et al. (2002) have noted, fire suppression has had pervasive impact on ecosystem processes and biodiversity in the Rocky Mountains, and VCNP forest communities are no exception. Fire has effectively been shut out of the VCNP since the early twentieth century, which in turn has led to altered stand structures and shifts in the landscape mosaic. The most conspicuous pattern is the development of dense "dog hair" stands of reproducing ponderosa pine that occur in the forests along the southern boundary of the preserve (Figure 34). Although we have no direct studies from the VCNP, data from the nearby USFS Monument Canyon Research

Figure 34. Ponderosa pine forests in the Banco Bonito area are developing dense stands of saplings and poles under the mature canopy, creating fire hazards and poor stand quality.

Natural Area (two miles to the south of the VCNP boundary) can provide some insight into how stand structures of ponderosa pine forests in the area have changed as a function of fire suppression. The Monument Canyon RNA supports an old growth ponderosa pine forest characterized by scattered large and old overstory ponderosa trees with thickets of sapling pines in the understory. An analysis of the age structure of the stand indicates that most of the young ponderosas were established during the early part of the twentieth century following the last spreading surface fire in 1892 (Figure 35). The high degree of recruitment during this period has led to ponderosa pine densities estimated at nearly 6,000 stems/ha (2,428/ac), well beyond what would be expected if there had at least been some reoccurring fire in the stand during the last 100 years. Such densities in the understory coupled with litter fuel buildups have led to the increased number of crown fires in ponderosa (Bogan et al. 1998), culminating in the Cerro Grande Fire of 2000 on the eastern boundary of the preserve. Conditions like these are common in the Banco Bonita area in the southwestern corner of the VCNP (even though much of this area was logged early on from 1930 to 1950). Hence, there is a need for restoration to lower densities to reduce fire hazard, improve stand vigor, and enrich overall biodiversity (Allen et al. 2002). This could be done either through mechanical thinning or prescribed burns, but care must be taken that the entry into the stands does not accelerate erosion, and that some reproduction is left behind to ensure the development of a multiple-aged stand structure through time.

The lack of fire appears to also be responsible for expansion of ponderosa pine into the valle grasslands (Allen 1989) (see Figure 26). Mast et al. (1997) found that moderate cattle grazing combined with fire exclusion has favored interior ponderosa pine seedling establishment on ponderosa pine/grassland ecotonal communities of the Colorado Front Range. Before fire exclusion, frequent fire likely excluded the majority of ponderosa pine seedlings at the ecotonal boundary (Allen 1989). Now on the VCNP, trees at the back of the stands against the hills can be 200 years or older while those at the front are less than 50 years. Additional studies on stand structure and fire history are needed to further help inform the management prescriptions for these communities.

The impact of fire suppression continues into the mixed conifer forest communities, but it is not as extreme. Prior to settlement, the fire regime was likely a mixture of small patch crown fires along with surface fires that were started locally by lightning or that may have swept up from the ponderosa pine belt (Touchan et al. 1996). This led to a heterogeneous forest patch mosaic mediated by differences in local moisture and fuel conditions found in a complex mountain landscape. With fire suppression, forest stands have become more homogenous as they mature and differences in structure among stands has lessened with time. This increases the potential for large crown fires as fuels build up, which in turn brings further uniformity to the forest in an ever increasing cycle of departure from normal and a movement away from the small patch mosaic. But unlike ponderosa pine forests, understory densities of reproducing conifers are lower and less of a concern with respect to fuel hazard. However, their densities in the Douglas-fir and white fir stands of the VCNP are probably still higher today than they would be without suppression.

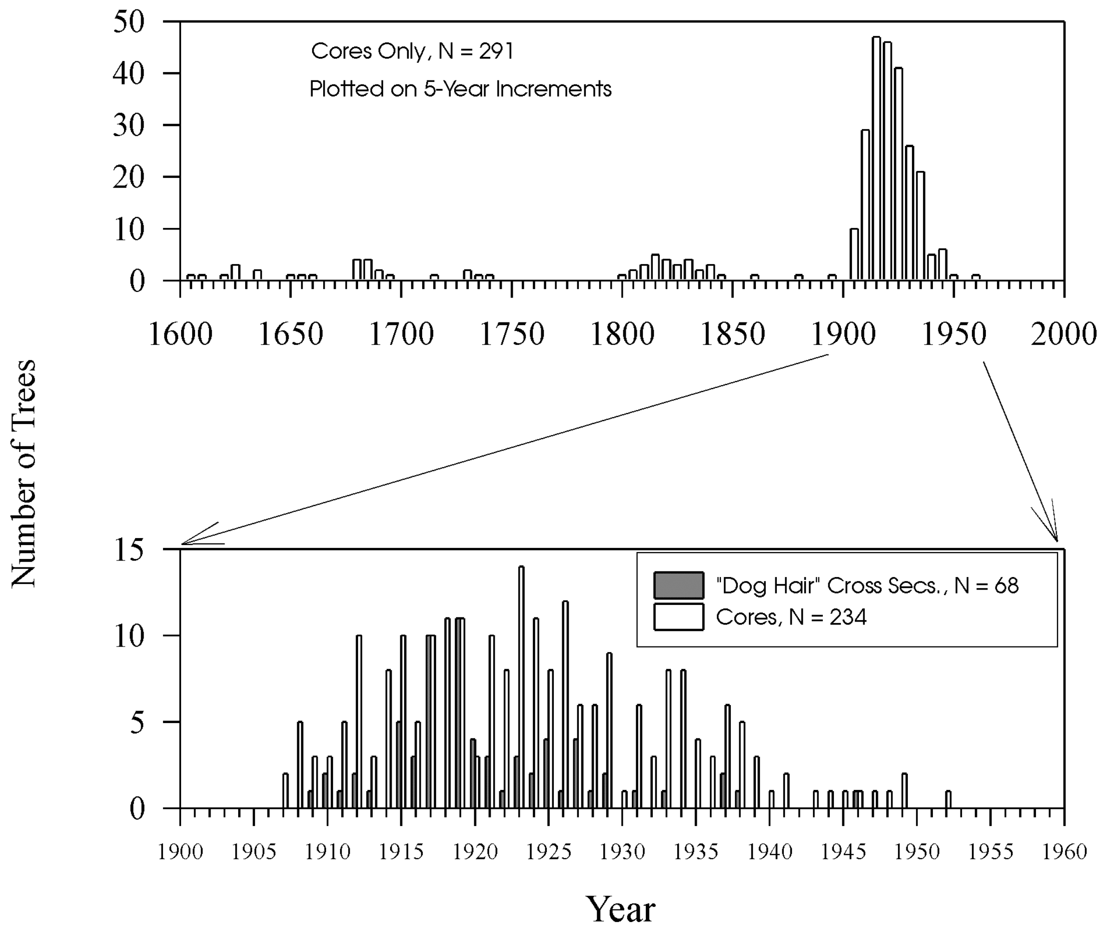


Figure 35. Stand structure of an old growth ponderosa pine forest at Monument Canyon Research Natural Area, two miles south of the southern boundary of the VCNP. Dates represent the year of establishment of 310 sampled trees. Note the pulses of recruitment that occur at a low level through the time leading up to the dramatic increase in the first half of the twentieth century, following the last known fire in 1910 (data from Muldavin et al. 1995 and Allen 1989).

Fire suppression has been key in the development of young blue spruce forests that fringe the upper borders of the valles, particularly on northerly slopes. Early photographs taken from around the turn of the century (Hogan and Allen 1999) show this fringe to be largely absent on the VCNP (Figure 36). The trees are also found to be commonly less than 100 years old at most sample sites. Prior to settlement, fires likely moved up from the grasslands and burned into the forests a short way until they met natural fuel breaks caused by moisture and topography. Without fire, blue spruces have moved back downslope until they hit grassland soil conditions that are poor for tree growth.

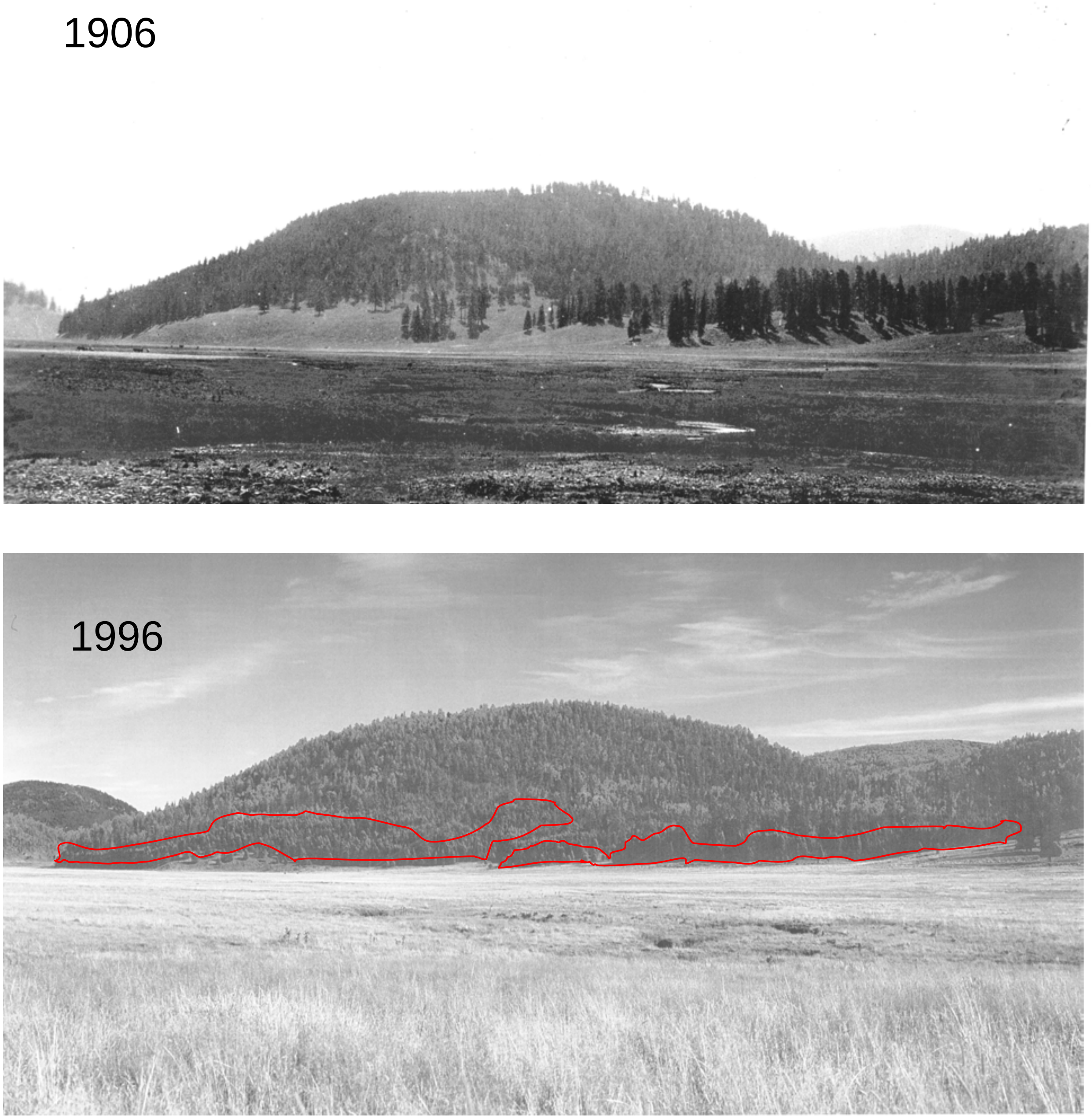


Figure 36. A comparison between 1906 and 1996 of the same slope in the Valle San Antonio showing the development of a fringe blue spruce forest along the lower edge adjacent to the grasslands (source: Hogan and Allen 1999).

Natural fire frequencies decline further in the Engelmann spruce-corkbark fir forests of the highest elevations. Return intervals there are commonly expected anywhere from 100 to 400 years. Hence, despite fire suppression, stands on the VCNP are probably just now extending out of the natural range of variation. But with the potential for larger fires in the mixed conifer zone increasing with suppression, fire incidence may also increase in the spruce-fir zone as more large fires move upslope from the mixed conifer.

With respect to aspens, although there are still large stands on the VCNP (see Figure 30), there are indications that fire suppression in twentieth century has led to significant declines regionally (Bogan et al. 1998), and the possibility that stands are also declining on the preserve (National Riparian Service Team 2002). The maturing of both mixed conifer and spruce-fir stands has led to the gradual decline of aspens within them. Fire or a disturbance that opens the stand (such as logging) is required for aspen. Hence, increased fire in any form is likely to enhance aspen regeneration and help maintain aspen in the landscape. Even given forest gaps for regeneration, browsing by wildlife (primarily elk) may also be affecting aspen regeneration success.


Figure 37. Spruce budworm damage on an Engelmann spruce.

Lastly, there are pest and parasite issues with respect to western spruce budworm (*Choristoneura occidentalis*), dwarf mistletoe (*Arceuthobium* spp.) and possible fir broom rusts (*Melampsorella caryophyllacearum*). Outbreaks of western spruce budworm can have significant effect on white fir and corkbark fir, causing defoliation and significant mortality, particularly in the lower elevation portions of the spruce-fir zone (Alexander et al. 1984; Swetnam and Lynch 1993). On the VCNP, there is an ongoing outbreak that is most prevalent in the mixed conifer zone, but there are occasional infestations within spruce-fir stands as well (Figure 37). Although budworm is common, actual tree mortality from budworm appears limited at this time. The infestation of dwarf mistletoe and broom rusts is most evident in old growth white fir and Douglas-fir forest, and the denser the stand the greater the infestation. The infestations are indicators of poor stand health brought on by long-term suppression of fire that has allowed stands to increase in density and, hence, promulgate the diseases and parasites. Possibly the best approach to restoration is to slowly reintroduce fire to these stands, leading to both within-stand thinning and stand replacement on a small patch scale (as opposed to intensive and costly mechanical thinning with its inherent site impacts from entry).

Grasslands

Outstanding Features

The montane grasslands cover approximately 27% of the VCNP, with the majority occurring in the Valle Grande, Valle San Antonio, and Valle Toledo and with smaller amounts in valles of the intervening mountains. Together, the 26,000 acres (10,500 ha) make up one of the largest occurrences of montane grasslands in the Southern Rocky Mountains Ecoregion. Not only is the occurrence large, it is also a critical representative of an ecosystem considered vulnerable and globally threatened, particularly Parry's oatgrass and Thurber fescue grasslands (Turner and Paulsen 1976; Neely et al. 2001). We estimate that there are about 1,300,000 acres (530,000 ha) of montane grasslands in the southern Rockies, or only about 2.6% of the entire mountain landscape from southern Wyoming to northern New Mexico. Most occurrences are small (<250 ha) and scattered—large expansive grasslands such as those found on the VCNP (Figure 38) are very rare (there are less than five large-area occurrences). Excluding the VCNP, only about 10% of the montane grasslands in this region are protected in national parks and other preserves. Most of the remaining acreage is subject to livestock grazing and other extractive uses, or threatened by development. Hence, the montane grasslands within the VCNP can potentially make a significant contribution to the existing preserve network for this ecosystem type in the southern Rocky Mountain region.

Figure 38. The expansive montane grasslands such as these of Valle Grande and other valles of the VCNP are rare in the southern Rocky Mountains.

Management Issues

On the VCNP, we think that montane grasslands have undergone significant modifications due to grazing. Our analysis suggests that in the course of nearly continuous grazing during the past 100 plus years, native grass species have been slowly replaced by exotic Kentucky bluegrass along with several exotic and weedy forbs. Under heavy grazing the exotic Kentucky bluegrass will displace both fescues and Parry's oatgrass, and its dominance is usually an indicator of intensive grazing practices (Dick-Peddie 1993; Uchytil 1993; Moir 1967). Although it is highly palatable, Kentucky bluegrass it is not as productive when compared to native grasses (it is often semi-dormant during the summer months and sensitive to drought conditions). But since it is both rhizomatus and a heavy seeder, it is an aggressive invader of rangelands and difficult to eradicate once established. Daubenmire (1970) referred to Kentucky bluegrass-dominated sites as stable "zootic climaxes" that result from long-term heavy grazing (Figure 39). The result is grasslands that have lower grass diversity and a forb component of low palatability.

Figure 39. A pasture adjacent to the VCNP where long-term livestock grazing has led to the decline of bunch grasses and an increase of Kentucky bluegrass along with an encroachment of shrubby cinquefoil (*Pentaphylloides floribunda*).

Much of the shift in species composition may be the residual effect of heavy sheep grazing in the late nineteenth and early twentieth centuries. To add to the complexity, Valle Grande has historically been one of the main summer ranges for elk in the Jemez Mountains, and large herds have been using these upland grasslands since the late 1970s, even during mild winters such as in 2002 (Figure 40). The past and current effects of elk are unclear. Although there are no data, it has been suggested that elk and livestock together may have contributed to range degradation in Valle Grande, such as the shift away from Arizona and Thurber fescues to Kentucky bluegrass, and the increased abundance of pine dropseed. Furthermore, and more importantly, elk may be responsible for limiting shrubby cinquefoil (*Pentaphylloides floribunda*) encroachment, a species known to increase with livestock grazing under certain conditions (Mueggler and Stewart 1980). On the VCNP, it appears to be a favored browse species for elk and, when compared to pastures heavily

Figure 40. There are large herds of re-introduced Rocky Mountain elk on the VCNP that may be having a significant impact on range biodiversity and productivity.

grazed by livestock on neighboring properties, may be impacted by the high elk numbers on the preserve.

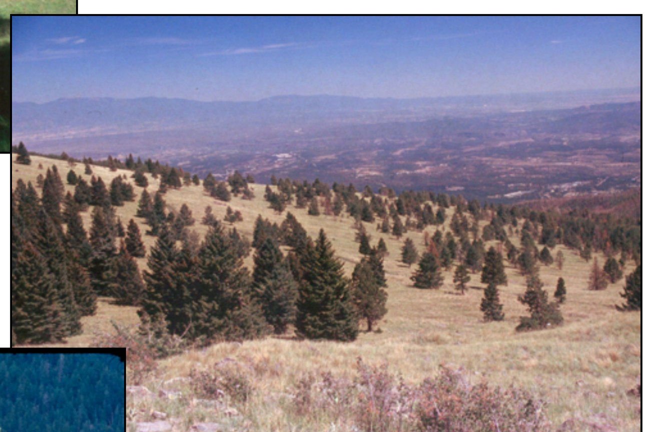
Historic grazing impacts vary across the preserve depending on pasture type, size, and water source distribution. For example, since Valle Grande housed the livestock operation headquarters, there were several pastures dedicated as holding pastures that likely received more impacts than more distant pastures in other valles. One pasture in the northwest portion of Valle Grande was divided into numerous small paddocks and dedicated to horses, leading to increased impacts due to high intensity grazing in small areas. While there are several springs on the slopes of Valle Grande, the East Fork of the Jemez and Jaramillo Creek remain the primary water sources. Hence, impacts tend to increase towards the stream channels with a shift towards Kentucky blue grass and weedy forb dominance. There is a similar pattern in Valle San Antonio and Valle Toledo where San Antonio Creek served as a locus for historic livestock concentrations. In the smaller valles (Valle de los Posos, Valle Jaramillo, Valle Santa Rosa and Valle Seco), historic grazing impacts tend to be concentrated near stock tanks, small watering holes, and springs. Grazing pressure on the lower elevation valle rangelands may have been alleviated by dispersed grazing in forests and woodlands, and in open logged areas of mountains (with unknown effects on forest diversity and productivity). The high mountain meadows of the rim, ridges and mountain tops have perhaps had the fewest grazing impacts from cattle in recent decades due to limited water availability, although earlier grazing by large numbers of sheep may have been significant (Allen 1989).

Overall, these globally significant grasslands carry a strong imprint of past livestock use and are in need of rehabilitation. There is evidence from the Sangre de Cristo Mountains that montane fescue grasslands can recover when rested from livestock, but that Kentucky bluegrass usually remains in the inter-bunch spaces, and in many cases it remains the long-term dominant or codominant (Dick-Peddie 1993). Fire may have some potential to aid restoration, but current research suggests that it needs to be applied with caution. The VCNP grasslands were subject to management burns during the past owner's tenure to improve range conditions, but there is no direct data on the positive or negative effects of the burning program, and such burns were discontinued. Whether burning might favor or harm Arizona fescue, Thurber fescue and other native bunch grasses over Kentucky bluegrass appears to be dependent on season and intensity of fire. Although there is no direct information on Arizona fescue, research on Idaho fescue suggests that light fires are not likely harm Arizona fescue and may promote tillering (Robberecht et al. 1995). Singer and Harter (1996) report enhanced productivity for Idaho fescue after the Yellowstone fires of 1988. But in other studies, hot fires have resulted in high mortality and reports that up to 25 years were needed for recovery (Zouhar 2000). Fire can be used to either enhance or control Kentucky bluegrass, depending on the season of burn. Late spring burns at the peak of standing biomass appear to significantly reduce bluegrass abundance (Uchytil 1993), but the burns must be hot enough to penetrate the soil and reach the rhizomes. Fire is also less effective as a control in lowland moist areas, and when applied during the dormant season may enhance the Kentucky bluegrass (apparently fire has little effect on the mature dormant plants and encourages propagation by seed). The limited research on Thurber fescue suggests it may respond positively to burn treatments, by both by tillering and seedling establishment (Paulsen 1970; McMurray 1987).

