Final Report

U.S. Geological Survey and National Park Service Vegetation Mapping Survey

National Park Service Inventory and Monitoring Program

National Biological Information Infrastructure Program

Florissant Fossil Beds National Monument

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U.S.Geological Survey and National Park Service Vegetation Mapping Program

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ACKNOWLEDGEMENTS

This project was completed efficiently because of the effort and dedication of several individuals and organizations. In particular, the foresight of Mike Story and Tom Owens to recognize this Monument as a high priority vegetation classification and mapping project site was integral. The effort by Marion Reid and Denise Culver to provide a preliminary classification to be discussed at the scoping meeting and to guide the initial field review was a key first step. In addition, the effort by Marion Reid and Keith Schulz to provide the classification, and allow preparation of the field key and cross-walk tables allowed sufficient time to prepare a preliminary report and design the accuracy assessment.

Participation by the Florissant Fossil Beds National Monument staff, under the guidance of Superintendent Jean Rodek and Senior Natural Resources Specialist Tom Ulrich, was outstanding. During the course of the study, staff members Sharon Anderson, Dan Carlisle, Michelle Dooley, and Emma Danby participated in the field data collection with energy and enthusiasm, allowing the effort to run extremely smoothly. These staff members contributed to all phases of data collection; while their knowledge of the valley and meadow system allowed efficient sample site selection in the wetland environments.

Thanks go Stewart Wright of the USGS Rocky Mountain Mapping Center for his assistance in preparing the final materials for this project. Acknowledge is also made to Stacy Welding of Orkand Corporation for her automation of the accuracy assessment data.

EXECUTIVE SUMMARY

The United States Geological Survey (USGS), Biological Resources Discipline, in cooperation with the Inventory and Monitoring Program of the National Park Service, has initiated a multi-year project to classify, describe, and map vegetation for 270 national parks. As a cooperator under the national vegetation mapping program, the USGS Rocky Mountain Mapping Center, with assistance from the Monument, NatureServe, the Colorado Natural Heritage Program, and engineering-environmental Management, Inc. has classified and mapped the vegetation occurring in and around Florissant Fossil Beds National Monument. Twenty eight vegetation map units (**Table ES-1**) and Anderson Level II land-use units were used for interpretation of approximately 8,000 acres encompassing the Monument (approximately 5,998 acres) and surrounding environs (approximately 2,002 acres). The interpreted data were digitally transferred into a geographic information system database.

Vegetation map units were determined through thorough field reconnaissance, data collection, and analysis in accordance with the National Vegetation Classification System. The vegetation map was created from photographic interpretation of 1996, 1:15,000 scale color aerial photographs (0.5 hectare minimum mapping unit). All vegetation and land-use information was then transferred to USGS digital orthophoto quarter-quads created from the color photography using a combination of on-screen digitizing and image processing techniques. Arc/Info™ (ESRI, Inc.) software was used throughout the project for digitizing, scanning, transforming, registering, and plotting the interpreted data. Overall thematic accuracy for the entire mapping effort was assessed at 76.9% with a Kappa Index of .744. The overall 90% confidence interval was 73.8% to 80.0 %.

The final products are described in this report and occur on the accompanying CD-ROM; they include the following:

- Vegetation Classification and Descriptions
- Map Classification System
- Illustrated Vegetation Key
- Representative Photos from Field Studies
- Digital and Hard Copy Vegetation Maps
- Digital Vegetation, Boundary, Field Data Points, and Road Coverages
- Accuracy Assessment
- FGDC Compliant Spatial Database Metadata
- Final Report

The Florissant Fossil Beds National Monument and similar national park vegetation mapping databases can be accessed at the USGS web site: http://biology.usgs.gov/npsveg.

TABLE ES - 1. MAP UNIT DESCRIPTIONS AND VEGETATION CLASSIFICATION FOR FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

MAP CODE	MAP UNIT CODE	MAP UNIT NAME	NatureServe Unique Identifier	ASSOCIATIONS
More than one Map Unit corresponds to more than one Association (many to many)				
3	SDF	*Picea pungens / Juniperus communis* Forest + *Pseudostuga menziesii / Juniperus communis* Forest	*[CEGL000392]*	*Picea pungens / Juniperus communis Forest*
			[CEGL000439]	*Pseudostuga menziesii / Juniperus communis* Forest
4	SDAF	*Picea pungens / Juniperus communis* Forest + *Pseudostuga menziesii / Juniperus communis* Forest + *Populus tremuloides / Juniperus communis* Forest	[CEGL000392]	*Picea pungens / Juniperus communis* Forest
			[CEGL000439]	*Pseudostuga menziesii / Juniperus communis* Forest
			[CEGL000587]	*Populus tremuloides / Juniperus communis* Forest
One Map Unit corresponds to more than one Association (one to many)				
21	MWS	*Salix monticola / Carex utriculata* Shrubland + *Salix monticola /* Mesic Graminoids Shrubland	[CEGL002657]	*Salix monticola / Carex utriculata* Shrubland
			[CEGL002654]	*Salix monticola* / Mesic Graminoids Shrubland
23	DHV	*Lemna* spp. Permanently Flooded Herbaceous Vegetation + *Myriophyllum sibiricum* Herbaceous Vegetation	[CEGL003059]	*Lemna* spp. Permanently Flooded Herbaceous Vegetation
			[CEGL002000]	*Myriophyllum sibiricum* Herbaceous Vegetation
26	SRHV	*Carex aquatilis* Herbaceous Vegetation + Carex utriculata Herbaceous Vegetation + *Juncus balticus* Herbaceous Vegetation	[CEGL001802]	*Carex aquatilis* Herbaceous Vegetation
			[CEGL001562]	*Carex utriculata* Herbaceous Vegetation
			[CEGL001838]	*Juncus balticus* Herbaceous Vegetation
28	AFMMHV	*Festuca arizonica - Muhlenbergia montana* Herbaceous Vegetation + *Muhlenbergia montana* Herbaceous Vegetation	[CEGL001606]	*Festuca arizonica - Muhlenbergia montana* Herbaceous Vegetation
			[CEGL001646]	*Muhlenbergia montana* Herbaceous Vegetation
30	AFSMHV	*Muhlenbegia filiculmis* Herbaceous Vegetation + *Festuca arizonica - Muhlenbergia filiculmis* Hebaceous Vegetation	[CEGL001780]	*Muhlenbergia filiculmus* Herbaceous Vegetation
			[CEGL001605]	*Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation
31	LBY	*Schizachyrium scoparium* Herbaceous Vegetation + *Yucca glauca / Muhlenbergia montana* Shrubland	Park Special*	*Schizachyrium scoparium* Herbaceous Vegetation
			Park Special	*Yucca glauca / Muhlenbergia montana* Shrubland

One Map Unit corresponds to one Association (one to one)				
5	BPW	*Pinus aristata / Festuca arizonica* Woodland	[CEGL000759]	*Pinus aristata / Festuca arizonica* Woodland
7	PPW	*Pinus ponderosa / Festuca arizonica* Woodland	[CEGL000856]	*Pinus ponderosa / Festuca arizonica* Woodland

9	PPSBW	*Pinus ponderosa / Bromus inermis* Semi-natural Woodland	New CEGL002943	*Pinus ponderosa / Bromus inermis* Semi-natural Woodland
10	BAPW	*Populus balsamifera* Woodland	Park Special	*Populus balsamifera* Woodland
11	AF	*Populus tremuloides / Juniperus communis* Forest	[CEGL000587]	*Populus tremuloides / Juniperus communis* Forest
14	TAS	*Alnus incana* / Mesic Graminoids Shrubland	[CEGL0001148]	*Alnus incana* / Mesic Graminoids Shrubland
15	SSS	*Artemisia frigida / Bouteloua gracilis* Dwarf-Shrubland	Park Special CEGL002782	*Artemisia frigida / Bouteloua gracilis* Dwarf-Shrubland
16	MMS	*Cercocarpus montanus / Muhlenbergia montana* Shrubland	New CEGL002914	*Cercocarpus montanus / Muhlenbergia montana* Shrubland
17	SCS	*Dasiphora fruticosa* Temporarily Flooded Shrubland	Alliance**	*Dasiphora fruticosa* Temporarily Flooded Shrubland
18	WROS	*Jamesia americana* Rock Outcrop Shrubland	New CEGL002783	*Jamesia americana* Rock Outcrop Shrubland
19	SHWS	*Salix brachycarpa / Carex aquatilis* Shrubland	[CEGL001244]	*Salix brachycarpa / Carex aquatilis* Shrubland
20	SBWS	*Salix exigua* Temporarily Flooded Shrubland	[CEGL001197]	*Salix exigua* Temporarily Flooded Shrubland
22	CTHV	*Cirsium arvense* - Weedy Forbs Herbaceous Vegetation	Park Special	Cirsium arvense - Weedy Forbs Herbaceous Vegetation
24	THV	*Linaria vulgaris* / Mixed Graminoids Semi-natural Herbaceous Vegetation	Park Special	*Linaria vulgaris* / Mixed Graminoids Semi-natural Herbaceous Vegetation
25	SBHV	*Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Hebaceous Vegetation	New CEGL005264	*Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Hebaceous Vegetation
27	POHV	*Danthonia parryi* Herbaceous Vegetation	[CEGL001795]	*Danthonia parryi* Herbaceous Vegetation
29	FBHV	*Hordeum jubatum* Semi-natural Herbaceous Vegetation	[CEGL001798]	*Hordeum jubatum* Semi-natural Herbaceous Vegetation
Associations below minimum mapping unit				
None	None	*Picea pungens / Betula occidentalis* Woodland (2 points of known instances)	[CEGL002637]	*Picea pungens / Betula occidentalis* Woodland
None	None	*Prunus virginiana* - (*Prunus americana*) Shrubland (1 point of known instance)	Park Special CEGL001108	*Prunus virginiana* - (*Prunus americana*) Shrubland
None	None	*Elaeagnus commutat*a Shrubland (1 point of known instance)	Park Special	*Elaeagnus commutata* Shrubland
None	None	*Agropyron cristatum* - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation (1 point of known instance)	Park Special	*Agropyron cristatum* - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation
None	None	*Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation (2 points of known instances)	Park Special CEGL001647	*Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation
None	None	*Carex nebrascencis* Herbaceous Vegetation (1 point of known instance)	Park Special CEGL001813	*Carex nebrascencis* Herbaceous Vegetation

None	None	*Phalaris arundinacea* Western Herbaceous Vegetation (3 points of known instances)	[CEGL001474]	*Phalaris arundinacea* Western Herbaceous Vegetation
None	None	*Chrysothamnus viscidiflorus - Ericameria parryi* Shrub Herbaceous Vegetation (6 points of known instances)	New CEGL002781	*Chrysothamnus viscidiflorus - Ericameria parryi* Shrub Herbaceous Vegetation
None	None	*Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation (1 point of known instance)	Park Special	*Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation
None	None	*Paronychia sessiliflora* Herbaceous Vegetation (1 point of known instance)	Park Special	*Paronychia sessiliflora* Herbaceous Vegetation
Association in list, but does not have any field data				
None	None	(*Salix ligulifolia* Shrubland) (1 point of known instance recorded as *Salix lutea*)	Park Special CEGL001218	*Salix ligulifolia* Shrubland

* Park Special = Plant associations that are unique to the Monument and do not meet NVC standards
** Alliance = This vegetation was identified only to the Alliance level, one level above the association level. An Alliance is a group of plant associations characterized by a common overstory species

1.0 INTRODUCTION

1.1 U.S. GEOLOGICAL SURVEY - NATIONAL PARK SERVICE VEGETATION MAPPING PROGRAM

The USGS-NPS Vegetation Mapping Program is a cooperative effort between the U.S. Geological Survey (USGS) and the National Park Service (NPS) to produce detailed digital databases, including vegetation maps of National Parks. The NPS Inventory and Monitoring Program is managing the Park Service effort and has established a repeatable set of standards and flexible protocols (**Appendix A**).The USGS, as part of the National Biological Information Infrastructure Program (NBII), is managing its portion of the program (NBII 2002a). Approximately 270 National Park units will benefit from this cooperative effort.

At the program's inception in 1994, four documents were written to describe protocols and standards for data collection and analysis. The basic tenets of these documents are (from USGS 2002):

- Developing and documenting a National Vegetation Classification Standard (The Nature Conservancy and ESRI 1994a),
- Establishing standards for field methods and mapping procedures (TNC and ESRI 1994b),
- Producing rigorous and consistent accuracy assessment procedures (ESRI, NCGIA, and TNC 1994), and
- Establishing standards for using existing vegetation data (TNC and ESRI 1994a).

National Park vegetation data are entered in a digital database in accordance with the Federal Geographic Data Committee (FGDC) National Vegetation Classification Standard (NVCS). Under the NPS Inventory and Monitoring Program, national mapping accuracy standards must be met for the map unit level at a scale of 1:24,000 and with a minimum mapping unit of 0.5 hectare (ha) (NBII 2002a). This means that each well-defined object in the spatial database will be within 1/50 of an inch of its actual location (which equals 40 feet or 12.2 meters). The classification accuracy standard states that each map class or unit will meet or exceed 80% accuracy at the 90% confidence level. The classification accuracy will be established by the program accuracy assessment protocols defined under Section 4.0 of this report.

All map products are accompanied by detailed FGDC-compliant metadata. Metadata are data about data, e.g., information that describe how the spatial dataset was developed, the projection of the spatial dataset, the attribute definitions, etc. Metadata are critical elements of each spatial dataset, allowing future users of the spatial dataset to understand its creation, data discovery and use, and by expediting the exchange of vegetation data and information. The basic tool for metadata creation is MetaMaker: http://www.nbii.gov/datainfo/metadata/tools/metamaker.

1.2 FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

Prior to European settlement, Florissant Fossil Beds National Monument (hereinafter referred to as FLFO, the Monument, or Florissant) and the surrounding area were occupied by two Ute tribes; the primary occupant was the Uncompahgre (Taviwach) Tribe (Horn et al. 1996). Ute tribal members had acquired horses from Spanish explorers and settlers in New Mexico, and moved freely across what is now the Monument. The town of Florissant was founded and named by Judge James M. Castello when he opened a trading post on the site around 1870 (Teller County Division of Parks (TCDP) 1997; Cahill 1996; and Kimmet n.d.). Florissant was the name of Judge Castello's Missouri hometown Missouri and means "flowering" in French. The geologic and paleontologic resources near Florissant were described professionally three years later (TCDP 1997).

During the 1880s, ranching and farming operations became established around the town of Florissant. The homestead of Adelaine Hornbek, which was recently restored, was constructed around 1878 and has been subsequently restored by the NPS (**Figure 1-1**). Between 1887 and 1918, the Colorado Midland Railroad maintained tracks and provided services to Florissant and hauled both visitors and petrified wood to and from the Monument area (COSHS n.d.). These tracks, the wagon roads, and seed for crops provided introduction routes for the first exotic plant species introduced to the region.

FIGURE 1-1. HORNBEK HOMESTEAD

Florissant Fossil Beds National Monument was authorized by Congress on August 20, 1969, because of concern over rapidly expanding real estate subdivisions within the Florissant area (Scott 1990). The Monument covers approximately 5,998 acres and lies immediately south of the town of Florissant, Colorado. However, the total area of present outcrop of fossil beds is about 15-square miles and the Monument lies near the south-central portion. The Monument (**Figure 1-3**) was established under Public Law 91-90:

> *"That in order to preserve and interpret for the benefit and enjoyment of present and future generations, the excellently preserved insect and leaf fossils and related geologic sites and objects at the Florissant lakebeds, the Secretary of the Interior may acquire by donation, purchase with donated or appropriated funds or exchange such lands and interests in land in Teller County, Colorado as he may designate from lands shown on the map."*

FIGURE 1-2. MONUMENT ENTRY SIGN

The fossil deposits were first professionally described by A.C. Peale in 1873 as part of the Hayden Geological and Geographical Survey (Scott 1990). At this time, the area was recognized as a petrified forest because of the tremendous amount of stumps and limbs remaining above ground, which were since removed from the landscape by collectors (Kimmet n.d.). This same area, following removal of the petrified wood, became known as the fossil beds because of the organisms preserved underground. Over 225 scientific articles have been written about the fossil beds, particularly the fossil forms recovered. These forms include an assemblage of delicately and beautifully preserved fossil plants and insects. Additionally, specimens of fossil fish and birds were found within the beds.

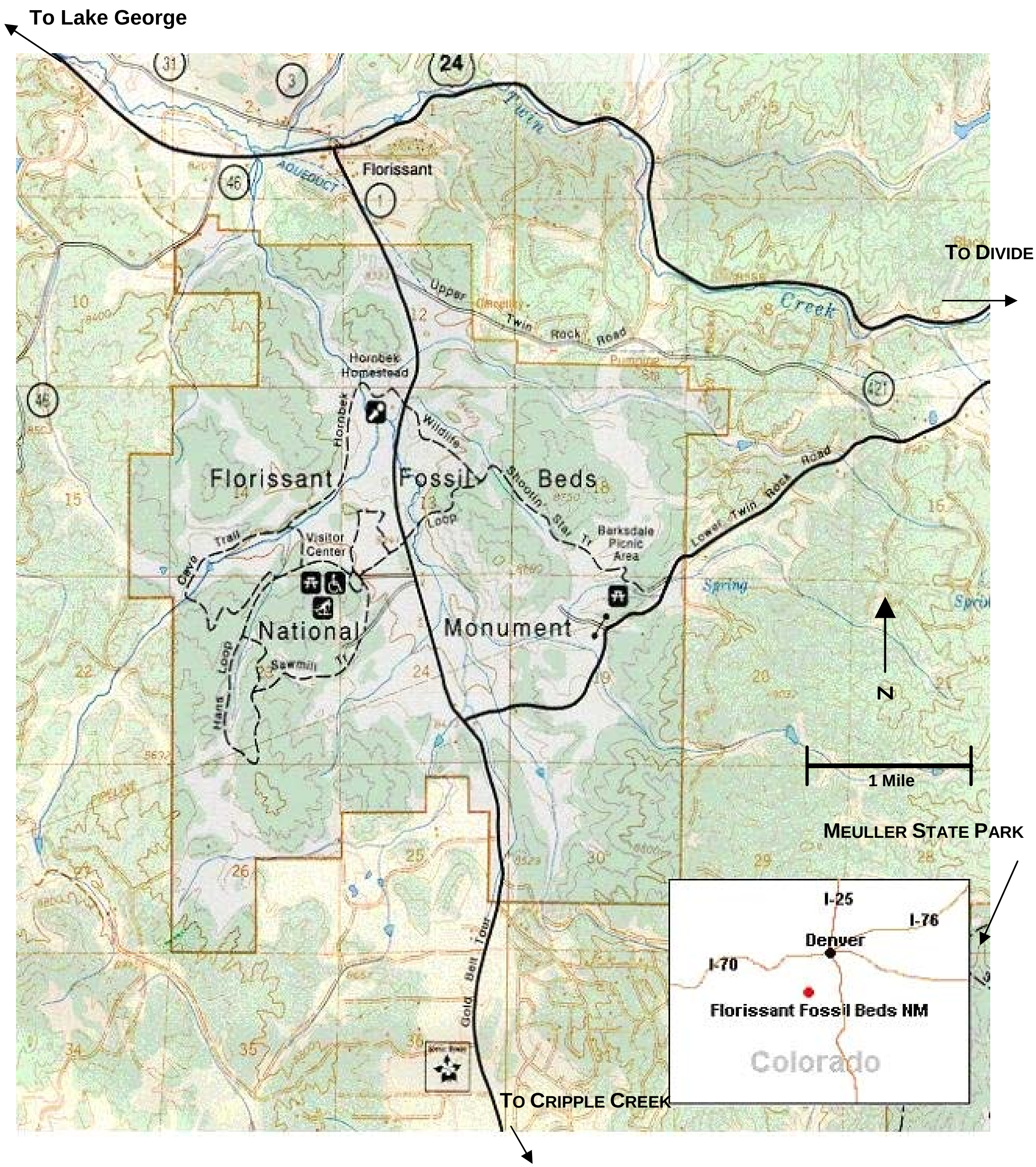


FIGURE 1-3. REGIONAL LOCATION MAP FOR FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

The lakebed deposits consist of a heterogeneous series of beds composed of intermediate composition volcanic detritus. They are less than 150-feet thick and because they are soft, are poorly exposed except in road cuts, recent stream valleys, and gullies (Scott 1990). Most of the delicate insect fossils are preserved in tuffaceous shale and mudstone near the middle of the sequence, e.g., arkosic conglomerate; andesitic tuff and mudflow breccia (lahar); thin-bedded tuffaceous shale, mudstone, and sandstone; pumiceous tuff; and volcanic conglomerate. Petrified stumps and logs of giant sequoia trees have been preserved in the andesitic tuff and mudflow deposits.

Climatic conditions were quite warm, perhaps even sub-tropical, when the lake was viable and active. Possible present-day climatic conditions simulating the ancient climate would include places such as northeastern Mexico, northeastern Australia, and northwestern India (Scott 1990).

Presently, there are seven maintained nature and hiking trails in the Monument (**Figure 1-3**), as follows (Platt 1993):

- Walk Through Time, 0.5 miles
- Petrified Forest Loop, 1.0 mile
- Hans Loop, 1.2 miles
- Sawmill Trail, 2.1 miles
- Cave Trail, 4.0 miles
- Hornbek Wildlife Loop, 4.0 miles
- Shootin' Star Trail, 2.0 miles

Three roads enter the Monument, i.e., Teller County 1 (TC-1) (3.8 miles long – asphalt), Lower Twin Rock Road (1.7 miles long – gravel), and Upper Twin Rock Road (1.7 miles long – gravel) (**Figure 1-3**). There are approximately 0.8 miles of internal Monument access roads.

1.3 GOALS OF VEGETATION MAPPING PROJECT

This report details the work performed for the Monument under the USGS-NPS Vegetation Mapping Program. The specific objectives of this study are:

- Collection and analysis of Florissant vegetation data,
- Creation of vegetation and mapping classifications based on the NVCS,
- Creation of a spatial database for the vegetation and land use of the Monument, using remote sensing and geographic information system (GIS) techniques, and
- Production of digital and hard-copy vegetation/land-use maps that are at least 80% accurate.

Various work contracts were approved for the following federal agencies and private organizations to produce a successful vegetation database for the Monument:

- USGS Rocky Mountain Mapping Center, at the Denver Federal Center, Lakewood, Colorado (CO) was the prime contractor and provided image analysis, created the GIS database, performed the accuracy assessment, and produced the final report.

- engineering-environmental Management, Inc., Littleton, CO, provided the vegetation data collection, data analysis, vegetation description, illustrated field key, accuracy assessment field data collection, and contributed to the final report.
- NatureServe, Boulder, CO, provided vegetation classification, vegetation description, and vegetation characterization services.

2.0 NATURAL RESOURCES

2.1 INTRODUCTION

Florissant Fossil Beds National Monument is located in a relatively dry park setting within the montane coniferous forest zone. The elevation is moderate for the region, with topographic variation of approximately 800 feet. The combination of geology, soils, hydrology, topography, and historic land-use patterns, has resulted in an unique array of plant associations and wildlife habitat.

2.1.1 Climate

The climate of the Florissant region is relatively dry, averaging approximately 15.49 inches of precipitation annually (**Figure 2-1**) (WRCC 2002). Most precipitation is in the form of afternoon showers from May through September. Total annual snowfall amounts average approximately 50 inches with a maximum accumulation of about two feet at any one time. However, the moisture equivalent of snow at the Monument is low, approximately 20:1 during the winter and 12:1 during the spring and fall months (the moisture equivalent ratio represents the depth of snow, in inches, required to produce one inch of moisture).

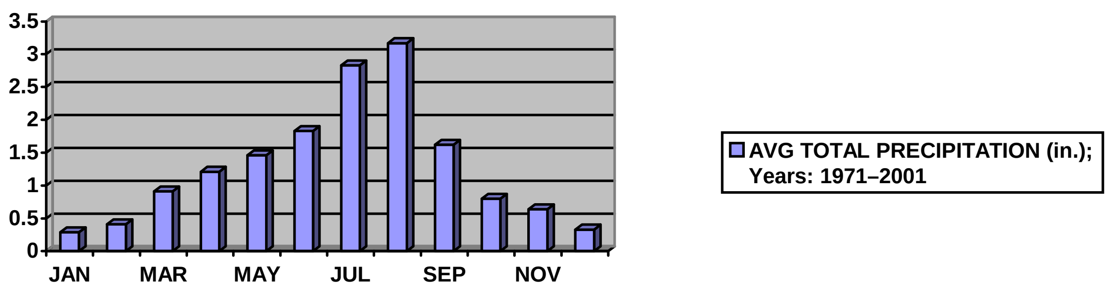


FIGURE 2-1. AVERAGE MONTHLY PRECIPITATION FOR FLFO

The weather can be described as typical for a mountain climate. Summers are short with warm days and cool nights; freezing temperatures can occur during the summer months. In the summer, afternoon thundershowers produce a significant amount of lightning and small hail. Temperatures can reach over 90 degrees Fahrenheit (ºF) in the summer, but begin to drop significantly in September, and snow is not uncommon in early fall. Winter months typically produce severe temperature drops and temperatures can drop to –35ºF. During 1992, 35 sub-zero ºF days were recorded, and in February 1989, sub-zero temperatures occurred for 72 hours.

The prevailing winds are from the west and may attain velocities of 35–40 miles per hour (mph) during the warmer seasons (USDI-NPS 1984). During the colder seasons, winds up to 70 mph have been recorded. Air quality was considered very good; the most important threat was considered to be rapid development of residential housing in the area (USDI-NPS 1984). Air quality may be affected by increased vehicular traffic and also by wood burning for home heating. A more recent effect that was not considered in 1984 is the increased traffic and pollution resulting from casino development in the town of Cripple Creek.

There are no fire weather data collected in the Monument; however, data collected at Lake George, CO, five miles away, are available. These data are collected by the Pike National Forest (USDI-NPS 1994).

2.1.2 Topography

The Monument occurs on the eastern slope of the Rocky Mountains between the elevations of 8,300–8,950 feet. Florissant is visually dominated by Pikes Peak (14,110-foot elevation), located 18 miles due east of the Monument (FLFO n.d.). The Monument is situated in a broad valley with several narrower branches surrounded by low hills and ridges (**Figures 1-3 and 2-2**). The valley floor ranges from approximately 8,300-feet in elevation at the north end of the Monument, to approximately 8,450 feet on the southern boundary. The highest elevations occur in the southeastern portion of the Monument at approximately 8,900 feet. Uplands in the Monument range from 8,500–8,800-feet in elevation.

2.2 GEOLOGY AND SOILS

2.2.1 Geology

Florissant was protected under the National Park System because it contains fossil-bearing beds of unusual significance (Taylor 1999). Most of the Monument is underlain by Precambrian Pikes Peak granite, part of the Pikes Peak batholith that is possibly one billion years old (USGS 1978; Taylor 1999). These rocks are coarse-grained biotite or biotite-hornblende granite exposed as outcrops on the flanks of hills and ridges within the Monument (**Figure 3-3**). In addition to Pikes Peak granite, small areas of Precambrian Cripple Creek granite and Tertiary extrusive volcanics have been documented in the area (Winternitz 1981). Four different rock units occured within the Monument and are described below from oldest to youngest (USDI-NPS 2001):

- Eocene: 39 million years ago; Echo Park Alluvium – reddish-brown to rusty red, massive, crudely stratified, poorly sorted, coarse grained, porphyritic; composed of microcline feldspar and quartz, minor plagioclase feldspar, clusters of sabiotite mica and hornblendes, with the red color due to finely disseminated hematite; an unconsolidated boulder alluvium with micaceous, silty, and sandy matrix; clasts are composed of Precambrian rocks, no volcanic detritus is present; and occurs as small isolated patches of valley fill in the Florissant Basin (Wobus and Epis 1978).

- Eocene: 36 to 35.5 million years ago; Wall Mountain Tuff – multiple flow, simple cooling unit of moderate to dense welding with autoxitic foliation; reddish-brown to yellowish-buff; potassic calc-alkalic rhyolite; abundant glassy sanidine and less abundant argillized andesine form principal phenocrysts, with some biotite; and occurs as remnants in paleovalleys, especially along margins of the Florissant Basin.

- Eocene: 55 to 34 million years ago; Florissant formation 34 to 33 million years ago – a) basal arkosic breccia; b) lower tuff; c) lower tuff and interfingering lake shales; d) lake shales: 1) whitish clay shales, 2) chocolate-colored clay shales with fossil leaves – upper part are black, 3) coarse gray and yellowish sandstone, 4) fine-grained, soft, yellowish-white sandstone, with bands that are more or less argillaceous, and containing fragments and stems of leaves, and 5) coarse, conglomeritic sandstone; e) upper tuff and interfingering lake shales; and f) upper tuff.

- Quaternary: 10,000 years ago to present; slope wash – coarse grained detrital fragments of Pikes Peak granite, forms steep slopes and low hills at base of eroded granite and at edges of valleys in the Florissant Basin; alluvium – fine to coarse grained sands, silts, and bog soils found along stream drainages.

FIGURE 2-2. OUTCROPS OF PIKES PEAK GRANITE WITHIN FLFO

The geomorphological elements observed at Florissant are primarily the result of mid- to late-Cenozoic volcanism, uplift, basin-range style of block faulting, and attendant erosion, as summarized below (USDI-NPS 2001):

- Laramide Orogeny: 72 million years ago; uplift of the central Colorado Rocky Mountains, initiated in the western part of the state, elevated the area probably no more than 3,000 feet.

- Eocene Erosion: 50 million years ago; paleo valleys indicate that drainage was to the east and southeast into the Great Plains (the Great Plains and the uplifted Rocky Mountains were at nearly the same elevation); many monadnocks (rocky masses that have resisted erosion and stands isolated in a level area) were produced within a nearly flat erosional surface; the products of this erosion filled basins and grabens elongated depressions between geologic faults) formed by the Laramide Orogeny; at the Monument, the Echo Park Alluvium was deposited by streams draining down Currant and Oil Creeks.

- Eocene Volcanism: 36 million years ago; massive ash flows emanating from the Mount Aetna caldera in the Sawatch Range resulted in the formation of the Wall Mountain Tuff; stream conglomerates containing clasts of the tuff were deposited over the tuff and are found presently as the Tallahassee Creek and Castle Rock conglomerates.

- Neogene Uplift and Block Faulting: 25 to 7 million years ago; during early Miocene (25 to 20 million years ago), the upper Arkansas River flowed south into the San Luis Valley; by the Pliocene (7 million years ago) the drainage became blocked south of Poncha Springs, CO, and the Arkansas River was diverted eastward; The Divide, Colorado paleovalley became blocked to the east; the drainage diverted to the South Platte River and through Florissant, CO; the Florissant Basin became filled with alluvial deposits.

- Late Pliocene: 3 million years ago; the uplift accelerates and runoff increases with the greater elevation of the Rocky Mountains; the shoulders of Pikes Peak become prominent landscape features; the area rises approximately 4,000 feet and the Monument approaches the present elevation of approximately 8,400 feet.

- Quaternary Glaciation and Alluviation: 2.5 million years ago to present: glaciers formed on Pikes Peak, but not in Florissant, CO; the climate became wetter and colder; large quantities of alluvium and slope wash was produced and deposited in the Florissant Basin; approximately 10,000 years ago the area warmed and dried; Grape Creek began to cut a canyon through Pikes Peak granite north of Florissant; and modern drainage in the Monument became established and erosion exposed the fossil beds.

The Monument features the ancestral Lake Florissant that covered an area approximately 12-to15-miles long by one-mile wide with water, during the Eocene Epoch, between 34–35 million years ago (USDI-NPS 1999). Ancient Lake Florissant extended from near Lake George along State Highway (SH) 24 to the town of Florissant, then south for another seven miles. The lake was formed behind volcanic mudflows that had dammed the valley. The large Thirty-Nine Mile volcanic field, which is located 16 miles west of Florissant, may have produced the andesitic lahars that blocked the drainage and created the lake (Taylor 1999). These mudflows, approximately 15-feet deep, buried trees such as the redwood (sequoia) (*Sequoia affinis*) directly (**Figure 2-4**). The lower portion of the trees covered by mud was replaced by silica, possibly from fluids contained in the mud, or from silicic acid that forms from the chemical decomposition of abundant feldspar minerals found in volcanic tuffs (Bloom 1998).

During the Oligocene, ash falling from nearby volcanoes buried rich deposits of plants and insects, creating the fossil beds at Florissant (Dunbar and Waage 1969). The Monument's fossil

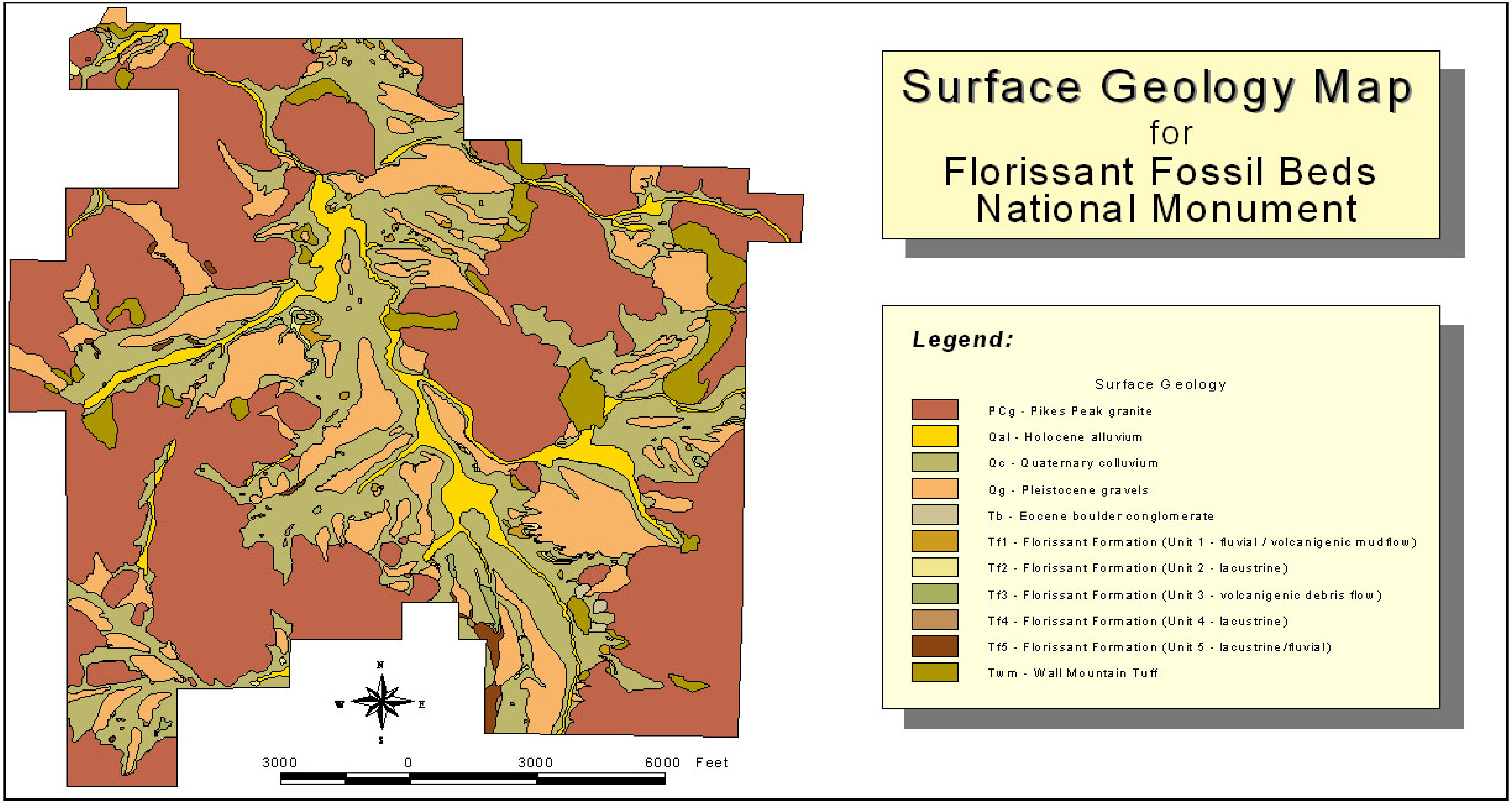


FIGURE 2-3. SURFICIAL GEOLOGY MAP FOR FLFO

beds have yielded more than 100,000 fossil specimens representing approximately 1,400 species of insects (including some as exotic as the tsetse fly) and 140 species of plants (Voynick 2000). Successive eruptions of ash and pumice produced fine-grained material that washed into ancient Lake Florissant during rainfalls and provided a protective cover over leaves, twigs, cones, pollen grains, invertebrates, and diatoms. The volcanic ash that washed into Lake Florissant was finer than talcum powder and was ideal to preserve delicate insect and other fossils. It is also surmised that insects caught directly, and killed in the cloud of fine ash, fell into the lake and were immediately covered with the talc-like material. Over time, these sediments solidified into finely-layered shale with the fossils preserved as detailed impressions or compressions. It is estimated that volcanic eruptions occurred for as long as 5-10,000 years (USDI-NPS 2001).

FIGURE 2-4. FOSSIL STUMP OF THE REDWOOD TREE WITHIN FLFO

These fossil remains of prehistoric animals and plants are relatively young in geologic terms (USDI-NPS 1999). Because of the fossil record, it is known that the Eocene environment consisted of redwood groves associated with palms, fir, cedar, aspen, and pine forest and shorter-statured forest of the mixed hardwood trees: maple, hickory, beech, and oak (Taylor 1999; USDI-NPS 1999). The vegetation, composed of more than 140 known species of plants, suggests a warm humid climate (possibly in transition to a temperate climate) that supported lush ferns in the forest understory, thousands of insects, fish, mollusks, birds, and mammals. Trees and shrubs present in Colorado during the Eocene have living relatives that are now found in the southeastern United States, Mexico, and China. Eocene Epoch mammals included opossums, a type of horse (mesohippus), a large herbivore (brontothere), and a type of pig (oreodont). Some evolutionary information has also been observed, e.g., some leaves show patterns of insect foraging with many insects similar to present-day species.

The climate of ancient Lake Florissant was warm-temperate, with an average annual temperature of about 65^{o}F (MacGinite 1953 in Taylor 1999). Freezing temperatures would have been uncommon. Annual precipitation was approximately 20–25 inches with a pronounced dry season. The elevation of Lake Florissant was approximately 3,000 feet. Because insects are sensitive to climatic change, the insect fossil record can help to describe paleoclimatology - the study of ancient climates (Voynick 2000). The paleoelevation of the ancient flora has also been examined and was determined to be at least 2300 meters, or approximately 7,000 feet. Some estimates of over 4000 meters, or nearly as high as the present Pikes Peak, have also been calculated (Meyer n.d.). These calculations and estimates can be compared to the current Monument elevation of approximately 2500–2550 meters (8200 – 8366 feet).

2.2.2 Soils

The soils of the area are characterized by decomposed granite and alluvial materials (Ulrich 2000). When surface vegetation is disturbed, the soil erodes easily because of poor cohesive qualities. Soils derived from volcanic tuff and lake-deposited shale are clay and silty clay, predominantly. Past land-use practices, including farming, terracing, water pipeline and stock pond construction, logging, fossil hunting/removal, and grazing have removed or greatly disturbed soils, exposing decomposed granite substrate. Thirty-four of the stock dams were considered a potential safety concern in 1984. Along Lower Twin Rock Road, ten check dams constructed of riprap were placed in September 1990 to control gully erosion (Ulrich 2000).

A soil survey is under preparation for portions of Teller and Park Counties, and all named soil types are presented and described in **Table 2-1** (USDA-NRCS 2002b and 2001). Preliminary soils mapping has been completed and the types present on the Monument are illustrated in **Figure 2-5**. Some soils data are also available from the Soil Survey of Pike National Forest (USDA-SCS 1983).

In general, most soils in the region were classified as Cryoboralfs or Cryoborolls (Winternitz 1981). Cryoboralfs generally support forest communities on thin soils, interspersed with outcrops of Precambrian Pikes Peak granite. Cryoborolls are the dark and nutrient-rich soils that support grassland communities in the region. Soils supporting wetland and riparian plant communities were predominantly Aquolls; deep, poorly-drained soils formed of material weathered from granite, schist, gneiss, and feldspar (USDA-SCS 1983). These are dark brown to black silty clays that were deposited over sand and gravel and often had a layer of peat deposited on top of the mineral soil portion. In areas where soils are derived from volcanic tuff and lake shales, clay and silty clay soil types are predominant and are also highly susceptible to erosion following surface disturbance.

Soils known to occur within Florissant are shown in **Figure 2-5** and include Adderton loam (Ad), Fourmile-Lymanson-Vabem complex (FLV), Fourmile very gravelly coarse sandy loam (Fo), Guffey-Raleigh association (GA), Cryaquolls (Nv), Raleigh very gravelly sandy loam (Rl), and Catamount-Guffey complex (SG) (USDA–NRCS 2002b). A few open bodies of water (W) were also mapped in the vicinity of the Monument. **Table 2-1** provides additional information specific to the soils occurring within Florissant and structured to reflect range site, soils, and detailed descriptions.

TABLE 2-1. RANGE SITES AND SOILS IDENTIFIED FOR FLFO

SOIL	SOIL DESCRIPTION	RANGE SITE DESCRIPTION
Adderton loam, 2–6% slopes	Located on stream terraces; alluvium parent material; 0–4 in. very dark gray loam, 42–60 in. very gravelly sandy loam; well drained; moderate permeability; slow to rapid runoff; average production of 1,800 lbs/acre of air-dry vegetation; Arizona Fescue-Mountain Muhly Herbaceous Vegetation.	Loamy Park: occurs on alluvial and colluvial fans, hillsides, plains, sideslopes, terraces, valley sideslopes, upland drainageways, and upland depressions; 0–30% slopes; 7,000–9,700 ft. elevation; 16–20 in. annual average precipitation; 75–100 day growing season; 42.5°F average annual temperature; bunchgrasses dominant – Arizona fescue, mountain muhly, Parry oatgrass; vegetation density averages 25–30%, basal area cover; annual production is 800–2000 lbs/acre; stocking rates for cattle are 1.8 (excellent condition) –7 (poor condition) acres/animal unit month.
Fourmile-Lymanson-Vabem complex, 2–30% slopes	Located on tops of fan terraces and on alluvial fans; granite alluvium parent material; 0–5 in. dark grayish-brown gravelly coarse sandy loam, 5–9 in. very gravelly coarse sandy loam, 9–24 in. very gravelly sandy clay loam, 24–60 in. very gravelly coarse sand; somewhat excessively drained; moderately rapid permeability; slow to medium runoff; average production of 1,400 and 800 lbs/acre of air-dry vegetation; Arizona Fescue-Mountain Muhly Herbaceous Vegetation and Sparse Ponderosa Pine Woodland.	Loamy Park: occurs on alluvial and colluvial fans, hillsides, plains, sideslopes, terraces, valley sideslopes, upland drainageways, and upland depressions; 0–30% slopes; 7,000–9,700 ft. elevation; 16–20 in. annual average precipitation; 75–100 day growing season; 42.5°F average annual temperature; bunchgrasses dominant – Arizona fescue, mountain muhly, Parry oatgrass; vegetation density averages 25–30%, basal area cover; annual production is 800–2000 lbs/acre; stocking rates for cattle are 1.8 (excellent condition) –7 (poor condition) acres/animal unit month. Shallow Pine: occurs on moderately sloping to steep mountainous terrain; 5–65% slopes; 8500–9700-ft. elevation; 15–20 in. annual average precipitation; 85–100 day growing season; 39.3°F average annual temperature; open Ponderosa Pine Woodland with bunchgrasses – Arizona fescue, mountain muhly, Parry oatgrass; vegetation density averages 30–35% (0–15% canopy class) – 20–25% (16–35% canopy class), basal area cover; annual production is 450–1450 lbs/acre; stocking rates for cattle are 2.4 (excellent condition) –8.2 (poor condition) acres/animal unit month.
Fourmile very gravelly coarse sandy loam, 3–20% slopes	Located on fan terraces; alluvium parent material; 0–6 in. dark grayish brown very gravelly coarse sandy loam, 6–13 in. very gravelly sandy clay loam, 13–60 in. extremely gravelly very coarse sand; somewhat excessively drained; moderately rapid permeability; slow to rapid runoff; average production of 1,400 lbs/acre of air-dry vegetation; Arizona Fescue-Mountain Muhly Herbaceous Vegetation.	Loamy Park: occurs on alluvial and colluvial fans, hillsides, plains, sideslopes, terraces, valley sideslopes, upland drainageways, and upland depressions; 0–30% slopes; 7,000–9,700 ft. elevation; 16–20 in. annual average precipitation; 75–100 day growing season; 42.5°F average annual temperature; bunchgrasses dominant – Arizona fescue, mountain muhly, Parry oatgrass; vegetation density averages 25–30%, basal area cover; annual production is 800–2000 lbs/acre; stocking rates for cattle are 1.8 (excellent condition) –7 (poor condition) acres/animal unit month.
Guffey-Raleigh association, 5–50% slopes	Located on mountainsides, north-facing side slopes under Douglas-fir; granite colluvium and residuum parent material; 1–0 in. organic mat, 0–12 in. pale brown very gravelly coarse sandy loam, 12–26 in. very gravelly sandy clay loam, 26–41 in. weathered granite that breaks down, 41 in. hard granite; well drained; moderate permeability; medium to very rapid runoff; average production of 1,200-800 lbs/acre (0–15% canopy – 16–35% canopy) of air-dry vegetation; Douglas-fir Forest and Ponderosa Pine/Arizona Fescue-Mountain Muhly Herbaceous Vegetation.	Shallow Pine: occurs on moderately sloping to steep mountainous terrain; 5–65% slopes; 8500–9700-ft. elevation; 15–20 in. annual average precipitation; 85–100 day growing season; 39.3°F average annual temperature; open Ponderosa Pine Woodland with bunchgrasses – Arizona fescue, mountain muhly, Parry oatgrass; vegetation density averages 30–35% (0–15% canopy class) – 20–25% (16–35% canopy class), basal area cover; annual production is 450–1450 lbs/acre; stocking rates for cattle are 2.4 (excellent condition) –8.2 (poor condition) acres/animal unit month. Douglas-fir: this woodland site is not considered forage for livestock by the NRCS (Kot 2002), it occurs on moderately sloping to steep mountainous terrain; 5-50% slopes; 8,500-9,500-ft. elevation; 85-100 day growing season; occurs in pure stands or stands

SOIL	SOIL DESCRIPTION	RANGE SITE DESCRIPTION
		in which it constitutes a majority of the stocking; this woodland site is increasing due to historic fire suppression; common juniper is the dominant understory with little herbaceous vegetation; can grow on a wide variety of soils and parent materials, including substrates of granitic and volcanic origin; its occurrence appears to be determined primarily by climate; no forage production or stocking rates are assigned to this woodland site.
Cryaquolls, 0–1% slopes	Located on low stream terraces and floodplains; alluvium parent material; 0–18 in. dark gray loam, 18–30 in. very gravelly sandy clay loam, 30–60 in. extremely gravelly sand; very poorly to poorly drained; moderate permeability; slow runoff; average production of 3,000 lbs/acre of air-dry vegetation; Baltic Rush-Sedge Herbaceous Vegetation.	Mountain Meadow: occurs in mountain valleys, swales, parks, and around potholes; 0–3% slopes; 7,000–11,500-ft. elevation; 15–40 in. annual average precipitation; 50–100 day growing season; 30–44^{o}F average annual temperature; sedges, rushes, grasses, willow shrubs; vegetation density averages 70%, basal cover; annual production ranges from 3000–4000 lbs/acre.
Raleigh very gravelly sandy loam, 5–55% slopes	Located on mountainsides; granite residuum parent material; 0–5 in. brown very gravelly sandy loam, 5–9 in. extremely gravelly sandy loam, 9–14 in. extremely gravelly very coarse sand, 14 in. decomposed granite; well drained; moderately rapid permeability; medium to very rapid runoff; average production of 1,200-800 lbs/acre (0–16% canopy – 16–35% canopy) of air-dry vegetation; Mountain Mahogany / Arizona Fescue-Mountain Muhly Shrubland.	Shallow Pine: occurs on moderately sloping to steep mountainous terrain; 5–65% slopes; 8500–9700-ft. elevation; 15–20 in. annual average precipitation; 85–100 day growing season; 39.3^{o}F average annual temperature; open Ponderosa Pine Woodland with bunchgrasses – Arizona fescue, mountain muhly, Parry oatgrass; vegetation density averages 30–35% (0–15% canopy class) – 20–25% (16–35% canopy class), basal area cover; annual production is 450–1450 lbs/acre; stocking rates for cattle are 2.4 (excellent condition) –8.2 (poor condition) acres/animal unit month.
Catamount-Guffey complex, 15–40% slopes	Located on mountainsides; granite residuum and colluvium parent material; 1.5–0 in. pine litter, 0–2 in. dark grayish brown gravelly sandy loam, 2–8 in. very gravelly sandy loam, 8–12 in. extremely gravelly loamy coarse sand, 12–21 in. weathered granite that breaks into grus, 21-in. granite; somewhat excessively drained; rapid permeability; very rapid runoff; Douglas-fir Forest.	Douglas-fir: this woodland site is not considered forage for livestock by the NRCS (Kot 2002), it occurs on moderately sloping to steep mountainous terrain; 5-50% slopes; 8,500-9,500-ft. elevation; 85-100 day growing season; occurs in pure stands or stands in which it constitutes a majority of the stocking; this woodland site is increasing due to historic fire suppression; common juniper is the dominant understory with little herbaceous vegetation; can grow on a wide variety of soils and parent materials, including substrates of granitic and volcanic origin; its occurrence appears to be determined primarily by climate; no forage production or stocking rates are assigned to this woodland site.
Water	N/A	N/A

Source: USDA-NRCS 2002b

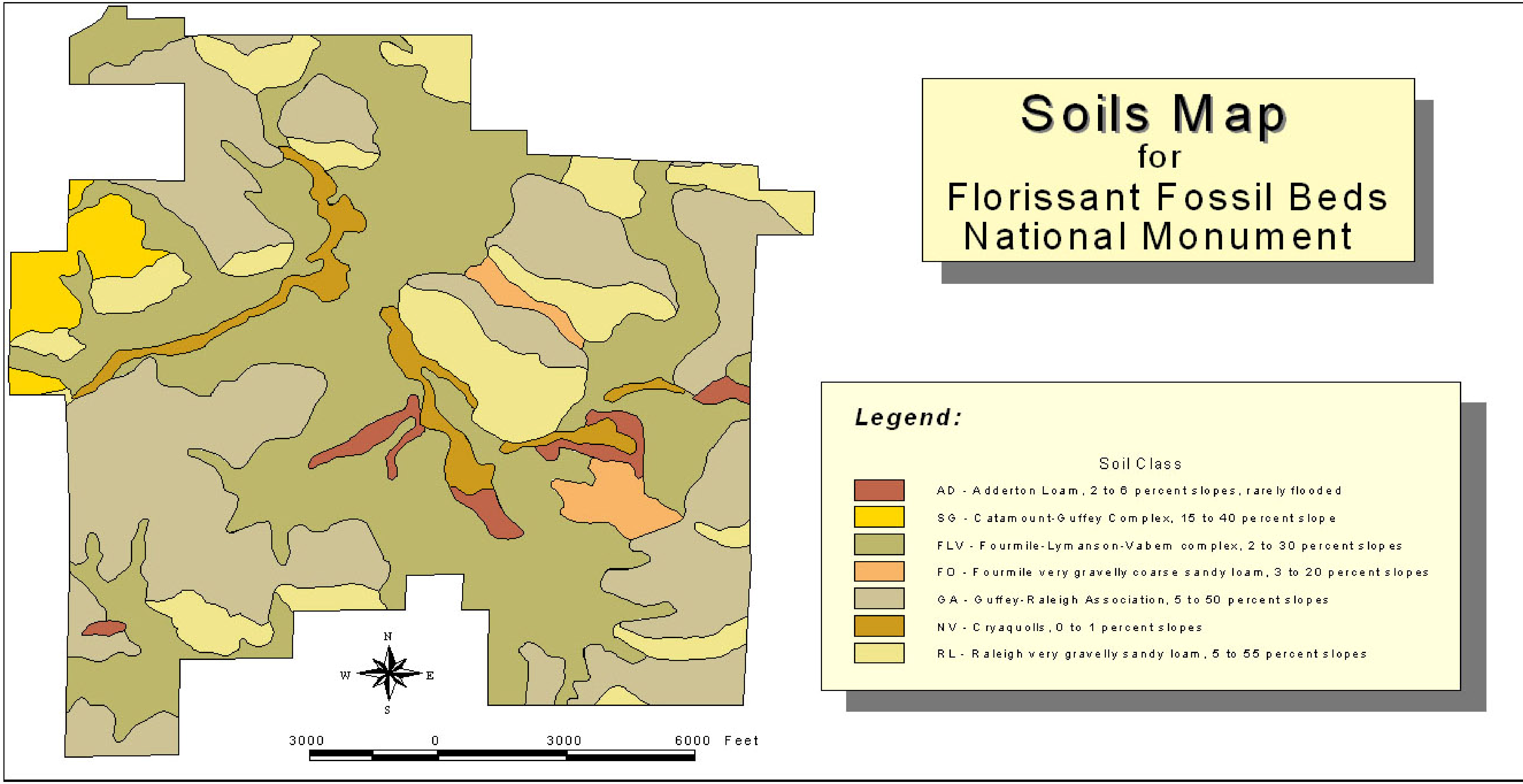


FIGURE 2-5. SOILS MAP FOR FLFO

2.3 HYDROLOGY AND WATER RESOURCES

2.3.1 Water Resources

Hydrology for Florissant is related directly to precipitation events and runoff following snowmelt. The Monument drains via Grape and Boulder Creeks and several tributary drainages to Twin Creek, then to the South Platte River just above Lake George (**Figure 3-6**) (National Geographic Maps 1996). The water supplying flows in these streams percolates through the soil and around geologic exposures within and surrounding Florissant from the adjacent private lands. Also present are springs, seeps, and 40–50 constructed earthen dams, forming stock ponds. In addition, over 100 erosion control structures were constructed within the Monument drainages during the 1950s. The stock ponds supported past grazing activities, primarily cattle grazing, within the Monument area. It is possible that these ponds were also stocked with trout, historically for sport fishing opportunities. Six dams permanently impound water and are used extensively by aquatic and semi-aquatic wildlife.

2.3.2 Surface Water

Surface waters within the Monument area appear to be generally of good quality, with some effects from human activities (USDI-NPS 1998). Natural water quality of surface flows tends to vary based on whether the water surfaces are from shale or from granite bedrock layers (USDI-NPS 1994). Potential sources of anthropogenic (human-caused) contaminants include individual wells and septic systems within the aquifer shared by the Monument, livestock grazing and agricultural operations, logging, recreation, mining, stormwater runoff, residential development and runoff, and atmospheric deposition. Surface water chemistry for this region is considered typical and reflects the influence of insoluble granitic soil and coniferous forest cover (Winternitz 1981). The pH ranges from 7.0 to 8.5 and the water has high fluoride content. Alkalinity or hardness results from calcium carbonate (30–90 ppm) and magnesium carbonate (0–20 ppm) concentrations (Winternitz 1981).

Storage and Retrieval (STORET) data for Florissant and the vicinity resulted in 1,779 observations for 101 separate water quality parameters at 31 monitoring stations from 1974–1997 (USDI-NPS 1998). The data were collected and recorded by the NPS, USGS, and the Denver Board of Water Commissioners. Ten water quality-monitoring stations were located within the Monument boundaries (**Figure 2-6**, **Table 2-2**) and resulted in approximately 47% of the reported observations between 1976 and 1997 (USDI-NPS 1998). Other water quality retrieval efforts resulted in determining that there were: 1) no industrial/municipal dischargers, 2) no drinking water intakes, 3) one inactive USGS stream gage (1929 was the last recorded data year), and 4) five water impoundments (USDI-NPS 1998). Most of the monitoring stations represent either one-time or intensive single-year sampling efforts by the various collecting agencies. Longer-term records were available at four stations within the Monument, including: 1) Grape Creek #1, 2) Grape Creek #2, 3) Barksdale Picnic Area, and 4) the stock pond downstream of Sanborn’s Camp. Longer-term records are also available outside Florissant for the South Platte River near Lake George at the SH 24 bridge.