In another context, fire may be critical in preventing tree and shrub invasion of grasslands (Allen 1989). Trees and shrubs are normally absent or minor in montane grasslands, but with fire suppression and intensive livestock grazing during the twentieth century there has been a slow invasion by conifers or aspens into once open grasslands in the VCNP and the surrounding mountains (Figure 41). In the high mountain meadows, once open grasslands are now dotted with ponderosa pine, fir or aspen. On some southerly slopes of the valles, ponderosa pine is invading and creating open "woodland savannas" (see Figure 26). Similarly, blue spruce fringe forests have formed along the northerly upper edges, all within the last 100 years of fire suppression (see Figure 36). Bogan et al. (1998) suggest that careful livestock management (including the exclusion of sheep), and the restoration of a natural fire regime can significantly improve range condition in these montane grasslands. In contrast, Dyer and Moffett (1999) suggest that climate change, not fire suppression and grazing, has driven the encroachment of trees. In the midst of this conundrum (is it fire, is it climate), Jonathon Coop (2001) is investigating the competitive interactions and physical controls in this ecotone between forests and grasslands on the VCNP, and ultimately may be able to provide additional insights that will aid management.

a) Aspen encroachment in Deer Canyon.

b) Douglas-fir and ponderosa pine establishment on Pajarito Mt.



c) Ponderosa pine invasion in Valle Toledo.

Figure 41. Examples of aspen and conifer invasions of montane grasslands on the VCNP that are likely the result of fire suppression during the twentieth century.

By the end of the summer of 2001, the pastures of the VCNP—for the first time in more than century—had been rested from livestock use for two full growing seasons. At the end of the season, despite continued elk use, the overall grass cover was high and seed output good (Figure 42). The significance of this can only be addressed with a large scale, long-term monitoring program that is designed to scientifically test the effect of livestock and elk use along with other processes such as fire and the interactions with climate/weather conditions (such as the drought of 2002). Reintroduction of livestock into the ecologically important grasslands of the VCNP should monitor conditions to avoid the potential for further degradation of grassland productivity and biodiversity through the combined effects of livestock and elk.

Figure 42. By August 2001 the grasslands of Valle Toledo, like most grasslands of the VCNP, had had a high standing crop and were seeding out.

Wet Meadows and Wetlands

Outstanding Features

As with montane grasslands, the 1,650 acres (670 ha) or so of montane wet meadows and wetlands that occur on the VCNP are some of the largest in the Southern Rocky Mountains Ecoregion (most occurrences elsewhere are small and scattered in isolated mountain valleys). On a regional basis these wetlands have become increasingly vulnerable to the impacts of livestock grazing and development, and it is estimated that as much as 50% of the wetlands in the southern Rocky Mountains have been destroyed (Dahl 1990). In addition, these wetlands play a critical role in the ecology of the adjacent aquatic systems of the Jemez and San Antonio rivers, both in terms of water quality and as native coldwater fisheries (Figure 43).

Figure 43. Montane wet meadows and wetlands line San Antonio Creek and play a critical role in water quality and aquatic habitat. Note the complex meander pattern inherent in these low-gradient streams.

Management Issues

The wet meadows and wetlands can be highly productive. Mueggler and Stewart (1980), working in Montana, indicate that tufted hairgrass meadows can produce 2,595 lbs/ac (2,900 kg/ha), although as much as 50% of that can be ascribed to less palatable sedges and forbs. Because of this high productivity, they state that cattle tend to congregate and use wet meadows intensively before moving upslope (particularly in the spring), and that the consequent trampling and general overuse can lead to stream erosion and channel degradation. This, in turn, leads to lowered water tables, altered soil moisture conditions and lower productivity.

Figure 44. An example of degraded banks along San Antonio Creek in near the confluence with Los Indios Creek. Native sedges that once armored the bank have been replaced by Kentucky bluegrass and forbs that are less effective at bank stabilization.

The National Riparian Service Team (2002) Proper Functioning Condition assessment gave the major reaches of East Fork of the Jemez a “functional-at-risk rating with an upward health trend.” They noted the increase in Kentucky bluegrass in “dry meadows” (those dominated by tufted hairgrass) as a function of past selective grazing, along with an increase in other upland graminoid species that point to a drying trend among wetland types. Yet, they feel that these lowland wetland systems have enough attributes in place whereby recovery is possible under proper management.

These wetland systems are integral to adjacent stream function and biodiversity and hence, how the wetlands are managed has direct implications for aquatic habitat and the establishment and maintenance of a native coldwater fishery. For example, Simino (2001) in his evaluation of Rio Grande cutthroat trout habitat in the East Fork in Valle Grande indicated several important conditions for trout that were tied to wetland function. He separated the East Fork into two reaches: Reach 7, below the confluence with Jaramillo Creek to the VCNP boundary, and Reach 8, above the confluence to the end of surface waters at the springs at the upper end of valley. The reaches were characterized as low-gradient meadow systems with a severely limited pool versus riffle habitat (only 1 to 5% pool as opposed to a desired 30%) and diminished undercut banks critical to trout habitat. They concluded the reaches had been severely impacted by past livestock that had lead to eroded banks, widening of the stream channel, excessive deposition of sand and silt, and lack of pool versus riffle habitat and undercut banks (Figure 44). In addition, the New Mexico Environment Department found that Reach 7 exceeded allowable water quality standards for a cold-water fishery on several dates during 2001 (temperatures, pH levels, and fecal coliform counts). The implication is that past livestock use has lowered water quality in the reach. Overall, Simino (2001) rated the reaches with respect to Rio Grande cutthroat habitat as "not properly functioning" for all attributes *except* pool quality, and, in Reach 8, pool quality and width-to-depth ratio.

To help improve the function of these systems, Simino (2001) recommended that woody riparian vegetation be established to help stabilize banks and decrease water temperatures. This recommendation was based on what is known about other high elevation meadow systems in the southern Rocky Mountains where woody shrubs often line stream banks. But at this time, we have found no evidence, past or present, of willow, alder, or birch along any of the open valle stream systems (we did find Bebb willow in a wetland area of southeastern area of Valle Seco, around an old cienega in the northwestern corner of the VCNP, in the headwaters of the Jaramillo Creek, along Redondo Creek, and in Sulphur Canyon, but these are more like montane woody riparian systems rather than the wet meadows and stream-associated wetlands of the larger valles). This suggests that woody shrub species may never have been a significant element of these systems, possibly because of soil conditions or the gradient of the streams, and is keeping with the conclusions of the National Riparian Service Team (2002). Hence, the introduction of woody species to enhance stream bank stability and other stream functions should be considered with caution, and more research is needed to ensure success. But controlling livestock access and use of the wetlands is very important for improving water quality, preventing further destruction of banks and stabilizing the system in a way that will lead to a stream channel morphology more conducive to sustaining a native cold-water fishery.

Because they have been heavily used by livestock, the wet meadow systems have a high degree of exotic plant species encroachment, particularly Kentucky bluegrass and weedy forbs (Barnes 2002). Since native sedges and rushes act as very effective bank stabilizers and filters for enhanced water quality, they are preferable for improvement of the adjacent aquatic system. Hence, Simino (2001) recommended a prescribed burn program to help favor natives in the system. As with montane grasslands, a well-designed research and monitoring program with large livestock and elk exclosures will be needed to determine the best approach for improving wetland composition and function.

Montane riparian forests and shrublands

Outstanding features

The montane riparian zones of the VCNP are also special habitats of high diversity and importance for water quality. On a regional basis they occupy less than 1% of the Southern Rocky Mountain landscape, and they are considered rare and globally threatened (Neely et al. 2001; Anderson et al. 1998). Upper La Jara Creek in particular supports a species-rich and productive riparian zone dominated by thinleaf alder and blue spruce (see Figure 19). This is in part because past management wanted to ensure protection of the headquarters water by limiting logging and livestock grazing in the watershed. Other stream systems of the preserve also support shrubby riparian communities, but these have been variously impacted by livestock, elk browsing, and logging (Redondo Creek, Sulphur Creek, Rito de los Indios, and upper Jaramillo Creek).

Management concerns

The primary ecological management issues revolve around protection of water quality and quantity, and the enhancement of these sites for their intrinsic biodiversity values and importance to wildlife. Most of the streamside riparian zones (other than upper La Jara) are in need of restoration to increase function and reestablish riparian vegetation (National Riparian Service Team 2002). Bebb willow populations are being browsed into extirpation everywhere except perhaps along Redondo Creek, where the largest population is currently found. In keeping with the National Riparian Service Team (2002) recommendations, we suggest that good livestock and wildlife management is the key to recovery. Any future management plans should address protections for these riparian communities from livestock use and elk browsing, and consider logging road restoration options to reduce sediment loads and reestablish the original drainage patterns.

Alamo Canyon Wetland Complex

An area of special interest is the wetland complex that occurs in the bottom of Alamo Canyon on the western side of the preserve (Figure 45). Although locally called Alamo Bog, this site is technically a fen because it is dominated by grasses and sedges (tufted hair grass and water sedge); bogs are typically dominated by *Sphagnum* moss (present in Alamo Canyon, but uncommon). Fens are also fed by ground water (warm springs in this case) and runon from surrounding slopes (Figure 46) while bogs receive inputs of water and nutrients only from precipitation (hence, bogs tend to become convex in shape as they develop vertically and can only receive precipitation rather than runon from a surrounding slopes or groundwater). Regardless, both fens and bogs are saturated with water throughout the year with water at or near the surface. As a result, they develop deep organic layers of peat as production exceeds decomposition under the waterlogged conditions. Because production can be significantly lower when compared to other ecosystems, fens and bogs can take centuries, even millennia to develop. In the case of Alamo Canyon, the peat ranges from six to 16 ft (2 to 5 m) deep in some locations, suggesting that the fen complex is ancient (an initial carbon-14 date gives an approximate calendar age of 9,000 years at 493 cm). An additional feature of the fen is its high acidity (2.0 to 4.0 pH) resulting from the influx of sulfuric acid from the underlying and adjacent warm springs (Goff and Janik 2002). Besides the grass- and sedge-dominated fen communities, a small portion of the complex also supports a Bog Birch/Water Sedge/Club Moss Association that is found nowhere else in New Mexico (see Figure 20).

Figure 45. The montane fen in Alamo Canyon is a unique site in New Mexico.

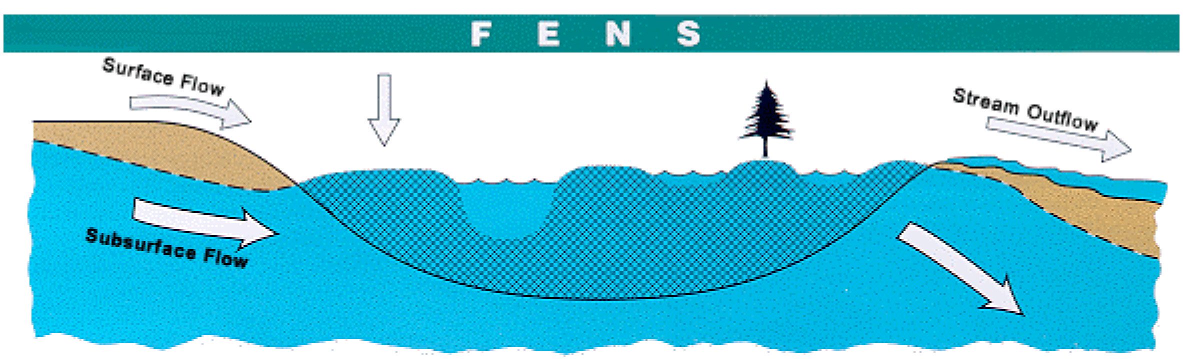


Figure 46. Fens receive surface and subsurface water along with direct precipitation; bogs receive only precipitation. Fens have both surface and subsurface outflows while bogs have only subsurface outflow directly to groundwater (drawing from Welsh 1995).

The Alamo Canyon wetland complex is unique among bogs and fens in the Southern Rocky Mountains and possibly elsewhere. The high acidity driven by warm springs coupled with long-term hydrological stability and water saturation, are unusual conditions not commonly found together, and which have likely led to the large peat accumulations in the fen. The closest examples of something similar are found in Yellowstone National Park, although the dynamic geothermal systems in the park often prevent the stability needed to develop fens (Jennifer Whipple pers. com.). Furthermore, fens in general are considered rare throughout the Southern Rocky Mountains Ecoregion, and they tend to be more compositionally variable than their more northern boreal cousins. In Colorado, they are found only in a few isolated small areas, notably South Park, Mount Evans, Grand Mesa, Iron Creek, and High Creek (Neely et al. 2001), and hence, the Alamo Canyon fen may represent the furthest southern occurrence of this uncommon ecosystem type. This regional rarity is compounded by significant declines worldwide of fens and bogs due to draining, fuel use, and cropping. This has led to multinational government efforts to preserve and protect them (USA, Canada, UK, and the European Union), and the Alamo Canyon complex provides an opportunity for the VCNP to participate in that initiative.

Beyond their biological uniqueness, fens and bogs often contain an unparalleled record of our past. A rich archive of information on vegetation, fire and climate lies preserved in bogs (through pollen, plants, charcoal, and occasional human implements and remains) that has the capacity to expand our understanding of people, culture, and ecological change far back into prehistory (Brunner-Jass 1999).

To help ensure the continued integrity of the fen complex, the provisional boundary of the special management area has been delineated to encompass most of the immediate surrounding watershed (Figure 47, Area A). Careful management at a watershed level will be necessary to maintain the unique hydrological regime that sustains the fen. In the past, the site has been affected not only by livestock use and timber harvesting, but also geothermal exploration. There were several “wellpad” platforms excavated in the canyon during the 1970s that were then abandoned with limited reclamation. Some of these pads are still contributing sediments to the fen, and because the hydrological patterns have been altered, they are causing erosion in the canyon and affecting fen stability. Regardless of causes, there is a large erosional headcut in the middle portion of the complex that is in need of immediate management action to prevent further degradation of the fen system. Also, the rare bog birch community has been adversely affected by elk browsing (see Figure 25), and will likely require an elk-proof exclosure to help maintain the community in the bog complex.

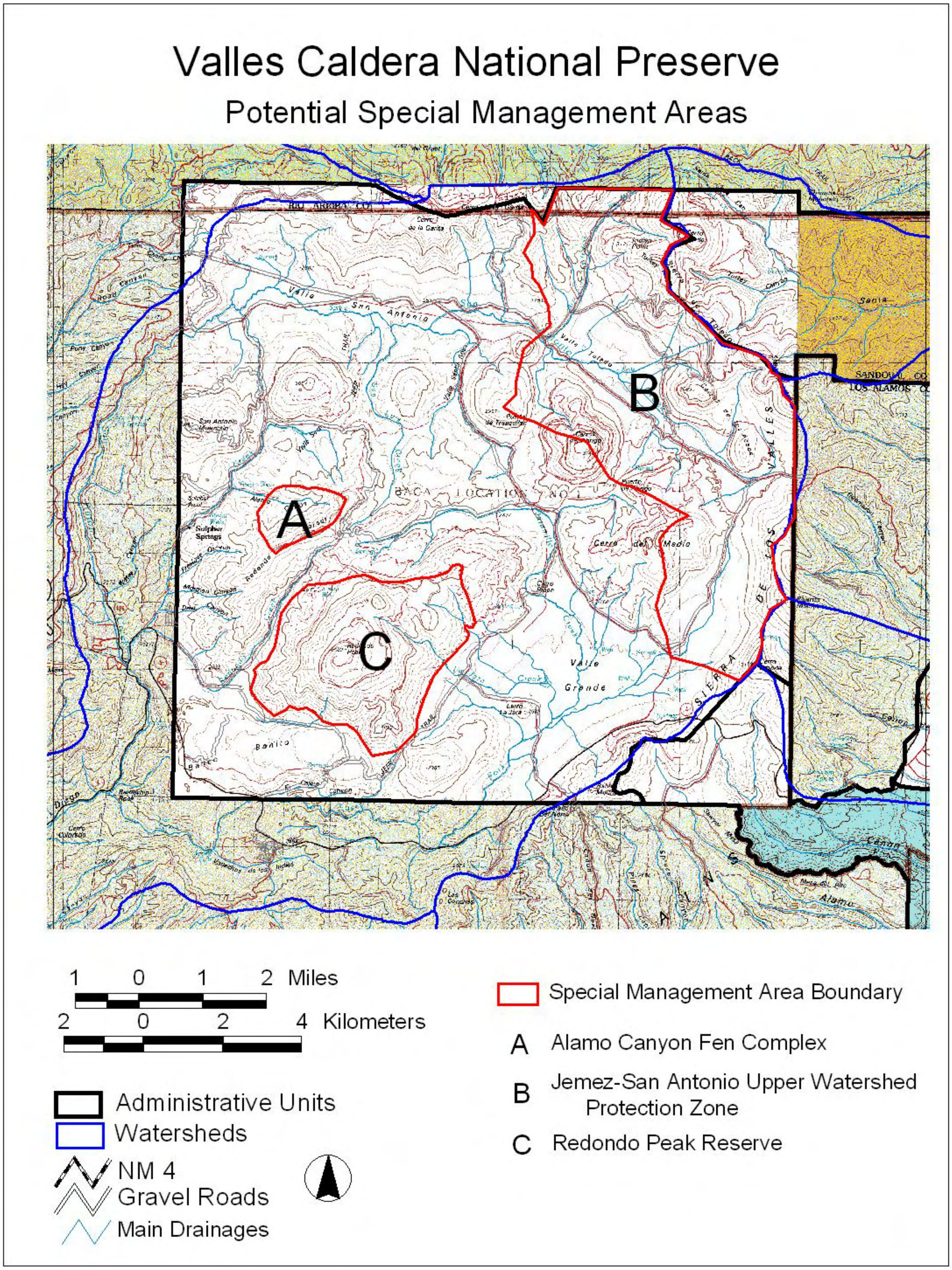


Figure 47. Potential special management areas for the Valles Caldera National Preserve.

Jemez - San Antonio Upper Watershed Protection Zone

Stable upper watershed conditions are critical for restoring and enhancing downstream riparian zones and aquatic ecosystems, particularly the cold-water fishery. Slope stability is usually increased by adding vegetation cover, which in turn reduces sedimentation and nutrient loads that adversely affect stream channel morphology and water quality. In contrast, extensive timber harvests no doubt lead to increased stream sedimentation, and grazing also makes a contribution by increasing exposed soil and subsequent erosion (Turner and Dortignac 1954). The legacy of past forest practices and grazing on the VCNP can still be seen in the East Fork of the Jemez River and San Antonio Creek where there has been excessive sand and silt deposition, increased channel incision and bank erosion, and a dramatic loss of pool-riffle habitat, all leading to significant impacts on the cold-water fishery (Simino 2001).

As a first step in addressing the issue of enhancing conditions for these drainages, a Jemez – San Antonio Upper Watershed Protection Zone could be established that would include the headwaters of the East Fork of the Jemez River and San Antonio Creek in the upper Valle Grande and Valle Toledo, respectively (Figure 47 – Area B and Figure 48). Within this zone timber harvest and livestock grazing would be excluded to allow the watersheds to recover. Besides leading to reduced impacts on downstream aquatic and riparian/wetland systems, the zone would provide an opportunity to reestablish natural ecosystem processes on a limited experimental basis, both in the grasslands and forests. For example, while much of the Pajarito rim country of the upper Valle Grande remains virgin forest, similar rim country in Valle Toledo was extensively logged. Road and forest rehabilitation projects could be initiated there and compared against the “control” of the more intact Upper Valle watershed — allowing for a real measure of success that might not be afforded elsewhere in the preserve. Similarly, with resting the grasslands comes the opportunity to evaluate recovery in terms of exotic encroachment and productivity in a setting where natural processes such as fire can be reintroduced at a landscape scale. In effect, such a watershed protection zone would not only lead to enhanced conditions for a major portion of the preserve, it would also play a role in fulfilling the science mandate in the enabling legislation for the preserve. A collateral benefit of an upper watershed protection zone would be the preservation and enhancement of habitats for several federal and state sensitive species known to the VCNP. The virgin forests and associated rocklands (felsenmeers) found along the rim country of the zone are prime habitats for the Jemez Mountain salamander and Goat Peak pika, and potentially the northern goshawk. In addition, the grasslands of the valles are important to Gunnison’s prairie dog, since their populations are significantly declining elsewhere within their range. The establishment of an upper watershed protection zone would be a step towards the long-term preservation of these species, and the avoidance of future conflicts over threatened and endangered species.

Figure 48. Valle Toledo (in the distance) and Valle de los Posos (mid-ground) would form the heart of the Jemez- San Antonio Upper Watershed Management Zone.

Redondo Peak Reserve

Redondo Peak is held sacred by the people of Walatowa and other local Native Americans and is a place requiring special management consideration (Figure 49). Hence, the enabling legislation of the VCNP specifically set aside the area on Redondo Peak above 10,000 ft for preserving the natural, cultural, religious, and historic resources on the mountain. While the 10,000 ft designation was an efficient way to demarcate the core of this site for legislative purposes, from an ecosystem perspective, the peak must include a wider area to ensure effective management at a landscape scale (Figure 47). Specifically, the patterns and processes of the lower elevations of the mountain cannot be divorced from what goes on at the summit, particularly with respect to fire (but also seed dispersal, wildlife movements, and the effects of fragmentation on forest health). Accordingly, we suggest delineation of a “reserve” area around the mountain that encompasses not only the high subalpine forest and montane grasslands but also the aspen and mixed conifer forests, and the montane shrublands of lower elevations along with the extensive rock fields or felsenmeers that make up the landscape mosaic of the mountain. At the same time, this suggested boundary captures the major hydrological features of the mountain, particularly the headwaters of La Jara Creek—the headquarters water supply, and similarly, much of the Redondo Creek watershed drinking supply. Through this landscape approach, management initiatives could effectively be applied to ensure the preservation of both the cultural heritage and biodiversity values of the mountain.

Figure 49. Looking south from Garita ridge, Redondo Peak towers in the distance over Redondo Border (mid-ground), and Cerro Seco and Valle San Antonio in the foreground.