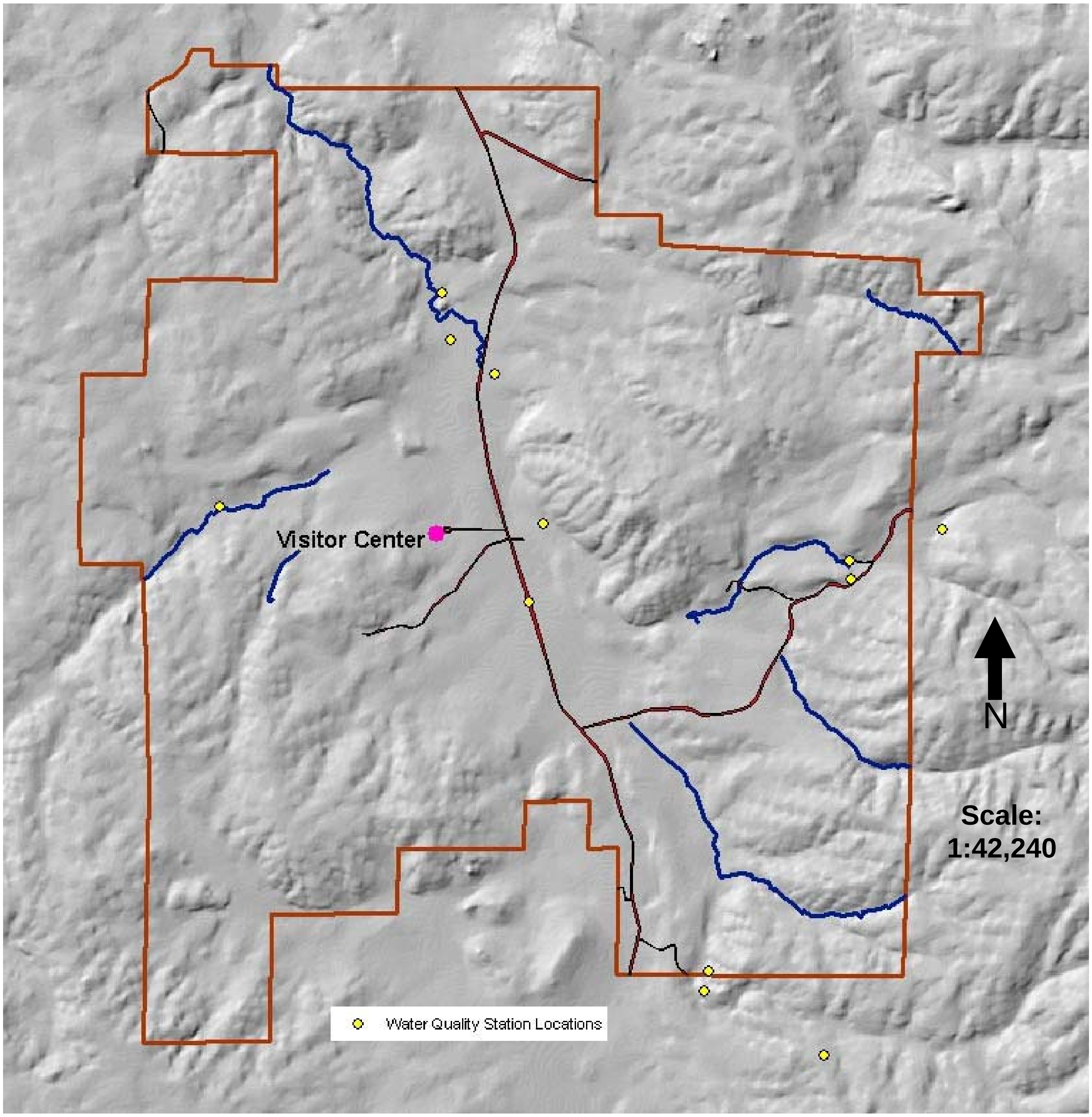


FIGURE 2-6. WATER QUALITY STATIONS [USGS]

TABLE 2-2. DESCRIPTION OF WATER QUALITY MONITORING STATIONS WITHIN FLFO BOUNDARIES

Station Identification	Location Description	Total Observations
FLFO0008	Barksdale Picnic Area	64 – 1985-97
FLFO0009	C20347	16 – 1975-84
FLFO0011	Grape Creek Number 1	96 – 1985-97
FLFO0015	Grape Creek in FLFO	29 – 1985-97
FLFO0016	Grape Creek in FLFO	153 – 1985-97
FLFO0017	C20333	16 – 1975-84
FLFO0018	C20332	16 – 1975-84
FLFO0020	C20346	16 – 1975-84
FLFO0021	Grape Creek Number 2	91 – 1985-97
FLFO0024	Stock Pond Downstream of Sanborn's Camp	63 – 1985-97

Source: USDI-NPS 1998

Nine groups of water quality parameters exceeded screening criteria at least once within the study area (**Table 2-3**). The pH, cadmium, copper, silver, and zinc exceeded the respective United States Environmental Protection Agency (USEPA) criteria for the protection of freshwater aquatic life. Cadmium, lead, nickel, and uranium exceeded the respective USEPA drinking water criteria, and total fecal coliforms exceeded the NPS Water Resources Division (WRD) screening limit for freshwater bathing.

TABLE 2-3. WATER QUALITY PARAMETERS, CRITERIA AND STANDARDS, AND DESCRIPTION OF EXCEEDANCES IN AND NEAR FLFO

PARAMETER	CRITERION/STANDARD	DESCRIPTION OF EXCEEDANCES IN/NEAR FLFO
pH	6.5–9.0 SU	9.4 at stock pond below Sanborn's Camp. 9.31 at stock pond below Sanborn's Camp. 6.4 at a spring 4.0 miles northeast of FLFO.
Total Coliform	1,000 CFU/100ml	3,000 CFU/100ml at Grape Creek #2.
Cadmium	3.9 μg/L	5.0 μg/L from South Platte River at SH 24. 4.0 μg/L from South Platte River at SH 24.
Copper	18 μg/L	24 μg/L from South Platte River at SH 24.
Lead	5 μg/L	36 μg/L from South Platte River at SH 24. 17 μg/L from South Platte River at SH 24.
Nickel	100 μg/L	110 μg/L at a spring just east of FLFO. 102 μg/L at a pond 2.0 miles east of FLFO.
Silver	4.1 μg/L	One concentration of 10 μg/L from South Platte River at SH 24.
Uranium	20μg/L	One concentration of 84.6 μg/L from a pond 2.5 miles west of FLFO.
Zinc	120 μg/L	14 stations exceeded acute freshwater criterion in August, 1976. 446 μg/L was the high recorded 2.5 miles north of FLFO.

Source: USDI-NPS-WRD 1998

2.3.3 Groundwater

During an initial survey of Florissant lands in the early 1960s, one 40-foot-deep groundwater well was identified that yielded 100 gallons/minute (USDI-NPS undated). Groundwater pumped from a 100-foot-deep well at the interim visitor center, and another well drilled two miles distant from this site contained high concentrations of iron oxide and manganese, which made the water unfit for human consumption (USDI-NPS 1984). In addition, when groundwater was collected during periods of drought, an oily film formed on the water surface. A 450-foot-deep well serving the current visitor center pumps four gallons/minute and contains moderately high levels of fluoride, manganese, iron, sodium, and calcium, but all levels are considered normal for this portion of Teller County (USDI-NPS 1994). Ten wells were registered in district water court during 1984 and four hand-dug shallow wells were abandoned and back-filled between 1984 and 1990 (USDI-NPS 1994).

2.4 AIR RESOURCES

The air quality of the Monument region was considered very good for this federal Class II clean air area. However, there have been no studies or monitoring of air quality or acid precipitation at Florissant. It has been suggested (USDI-NPS 1994) that baseline air quality data, including acid precipitation, be collected to aid in evaluation of future change for both extant vegetation and exposed fossil trunks. Increasing use of major county roads by automobiles results in contaminants being emitted to the atmosphere and dust deposition on roadside vegetation, possibly affecting plant growth and reproduction.

2.5 WILDLIFE RESOURCES

The natural resource inventories for the Monument are incomplete; no inventories have been conducted for fish, amphibians, and reptiles, and only anecdotal species lists have been created for most biotic groups. The bird inventory is considered complete. Early in the history of Florissant, a concern was expressed for the Richardson’s ground squirrel populations because of high population densities and the potential for plague due to rodent overpopulation (USDI-NPS 1985). **Figure 2-7** provides an illustration of typical wildlife species present within the Monument.

2.5.1 Mammals

The baseline inventory for mammal species was determined from the *Colorado Mammal Distribution Latilong Study* (CDOW 1982). Twenty-six species of big game, predators, and small mammals were identified for the Monument from this source (USDI-NPS 1994) (**Appendix B**). Twenty-five mammal species have been confirmed and summarized for Florissant, based on wildlife observations recorded by Monument staff and visitors (Korer 1997).

Badger

Coyote

Elk

Golden Eagle

Mule Deer

Porcupine

Prairie Dog

Red-Tailed Hawk

FIGURE 2-7. TYPICAL WILDLIFE SPECIES PRESENT WITHIN FLFO

Mule deer were occasionally observed during year 2001 vegetation sampling at Florissant, mostly under dense ponderosa pine stands in the southeastern portion of the Monument. The deer herds also use the Monument for winter forage and this use was encouraged by the removal of interior fences originally placed by livestock ranchers (USDI-NPS 1985). Pronghorn were considered seasonal within Florissant boundaries, with a large herd present in nearby South Park (USDI-NPS 1985; Korer 1997).

Approximately 1,700 head of elk are present in the vicinity of the Monument, within Colorado Division of Wildlife (CDOW) designated game management units 581, 511, and 59 (Rousch 1997). Elk use within the Monument occurs during different times of the year, e.g., from 300–400 head may be observed during the winter months in the large grassland that borders the eastern and western sides of TC-1. Elk were observed on a few occasions during the 2001 vegetation sampling, but the groups were small, under thirty individuals. They were typically observed at the highest elevations in the southeastern portion of Florissant; however, elk scat was observed throughout the Monument.

During the spring, cows with newborn calves were observed within the dense forests of the northern and western portions of the Monument (Roush 1997). The Monument was used as a secure area by elk during fall hunting seasons and the eastern portion served as a corridor for movement to Mueller State Park (MSP) (Roush 1997). Elk winter range appeared to be concentrated within Florissant, MSP, and the B Lazy M Ranch areas. One radio-collared cow elk remained on or near Fthe Monument throughout 1990 and 1991, indicating year-round habitat availability. In general, elk that summer in the MSP area winter in the area around Florissant. A portion of the elk over-wintering at FLFO, spend the summer in the area of Big Bull Mountain (Roush 1997).

All quaking aspen stands on Florissant contain bark and root shoots chewed by elk from year-round, frequent use of the stands. The vegetation sampling team noted this use in every stand observed during the summer of 2001. Roush and others (1997) observed elk rising on their hind legs to forage on quaking aspen leaves and also to forage leaves from fallen trees. As a result, quaking aspen regeneration is very limited to non-existent through the area (Roush 1997). The CDOW has established the current population objective for the Eleven Mile elk herd at approximately 1,200 animals. Current conflicts with local ranchers include fence damage, consumption of forage planned for livestock use, and reduced yields from hay fields (Roush 1997). Several elk management needs/issues were presented by Roush (1997), they include:

- Increase the proportion of the elk herd using public lands to lessen conflict on private lands,
- Wildlife viewing for elk will be of high public interest,
- Provide basic habitat needs for elk on public lands, e.g., forage, water, and cover, providing a sense of security,
- Forage quality is the most important factor for attracting elk, e.g., annual growth from grazed and burned areas,
- Controlled or prescribed fire,
- Increase water availability in drier areas,
- Preserve surface water in areas currently providing this resource,

- Disperse human presence in recreation areas and enact trail closures during sensitive periods (calving), and
- Create or support conservation easements and other land-use tools to provide elk movement between fragmented habitats.

Black bear are possibly resident in the Monument and occasionally use the habitats available. Monument personnel and visitors have observed the mountain lion within Florissant. The coyote was occasionally observed in the vicinity of the Hornbek Homestead and the visitor center during the summer of 2001. The bobcat, red fox, badger, and long-tailed weasel are additional predatory species of mammals present within the Monument (Korer 1997).

Badger and their burrow/foraging holes were evident in lower elevations of Florissant also occupied by prairie dogs. Korer (1997) identified these as Gunnison's prairie dogs, which occupied areas with deeper soils along Grape Creek and minor tributary drainages at the lowest Monument elevations. Most hillslopes support populations of ground-dwelling squirrels, including the least chipmunk, Richardson's ground squirrel, golden-mantled ground squirrel, and thirteen-lined ground squirrel. The common arboreal species are Abert's and red squirrels. Abert's squirrels feed on tree cambium high in pine trees, and this feeding activity often kills the top (Williams 2001).

Porcupines were observed throughout the forest and woodland areas of the Monument and have girdled many young trees completely, causing death, and have girdled or nearly girdled many branches and tops of older trees, as described by Williams (2001). The porcupine was nearly always observed using ponderosa pine for food and shelter. One porcupine was observed in a stand of mountain willow riparian wetland habitat and may have been foraging, but it was likely in transit to a stand of ponderosa pine trees nearby.

Beaver have dammed a significant portion of Grape Creek, from the northern boundary fence to northwest of Hornbek Homestead (**Figure 2-8**). Those dams consistently maintained and occupied are on the up-drainage end, while the dams and resultant ponds placed near the northern boundary fence are mostly abandoned. This could be due to lack of forage and building materials, as willow stands (a primary forage shrub) tend to be extremely small and often scattered within Florissant. Muskrat are also present in the ponds maintained by beaver.

Other mammal species known within the Monument include rodents, rabbits and hares, and bats. Nocturnal rodents common within Florissant habitats include deer mice, northern pocket gopher, bushy-tailed woodrat, and montane vole (Korer 1997). Lagomorphs common to Florissant include Nuttall's cottontail, white-tailed jackrabbit, and snowshoe hare. Species of bats that may be present include the little brown myotis, big brown bat, and hoary bat (Korer 1997). During 1994, there was one observation of a "masked weasel," possibly an endangered black-footed ferret, reported by a Monument employee (USDI-NPS 1994).

FIGURE 2-8. BEAVER DAMS ON LOWER GRAPE CREEK

2.5.2 Birds

A bird list has been prepared for Florissant containing 95 species compiled by the Audubon Society, and is considered complete. However, records of wildlife observations recorded by Monument staff and visitors contain observations of 105 species of birds (**Appendix B**). *The Colorado Bird Atlas* confirmed 34 breeding species in the Monument. Some of the common species listed by Muth and Weber (n.d.), include: Waterfowl and Shorebirds: green-winged teal, mallard, killdeer; Raptors: turkey vulture, red-tailed hawk, golden eagle, American kestrel; Passerines and Corvids: common nighthawk, broad-tailed hummingbird, Williamson's sapsucker, northern flicker, olive-sided flycatcher, Cordilleran flycatcher, western wood peewee, tree swallow, violet-green swallow, gray jay, Stellar's jay, black-billed magpie, American crow, common raven, mountain chickadee, white-breasted nuthatch, pygmy nuthatch, brown creeper, house wren, western bluebird, mountain bluebird, hermit thrush, American robin, European starling, yellow-rumped warbler, western tanager, chipping sparrow, savannah sparrow, song sparrow, red-winged blackbird, western meadowlark, Brewer's blackbird, pine siskin, and evening grosbeak.

Two rare raptor species, observed as summer residents, were the bald eagle and the American peregrine falcon (USDI-NPS 1985, 1994). Both the golden eagle and red-tailed hawk were observed nesting within the Monument during the summer of 2001. Golden eagles have been nesting in Florissant at least since 1976 (USDI-NPS 1994).

2.5.3 Fish

Non-native trout, species unknown, have been identified within the Monument by CDOW (USDI-NPS 1994). The CDOW has also requested permission to stock ponds for public fishing; however, these requests have been denied. Fishing is permitted within the Monument with possession of a valid state license, but this is considered an infrequent activity (USDI-NPS 1994).

2.5.4 Amphibians and Reptiles

Two species of amphibians and two species of reptiles have been identified within the Monument (**Appendix B**). These are the tiger salamander, an unknown species of frog, the bullsnake, and the western garter snake (USDI-NPS 1994). At MSP, located southeast of the Monument, the red-lipped spiny lizard and the northern leopard frog were observed (Winternitz 1981).

2.5.5 Insects and Aquatic Invertebrates

Approximately 253 species of insects have been identified for Florissant using a collection of 630 specimens captured over a seven-year period (USDI-NPS 1994). Specimen data and collection parameters can be retrieved by genus and species from ANCS (the NPS Automated National Catalog System). The common insects observed at MSP, located northeast of Florissant, included the terrestrial species of short-horned grasshoppers, leaf bugs, seed bugs, damsel bugs, leafhoppers, paper wasps, halictid bees, andrenid bees, and several species of ants (Winternitz 1981). Common aquatic insects and invertebrates of MSP included the mayfly, caddisfly, stonefly, blackfly, cranefly, damselfly, dragonfly, diving beetle, whirlygig beetle, water strider, water boatman, leech, earthworm, and freshwater clam (Winternitz 1981).

2.6 VEGETATION RESOURCES

This section describes the vegetation and plant associations of the Monument from the historical perspective and from more recent studies. Discussions of data and observations resulting from the current study for vegetation classification and mapping are presented in section 4.0 of this report. Humans have been part of this landscape for at least 10,000 years and the land use has intensified due to settlement over the past 130 years resulting in rapid floristic change. The Florissant region is very dry when compared with regions farther north within the same life zone, e.g., the Montane Life Zone (Mutel and Emerick 1984; Edwards and Weber 1990). The degree of dryness within the Monument is partially due to the extreme porosity of the friable Pikes Peak granite that weathers to coarse gravel (Edwards and Weber 1990).

The southern Rocky Mountains have been considered a crossroads of plant migration for millions of years (Edwards and Weber 1990). Some plant species characteristic of the Great Basin desert steppe, e.g., viscid and Parry rabbitbrush (*Chrysothamnus viscidiflorus* and *Ericameria parryi*), Colorado rubber-weed (*Hymenoxys richardsonii*), horsebrush (*Tetradymia canescens*), and snakeweed (*Gutierrezia sarothrae*) reach their eastern limits in this area along the flanks of the Rocky Mountains. Species characteristic of the eastern woodlands and prairies, e.g., white upland aster (*Unamia alba*) and Canada lousewort (*Pedicularis canadensis* ssp. *fluviatilis*) were isolated in relictual pockets along the Rocky Mountains during the desiccation of the high plains region.

Several species currently found at Florissant, mostly on outcrops of Pikes Peak granite, have a high probability of being relictual since the Tertiary period, including waxflower (*Jamesia americana*), boulder raspberry (*Rubus deliciosus*), mountain parsley (*Harbouria trachypleura*), Rocky Mountain Indian parsley (*Aletes anisatus*), grassfern (*Asplenium septentrionale*), and male fern (*Dryopteris filix-mas*) (Edwards and Weber 1990). Species present in the fossil flora of Florissant were morphologically very close to modern species, including waxflower, ponderosa pine, mountain mahogany, and sandbar willow, to name a few.

2.6.1 Prehistoric and Historic Vegetation

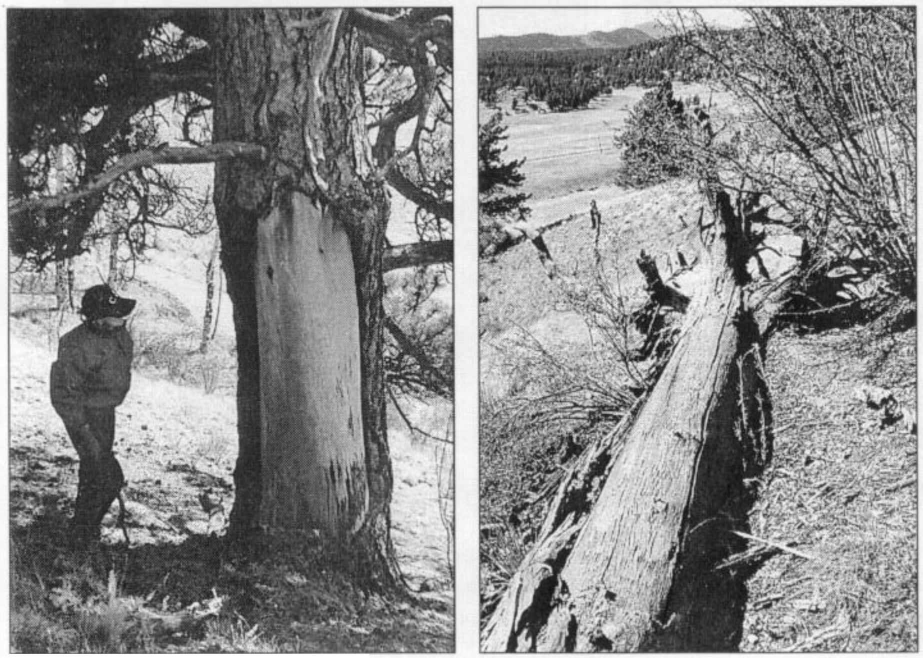
In 1908, the paleobotanists T.D.A. Cockerell described 106 genera of fossil plants from the Florissant shales. Of the 106 genera described, 45 genera are extant in the Colorado flora, including common trees and shrubs of the genera *Pinus, Juniperus, Populus, Salix, Alnus, Betula, Acer, Ribes,* and *Rosa* (Cockerell 1908). Cockerell (1908) noted the absence of the tree genera *Picea* and *Pseudostuga* as important. Thirty-six genera described from Florissant are now found in the eastern and southern United States, and one genera, *Sequoia*, is now limited to central California (Cockerell 1908).

Fifty years ago, the Monument vegetation and habitats were described as largely "a grassland, although hillsides and numerous small knolls and buttes bear a sparse cover of ponderosa pine and aspen — most of the vegetation is of an arid-adapted type" (Rogers and Alberts 1953). Ramaley (1906) thought that this country was once covered by sagebrush and rabbitbrush. Rogers and Albert (1953) also reported that the Fossil Forest area had no notable botanical values. The Monument presently consists of rolling terrain with hills and ridges supporting shrublands, woodlands, and forests standing above and sometimes within large stands of wet meadows and upland grasslands.

Human occupation and use of the vegetation resources/habitat of the Florissant area has occurred for over 10,000 years, as determined from archaeological investigation of the Monument and surrounding environs (Culpin 1979). Seven culturally scarred trees have been located within the Monument, representing isolated examples of possible ethnographic resources (**Figure 2-9**) (Ulrich 2000). Native American people present in the area during the use of these trees were primarily of the Uncompahgre (Taviwach) Tribe (Horn et al. 1996).

These trees, six ponderosa pine and one Colorado blue spruce, were peeled; tree bark and bark substances were used for a variety of purposes by Native Americans. Examples of this tree use included: 1) inner bark used as a regular and emergency food source, 2) outer bark in the construction of cradleboards and as a building material for habitation, and 3) pitch as an adhesive and waterproofing agent. Three large, scarred ponderosa pine trees have been studied during 1990 and determined to range in age from 181 to 265 years old, using tree-ring counts (Ulrich 2000). Also during 1990, the tree scars were determined to range in age from 79, 83, and 119 years ago (approximately 91, 95, and 131 years ago at the time of this report). According to Cassells (1983):

> *"Seldom reported and fast disappearing remnants of Ute culture in Colorado are scarred trees. The Utes would strip bark from trees, principally pine, for a variety of purposes. Some are said to be medicine trees and an ill person would be placed next to the scar during the healing process. Medicinal teas were brewed from the inner bark, and other peelings for food. Such practices have been characterized as associated with starvation diets during hard times. Other reported uses were as materials for cradleboards and other items."*



Far Left: *A classic "living history" Ute culture tree of ±300 years of age. The scar is 36-in. across and faces northwest. There are some within the Monument that are older.*

Immediate Left: *This long dead ponderosa pine was Ute culture scarred. The blaze is over 18-in. wide and 6-ft.+ tall. This is visible evidence of an old culture trait.*

Photo: Jack R. Williams©

FIGURE 2-9. UTE CULTURE TREE

Williams (2001) reported 26 ponderosa pine trees within the Monument that were culturally scarred by Ute tribal members. The trees were scarred during harvesting of sap and pitch, typically when they were from 20–40 years old. The tree cambium may have been harvested annually in the spring or biannually during the spring and fall when the cambium was mashed and cooked to form sweet cakes. The cambium was also used for medicinal purposes, and the resin was collected in globs, chewed like gum to clean the teeth, and ground to be used in medicines such as a laxative tea.

The Ute tribal members may have also influenced the presettlement fire regime within Florissant by intentionally setting fires to drive game or create conditions for new growth to attract game (Lukas 1994). Studies of a tribe in Montana showed a doubling of fire frequency because of the Native American influence. It is possible that Ute tribal members had a similar effect to woodlands and forests of Florissant relative to fire; however, over the several hundred years that this would have occurred, the forests would have adapted to the altered fire regime, making it essentially natural (Lukas 1994).

2.6.2 Logging and Lumber Mills

Williams (2001) described the Pikes Peak region as having a huge logging operation between 1860 and the 1940s. In the historical account of Florissant provided by Kimmet (n.d.), a sawmill was present and tree cutting (but not commercial logging) had commenced in the area and at Florissant by 1871. Fossil hunting, particularly for the large stumps, trunks, and branches of petrified wood also began around 1870. During 1882, a large lumber mill was opened in Florissant by H.H. Bean, and two additional sawmills were opened in 1887 (Kimmet n.d.). However, Rogers and Albert (1953), during a visit to the Monument area, stated: “logging has not been commercially profitable.”

Edwards and Weber (1990) state that while farming and ranching had the greatest effect on the Florissant area flora, lumbering was very important to the lives of settlers. The remnants of a small, local sawmill can be seen a short distance from the visitor center of the Monument. An early photograph taken by Francis Ramaley shows a rather barren scene of downed trees and stumps (Edwards and Weber 1990).

Evidence of logging, i.e., tree stumps, was recorded on nearly every forest or woodland vegetation plot sampled during the 2001 fieldwork. Many of these were very large Douglas-fir and ponderosa pine trees that must have had considerable age in light of the dry conditions relative to tree growth within the Monument. Undoubtedly these trees that were cut by hand axe and by saws, were used for logs, poles, beams, boards, and firewood by the local residents and probably for the commercial trade.

2.6.3 Insect and Disease Damage and Mortality

A general aerial detection survey of forest stand damage and mortality due to insects, diseases, and other forest health stressors was flown between July and September of 2000 (USDA-FS 2001). Mountain pine beetle had killed approximately 170 trees in Teller County, although the number of affected trees within Florissant, if any, was unknown. The number of forested acres affected in national parks and monuments throughout the Rocky Mountains, were as follows: 1) unknown bark beetle species (6.4 acres – 20 trees), 2) mountain pine beetle (344 acres – 305 trees), 3) spruce beetle (5.0 acres – 5 trees), and 4) dwarf mistletoe (1,176 acres) (USDA-FS 2001). It is unknown how much of this acreage occurred within the Monument.

2.6.4 Fire History and Management

Fire suppression within the Monument and within the region has been ongoing since European settlement in the 1860s. Upon first inspection at Florissant, ponderosa pine trees, from seedlings to approximately 25-year-old saplings, were noticeably expanding into adjacent native and exotic wet meadows and grasslands (Anonymous n.d.). This expansion may be due to the cessation of cattle grazing and agricultural practices within the Monument, in addition to fire exclusion. The abundance of pole-sized trees within forested and woodland stands would likely not occured if fire had not been excluded. Other traits noted in these stands included very little dead and down fuel, deep needle accumulation immediately under trees, and dense stands of grasses that would carry fire when they cured (Anonymous n.d.).

No fire records are available for the Florissant area; however, records from Pike National Forest show that the amount of area burned has not been extensive (USDI-NPS undated). During a documented ten-year period (probably the 1950s or 1960s), 452 fires were recorded, burning only 285 acres. The small area burned by fire has been attributed to prompt reporting and immediate response by fire fighters (USDI-NPS undated). Lightning was the cause recorded for 62% of the wildfires. The remaining 38% of wildfires were possibly arson or accident related starts by humans.

Research into the fire history of the Monument was designed to resolve two basic questions (Lukas 1994), they are: 1) what was the nature of the presettlement (prior to 1870) fire regime?, and 2) what changes in stand structure can be attributed to modern fire suppression? To adequately provide presettlement data, fire-scarred trees to be sampled should be from 200–300 years old. Due primarily to mortality and logging, however, fire-scarred trees this old are rare within the Monument (Lukas 1994). Trees that do meet these requirements tend to be large and/or have deeply embedded scars and these characteristics increase the potential of injury or windthrow when samples are removed for fire scar analysis.

Presettlement intervals between fires are relatively long at Florissant and on other Front Range sites (Lukas 1994). This can be attributed to low forest productivity resulting in slow fuel accumulation and also with the coincidence of the peak period of lightning strikes with the wettest months (July and August). Significant differences in the fire intervals of the Monument occurred on south-facing (mean of 32 years) versus north-facing (mean of 68 years) slopes (Lukas 1994). This difference was consistent with data from other ponderosa pine stands where the drier conditions of south-facing slopes created a more favorable environment for fire ignition and spread.

Multiple fire scars, as many as six per fire-scarred tree encountered, suggest low-intensity surface and ground fires predominated within the Monument (Lukas 1994). Very low fire intensity was also indicated by the measured age and size of the trees at the formation of the first fire scar, e.g., the first scarring fire on ponderosa pine trees ranged from 39–50 years, with a mean of 44 years. Additionally, seedling ponderosa pine, less than 5.0 cm in diameter, survived the fire, again indicating very low intensity. Tree diameters, reconstructed for the first fire scar, ranged from 3.5–16.0 cm (Lukas 1994).

The mean age of first fire scarring on ponderosa pine at Florissant of 44 years is significantly lower than ponderosa pine tree ages recorded from other studies (Lukas 1994). Means of 103 (33–219 years) and 121 (63–192 years) years were calculated for ponderosa pine trees in other research studies. Slow tree growth was observed during this research effort through a comparison of historic and recent ground photography. For example, a one-meter tall seedling in 1964 was only three meters tall in 1994 (Lukas 1994).

Several observations concerning woodland and forest vegetation types at Florissant were discussed (Lukas 1994), as follows:

- In terms of meadow invasion, the proportion of meadows occupied by young trees is generally small;

- Ponderosa pine woodlands have retained their presettlement character of open woodlands with only slight increases in density;
- Douglas-fir removal by logging opened many canopy gaps that were aggressively filled by Douglas-fir, resulting in large numbers of suppressed, stagnating trees;
- Ponderosa pine stands typically have a single-story canopy, so the development of fuel ladders was considered insignificant;
- Douglas-fir stands are more typically multi-storied, have developed a fuel ladder, and the risk of stand-replacing fire exists and is higher than 150 years ago; and
- Given continued fire exclusion on Florissant, the more mesic sites will remain as, or shift towards, Douglas-fir forests.

Observations made relative to controlled burning within the Monument included: 1) two ponds have year-around water, 2) several trails, roads, and a buried water pipeline corridor could be used as control lines in conjunction with hoselays, 3) availability of useable aerial photography, 4) a detailed plant species list was prepared, and 5) a fire history report was available. A primary consideration for controlled burning was the amount of time and personnel required to successfully execute a burn of any size. Using a Prescribed Fire Module, a somewhat larger burn unit should be considered for the Monument's environment. Fire management in the Monument should focus on specific structural objectives, e.g., remove a percentage of the regeneration under the stand canopy. Complete re-establishment of the presettlement fire regime may be an unrealistic management goal. Thinning or other mechanical treatments could be an appropriate replacement for prescribed burns for some, but not all management objectives.

2.6.5 Historic Agriculture

Farming and grazing occurred within the Monument from the 1860s until 1984 (USDI-NPS 1994). However, Rogers and Albert (1953), during a visit to the Monument area, acknowledged livestock production but made the observation that "there is no agriculture." Historically, in order to homestead, cultivation of the land for at least two years was required and was generally to consist of actual breaking of the soil followed by planting, sowing of seed, and tillage for a crop other than native grasses (Culpin 1979). Homesteaders used the lands of Florissant primarily for grazing, with small acreages used to grow hay, seed potatoes, oats, barley, rye, and garden vegetables (Culpin 1979).

Agricultural activity in the vicinity of Florissant reached its peak in the late 1800s and early 1900s, with cabbage, potatoes, and lettuce the principal crops (TCDP 1997). Produce was shipped from the area across the United States until the soil was depleted of nutrients (**Figure 2-10**). A historic potato cellar formerly owned by the Cusack family stands near the Barksdale Picnic Area in the southeastern portion of the Monument.

Certified seed potato production in the Florissant area represented a significant contribution to the local agricultural industry (Culpin 1979). The Florissant-Cripple Creek region supplied all the certified seed potatoes for farms of the San Luis Valley and the Greeley, CO regions. Potato fields would produce for about three years, then new types of potatoes would need to be introduced from outside the region. The Cusack family raised potatoes in the fields along the eastern Monument boundary until the 1940s (Culpin 1979). Certified seed potatoes had been produced from these fields since about 1912. Currently, there is little soil associated with these fields and the surface is composed of Pikes Peak granite gravel (**Figure 2-10)**. The extensive series of contoured berms within the fields is evident, both on the ground and from aerial photography.

FIGURE 2-10. ABANDONED AGRICULTURAL FIELD WITHIN FLFO

Ponderosa pine trees were beginning to re-establish on the potato field terraces that were to be interpreted (USDI-NPS 1985). The trees would diminish the views across these terraces and there was concern that tree establishment would weaken the terrace structures resulting in increased erosion from the fields.

Livestock grazing had occurred on the lands within the Monument since the 1870s (Culpin 1979). In 1893, Mr. Herman Halthusen obtained ownership of land within the Monument where he grazed approximately 10,000 head of sheep in addition to cattle and horses. Cattle and horse grazing continued on Monument lands until the mid-1980s (Ulrich 2000). Fifty years ago the land within the Monument was either being grazed or hay was being harvested from the lowland meadows to support livestock (Rogers and Albert 1953). One acre of meadowland was considered to be equal to 250 acres of upland for grazing livestock, and range deterioration was noted during the evaluation visit (Rogers and Albert 1953).

2.6.6 Other Land Use

Teller County Road 1 (TC-1), a paved highway, and the gravel-surface Upper Twin Rock and Lower Twin Rock Roads (**Figure 1-3**) represent the major access within the Monument (5.5 miles total length within Florissant). The rights-of-way claimed for these roads are 60-feet wide, and are planted largely to the exotic grass smooth brome. Several other ingress-egress easements were in place.

Adjacent to TC-1 is an overhead electric power line maintained by the Intermountain Rural Electric Association. There are also four right-of-way permits for buried telephone cables within the Monument, three for fiber-optic transmission cables and one for the local exchange. A housing subdivision with county road access is located on the southeastern boundary of the Monument, and the Florissant Cemetery is located on the northeastern boundary.

It is unknown to what degree salts are sprayed in the liquid form or added to sanding material used for traction in highway safety programs during winter travel on TC-1. Road traction salts may have a localized effect on plant growth and reproduction along roadways and in receiving waters, and sanding materials tend to increase sedimentation to drainage systems. Water draining from the road systems, in general, contribute to sediment introduction to creeks and streams and tend to flow at high velocities, which could increase scouring, bed erosion, and aggradation.

FIGURE 2-11. WATER PIPELINE CORRIDOR ESTABLISHED WITHIN FLFO

The Lower Homestake Pipeline was constructed across the area now occupied by the Monument during 1965 (USDI-NPS undated). This water pipe is 48-inches in diameter and carries water to the city of Colorado Springs, which had acquired right-of-way and easement from property owners for construction and maintenance of the pipeline. This area is 66-feet wide and was completely disturbed during pipeline emplacement (**Figure 2-11**). The grantee was required to reseed the right-of-way, and the exotics smooth brome, crested wheatgrass, and possibly western wheatgrass were planted. These species persist to date; however, the corridor is also being vegetated by a number of native plant species, including species of locoweed, cryptantha, prairie Junegrass, and fringed sagewort among several other species. Native flora seed collection is currently underway within the Monument to further revegetate this pipeline corridor (Ulrich, pers. com. 2001).

The Blue River pipeline right-of-way crosses the Monument on the northeast corner (USDI-NPS 1985). This pipeline also delivers water to the city of Colorado Springs. Both water pipelines have easements called corridors within rights-of-way, allowing maintenance and patrol access within the corridors.

2.6.7 Recent Vegetation Studies

Three vegetation classifications to habitat classes or plant communities have been made during past research efforts (**Table 2-4**). The most recent classification studies included Edwards and Weber (1990), who used a habitat approach while developing a species inventory. Boughton (1987) described habitat sites using ground surveys and 0.25-acre plots, and Bernatas (n.d.) developed plant community types from the regional literature, stating that: “it is generally recognized that all vegetation classifications are artificial, because vegetation grows in a continuum across the landscape.”

Plant communities are defined as an assembly of plants living together reflecting any sequence in ecological or successional status (early or late seral) (Steele et al. 1981 in Bernatas n.d.). The habitat type typically correlates a climax plant association to soil type, topography, and climate (USDA-FS 1983 in Bernatas n.d.). Habitat sites are based on the plant community, but also include land forms and animal use, and make no assumptions about vegetation succession status or potential vegetation (Boughton 1987).

TABLE 2-4. A COMPARISON OF RECENT VEGETATION CLASSIFICATIONS IN FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

BOUGHTON 1987 [HABITAT SITES]	EDWARDS AND WEBER 1990 [HABITATS]	BERNATAS UNDATED [PLANT COMMUNITIES]
VALLEY: Grassland Habitat –*Muhlenbergia montana, Festuca arizonica*	GRASSLANDS –Broad, dry meadows or grasslands –Probable former lake bed	GRASSLANDS –*Muhlenbergia montana-Danthonia parryi* –*Festuca arizonica-Muhlenbergia montana* –*Muhlenbergia montana-Blepharoneuron tricholepis* –Disturbed-exotic and introduced –Disturbed with *Pinus ponderosa* regeneration
VALLEY: Mountain Meadow Habitat; Low areas around creek –*Poa* sp., *Agropyron repens*	OTHER WETLAND COMMUNITIES –Open wet or moist meadows near streams or ponds –Marshy areas –Mud flats –Aquatic habitats, floating or submerged	RIPARIAN
VALLEY: Willow and Alder Habitat; Beaver ponds northwest of Hornbek –*Alnus tenuifolia, Salix exigua* (and other willow species), *Pentaphylloides (Dasiphora) floribunda, Ribes inerme*	RIPARIAN –Wooded streamsides (riparian)	RIPARIAN SHRUB –*Pentaphylloides* (*Dasiphora*) *floribunda*
HILL: South Aspect –*Pinus ponderosa – Cercocarpus montanus* Hillside –Pinus ponderosa, Cecocarpus montanus	ROLLING WOODED PARKLAND –Open ponderosa pine forest DRY ROCKY SLOPES AND RIDGES –South or southwest-facing slopes	FOREST –*Pinus ponderosa / Cercocarpus montanus* –*Pinus ponderosa / Festuca arizonica* SHRUB –*Cercocarpus montanus*
HILL: North Aspect –*Pseudostuga menziesii, Calamagrostis purpurascens*	ROLLING WOODED PARKLAND –Aspen groves –Shaded north-facing slopes, mixed woods DRY ROCKY SLOPES AND RIDGES –North- or northwest-facing slopes	FOREST –*Pinus ponderosa – Pseudostuga menziesii / Muhlenbergia montana* –*Pinus ponderosa / Danthonia parryi* –*Pseudostuga menziesii / Arctostaphylos uva-ursi – Juniperus communis* –Pseudostuga menziesii / Jamesia americana –*Populus tremuloides*
–Stock Ponds	–Aquatic Habitats (floating or submerged)	N/A

Three principle land forms are present within the Monument and include valleys, slopes, and hill and ridgetops. In addition, vegetation of disturbed sites have been described previously and is further discussed following the land form discussions.

Valleys

The valleys are represented by flowing and intermittent streams, adjacent floodplain terraces, tributary drainages, ponds created by beaver and for livestock water, and grassland-covered toe- to mid-slopes, occupying the area covered under ancient Lake Florissant (**Figure 2-12**). Valleys within Florissant contain hills and ridges that persisted as islands and peninsulas in ancient times (described below under the hill and ridgetop discussion). Immediately adjacent to ponds and perennial streams, including Grape and Boulder Creeks, are narrow bands and patches of willow (*Salix* spp.), water birch (*Betula occidentalis*), and speckled alder (*Alnus incana ssp. tenuifolia*). These narrow strips of shrub wetland vegetation grow within wetland meadows supporting sedge, rush, grass, and forb species. Along the valley sides, upland grasslands occupied the mid- and toeslopes of hills and ridges, the upper limits of the prehistoric Lake Florissant bed.

<u>Streams and Floodplain Terraces</u>

Narrow valleys with small streams tributary to Grape Creek support a variety of shrub species, e.g., water birch, thinleaf alder, shrubby cinquefoil (*Dasiphora fruticosa*), and mountain willow (*Salix monticola*), in addition to the introduced balsam poplar (*Populus balsamifera*), quaking aspen (*Populus tremuloides*), and Colorado blue spruce (*Picea pungens*) on the streambanks (Edwards and Weber 1990). Where the stream valleys widen and the streambed aggrades, sandbar willow (*Salix exigua*) shrubs become established. Understory species of aggraded sites are often weedy native and exotic, including timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), foxtail barley (*Hordeum jubatum*), and silverweed (*Argentina anserina*) (Edwards and Weber 1990).

Herbaceous species that were understory to the riparian wetland shrublands also occupied marshy meadows where the water table is at or near the ground surface (Edwards and Weber 1990). The substrate was sometimes saturated peat and would “quake” when walked upon. Common wetland grass and graminoid species included beaked, aquatic, and Nebraska sedge (*Carex utriculata, C. aquatilis*, and *C. nebrascensis*), Baltic rush (*Juncus balticus*), bluejoint reedgrass (*Calamagrostis canadensis*), tufted hairgrass (*Deschampsia caespitosa*), mannagrass (*Glyceria maxima*), and redtop (*Agrostis gigantea*). Common wetland forbs included cow parsnip (*Heracleum maximum*), scouring-rush (*Equisetum laevigatum*), chiming bells (*Mertensia ciliata*), butterweed (*Senecio bigelovii*), iris (*Iris missouriensis*), and dock (*Rumex densiflorus*).

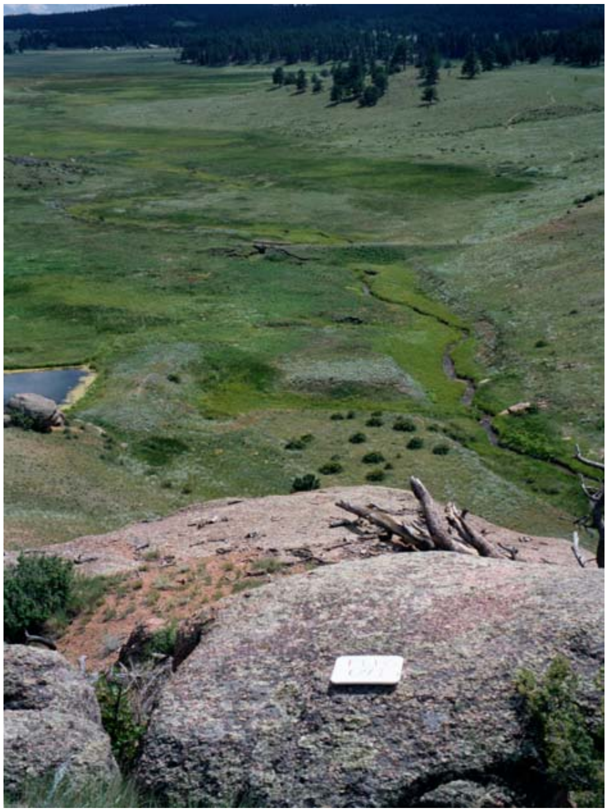


FIGURE 2-12. REPRESENTATIVE PHOTOS DEPICTING VALLEY TOPOGRAPHY OF FLFO

A shrubby cinquefoil type was described along intermittent streams by Bernatas (n.d.). This type was considered heavily disturbed by cattle and supported iris and species of sedges and rushes.

During the1996 growing season, Kittel et al. (1997) sampled riparian vegetation types at two locations within Florissant, both on Grape Creek. The sites are described as follows:

- Site #231 (Plot # 96AM37): This sample site was located on Grape Creek and was dominated by beaked sedge (*Carex utriculata*). Beaked sedge was the stand dominant, with a foliar cover value of 42%, and minor contributions to cover by Baltic rush , Kentucky bluegrass , field mint (*Mentha arvensis*), yarrow (*Achillea millefolium*), angelica (*Angelica ampla*), and pennycress (*Thlaspi arvense*). The total vegetative cover for this site was 65%.

- Site #234 (Plot #96AM40): This sample site was located on Upper Grape Creek and was dominated by aquatic sedge (*Carex aquatilis*). Aquatic sedge was the stand dominant (foliar cover value of 13%) within a very mixed stand. Other species having high foliar cover values in this stand were dock (11%), angelica (7%), Kentucky bluegrass (6%), and 6% each for the shrubs sandbar willow (*Salix exigua*) and shrubby cinquefoil. The total vegetative cover for this site was 88%.

Ponds and Mudflats

In excess of 100 livestock watering ponds and check dams have been constructed historically within the Monument (**Figure 2-13**). Some lateral drainages also appear to have been ditched historically, presumably to speed flow of surface runoff into the pond structures rather than allow it to spread across the drainage and percolate into the soil. These ditched drainages have formed head cuts that migrated farther up-drainage over time and the ditches have widened laterally as the bottom developed sinuosity resulting in bank or lateral erosion.

FIGURE 2-13. EXAMPLES OF DRY AND FULL LIVESTOCK PONDS WITHIN FLFO

Boughton (1987) recognized that these stock ponds were important as wildlife habitat and could be given a designation such as “special habitat feature.” Bernatas (n.d.) concluded that riparian types, including ponds, could be important in a sediment yield study. Also noted were signs of cattle disturbance, streambank-cutting resulting in bare ground being exposed, and dominance by the genera *Salix*, *Juncus*, and *Carex* (Bernatas n.d.).

A few aquatic plant species were described from stock ponds and slow streams in Florissant, and each pond was recognized as having a slightly different plant association (Edwards and Weber 1990). Aquatic species observed included water milfoil (*Myriophyllum sibiricum*), water crowfoot (*Ranuculus trichophyllus*), northern water starwort (*Callitriche hermaphroditica*), duckweed (*Lemna minor*), and pondweed (*Potamogeton pusillus*). At least one pond that had dried rapidly showed no evidence of aquatic vegetation, while drying mudflats of another pond supported mudwort (*Limosella aquatica*), cudweed (*Filaginella uliginosa*), and water starwort (*Callitriche verna*).

Upper Floodplain Terraces and Slopes

Dry floodplain terraces and valley slopes occured above the drainage bottoms and moist meadows, identify the ancient Lake Florissant basin, and support dry grasslands and low shrublands predominantly (Edwards and Weber 1990). The most common grass and forb species of the dry grasslands were Arizona fescue (*Festuca arizonica*), mountain muhly (*Muhlenbergia montana*), blue grama (*Bouteloua gracilis*), needle-and-thread (*Hesperotipa comata*), sleepygrass (*Stipa robusta*), pine dropseed (*Blepharoneuron tricholepis*), nodding (Porter) brome (*Bromus porteri*), squirreltail (*Elymus longifolius*), Parry oatgrass (*Danthonia parryi*), smooth brome, golden-aster (*Heterotheca fulcrata*), daisy fleabane (*Erigeron vetensis*), ground plum (*Astragalus crassicarpus*), blue flax (*Linum lewisii*), and penstemon (*Penstemon virgatus*). Common low-growing shrubs included fringed sagewort (*Artemisia frigida*), viscid rabbitbrush, Parry rabbitbrush, and Colorado rubber plant (Edwards and Weber 1990).

Boughton (1987) described and sampled one grassland habitat site having a high amount of uniformity, dominated by Arizona fescue and mountain muhly. Bernatas (n.d.) described three grassland communities within the Monuemnt; they were: 1) *Festuca arizonica – Muhlenbergia montana* (Arizona fescue – mountain muhly), 2) *Muhlenbergia montana – Blepharoneuron trichcolepis* (mountain muhly – pine dropseed), and 3) *Muhlenbergia montana – Danthonia parryi* (mountain muhly – Parry oatgrass).

The Arizona fescue – mountain muhly type, was characterized by the type dominants in addition to bluegrass (*Poa secunda*), prairie Junegrass (*Koeleria macrantha*), *Stipa* spp., blue grama, obtuse sedge (*Carex obtusata*), slimstem muhly (*Muhlenbergia filiculmis*), cinquefoil (*Potentilla* spp.), aster (*Aster* spp.), fleabane (*Erigeron flagellaris*), pussytoes (*Antennaria aprica*), yarrow, Colorado rubber plant, and fringed sagewort (Bernatas n.d.). Research conducted by Boughton (1987) also identified squirreltail and locoweed (*Oxytropis splendens*) as common for this association.

Foliar cover values were estimated for Arizona fescue (1–50%), mountain muhly (1–45%), blue grama (1–15%), and prairie Junegrass (2–30%) for 18 plots across this habitat site (Boughton 1987). Edwards and Weber (1990) considered Arizona fescue and mountain muhly to be subclimax species in the Pikes Peak region. Arizona fescue was the more dominant grass on undifferentiated lake shales and tuff, lower tuff, and lake shale geologic formations; and mountain muhly was more dominant on Quaternary alluvium and colluvium, in addition to upper tuff, Pikes Peak granite, and undifferentiated lake shales and tuff (Boughton 1987).

The mountain muhly – pine dropseed type, was characterized by the type dominants in addition to prairie Junegrass, squirreltail, blue grama, species of bluegrass, fleabane, pussytoes, species of aster, geranium (*Geranium caespitosum*), yarrow, and fringed sagewort (Bernatas n.d.). This type occurs as park-like areas among lower ponderosa pine woodlands. Pine dropseed was not recorded for the habitat site research performed by Boughton (1987). Foliar cover values estimated for mountain muhly (1–45%), blue grama (1–15%), prairie Junegrass (2–30%), squirreltail (1–35%), pussytoes (1–30%), and fringed sagewort (0–1%) (Boughton 1987).

The mountain muhly – Parry oatgrass type, was characterized by the type dominants in addition to prairie Junegrass, Sandberg bluegrass (*Poa sandbergii*), sunsedge (*Carex heliophila*), cinquefoil (*Potentilla hippiana*), pussytoes, bluebells (*Mertensia lanceolata*), golden-aster, and fringed sagewort (Bernatas n.d.). This type occurs as small, potentially park-like openings within ponderosa pine forests and grow from alluvial and colluvial gneiss and schists. Boughton (1987) observed Parry oatgrass in two habitat site plots where the species was recorded as a trace in foliar cover value. Foliar cover values were estimated for mountain muhly (1–45%), prairie Junegrass (2–30%), and pussytoes (1–30%) occurring in this habitat site (Boughton 1987).

Slopes

Slopes within Florissant are represented by shrub-dominated and dry rocky outcrops and ridges, woodland stands on southern exposures, and forests on northern exposures (**Figure 2-14**). The shrubby communities and habitats of upper slopes are described here and intersperse with the woodland and forest types that are described under Hill and Ridgetop habitats below. The grassland communities occupying much of the area between rocky outcrops were described in the foregoing section under the Upper Floodplain Terraces and Slopes discussion.

The mountain mahogany / mountain muhly type was characterized by the type dominants in addition to fringed sagewort, yucca (*Yucca glauca*), wax currant (*Ribes cereum*), blue grama, species of sedge, and Britton skullcap (*Scutellaria brittoni*) (Bernatas n.d.). Edwards and Weber (1990) considered mountain mahogany to be an abundant shrub on many south- and west-facing slopes, but Boughton (1987) determined it to be a rare shrub of ponderosa pine and Douglas-fir woodland and forest stands.

FIGURE 2-14. REPRESENTATIVE PHOTOS FOR SLOPE TOPOGRAPHY WITHIN FLFO

Edwards and Weber (1990) also described rock outcrop areas as crowning slopes and ridges and supporting bristlecone pine (*Pinus aristata*) woodland, in addition to waxflower (*Jamesia americana*) and boulder raspberry (*Rubus deliciosus*) boulder fields. Associated species described for these habitats included the dominants and Arizona fescue, mountain muhly, slimstem muhly (*Muhlenbergia filiculmis*), mountain ball cactus (*Pediocactus simpsonii*), geranium, golden smoke (*Corydalis aurea*), and cinquefoil.

Hill and Ridgetops

Edwards and Weber (1990) estimated that approximately 90% of the forested area of Florissant was made up of ponderosa pine interspersed with small quaking aspen groves (**Figure 2-15**). Boughton (1987) recognized open forests of southern exposures dominated by ponderosa pine and open or closed forests of northern exposures dominated by ponderosa pine, Douglas-fir, a mixture of the two, and quaking aspen. Four ponderosa pine and one Douglas-fir woodland and forest types were listed by Bernatas (n.d.); they were: 1) Ponderosa pine – Douglas-fir / Mountain muhly, 2) Ponderosa pine / Parry oatgrass, 3) Ponderosa pine / Mountain mahogany, 4) Ponderosa pine / Arizona fescue, and 5) Douglas-fir / Kinnikinnick (*Arctostaphylos uva-ursi*) – Common juniper (*Juniperus communis*).

FIGURE 2-15. REPRESENTATIVE PHOTOS OF HILL AND RIDGETOP TOPOGRAPHY FOR FLFO

The ponderosa pine - Douglas-fir / mountain muhly association, was described for gentle slopes with northerly aspects and soils derived from Pikes Peak granite (Bernatas n.d.). Understory shrubs common for the type (considered widely scattered with low foliar cover) included fringed sagewort, wax currant, boulder raspberry, mountain mahogany, kinnikinnick, and common juniper. The most common grasses and forbs included mountain muhly, Arizona fescue, prairie Junegrass, slimstem muhly, pine dropseed, yarrow, geranium, gold-aster, Colorado rubber weed, and bluebells (*Campanula rotundifolia*). For stands with similar structure, Boughton (1987) found common juniper (8–10% foliar cover), reedgrass (5–30% foliar cover), and Arizona fescue (5–30% foliar cover) as the common understory species. One stand contained Parry oatgrass that was estimated to have 50% foliar cover.

The ponderosa pine / Parry oatgrass type was presented as a phase of the ponderosa pine / Arizona fescue association (Bernatas n.d.). The species of both types are the same; however, Parry oatgrass was higher in foliar cover, much as in the plot described by Boughton (1987). A mixed stand of ponderosa pine and Douglas-fir contained Parry oatgrass with an estimated 50% foliar cover value.

The ponderosa pine / mountain mahogany association was described for southern exposures and moderate to steep slopes by Bernatas (n.d.). Common plant species found within this association included Douglas-fir, fringed sagewort, yucca, species of sedge, needle-and-thread, prairie Junegrass, blue grama, mountain muhly, little bluestem (*Schizachyrium scoparium*), puccoon (*Lithospermum multiflorum*), and catseye (*Cryptanha thyrsiflora*).

The ponderosa pine / Arizona fescue association was found at the lowest woodland elevation on cool, wet, rocky slopes and benches with interspersed meadows (Bernatas n.d.). The association was an open, park-like stand with Douglas-fir, kinnikinnick, common juniper, fringed sagewort, mountain muhly, prairie Junegrass, bluebells, geranium, and yarrow the common understory species. Boughton (1987) estimated Arizona fescue foliar cover in this type to range from <1–50% in the open ponderosa pine stands.

The small quaking aspen groves occurred in the more moist portions of the ponderosa pine woodland and on north-facing slopes and streamsides (Edwards and Weber 1990). Bernatas (n.d.) described the understory of quaking aspen stands as being unique within each stand and did not attempt an understory designation. Understory and associated tree species in quaking aspen stands included ponderosa pine, Douglas-fir, and Colorado blue spruce. Because the stands are cool, cattle (and probably elk) select them for summer shade and the understory can be quite disturbed as a result (Bernatas n.d.).

Douglas-fir / kinnikinnick – common juniper was described for gentle slopes of east or west aspects, with common juniper increasing in foliar cover as the overstory density increased (Bernatas n.d.). Bernatas (n.d.) also described a Douglas-fir / waxflower association, but the species composition was the same as for this type and did not mention waxflower as being present. Edwards and Weber (1990) observed that Douglas-fir was usually present on rocky north-facing slopes where the soil was cooler and the microclimate was more mesic. Including the dominant species, common species to this type were ponderosa pine, quaking aspen, wax currant, species of rose (*Rosa* spp.), mountain muhly, Arizona fescue, pine dropseed, species of strawberry (*Fragaria* spp.), and geranium. Boughton (1987) observed a closed canopy Douglas-fir forest with 40% cover by common juniper. In more open stands, common juniper ranged from 2–10% foliar cover and kinnikinnick obtained from <1–5% foliar cover.

2.6.8 Rare Plant Species

The Colorado Native Plant Society (CONPS) has collected and identified 452 plant species, 308 genera, and 88 families within Florissant (Edwards and Weber 1990). These specimens have been accessioned and cataloged into the ANCS and are stored within the Monument educational facilities. It should be noted that the taxonomic reference used for this research was the *Colorado Flora, Eastern Slope* (Weber 1990). **Appendix B** provides a comparison of the nomenclature of Weber (1990), the national PLANTS database, and the database provided by ITIS (see discussion under section 2.3.2). To date, an inventory of nonvascular plants within the Monument has yet to be conducted (USDI-NPS 1994).