DISCUSSION

There were two goals set for this project in its first year. One was to develop a vegetation community classification of the VCNP as a foundation for subsequent vegetation mapping and biological inventories, and the other was to provide an ecological assessment as a preamble for the development of an integrated natural resources management plan for the preserve. With respect to the former, using the data from 100 vegetation plots gathered during the summer of 2001, we have presented a broad outline of the vegetation pattern and ecology of the VCNP. The objective in 2003 is to build a high-resolution vegetation map that fully characterizes this pattern to aid future management prescriptions. The vegetation map will be based on the vegetation classification presented here and will be developed from high-resolution 1:12,000 scale aerial color photography in combination with satellite imagery. It will also be coordinated with vegetation maps being produced for the Bandelier National Monument, Los Alamos National Laboratory and the intervening USFS lands. We hope that such a unified vegetation approach will not only provide a landscape context for the VCNP, but also that it will foster interagency cooperation on natural resources management in general.

It is evident that the VCNP supports large occurrences of communities known for their rarity in the southern Rocky Mountain region—particularly montane grasslands and wetlands. In addition, the preserve contains some the largest tracts of virgin forest remaining in the Jemez Mountains, and is home to several rare species. Our intent in the ecological assessment was to not only point out these outstanding features of the preserve, but to also draw attention to some of the management issues that will need to be addressed in the planning process. The heterogeneity of the post-harvest landscape and the impacts of past grazing pose challenges that we suggest would be best met through an ecosystem approach that recognizes the role humans play in balancing biodiversity protection with sustainable resource extraction along with recreational and scenic values. We would recommend a strategy based on watershed protection that focuses on the services provided by the ecosystem to maintain productivity and health within a given landscape and to the downsteam users, particularly aquatic ecosystems. Through the reestablishment of ecosystem-level processes such as appropriate fire regimes and levels of grazing, coupled with an understanding of how water and nutrients flow, the long-term sustainability of the VCNP ecosystems can be ensured and appreciated by many generations to come.

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Appendix A

Field Forms

Examples follow of the field data sheets used for the Valles Caldera National Preserve Ecological Survey. These include the plot description, floristics, point intercept, and tree inventory forms along with the ecological assessment form used to evaluate conditions with a stand and the surrounding landscape. See the Methods section in the report for applications. In addition, the New Mexico Natural Heritage Program Field Vegetation Survey Manual is included in Data Addendum and contains the specific protocols for sampling.

NMNHP VEGETATION SURVEY—GENERAL PLOT DESCRIPTION FORM 2 (MAY 2002)

PLOT ID__________PLOT TYPE_____PROJECT_____________Subproject _____________ MO___DAY___YEAR_____
EO/PA____
EO/PA Comment____
____
SURVEY SITE____________________________________ SURVEYORS_________________________________
LOCATION/DIRECTIONS____
____
COUNTY______ NM/____ MAP NAME__________________ QUADCODE _ _ _ _ _ _ _ _ - _ MARGNUM___ 10,10 __,__
GPS Unit________________ GPS File____________ UTM:EASTING _ _ _ _ _ _ NORTHING _ _ _ _ _ _ _
PREC_____m Zone_____ Datum:☐NAD27☐/WGS84; Other__________________ T ____ R____ S ____ 4/S _____ 4/S ____
☐ **Mapping:____**
PLOTDIM(M)L/R ____W ____ Comments:____
☐ **Monument/:____**
☐ **Photo Pt:____/Cam Ht_______**
PP1: AZM_____FocLen____ Com_______________________ PP5: AZM_____FocLen____ Com_______________________
PP2: AZM_____FocLen____ Com_______________________ PP6: AZM_____FocLen____ Com_______________________
PP3: AZM_____FocLen____ Com_______________________ PP7: AZM_____FocLen____ Com_______________________
PP4: AZM_____FocLen____ Com_______________________ PP8: AZM_____FocLen____ Com_______________________
Other Site Photos/com:____
____
ELEV _________ ft. SLOPE _______% ASPECT________ SLOPE SHAPE_______________________________/______
LANDFORM:____/ __ __ __ __ __ __
Landform/Geology/Soil Comment____
SURFACE ROCK TYPE____/__________
Surface Soil Texture/Color________________________________ Soil Taxon/Map Unit__________________________
VEG/SITE SUMMARY:____
____
____
____
____
____
____
____
____
Adjacent Communities:____
____
____
Condition (Disturbance/Fragmentation):____
____
____
____
Disease:____
____
Animal Use Evidence:____
____
_____EO Size ☐HA ☐AC ☐ Ground Estimate ☐ Mapped Estimate Comments:_____________________________
_____EO Condition, Comments:____
_____EO Landscape Context, Comments:____
_____EO RANK ☐ Field/ ☐ Office Assignment / ☐ EO Assessment Form Completed
Management/Conservation/Other Comments:____
____
____
____
____
____
Forms: ☐ **Floristics** ☐ **Trees** ☐ **Soils** ☐ **Quadrats** ☐ **Point/Line Intercept** ☐ **Site Evaluation** (July 2002)

NMNHP VEGETATION SURVEY - Floristic Inventory

PLOT ID__________________ MO____ DAY ___ YEAR ______ Surveyors______________________________________
EO/PA____
Ground Surface Cover (%) Soil____ Grav____ Rock____ Liter_____ HCC_____ Wood_____Micro____ =100%

CIRCLE YOUR VOUCHER NUMBERS

Phenology: *=Flowering @=fruiting X=dead annual ☐ **Cover Scale or** ☐ **Percent Cover**

TREES Total Cov____%	**P**	**Cov**	**Ht**	**FORBS Total Cover____%**	**P**	**Cov**	**HT**
T1				**F1**			
T2				**F2**			
T3				**F3**			
T4				**F4**			
T5				**F5**			
T6				**F6**			
T7				**F7**			
T8				**F8**			
SHRUBS >.5m Total Cov____ %	**P**	**Cov**	**Ht**	**F9**			
S1				**F10**			
S2				**F11**			
S3				**F12**			
S4				**F13**			
S5				**F14**			
S6				**F15**			
S7				**F16**			
S8				**F17**			
S9				**F18**			
S10				**F19**			
S11				**F20**			
S12				**F21**			
DWARF SHRUBS < .5m Tot.Cov____ %	**P**	**Cov**	**Ht**	**F22**			
DS1				**F23**			
DS2				**F24**			
DS3				**F25**			
DS4				**F26**			
DS5				**F27**			
DS6				**F28**			
DS7				**F29**			
DS8				**F30**			
GRAMINOIDS Tot Cov____%; Green____%	**P**	**Cov**	**Ht**	**Additional Species**	**P.**	**Cov**	**Ht**
G1				___			
G2				___			
G3				___			
G4				___			
G5				___			
G6				___			
G7				___			
G8				___			
G9				___			
G10				___			
G11				___			
G12				___			
G13				___			
G14				___			
G15				**# of Spp. T___ S___ DS___ G___ F___ Tot_________**			

Tot.Cov.= Aerial non-overlapping cover by strata
Ht= species modal height (trees nearest m, shrubs nearest .5m, grasses & forbs nearest dm)

Cover Scale:
- **+0**=outside plot,in stand
- **+**=solitary/very few(<0.2m^2/400m^2)
- **1**=very scattered (0.2m^2 -<.5m/400m^2)
- **2**=scattered, <1% (.5m^2 & <4m^2)
- **3**=1-<5% (>4m^2 & <20m^2)
- **4**=5-<10%(>20m^2 & <40m^2)
- **5**=10-<25%(40m^2 & <100m^2)
- **6**=25-<33%(100m^2 & <132m^2)
- **7**=33-<50%
- **8**=50-<75%
- **9**=75-<95%
- **10**=95-100%

Percent Scale:
- **+0**=outside plot,in stand
- **+**=solitary/very few(<0.2m^2/400m^2)
- **0.1%**=very scattered (0.2m^2 -<.5m/400m^2)
- **0.5%**= scattered, <1% (.5m^2 & <4m^2)
- **1-10%** to the nearest 1% (each % equals 4m^2/400m^2)
- **10-30%** to the nearest 5%
- **30-100%** to nearest 10%

NMNHP Vegetation Survey - Transect Point Intercept Form

PLOTID__________________________ Surveyors __________________Date___________________

Line Length__________ Total # of Pts/Line __________________ Read Interval __________________

	Reader:				Reader:				SUMMARY			
	Line 1 – Start Pt:				**Line 2 –** Start Pt:				Tot Canopy	% Canopy	Tot BA	% BA
Code	Canopy Top	K	Basal	K	Canopy Top	K	Basal	K				
LITTER												
WOOD												
MICROPHY												
SOIL												
GRAVEL												
ROCK												
TOTAL												

Plot #___________________ **Date __________________** **Valles Caldera National Preserve Tree Inventory Form**

Species Code	0-2” <4.5’	0-2” >4.5’	2-4”	4-6”	6-8”	8-10”	10-12”	12-14”	14-16”	16-18”	18-20”	>20”
Stump → Snag →												

Tree Species	DBH	DCH	Core Age	Tree Height	Comment	Tree Species	DBH	DCH	Core Age	Tree Height	Comment

Element Occurrence Condition Evaluation -- NMNHP JULY 2001

PLOT ID __________________ Survey Site Name____________________________Dates_________________
Evaluator ___________________________ Evaluation Time ☐Brief (<5 min) ☐Moderate (5-30 min) ☐In depth

Condition	NA	A Rank	B Rank	C Rank	D Rank
Succession Stage	☐	☐ Old Growth	☐ Late Seral	☐ Mid Seral	☐ Early Seral
Microphytic Crusts	☐	☐ Well-established in protected areas and intersspaces	☐ Present in protected areas; minor in interspaces	☐ Disrupted; found only in protected areas	☐ Severely disrupted; absent or rare.
Herbaceous Litter Status	☐	☐ Significant, even accumulation over multiple growing seasons; multiple stages of decomposition (>4cm)	☐ Moderate, patchy accumulation; most stages of decomposition present (2-4 cm)	☐ Litter largely absent; majority of litter depth and % cover attributed to dead basal vegetation (1-2 cm)	☐ Absent or fould only the lee of obstructions (<1cm)
Erosion	☐	☐ Minimal; no excessive soil movement or litter movement; erosion features rare or absent.	☐ Slight; flow patterns stable; rills muted; active pedestals uncommon; vegetation present to stabilize slopes.	☐ Moderate; surface flw cuts common and interconnected; rills distinct; active pedestals with occasional exposed roots	☐ Severe; surface flw patterns extensive and unstable; rills well-defined; pedestals and exposed plant roots common; active down cutting.
Streambank Conditions	☐	☐ Streambanks well-vegetated and stable.	☐ Streambanks mostly vegetated and stable.	☐ Many streambanks unstable and poorly vegetated.	☐ Most streambanks unstable and poorly-vegetated.
Comments:					
Logging History	☐	☐ None ☐ Second growth >100 yrs	☐ 50-100 yrs ago Date________________	☐ 25- 50 years ago Date____________________	☐ <25 years ago Date____________________
Logging Tytpe	☐	☐ None	☐ Light Selective (5-25% removal)	☐ Moderate Selective ☐ 25%-50% ☐ 50%-75%	☐ Shelterwood/clearcut (>75% removal)
Logging Method	☐	☐ None	☐ Helicopter	☐ High-Lead	☐ Tractor
Forest Fire Fuel loads	☐	☐ Light fuel loads; little or no fire potential.	☐ Greater than normal fuel loads; possible fire potential.	☐ Moderate fuel loads representing a definite fire potential.	☐ Excessive fuel loads, catastrophic element-removing fire likely.
Fire Evidence	☐	☐ Recent fire evidence (<10 Yr)	☐ fire evidence (10-50 yr)	☐ fire evidence (50 yr-100 yr)	☐ fire evidence (>100 years) ☐ No fire Evidence
Comments:					
Agriculture	☐	☐ Untilled	☐ Very old field (>100 yr)	☐ Old Field (10-100 yr)	☐ Recent (<10 yr)
Livestock Use	☐	☐None	☐ Light; 5-25% cropping; no trails; little sign	☐ Moderate 25%- 75% cropping; Some trails present; some sign	☐ Heavy >75% cropping; many trails; heavy sign
Comments:					
Wildlife Use	☐	☐ None	☐ Light; 5-25% cropping; no trails; little sign	☐ Moderate Some trails present; some sign ☐ 25%- 50% cropping ☐ 50-75 cropping	☐ Heavy >75% cropping; many trails; heavy sign
Praire Dogs Towns	☐	☐ Very large active town	☐ Moderate, active town	☐ Small active town	☐ No town or inactive
Comments:					
Parasites and Disease	☐	☐ No detrimental parasitic species or evidence of disease.	☐ Few scattered parasites, limited disease indications.	☐ Moderate parasite infestation or disease indications.	☐ Intense parasite infestation or disease indications
Comments:					
Vehicle Use (Incl. ORVs)	☐	☐ None – no roads	Little use –roads and trails unused	moderate – active roads and trails	Heavy - many active roads and trails
Comments:					
Contaminants	☐	☐ No effects from toxic contaminants	☐ Contaminants known to be or have been present, but effects appear minimal.	☐ Contaminants known in the occurrence, with minor effects on species diversity, use and management .	☐ Contaminants known in the occurrence, significant effect on species diversity, and major effects on use and management .
Comments:					

APPENDIX B

Plant Species List

Plant species found on the VCNP as part of the vegetation survey by the NMNHP in 2001 and 2002. The two tables that follow are the same except for th eordering of species. Table B-1 is ordered by liform category then by scientific name. Table B-2 is ordered by lifeform then common name. Lifeform categories are: 1 = trees greater than 3 m; 2 = tall shrubs 0.5 to 3 m; 2.5 = woody sub-shrubs less than 0.5 m; 3 = grasses and graminoids (rushes, sedges, etc.), and 4 = herbaceous forbs. The scientific, common and family names, and wetland status follow the conventions of the USDA-NRCS (2003) PLANTS database as accessed on line at http://plants.usda.gov on February 8, 2003. “Species code” refers to the NMNHP seven-letter acronym in its database, and “Kartesz Symbol” refers to the five-letter acronym in the PLANTS database. “H” indicates if the species is referenced on the Hartman (2002) checklist for the VCNP. The “Comments” primarily refer to differences from Hartman (2002).

Table B-1. Plant species found on the VCNP as part of the vegetation survey by the NMNHP in 2001 and 2002 ordered by lifeform and scientific name.

LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
1	Abies concolor	white fir	Pinaceae	NI (FAC)	ABICON	ABCO	x	
1	Abies lasiocarpa var. arizonica	subalpine fir	Pinaceae	FACU+	ABILASA	ABLAA	x	Hartman uses: Abies arizonica
1	Acer glabrum	Rocky Mountain maple	Aceraceae	FAC (FACW)	ACEGLA	ACGL	x	Hartman specifies: var. glabrum
1	Alnus incana ssp. tenuifolia	thinleaf alder	Betulaceae	NI (OBL)	ALNINCT	ALINT	x	Hartman uses: Alnus incana var. occidentalis
1	Juniperus monosperma	oneseed juniper	Cupressaceae	NI (UPL)	JUNMON	JUMO		
1	Juniperus scopulorum	Rocky Mountain juniper	Cupressaceae	NI (UPL)	JUNSCO	JUSC2	x	
1	Picea engelmannii	Engelmann's spruce	Pinaceae	FAC-	PICENG	PIEN	x	Hartman specifies: var. engelmannii
1	Picea pungens	blue spruce	Pinaceae	FAC	PICPUN	PIPU	x	
1	Pinus edulis	pinyon pine	Pinaceae	NI (UPL)	PINEDU	PIED	x	
1	Pinus flexilis	limber pine	Pinaceae		PINFLE	PIFL2	x	
1	Pinus ponderosa	ponderosa pine	Pinaceae	NI (FACU)	PINPON	PIPO	x	Hartman specifies: var. scopulorum
1	Populus tremuloides	quaking aspen	Salicaceae	FACU (FAC)	POPTRE	POTR5	x	
1	Pseudotsuga menziesii	Douglas fir	Pinaceae	NI (FAC)	PSEMEN	PSME	x	Hartman specifies: var. glauca
1	Quercus gambelii	Gambel's oak	Fagaceae	NI (UPL)	QUEGAM	QUGA	x	
1	Robinia neomexicana	New Mexico locust	Fabaceae	NI (FACU)	ROBNEO	RONE	x	Hartman specifies: var. neomexicana
2	Amelanchier pumila	dwarf serviceberry	Rosaceae		AMEPUM	AMPU5	x	Hartman uses: Amelanchier alnifolia var. pumila
2	Berberis fendleri	Colorado barberry	Berberidaceae		BERFEN	BEFE	x	
2	Brickellia californica	California brickellbush	Asteraceae	FACU+	BRICAL	BRCA3	x	
2	Brickellia fendleri	Fendler's brickellbush	Asteraceae		BRIFEN	BRFE	x	
2	Ceanothus fendleri	Fendler's ceanothus	Rhamnaceae	NI (UPL)	CEAFEN	CEFE	x	
2	Cercocarpus montanus	mountain mahogany	Rosaceae	NI (UPL)	CERMON	CEMO2		
2	Holodiscus dumosus	rockspirea	Rosaceae	NI (UPL)	HOLDUM	HODU	x	Hartman specifies: var. dumosus
2	Jamesia americana	cliffbush	Hydrangeaceae		JAMAME	JAAM	x	Hartman specifies: var. americana
2	Juniperus communis	common juniper	Cupressaceae	NI (UPL)	JUNCOM	JUCO6	x	Hartman specifies: var. depressa
2	Lonicera involucrata	twinberry honeysuckle	Caprifoliaceae	FACU (FACW)	LONINV	LOIN5		
2	Pentaphylloides floribunda	shrubby cinquefoil	Rosaceae	FACW-	PENFLO	PEFL15	x	Hartman uses: Potentilla fruticosa
2	Philadelphus microphyllus	littleleaf mockorange	Hydrangeaceae		PHIMIC	PHMI4	x	
2	Physocarpus monogynus	mountain ninebark	Rosaceae	FACU	PHYMON	PHMO4	x	
2	Prunus virginiana	common chokecherry	Rosaceae	FAC (FACW)	PRUVIR	PRVI	x	Hartman specifies: var. melanocarpa
2	Ribes cereum	wax currant	Grossulariaceae	NI (FAC)	RIBCER	RICE	x	
2	Ribes leptanthum	trumpet gooseberry	Grossulariaceae	NI (FAC)	RIBLEP	RILE	x	
2	Rosa woodsii	Woods' rose	Rosaceae		ROSWOO	ROWO		Hartman has Rosa nutkana (not a synonym)
2	Rubus idaeus	Red Raspberry	Rosaceae		RUBIDA	RUID	x	
2	Rubus parviflorus	thimbleberry	Rosaceae	NI (FAC)	RUBPAR	RUPA	x	
2	Salix bebbiana	Bebb willow	Salicaceae	FACW	SALBEB	SABE2	x	

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
2	Sambucus racemosa	scarlet elderberry	Caprifoliaceae	FACU (FACW)	SAMRAC	SARA2	x	Hartman specifies: var. microbotrys
2	Shepherdia canadensis	russet buffaloberry	Elaeagnaceae		SHECAN	SHCA		
2	Symphoricarpos oreophilus	whortleleaf snowberry	Caprifoliaceae	NI (UPL)	SYMORE	SYOR2		
2	Yucca baccata	banana yucca	Agavaceae		YUCBAC	YUBA	x	
2.5	Arctostaphylos uva-ursi	kinnikinnick	Ericaceae		ARCUVA	ARUV	x	Hartman specifies: var. adenotricha
2.5	Artemisia frigida	fringed sagewort	Asteraceae	NI (FACU)	ARTFRI	ARFR4	x	
2.5	Betula pumila var. glandulifera	bog birch	Betulaceae		BETGLA	BEPUG		Hartman has Betula occidentalis (not a synonym)
2.5	Echinocereus coccineus	scarlet hedgehog cactus	Cactaceae		ECHCOC	ECCO5		
2.5	Echinocereus triglochidiatus	kingcup cactus	Cactaceae		ECHTRI	ECTR		
2.5	Escobaria tuberculosa	whitecolumn foxtail cactus	Cactaceae		ESCTUB	ESTU		NMNHP voucher being confirmed
2.5	Heterotheca villosa	hairy goldenaster	Asteraceae		HETVIL	HEVI4	x	Hartman specifies: var. nana
2.5	Mahonia repens	Oregongrape	Berberidaceae	NI (UPL)	MAHREP	MARE11	x	
2.5	Paxistima myrsinites	myrtle boxleaf	Celastraceae	NI (FACU)	PAXMYR	PAMY	x	
2.5	Pyrola chlorantha	greenflowered wintergreen	Pyrolaceae		PYRCHL	PYCH	x	Hartman uses Ericaceae
2.5	Vaccinium myrtillus	whortleberry	Ericaceae		VACMYR	VAMY2	x	
3	Agrostis gigantea	redtop	Poaceae	FACW+	AGRGIG	AGGI2		
3	Agrostis scabra	rough bentgrass	Poaceae		AGRSCA	AGSC5	x	Hartman specifies: var. scabra
3	Alopecurus aequalis	shortawn foxtail	Poaceae	OBL	ALOAEQ	ALAE	x	Hartman specifies: var. aequalis
3	Blepharoneuron tricholepis	pine dropseed	Poaceae		BLETRI	BLTR	x	
3	Bouteloua gracilis	blue grama	Poaceae	NI (UPL)	BOUGRA	BOGR2	x	Hartman specifies: var. gracilis
3	Bromus anomalus	nodding brome	Poaceae		BROANO	BRAN	x	
3	Bromus carinatus	California brome	Poaceae	NI (FACU)	BROCAR	BRCA5	x	
3	Bromus ciliatus	fringed brome	Poaceae	FAC	BROCIL	BRCI2	x	
3	Calamagrostis canadensis	Canada reedgrass	Poaceae	OBL	CALCAN	CACA4	x	Hartman specifies: var. canadensis
3	Calamagrostis stricta	slimstem reedgrass	Poaceae		CALSTR	CAST36		NMNHP voucher being confirmed
3	Calamagrostis stricta var. inexpansa	northern reedgrass	Poaceae		CALSTRI			NMNHP voucher being confirmed
3	Carex aquatilis	water sedge	Cyperaceae	OBL	CARAQU	CAAQ	x	Hartman specifies: var. aquatilis
3	Carex foenea	dryspike sedge	Cyperaceae	NI (FACW)	CARFOE		x	Hartman specifies: var. foenea
3	Carex geophila	White Mountain sedge	Cyperaceae	NI (FACW)	CARGEO	CAGE	x	
3	Carex inops ssp. heliophila	sun sedge	Cyperaceae		CARINOH	CAINH2	x	Hartman uses: Carex pensylvanica var. digyna
3	Carex lanuginosa	woolly sedge	Cyperaceae	OBL	CARLAN	CALA30	x	
3	Carex microptera	smallwing sedge	Cyperaceae	FACW	CARMIC	CAMI7	x	Hartman specifies: var. microptera
3	Carex obtusata	obtuse sedge	Cyperaceae		CAROBT	CAOB4		
3	Carex occidentalis	western sedge	Cyperaceae	NI (FACW)	CAROCC	CAOC2	x	