A list of sensitive or unusual plant species present within Florissant, and distribution maps, was prepared by Monument staff (FLFO n.d.). These species included:

- white upland aster (*Unamia alba* or *Solidago ptarmicoides*)
- water-milfoil (*Myriophyllum sibericum*)
- brook grass (*Catabrosa aquatica*)
- fairy slipper orchid (*Calypso bulbosa*)
- Canada lousewort (*Pedicularis canadensis* ssp. *fluviatilis*)
- one-sided wintergreen (*Orthilia secunda*)
- twin-flower (*Linnaea borealis* ssp. *americana*)
- brittle fern (*Cystopteris fragilis*)
- Reeves brittle fern (*Cystopteris reevesiana*)
- zigzag cloak fern (*Cheilanthes cancellata*)
- Fendler cloak fern (*Cheilanthes fendleri*)
- male fern (*Dryopteris filix-mas*)
- grass fern (*Asplenium septentrionale*)

- maidenhair spleenwort (*Asplenium trichomanes*)
- Mexican woodsia (*Woodsia mexicana*)
- Oregon woodsia (*Woodsia oregana*)
- woolly actinella (*Tetraneuris brevifolia*)
- wild caroway (*Aletes anisatus*)
- Colorado blue columbine (*Aquilegia caerulea*)
- bristlecone pine (*Pinus aristata*)

2.6.9 Exotic Plant Species and Associations

Several exotic plant species are present within Florissant and their distribution has been greatly influenced by human activity including: 1) fire suppression, 2) transportation corridor and utility line construction, 3) logging since the 1860s, 4) residence construction and occupation, 5) farming and grazing activities, 6) limited mining, 7) introduction of soil conservation structures, and 8) fossil removal and hunting activities. Of the 452 plant species identified, 52 (12%) species were considered exotic. Further, 10 of the exotic species were classified as noxious weeds by the state of Colorado.

Exotic plant species are considered a threat to native plant associations because they: 1) replace native species, 2) reduce the carrying capacity of land for livestock and grazing wildlife, 3) may be poisonous to livestock or wildlife, 4) decrease plant species diversity and can further reduce and/or imperil populations of rare species, 5) may carry detrimental insects, diseases, or parasites, 6) can alter fire patterns and intensity, 7) can increase soil nitrogen levels to be detrimental to native species, 8) can result in increased soil erosion and runoff, and 9) can generally degrade or destroy wildlife habitat (CNAP 1999; Trammell 1994).

Much of the disturbed land was vegetated with the exotic grass species smooth brome and crested wheatgrass (*Agropyron cristatum*). Ponderosa pine (*Pinus ponderosa*) trees have begun re-establishing on old agricultural fields planted with smooth brome. Livestock grazing, which suppressed tree reproduction, was halted when agreements expired during the 1980s (Bernatas n.d.). Adventive plant species common to disturbed sites in the Monument included yellow sweetclover (*Melilotus officianalis*), Canada thistle (*Cirsium arvense*), pigweed (*Chenopodium berlandieri*), knotweed (*Polygonum aviculare*), and Russian pigweed (*Axyris amaranthoides*) (Edwards and Weber 1990).

An inventory of the seven most significant exotic plant species was completed in 1999, a distribution map was produced, and the species were prioritized in a weed management plan for control efforts. A modified version of the Hiebert and Stubbendieck ranking system was used to prioritize exotic plant species for control efforts. The analysis of the data indicated that two noxious weed species, Canada thistle and toadflax (*Linaria vulgaris*), warranted the most management attention (**Figure 2-16**). Using a combination of mechanical control and chemical methods (where warranted), populations of the most invasive noxious weeds were placed under Monument management control. The management prescriptions were focused on areas with the potential to be a seed source and any new infestations of noxious weed species (**Figure 2-16**).

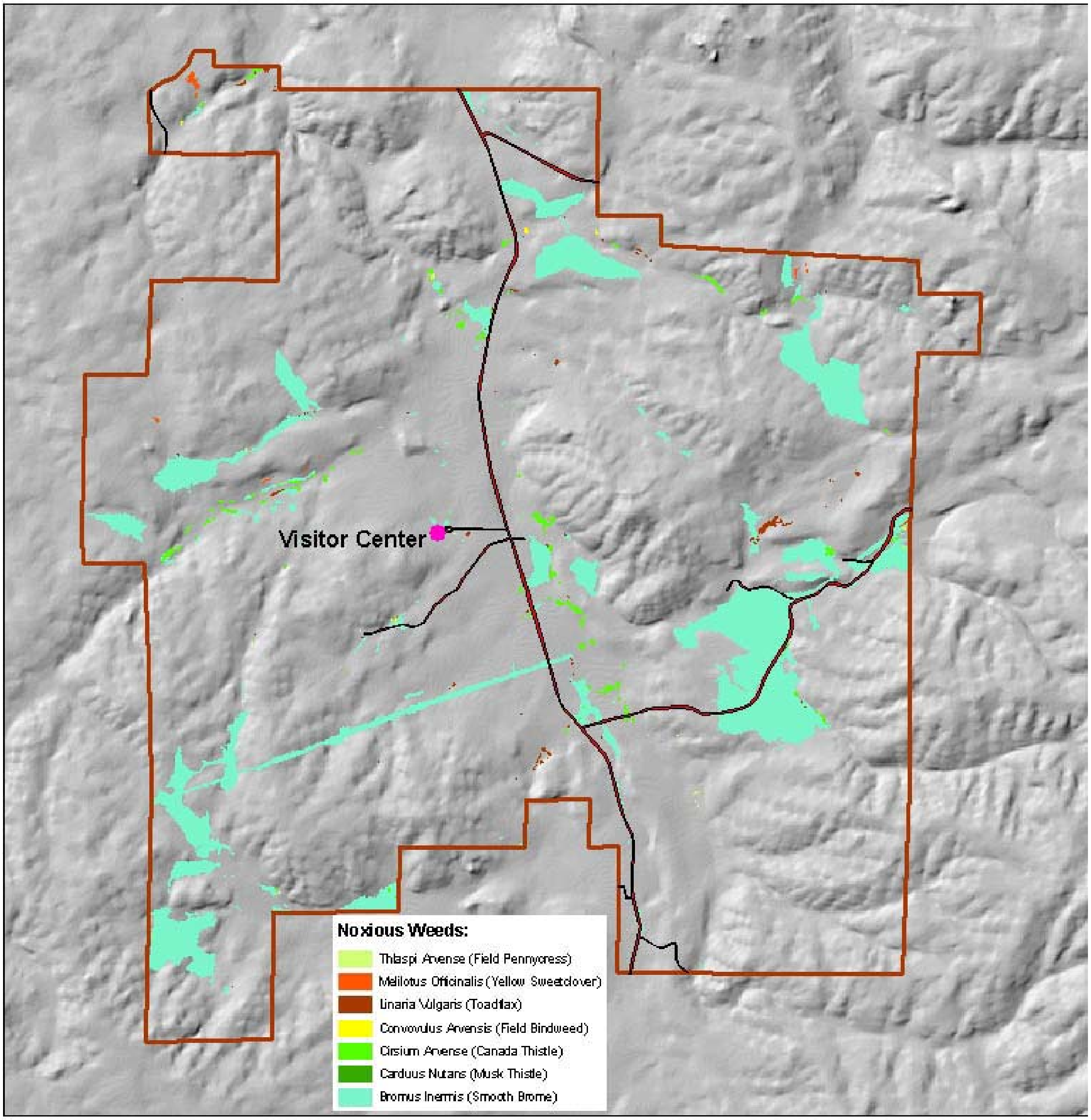


Figure 2-16. Map of Noxious Weeds for FLFO [USGS]

3.0 METHODS

3.1 PLANNING AND SCOPING

Florissant vegetation mapping combined the expertise and oversight of many organizations, as follows:

- United States Geological Survey (USGS) Center for Biological Informatics – provided oversight and programmatic guidance.

- National Park Service (NPS) Washington Office (WASO) – provided oversight and programmatic guidance.

- NPS Florissant Fossil Beds National Monument (FLFO) – provided support for field sampling, field data collection assistance, and guidance for specific Monument needs.

- USGS Rocky Mountain Mapping Center (RMMC) – acquired existing true color aerial photography from NPS, provided field data collection assistance, aerial photointerpretation, conducted meetings to determine vegetation and land-use mapping units, digital spatial database preparation, conducted a field verification trip to assess visual accuracy of draft vegetation maps, created digital vegetation and land-use coverages including relevant attribute information, produced Arc/Info export file of vegetation plot, observation point, and accuracy assessment locations, prepared a final report, provided ancillary digital files (geology, soils, etc.) developed during the mapping process, documented FGDC-compliant metadata files for all created spatial data, prepared a spreadsheet and contingency table comparing the mapped vegetation units with the accuracy assessment units in order to determine map accuracy, and produced a CD-ROM describing procedures used in preparing vegetation map products.

- NatureServe – developed a preliminary vegetation classification for the study area from the NVC and secondary sources, participated in meetings, provided field data collection oversight, prepared the final plant association classification, prepared global plant association descriptions, and provided draft report review and comment.

- Colorado Natural Heritage Program (CNHP) – provided a preliminary vegetation classification review for the study area from a brief field survey and from secondary sources.

- engineering-environmental Management, Inc. – provided vegetation mapping guidance; designed a sampling strategy; collected observation points to refine the preliminary classification and familiarize investigators with plant associations and the range of variability; collected field data to determine plant associations and vegetative variability within the Monument by selecting and sampling representative stands for all community types; provided data entry and analysis; prepared local plant association descriptions; prepared a field key to plant associations; field tested final classification, descriptions, and key while collecting accuracy assessment data; provided an annotated list of representative field site photographs/digital photographs; and draft report preparation.

A kick-off meeting was held at the Monument Education Center on June 7, 2001. The purpose of this scoping meeting was to 1) inform the Monument staff and interested neighbors about the Vegetation Mapping Program, 2) allow the Monument to present relevant management and science issues, 3) determine the existing data that had been delivered or ordered, 4) develop a preliminary schedule with assigned tasks, 5) define possible cooperation with neighbors and partners, and 6) define a project boundary by incorporating interested neighbors' concerns on areas bordering the Monument. A project boundary of approximately 0.5 miles around the edge of the Monument (the environs area) was selected, covering an area of approximately 8,000 acres. This mapping area was included on two 7.5-minute topographic quadrangles: Divide and Lake George.

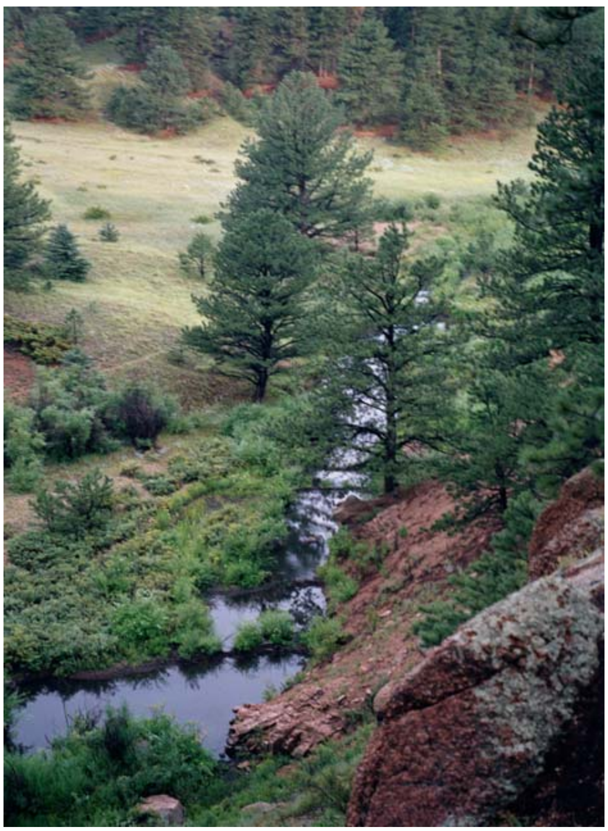


Figure 3-1 Grape Creek, North-Central FLFO

3.2 FIELD SURVEY VEGETATION COMMUNITY CLASSIFICATION

3.2.1 Survey Approach

Field surveys began during the second week of July 2001 and completed during the third week of August 2001. Data collection included both intensive quantitative plots and observation points, allowing researchers to record typical vegetation types and note variation within plant communities across the Monument. Because the Monument is relatively small and the topographic features are readily accessible, sampling occurred in all map units across the project area, except the private lands of the environs.

3.2.2 Plant Species List and Taxonomy

A comprehensive review of previous botanical studies performed on the Monument and in the vicinity was conducted. Specimens housed in the Florissant herbarium were reviewed to determine locations for selected rare plant species and potentially dominant plant species. The most complete taxonomic work to date is a plant inventory performed by Edwards and Weber (1990). This was used as the basic species list for field inventory in combination with the *Colorado Flora, Eastern Slope* (Weber 1990). Taxonomically, these two references complemented one another and allowed fieldwork to be conducted more smoothly.

The nationally defined standard for the USGS-NPS Vegetation Mapping Program is the Integrated Taxonomic Information System (ITIS), an on-line, scientifically credible list of biological nomenclature focusing on the biota of North America. All plant species names used in the development of the classification system were consistent with ITIS standards (NBII 2002b). The the Monument plant species list prepared by Edwards and Weber (1990) was referenced to ITIS in order to establish nationally accepted taxonomy and to obtain the unique taxonomic serial number for each plant species.

Plant species data entry into the TNC PLOTS database requires the use of an acronym representing an individual species. To obtain the proper acronym, the plant species listed by Edwards and Weber were corrected to the ITIS database and were also evaluated using the national PLANTS Database, which is part of the ITIS for North American (USDA 2001). PLANTS provides species names and accepted acronyms, species checklists, automated tools, identification information, species abstracts, distributional data, crop information, plant symbols, plant growth data, plant materials information, plant links, references, and other plant information. **Appendix B** contains the final plant species list and the relationships among the taxonomy of Weber (1990), National PLANTS database, and the ITIS database.

3.2.3 Vegetation Observation Point Collection

Field observations took three forms to help guide vegetation data collection and aerial photointerpretation for this project. First, an aerial photo mosaic plot was produced from approximately 1:24,000 scale true color aerial photographs, orthorectified, and a preliminary interpretation was performed to identify like vegetation signatures. Each signature type was visited in the field to determine if a land-use or vegetation pattern could be discerned. In addition, discernible geologic formations observed on these photo mosaic plots were also visited in an effort to examine the flora of both volcanic and granitic exposures. Field notes of vegetation dominance and some distinct plant association boundary lines were recorded directly on the photo mosaic plots. These plots were used for navigation across the Monument throughout the field season.

Second, a set of older, color infrared aerial photographs at the approximately 1:18,000 scale were examined to determine if consistent vegetation signatures could be identified, particularly in mesic habitats. This set of photos was covered for protection from moisture; however, notes related to plant species dominance were recorded on the plastic moisture barrier.

The third form of recording field observation points used 60 standard observation point forms (**Appendix C**) to record locational (Universal Transverse Mercator (UTM) X-Y coordinates in NAD83 datum), environmental (characteristics of geology, soils, hydrology, etc.), plant community (structure and physiognomy), plant species information (cover values by dominant species), and field notes (including human and wildlife effects) for the site. This dataset (contained on accompanying data CD) allowed examination of the complex grassland, emergent wetland, shrubland, woodland, and forest communities, in addition to the vegetation of historically disturbed sites. Both representative plant associations and variation within vegetation types were recorded in this manner. This dataset can be valuable in two ways: as a guide to photointerpretation, or as an interim accuracy check of interpreted areas. The basic limitation of observation point data includes no measurement or delineation of sampling area, and vegetation cover values were estimated only for common species in each stratum.

3.2.4 Vegetation Quantitative Data Collection

Field researchers chose representative stands of plant communities to locate vegetation samples (**Figure 3-1**), which are more rigorous than observation points. Sampling sites were selected from homogeneous photo signatures identified during preliminary interpretation and through field identification during the observation phase of the study. For most sites, plots were subjectively placed in vegetation types that were representative of an area, relatively homogenous, and larger than the 0.5 ha minimum mapping unit (MMU). Ecotones were avoided to the extent possible; however, some streamside types were extremely narrow and some ecotonal data collection was inevitable. In addition, some vegetation patches were less than the project MMU, but were unique, e.g., balsam poplar (*Populus balsamifera*), Nebraska sedge (*Carex nebrascensis*), shortfruit willow and strapless willow (*Salix brachycarpa* and *Salix ligulifolia*), etc. These were sampled using the more detailed vegetation plots, but termed "park specials" because of their value for overall Monument management prescriptions. Data were entered on standard forms; an example is presented in **Appendix C.**

Forest, woodland, and sparse shrublands were sampled with 20 x 20 meter plots, while more dense shrubland, grassland, graminoid, and forb communities were sampled with 10 x 10 meter plots. Long, linear stands of alder, willow, and birch were sampled with rectangular plots equaling 100 m^2, where appropriate. The data collected at each site included locational (UTM X-Y coordinates in NAD83 datum), environmental (characteristics of geology, soils, hydrology, etc.), habitat characteristics (aspect, slope, elevation), plant community (vegetation composition, structure, and physiognomy), plant species information (cover values by dominant species, tree height and diameter, etc.), and field notes (including human and wildlife effects) for the plot site. A few sites were selected because they represented exotic plant communities introduced following historic human use such as potato fields and aqueduct placement.

The spatial coordinates and elevation for all plots were recorded from a hand-held Precision Light-weight Global Positioning System (GPS) Receiver (PLGR) unit. Still photos were taken to record the condition of each plot site. A minimum of two photos for each vegetation plot were taken (**Appendix D**). The photos were developed to prints and digitally scanned onto compact disks for ease of handling, logged in a summary table, and labeled. These photos were also used to illustrate the field key to plant associations. The field photos can be found on the data CD accompanying this report under Field_Data\Field_Photos. At least three plots were placed in each plant community determined in the Monument, when three stands of vegetation were available for sampling. For some rare communities, only one or two stands were sampled. All of the data were entered into the PLOTS database created by TNC.

To characterize vegetation structure, all species observed within the plot were listed by strata (tree, shrub, graminoid, forb), and foliar cover was estimated using a modified Daubenmire (1959) method.Tree and large shrub diameters were recorded for all trunks 10 cm dbh (diameter at breast height) or larger. Environmental data were also collected for each plot to characterize abiotic conditions associated with the vegetation and to further describe the plant community.

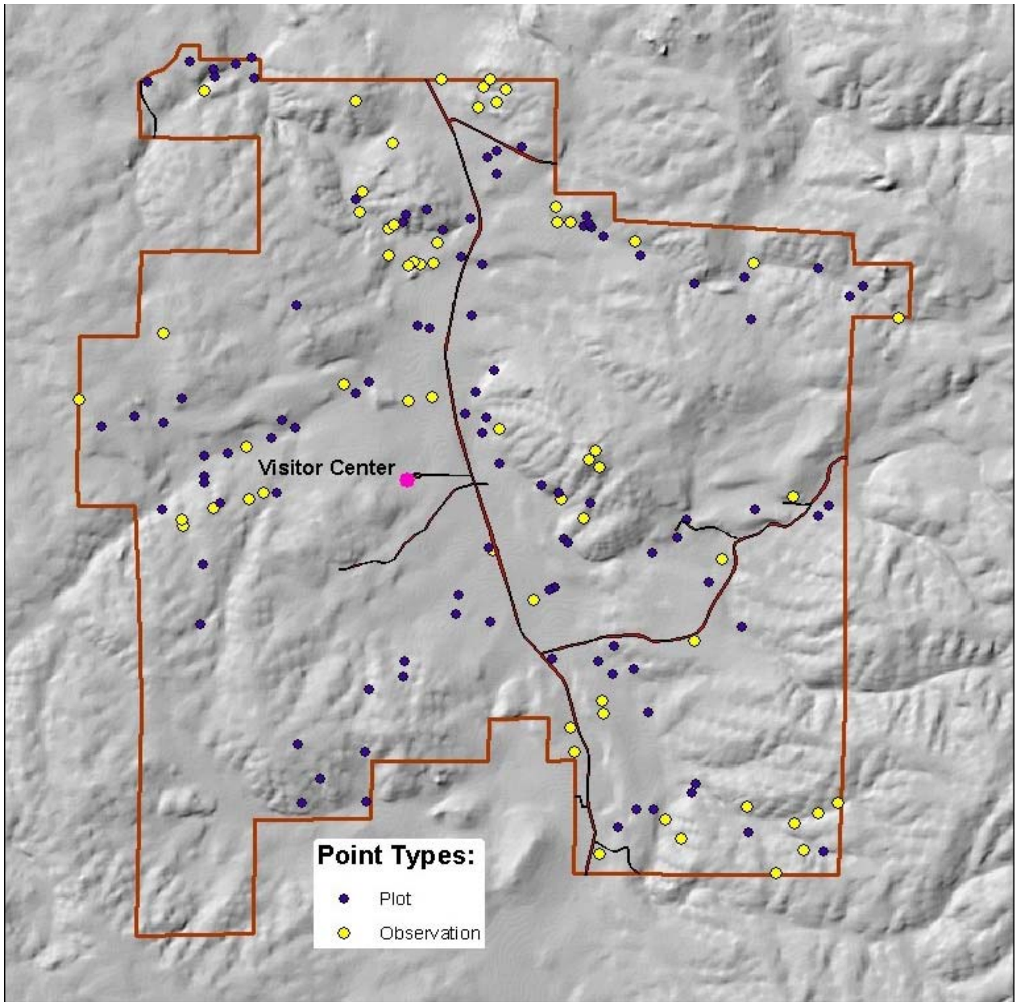


FIGURE 3-2. MAP OF PLOT AND OBSERVATION POINTS

3.2.5 Vegetation Classification and Characterization

Data from the 99 vegetation plots collected from the Monument during the 2001 field season were entered into the PLOTS database following procedures outlined by Grossman et al. (1998). The National Vegetation Classification System (NVCS; Grossman et al. 1998) is a national system containing seven classification levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species. For the name or title given to an association or alliance, a single dominant species may be used (*Pinus aristata* Woodland), if two species of the same stratum are used they are separated by a dash (*Chrysothamnus viscidiflorus – Ericameria parryi* Shrubland), and if two species occured in a different strata, then a slash is used to separate them (*Picea pungens / Betula occidentalis* Woodland). Parentheses are used when the diagnostic species are not consistently present in the vegetation association or alliance (*Bromus inermis* – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation).

Following entry into the PLOTS database, species foliar cover values for each plot were then exported into a spreadsheet format and arranged into a plot by species data matrix (**Appendix E**). Several of the species recorded in the PLOTS database, primarily trees and shrubs, occupied more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer were subscripted with the strata codes (T1, T2, S1, S2, S3, for example). The matrix was then used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix was analyzed using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique).The use of TWINSPAN (two-way indicator species analysis) and DECORANA (detrended correspondence analysis - for ordination) was part of the suite of statistical analyses for seperating associations and relating them to the NVCS in a preliminary fashion. TWINSPAN and DECORANA, along with Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage) were run several times to develop the relationship among plots and relative to the NVCS The matrix was edited prior to analysis by first removing all species that had total cover values (summed over all 99 plots) of < or = 1% to keep the influence of minor species at a minimum. Raw foliar cover scores were used in all data analysis procedures. The data matrix was then subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in data sets such as this one, and occured because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers increased the efficiency of the analysis and substantially improved the interpretability of the results.

Initial data analysis revealed two groups that appeared to follow natural physiognomic boundaries: 1) mesic and wetland communities, and 2) forest, woodland, shrubland, and upland grassland communities. This second group was then further divided into the dry forest, sparse woodland, and grassland class and a second class containing the majority of the forest, woodland, and shrubland plots. The overall goal of these three initial classifications was to reduce the size of the data matrix along natural physiognomic boundaries prior to classification and ordination (McCune and Mefford 1999). Forests were defined as vegetation types dominated by tree species with overlapping canopies of 60–100% foliar cover, and woodlands were considered more open stands of trees that exhibit non-overlapping canopies with 25–60% foliar cover (Grossman et al. 1998).

3.3 VEGETATION MAP AND DATABASE PREPARATION

3.3.1 Aerial Photography and Other Source Materials

Natural color aerial photographs were acquired from three different photo missions between 1995 and 1997. A total of 13 photos along three flight lines were used. The photo missions cover the entire project area, which includes the entire park and environs **(Figure 1-3**).

Skytech Aero, Inc. (North Little Rock, AR) took aerial photographs for the western portion of the project on August 27, 1995. The photos were taken at a flight height of approximately 13,000 feet with a Jena MRB 15/2323 camera using color negative film. The scale of the 9 x 9-inch paper prints was approximately 1:26,500.

Skytech Aero, Inc. (North Little Rock, AR) took aerial photographs for the central portion of the project on September 5, 1996. The photos were taken at a flight height of approximately 12,000 feet with a Jena MRB 15/2323 camera using color negative film. The scale of the 9 x 9-inch paper prints was approximately 1:23,700.

Skytech Aero, Inc. (North Little Rock, AR) took aerial photographs for the eastern portion of the project on September 28, 1997. The photos were taken at a flight height of approximately 11,000 feet with a Jena MRB 15/2323 camera using color negative film. The scale of the 9 x 9-inch paper prints was approximately 1:22,000.

Two sets of ancillary aerial photography were used as collateral information. The first was a set of CIR paper prints. Intrasearch (*12424 E Weaver Place, Ste 100, Englewood, CO 80111*) took aerial photographs on August 9, 1983. The photos were taken at a flight height of 12,000 feet above mean ground level with a RC8 camera using Kodak 2443 Infrared film. The scale of the 9 x 9-inch paper prints was approximately 1:24,000.

The second ancillary photography was a set of black-and-white paper prints. Rocky Mountain Aerial Surveys, Inc (14 Inverness Drive East, Building G-136, Englewood, CO 80111-6406) took aerial photographs on October 18,1997. The photos were taken at a flight height of 6000 feet above mean ground level with a Zeiss RMKA/15/23 camera using Kodak 2405 XX Black and White film. The scale of the 9 x 9-inch paper prints was approximately 1:12,000.

Other source information supplied by the NPS includes (all digital): the park boundary, surficial geology, soils, and noxious weeds.

The USGS supplied Digital Raster Graphic data (DRG), Digital Elevation Model data (DEM), and Digital Orthophoto data (DOQ). Slope and aspect data was derived from the DEM.

3.3.2 Vegetation Map and Database Preparation

Preparation

Six exposures from the source imagery that covers the project area and the ½-mile “environs” around the park were scanned in color at 800 dpi. These were orthorectified using the Image

Geometric Correction - Camera tool in ERDAS Imagine, employing data from the DEM, DOQ, and the camera calibrations. Six orthoimages were produced from the following photographs: USDA-F 612120) 495-11, 495-13, 1095-31, 1095-33, 2095-37, and 2095-39. Using the park

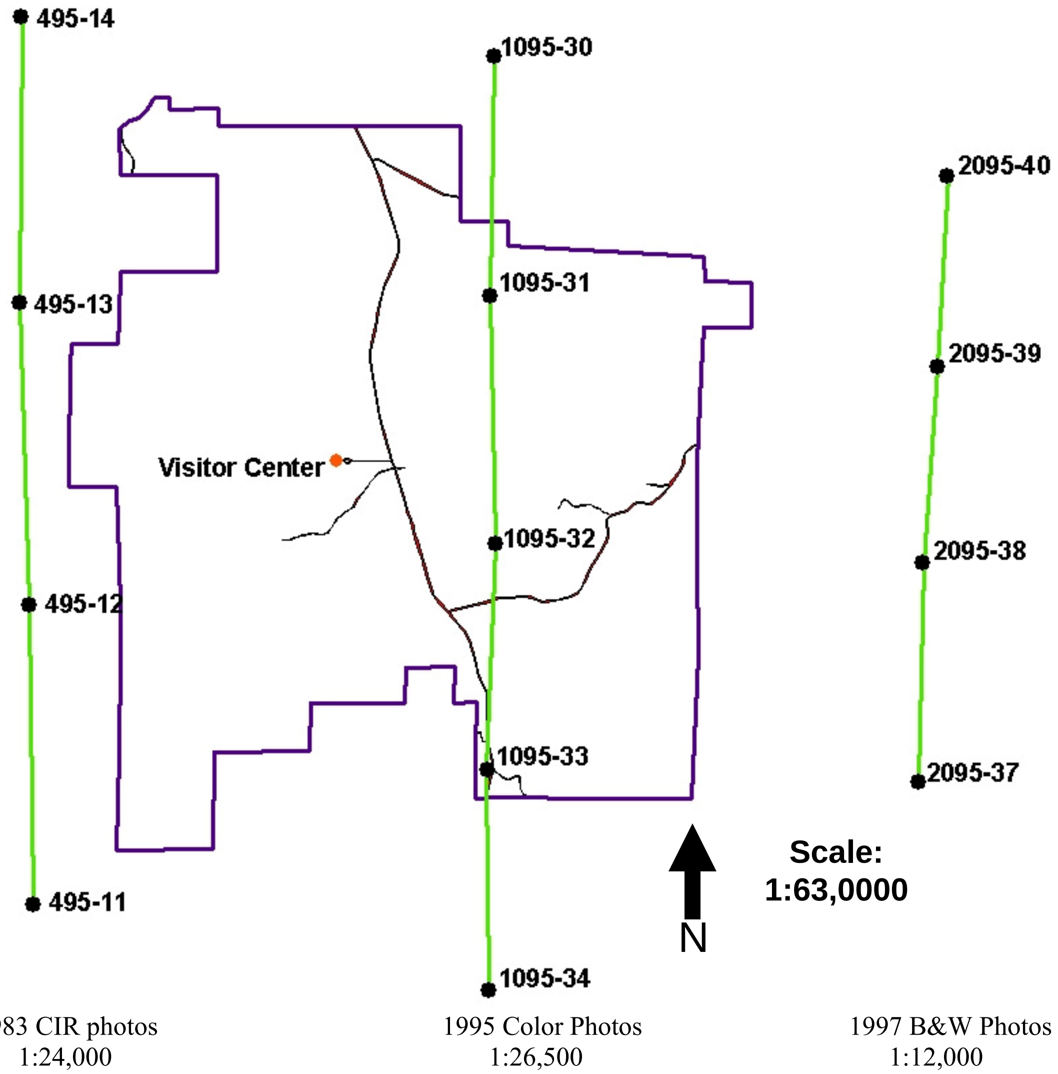


Figure 3-3. Aerial Photographs of Florissant Fossil Beds National Monument

boundary as a reference, the ½-mile environs limit was delineated and used to subset each orthoimage to include just the area needed for mapping. The orthoimages were further combined into two mosaics, the east half and the west half, using PCI software.