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
3	Carex rossii	Ross' sedge	Cyperaceae		CARROS	CARO5		
3	Carex rostrata	beaked sedge	Cyperaceae	OBL	CARROS2	CARO6		
3	Carex utriculata	Northwest Territory sedge	Cyperaceae		CARUTR	CAUT	x	
3	Cinna latifolia	drooping woodreed	Poaceae		CINLAT	CILA2	x	
3	Cyperus fendlerianus	Fendler's flatsedge	Cyperaceae	FAC	CYPFEN	CYFE2	x	
3	Danthonia parryi	Parry's Danthonia	Poaceae		DANPAR	DAPA2	x	
3	Deschampsia cespitosa	tufted hairgrass	Poaceae	FACW-	DESCES	DECE	x	
3	Eleocharis acicularis	needle spikerush	Cyperaceae		ELEACI	ELAC	x	
3	Eleocharis palustris	common spikerush	Cyperaceae	OBL	ELEPAL	ELPA3	x	
3	Eleocharis quinqueflora	fewflower spikerush	Cyperaceae		ELEQUI	ELQU2		
3	Elymus elymoides	bottlebrush squirreltail	Poaceae	NI (FACU)	ELYELY	ELEL5	x	Hartman specifies: var. brevifolius and var. elymoides
3	Elymus trachycaulus	slender wheatgrass	Poaceae	FAC	ELYTRA	ELTR7	x	Hartman specifies: var. trachycaulus
3	Elymus trachycaulus ssp. subsecundus	bearded wheatgrass	Poaceae		ELYTRAS	ELTRS	x	Hartman uses: E. trachycaulus var. andinus
3	Elymus x pseudorepens	false quackgrass	Poaceae	NI (FAC)	ELYPSE	ELPS		
3	Festuca arizonica	Arizona fescue	Poaceae	NI (FACU)	FESARI	FEAR2	x	
3	Festuca idahoensis	Idaho fescue	Poaceae		FESIDA	FEID	x	Hartman specifies: var. idahoensis
3	Festuca sororia	ravine fescue	Poaceae		FESSOR	FESO	x	
3	Festuca thurberi	Thurber's fescue	Poaceae		FESTHU	FETH	x	
3	Glyceria borealis	northern mannagrass	Poaceae	OBL	GLYBOR	GLBO	x	
3	Hordeum brachyantherum	meadow barley	Poaceae	FAC*	HORBRA	HOBR2	x	
3	Hordeum jubatum	foxtail barley	Poaceae	NI (FAC)	HORJUB	HOJU	x	
3	Juncus balticus	Baltic rush	Juncaceae	OBL	JUNBAL	JUBA	x	Hartman uses: Juncus arcticus var. balticus
3	Juncus dudleyi	slender rush	Juncaceae	FACW-	JUNDUD	JUDU2	x	
3	Juncus ensifolius	swordleaf rush	Juncaceae		JUNENS	JUEN	x	Hartman specifies: var. montanus
3	Juncus interior	inland rush	Juncaceae		JUNINT	JUIN2	x	
3	Juncus longistylis	longstyle rush	Juncaceae	FACW	JUNLON	JULO	x	
3	Koeleria macrantha	prairie junegrass	Poaceae	NI (UPL)	KOEMAC	KOMA	x	
3	Lycurus setosus	bristly wolfstail	Poaceae		LYCSET	LYSE3		NMNHP voucher being confirmed
3	Melica porteri	Porter's melicgrass	Poaceae	NI (UPL)	MELPOR	MEPO	x	
3	Muhlenbergia andina	foxtail muhly	Poaceae		MUHAND	MUAN		
3	Muhlenbergia filiformis	pullup muhly	Poaceae		MUHFIL			
3	Muhlenbergia montana	mountain muhly	Poaceae		MUHMON	MUMO	x	
3	Muhlenbergia richardsonis	Mat muhly	Poaceae		MUHRIC	MURI	x	
3	Muhlenbergia wrightii	spike muhly	Poaceae		MUHWRI	MUWR	x	
3	Oryzopsis asperifolia	roughleaf ricegrass	Poaceae		ORYASP	ORAS	x	

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
3	Oryzopsis hymenoides	Indian ricegrass	Poaceae	FACU-	ORYHYM	ORHY		NMNHP voucher being confirmed
3	Pascopyrum smithii	western wheatgrass	Poaceae	NI (FACU)	PASSMI	PASM	x	Hartman use: Elymus smithii
3	Phleum alpinum	alpine timothy	Poaceae		PHLALP	PHAL2	x	Hartman specifies: var. alpinum
3	Phleum pratense	timothy	Poaceae	FACU	PHLPRA	PHPR3	x	Hartman specifies: var. pratense
3	Poa compressa	Canada bluegrass	Poaceae	FACU	POACOM	POCO	x	
3	Poa fendleriana	muttongrass	Poaceae	NI (FACU)	POAFEN	POFE	x	
3	Poa palustris	fowl bluegrass	Poaceae	FAC	POAPAL	POPA2	x	
3	Poa pratensis	Kentucky bluegrass	Poaceae	FACU	POAPRA	POPR	x	
3	Schizachyrium scoparium	little bluestem	Poaceae	FACU	SCHSCO	SCSC	x	Hartman specifies: var. scoparium
3	Stipa lettermannii	Letterman's needlegrass	Poaceae	NI (UPL)	STILET	STLE4	x	
3	Torreyochloa pallida var. pauciflora	pale false mannagrass	Poaceae		TORPALP	TOPAP3	x	
3	Triglochin palustre	marsh arrowgrass	Juncaginaceae	OBL	TRIPAL	TRPA6		
3	Trisetum montanum	Rocky Mountain trisetum	Poaceae		TRIMON	TRMO5	x	Hartman specifies: var. montanum
4	Achillea millefolium	common yarrow	Asteraceae	FACU	ACHMIL	ACMI2	x	Hartman spcifies: var. lanulosa
4	Achillea millefolium var. occidentalis	yarrow	Asteraceae	FACU	ACHMILO	ACMIO		
4	Aconitum columbianum	Columbian monkshood	Ranunculaceae	FACW	ACOCOL	ACCO4	x	Hartman specifies: var. columbianum
4	Actaea rubra	red baneberry	Ranunculaceae	FACW	ACTRUB	ACRU2	x	
4	Agoseris aurantica	orange agoseris	Asteraceae		AGOAUR	AGAU2	x	
4	Allium cernuum	nodding onion	Liliaceae	NI (FACU)	ALLCER	ALCE2	x	
4	Allium cernuum var. neomexicanum	New Mexican nodding onion	Liliaceae		ALLCERN	ALCEN		
4	Allium geyeri	Geyer's onion	Liliaceae	NI (FACU)	ALLGEY	ALGE	x	Hartman specifies: var. geyeri
4	Amaranthus hybridus	slim amaranth	Amaranthaceae		AMAHYB	AMHY	x	
4	Androsace septentrionalis	pygmyflower rockjasmine	Primulaceae		ANDSEP	ANSE4	x	
4	Antennaria parvifolia	smallleaf pussytoes	Asteraceae	NI (UPL)	ANTPAR	ANPA4	x	
4	Aquilegia coerulea	Colorado columbine	Ranunculaceae	FACW-	AQUCOE	AQCO	x	Hartman specifies: var. coerulea
4	Aquilegia elegantula	western red columbine	Ranunculaceae		AQUELE	AQEL	x	
4	Arabis drummondii	Drummond's rockcress	Brassicaceae	FACU	ARADRU	ARDR	x	
4	Arabis hirsuta	hairy rockcress	Brassicaceae		ARAHIR	ARHI		
4	Arabis hirsuta var. pycnocarpa	creamflower rockcress	Brassicaceae		ARAHIRP	ARHIP	x	
4	Arabis perennans	perennial rockcress	Brassicaceae		ARAPER	ARPE2	x	
4	Arenaria fendleri	Fendler's sandwort	Caryophyllaceae		AREFEN	ARFE3		
4	Arenaria fendleri var. fendleri	Fendler's sandwort	Caryophyllaceae		AREFENF	ARFEF3	x	
4	Arenaria lanuginosa	spreading sandwort	Caryophyllaceae	FACU,FAC	ARELAN	ARLA4		

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	Arenaria lanuginosa ssp. saxosa	spreading sandwort	Caryophyllaceae		ARELANS	ARLAS	x	Hartman uses: A. lanuginosa var. cinerascens
4	Argentina anserina	silverweed cinquefoil	Rosaceae	OBL	ARGANS	ARAN7	x	Hartman uses: Potentilla anserina
4	Artemisia campestris	field sagewort	Asteraceae	FAC	ARTCAM	ARCA12		
4	Artemisia campestris ssp. pacifica	Pacific wormwood	Asteraceae		ARTCAMP	ARCAP2	x	
4	Artemisia carruthii	Carruth's sagewort	Asteraceae	NI (FAC)	ARTCAR	ARCA14	x	
4	Artemisia franserioides	ragweed sagebrush	Asteraceae		ARTFRA	ARFR3	x	
4	Artemisia ludoviciana	Louisiana sagewort	Asteraceae	NI (FACU)	ARTLUD	ARLU	x	Hartman specifies: var. ludoviciana
4	Artemisia ludoviciana ssp. mexicana	Mexican white sagebrush	Asteraceae	NI (FAC)	ARTLUDM	ARLUM2		
4	Bahia dissecta	ragleaf bahia	Asteraceae		BAHDIS	BADI	x	
4	Bidens tripartita	threelobe beggarticks	Asteraceae		BIDTRI	BITR		
4	Calochortus gunnisonii	Gunnison's Mariposa lily	Liliaceae		CALGUN	CAGU	x	Hartman specifies: var. gunnisonii
4	Campanula parryi	Parry's bellflower	Campanulaceae	FAC-	CAMPAR	CAPA10	x	Hartman specifies: var. parryi
4	Campanula rotundifolia	bluebell bellflower	Campanulaceae	FAC	CAMROT	CARO2	x	
4	Capsella bursa-pastoris	shepherd's purse	Brassicaceae	UPL	CAPBUR		x	
4	Castilleja miniata	scarlet Indian paintbrush	Scrophulariaceae	FACU	CASMIN	CAMI12	x	Hartman specifies: var. miniata
4	Cerastium arvense	mouseear chickweed	Caryophyllaceae	FACW	CERARV	CEAR4	x	
4	Cerastium fontanum ssp. vulgare	big chickweed	Caryophyllaceae		CERFONV	CEFOV2	x	
4	Chamaesyce serpyllifolia	thymeleaf sandmat	Euphorbiaceae	NI (FACU)	CHASER2	CHSE6	x	
4	Chenopodium atrovirens	pinyon goosefoot	Chenopodiaceae		CHEATR	CHAT	x	
4	Chenopodium graveolens	fetid goosefoot	Chenopodiaceae		CHEGRA	CHGR2	x	
4	Chenopodium leptophyllum	narrowleaf goosefoot	Chenopodiaceae		CHELEP	CHLE4	x	
4	Chenopodium neomexicanum	New Mexico goosefoot	Chenopodiaceae		CHENEO	CHNE3		
4	Chenopodium simplex	mapleleaf goosefoot	Chenopodiaceae		CHESIM	CHSI2		
4	Cirsium parryi	Parry's thistle	Asteraceae		CIRPAR	CIPA	x	
4	Cirsium wheeleri	Wheeler's thistle	Asteraceae		CIRWHE	CIWH		NMNHP voucher being confirmed
4	Clematis columbiana	rock clematis	Ranunculaceae		CLECOL	CLCO2	x	Hartman specifies: var. tenuiloba
4	Collomia linearis	tiny trumpet	Polemoniaceae		COLLIN	COLI2	x	
4	Commelina dianthifolia	birdbill dayflower	Commelinaceae		COMDIA	CODI4	x	
4	Conioselinum scopulorum	Rocky Mountain hemlockparsley	Apiaceae		CONSCO	COSC2	x	
4	Corallorrhiza maculata	summer coralroot	Orchidaceae		CORMAC	COMA4	x	
4	Corydalis aurea	golden smoke	Fumariaceae	NI (FACU)	CORAUR	COAU2	x	Hartman specifies: var. aurea
4	Crepis runcinata	fiddleleaf hawksbeard	Asteraceae		CRERUN	CRRU3	x	Hartman specifies: var. runcinata
4	Cystopteris fragilis	brittle bladderfern	Dryopteridaceae	FACU+ (FACW)	CYSFRA	CYFR2	x	

Table B-1. Plant species found on the VCNP as part of the vegetation survey by the NMNHP in 2001 and 2002 ordered by lifeform and scientific name.

LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	Descurainia incana ssp. incisa	mountain tanseymustard	Brassicaceae	NI (FAC)	DESINCI	DEINI2		Hartman uses: D. incana var. macrosperma
4	Descurainia incana ssp. viscosa	mountain tansymustard	Brassicaceae		DESINCV	DEINV	x	Hartman uses: D. incana var. viscosa
4	Draba aurea	golden draba	Brassicaceae		DRAAUR	DRAU	x	
4	Draba helleriana	Heller's draba	Brassicaceae		DRAHEL	DRHE	x	Hartman specifies: var. helleriana
4	Draba rectifructa	mountain draba	Brassicaceae		DRAREC	DRRE		
4	Epilobium angustifolium	fireweed	Onagraceae		EPIANG	EPAN2		
4	Epilobium ciliatum	hairy willowherb	Onagraceae	FACW	EPICIL	EPCI	x	Hartman specifies: var. ciliatum
4	Epilobium leptophyllum	bog willowherb	Onagraceae		EPILEP	EPLE2		
4	Epilobium spp. (depauperate)	willowherb	Onagraceae	FACW	EPILOB	EPILO		
4	Equisetum arvense	field horsetail	Equisetaceae	FACW- (FACW)	EQUARV	EQAR	x	
4	Erigeron divergens	spreading fleabane	Asteraceae	NI (FAC-)	ERIDIV	ERDI4	x	Hartman specifies: var. divergens
4	Erigeron eximius	sprucefir fleabane	Asteraceae		ERIEXI	EREX4	x	
4	Erigeron flagellaris	trailing fleabane	Asteraceae	FAC-	ERIFLA	ERFL	x	
4	Erigeron formosissimus	beautiful fleabane	Asteraceae		ERIFOR	ERFO3	x	
4	Erigeron lonchophyllus	shortray fleabane	Asteraceae		ERILON	ERLO		
4	Erigeron speciosus	aspen fleabane	Asteraceae	NI (FAC)	ERISPE	ERSP4	x	
4	Erigeron subtrinervis	threenerve fleabane	Asteraceae		ERISUB	ERSU2	x	Hartman specifies: var. subtrinervis
4	Eriogonum racemosum	redroot buckwheat	Polygonaceae		ERIRAC	ERRA3	x	Hartman specifies: var. racemosum
4	Erodium cicutarium	redstem stork's bill	Geraniaceae	NI (UPL)	EROCIC	ERCI6	x	
4	Erysimum capitatum	sanddune wallflower	Brassicaceae	NI (UPL)	ERYCAP	ERCA14	x	Hartman specifies: var. capitatum
4	Fragaria vesca	woodland strawberry	Rosaceae		FRAVES	FRVE		Hartman has: Fragaria virginiana (not a synonym)
4	Fragaria vesca ssp. americana	woodland strawberry	Rosaceae	NI (FACU)	FRAVESA	FRVEA2		
4	Galium aparine	stickywilly	Rubiaceae	FACU (FAC)	GALAPA	GAAP2	x	Hartman specifies: var. echinospermum
4	Galium boreale	Northern bedstraw	Rubiaceae	FAC-	GALBOR	GABO2	x	
4	Gentiana affinis	pleated gentian	Gentianaceae		GENAFF	GEAF		
4	Gentianella amarella ssp. acuta	autumn dwarf gentian	Gentianaceae		GENAMAA	GEAMA	x	
4	Gentianopsis thermalis	Rocky Mountain fringedgentian	Gentianaceae		GENTHE	GETH		
4	Geranium caespitosum	pineywoods geranium	Geraniaceae	NI (FAC)	GERCAE	GECA3	x	Hartman specifies: var. caespitosum and var. fremontii
4	Geranium richardsonii	Richardson's geranium	Geraniaceae	FAC	GERRIC	GERI	x	
4	Geum macrophyllum	largeleaf avens	Rosaceae	FACW	GEUMAC	GEMA4	x	Hartman specifies: var. perincisum
4	Geum triflorum	old man whiskers	Rosaceae	FAC	GEUTRI	GETR	x	Hartman specifies: var. ciliatum
4	Gnaphalium exilifolium	slender cudweed	Asteraceae		GNAEXI	GNEX	x	
4	Goodyera oblongifolia	western rattlesnake plantain	Orchidaceae		GOOOBL	GOOB2	x	

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	Goodyera repens	lesser rattlesnake plantain	Orchidaceae		GOOREP	GORE2	x	
4	Heliomeris multiflora	showy goldeneye	Asteraceae	NI (UPL)	HELMUL	HEMU3	x	Hartman uses: Viguiera multiflora var. multiflora
4	Hieracium fendleri	yellow hawkweed	Asteraceae		HIEFEN	HIFE	x	Hartman specifies: var. fendleri
4	Humulus lupulus var. neomexicanus	common hop	Cannabaceae		HUMLUPN	HULUN	x	
4	Hydrophyllum fendleri	Fendler's waterleaf	Hydrophyllaceae	FACW	HYDFEN	HYFE	x	Hartman specifies: var. fendleri
4	Hymenopappus newberryi	Newberry's hymenopappus	Asteraceae		HYMNEW	HYNE	x	
4	Hymenoxys hoopesii	Orange sneezeweed	Asteraceae	FAC+	HYMHOO	HYHO	x	
4	Hymenoxys richardsonii	pingue hymenoxys	Asteraceae	NI (UPL)	HYMRIC	HYRI	x	Hartman specifies: var. floribunda
4	Hypericum scouleri	Scouler's St. Johnswort	Clusiaceae	NI (FAC)	HYPSCO	HYSC5		
4	Hypericum scouleri ssp. nortoniae	Norton's St. Johnswort	Clusiaceae		HYPSCON	HYSCN		
4	Ipomopsis aggregata	skyrocket gilia	Polemoniaceae	NI (FACU)	IPOAGG	IPAG	x	Hartman specifies: subsp. formosissima
4	Iris missouriensis	Rocky Mountain iris	Iridaceae	FACW	IRIMIS	IRMI	x	
4	Lactuca serriola	prickly lettuce	Asteraceae	FAC	LACSER	LASE	x	
4	Lappula occidentalis	flatspine stickseed	Boraginaceae	NI (UPL)	LAPOCC	LAOC3	x	
4	Lepidium densiflorum	common pepperweed	Brassicaceae		LEPDEN	LEDE		
4	Lepidium ramosissimum	manybranched pepperweed	Brassicaceae		LEPRAM	LERA2	x	Hartman specifies: var. bourgeauanum
4	Linum lewisii	prairie flax	Linaceae		LINLEW	LILE3	x	Hartman specifies: var. lewisii
4	Lithospermum multiflorum	manyflowered gromwell	Boraginaceae	NI (UPL)	LITMUL	LIMU3	x	
4	Lotus wrightii	Wright's deervetch	Fabaceae	NI (FACU)	LOTWRI	LOWR	x	
4	Lupinus argenteus	silvery lupine	Fabaceae	UPL	LUPARG	LUAR3	x	Hartman specifies: var. argophyllus and var. fulvomaculatus
4	Lycopodium annotinum	clubmoss	Lycopodiaceae		LYCANN	LYAN2		
4	Madia glomerata	mountain tarweed	Asteraceae		MADGLO	MAGL2	x	
4	Maianthemum racemosum ssp. amplexicaule	feathery false Solomon's seal	Liliaceae	FACU- (FACW)	MAIRACA	MARAA	x	
4	Maianthemum stellatum	starry false Solomon's seal	Liliaceae	FACU (FACW)	MAISTE	MAST4		
4	Matricaria discoidea	disc mayweed	Asteraceae		MATDIS	MADI6		
4	Mentha arvensis	wild mint	Lamiaceae	FACW	MENARV	MEAR4	x	
4	Mertensia franciscana	Franciscan bluebells	Boraginaceae	FACW	MERFRA	MEFR2	x	
4	Mertensia lanceolata	prairie bluebells	Boraginaceae		MERLAN	MELA3	x	
4	Mimulus guttatus	seep monkeyflower	Scrophulariaceae	OBL	MIMGUT	MIGU	x	Hartman specifies: var. guttatus
4	Mirabilis decipiens	broadleaf four o'clock	Nyctaginaceae		MIRDEC	MIDE5		NMNHP voucher being confirmed

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	Mirabilis oxybaphoides	smooth spreading four o'clock	Nyctaginaceae		MIROXY	MIOX		NMNHP voucher being confirmed
4	Monotropa hypopithys	Pinesap	Monotropaceae		MONHYP	MOHY3	x	Hartman uses Ericaceae family
4	Oenothera caespitosa	tufted eveningprimrose	Onagraceae		OENCAE	OECA10		
4	Oenothera flava	yellow eveningprimrose	Onagraceae		OENFLA	OEFL	x	
4	Oreochrysum parryi	Parry's goldenrod	Asteraceae		OREPAR	ORPA3	x	
4	Orobanche ludoviciana	Louisiana broomrape	Orobanchaceae	NI (UPL)	OROLUD	ORLU		
4	Orthila secunda	sidebells wintergreen	Pyrolaceae		ORTSEC	ORSE	x	Hartman uses Ericaceae family
4	Orthocarpus luteus	yellow owlclover	Scrophulariaceae		ORTLUT	ORLU2	x	
4	Osmorhiza depauperata	bluntseed sweetroot	Apiaceae		OSMDEP	OSDE	x	
4	Oxalis violacea	violet woodsorrel	Oxalidaceae		OXAVIO	OXVI	x	
4	Oxypolis fendleri	Fendler's cowbane	Apiaceae	FACW	OXYFEN	OXFE	x	
4	Packera dimorphophylla ssp. dimorphophylla	splitleaf groundsel	Asteraceae		PACDIMD	PADID2		
4	Packera fendleri	Fendler's ragwort	Asteraceae		PACFEN	PAFE4	x	
4	Pedicularis procera	giant lousewort	Scrophulariaceae	FACU (FACW)	PEDPRO	PEPR7	x	
4	Penstemon barbatus	beardlip penstemon	Scrophulariaceae	NI (UPL)	PENBAR	PEBA2	x	Hartman specifies: var. trichander
4	Penstemon rydbergii	Rydberg's penstemon	Scrophulariaceae		PENRYD	PERY	x	Hartman specifies: var. rydbergii
4	Penstemon whippleanus	Whipple's penstemon	Scrophulariaceae		PENWHI	PEWH	x	
4	Phacelia heterophylla	varileaf phacelia	Hydrophyllaceae		PHAHET	PHHE2	x	Hartman specifies: var. heterophylla
4	Plantago major	common plantain	Plantaginaceae	FACW	PLAMAJ	PLMA2	x	Hartman specifies: var. major
4	Polemonium foliosissimum	towering Jacobsladder	Polemoniaceae	FAC	POLFOL	POFO	x	
4	Polygonum amphibium	water knotweed	Polygonaceae	OBL	POLAMP	POAM8	x	Hartman specifies: var. stipulaceum
4	Polygonum douglasii	Douglas' knotweed	Polygonaceae	NI (FACU)	POLDOU	PODO4	x	Hartman specifies: var. douglasii
4	Polygonum erectum	erect knotweed	Polygonaceae		POLERE	POER2		
4	Polygonum persicaria	Lady's thumb	Polygonaceae	FACW+	POLPER	POPE3		
4	Potamogeton nodosus	longleaf pondweed	Potamogetonaceae		POTNOD	PONO2	x	
4	Potentilla hippiana	woolly cinquefoil	Rosaceae		POTHIP	POHI6	x	Hartman specifies: var. hippiana
4	Potentilla norvegica	Norwegian cinquefoil	Rosaceae	FAC	POTNOR	PONO3	x	Hartman specifies: subsp. monspeliensis
4	Potentilla pensylvanica	Pennsylvania cinquefoil	Rosaceae		POTPEN	POPE8	x	Hartman specifies: var. pensylvanica
4	Potentilla pulcherrima	beautiful cinquefoil	Rosaceae	NI (FACW)	POTPUL	POPU9		
4	Prunella vulgaris	common selfheal	Lamiaceae	FACW-	PRUVUL	PRVU	x	
4	Pseudocymopterus montanus	alpine false springparsley	Apiaceae	NI (FAC)	PSEMON	PSMO	x	Hartman uses: Cymopterus lemmonii
4	Pseudognaphalium macounii	Macoun's cudweed	Asteraceae		PSEMAC	PSMA11	x	Hartman uses: Pseudognaphalium viscosum
4	Pseudostellaria jamesiana	tuber starwort	Caryophyllaceae	NI (FACW)	PSEJAM	PSJA2	x	
4	Pteridium aquilinum	western brackenfern	Dennstaestiaceae	FACU	PTEAQU	PTAQ	x	Hartman specifies: var. pubescens
4	Pterospora andromedea	woodland pinedrops	Monotropaceae		PTEAND	PTAN2	x	Hartman uses Ericaceae family

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	Ranunculus cardiophyllus	heartleaf buttercup	Ranunculaceae	OBL	RANCAR	RACA4	x	
4	Ranunculus longirostris	longbeak buttercup	Ranunculaceae		RANLON	RALO2		
4	Ranunculus spp. (depauperate)	buttercup	Ranunculaceae	FACW	RANUNC	RANUN		
4	Rorippa curvipes	bluntleaf yellowcress	Brassicaceae		RORCUR	ROCU2		
4	Rorippa nasturtium-aquaticum	watercress	Brassicaceae	OBL	RORNAS	RONA2		
4	Rorippa sphaerocarpa	roundfruit yellowcress	Brassicaceae	OBL	RORSPH	ROSP4	x	
4	Rudbeckia hirta	black-eyed Susan	Asteraceae	FACU	RUDHIR	RUHI2	x	Hartman specifies: var. pulcherrima
4	Rudbeckia laciniata	cutleaf coneflower	Asteraceae	FACW- (FACW)	RUDLAC	RULA3	x	Hartman specifies: var. ampla
4	Rumex acetosella	common sheep sorrel	Polygonaceae	FACW	RUMACE	RUAC3	x	
4	Rumex crispus	curly dock	Polygonaceae	FACW	RUMCRI	RUCR	x	
4	Sagittaria cuneata	arumleaf arrowhead	Alismataceae	OBL	SAGCUN	SACU	x	
4	Saxifraga rhomboidea	diamondleaf saxifrage	Saxifragaceae		SAXRHO	SARH2	x	
4	Scutellaria drummondii	Drummond's skullcap	Lamiaceae		SCUDRU	SCDR2		
4	Senecio atratus	tall blacktip ragwort	Asteraceae		SENATR	SEAT	x	
4	Senecio bigloviii	nodding ragwort	Asteraceae	NI (UPL)	SENBIG	SEBI2	x	Hartman specifies: var. bigelovii and var. halli
4	Senecio eremophilus	desert groundsel	Asteraceae		SENERE	SEER2	x	Hartman specifies: var. kingii
4	Senecio wootonii	Wooton's ragwort	Asteraceae	NI (FAC)	SENWOO	SEWO	x	
4	Sidalacea candida	white checkermallow	Malvaceae	FAC (FACW)	SIDCAN	SICA3	x	Hartman specifies: var. candida
4	Silene drummondii	Drummond's campion	Caryophyllaceae		SILDRU	SIDR	x	Hartman specifies: var. drummondii
4	Silene scouleri	Scouler's campion	Caryophyllaceae		SILSCO	SISCP		
4	Silene scouleri ssp. pringlei	Pringle's campion	Caryophyllaceae	NI (FACW)	SILSCOP	SISCP	x	
4	Sisyrinchium montanum	mountain blue-eyed grass	Iridaceae	FACW	SISMON	SIMO2	x	
4	Solidago missouriensis	Missouri goldenrod	Asteraceae		SOLMIS	SOMI2		NMNHP voucher being confirmed
4	Sonchus asper	spiny sowthistle	Asteraceae	NI (FACW)	SONASP	SOAS		NMNHP voucher being confirmed; Hartman has S. arvensis (not a synonym)
4	Sparganium angustifolium	narrowleaf burreed	Sparganiaceae		SPAANG	SPAN2	x	
4	Spiranthes romanzoffiana	hooded ladies tresses	Orchidaceae	OBL	SPIROM	SPRO		
4	Stellaria longifolia	longleaf starwort	Caryophyllaceae	FAC (FACW)	STELON1	STLO	x	
4	Symphyotrichum ascendens	western aster	Asteraceae		SYMASC	SYAS3	x	Hartman uses: Aster ascendens
4	Symphyotrichum falcatum var. commutatum	Cluster aster	Asteraceae		SYMFALC	SYFAC		
4	Symphyotrichum laeve var. geyeri	Geyer's aster	Asteraceae		SYMLAEG	SYLAG		Hartman use: Aster laevis var. laevis
4	Taraxacum officinale	common dandelion	Asteraceae	FACU	TAROFF	TAOF	x	Hartman has: Taraxacum laevigatum (not a synonym)
4	Thalictrum fendleri	Fendler's meadowrue	Ranunculaceae	FACU-	THAFEN	THFE	x	

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LF	Species Name	COMNAME	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	Thermopsis montana var. montana	mountain goldenbanner	Fabaceae		THEMONM	THMOM3	x	
4	Tragopogon dubius	yellow salsify	Asteraceae		TRADUB	TRDU	x	
4	Trifolium repens	white clover	Fabaceae	NI (FAC)	TRIREP	TRRE3	x	
4	Trifolium wormskioldii	cows clover	Fabaceae		TRIWOR	TRWO	x	Hartman specifies: var. arizonicum
4	Urtica dioica	stinging nettle	Urticaceae	NI (FACW)	URTDIO	URDI	x	Hartman specifies: var. procera
4	Verbascum thapsus	common mullein	Scrophulariaceae	NI (FAC)	VERTHA	VETH	x	
4	Veronica americana	American speedwell	Scrophulariaceae	OBL	VERAME	VEAM2	x	
4	Veronica peregrina ssp. xalapensis	hairy purslane speedwell	Scrophulariaceae		VERPERX	VEPEX2	x	
4	Vicia americana	american vetch	Fabaceae	NI (FACW)	VICAME	VIAM	x	Hartman specifies: var. americana and var. minor
4	Viola canadensis	Canadian white violet	Violaceae	NI (FACW)	VIOCAN	VICA4	x	
4	Woodsia oregana	Oregon woodsia	Dryopteridaceae		WOOORE	WOOR	x	Hartman specifies: var. cathcartiana
4	Zigadenus elegans	mountain deathcamas	Liliaceae		ZIGELE	ZIEL2	x	

Table B-2. Plant species found on the VCNP as part of the vegetation survey by the NMNHP in 2001 and 2002 ordered by lifeform and common name.

LF	COMNAME	Species Name	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
1	blue spruce	Picea pungens	Pinaceae	FAC	PICPUN	PIPU	x	
1	Douglas fir	Pseudotsuga menziesii	Pinaceae	NI (FAC)	PSEMEN	PSME	x	Hartman specifies: var. glauca
1	Engelmann's spruce	Picea engelmannii	Pinaceae	FAC-	PICENG	PIEN	x	Hartman specifies: var. engelmannii
1	Gambel's oak	Quercus gambelii	Fagaceae	NI (UPL)	QUEGAM	QUGA	x	
1	limber pine	Pinus flexilis	Pinaceae		PINFLE	PIFL2	x	
1	New Mexico locust	Robinia neomexicana	Fabaceae	NI (FACU)	ROBNEO	RONE	x	Hartman specifies: var. neomexicana
1	oneseed juniper	Juniperus monosperma	Cupressaceae	NI (UPL)	JUNMON	JUMO		
1	pinyon pine	Pinus edulis	Pinaceae	NI (UPL)	PINEDU	PIED	x	
1	ponderosa pine	Pinus ponderosa	Pinaceae	NI (FACU)	PINPON	PIPO	x	Hartman specifies: var. scopulorum
1	quaking aspen	Populus tremuloides	Salicaceae	FACU (FAC)	POPTRE	POTR5	x	
1	Rocky Mountain juniper	Juniperus scopulorum	Cupressaceae	NI (UPL)	JUNSCO	JUSC2	x	
1	Rocky Mountain maple	Acer glabrum	Aceraceae	FAC (FACW)	ACEGLA	ACGL	x	Hartman specifies: var. glabrum
1	subalpine fir	Abies lasiocarpa var. arizonica	Pinaceae	FACU+	ABILASA	ABLAA	x	Hartman uses: Abies arizonica
1	thinleaf alder	Alnus incana ssp. tenuifolia	Betulaceae	NI (OBL)	ALNINCT	ALINT	x	Hartman uses: Alnus incana var. occidentalis
1	white fir	Abies concolor	Pinaceae	NI (FAC)	ABICON	ABCO	x	
2	banana yucca	Yucca baccata	Agavaceae		YUCBAC	YUBA	x	
2	Bebb willow	Salix bebbiana	Salicaceae	FACW	SALBEB	SABE2	x	
2	California brickellbush	Brickellia californica	Asteraceae	FACU+	BRICAL	BRCA3	x	
2	cliffbush	Jamesia americana	Hydrangeaceae		JAMAME	JAAM	x	Hartman specifies: var. americana
2	Colorado barberry	Berberis fendleri	Berberidaceae		BERFEN	BEFE	x	
2	common chokecherry	Prunus virginiana	Rosaceae	FAC (FACW)	PRUVIR	PRVI	x	Hartman specifies: var. melanocarpa
2	common juniper	Juniperus communis	Cupressaceae	NI (UPL)	JUNCOM	JUCO6	x	Hartman specifies: var. depressa
2	dwarf serviceberry	Amelanchier pumila	Rosaceae		AMEPUM	AMPU5	x	Hartman uses: Amelanchier alnifolia var. pumila
2	Fendler's brickellbush	Brickellia fendleri	Asteraceae		BRIFEN	BRFE	x	
2	Fendler's ceanothus	Ceanothus fendleri	Rhamnaceae	NI (UPL)	CEAFEN	CEFE	x	
2	littleleaf mockorange	Philadelphus microphyllus	Hydrangeaceae		PHIMIC	PHMI4	x	
2	mountain mahogany	Cercocarpus montanus	Rosaceae	NI (UPL)	CERMON	CEMO2		
2	mountain ninebark	Physocarpus monogynus	Rosaceae	FACU	PHYMON	PHMO4	x	
2	Red Raspberry	Rubus idaeus	Rosaceae		RUBIDA	RUID	x	
2	rockspirea	Holodiscus dumosus	Rosaceae	NI (UPL)	HOLDUM	HODU	x	Hartman specifies: var. dumosus
2	russet buffaloberry	Shepherdia canadensis	Elaeagnaceae		SHECAN	SHCA		
2	scarlet elderberry	Sambucus racemosa	Caprifoliaceae	FACU (FACW)	SAMRAC	SARA2	x	Hartman specifies: var. microbotrys
2	shrubby cinquefoil	Pentaphylloides	Rosaceae	FACW-	PENFLO	PEFL15	x	Hartman uses: Potentilla fruticosa

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LF	COMNAME	Species Name	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
		floribunda						
2	thimbleberry	Rubus parviflorus	Rosaceae	NI (FAC)	RUBPAR	RUPA	x	
2	trumpet gooseberry	Ribes leptanthum	Grossulariaceae	NI (FAC)	RIBLEP	RILE	x	
2	twinberry honeysuckle	Lonicera involucrata	Caprifoliaceae	FACU (FACW)	LONINV	LOIN5		
2	wax currant	Ribes cereum	Grossulariaceae	NI (FAC)	RIBCER	RICE	x	
2	whortleleaf snowberry	Symphoricarpos oreophilus	Caprifoliaceae	NI (UPL)	SYMORE	SYOR2		
2	Woods' rose	Rosa woodsii	Rosaceae		ROSWOO	ROWO		Hartman has Rosa nutkana (not a synonym)
2.5	bog birch	Betula pumila var. glandulifera	Betulaceae		BETGLA	BEPUG		Hartman has Betula occidentalis (not a synonym)
2.5	fringed sagewort	Artemisia frigida	Asteraceae	NI (FACU)	ARTFRI	ARFR4	x	
2.5	greenflowered wintergreen	Pyrola chlorantha	Pyrolaceae		PYRCHL	PYCH	x	Hartman uses Ericaceae
2.5	hairy goldenaster	Heterotheca villosa	Asteraceae		HETVIL	HEVI4	x	Hartman specifies: var. nana
2.5	kingcup cactus	Echinocereus triglochidiatus	Cactaceae		ECHTRI	ECTR		
2.5	kinnikinnick	Arctostaphylos uva-ursi	Ericaceae		ARCUVA	ARUV	x	Hartman specifies: var. adenotricha
2.5	myrtle boxleaf	Paxistima myrsinites	Celastraceae	NI (FACU)	PAXMYR	PAMY	x	
2.5	Oregongrape	Mahonia repens	Berberidaceae	NI (UPL)	MAHREP	MARE11	x	
2.5	scarlet hedgehog cactus	Echinocereus coccineus	Cactaceae		ECHCOC	ECCO5		
2.5	whitecolumn foxtail cactus	Escobaria tuberculosa	Cactaceae		ESCTUB	ESTU		NMNHP voucher being confirmed
2.5	whortleberry	Vaccinium myrtillus	Ericaceae		VACMYR	VAMY2	x	
3	alpine timothy	Phleum alpinum	Poaceae		PHLALP	PHAL2	x	Hartman specifies: var. alpinum
3	Arizona fescue	Festuca arizonica	Poaceae	NI (FACU)	FESARI	FEAR2	x	
3	Baltic rush	Juncus balticus	Juncaceae	OBL	JUNBAL	JUBA	x	Hartman uses: Juncus arcticus var. balticus
3	beaked sedge	Carex rostrata	Cyperaceae	OBL	CARROS2	CARO6		
3	bearded wheatgrass	Elymus trachycaulus ssp. subsecundus	Poaceae		ELYTRAS	ELTRS	x	Hartman uses: E. trachycaulus var. andinus
3	blue grama	Bouteloua gracilis	Poaceae	NI (UPL)	BOUGRA	BOGR2	x	Hartman specifies: var. gracilis
3	bottlebrush squirreltail	Elymus elymoides	Poaceae	NI (FACU)	ELYELY	ELEL5	x	Hartman specifies: var. brevifolius and var. elymoides
3	bristly wolfstail	Lycurus setosus	Poaceae		LYCSET	LYSE3		NMNHP voucher being confirmed
3	California brome	Bromus carinatus	Poaceae	NI (FACU)	BROCAR	BRCA5	x	
3	Canada bluegrass	Poa compressa	Poaceae	FACU	POACOM	POCO	x	
3	Canada reedgrass	Calamagrostis canadensis	Poaceae	OBL	CALCAN	CACA4	x	Hartman specifies: var. canadensis
3	common spikerush	Eleocharis palustris	Cyperaceae	OBL	ELEPAL	ELPA3	x	
3	drooping woodreed	Cinna latifolia	Poaceae		CINLAT	CILA2	x	
3	dryspike sedge	Carex foenea	Cyperaceae	NI (FACW)	CARFOE		x	Hartman specifies: var. foenea
3	false quackgrass	Elymus x pseudorepens	Poaceae	NI (FAC)	ELYPSE	ELPS		

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LF	COMNAME	Species Name	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
3	Fendler's flatsedge	Cyperus fendlerianus	Cyperaceae	FAC	CYPFEN	CYFE2	x	
3	fewflower spikerush	Eleocharis quinqueflora	Cyperaceae		ELEQUI	ELQU2		
3	fowl bluegrass	Poa palustris	Poaceae	FAC	POAPAL	POPA2	x	
3	foxtail barley	Hordeum jubatum	Poaceae	NI (FAC)	HORJUB	HOJU	x	
3	foxtail muhly	Muhlenbergia andina	Poaceae		MUHAND	MUAN		
3	fringed brome	Bromus ciliatus	Poaceae	FAC	BROCIL	BRCI2	x	
3	Idaho fescue	Festuca idahoensis	Poaceae		FESIDA	FEID	x	Hartman specifies: var. idahoensis
3	Indian ricegrass	Oryzopsis hymenoides	Poaceae	FACU-	ORYHYM	ORHY		NMNHP voucher being confirmed
3	inland rush	Juncus interior	Juncaceae		JUNINT	JUIN2	x	
3	Kentucky bluegrass	Poa pratensis	Poaceae	FACU	POAPRA	POPR	x	
3	Letterman's needlegrass	Stipa lettermannii	Poaceae	NI (UPL)	STILET	STLE4	x	
3	little bluestem	Schizachyrium scoparium	Poaceae	FACU	SCHSCO	SCSC	x	Hartman specifies: var. scoparium
3	longstyle rush	Juncus longistylis	Juncaceae	FACW	JUNLON	JULO	x	
3	marsh arrowgrass	Triglochin palustre marsh arrowgrass	Juncaginaceae	OBL	TRIPAL	TRPA6		
3	Mat muhly	Muhlenbergia richardsonis	Poaceae		MUHRIC	MURI	x	
3	meadow barley	Hordeum brachyantherum	Poaceae	FAC*	HORBRA	HOBR2	x	
3	mountain muhly	Muhlenbergia montana	Poaceae		MUHMON	MUMO	x	
3	muttongrass	Poa fendleriana	Poaceae	NI (FACU)	POAFEN	POFE	x	
3	needle spikerush	Eleocharis acicularis	Cyperaceae		ELEACI	ELAC	x	
3	nodding brome	Bromus anomalus	Poaceae		BROANO	BRAN	x	
3	northern mannagrass	Glyceria borealis	Poaceae	OBL	GLYBOR	GLBO	x	
3	northern reedgrass	Calamagrostis stricta var. inexpansa	Poaceae		CALSTRI			NMNHP voucher being confirmed
3	Northwest Territory sedge	Carex utriculata	Cyperaceae		CARUTR	CAUT	x	
3	obtuse sedge	Carex obtusata	Cyperaceae		CAROBT	CAOB4		
3	pale false mannagrass	Torreyochloa pallida var. pauciflora	Poaceae		TORPALP	TOPAP3	x	
3	Parry's Danthonia	Danthonia parryi	Poaceae		DANPAR	DAPA2	x	
3	pine dropseed	Blepharoneuron tricholepis	Poaceae		BLETRI	BLTR	x	
3	Porter's melicgrass	Melica porteri	Poaceae	NI (UPL)	MELPOR	MEPO	x	
3	prairie junegrass	Koeleria macrantha	Poaceae	NI (UPL)	KOEMAC	KOMA	x	
3	pullup muhly	Muhlenbergia filiformis	Poaceae		MUHFIL			
3	ravine fescue	Festuca sororia	Poaceae		FESSOR	FESO	x	