Prior to visiting the park, the USGS cartographers delineated general vegetation polygons, using ERDAS Imagine and the orthoimages, based only on stereo photo interpretation. Paper plots were produced showing the resulting vector data overlaid on the - orthoimagery. These were used for the initial fieldwork.

The cartographers accompanied the ecologist on reconnaissance field trips to get first hand knowledge in the types of vegetation that exist at the Monument. This also gave the cartographers the opportunity to learn from the ecologist what factors drive the existence of the associations and to discuss what information could be extracted from the source imagery, natural color aerial photography was used, as well as the color infrared photography. Field notes were hand-annotated on the paper plots of the orthoimages for future reference. The cartographers also assisted in gathering plot and observation data. The initial field trips resulted in a working list of vegetation associations. The ecologist further refined this list and updates were supplied to the cartographers.

A working list of map units that could be extracted from the source information was generated by the cartographers and reviewed by the ecologist. The following table (**3-1**) contains the final map units and the associations they represent.

Table 3-1. Crosswalk between map units and NVC associations

FLFO MAP CODE	FLFO MAP UNIT CODE	FLFO MAP UNIT NAME	FLFO ASSOCIATIONS
FOREST MAP UNITS			
3	SDF	Colorado Blue Spruce - Douglas-fir Forest	**Combination:** *Picea pungens / Juniperus communis* Forest Association + *Pseudostuga menziesii / Juniperus communis* Forest Association
4	SDAF	Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest	**Combination:** *Picea pungens / Juniperus communis* Forest Association + *Pseudostuga menziesii / Juniperus communis* Forest Association + Populus tremuloides Forest Alliance + *Populus tremuloides / Juniperus communis* Forest Association
11	AF	Quaking Aspen Forest	**Combination:** *Populus tremuloides* Forest Alliance + *Populus tremuloides / Juniperus communis* Forest Association
WOODLAND MAP UNITS			
5	BPW	Bristlecone Pine / Arizona Fescue Woodland	*Pinus aristata / Festuca arizonica* Woodland Association
9	PPSBW	Ponderosa Pine / Smooth Brome Semi-natural Woodland	*Pinus ponderosa / Bromus inermis* Semi-natural Woodland Association
7	PPW	Ponderosa Pine Woodland	**Combination:** *Pinus ponderosa / Festuca arizonica* Woodland Association + *Pinus ponderosa / Cercocarpus montanus* Woodland Association.
10	BAPW	Balsam Poplar Woodland	*Populus balsamifera* Woodland Park Special.
SHRUBLAND MAP UNITS			
14	TAS	Thinleaf Alder Shrubland	*Alnus incana* / Mesic Graminoids Shrubland Association
15	SSS	Fringed Sagewort Dwarf-shrubland	*Artemisia frigida / Bouteloua gracilis* Dwarf-shrubland Association
16	MMS	Mountain Mahogany / Mountain Muhly Shrubland	*Cercocarpus montanus / Muhlenbergia montana* Shrubland Association
17	SCS	Shrubby Cinquefoil Shrubland	*Dasiphora fruticosa* Shrubland Alliance

18	WROS	Waxflower Rock Outcrop Shrubland	*Jamesia americana* Rock Outcrop Shrubland Association
19	SHWS	Shortfruit Willow Shrubland	*Salix brachycarpa / Carex aquatilis* Shrubland Association
20	SBWS	Strapless Willow Shrubland	*Salix ligulifolia* Shrubland Association.
21	MWS	Mountain Willow Shrubland	**Combination:** *Salix monticola / Carex utriculata* Shrubland Association + *Salix monticola* / Mesic Graminoids Shrubland Association.
SHRUBLAND/GRASSLAND MAP UNITS			
31	LBY	Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland	**Combination:** *Schizachyrium scoparium* Herbaceous Vegetation Park Special + *Yucca glauca / Muhlenbergia montana* Dwarf-shrubland Park Special
GRASSLAND MAP UNITS			
25	SBHV	Smooth Brome Semi-natural Herbaceous Vegetation	*Bromus inermis* – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation Association
27	POHV	Parry Oatgrass Herbaceous Vegetation	*Danthonia parryi* Herbaceous Vegetation Association.
28	AFMMHV	Arizona Fescue – Mountain Muhly Herbaceous Vegetation	**Combination:** *Festuca arizonica – Muhlenbergia montana* Herbaceous Vegetation Association + *Muhlenbergia montana* Herbaceous Vegetation Association.
29	FBHV	Foxtail Barley Herbaceous Vegetation	*Hordeum jubatum* Semi-natural Herbaceous Vegetation Park Special
30	AFSMHV	Arizona Fescue – Slimstem Muhly Herbaceous Vegetation	**Combination:** *Festuca arizonica – Muhlenbergia filiculmis* Herbaceous Vegetation Association + *Muhlenbergia filiculmis* Herbaceous Vegetation Association.
GRAMINOID MAP UNITS			
26	SRHV	Aquatic Sedge - Beaked Sedge - Baltic Rush Herbaceous Vegetation	**Combination:** *Carex aquatilis* Herbaceous Vegetation Association + *Carex utriculata* Herbaceous Vegetation Association + *Juncus balticus* Herbaceous Vegetation Association
FORB MAP UNITS			
22	CTHV	Canada Thistle Herbaceous Vegetation	*Cirsium arvense* - Weedy Forbs Herbaceous Vegetation Park Special
23	DHV	Duckweed Permanently Flooded Herbaceous Vegetation	**Combination:** *Lemna* spp. Permanently Flooded Herbaceous Vegetation Park Special + *Myriophyllum sibiricum* Herbaceous Vegetation Park Special
24	THV	Toadflax Herbaceous Vegetation	*Linaria vulgaris* / Mixed Graminoids Semi-natural Herbaceous Vegetation Park Special
OTHER MAP UNITS			
1	ROAD	Roads	
2	VISITOR	Visitor Center	

Map Unit Modifiers

- Each map polygon was labled with a code and a modifier. The map unit code represents the vegetation type and land features, and the modifier represents the growth structure of the vegetation within the mapped polygon (**Table 3-2**).

- The first modifier represents **Coverage Density**. It describes the cover (a percent range) of the vegetation type within the polygon. Typically, the modifier defines the coverage of the tallest canopy layer (e.g. density of tree canopy, not density of any subtree or shrub canopy layer).

- The second modifier represents **Coverage Pattern**. It describes the pattern ordistribution of the vegetation type within the polygon. Like the density modifier, the pattern modifier defines the growth pattern of the tallest canopy layer.

- The third modifier represents **Height**. It describes the average height of the woody terrestrial vegetation within the polygon. Only map units for NVC Forest, Woodland, Shrubland, and Dwarf-shrubland Formation levels received this modifier.

- The last modifier represents **Dominance/Co-dominance**. It describes the degree of mixes between evergreen and deciduous trees (and shrubs for some woodland types) within a polygon. The only map unit that received this attribute in the Monument was SDAF - Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest, Map Unit 4.

Table 3-2. Map Unit Modifiers

Coverage Density (all vegetation map units)
1 – Closed Canopy/Continuous (60-100% coverage)
2 – Open Canopy/Discontinuous (25-60% coverage)
3 – Dispersed-Sparse Canopy (10-25% coverage)
Coverage Pattern (all vegetation map units)
A – Evenly Dispersed
B – Clumped/Bunched
C – Graditional/Transitional
D – Regularly Alternating
Height (forest, woodland, shrubland, & dwarf-shrubland map units)
1 - <0.5 meters (<1.5 feet)
2 - 0.5-5 meters (1.5-16 feet)
3 - 5-12 meters (16-40 feet)
4 - 12-20 meters (40-65 feet)
5 - 20-30 meters (65-98 feet)
6 - 30-50 meters (98-162 feet)
Dominance/Co-dominance (forest & woodland map units, evergreen-deciduous mix)
D – Deciduous dominant 60-75%, evergreen 25-40%
E – Evergreen dominant 60-75%, deciduous 25-40%
M – Deciduous/Evergreen co-dominant, each 40-60%

In addition to the map units that could be interpreted from the source information, several plant associations existed in the Monument that were not large enough to meet the 0.5-hectare Minimum Mapping Unit. These were represented on the map as points only. The following table contains these point map units and the associations they represent.

Table 3-3. Plant Associations that occured only as stands less than 0.5 ha

FLFO MAP CODE	FLFO MAP UNIT NAME	FLFO ASSOCIATION
WOODLAND MAP UNITS		
SBW	Colorado Blue Spruce / River Birch Woodland	*Picea pungens / Betula occidentalis* Woodland
SHRUBLAND MAP UNITS		
RDS	Rabbitbrush Dwarf-shrubland	*Chrysothamnus viscidiflorus – Ericameria parryi* Dwarf-shrubland
SILS	Silverberry Shrubland	*Elaeagnus commutata* Shrubland Park Special
CS	Chokecherry Shrubland	*Prunus virginiana* Shrubland Park Special
STW	Strapleaf Willow Shrubland	*Salix ligulifolia* Shrubland
GRASSLAND MAP UNITS		
CWHV	Crested wheatgrass Semi-natural Herbaceous Vegetation	*Agropyron cristatum* – (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation Park Special
MMNTHV	Mountain Muhly – Needle-and-thread Herbaceous Vegetation	*Muhlenbergia montana – Hesperostipa comata* Herbaceous Vegetation Park Special
RCHV	Reed Canarygrass Western Herbaceous Vegetation	*Phalaris arundinacea* Western Herbaceous Vegetation
GRAMINOID MAP UNITS		
NSHV	Nebraska Sedge Herbaceous Vegetation	*Carex nebrascensis* Herbaceous Vegetation Park Special
FORB MAP UNITS		
NHV	Nailwort Herbaceous Vegetation	*Paronychia sessiliflora* Herbaceous Vegetation Park Special

Mapping – General

The mapping work was performed using heads-up digitizing with the source orthoimagery and ancillary data sources. Data were collected by coding the raster image data using ERDAS Imagine software. Stereoscopes and the stereo pairs of the aerial photograph paper prints were used to provide information on the elevation of the vegetation communities in the landscape.

For four of the map units – 3-SDF, 4-SDAF, 27-POHV, and 31-LBY – modeling using GIS principles was also employed. Modeling involves using environmental conditions of a map unit, such as elevation, slope, and aspect, which were determined by the field-collected ecological data. Data satisfying these conditions were obtained from ancillary data sources, such as USGS DEM data. These data were fed into a model that will result in locations (pixels) where all the desired conditions exist. For example, if a certain map unit was a shrubland that predominantly occurs above 8000 feet, on slopes of 3-10%, and on west-facing aspects, the correctly-constructed model will output only locations where this combination of conditions will be found. The resulting areas were then examined manually with the traditional photo interpretation process to confirm that they indeed could be accepted as that map unit. If photo interpretation determines that the areas were not acceptable, then they were changed to a more appropriate map unit.

An example at FLFO where modeling was used was the separation between 3-SDF (Colorado Blue Spruce - Douglas-fir Forest) and 7-PPW (Ponderosa Pine Woodland.) In most cases, the photo signature for these map units was similar. Modeling was used to determine locations where 3-SDF would more likely occur (see conditions in text below.) Manual examination of the resulting areas allowed the cartographers to change areas that were obviously 7-PPW (characterized by rounder-crowned trees, if clearly seen.) Otherwise, the areas were retained as 3-SDF.

Mapping – Roads, the Visitor Center, and Noxious Weeds

Roads and the park's visitor center were delineated as map units. The roads (Map Unit 1) were delineated from the orthoimagery as vectors, rasterized, and buffered to create polygons of the average road and shoulder widths. The area encompassing the visitor center and its associated parking lot, Map Unit 2, was interpreted from the orthoimagery by recoding the raster pixel data. Other cultural features outside the park, such as residential areas and the town of Florissant, were treated later in the environs mapping (see below.)

Polygonal vector data representing seven noxious weeds was supplied by the NPS. The data were collected in the field during 1998 and 1999 by Monument staff who walked the weed infested perimeters with a GPS receiver. Using ERDAS Imagine, the vector data was rasterized, and deleted if the polygons were less than the 0.5-hectare minimum mapping unit (MMU.) Three noxious weed species polygons were large enough to meet the MMU. Two of these were directly delineated: CTHV - Canada Thistle Herbaceous Vegetation, Map Unit 22; and THV - Toadflax Herbaceous Vegetation, Map Unit 24. The resulting polygons of the other weed, smooth brome, required further treatment. There were two map units that contain this species of noxious weed. Once the areas for PPSBW - Ponderosa Pine / Smooth Brome Semi-natural Woodland, Map Unit 9, were delineated (see below) then the remaining raster data were interpreted as SBHV – Smooth Brome Semi-natural Herbaceous Vegetation, Map Unit 25.

Mapping – Delineation of Major Groups

Each of the six subsetted orthoimages were treated separately, due to the large file size and the photographic image differences. However, the same mapping process was performed on each subset. The subsetted orthoimage was analyzed using an unsupervised classification resulting in 255 clusters. Each cluster represents pixels with closely related reflectances in the red-green-blue light wavelengths. Although similar, these pixels do not need to be contiguous to be in the same cluster. The clusters were grouped into two types. One group contained pixels in clusters that appear dark ("dark areas") representing mostly trees and their shadows, wetlands, and water bodies. The other group contained pixels in clusters that appear light ("light areas") representing mostly shrublands, grasslands, and bare rocks.

Mapping - Wetlands

The "dark" areas were further divided using stereo photo interpretation into low areas where wetlands and water bodies occured, and upland areas not likely to have wetlands. The "dark" areas in the uplands were predominantly trees and their shadows. Since all wetlands were considered important to the park, all polygons that were interpretable were delineated, even if below the 0.5-hectare MMU. The four major kinds of wetland areas were collected using stereo photo interpretation, field information, and the association descriptions. They were: MWS - Mountain Willow Shrubland, Map Unit 21; SCS - Shrubby Cinquefoil Shrubland, Map Unit 17; SRHV - Aquatic Sedge–Beaked Sedge–Baltic Rush Herbaceous Vegetation, Map Unit 26; and DHV - Duckweed Permanently Flooded Herbaceous Vegetation, Map Unit 23.

Other wetland map units were added from field delineated locations. These were: BAPW - Balsam Poplar Woodland, Map Unit 10; SBWS - Sandbar Willow Temporarily Flooded Shrubland, Map Unit 20; SHWS – Shortfruit Willow Shrubland, Map Unit 19; and TAS - Thinleaf Alder Shrubland, Map Unit 14.

Mapping – Delineation of Forests and Woodlands

The "dark" areas in the uplands were predominantly trees and their shadows ("tree areas".) Using the Clump, Sieve, and Neighborhood tools in ERDAS Imagine contiguous "tree areas" less than 300 square meters were removed; the size determined to be an average individual tree, mostly ponderosa pine or Douglas-fir. This resulted in retained data indicating "thick trees" (trees whose crowns were overlapping, representing a forest with more than 60% foliar cover) and also eliminated individual trees, which occurred in open areas or represented a woodland situation.

The next step started with the same "tree areas" discussed above. Using the Clump, Sieve, and Neighborhood tools in ERDAS Imagine, these areas were expanded to take in contiguous "tree areas" (forests) and individual trees close enough together to constitute 25-60% foliar cover (woodlands.) This resulted in retained data indicating “thick trees” (forests) and “sparse trees” (woodlands) and eliminated individual trees that could occured in open areas.

Using the Modeler tool in ERDAS Imagine, the results of the forest areas were subtracted from the forest and woodland areas to obtain only the woodland areas. Then, using the Eliminate tool, all pixel groups less than the 0.5-hectare MMU were subsumed into the surrounding map units. These results were checked against the orthoimagery and any inconsistancies were corrected. This method eliminated the subjectivity of forest and woodland polygon edge delineation, because the same rules were used for all determinations. It also saved time, because the cartographers did not have to manually delineated the forest and woodland outlines, or determine the 0.5-hectare MMU limits.

Mapping - Forests

The already-determined “forest” areas were one of four map units: 3-SDF, 4-SDAF, 11-AF, and the forest-like version of 7-PPW (**Table 3-1**).

- SDF - Colorado Blue Spruce - Douglas-fir Forest Map Unit, Map Unit 3, was initially delineated using the Modeler tool in ERDAS Imagine and the environmental conditions supplied by the ecological data (elevations above 2524 meters (8280 feet), slopes between 11 and 51%, and aspects greater than 351 degrees and less than 59 degrees.) The modeling results were examined using stereo photo interpretation, field information, and the association descriptions. The most likely areas were delineated as SDF.

- Similarly, SDAF - Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest, Map Unit 4, was initially delineated out using the Modeler tool in ERDAS Imagine and the environmental conditions supplied by the ecological data (elevations above 2524 meters (8280 feet), slopes between 11 and 51%, and aspects greater than 351 degrees and less than 59 degrees.) The results of the modeling were examined using stereo photo interpretation of the natural color photographs, since the aspen trees were changing color in September when the photos were taken, and could be differentiated from 3-SDF. The most likely areas were delineated as SDAF.

- AF - Quaking Aspen Forest, Map Unit 11, was easily delineated using stereo photo interpretation with CIR and B/W photographs, field information, and the association descriptions. Since all aspen clones were considered important to the park, all the polygons that were photo interpretable were delineated, even if below the 0.5-hectare MMU.

- The only other “forest” area found in the park was the forest-like version of PPW - Ponderosa Pine Woodland, Map Unit 7. By the process of elimination, any “forest” areas that were not 3-SDF, 4-SDAF, or 11-AF were assumed to be 7-PPW. The results of the forest mapping were checked against the orthoimagery and any inconsistencies were corrected. Officially, 7-PPW was woodland and was mapped as one integrated map unit, whether forest-like or woodland-like. A delineation of the forest-like versions of this map unit was supplied to the park as ancillary data, per their request, to help in wildfire management.

Mapping –Woodlands

The already-determined "woodland" areas could be one of only three possible map units: 5-BPW, 9-PPSBW, and the woodland-like version of 7-PPW (**Table 3-1**).

- BPW - Bristlecone Pine / Arizona Fescue Woodland, Map Unit 5, was added from field information, since it was rare and all instances were known.

- PPSBW - Ponderosa Pine / Smooth Brome Semi-natural Woodland, Map Unit 9, was initially broken out using the Modeler tool in ERDAS Imagine. The model searched for the overlap of the smooth brome data supplied by the NPS (see above) and the "woodland" areas. The results of the modeling were examined using stereo photo interpretation, field information, and the association descriptions. The most likely areas were delineated as PPSBW. Then the rest of the reduced raster data was delineated as SBHV – Smooth Brome Semi-natural Herbaceous Vegetation, Map Unit 25 (see above).

- The only other "woodland" area found in the park was the woodland-like version of PPW - Ponderosa Pine Woodland, Map Unit 7. By the process of elimination, any "woodland" areas that were not 5-BPW or 9-PPSBW were assumed to be 7-PPW. The results were checked against the orthoimagery and any inconsistencies were corrected.

- Finally, using the Eliminate tools in ERDAS Imagine, all forest and woodland map units less than the 0.5-hectare MMU (except 11-AF) were deleted and absorbed into the surrounding map units. These results were checked against the orthoimagery and any inconsistencies were corrected.

Mapping – Shrublands and Grasslands

The already-determined "light" areas (shrublands, grasslands, and bare rocks) could be one of only eight possible map units: 15-SSS, 16-MMS, 18-WROS, 27-POHV, 28-AFMMHV, 29-FBHV, 30-AFSMHV, and 31-LBY (**Table 3-1**).

- SSS – Fringed Sagewort Dwarf-shrubland, Map Unit 15, was delineated using stereo photo interpretation with the B/W photographs, field information, and the association descriptions. The piles of bare soil next to the individual prairie dog burrows were clearly seen on the B/W photographs, which were at a larger scale.

- MMS – Mountain Mahogany / Mountain Muhly Shrubland, Map Unit 16, was delineated using stereo photo interpretation with the CIR and, especially, the B/W photographs. Field information and the association descriptions were also used. The individual shrubs were clearly seen on the B/W photographs, which were at a larger scale.

- WROS – Waxflower Rock Outcrop Shrubland, Map Unit 18, was delineated using stereo photo interpretation with the natural color and CIR photographs, field information, and the association descriptions. The rock outcrops and their shadows were easily seen.

- POHV – Parry Oatgrass Herbaceous Vegetation, Map Unit 27, was initially broken out using the Modeler tool in ERDAS Imagine and the environmental conditions supplied by the ecological data (elevations above 2575 meters (8448 feet), slopes between 3 and 10%, aspects greater than 293 degrees and less than 68 degrees, and within 75 meters of the edge of a forest or woodland area.) The results of the modeling were examined using stereo photo interpretation with the natural color, CIR, and B/W photographs, field information, and the association descriptions. The most likely areas were delineated as POHV.

- FBHV – Foxtail Barley Herbaceous Vegetation, Map Unit 29, was added from field information, since it was rare and all instances were known.

- LBY – Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland, Map Unit 31, was initially delineated using the Modeler tool in ERDAS Imagine and the environmental conditions supplied by the ecological data (for Little Bluestem Herbaceous Vegetation - elevations between 2500 and 2598 meters (8200-8525 feet), slopes between 23 and 35%, and aspects between 164 and 218 degrees; for Yucca Dwarf-shrubland - elevations between 2560 and 2637 meters (8400-8650 feet), slopes between 16 and 28%, and aspects between 114 and 202 degrees.) The results of these two models were combined. The combination was examined using stereo photo interpretation with the natural color photographs, field information, and the association descriptions. The most likely areas were delineated as LBY.

- By the process of elimination, the remaining “light” areas were assumed to be AFMMHV – Arizona Fescue – Mountain Muhly Herbaceous Vegetation, Map Unit 28; or AFSMHV – Arizona Fescue – Slimstem Muhly Herbaceous Vegetation, Map Unit 30. These areas were divided up and delineated based on stereo photo interpretation with the natural color and CIR photographs, field information, and the association descriptions.

- Other grassland features outside the park, such as land used for grazing or residential yards, were left combined in the AFMMHV – Arizona Fescue – Mountain Muhly Herbaceous Vegetation, Map Unit 28, which were to be treated later in the environs mapping (see below.)

- Finally, using the Eliminate tools in ERDAS Imagine, all shrubland and grassland map units less than the 0.5-hectare MMU were deleted and absorbed into the surrounding map units. These results were checked against the orthoimagery and any inconsistencies were corrected.

Mapping – Combining the Map Units

The results of the collection of the roads, visitor center, noxious weeds, wetlands, forests, woodlands, shrublands, and grasslands (a total of 27 different map units) were combined using the Modeler tool in ERDAS Imagine. These results were checked against the orthoimagery and any inconsistencies were corrected.

Mapping - Environs

Per requests from the the Monument staff, the area in the ½-mile “environs” around the park was mapped two different ways. One was to extend the USGS-NPS Vegetation Mapping scheme used inside the park as much as possible to the environs. The other approach applied the Anderson Land Use/Land Cover Classification system to the lowest level possible.

Using the Subset tool in ERDAS Imagine and the park boundary data, the entire project area was divided into the park-only combined data (27 map units) and the environs-only combined data (27 map units.) Both of these data sets were edited for slivers and extremely small areas.

One copy of the combined data in the environs was crosswalked to a modified version of the USGS-NPS Vegetation Mapping scheme. This worked well for wetlands, forests, woodlands, and shrublands. The classification accuracy of the grassland mapping could not be maintained due to a lack of field information and the intensive alteration of these areas outside the park. The following six map units were generalized into a “General Forbs and Grasses” map unit: 15-SSS, 27-POHV, 28-AFMMHV, 29-FBHV, 30-AFSMHV, and 31-LBY. A new “developed” map unit was added to address features not found inside the park, such as residential, commercial, and mining areas. This map unit was delineated based on stereo photo interpretation with the natural color and CIR photographs. The following table contains the modified version of the USGS-NPS Vegetation Mapping scheme for the environs around the Monument (“ENVIRONS USGS-NPS”) along with the equivalent map units inside the park (“FLFO”.)

Table 3-4. Map Codes for Environs' Vegetation Classification

ENVIRONS USGS-NPS MAP CODE	ENVIRONS USGS-NPS MAP UNIT CODE	FLFO MAP UNIT NAME	FLFO MAP CODE	FLFO MAP UNIT CODE
FOREST MAP UNITS				
4	SDF	Colorado Blue Spruce - Douglas-fir Forest	3	SDF
5	SDAF	Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest	4	SDAF
9	AF	Quaking Aspen Forest	11	AF
WOODLAND MAP UNITS				
7	PPW	Ponderosa Pine Woodland	7	PPW
SHRUBLAND MAP UNITS				
12	MMS	Mountain Mahogany Shrubland	16	MMS
13	WROS	Waxflower Rock Outcrop Shrubland	18	WROS
14	SBWS	Strapless Willow Shrubland	20	SBWS
15	MWS	Mountain Willow Shrubland	21	MWS
GRAMINOIDS				
16	SRHV	Aquatic Sedge - Beaked Sedge - Baltic Rush Herbaceous Vegetation	26	SRHV
OPEN WATER				
3	OPEN WATER	Duckweed Permanently Flooded Herbaceous Vegetation	23	DHV
GENERAL FORBS AND GRASSES				
17	GENERAL FORBS AND GRASSES	Fringed Sagewort Dwarf-shrubland	15	SSS
17	GENERAL FORBS AND GRASSES	Parry Oatgrass Herbaceous Vegetation	27	POHV
17	GENERAL FORBS AND GRASSES	Arizona Fescue – Mountain Muhly Herbaceous Vegetation	28	AFMMHV
17	GENERAL FORBS AND GRASSES	Foxtail Barley Herbaceous Vegetation	29	FBHV
17	GENERAL FORBS AND GRASSES	Arizona Fescue – Slimstem Muhly Herbaceous Vegetation	30	AFSMHV
17	GENERAL FORBS AND GRASSES	Little Bluestem Herbaceous Vegetation/Yucca Dwarf-shrubland	31	LBY
OTHER MAP UNITS				
1	ROAD	Roads	1	ROAD
2	DEVELOPED	-	-	-

The other mapping approach for the combined data in the environs applied the Anderson Land Use/Land Cover Classification [PLEASE DEFINE THIS SYSTEM]system to the lowest level possible. This was Level 4 for several map units, such as 2.212 Mixed/Minor Retail and Services and 4.111 Forest-Deciduous. In this scheme, the natural map units are more generalized and the "developed" areas are mapped to a greater detail.

The combined data in the environs was crosswalked to the Anderson Land Use/Land Cover Classification system. This worked well for wetlands, forests, woodlands, shrublands, and grasslands. Nine new map units were added to treat the wider streams and man-made features not found inside the park, such as residential, commercial, and mining areas. These map units were collected based on stereo photo interpretation with the natural color and CIR photographs. The following table contains the modified version of the Anderson Land Use/Land Cover Classification system for the environs around Florissant ("ENVIRONS ANDERSON") along with the equivalent map units inside the park ("FLFO".)