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3	redtop	Agrostis gigantea	Poaceae	FACW+	AGRGIG	AGGI2		
3	Rocky Mountain trisetum	Trisetum montanum	Poaceae		TRIMON	TRMO5	x	Hartman specifies: var. montanum
3	Ross' sedge	Carex rossii	Cyperaceae		CARROS	CARO5		
3	rough bentgrass	Agrostis scabra	Poaceae		AGRSCA	AGSC5	x	Hartman specifies: var. scabra
3	roughleaf ricegrass	Oryzopsis asperifolia	Poaceae		ORYASP	ORAS	x	
3	shortawn foxtail	Alopecurus aequalis	Poaceae	OBL	ALOAEQ	ALAE	x	Hartman specifies: var. aequalis
3	slender rush	Juncus dudleyi	Juncaceae	FACW-	JUNDUD	JUDU2	x	
3	slender wheatgrass	Elymus trachycaulus	Poaceae	FAC	ELYTRA	ELTR7	x	Hartman specifies: var. trachycaulus
3	slimstem reedgrass	Calamagrostis stricta	Poaceae		CALSTR	CAST36		NMNHP voucher being confirmed
3	smallwing sedge	Carex microptera	Cyperaceae	FACW	CARMIC	CAMI7	x	Hartman specifies: var. microptera
3	spike muhly	Muhlenbergia wrightii	Poaceae		MUHWRI	MUWR	x	
3	sun sedge	Carex inops ssp. heliophila	Cyperaceae		CARINOH	CAINH2	x	Hartman uses: Carex pensylvanica var. digyna
3	swordleaf rush	Juncus ensifolius	Juncaceae		JUNENS	JUEN	x	Hartman specifies: var. montanus
3	Thurber's fescue	Festuca thurberi	Poaceae		FESTHU	FETH	x	
3	timothy	Phleum pratense	Poaceae	FACU	PHLPRA	PHPR3	x	Hartman specifies: var. pratense
3	tufted hairgrass	Deschampsia cespitosa	Poaceae	FACW-	DESCES	DECE	x	
3	water sedge	Carex aquatilis	Cyperaceae	OBL	CARAQU	CAAQ	x	Hartman specifies: var. aquatilis
3	western sedge	Carex occidentalis	Cyperaceae	NI (FACW)	CAROCC	CAOC2	x	
3	western wheatgrass	Pascopyrum smithii	Poaceae	NI (FACU)	PASSMI	PASM	x	Hartman use: Elymus smithii
3	White Mountain sedge	Carex geophila	Cyperaceae	NI (FACW)	CARGEO	CAGE	x	
3	woolly sedge	Carex lanuginosa	Cyperaceae	OBL	CARLAN	CALA30	x	
4	alpine false springparsley	Pseudocymopterus montanus	Apiaceae	NI (FAC)	PSEMON	PSMO	x	Hartman uses: Cymopterus lemmonii
4	American speedwell	Veronica americana	Scrophulariaceae	OBL	VERAME	VEAM2	x	
4	american vetch	Vicia americana	Fabaceae	NI (FACW)	VICAME	VIAM	x	Hartman specifies: var. americana and var. minor
4	arumleaf arrowhead	Sagittaria cuneata	Alismataceae	OBL	SAGCUN	SACU	x	
4	aspen fleabane	Erigeron speciosus	Asteraceae	NI (FAC)	ERISPE	ERSP4	x	
4	autumn dwarf gentian	Gentianella amarella ssp. acuta	Gentianaceae		GENAMAA	GEAMA	x	
4	beardlip penstemon	Penstemon barbatus	Scrophulariaceae	NI (UPL)	PENBAR	PEBA2	x	Hartman specifies: var. trichander
4	beautiful cinquefoil	Potentilla pulcherrima	Rosaceae	NI (FACW)	POTPUL	POPU9		
4	beautiful fleabane	Erigeron formosissimus	Asteraceae		ERIFOR	ERFO3	x	
4	big chickweed	Cerastium fontanum ssp. vulgare	Caryophyllaceae		CERFONV	CEFOV2	x	
4	birdbill dayflower	Commelina dianthifolia	Commelinaceae		COMDIA	CODI4	x	
4	black-eyed Susan	Rudbeckia hirta	Asteraceae	FACU	RUDHIR	RUHI2	x	Hartman specifies: var. pulcherrima
4	bluebell bellflower	Campanula rotundifolia	Campanulaceae	FAC	CAMROT	CARO2	x	

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4	bluntleaf yellowcress	Rorippa curvipes	Brassicaceae		RORCUR	ROCU2		
4	bluntseed sweetroot	Osmorhiza depauperata	Apiaceae		OSMDEP	OSDE	x	
4	bog willowherb	Epilobium leptophyllum	Onagraceae		EPILEP	EPLE2		
4	brittle bladderfern	Cystopteris fragilis	Dryopteridaceae	FACU+ (FACW)	CYSFRA	CYFR2	x	
4	broadleaf four o'clock	Mirabilis decipiens	Nyctaginaceae		MIRDEC	MIDE5		NMNHP voucher being confirmed
4	buttercup	Ranunculus spp. (depauperate)	Ranunculaceae	FACW	RANUNC	RANUN		
4	Canadian white violet	Viola canadensis	Violaceae	NI (FACW)	VIOCAN	VICA4	x	
4	Carruth's sagewort	Artemisia carruthii	Asteraceae	NI (FAC)	ARTCAR	ARCA14	x	
4	clubmoss	Lycopodium annotinum	Lycopodiaceae		LYCANN	LYAN2		
4	Cluster aster	Symphyotrichum falcatum var. commutatum	Asteraceae		SYMFALC	SYFAC		
4	Colorado columbine	Aquilegia coerulea	Ranunculaceae	FACW-	AQUCOE	AQCO	x	Hartman specifies: var. coerulea
4	Columbian monkshood	Aconitum columbianum	Ranunculaceae	FACW	ACOCOL	ACCO4	x	Hartman specifies: var. columbianum
4	common dandelion	Taraxacum officinale	Asteraceae	FACU	TAROFF	TAOF	x	Hartman has: Taraxacum laevigatum (not a synonym)
4	common hop	Humulus lupulus var. neomexicanus	Cannabaceae		HUMLUPN	HULUN	x	
4	common mullein	Verbascum thapsus	Scrophulariaceae	NI (FAC)	VERTHA	VETH	x	
4	common pepperweed	Lepidium densiflorum	Brassicaceae		LEPDEN	LEDE		
4	common plantain	Plantago major	Plantaginaceae	FACW	PLAMAJ	PLMA2	x	Hartman specifies: var. major
4	common selfheal	Prunella vulgaris	Lamiaceae	FACW-	PRUVUL	PRVU	x	
4	common sheep sorrel	Rumex acetosella	Polygonaceae	FACW	RUMACE	RUAC3	x	
4	common yarrow	Achillea millefolium	Asteraceae	FACU	ACHMIL	ACMI2	x	Hartman spcifies: var. lanulosa
4	cows clover	Trifolium wormskioldii	Fabaceae		TRIWOR	TRWO	x	Hartman specifies: var. arizonicum
4	creamflower rockcress	Arabis hirsuta var. pycnocarpa	Brassicaceae		ARAHIRP	ARHIP	x	
4	curly dock	Rumex crispus	Polygonaceae	FACW	RUMCRI	RUCR	x	
4	cutleaf coneflower	Rudbeckia laciniata	Asteraceae	FACW- (FACW)	RUDLAC	RULA3	x	Hartman specifies: var. ampla
4	desert groundsel	Senecio eremophilus	Asteraceae		SENERE	SEER2	x	Hartman specifies: var. kingii
4	diamondleaf saxifrage	Saxifraga rhomboidea	Saxifragaceae		SAXRHO	SARH2	x	
4	disc mayweed	Matricaria discoidea	Asteraceae		MATDIS	MADI6		
4	Douglas' knotweed	Polygonum douglasii	Polygonaceae	NI (FACU)	POLDOU	PODO4	x	Hartman specifies: var. douglasii
4	Drummond's campion	Silene drummondii	Caryophyllaceae		SILDRU	SIDR	x	Hartman specifies: var. drummondii
4	Drummond's rockcress	Arabis drummondii	Brassicaceae	FACU	ARADRU	ARDR	x	
4	Drummond's skullcap	Scutellaria drummondii	Lamiaceae		SCUDRU	SCDR2		

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LF	COMNAME	Species Name	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	erect knotweed	Polygonum erectum	Polygonaceae		POLERE	POER2		
4	feathery false Solomon's seal	Maianthemum racemosum ssp. amplexicaule	Liliaceae	FACU- (FACW)	MAIRACA	MARAA	x	
4	Fendler's cowbane	Oxypolis fendleri	Apiaceae	FACW	OXYFEN	OXFE	x	
4	Fendler's meadowrue	Thalictrum fendleri	Ranunculaceae	FACU-	THAFEN	THFE	x	
4	Fendler's ragwort	Packera fendleri	Asteraceae		PACFEN	PAFE4	x	
4	Fendler's sandwort	Arenaria fendleri	Caryophyllaceae		AREFEN	ARFE3		
4	Fendler's sandwort	Arenaria fendleri var. fendleri	Caryophyllaceae		AREFENF	ARFEF3	x	
4	Fendler's waterleaf	Hydrophyllum fendleri	Hydrophyllaceae	FACW	HYDFEN	HYFE	x	Hartman specifies: var. fendleri
4	fetid goosefoot	Chenopodium graveolens	Chenopodiaceae		CHEGRA	CHGR2	x	
4	fiddleleaf hawksbeard	Crepis runcinata	Asteraceae		CRERUN	CRRU3	x	Hartman specifies: var. runcinata
4	field horsetail	Equisetum arvense	Equisetaceae	FACW- (FACW)	EQUARV	EQAR	x	
4	field sagewort	Artemisia campestris	Asteraceae	FAC	ARTCAM	ARCA12		
4	fireweed	Epilobium angustifolium	Onagraceae		EPIANG	EPAN2		
4	flatspine stickseed	Lappula occidentalis	Boraginaceae	NI (UPL)	LAPOCC	LAOC3	x	
4	Franciscan bluebells	Mertensia franciscana	Boraginaceae	FACW	MERFRA	MEFR2	x	
4	Geyer's aster	Symphyotrichum laeve var. geyeri	Asteraceae		SYMLAEG	SYLAG		Hartman use: Aster laevis var. laevis
4	Geyer's onion	Allium geyeri	Liliaceae	NI (FACU)	ALLGEY	ALGE	x	Hartman specifies: var. geyeri
4	giant lousewort	Pedicularis procera	Scrophulariaceae	FACU (FACW)	PEDPRO	PEPR7	x	
4	golden draba	Draba aurea	Brassicaceae		DRAAUR	DRAU	x	
4	golden smoke	Corydalis aurea	Fumariaceae	NI (FACU)	CORAUR	COAU2	x	Hartman specifies: var. aurea
4	Gunnison's Mariposa lily	Calochortus gunnisonii	Liliaceae		CALGUN	CAGU	x	Hartman specifies: var. gunnisonii
4	hairy purslane speedwell	Veronica peregrina ssp. xalapensis	Scrophulariaceae		VERPERX	VEPEX2	x	
4	hairy rockcress	Arabis hirsuta	Brassicaceae		ARAHIR	ARHI		
4	hairy willowherb	Epilobium ciliatum	Onagraceae	FACW	EPICIL	EPCI	x	Hartman specifies: var. ciliatum
4	heartleaf buttercup	Ranunculus cardiophyllus	Ranunculaceae	OBL	RANCAR	RACA4	x	
4	Heller's draba	Draba helleriana	Brassicaceae		DRAHEL	DRHE	x	Hartman specifies: var. helleriana
4	hooded ladies tresses	Spiranthes romanzoffiana	Orchidaceae	OBL	SPIROM	SPRO		
4	Lady's thumb	Polygonum persicaria	Polygonaceae	FACW+	POLPER	POPE3		
4	largeleaf avens	Geum macrophyllum	Rosaceae	FACW	GEUMAC	GEMA4	x	Hartman specifies: var. perincisum
4	lesser rattlesnake plantain	Goodyera repens	Orchidaceae		GOOREP	GORE2	x	
4	longbeak buttercup	Ranunculus longirostris	Ranunculaceae		RANLON	RALO2		
4	longleaf pondweed	Potamogeton nodosus	Potamogetonaceae		POTNOD	PONO2	x	

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4	longleaf starwort	Stellaria longifolia	Caryophyllaceae	FAC (FACW)	STELON1	STLO	x	
4	Louisiana broomrape	Orobanche ludoviciana	Orobanchaceae	NI (UPL)	OROLUD	ORLU		
4	Louisiana sagewort	Artemisia ludoviciana	Asteraceae	NI (FACU)	ARTLUD	ARLU	x	Hartman specifies: var. ludoviciana
4	Macoun's cudweed	Pseudognaphalium macounii	Asteraceae		PSEMAC	PSMA11	x	Hartman uses: Pseudognaphalium viscosum
4	manybranched pepperweed	Lepidium ramosissimum	Brassicaceae		LEPRAM	LERA2	x	Hartman specifies: var. bourgeauanum
4	manyflowered gromwell	Lithospermum multiflorum	Boraginaceae	NI (UPL)	LITMUL	LIMU3	x	
4	mapleleaf goosefoot	Chenopodium simplex	Chenopodiaceae		CHESIM	CHSI2		
4	Mexican white sagebrush	Artemisia ludoviciana ssp. mexicana	Asteraceae	NI (FAC)	ARTLUDM	ARLUM2		
4	Missouri goldenrod	Solidago missouriensis	Asteraceae		SOLMIS	SOMI2		NMNHP voucher being confirmed
4	mountain blue-eyed grass	Sisyrinchium montanum	Iridaceae	FACW	SISMON	SIMO2	x	
4	mountain deathcamas	Zigadenus elegans	Liliaceae		ZIGELE	ZIEL2	x	
4	mountain draba	Draba rectifructa	Brassicaceae		DRAREC	DRRE		
4	mountain goldenbanner	Thermopsis montana var. montana	Fabaceae		THEMONM	THMOM3	x	
4	mountain tanseymustard	Descurainia incana ssp. incisa	Brassicaceae	NI (FAC)	DESINCI	DEINI2		Hartman uses: D. incana var. macrosperma
4	mountain tansymustard	Descurainia incana ssp. viscosa	Brassicaceae		DESINCV	DEINV	x	Hartman uses: D. incana var. viscosa
4	mountain tarweed	Madia glomerata	Asteraceae		MADGLO	MAGL2	x	
4	mouseear chickweed	Cerastium arvense	Caryophyllaceae	FACW	CERARV	CEAR4	x	
4	narrowleaf burreed	Sparganium angustifolium	Sparganiaceae		SPAANG	SPAN2	x	
4	narrowleaf goosefoot	Chenopodium leptophyllum	Chenopodiaceae		CHELEP	CHLE4	x	
4	New Mexican nodding onion	Allium cernuum var. neomexicanum	Liliaceae		ALLCERN	ALCEN		
4	New Mexico goosefoot	Chenopodium neomexicanum	Chenopodiaceae		CHENEO	CHNE3		
4	Newberry's hymenopappus	Hymenopappus newberryi	Asteraceae		HYMNEW	HYNE	x	
4	nodding onion	Allium cernuum	Liliaceae	NI (FACU)	ALLCER	ALCE2	x	
4	nodding ragwort	Senecio bigloviii	Asteraceae	NI (UPL)	SENBIG	SEBI2	x	Hartman specifies: var. bigelovii and var. halli
4	Northern bedstraw	Galium boreale	Rubiaceae	FAC-	GALBOR	GABO2	x	
4	Norton's St. Johnswort	Hypericum scouleri ssp. nortoniae	Clusiaceae		HYPSCON	HYSCN		
4	Norwegian cinquefoil	Potentilla norvegica	Rosaceae	FAC	POTNOR	PONO3	x	Hartman specifies: subsp. monspeliensis
4	old man whiskers	Geum triflorum	Rosaceae	FAC	GEUTRI	GETR	x	Hartman specifies: var. ciliatum

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4	orange agoseris	Agoseris aurantica	Asteraceae		AGOAUR	AGAU2	x	
4	Orange sneezeweed	Hymenoxys hoopesii	Asteraceae	FAC+	HYMHOO	HYHO	x	
4	Oregon woodsia	Woodsia oregana	Dryopteridaceae		WOOORE	WOOR	x	Hartman specifies: var. cathcartiana
4	Pacific wormwood	Artemisia campestris ssp. pacifica	Asteraceae		ARTCAMP	ARCAP2	x	
4	Parry's bellflower	Campanula parryi	Campanulaceae	FAC-	CAMPAR	CAPA10	x	Hartman specifies: var. parryi
4	Parry's goldenrod	Oreochrysum parryi	Asteraceae		OREPAR	ORPA3	x	
4	Parry's thistle	Cirsium parryi	Asteraceae		CIRPAR	CIPA	x	
4	Pennsylvania cinquefoil	Potentilla pensylvanica	Rosaceae		POTPEN	POPE8	x	Hartman specifies: var. pensylvanica
4	perennial rockcress	Arabis perennans	Brassicaceae		ARAPER	ARPE2	x	
4	Pinesap	Monotropa hypopithys	Monotropaceae		MONHYP	MOHY3	x	Hartman uses Ericaceae family
4	pineywoods geranium	Geranium caespitosum	Geraniaceae	NI (FAC)	GERCAE	GECA3	x	Hartman specifies: var. caespitosum and var. fremontii
4	pingue hymenoxys	Hymenoxys richardsonii	Asteraceae	NI (UPL)	HYMRIC	HYRI	x	Hartman specifies: var. floribunda
4	pinyon goosefoot	Chenopodium atrovirens	Chenopodiaceae		CHEATR	CHAT	x	
4	pleated gentian	Gentiana affinis	Gentianaceae		GENAFF	GEAF		
4	prairie bluebells	Mertensia lanceolata	Boraginaceae		MERLAN	MELA3	x	
4	prairie flax	Linum lewisii	Linaceae		LINLEW	LILE3	x	Hartman specifies: var. lewisii
4	prickly lettuce	Lactuca serriola	Asteraceae	FAC	LACSER	LASE	x	
4	Pringle's campion	Silene scouleri ssp. pringlei	Caryophyllaceae	NI (FACW)	SILSCOP	SISCP	x	
4	pygmyflower rockjasmine	Androsace septentrionalis	Primulaceae		ANDSEP	ANSE4	x	
4	ragleaf bahia	Bahia dissecta	Asteraceae		BAHDIS	BADI	x	
4	ragweed sagebrush	Artemisia franserioides	Asteraceae		ARTFRA	ARFR3	x	
4	red baneberry	Actaea rubra	Ranunculaceae	FACW	ACTRUB	ACRU2	x	
4	redroot buckwheat	Eriogonum racemosum	Polygonaceae		ERIRAC	ERRA3	x	Hartman specifies: var. racemosum
4	redstem stork's bill	Erodium cicutarium	Geraniaceae	NI (UPL)	EROCIC	ERCI6	x	
4	Richardson's geranium	Geranium richardsonii	Geraniaceae	FAC	GERRIC	GERI	x	
4	rock clematis	Clematis columbiana	Ranunculaceae		CLECOL	CLCO2	x	Hartman specifies: var. tenuiloba
4	Rocky Mountain fringedgentian	Gentianopsis thermalis	Gentianaceae		GENTHE	GETH		
4	Rocky Mountain hemlockparsley	Conioselinum scopulorum	Apiaceae		CONSCO	COSC2	x	
4	Rocky Mountain iris	Iris missouriensis	Iridaceae	FACW	IRIMIS	IRMI	x	
4	roundfruit yellowcress	Rorippa sphaerocarpa	Brassicaceae	OBL	RORSPH	ROSP4	x	
4	Rydberg's penstemon	Penstemon rydbergii	Scrophulariaceae		PENRYD	PERY	x	Hartman specifies: var. rydbergii

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4	sanddune wallflower	Erysimum capitatum	Brassicaceae	NI (UPL)	ERYCAP	ERCA14	x	Hartman specifies: var. capitatum
4	scarlet Indian paintbrush	Castilleja miniata	Scrophulariaceae	FACU	CASMIN	CAMI12	x	Hartman specifies: var. miniata
4	Scouler's campion	Silene scouleri	Caryophyllaceae		SILSCO	SISCP		
4	Scouler's St. Johnswort	Hypericum scouleri	Clusiaceae	NI (FAC)	HYPSCO	HYSC5		
4	seep monkeyflower	Mimulus guttatus	Scrophulariaceae	OBL	MIMGUT	MIGU	x	Hartman specifies: var. guttatus
4	shepherd's purse	Capsella bursa-pastoris	Brassicaceae	UPL	CAPBUR		x	
4	shortray fleabane	Erigeron lonchophyllus	Asteraceae		ERILON	ERLO		
4	showy goldeneye	Heliomeris multiflora	Asteraceae	NI (UPL)	HELMUL	HEMU3	x	Hartman uses: Viguiera multiflora var. multiflora
4	sidebells wintergreen	Orthila secunda	Pyrolaceae		ORTSEC	ORSE	x	Hartman uses Ericaceae family
4	silverweed cinquefoil	Argentina anserina	Rosaceae	OBL	ARGANS	ARAN7	x	Hartman uses: Potentilla anserina
4	silvery lupine	Lupinus argenteus	Fabaceae	UPL	LUPARG	LUAR3	x	Hartman specifies: var. argophyllus and var. fulvomaculatus
4	skyrocket gilia	Ipomopsis aggregata	Polemoniaceae	NI (FACU)	IPOAGG	IPAG	x	Hartman specifies: subsp. formosissima
4	slender cudweed	Gnaphalium exilifolium	Asteraceae		GNAEXI	GNEX	x	
4	slim amaranth	Amaranthus hybridus	Amaranthaceae		AMAHYB	AMHY	x	
4	smallleaf pussytoes	Antennaria parvifolia	Asteraceae	NI (UPL)	ANTPAR	ANPA4	x	
4	smooth spreading four o'clock	Mirabilis oxybaphoides	Nyctaginaceae		MIROXY	MIOX		NMNHP voucher being confirmed
4	spiny sowthistle	Sonchus asper	Asteraceae	NI (FACW)	SONASP	SOAS		NMNHP voucher being confirmed; Hartman has S. arvensis (not a synonym)
4	splitleaf groundsel	Packera dimorphophylla ssp. dimorphophylla	Asteraceae		PACDIMD	PADID2		
4	spreading fleabane	Erigeron divergens	Asteraceae	NI (FAC-)	ERIDIV	ERDI4	x	Hartman specifies: var. divergens
4	spreading sandwort	Arenaria lanuginosa	Caryophyllaceae	FACU,FAC	ARELAN	ARLA4		
4	spreading sandwort	Arenaria lanuginosa ssp. saxosa	Caryophyllaceae		ARELANS	ARLAS	x	Hartman uses: A. lanuginosa var. cinerascens
4	sprucefir fleabane	Erigeron eximius	Asteraceae		ERIEXI	EREX4	x	
4	starry false Solomon's seal	Maianthemum stellatum	Liliaceae	FACU (FACW)	MAISTE	MAST4		
4	stickywilly	Galium aparine	Rubiaceae	FACU (FAC)	GALAPA	GAAP2	x	Hartman specifies: var. echinospermum
4	stinging nettle	Urtica dioica	Urticaceae	NI (FACW)	URTDIO	URDI	x	Hartman specifies: var. procera
4	summer coralroot	Corallorrhiza maculata	Orchidaceae		CORMAC	COMA4	x	
4	tall blacktip ragwort	Senecio atratus	Asteraceae		SENATR	SEAT	x	
4	threelobe beggarticks	Bidens tripartita	Asteraceae		BIDTRI	BITR		
4	threenerve fleabane	Erigeron subtrinervis	Asteraceae		ERISUB	ERSU2	x	Hartman specifies: var. subtrinervis
4	thymeleaf sandmat	Chamaesyce serpyllifolia	Euphorbiaceae	NI (FACU)	CHASER2	CHSE6	x	
4	tiny trumpet	Collomia linearis	Polemoniaceae		COLLIN	COLI2	x	
4	towering Jacobsladder	Polemonium foliosissimum	Polemoniaceae	FAC	POLFOL	POFO	x	

Table B-2. Plant species found on the VCNP as part of the vegetation survey by the NMNHP in 2001 and 2002 ordered by lifeform and common name.