TABLE 3-5. Map Codes for Environs' Anderson Classification

ENVIRONS ANDERSON MAP CODE	ENVIRONS ANDERSON CODE AND NAME	FLFO MAP UNIT NAME	FLFO MAP CODE	FLFO MAP UNIT CODE
WATER MAP UNITS				
1	1.11 Stream/River	-	-	-
2	1.14 Reservoir	Duckweed Permanently Flooded Herbaceous Vegetation	23	DHV
DEVELOPED MAP UNITS				
3	2.11 Single-Family Residential	-	-	-
4	2.212 Mixed/Minor Retail and Services	-	-	-
5	2.23 Communications and Utilities	-	-	-
6	2.242 Cemetery	-	-	-
7	2.26 Transportation	Roads	1	ROAD
8	2.261 Airport	-	-	-
9	2.27 Entertainment/Recreational	-	-	-
BARE MAP UNITS				
10	3.1 Transitional	-	-	-
11	3.2 Quarries/Strip Mines/ Gravel Pits	-	-	-
12	3.3 Bare Rock/Sand	Waxflower Rock Outcrop Shrubland	18	WROS
VEGETATED MAP UNITS				
13	4.111 Forest-Deciduous	Quaking Aspen Forest	11	AF

14	4.112 Forest-Evergreen	Colorado Blue Spruce - Douglas-fir Forest	3	SDF
14	4.112 Forest-Evergreen	Ponderosa Pine Woodland	7	PPW
15	4.113 Forest-Mixed	Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest	4	SDAF
16	4.121 Shrubland-Deciduous	Mountain Mahogany Shrubland	16	MMS
17	4.21 Natural Herbaceous	Fringed Sagewort Dwarf-shrubland	15	SSS
17	4.21 Natural Herbaceous	Little Bluestem Herbaceous Vegetation/Yucca Dwarf-shrubland	31	LBY
17	4.21 Natural Herbaceous	Arizona Fescue – Mountain Muhly Herbaceous Vegetation	28	AFMMHV
17	4.21 Natural Herbaceous	Arizona Fescue – Slimstem Muhly Herbaceous Vegetation	30	AFSMHV
17	4.21 Natural Herbaceous	Foxtail Barley Herbaceous Vegetation	29	FBHV
17	4.21 Natural Herbaceous	Parry Oatgrass Herbaceous Vegetation	27	POHV
18	4.31 Woody Wetlands	Mountain Willow Shrubland	21	MWS
18	4.31 Woody Wetlands	Sandbar Willow Temporarily Flooded Shrubland	20	SBWS
19	4.32 Emergent Wetlands	Aquatic Sedge - Beaked Sedge - Baltic Rush Herbaceous Vegetation	26	SRHV

Mapping – Converting Raster to Vector

Each of the three raster data sets that were generated above (park-only data, environs-only data - USGS-NPS Vegetation Mapping scheme, and the environs-only data - Anderson Classification system) were then converted to Arc Coverage format using the Raster to Vector tool in ERDAS Imagine. A tolerance of 1.0 (a setting in ARCINFO software to smooth lines) was employed to smooth the vectors. All of these data sets were edited to eliminate extremely small areas.

3.3.3 Field Key Preparation

An illustrated field key to the plant associations and alliances of the Monument was written once the final vegetation classification was developed by NatureServe (**Appendix F**). To make the Key useful for many potential users, small stands of unique vegetation known as “park specials” were included. The Key has 2 levels. The first level was physiognomic, determining which major group, i.e., forest, woodland, tall shrubland, shrubland, dwarf shrubland, graminoid, grass, or forb, was being evaluated. The second level identifies to plant association or alliance based on the dominant species foliar cover.

The key is dichotomous, illustrated with images taken during the vegetation sampling effort. This key allows users to crosswalk plant associations or alliances directly to the the Monument vegetation map units and database, such that future research can have a common focal point relative to the baseline year of aerial photography (1996) and the field data (2001).

3.3.4 Accuracy Assessment

An essential part of the USGS-NPS Vegetation Mapping Program is an accuracy assessment of the final spatial data (ESRI et al. 1994). The accuracy assessment includes: 1) estimates of thematic and positional errors that will allow data users to assess data suitability for a particular application, and 2) mapping projects are specified to be 80% accurate for each vegetation class that is mapped (ESRI et al. 1994). Error is defined as a difference between the vegetation class specified at a point (x, y) by the database, and the vegetation class observed at that location in the field, while accuracy is a measure of the absence of such errors.

Accuracy assessment (AA) conducted at the Monument had very good accessibility and selected AA points were not or only rarely required dropping and replacement.The AA sampling was conducted slightly earlier in the 2002 season (late spring) because of unusually warm and dry weather, versus 2001 plot sampling (early summer), and areas of temporal change, e.g., removal sites for stock dams, etc., were dropped from the sample when encountered. A stratified random sampling approach was used, with each vegetation class representing a stratum. The sampling area at each AA point equaled the project MMU (0.5 ha), using a circle with a radius of approximately 40 m. This was adjusted according to ESRI et al. (1994) in areas with linear plant associations (riparian habitats). The number of AA points used for the Monument was proportional to the abundance and frequency of vegetation types, and included extra points for rare vegetation classes.

The field data were manually recorded on accuracy assessment field sheets (see **Appendix C** for a sample accuracy field sheet). Data were entered into a Microsoft Excel spreadsheet. The coordinates from each point, along with its attributes were used to generate an ArGIS coverage that was intersected with the vegetation community coverage. Attributes derived from the photo interpretation (map attributes) were compared with the attributes derived from the accuracy assessment field work (AA attributes). Up to three AA attributes could be recorded for each point; the AA attribute for the vegetation within the 0.5 ha sampling area, , and if there were other vegetation types within 50 meters of the point, up to two more were recorded. If the map attribute agreed with any one of these AA attributes it was considered agreement between the map attribute. If there was no agreement, the point was considered to disagree. All of the data were compiled by map classes and arrayed into a contingency matrix where errors of commission and omission were calculated.

Errors of commission (user's errors) for each class were calculated by dividing the number of samples classified correctly by the total number of samples that were classified as belonging to that map class. Errors of omission (producer's errors) for each class were calculated by dividing the number of samples that were classified correctly by the total number of reference samples in that class. Confidence intervals for each map class were calculated using the appropriate statistical method for the normality and size of the database. [This needs further explaintion]

Overall, total accuracy for the Monument was calculated across all sampled map classes by dividing the number of correctly classified accuracy points by the total number of accuracy points. Confidence intervals for overall total accuracy were calculated using the equation for normally-distributed data. A Kappa index was used to help account for any correct classification due to chance.

4.0 RESULTS

4.1 VEGETATION CLASSIFICATION AND CHARACTERIZATION

The NVCS classification developed for the Monument includes 38 vegetation types: 4 forest, 5 woodland, 11 shrubland, and 18 herbaceous types. Some of these (17) occured below the project MMU, but represent distinct vegetation types. Five of the associations described are semi-natural types dominated by exotic species. For the benefit of field researchers, five additional plant associations, which represent local variations in vegetation types, were presented in the Illustrated Key (**Appendix F**), these included: 1) *Artemisia frigida / Bouteloua gracilis* Dwarf-shrubland (a result of prairie dog burrowing and grazing activity), 2) *Paronychia sessiliflora* Herbaceous Vegetation (a result of historic topsoil removal and subsequent erosion), 3) *Cirsium arvense* Herbaceous Vegetation (a result of exotic species invasion), 4) *Linaria vulgaris* Herbaceous Vegetation (a result of exotic species invasion), and 5) *Hordeum jubatum* Herbaceous Vegetation (a result of drying stock pond).

The final classification summary and the detailed NVC descriptions are presented in **Appendix G**. Several of the plant associations determined for the Monument were known from previous studies and fit well the current national descriptions. A few associations represented regional/local variations of recognized types, and a few were new to the classification. **Appendix G** contains both the national (global) and local descriptions. The number of Woodland and Herbaceous plant communities were nearly equally represented within the Monument. These major physiognomic groups, their general distribution within the Monument, and specific observations are presented in the following discussion.

4.1.1 Forest Associations

Dense forest stands of Douglas-fir, Colorado blue spruce, and ponderosa pine grow on the northern exposures of the hills and ridges throughout the Monument, and also at the highest elevations in the southeastern portion of the Monument. Quaking aspen, one of the most popular trees for tourism because of its early fall color display, was limited in distribution in the Monument, confined to small moist drainages and on rock outcrops. The largest stands of quaking aspen occured adjacent to the the Monument boundary on private lands in the environs mapping area. Some quaking aspen clones have mature trees with large dbhs and are very tall (up to 35 meters); however, most clones are moderate (20–25 meters) in height. All quaking aspen trees and root sprouts within the Monument show evidence of heavy browsing by elk. The trunks are nearly black where bark has overgrown the bite marks, to about three meters high.

The following vegetation units comprise the forest communities of Florissant Fossil Beds National Monument:

- *Picea pungens / Juniperus communis* (Colorado Blue Spruce / Common Juniper) Forest [CEGL000392]
- *Pseudostuga menziesii / Juniperus communis* (Douglas-fir / Common Juniper) Forest [CEGL000439]
- *Populus tremuloides* (Quaking Aspen) Forest [Alliance]

- *Populus tremuloides / Juniperus communis* (Quaking Aspen / Common Juniper) Forest [CEGL000587]

The Colorado Blue Spruce / Common Juniper Forest type occupied moist drainages and toeslopes at the highest elevations of the Monument, mostly on northern exposures in the southeastern portion of the Monument. This forest type also occurred along Grape Creek west of Hornbek Homestead, where the creek enters a narrow canyon, and also as narrow stringers (one to a few trees deep) along moist draws and drainages at the edge of Douglas-fir / Common Juniper Forest stands throughout the Monument. These stands were very tall (30–35 meters) and typically included quaking aspen and Douglas-fir in the canopy. The sub-canopy occasionally contained limber pine (*Pinus flexilis*) in addition to the tree species previously mentioned. Shrubs common to this type provided from 5–20% foliar cover and included common juniper, shrubby cinquefoil, wax currant, kinnikinnick, and Wood's rose. Dense shading and accumulation of woody and organic debris occured at the forest floor, therefore, little herbaceous cover was present and consists predominantly of Parry oatgrass, strawberry (*Fragaria virginiana* and *F. vesca*), and meadow-rue.

The most common forest type of northern exposures within the Monument was the Douglas-fir / Common Juniper Forest. This forest type occupied moderate to steep slopes, upper drainages, and hill and ridge crowns throughout the Monument. One interesting observation made during this vegetation classification effort was the replacement of this forest type on the north-facing slopes of small hills and ridges (on the northern edge of the Monument) by forest stands of ponderosa pine. It was thought that these small hills and ridges, even on their northern exposures, were too dry to support Douglas-fir trees.

Tree species common to the Douglas-fir / Common Juniper Forest included ponderosa pine (particularly near the dry upper slopes and dry toeslopes), Colorado blue spruce (near moist drainages and on moist slopes), quaking aspen, and a few limber pine. Understory tree species were the same as above, but predominantly Douglas-fir. The common shrubs within the type included common juniper, kinnikinnick, wax currant, and Wood's rose. Shrub foliar cover can be high (up to 20%) within Douglas-fir stands and a few stands were observed with patches of common juniper exceeding 40% foliar cover. Herbaceous species cover values were typically less than 5% and Parry oatgrass, mountain muhly, meadow-rue, and false Solomon's seal (*Maianthemum stellatum*) were the more common species. A large amount of downed wood was observed in Douglas-fir stands, sometimes exceeding 40% ground cover.

Two associations of quaking aspen, e.g., the Quaking Aspen Forest and the Quaking Aspen / Common Juniper Forest have been used to classify stands within the Monument. All aspen stands observed within the Monument were smaller than the project MMU of 0.5 ha, and most of them had a unique understory. The Quaking Aspen Forest Alliance tended to be younger aspen stands occupying a variety of grass and forb dominated sites, with some of the sites being quite dry hillslopes. Shrub cover under these stands was sparse, rarely exceeding 10% foliar cover for shrubby cinquefoil, common juniper, currant, and Wood's rose. Herbaceous plant species common to these stands included nodding brome, Parry oatgrass, pine dropseed, meadow-rue, American vetch, and a few Colorado columbine (*Aquilegia coerulea*). Where the clones were heavily grazed historically, smooth brome, Kentucky bluegrass, and redtop were common.

A few stands were dominated by common juniper in the understory, from 5–50% foliar cover, and fit well within the Quaking Aspen / Common Juniper type. These stands appeared to be the more mature ones present, but they also tended to occupied the most mesic sites, often adjacent to Colorado blue spruce and Douglas-fir stands or to riparian areas. In addition to common juniper, other plant species common to this type included shrubby cinquefoil, currant (*Ribes inerme*), Wood's rose (*Rosa woodsii*), nodding brome (*Bromus porteri*), Parry oatgrass (*Danthonia parryi*), meadow-rue (*Thalictrum fendleri*), American vetch (*Vicia americana*), dandelion (*Taraxacum officianale*), and the exotics smooth brome and Kentucky bluegrass.

4.1.2 Woodland Associations

Woodlands within the Monument occuped hilltops and ridgetops, upper slopes of ridges and hills, small hill crowns, and as stringers along low ridges. The following vegetation units comprise the woodland communities of Florissant Fossil Beds National Monument:

- *Pinus ponderosa / Festuca arizonica* (Ponderosa Pine / Arizona Fescue) Woodland [CEGL000856]
- *Pinus ponderosa / Cercocarpus montanus* (Ponderosa Pine / Mountain Mahogany) Woodland [CEGL000851]
- *Pinus ponderosa / Bromus inermis* (Ponderosa Pine / Smooth Brome) Semi-natural Woodland [NEW]
- *Pinus aristata / Festuca arizonica* (Bristlecone Pine / Arizona Fescue) Woodland [CEGL000759]
- *Picea pungens / Betula occidentalis* (Colorado Blue Spruce / River Birch) Woodland [CEGL002637]
- *Populus balsamifera* (Balsam Poplar) Woodland [Park Special]

Ponderosa Pine / Arizona Fescue Woodlands occupied small hilltops and ridges that were once islands within the ancient lake, and also occupied the dry hillslopes and ridges that comprised the lake shoreline. This type also occured on the north-facing aspect of small hills and ridges, and the canopy closure may exceed 60% under these northern exposed situations. Shrubs were sparse in the understory of this type and include wax currant, common juniper, mountain mahogany, kinnikinnick, and fringed sagewort. Several species of grass, including Arizona fescue, mountain muhly, blue grama, Parry oatgrass, and little bluestem, and the sun sedge were present in these stands and provided vegetative cover up to 15%. The amount of ground cover provided by ponderosa pine branches, needles, and mast was typically high, from 90–100% depending on the stand.

Ponderosa Pine / Mountain Mahogany Woodlands were found on upper hillslopes and on ridgetops with southern exposures. Openings within the ponderosa pine tree canopies were sufficiently small that the shrub component was less than the project MMU of 0.5 ha. The ponderosa pine trees occupying these very dry slopes were often infested with mistletoe and show signs of stress, e.g., stunted growth, growth similar to witch's broom, dead or dying branches, and dead or dying trees. At two sites, trees of lodgepole pine (*Pinus contorta*) were also present, but not common enough to support classification as a different plant association.

Commonly associated species for this type include wax currant, fringed sagewort, yucca, Arizona fescue, blue grama, mountain muhly, and gumweed. The substrate supporting this type consists of gravel eroded from Pikes Peak granite bedrock.

Ponderosa pine trees were re-establishing on former pastureland that was planted to the exotic smooth brome. A Ponderosa Pine / Smooth Brome Woodland type has developed where young ponderosa pine trees of approximately 20–40 years old form a woodland canopy. The canopy cover was low, approximately 20–25%, and the trees do not exceed five meters in height. The most abundant plant species in terms of foliar cover include smooth brome and ponderosa pine, in addition to the exotic field bindweed (*Convolvulus arvensis*), Colorado rubber plant, Lambert locoweed (*Oxytropis lambertii*), and slimstem muhly.

Two stands of Bristlecone Pine / Arizona Fescue Woodland were observed and sampled, one was located on Fossil Stump Hill, the other across the valley on the large hillslope; both stands were on steep, northwest-facing aspects. Soils supporting the bristlecone pine stands were principally derived from volcanic rocks. These stands were unique in the Monument and both were under the project MMU of 0.5 ha in size. The understory was relatively sparse within the bristlecone pine stands and consists of seedling and sapling bristlecone pine, wax currant, fringed sagewort, Arizona fescue, and kittentails (*Besseya plantaginea*).

The Colorado Blue Spruce / River Birch Woodland occupied two drainages in the Monument, one west of the visitor center and the other near the southeastern Monument boundary fence. The standswere adjacent to the stream and were dominated by Colorado blue spruce. Significant canopy cover was also provided by quaking aspen. The water birch shrubs were tall, from 8–10 meters and provided up to 30% foliar cover. Common associates of this type include common juniper, shrubby cinquefoil, bluejoint reedgrass, and meadow-rue (*Thalictrum fendleri*).

One introduced woodland stand was identified occupying streambanks on the eastern side of the Monument, e.g., the Balsam Poplar Woodland. This short-stature deciduous woodland has spread along the streambanks, reproducing by root sprouts, for a linear distance of approximately 0.5 km. It was a narrow stand and may not meet the project MMU of 0.5 ha. The canopy cover was relatively dense for the stand as approximately 75% was estimated near its center. The understory species observed with balsam poplar included shrubby cinquefoil, mountain willow, aquatic sedge, and cow parsnip.

4.1.3 Tree Diameters

In general, the habitats supporting trees within the Monument reflected the past land uses associated with homestead-style settlement, including logging, farming, and ranching activities. Several of the surviving large trees have been described as culturally scarred, relating to prehistoric use by Ute tribal members that did not result in tree death, and the resulting trunk scarring may have precluded them from logging because they were perceived to be visually less desirable. Many large-diameter stumps of ponderosa pine and Douglas-fir were observed throughout forest and woodland tree stands, having been progressively logged by hand axe, cross-cut saw, and chain saw. Currently, sapling trees of all conifer trees were present and in some cases invasive into grasslands, including former exotic-species pastures.

Trees were identified to species and the dbh was recorded on vegetation classification plot forms for each tree with 10.0 cm or greater dbh (**Figure 4-1**). **Table 4-1** illustrates the tree diameters for each habitat type sampled within the Monument. Only one lodgepole pine (16.6 cm dbh) and one limber pine (28.0 cm dbh) were recorded in vegetation classification plot data, because these species and the pinyon pine (*Pinus edulis*) were scattered, small in stature, and relatively rare within the Monument. One mature thinleaf alder shrub/small tree, occupying an incised drainage at the edge of a quaking aspen stand, exceeded the minimum value and was measured at 12.3 cm dbh. An unusual occurrence of balsam poplar trees were sampled and the 35 trees measured, averaged 15.6 cm dbh.

FIGURE 4-1. OBTAINING A TREE DIAMETER FOR A PONDEROSA PINE AT FLFO

Quaking aspen trees growing as clones in a forest habitat type averaged 20.5 cm dbh. However, both young and mature quaking aspen clones were sampled and the range of dbh values between age groups was 18 cm dbh (young clones) versus 27 cm dbh (largest was 42.0 cm dbh) (mature clone). Colorado blue spruce trees growing in nearly pure stands on slopes and along drainages averaged from 20.7–22.8 cm dbh (largest was 47.0 cm dbh); however, as understory trees in Douglas-fir stands the average dbh was 18.3 cm. The largest Colorado blue spruce measured was 73.1 cm dbh and it was located within a stand of balsam poplar trees. Douglas-fir trees averaged 20.7 cm (largest was 54.0 cm dbh) in forest stands and 21.3 cm dbh within more open woodland patches.

Ponderosa pine trees invading former pastures planted with exotic grasses were mostly less than 30 years old and averaged 13.4 cm dbh. Ponderosa pine trees, growing in dense stands on north-facing hills and ridges, averaged 18.9–22.1 cm dbh. As an understory tree in Douglas-fir forest stands, ponderosa pine averaged 27.2 cm dbh, while open-growing ponderosa pine trees of woodlands growing on dry south-facing slopes averaged 32.0–35.4 cm dbh (largest)

TABLE 4-1. SUMMARY STATISTICS FOR TREE SPECIES OCCURRING IN SHRUBLAND, WOODLAND, AND FOREST ASSOCIATIONS IN FLORISSANT FOSSIL BEDS NATIONAL MONUMENT, COLORADO

(NOTE: TREES AND SHRUBS WITH TRUNK DIAMETERS GREATER THAN 10 CM. WERE MEASURED AT BREAST-HEIGHT DURING THIS STUDY.)

Association / Species	No. of Plots	No. of Trees	Mean dbh (cm) (± SD)
***Cercocarpus montanus* Shrubland**	1		
Pinus ponderosa		4	35.4 (± 10.3)
***Elaeagnus commutata* Shrubland**	1		
Pinus ponderosa		1	28.0
***Picea pungens* Forest**	3		
Picea pungens		54	20.7 (± 8.1)
Pinus flexilis		1	28.0
Populus tremuloides		13	20.7 (± 4.5)
Pseudostuga menziesii		20	24.3 (± 9.4)
Picea pungens / Betula occidentalis Forest	2		
Picea pungens		40	22.8 (± 10.3)
Populus tremuloides		14	18.3 (± 9.6)
***Pinus aristata* Woodland**	2		
Pinus aristata		26	21.8 (± 10.6)
Pinus ponderosa		2	24.1 (± 14.5)
***Pinus ponderosa – Pinus contorta* Woodland**	1		
Pinus contorta		3	16.6 (± 7.2)
Pinus ponderosa		3	21.1 (± 8.4)
***Pinus ponderosa / Festuca arizonica – Muhlenbergia montana* Woodland**	2		
Pinus ponderosa		13	32.0 (± 12.2)
***Pinus ponderosa / Bromus inermis* Woodland**	1		
Pinus ponderosa		12	13.4 (± 2.7)
***Pinus ponderosa / Cercocarpus montanus* Woodland**	3		
Pinus ponderosa		27	23.7 (± 8.7)
***Pinus ponderosa / Juniperus communis* Forest**	4		
Pinus ponderosa		84	22.1 (± 9.3)
Populus tremuloides		4	16.5 (± 1.5)
Pinus ponderosa *Forest*	2		
Pinus ponderosa		66	18.9 (± 6.0)
***Populus balsamifera* Woodland**	1		
Alnus incana		1	12.3
Picea pungens		3	39.5 (± 29.3)
Populus balsamifera		35	15.6 (± 3.7)
***Populus tremuloides* Forest**	3		
Pinus ponderosa		1	15.5
Populus tremuloides		105	20.8 (± 9.3)
Pseudostuga menziesii		1	15.7
***Pseudostuga menziesii / Cercocarpus montanus* Woodland**	1		
Pseudostuga menziesii		4	28.4 (± 12.6)
***Pseudostuga menziesii / Juniperus communis* Forest**	5		
Picea pungens		40	18.3 (± 8.0)
Pinus ponderosa		11	27.2 (± 11.5)
Populus tremuloides		12	14.6 (± 2.4)
Pseudostuga menziesii		89	20.7 (± 9.0)
***Pseudostuga menziesii* Woodland**	1		
Pinus ponderosa		6	30.1 (± 7.5)
Populus tremuloides		4	14.5 (± 2.9)
Pseudostuga menziesii		9	21.3 (± 6.3)

Table and Statistical Data Contributed by Jack L. Butler, PhD.

(was 52.0 cm dbh). Bristlecone pine trees occured in only two woodland stands on dry northwest-facing slopes and these naturally short-stature trees averaged 21.8 cm dbh (largest was 61.6 cm dbh).

4.1.4 Shrubland Associations

Shrublands have become established on the upper and middle slopes of hills and ridges, rock outcrops, active prairie dog towns, swales, drainages, and on streambanks. The most widespread shrublands included the Waxflower Rock Outcrop Shrubland (occupies exposures of Pikes Peak granite boulders), the Mountain Mahogany / Mountain Muhly Shrubland (forms open stands on southern aspects of slopes and ridges), and the Shrubby Cinquefoil Temporarily Flooded Shrubland Alliance (occupies swales, drainage margins, and mesic slopes). Many shrub associations were patches or small stands that were less than the project MMU (0.5 ha).

The following vegetation units comprise the upland shrubland communities of Florissant Fossil Beds National Monument:

- *Cercocarpus montanus / Muhlenbergia montana* (Mountain Mahogany / Mountain Muhly) Shrubland [NEW]
- *Jamesia americana* (Waxflower) Rock Outcrop Shrubland [NEW]
- *Artemisia frigida / Bouteloua gracilis* (Fringed Sagewort / Blue Grama) Dwarf-shrubland [NEW]
- *Chrysothamnus viscidiflorus – Ericameria parryi* (Viscid Rabbitbrush – Parry Rabbitbrush) Dwarf-shrubland [NEW]
- *Elaeagnus commutata* (Silverberry) Shrubland [Park Special]
- *Prunus virginiana* (Chokecherry) Shrubland [Park Special]
- *Yucca glauca / Muhlenbergia montana* (Yucca / Mountain Muhly) Dwarf-shrubland [Park Special]

Mountain Mahogany / Mountain Muhly Shrubland occupied southern exposures of ridges and hills near the crown of these topographic features. Most stands were open and easily traversed, thus the high foliar cover by grass and forb species. Mountain mahogany shrubs occupied large openings between stands of ponderosa pine woodland, or were located on exposed hill and ridgetops. One stand west of the visitor center was unusual because it occupied an opening surrounded by Douglas-fir forest and was predominantly east to northeast-facing. Where ponderosa pine becomes the dominant species, with small stands of mountain mahogany interspersed, the stands were classified as the Ponderosa Pine / Mountain Mahogany Woodland type. Commonly associated species included a few wax currant shrubs, seedling/sapling ponderosa pine, mountain muhly, slimstem muhly, fringed sagewort, mountain ball cactus, yucca, and puccoon. Scattered pinyon individuals present in the center portion of the Monument.

Several rock outcrops were exposed within the Monument, the most prominent of these were the large Pikes Peak granite boulders that occupied upper hill and ridge slopes. The Waxflower Rock Outcrop Shrubland grows from the gravel and sand that has collected at the base and in the crevices of cracks within these boulders. Waxflower and boulder raspberry were consistently present in these outcrops and boulder fields, which also serve as habitat for several other plant species.

The Fringed Sagewort / Blue Grama Dwarf-shrubland occupies areas intensively grazed by prairie dogs. This type was present along Grape Creek on the upper floodplain terrace and adjacent toeslope, a few more upland swales and hillslopes, and was extensive on a broad plain north of the northern the Monument boundary, east of TC-1. This type was characterized by prairie dog burrows, the adjacent disturbed areas, and the presence of fringed sagewort (*Artemisia frigida*). Other disturbance-tolerant species present within active prairie dog towns included blue grama, viscid rabbitbrush (*Chrysothamnus viscidiflorus*), and nightshade (*Solanum triflorum*).

Occupying the middle and lower slopes of small hills and ridges in the vicinity of TC-1, the Viscid Rabbitbrush – Parry Rabbitbrush Shrub Herbaceous Vegetation association was relatively common. This association occupies predominantly south and east-facing slopes that were moderate to gentle. This appears to be a grazing-tolerant plant association, because fairly extensive ground squirrel and other burrowing mammal activity occured in each stand. In addition to the dominant dwarf shrubs, viscid rabbitbrush and Parry rabbitbrush, other plant species present in the type included fringed sagewort, Colorado rubber plant, Arizona fescue, blue grama, and prairie Junegrass.

A small outcrop of platy rhyolite on the hillslope east of Grape Creek supports a unique Chokecherry Shrubland. A patch or small stand of chokecherry (*Prunus virginiana*) was present, but it was the only such occurrence observed during the data gathering effort. South of Upper Twin Rock Road, a west-facing volcanic exposure supports a stand of Silverberry Shrubland. Silverberry (*Elaeagnus commutatus*) was only observed at this location, associated with wax currant, Arizona fescue, and gumweed (*Grindelia subalpina*). Possibly all of the shrublands associated with rock outcrops fall below the project MMU (0.5 ha).

A few patches of Yucca / Mountain Muhly Shrubland were present on south-facing slopes and ridges. Yucca or soapweed was occasionally present in other plant associations and dominates small patches that were below the project MMU (0.5 ha). Common associates of this shrubland type were blue grama, fringed sagewort, and Arizona fescue.