LF	COMNAME	Species Name	Family	Wetland Status	Species Code	Kartesz Symbol	H	Comments
4	trailing fleabane	Erigeron flagellaris	Asteraceae	FAC-	ERIFLA	ERFL	x	
4	tuber starwort	Pseudostellaria jamesiana	Caryophyllaceae	NI (FACW)	PSEJAM	PSJA2	x	
4	tufted eveningprimrose	Oenothera caespitosa	Onagraceae		OENCAE	OECA10		
4	varileaf phacelia	Phacelia heterophylla	Hydrophyllaceae		PHAHET	PHHE2	x	Hartman specifies: var. heterophylla
4	violet woodsorrel	Oxalis violacea	Oxalidaceae		OXAVIO	OXVI	x	
4	water knotweed	Polygonum amphibium	Polygonaceae	OBL	POLAMP	POAM8	x	Hartman specifies: var. stipulaceum
4	watercress	Rorippa nasturtium-aquaticum	Brassicaceae	OBL	RORNAS	RONA2		
4	western aster	Symphyotrichum ascendens	Asteraceae		SYMASC	SYAS3	x	Hartman uses: Aster ascendens
4	western brackenfern	Pteridium aquilinum	Dennstaestiaceae	FACU	PTEAQU	PTAQ	x	Hartman specifies: var. pubescens
4	western rattlesnake plantain	Goodyera oblongifolia	Orchidaceae		GOOOBL	GOOB2	x	
4	western red columbine	Aquilegia elegantula	Ranunculaceae		AQUELE	AQEL	x	
4	Wheeler's thistle	Cirsium wheeleri	Asteraceae		CIRWHE	CIWH		NMNHP voucher being confirmed
4	Whipple's penstemon	Penstemon whippleanus	Scrophulariaceae		PENWHI	PEWH	x	
4	white checkermallow	Sidalacea candida	Malvaceae	FAC (FACW)	SIDCAN	SICA3	x	Hartman specifies: var. candida
4	white clover	Trifolium repens	Fabaceae	NI (FAC)	TRIREP	TRRE3	x	
4	wild mint	Mentha arvensis	Lamiaceae	FACW	MENARV	MEAR4	x	
4	willowherb	Epilobium spp. (depauperate)	Onagraceae	FACW	EPILOB	EPILO		
4	woodland pinedrops	Pterospora andromedea	Monotropaceae		PTEAND	PTAN2	x	Hartman uses Ericaceae family
4	woodland strawberry	Fragaria vesca	Rosaceae		FRAVES	FRVE		Hartman has: Fragaria virginiana (not a synonym)
4	woodland strawberry	Fragaria vesca ssp. americana	Rosaceae	NI (FACU)	FRAVESA	FRVEA2		
4	woolly cinquefoil	Potentilla hippiana	Rosaceae		POTHIP	POHI6	x	Hartman specifies: var. hippiana
4	Wooton's ragwort	Senecio wootonii	Asteraceae	NI (FAC)	SENWOO	SEWO	x	
4	Wright's deervetch	Lotus wrightii	Fabaceae	NI (FACU)	LOTWRI	LOWR	x	
4	yarrow	Achillea millefolium var. occidentalis	Asteraceae	FACU	ACHMILO	ACMIO		
4	yellow eveningprimrose	Oenothera flava	Onagraceae		OENFLA	OEFL	x	
4	yellow hawkweed	Hieracium fendleri	Asteraceae		HIEFEN	HIFE	x	Hartman specifies: var. fendleri
4	yellow owlclover	Orthocarpus luteus	Scrophulariaceae		ORTLUT	ORLU2	x	
4	yellow salsify	Tragopogon dubius	Asteraceae		TRADUB	TRDU	x	

APPENDIX C

Vegetation Plot List

Table C-1. Locations and vegetation classification for vegetation plots established in 2001 as part of the Valles Caldera National Preserve Ecological Survey. See Table 6 of report text for Alliances and Plant Associations (PA) that correspond to the codes.

Plot Number	UTM Easting	UTM Northing	Datum	Alliance Acronym	PA1 Acronym	PA2 Acronym	Phase Acronym
01VC001	363694	3968586	NAD27	ABICON	VACMYR		PSEMEN
01VC002	363942	3969042	NAD27	FESARI	MUHMON		BOUGRA
01VC003	365284	3968141	NAD27	BLETRI	KOEMAC		
01VC004	365340	3968220	NAD27	JUNBAL	DESCES		POAPRA
01VC005	365923	3966903	NAD27	DANPAR	POAPRA	POTHIP	
01VC006	362010	3970834	NAD27	ABICON	PSEMEN	ACEGLA	
01VC007	362259	3970853	NAD27	ABICON	PSEMEN	FESTHU	
01VC008	370668	3969326	NAD27	PICPUN	ERIEXI		PSEMEN
01VC009	361840	3970851	NAD27	PSEMEN	VACMYR		
01VC010	361822	3970928	NAD27	PICPUN	ALNINC	HYDFEN	
01VC011	370912	3969231	NAD27	ABICON	POPTRE	ACEGLA	JAMAME
01VC012	370780	3969382	NAD27	DANPAR	FESTHU		
01VC013	372337	3972428	NAD27	PSEMEN	JAMAME		
01VC014	372466	3972449	NAD27	PSEMEN	ACEGLA		
01VC015	372236	3972546	NAD27	POPTRE	THAFEN		POAPRA
01VC016	372132	3972500	NAD27	PINPON	DANPAR		POAPRA
01VC017	357547	3966619	NAD27	PINPON	QUEGAM	FESARI	ROBNEO
01VC018	354993	3969134	NAD27	CARUTR	CARMIC		
01VC019	372204	3971609	NAD27	PINPON	RIBLEP	CARINOH	
01VC020	369673	3969681	NAD27	CARUTR	CARMIC		
01VC021	368052	3978244	NAD27	PICPUN	ERIEXI		DANPAR
01VC022	372059	3976718	NAD27	PSEMEN	MAHREP		
01VC023	364800	398500	NAD27	PICENG	DANPAR		
01VC024	366083	3980751	NAD27	DANPAR	FESARI		BLETRI
01VC025	365964	3980854	NAD27	CARUTR	CARMIC		
01VC026	365256	3984716	NAD27	DANPAR	FESARI		
01VC027	365228	3984831	NAD27	PICENG	CARFOE		
01VC028	364848	3984671	NAD27	DANPAR	FESTHU		
01VC029	368196	3985222	NAD27	PICENG	ERIEXI		
01VC030	366811	3980290	NAD27	BLETRI	JUNBAL		
01VC031	362384	3981902	NAD27	JUNBAL	POAPRA		CAREX
01VC032	365169	3981048	NAD27	PICPUN	CARFOE		POAPRA
01VC033	366761	3980044	NAD27	CARUTR	CARMIC		
01VC034	361889	3981955	NAD27	FESARI	BOUGRA		POAPRA
01VC035	356875	3975429	NAD27	BETGLA	CARAQU		LYCANN
01VC036	356801	3975378	NAD27	DESCES	CARAQU		
01VC037	357716	3975620	NAD27	QUEGAM	POAPRA		
01VC038	357901	3975400	NAD27	POPTRE	THAFEN		PSEMEN
01VC039	357153	3985151	NAD27	PSEMEN	MAHREP		
01VC040	363055	3967053	NAD27	ABICON	PSEMEN	JUNCOM	
01VC041	356990	3985054	NAD27	ABICON	PSEMEN	MAHREP	
01VC042	356555	3970841	NAD27	PINPON	DANPAR		
01VC043	355328	3972899	NAD27	PSEMEN	MAHREP		

Table C-1 (continued). Locations and vegetation classification for vegetation plots established in 2001 as part of the Valles Caldera National Preserve Ecological Survey.

Plot Number	UTM Easting	UTM Northing	Datum	Alliance Acronym	PA1 Acronym	PA2 Acronym	Phase Acronym
01VC044	356515	3971072	NAD27	QUEGAM	ROBNEO		PRUVIR
01VC045	355816	3972689	NAD27	POPTRE	THAFEN		POAPRA
01VC046	358244	3982925	NAD27	PINPON	FESARI		DANPAR
01VC047	373696	3975684	NAD27	PSEMEN	VACMYR		PICENG
01VC048	358261	3982888	NAD27	PINPON	FESARI		DANPAR
01VC049	373641	3975498	NAD27	DANPAR	FESTHU		
01VC050	355863	3983162	NAD27	DANPAR	FESARI		POAPRA
01VC051	373568	3975470	NAD27	PSEMEN	PINFLE	TRISPIM	
01VC052	359109	3981837	NAD27	FESARI	MUHMON		
01VC053	363203	3969294	NAD27	CARAQU	CARUTR		
01VC054	360643	3984022	NAD27	ABICON	JAMAME		
01VC055	363417	3984976	NAD27	ABILAS	VACMYR		
01VC056	356456	3972563	NAD27	ABICON	PSEMEN	MAHREP	
01VC057	356379	3972724	NAD27	ABICON	PSEMEN	ACEGLA	
01VC058	356241	3972767	NAD27	BLETRI	MUHMON		
01VC059	358955	3975478	NAD27	DANPAR	FESTHU		
01VC060	367658	3968107	NAD27	FESTHU	STILET		
01VC061	367695	3968121	NAD27	DANPAR	FESARI		POAPRA
01VC062	367583	3968288	NAD27	DESCES	POTHIP		
01VC063	367392	3968810	NAD27	BLETRI	MUHWRI		
01VC064	367311	3968925	NAD27	DESCES	CARMIC		
01VC065	366741	3969655	NAD27	DESCES	GLYBOR	CARAQU	
01VC066	366330	3969682	NAD27	BLETRI	MUHMON		
01VC068	366197	3969655	NAD27	POAPRA	POTHIP		
01VC069	362613	3983020	NAD27	PINPON	FESARI		DANPAR
01VC070	362341	3983356	NAD27	QUEGAM	HOLDUM		
01VC071	362086	3983994	NAD27	POPTRE	FESTHU		BROCIL
01VC072	362063	3983777	NAD27	ABICON	PSEMEN	ACEGLA	
01VC073	362712	3970182	NAD27	PINPON	JUNCOM		CAREX
01VC074	365773	3969286	NAD27	CARLAN	ELEPAL	ELEACI	
01VC075	354213	3973694	NAD27	PINEDU	QUEGAM		
01VC076	354253	3973697	NAD27	QUEGAM	CARINOH		
01VC077	361800	3981073	NAD27	DESCES	CARUTR		
01VC078	361993	3981088	NAD27	JUNBAL	CARFOE		
01VC079	357768	3977685	NAD27	SPAANG	POTNOD		
01VC080	357785	3977666	NAD27	GLYBOR	MONTYP		
01VC081	357794	3977614	NAD27	ELEPAL	RORSPH		
01VC082	358147	3977505	NAD27	DANPAR	FESARI		BLETRI
01VC083	363556	3969759	NAD27	JUNBAL	POAPRA		
01VC084	368028	3979068	NAD27	FESARI	BLETRI		
01VC085	368102	3979586	NAD27	DESCES	CARFOE		
01VC086	367788	3979852	NAD27	DESCES	CARFOE		CARLAN
01VC087	367435	3979785	NAD27	DESCES	CARUTR		
01VC088	370257	3973445	NAD27	PSEMEN	JAMAME		
01VC089	370187	3973287	NAD27	PINFLE	JUNCOM		
01VC090	370571	3972711	NAD27	FESARI	BLETRI		POAPRA
01VC091	369456	3970749	NAD27	FESARI	BOUGRA		
01VC092	370692	3971801	NAD27	FESARI	BLETRI		ACHMIL
01VC093	373578	3976141	NAD27	PICENG	ERIEXI		
01VC094	372790	3976207	NAD27	DANPAR	FESARI		BLETRI

Table C-1 (continued). Locations and vegetation classification for vegetation plots established in 2001 as part of the Valles Caldera National Preserve Ecological Survey.

Plot Number	UTM Easting	UTM Northing	Datum	Alliance Acronym	PA1 Acronym	PA2 Acronym	Phase Acronym
01VC095	362981	3981683	NAD27	CARUTR	JUNLON		
01VC096	362981	3981683	NAD27	JUNBAl	AGRGIG		
01VC097	362993	3981667	NAD27	FESARI	BLETRI		POAPRA
01VC098	363000	3981612	NAD27	DANPAR	FESARI		BLETRI
01VC099	365794	3975166	NAD27	FESARI	BOUGRA		POAPRA
01VC100	366166	3974981	NAD27	ABICON	ERIEXI		

APPENDIX D -- VEGETATION SUMMARY TABLES

Table D-1. The most common species encountered in Montane Valley Grasslands during 2001 (>10% of the plots). N= number of plots out of 28; Avg Cov = average cover where present; Max Cov = maximum recorded cover.

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov
Tree	Pinus ponderosa	ponderosa pine	PINPON	3	0.001	0.001
Shrub	Pentaphylloides floribunda	shrubby cinquefoil	PENFLO	6	0.567	3.000
	Artemisia frigida	fringed sagewort	ARTFRI	4	0.075	0.100
Grass	Agrostis scabra	rough bentgrass	AGRSCA	7	0.686	3.000
	Blepharoneuron tricholepis	pine dropseed	BLETRI	23	14.826	62.000
	Bouteloua gracilis	blue grama	BOUGRA	6	18.933	41.500
	Bromus anomalus	nodding brome	BROANO	4	0.925	3.000
	Bromus ciliatus	fringed brome	BROCIL	6	0.500	0.500
	Carex foenea	dryspike sedge	CARFOE	7	3.286	17.500
	Carex obtusata	obtuse sedge	CAROBT	3	4.500	7.500
	Danthonia parryi	Parry's Danthonia	DANPAR	16	40.381	85.000
	Elymus elymoides	bottlebrush squirreltail	ELYELY	16	1.238	7.500
	Elymus trachycaulus	slender wheatgrass	ELYTRA	5	0.900	3.000
	Festuca arizonica	Arizona fescue	FESARI	22	16.050	41.500
	Festuca thurberi	Thurber's fescue	FESTHU	8	18.875	62.500
	Juncus balticus	Baltic rush	JUNBAL	13	3.169	17.500
	Koeleria macrantha	prairie junegrass	KOEMAC	18	3.165	13.000
	Muhlenbergia montana	mountain muhly	MUHMON	16	8.100	62.500
	Muhlenbergia wrightii	spike muhly	MUHWRI	4	1.900	4.000
	Phleum pratense	timothy	PHLPRA	3	0.337	0.500
	Poa pratensis	Kentucky bluegrass	POAPRA	17	13.942	97.500
Forb	Achillea millefolium	common yarrow	ACHMIL	28	4.712	17.500
	Agoseris aurantica	orange agoseris	AGOAUR	12	0.185	0.500
	Allium cernuum	nodding onion	ALLCER	3	0.070	0.100
	Antennaria parvifolia	smallleaf pussytoes	ANTPAR	3	3.667	5.000
	Antennaria spp.	pussytoes	ANTENN	17	4.476	17.500
	Arenaria fendleri	Fendler's sandwort	AREFEN	13	3.931	17.500
	Artemisia carruthii	Carruth's sagewort	ARTCAR	7	0.629	3.000
	Artemisia ludoviciana	Louisiana sagewort	ARTLUD	6	1.200	3.000
	Campanula parryi	Parry's bellflower	CAMPAR	3	0.037	0.100
	Campanula rotundifolia	bluebell bellflower	CAMROT	20	0.420	3.000
	Cerastium arvense	mouseear chickweed	CERARV	5	0.340	0.500
	Chenopodium neomexicanum	New Mexico goosefoot	CHENEO	3	0.367	0.500
	Erigeron flagellaris	trailing fleabane	ERIFLA	15	2.153	7.500
	Erigeron formosissimus	beautiful fleabane	ERIFOR	19	2.134	17.500
	Gentiana affinis	pleated gentian	GENAFF	10	0.210	0.500
	Heterotheca villosa	hairy goldenaster	HETVIL	6	0.150	0.500
	Hieracium spp.	hawkweed	HIERAC	3	1.200	3.000
	Iris missouriensis	Rocky Mountain iris	IRIMIS	12	0.608	3.000
	Polygonum douglasii	Douglas' knotweed	POLDOU	4	0.825	3.000
	Potentilla hippiana	woolly cinquefoil	POTHIP	28	4.982	17.500
	Potentilla pulcherrima	beautiful cinquefoil	POTPUL	4	0.300	0.500
	Pseudocymopterus montanus	alpine false springparsley	PSEMON	6	0.135	0.500
	Ranunculus cardiophyllus	heartleaf buttercup	RANCAR	13	0.855	3.000
	Rumex acetosella	common sheep sorrel	RUMACE	4	1.025	3.000
	Silene	catchfly	SILENE	4	0.100	0.100
	Sisyrinchium montanum	mountain blue-eyed grass	SISMON	3	0.100	0.100
	Symphyotrichum ascendens	western aster	SYMASC	3	1.067	3.000
	Taraxacum officinale	common dandelion	TAROFF	25	2.040	7.500
	Trifolium repens	white clover	TRIREP	5	3.800	7.500

Vicia americana	american vetch	VICAME	9	0.278	0.500

Table D-2. The most common species encountered in Mixed Conifer Forests during 2001 (>10% of the plots). N= number of plots out of 25; Avg Cov = average cover where present; Max Cov = maximum recorded cover.

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov
Tree	Abies concolor	white fir	ABICON	16	14.322	50.000
	Acer glabrum	Rocky Mountain maple	ACEGLA	9	3.600	15.000
	Picea pungens	blue spruce	PICPUN	7	18.120	40.000
	Pinus flexilis	limber pine	PINFLE	14	4.650	21.000
	Pinus ponderosa	ponderosa pine	PINPON	8	6.375	15.000
	Populus tremuloides	quaking aspen	POPTRE	16	3.215	15.000
	Pseudotsuga menziesii	Douglas fir	PSEMEN	20	37.643	60.000
	Robinia neomexicana	New Mexico locust	ROBNEO	4	0.300	0.500
Shrub	Holodiscus dumosus	rockspirea	HOLDUM	5	1.900	3.000
	Jamesia americana	cliffbush	JAMAME	11	3.873	17.500
	Juniperus communis	common juniper	JUNCOM	16	4.981	41.500
	Physocarpus monogynus	mountain ninebark	PHYMON	5	2.900	7.500
	Ribes leptanthum	trumpet gooseberry	RIBLEP	3	0.367	0.500
	Rosa woodsii	Woods' rose	ROSWOO	11	0.355	1.000
	Rubus parviflorus	thimbleberry	RUBPAR	10	0.461	3.000
	Mahonia repens	Oregongrape	MAHREP	7	4.529	17.500
	Paxistima myrsinites	myrtle boxleaf	PAXMYR	16	2.344	7.500
	Vaccinium myrtillus	whortleberry	VACMYR	4	10.025	17.500
Grass	Agrostis scabra	rough bentgrass	AGRSCA	3	0.233	0.500
	Bromus ciliatus	fringed brome	BROCIL	23	1.204	7.000
	Carex spp.	sedge	CAREX	14	2.400	7.500
	Carex foenea	dryspike sedge	CARFOE	3	0.367	0.500
	Carex rostrata	beaked sedge	CARROS	7	1.100	3.000
	Elymus trachycaulus	slender wheatgrass	ELYTRA	4	2.375	3.000
	Festuca arizonica	Arizona fescue	FESARI	3	2.033	3.000
	Festuca sororia	ravine fescue	FESSOR	4	1.650	3.000
	Festuca thurberi	Thurber's fescue	FESTHU	5	4.400	15.000
	Koeleria macrantha	prairie junegrass	KOEMAC	10	1.090	3.000
	Melica porteri	Porter's melicgrass	MELPOR	3	0.367	0.500
	Phleum pratense	timothy	PHLPRA	3	1.167	3.000
	Poa pratensis	Kentucky bluegrass	POAPRA	6	4.033	17.500
	Trisetum montanum	Rocky Mountain trisetum	TRIMON	11	1.600	3.000
Forb	Achillea millefolium	common yarrow	ACHMIL	4	0.400	0.500
	Antennaria spp.	pussytoes	ANTENN	4	1.025	3.000
	Aquilegia coerulea	Colorado columbine	AQUCOE	7	0.200	0.500
	Artemisia franserioides	ragweed sagebrush	ARTFRA	16	1.106	3.000
	Campanula rotundifolia	bluebell bellflower	CAMROT	5	0.080	0.100
	Castilleja miniata	scarlet Indian paintbrush	CASMIN	3	0.067	0.100
	Clematis columbiana	rock clematis	CLECOL	9	0.233	0.500
	Draba aurea	golden draba	DRAAUR	8	0.088	0.100
	Erigeron eximius	sprucefir fleabane	ERIEXI	8	4.950	17.500
	Erigeron flagellaris	trailing fleabane	ERIFLA	3	0.367	0.500
	Erigeron formosissimus	beautiful fleabane	ERIFOR	4	1.625	3.000
	Erigeron subtrinervis	threenerve fleabane	ERISUB	3	0.367	0.500
	Fragaria vesca	woodland strawberry	FRAVES	21	2.371	7.500
	Galium aparine	stickywilly	GALAPA	7	0.373	0.500
	Galium boreale	Northern bedstraw	GALBOR	5	0.840	3.000
	Geranium richardsonii	Richardson's geranium	GERRIC	9	0.922	3.000
	Goodyera oblongifolia	western rattlesnake plantain	GOOOBL	8	0.100	0.100
	Goodyera repens	lesser rattlesnake plantain	GOOREP	4	0.100	0.100
	Iris missouriensis	Rocky Mountain iris	IRIMIS	4	1.125	3.000

Table D-2 (continued). The most common species encountered in Mixed Conifer Forests during 2001 (>10% of the plots). N= number of plots out of 25; Avg Cov = average cover where present; Max Cov = maximum recorded cover

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov
	Lathyrus spp.	peavine	LATHYR	12	0.508	3.000
	Maianthemum racemosum ssp. amplexicaule	feathery false Solomon's seal	MAIRACA	6	0.167	0.500
	Maianthemum stellatum	starry false Solomon's seal	MAISTE	3	0.100	0.100
	Mertensia lanceolata	prairie bluebells	MERLAN	3	0.067	0.100
	Mertensia spp.	Bluebells	MERTEN	4	0.200	0.500
	Oreochrysum parryi	Parry's goldenrod	OREPAR	12	0.942	3.000
	Orthila secunda	sidebells wintergreen	ORTSEC	5	0.760	3.000
	Osmorhiza spp	sweetcicely	OSMORH	8	0.300	0.500
	Oxalis violacea	violet woodsorrel	OXAVIO	3	1.167	3.000
	Pedicularis procera	giant lousewort	PEDPRO	3	0.500	0.500
	Pseudocymopterus montanus	alpine false springparsley	PSEMON	7	0.271	0.500
	Pterospora andromedea	woodland pinedrops	PTEAND	3	0.037	0.100
	Senecio eremophilus	desert groundsel	SENERE	5	0.178	0.500
	Senecio fendleri	Fendler's ragwort	SENFEN	6	0.300	0.500
	Silene scouleri ssp. pringlei	Pringle's campion	SILSCOP	3	0.100	0.100
	Taraxacum officinale	common dandelion	TAROFF	6	1.184	3.000
	Thalictrum fendleri	Fendler's meadowrue	THAFEN	13	2.639	17.500
	Trifolium repens	white clover	TRIREP	4	2.150	7.500
	Vicia americana	american vetch	VICAME	3	0.233	0.500
	Viola canadensis	Canadian white violet	VIOCAN	10	1.290	7.500
	Woodsia oregana	Oregon woodsia	WOOORE	5	1.322	3.000

Table D-3. The most common species encountered in Spruce-Fir Forests during 2001 (>20% of the plots). N= number of plots out of 5; Avg Cov = average cover where present; Max Cov = maximum recorded cover.

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov
1	Abies lasiocarpa	subalpine fir	ABILAS	1	40	40
1	Picea engelmannii	Engelmann's spruce	PICENG	5	9	15
1	Pinus flexilis	limber pine	PINFLE	2	3.85	7.5
1	Populus tremuloides	quaking aspen	POPTRE	2	0.001	0.001
1	Pseudotsuga menziesii	Douglas fir	PSEMEN	2	7.75	8
2.5	Paxistima myrsinites	myrtle boxleaf	PAXMYR	3	1.2	3
2.5	Vaccinium myrtillus	whortleberry	VACMYR	2	9	17.5
3	Agrostis scabra	rough bentgrass	AGRSCA	2	0.0505	0.1
3	Bromus ciliatus	fringed brome	BROCIL	5	1.42	3
3	Carex spp.	sedge	CAREX	3	3	3
3	Danthonia parryi	Parry's Danthonia	DANPAR	2	22.25	41.5
3	Festuca thurberi	Thurber's fescue	FESTHU	2	3	3
3	Koeleria macrantha	prairie junegrass	KOEMAC	2	1.75	3
3	Trisetum montanum	Rocky Mountain trisetum	TRIMON	2	1.55	3
4	Achillea millefolium	common yarrow	ACHMIL	4	1.55	3
4	Artemisia franserioides	ragweed sagebrush	ARTFRA	2	0.1	0.1
4	Campanula rotundifolia	bluebell bellflower	CAMROT	2	0.3	0.5
4	Erigeron eximius	sprucefir fleabane	ERIEXI	2	17.5	17.5
4	Erigeron formosissimus	beautiful fleabane	ERIFOR	3	1.2	3
4	Fragaria vesca	woodland strawberry	FRAVESA	3	1.75	3
4	Galium boreale	Northern bedstraw	GALBOR	2	0.3	0.5
4	Geranium richardsonii	Richardson's geranium	GERRIC	3	0.5	0.5
4	Iris missouriensis	Rocky Mountain iris	IRIMIS	2	0.5	0.5
4	Lathyrus spp.	peavine	LATHYR	4	0.2	0.5
4	Orthila secunda	sidebells wintergreen	ORTSEC	2	1.55	3
4	Osmorhiza spp	sweetcicely	OSMORH	2	0.1	0.1
4	Potentilla hippiana	woolly cinquefoil	POTHIP	2	1.55	3
4	Pseudocymopterus montanus	alpine false springparsley	PSEMON	4	0.8	2.5
	Silene scouleri ssp. pringlei	Pringle's campion	SILSCOP	2	0.1	0.1
4	Taraxacum officinale	common dandelion	TAROFF	2	0.3	0.5
4	Vicia americana	american vetch	VICAME	3	1.2	3
4	Viola canadensis	Canadian white violet	VIOCAN	2	0.3	0.5

Table D-4. The most common species encountered in Ponderosa and Pinyon-Juniper Woodlands during 2001 (>10% of the plots). N= number of plots out of 9; Avg Cov = average cover where present; Max Cov = maximum recorded cover.

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov
`1	Abies concolor	white fir	ABICON	3	2.501	5.000
	Pinus edulis	pinyon pine	PINEDU	1	5.000	5.000
1	Pinus flexilis	limber pine	PINFLE	3	0.001	0.001
1	Pseudotsuga menziesii	Douglas fir	PSEMEN	2	3.000	3.000
1	Quercus gambelii	Gambel's oak	QUEGAM	3	1.067	3.000
1	Robinia neomexicana	New Mexico locust	ROBNEO	2	1.550	3.000
2	Juniperus communis	common juniper	JUNCOM	5	7.101	35.000
2	Rosa woodsii	Woods' rose	ROSWOO	2	1.750	3.000
3	Agrostis scabra	rough bentgrass	AGRSCA	2	0.100	0.100
3	Bromus ciliatus	fringed brome	BROCIL	7	0.986	3.000
3	Carex spp.	sedge	CAREX	6	10.500	41.500
3	Carex rostrata	beaked sedge	CARROS	2	0.300	0.500
3	Danthonia parryi	Parry's Danthonia	DANPAR	6	14.833	41.500
3	Elymus elymoides	bottlebrush squirreltail	ELYELY	8	0.350	0.500
3	Elymus x pseudorepens	false quackgrass	ELYPSE	3	1.200	3.000
3	Festuca arizonica	Arizona fescue	FESARI	5	6.220	17.500
3	Festuca thurberi	Thurber's fescue	FESTHU	2	1.750	3.000
3	Koeleria macrantha	prairie junegrass	KOEMAC	6	1.267	3.000
3	Muhlenbergia montana	mountain muhly	MUHMON	4	0.925	3.000
3	Phleum pratense	timothy	PHLPRA	2	0.100	0.100
3	Poa pratensis	Kentucky bluegrass	POAPRA	6	8.167	17.500
4	Achillea millefolium	common yarrow	ACHMIL	6	1.750	3.000
4	Allium cernuum	nodding onion	ALLCER	2	0.100	0.100
4	Antennaria spp.	pussytoes	ANTENN	4	1.750	3.000
4	Arenaria fendleri	Fendler's sandwort	AREFEN	2	0.100	0.100
4	Artemisia carruthii	Carruth's sagewort	ARTCAR	2	0.300	0.500
4	Artemisia ludoviciana	Louisiana sagewort	ARTLUD	2	0.300	0.500
4	Campanula rotundifolia	bluebell bellflower	CAMROT	6	0.233	0.500
4	Chenopodium neomexicanum	New Mexico goosefoot	CHENEO	3	0.233	0.500
4	Erigeron flagellaris	trailing fleabane	ERIFLA	4	0.300	0.500
4	Erigeron formosissimus	beautiful fleabane	ERIFOR	6	1.333	3.000
4	Erigeron speciosus	aspen fleabane	ERISPE	2	0.051	0.100
4	Fragaria spp	Strawberry	FRAGAR	2	1.750	3.000
4	Geranium caespitosum	pineywoods geranium	GERCAE	2	0.051	0.100
4	Geranium richardsonii	Richardson's geranium	GERRIC	3	1.333	3.000
4	Heterotheca villosa	hairy goldenaster	HETVIL	2	0.300	0.500
4	Iris missouriensis	Rocky Mountain iris	IRIMIS	4	0.400	0.500
4	Lathyrus spp.	peavine	LATHYR	5	0.500	0.500
4	Mertensia spp.	Bluebells	MERTEN	2	0.100	0.100
4	Osmorhiza spp	sweetcicely	OSMORH	2	0.100	0.100
4	Potentilla hippiana	woolly cinquefoil	POTHIP	6	1.200	3.000
4	Pseudocymopterus montanus	alpine false springparsley	PSEMON	7	0.157	0.500
4	Silene	catchfly	SILENE	2	0.100	0.100
4	Symphyotrichum laeve var. geyeri	Geyer's aster	SYMLAEG	2	0.051	0.100
4	Taraxacum officinale	common dandelion	TAROFF	5	4.320	17.500
4	Thalictrum fendleri	Fendler's meadowrue	THAFEN	2	0.051	0.100
4	Trifolium repens	white clover	TRIREP	3	2.167	3.000
4	Vicia americana	american vetch	VICAME	3	0.367	0.500

Table D-5. The most common species encountered in Quaking Aspen Forests during 2001 (>20% of the plots). N= number of plots out of 4; Avg Cov = average cover where present; Max Cov = maximum recorded cover.

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov
1	Abies concolor - adv regen	white fir	ABICON2	3	1.167	3.000
1	Pinus flexilis	limber pine	PINFLE	2	0.500	1.000
1	Pinus ponderosa	ponderosa pine	PINPON	2	8.750	10.000
1	Populus tremuloides	quaking aspen	POPTRE	4	47.000	75.000
1	Quercus gambelii	Gambel's oak	QUEGAM	2	0.001	0.001
2	Holodiscus dumosus	rockspirea	HOLDUM	2	0.051	0.100
2	Juniperus communis	common juniper	JUNCOM	2	9.000	17.500
3	Bromus ciliatus	fringed brome	BROCIL	4	5.375	17.500
3	Carex spp.	sedge	CAREX	4	4.625	7.500
3	Elymus elymoides	bottlebrush squirreltail	ELYELY	2	0.100	0.100
3	Elymus trachycaulus	slender wheatgrass	ELYTRA	2	1.750	3.000
3	Festuca thurberi	Thurber's fescue	FESTHU	3	14.867	41.500
3	Koeleria macrantha	prairie junegrass	KOEMAC	2	10.250	17.500
3	Poa pratensis	Kentucky bluegrass	POAPRA	2	45.750	62.500
4	Achillea millefolium	common yarrow	ACHMIL	4	3.000	3.000
4	Allium cernuum	nodding onion	ALLCER	2	0.100	0.100
4	Artemisia franserioides	ragweed sagebrush	ARTFRA	2	0.300	0.500
4	Campanula rotundifolia	bluebell bellflower	CAMROT	3	0.367	0.500
4	Erigeron subtrinervis	threenerve fleabane	ERISUB	2	0.100	0.100
4	Galium aparine	stickywilly	GALAPA	4	2.775	7.500
4	Geranium richardsonii	Richardson's geranium	GERRIC	2	1.750	3.000
4	Lathyrus spp.	peavine	LATHYR	2	1.550	3.000
4	Mertensia lanceolata	prairie bluebells	MERLAN	2	0.100	0.100
4	Phacelia heterophylla	varileaf phacelia	PHAHET	2	0.100	0.100
4	Pseudocymopterus montanus	alpine false springparsley	PSEMON	3	0.367	0.500
4	Senecio eremophilus	desert groundsel	SENERE	3	0.067	0.100
4	Taraxacum officinale	common dandelion	TAROFF	3	2.033	3.000
4	Thalictrum fendleri	Fendler's meadowrue	THAFEN	3	1.333	3.000
4	Trifolium repens	white clover	TRIREP	2	1.750	3.000
4	Vicia americana	american vetch	VICAME	3	2.833	7.500
4	Viola canadensis	Canadian white violet	VIOCAN	2	4.000	7.500

Table D-6. The most common species encountered in Montane Graminoid Wetlands during 2001 (>10% of the plots). N= number of plots out of 25; Avg Cov = average cover where present; Max Cov = maximum recorded cover. Wet Status= wetland status where OBL=obligate wetalnd species and FACW= facultative wetland species (can occasionally be found in non-wetland conditions)

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov	Wet Status
Shrub	Pentaphylloides floribunda	shrubby cinquefoil	PENFLO	9	1.222	7.500	FACW-
Grass	Agrostis scabra	rough bentgrass	AGRSCA	5	1.420	3.000	
	Alopecurus aequalis	shortawn foxtail	ALOAEQ	3	0.067	0.100	OBL
	Blepharoneuron tricholepis	pine dropseed	BLETRI	4	0.900	3.000	
	Calamagrostis stricta	slimstem reedgrass	CALSTR	3	1.067	3.000	
	Carex aquatilis	water sedge	CARAQU	3	33.500	41.500	OBL
	Carex foenea	dryspike sedge	CARFOE	5	28.400	62.500	
	Carex lanuginosa	woolly sedge	CARLAN	3	21.833	55.000	OBL
	Carex microptera	smallwing sedge	CARMIC	4	43.625	62.500	FACW
	Carex spp.	sedge	CAREX	8	27.138	85.000	
	Carex utriculata	Northwest Territory sedge	CARUTR	8	40.188	85.000	
	Deschampsia	hairgrass	DESCHA	5	16.220	41.500	
	Deschampsia cespitosa	tufted hairgrass	DESCES	10	25.000	85.000	FACW-
	Eleocharis acicularis	needle spikerush	ELEACI	2	10.050	20.000	
	Eleocharis palustris	common spikerush	ELEPAL	4	30.050	90.000	OBL
	Eleocharis spp.	spikerush	ELEOCH	2	2.750	5.000	
	Elymus trachycaulus	slender wheatgrass	ELYTRA	5	0.420	0.500	
	Glyceria borealis	northern mannagrass	GLYBOR	2	42.500	80.000	OBL
	Hordeum brachyantherum	meadow barley	HORBRA	2	0.300	0.500	
	Hordeum jubatum	foxtail barley	HORJUB	7	0.543	3.000	
	Juncus balticus	Baltic rush	JUNBAL	7	11.643	41.500	OBL
	Juncus longistylis	longstyle rush	JUNLON	5	1.420	3.000	FACW
	Juncus spp.	Rush	JUNCUS	2	41.500	41.500	
	Koeleria macrantha	prairie junegrass	KOEMAC	2	1.550	3.000	
	Lycurus setosus	bristly wolfstail	LYCSET	2	0.051	0.100	
	Muhlenbergia wrightii	spike muhly	MUHWRI	3	0.233	0.500	
	Phleum alpinum	alpine timothy	PHLALP	2	1.750	3.000	
	Phleum pratense	timothy	PHLPRA	13	2.831	17.500	
	Poa palustris	fowl bluegrass	POAPAL	4	3.500	7.500	
	Poa pratensis	Kentucky bluegrass	POAPRA	8	13.963	41.500	
Forb	Achillea millefolium	common yarrow	ACHMIL	13	4.410	7.500	
	Agoseris aurantica	orange agoseris	AGOAUR	6	0.150	0.500	
	Allium geyeri	Geyer's onion	ALLGEY	8	0.175	0.500	
	Argentina anserina	silverweed cinquefoil	ARGANS	13	4.277	17.500	OBL
	Campanula parryi	Parry's bellflower	CAMPAR	2	0.300	0.500	
	Cerastium arvense	mouseear chickweed	CERARV	2	0.300	0.500	FACW
	Cirsium parryi	Parry's thistle	CIRPAR	2	0.100	0.100	
	Conioselinum scopulorum	Rocky Mt. hemlock parsley	CONSCO	3	0.367	0.500	
	Crepis runcinata	fiddleleaf hawksbeard	CRERUN	4	0.175	0.500	
	Epilobium ciliatum	hairy willowherb	EPICIL	5	0.180	0.500	FACW
	Epilobium leptophyllum	bog willowherb	EPILEP	3	1.200	3.000	
	Equisetum arvense	field horsetail	EQUARV	2	0.100	0.100	FACW
	Erigeron formosissimus	beautiful fleabane	ERIFOR	4	2.150	7.500	
	Erigeron lonchophyllus	shortray fleabane	ERILON	4	0.900	3.000	
	Gentianopsis thermalis	Rocky Mountain fringed gentian	GENTHE	4	0.100	0.100	
	Gnaphalium exilifolium	slender cudweed	GNAEXI	4	0.100	0.100	
	Hypericum scouleri ssp. nortoniae	Norton's St. Johnswort	HYPSCON	4	1.550	3.000	
	Iris missouriensis	Rocky Mountain iris	IRIMIS	5	0.800	3.000	FACW

Table D-6 (continued). The most common species encountered in Montane Graminoid Wetlands during 2001 (>10% of the plots). N= number of plots out of 25; Avg Cov = average cover where present; Max Cov = maximum recorded cover. Wet Status= wetland status where OBL=obligate wetalnd species and FACW= facultative wetland species (can occasionally be found in non-wetland conditions)

LF	Common Name	Species Name	Species Code	N	Avg Cov	Max Cov	Wet Status
	Lemna spp.	duckweed	LEMNA	2	0.300	0.500	
	Mentha arvensis	wild mint	MENARV	5	0.220	0.500	FACW
	Orthocarpus luteus	yellow owlclover	ORTLUT	3	0.100	0.100	
	Polygonum amphibium	water knotweed	POLAMP	2	1.750	3.000	OBL
	Polygonum douglasii	Douglas' knotweed	POLDOU	2	0.051	0.100	
	Polygonum erectum	erect knotweed	POLERE	2	0.100	0.100	
	Potamogeton nodosus	longleaf pondweed	POTNOD	2	3.800	7.500	
	Potentilla hippiana	woolly cinquefoil	POTHIP	8	7.125	41.500	
	Potentilla pulcherrima	beautiful cinquefoil	POTPUL	2	0.300	0.500	
	Ranunculus cardiophyllus	heartleaf buttercup	RANCAR	6	0.684	3.000	OBL
	Rorippa sphaerocarpa	roundfruit yellowcress	RORSPH	3	0.200	0.500	OBL
	Rumex acetosella	common sheep sorrel	RUMACE	2	0.300	0.500	FACW
	Rumex crispus	curly dock	RUMCRI	4	0.100	0.100	FACW
	Sparganium angustifolium	narrowleaf burreed	SPAANG	2	37.000	69.000	
	Spiranthes romanzoffiana	hooded ladies tresses	SPIROM	3	0.100	0.100	OBL
	Symphyotrichum ascendens	western aster	SYMASC	8	0.550	3.000	
	Taraxacum officinale	common dandelion	TAROFF	10	3.640	17.500	
	Trifolium repens	white clover	TRIREP	12	3.713	17.500	
	Trifolium wormskioldii	cows clover	TRIWOR	3	0.233	0.500	
	Veronica americana	American speedwell	VERAME	2	0.051	0.100	OBL
	Veronica peregrina ssp. xalapensis	hairy purslane speedwell	VERPERX	4	0.100	0.100	
	Vicia americana	american vetch	VICAME	2	0.051	0.100	
	Viola spp.	Violet	VIOLA	3	6.033	17.500	OBL