The following vegetation units comprise the wetland shrubland communities of Florissant Fossil Beds National Monument:

- *Dasiphora fruticosa ssp. floribunda* (Shrubby Cinquefoil) Shrubland [CEGL]
- *Alnus incana* / Mesic Graminoids (Thinleaf Alder / Mixed Graminoids) Shrubland [CEGL001148]
- *Salix exigua* (Sandbar Willow) Shrubland [CEGL001197]
- *Salix ligulifolia* (Strapleaf Willow) Shrubland [CEGL]
- *Salix monticola / Carex utriculata* (Mountain Willow / Beaked Sedge) Shrubland [CEGL002657]
- *Salix monticola* / Mesic Graminoids (Mountain Willow / Mesic Graminoids) Shrubland [CEGL002659]
- *Salix brachycarpa / Carex aquatilis* (Shortfruit Willow / Aquatic Sedge) Shrubland [CEGL001244]

Floodplain margins, moist swales, hillsides moist from old ditch seepage, and the base of toeslope boulder fields supported a Shrubby Cinquefoil Temporarily Flooded Shrubland Alliance vegetation type. In narrow drainages and on moist floodplain terraces, shrubby cinquefoil forms dense stands; the shrubs were approximately 1.0-meters tall. Where the type occupies hillslopes or swales, the shrubs were more widely spaced. Typically, shrubby cinquefoil was associated with Baltic rush; however, the type has been invaded by the exotic species Kentucky bluegrass, Canada thistle, and toadflax. The soils supporting shrubby cinquefoil stands were typically moist and deep, although one site was sampled where the type was growing from an aggrading gravel bed.

The Thinleaf Alder / Mesic Graminoids Shrubland type was rarely observed in the Monument, only occupying two small drainages on the eastern edge of the Monument tributary to Grape Creek. The stands were relatively linear, less than 15-meters wide, and rarely exceed approximately 75-meters in length. One of the drainages was deeply incised, up to five meters deep, and the thinleaf alder (*Alnus incana*) shrubs were confined to the small stream flowing in its bottom. The other stream supporting thinleaf alder stands flowed through organic substrate dominated by sedge (beaked, aquatic, and Nebraska) species and Baltic rush. Other species present within thinleaf alder stands included mountain and sandbar willow, the exotic grasses Kentucky bluegrass and reed canarygrass, and the forbs elk thistle (*Cirsium tioganum*) and iris (*Iris missouriensis*).

Riparian shrublands or shrub wetlands occupied the banks of perennial streams and the bottoms of mesic drainages at the lowest elevations in the Monument. This growth pattern results in extremely narrow bands of wetland shrubs, rarely over a few meters wide. In addition, the bands of shrubs were not contiguous, with expanses of sedge and rush meadows in between. Where beaver dams had been constructed within the drainage, the ponds resulted in the shrub stands relocating along their margins in thin bands. Where beaver dams and ponds had been abandoned, the pioneering willow species, strapless willow, reinvaded the newly exposed sites.

Willow shrublands within the Monument were predominantly Mountain Willow / Beaked Sedge Shrubland or Mountain Willow / Mixed Graminoid Shrubland types. One small stand (below the MMU of 0.5 ha) of Shortfruit Willow / Aquatic Sedge was located on a tributary drainage to Grape Creek, located in the western portion of the Monument. The site also contained sediments from an adjacent toeslope, possibly making the substrate more gravelly than was apparent immediately under the dense vegetation. Plant species common to this site included both aquatic and beaked sedge, Baltic rush, tufted hairgrass, chiming bells, and field mint.

In a similar fashion, one small stand (below the project MMU of 0.5 ha) of Sandbar Willow Shrubland was observed and sampled; the stand was located on the banks of a small drainage east of Grape Creek. The common understory species for the strapleaf willow stand were Nebraska sedge and Baltic rush, in addition to exotic grasses such as smooth brome and Kentucky bluegrass.

Sandbar Willow Shrubland vegetation was observed on Grape Creek at the northern Monument perimeter fence line, up-drainage to the series of beaver ponds. This portion of Grape Creek was aggraded, with deposits of gravel up to one-meter deep supporting very tall sandbar willow shrubs. Commonly associated shrubs included mountain willow and shrubby cinquefoil, along with five species of exotic grasses and the exotic toadflax. Native plant species common to these stands included Baltic rush, spikerush (*Eleocharis palustris*), cow parsnip, and scouring rush (*Equisetum arvense*).

The common willow growing on streambanks within the Monument was mountain willow, which occupies long, linear reaches and also occurs as patches along drainages. In many places, mountain willow has become established within stands of beaked sedge, with lesser coverage of aquatic sedge, tufted hairgrass, cow parsnip, and chiming bells. Where beaver dams have been constructed, this type narrows and grows along the outer floodplain and pond margins. Around the beaver dams and ponds, the shrubs were smaller and younger because of the pruning by beaver in search of forage and dam construction materials. Stands of Mountain Willow / Mesic Graminoid Shrubland intermix with those occupying beaked sedge stands. Many of the mesic graminoids present were exotics, including reed canarygrass, smooth brome, and Kentucky bluegrass. The most common forb species present with the mesic graminoids included cow parsnip, chiming bells, field mint, and field horsetail.

4.1.5 Grassland Associations

Grasslands occupied the valleys that were once a part of ancient Lake Florissant, hill and ridgetops, and openings within woodland and shrubland canopies. The grasslands were diverse and reflect the more than one hundred years of land use for homesteads, agricultural crop production, livestock production, roads and trails, underground utility lines, and fossil collection. In some places, disturbed soils planted to exotic species were undergoing the re-establishment of native species; however, there were typically no developed soils present, only Pikes Peak granite gravel substrate.

The following vegetation units comprise the upland grass communities of Florissant Fossil Beds National Monument:

- *Festuca arizonica – Muhlenbergia filiculmis* (Arizona Fescue – Slimstem Muhly) Herbaceous Vegetation [CEGL001605]
- *Festuca arizonica – Muhlenbergia montana* (Arizona Fescue – Mountain Muhly) Herbaceous Vegetation [CEGL001606]
- *Bromus inermis* – (*Pascopyrum smithii*) Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation [CEGLNEW]
- *Danthonia parryi* (Parry Oatgrass) Herbaceous Vegetation [CEGL001795]
- *Muhlenbergia filiculmis* (Slimstem Muhly) Herbaceous Vegetation [CEGL001780]
- *Muhlenbergia montana – Hesperostipa comata* (Mountain Muhly – Needle-and-thread) Herbaceous Vegetation [CEGL00001647] [Park Special]
- *Hordeum jubatum* (Foxtail Barley) Herbaceous Vegetation [CEGL001798] [Park Special]
- *Muhlenbergia montana* (Mountain Muhly) Herbaceous Vegetation [CEGL001646]
- *Phalaris arundinacea* (Reed Canarygrass) Western Herbaceous Vegetation [CEGL001474]

- *Agropyron cristatum* – (*Pascopyrum smithii*, *Hesperostipa comata*) (Crested wheatgrass – (Western Wheatgrass, Needle-and-thread)) Semi-natural Herbaceous Vegetation [Park Special]
- *Schizachyrium scoparium* (Little Bluestem) Herbaceous Vegetation [Park Special]

Hilltops and ridgetops with dry gravel soils composed of Pikes Peak granite support both Slimstem Muhly Herbaceous Vegetation and Arizona Fescue – Slimstem Muhly Herbaceous Vegetation associations. The hilltops and ridgetops had nearly vertical orientation and were dominated by slimstem muhly in addition to prairie Junegrass, Colorado rubber plant, and fringed sagewort), among several other species. These sites typically supported good cover values for lichens. These habitats were likely too dry and exposed for the more robust bunchgrasses to become established.

As the vegetation was established around the crown of the hill and on the upper slopes, the bunchgrass, Arizona fescue, was present or becomes dominant with slimstem muhly. There was more soil formation on these sites and more available moisture for bunchgrass survival. Other species common to this association includes blue grama, mountain muhly, prairie Junegrass, and a variety of forbs. On the same slopes towards the mid-slope, with more northerly aspects, or with deeper soils, mountain muhly becomes common, resulting in an Arizona fescue – Mountain Muhly Herbaceous Vegetation association. Slimstem muhly and blue grama were present at lower densities when associated with these deeper soils, more robust bunchgrasses, and northerly exposures.

Many acres within the Monument have been converted to exotic grass species, principally smooth brome and crested wheatgrass. On abandoned agricultural land and along transportation and utility corridors, exotic grass species were planted to control erosion and to provide forage for grazing livestock. Nearly pure patches or stands of Crested Wheatgrass Semi-natural Herbaceous Vegetation were rare within the Monument, crested wheatgrass was typically sub-dominant to the exotic smooth brome. The largest crested wheatgrass stand observed occurred in a minor drainage or broad swale near the northeastern Monument boundary.

Where extra moisture was available, e.g., along roadsides, upper floodplain margins, and on north-facing slopes, the Smooth Brome Semi-natural Herbaceous Vegetation association forms relatively dense stands of tall grass (0.5–1.0 meter). However, on the dry, exposed gravels of old agricultural fields and utility corridors, smooth brome was more depauperate, less dense, and these stands were slowly being re-colonized by native plant species.

Moist sites occurring in narrow drainages, swales, and upper north-facing slopes at the mid- to high elevations within the Monument provided habitat for the Parry Oatgrass Herbaceous Vegetation association. Nearly pure stands of Parry oatgrass occupied these sites that appear to collect larger amounts of snow due to drifting, and slower moisture loss because of the northerly exposure. The soils of this grassland were deep and dark and some stands were becoming invaded by Colorado blue spruce and quaking aspen at the higher elevations, and Douglas-fir and ponderosa pine at lower elevations (including sites west of the visitor center). Where past invasion of this grassland type by tree species has occurred, Parry oatgrass persisted in the understory, although it was much less dense or even scattered due to the shading.

The Mountain Muhly Herbaceous Vegetation association occupied deep soils of the narrow drainages and swales down-gradient of ponderosa pine woodland stands. Along the lower margins of the stand, mountain muhly became codominant with Arizona fescue, while pine dropseed was common in the higher portions of the association, at the woodland margin.

Small patches or stands of the Western Wheatgrass – Green Needlegrass Herbaceous Vegetation association were present in the vicinity of the Hornbek Homestead. Edwards and Weber (1990) reported that western wheatgrass (*Pascopyrum smithii*) was introduced to this environment as a contaminant in livestock forage or as an erosion control planting. The largest patch of western wheatgrass observed occupies an upper floodplain terrace some 4–5 meters above an incised Grape Creek. A nearly pure patch of green needlegrass (*Nassella viridula*) was observed adjacent to a stock dam where soils had been disturbed during dam construction. This dam was located south of Lower Twin Rock Road in a tributary drainage to Grape Creek.

One small stock pond located south of Lower Twin Rock Road had dried at the time of the field survey, and supported a sparse stand of Foxtail Barley Herbaceous Vegetation. Foxtail barley (*Hordeum jubatum*) was the dominant grass species in association with several species typical of drying mudflats, including *Glaux maritima*. Another grass species of saturated soils was the exotic reed canarygrass, which occupies Grape and Boulder Creeks. Reed canarygrass grows amid graminoid (sedge and rush) associations.

Two unusual grassland associations were observed and sampled: the first was Little Bluestem Herbaceous Vegetation that occupied steep, south-facing, mid- and toeslopes of hills and ridges. Little bluestem formed small, monotypic stands (less than the project MMU of 0.5 ha) growing from Pikes Peak granite-derived gravel, which deposited as small shelves on the upper base of individual little bluestem clumps. The second occurrence was the Mountain Muhly – Needle-and-thread Herbaceous Vegetation that occurred as a few small patches on the south-facing lower slopes adjacent to Boulder Creek. Needle-and-thread, a common cool season bunchgrass more typical of lower elevations, dominated only one small stand with mountain muhly and blue grama . In other areas along Boulder Creek, needle-and-thread occurred as a few plants in association with the more abundant mountain muhly and Arizona fescue.

4.1.6 Wetland Graminoid Association

Emergent wetlands were common in the floodplains of the Monument and were dominated by graminoids or grass-like plants. One exotic grass species, reed canarygrass, had become established in Grape and Boulder Creeks, where it formed a few linear stands up to 20-meters wide. Reed canarygrass is a tall, coarse grass that grows in an extremely dense, linear patch or stand as a near monoculture. These stands may be spreading primarily via underground rhizomes, since no seed production was noted during field survey work. Dense litter characterized these stands, with small mammal tunnels evident throughout the litter mat. Four principal associations of tall (0.5–1.0 meter) graminoids have become established as stands within the floodplains of the Monument and included three sedge and one rush species.

The following vegetation units comprise the wetland graminoid communities of Florissant Fossil Beds National Monument:

- *Carex aquatilis* (Aquatic Sedge) Herbaceous Vegetation [CEGL001802]
- *Carex nebrascensis* (Nebraska Sedge) Herbaceous Vegetation [CEGL1813] [Park Special]
- *Carex urticulata* (Beaked Sedge) Herbaceous Vegetation [CEGL001562]
- *Juncus balticus* (Baltic Rush) Herbaceous Vegetation [CEGL001838]

Species of sedge may form relatively pure stands and were also observed as understory species to willow and alder shrubs. The Nebraska Sedge Herbaceous Vegetation was only observed in the northeast corner of the Monument, growing in small patches in narrow tributary drainages to Grape Creek, and did not exceed the project MMU. Beaked Sedge Herbaceous Vegetation occupied the saturated and inundated soils adjacent to streams and ponds, but also formed large stands on saturated first terraces within the broad floodplains. Saturated soils with high amounts of organic material, or saturated peat, typically supported Aquatic Sedge Herbaceous Vegetation at a slightly higher elevation than the previously described types. An ecotone between beaked and aquatic sedge was present, sometimes narrow, and may be confusing during vegetation sampling. Ecotones between sedge associations meeting the project MMU were not observed within the Monument.

The beaked sedge herbaceous vegetation, and to a lesser extent the aquatic sedge herbaceous vegetation, exhibited hummock formation. A dense layer of litter was present on the soil surface, and often pockets of water were maintained between hummocks. These water pockets were observed to support aquatic insects, their larvae, and other invertebrates, including leeches.

Baltic rush was the common emergent species of the mid- and upper floodplain terraces, where it formed broad and persistent stands. The persistence of this species was confirmed where Grape Creek has incised several feet, drying the terraces (west of Hornbek Homestead), and Baltic rush persists but has been invaded by prairie dogs on one terrace and blue flax, a dry upland species, on the opposite terrace. In more moist stands with saturated soil, tufted hairgrass (*Deschampsia caespitosa*), western bistort (*Polygonum bistortoides*), and elk thistle were common associates. A dense mat of litter covered the ground surface within Baltic rush stands.

Construction of the water pipeline across Grape Creek has resulted in an area of pooling above the aqueduct, widening the amount of Beaked Sedge Herbaceous Vegetation, Aquatic Sedge Herbaceous Vegetation, and Baltic Rush Herbaceous Vegetation, which grew in bands or zones along the creek. Below the pipeline crossing, the creek and associated saturated soils narrowed abruptly to only a few meters wide. The creek has become incised from one to three meters deep from the pipeline to northeast of the Maytag facility (**Figure 4-2**). Canada Thistle Herbaceous Vegetation and Smooth Brome Semi-natural Herbaceous Vegetation types formed dense stands on the floodplain edges, dried as a result of drainage incision. One stand of beaked sedge that was heavily invaded by Canada thistle was sampled east of the Maytag.

It was notable that spikerush, which often formed large stands on saturated soils of the region, was not often observed in Florissant. Small patches or bands of spikerush were noted adjacent to some stock ponds. Additionally, one small patch of broad-leaved cattail was observed on a stock pond dam, an unusual occurrence at this elevation.

FIGURE 4-2. THE MAYTAG FACILITY

4.1.7 Forb Associations

Five associations of forbs were described within Florissant, two were aquatic, two occupied moist soils of floodplains, and one occupied an upland area that had been scraped of topsoil. None of the forb associations was large enough spatially to meet or exceed the project MMU of 0.5 ha, although the two aquatic types were described from the national classification.

The following vegetation units comprise the forb communities of Florissant Fossil Beds National Monument:

- *Lemna* spp. (Duckweed) Permanently Flooded Herbaceous Vegetation [CEGL003059] [Park Special]
- *Myriophyllum sibiricum* (Water Milfoil) Herbaceous Vegetation [CEGL002000] [Park Special]
- *Paronychia sessiliflora* (Nailwort) Herbaceous Vegetation [Park Special]
- *Cirsium arvense* – Mixed Weedy Forb (Canada Thistle) Herbaceous Vegetation [Park Special]
- *Linaria vulgaris* (Toadflax) Herbaceous Vegetation [Park Special]

Aquatic Associations

Beaver and humans have had an influence on the hydrology, and thus the aquatic and wetland vegetation, in and adjacent to the creek beds and drainages. On lower Grape Creek, beaver have constructed dams from near the northern boundary fence to approximately 0.5 km northwest of Hornbek Homestead. This has resulted in a chain of dams and shallow ponds that support aquatic vegetation, including the Water Milfoil Herbaceous Vegetation rooted in the pond, Duckweed Permanently Flooded Herbaceous Vegetation floating on the pond surface, and Mountain Willow / Mixed Graminoid Shrubland adjacent to the shoreline. The lowest ponds have been abandoned, the dams were in disrepair, and mudflats were exposed. Where the ponds have been abandoned for a longer period of time, a Sandbar Willow Temporarily Flooded Shrubland type has become established (**Figure 4-3**).

Approximately six stock ponds constructed within the Monument retain water year-round and each maintains a unique flora. During 2001, stock ponds observed in the Monument ranged from dry with no vegetation, to dry and dominated by the Foxtail Barley Herbaceous Vegetation type, to aquatic types supporting either Water Milfoil Herbaceous Vegetation and/or Duckweed Permanently flood Herbaceous Vegetation (**Figure 4-4**). Every stock pond supports a band of sedges, grasses, and forbs around the pond margin; beaked sedge was the most commonly observed emergent species. A small patch of broad-leaved cattail, the only patch with the Monument, was found on the dam on one large stock pond.

FIGURE 4-3. BEAVER PONDS LOCATED WITHIN FLFO

FIGURE 4-4. STOCK PONDS WITH AQUATIC VEGETATION

Floodplain and Upland Associations

A site that was disturbed historically, in the vicinity of the aqueduct west of TC-1, supported a stand of Nailwort Herbaceous Vegetation. This site was below the project MMU, but was floristically interesting because the topsoil was removed and it was being re-colonized by native cushion plants, small shrubs, bunchgrasses, annuals, and a few ponderosa pine trees. The site contains erosive Pikes Peak granite gravel, and most of the plants growing on it show signs of pedastaling (**Figure 4-5**).

FIGURE 4-5. RE-COLONIZATION OF A DISTURBED SITE BY NATIVE PLANT SPECIES

Exotic plant species were widespread in some areas of the Monument, but the most abundant forbs were largely restricted to floodplain terraces. Both the Canada Thistle Herbaceous Vegetation and Toadflax Herbaceous Vegetation types were located on second and higher floodplain terraces (**Figure 4-6**). These rhizomatous perennial forbs were typically observed in small to large patches and rarely if ever exceed the project MMU in aerial cover. Exotic forbs were typically associated with an emergent wetland species such as Baltic rush or aquatic or beaked sedge, or a shrub such as shrubby cinquefoil, and often became established because of disturbance, e.g., downcutting drainage that drained and dried the associated terrace, aggrading stream, or drainage that contained exposed gravel for exotic species establishment, and historically disturbed sites such as corral or livestock feeding areas. Some prairie dog towns that have been extensively grazed and the soil disturbed by burrowing and foraging activity represented sites for exotic species to become established. An aggressive exotic plant control program has been undertaken on the Monument, using a variety of hand-pulling, mowing, and selective herbicide application techniques to achieve success (**Figure 4-7**).

4.2 PRAIRIE DOG HABITATS

A protocol for prairie dog colony interpretation and delineation, using CIR aerial photographs was created by Plumb et al. (1997). Although the colonies were wildlife habitats, a characteristic flora had been established over time. The mapping protocol stated: 1) all prairie dog colonies would be mapped, no matter what size, 2) prairie dog colonies were to be considered distinct plant communities, 3) incorporate physical features of colonies when possible, and 4) the entire colony, regardless of plant community type should be documented.

FIGURE 4-6. PHOTOS OF EXOTIC PLANT SPECIES ESTABLISHED WITHIN FLFO

FIGURE 4-7. TOADFLAX INVASION (ABOVE) AND USING MOWING AS A MANAGEMENT TOOL (BELOW)

4.3 MAP UNITS

For a complete description of the map units and their appearance on the aerial imagery refer to **Appendix H: PI Key**.

Table 4-2 shows the map units that were delineated with the area they occupied on the Monument and the number of polygons they occurred in.

Map Unit Number	Map Unit	Hectares	Polygons
3	Picpun + Psemen Forest	291.6	69
4	Picpun + Psemen + Poptre Forest	4.1	2
5	Pinari Woodland	1.2	2
7	Pinpon Woodland	915.5	109
9	Pinpon / Broine Woodland	3.5	2
10	Popbal Woodland	0.9	1
11	Poptre Forest	28.0	55
14	Alninc Shrubland	0.4	3
15	Artfri Dwarf Shrubland	8.3	10
16	Cermon Shrubland	93.5	52
17	Dasfru Shrubland	13.7	34
18	Jamame Rock Outcrop Shrubland	14.9	19
19	Salbra Shrubland	0.1	1
20	Salexi Temp. Flooded Shrubland	0.4	1
21	Salmon / Carutr + Salmon / Mesic Gram Shrubland	7.4	13
22	Cirarv HV	2.9	5
23	Lemspp HV + Myrsib HV	2.0	10
24	Linvul Semi-natural HV	0.7	1
25	Broine Semi-natural HV	157.5	36
26	Caraqu HV + Carutr HV + Junbal HV	90.6	41
27	Danpar HV	32.2	26
28	Fesari - Muhmon HV + Muhmon HV	687.8	113
29	Horjub Semi-natural HV	0.2	1
30	Muhfil + Fesari - Muhfil HV	34.2	25
31	Schsco HV + Yucgla / Muhmon Shrubland	7.5	20
Total		2,399.1	

Table 4-2 Area and number of polygons for map classes

4.4 ACCURACY ASSESSMENT

Five hundred fifty six AA sample points were collected using a stratified random sample following the methods outlined in ESRI, 1994. Data were collected in May and June of 2002.

Field conditions were dry, but all dominant plant species were readily identifiable. Perennial grasses maintained flower structures (panicles, spikes, etc.) from the last growing season and new growth was emerging from cool season grasses, common sedges, other wetland species, and shrubs, including species of willow. Weather conditions were cool and windy most of the initial trip, however, a snowstorm of up to three inches halted data collection mid-day on Friday (24 May). Later in the AA data collection, a large wildfire north of the Monument required some modification, in terms of more formal communication, to access the Monument. The Monument was closed to the public for over a week during the most critical fire stages. Depending on wind direction, a haze, thick smoke, or smoke odors were encountered during data collection.

The accuracy assessment data are found in the data CD that accompanies this report in the file Accuracy_Assessment\flfoaadata.xls. Of the 556 data points 125 points had disagreements between the mapped data and the accuracy assessment field data. These 125 points were analyzed to determine the cause of the disagreement. In general there were seven causes of disagreement between the map data and the AA field data: 1) mapping error – an error in the mapping attribute, 2) temporal change – the community has changed between the date of the photography and the the field data collection, 3) edge error – the AA data point was on an edge and the field crew identified the wrong polygon, 4) biologist's error – an error in the identification in the field, 5) locational error – the field crew was in the wrong location, 6) no association – the classification system changed after the AA field data were collected and the association was eliminated or changed, and 7) below minimum mapping unit – the vegetation association was below 0.5 hectares in size and was not mapped. The results of this analysis can be seen in the data CD under the "FLFO AA Data.xls" file. Five hundred and forty one points were used in the final analysis. 15 points were discarded because the classification system had changed during the process (error 6).

The AA field data, along with a preliminary contingency table were presented to Karl Brown, USGS Coordinator for the Program, Mike Story, NPS Coordinator for the Program, and Tom Ulrich, Natural Resources Manager for the Monument. After discussing the data and results with them, a final map classification was developed, and a final AA contingency table was developed (all of which were found in the data CD). The final contingency table is shown in **Table 4-3**.

The overall accuracy of all mapping classes was 76.9% (416 matches out of 541 total points) with a confidence interval at the 90% level of 3.1% and kappa coefficient of 74.4% which is the proportion of agreement obtained after removing agreement due to chance, Foody, 1992).

The values down the columns in **Table 4-3** are the number of AA points found during the AA field work. For example, for Map Unit 3 (Picpun + Psemen Forest) there are a total of 75 AA points found int the field. 56 of these AA points were correctly mapped. The remaining 19 points were incorrectly mapped, for a "producer's accuracy" of 75%; producer's accuracy shows how well a particular vegetation class can be mapped. The values across the rows are the number of AA points that were mapped as that map unit, regardless of what was found on the ground during the AA field work. Again using Map Unit 3, 61 points were mapped as Map Unit 3; 56 points were correctly mapped, and 5 points were found to be some other map unit. This produced a "user's accuracy" of 92%; users are interested in knowing how well spatial data actually represent what can be found on the ground.

Table 4-3 (link to another page)

5.0 DISCUSSION

Florissant Fossil Beds National Monument occupies the Montane Zone of the southern Rocky Mountains and includes the valley, hill, and ridge topography characteristic of the lower and middle elevations. Herbaceous communities of grass, graminoid, and forb species occupied the valley bottoms and the slopes, intermingling with forest and woodland types on the slopes and riparian shrub types along the streams. Outcrops of Pikes Peak granite boulders and exposures of volcanic tuff create unique environments for rare species such as waxflower, silverberry, and bristlecone pine, among others.

The area topography and geology, when viewed in respect to 130 years of settlement activities, combine to create a complex landscape mosaic supporting a variety of native and exotic plant species. The exotic species, particularly smooth brome, Canada thistle, and toadflax, are common enough to result in management actions related to control, eradication, and/or replacement through revegetation efforts. These factors combined to create challenging vegetation classification and mapping needs that were completed and addressed within the USGS/NPS National Park Vegetation Mapping Program. The map accuracy reflects the time and effort of all researchers involved to understand and appreciate the complex the Monument vegetation.

5.1 VEGETATION CLASSIFICATION AND CHARACTERIZATION

Existing plant association and alliance classifications were used to describe much of Florissant's current vegetation. Associations for quaking aspen, ponderosa pine, bristlecone pine, Douglas-fir, and Colorado blue spruce trees; sedge, rush, and willow meadows and shrublands, and fescue, muhly, and oatgrass grasslands were good examples of existing classification appropriate for the park. However, a few types were sampled that were newly described or represented unique variations of more common types. Among these were shrublands of mountain mahogany, silverberry, rabbitbrush, and fringed sagewort; little bluestem grassland; and the waxflower rock outcrops.

Because of the topography, soils, and elevation, several plant communities were observable and obvious in the field but were less than the project MMU of 0.5 ha. Vegetation types fitting this description included quaking aspen and bristlecone pine stands; rabbitbrush, yucca, silverberry, and some willow shrublands, little bluestem, needle-and-thread, and western wheatgrass grasslands; Canada thistle and toadflax forblands; and water milfoil and duckweed aquatic types. This patchy distribution of vegetation, while relatively repeatable within the landscape, made field data collection and aerial photointerpretation much more challenging.

Forests

The forest type was dominated by the Douglas-fir / Common Juniper Forest type on most slopes with north-facing exposures (ranging from northeast to northwest exposures). However, the north-facing slopes of a few small hills and ridges along the northern Monument boundary supported stands of the Ponderosa Pine / Arizona Fescue Woodland type, that had canopy closure greater than 60% and emulated Douglas-fir stands on the aerial photography. In a few sites, past logging activities have resulted in patches of Douglas-fir woodland stands, with canopy closure of less than 60%, and these were interpreted as the forest type. The Colorado Blue Spruce / Common Juniper Forest type was present along drainages and lower slopes (the more mesic sites) at the base of Douglas-fir / Common Juniper Forest stands. The type was often very narrow, consisting of only a few trees in width along the toeslopes and valley sides.

Although readily identifiable on the aerial photography, stands of the Quaking Aspen Forest types (with common juniper and with mixed graminoids and forbs in the understory), were less than the project MMU of 0.5 ha. The only stand of the introduced Balsam Poplar Woodland type had greater than 60% canopy closure.

Woodlands

Three of the six woodland types, e.g., bristlecone pine, Colorado blue spruce / river birch, and balsam poplar were present as stands below the project MMU. Only one stand of Ponderosa Pine / Smooth Brome Woodland was larger than the project MMU, because most stands occured as narrow bands adjacent to mature Ponderosa Pine Woodlands. The Ponderosa Pine / Mountain Mahogany Woodland type occupies the south-facing hillslopes and ridgetops and was heavily infested with mistletoe. As a result of the mistletoe, and to a lesser extent, porcupine foraging, it was not uncommon to see dead or dying trees and resultant downed branches from the dead trees.

Shrublands

Riparian shrublands of willow, alder, and shrubby cinquefoil provided the densest crown cover of shrub associations sampled within the Monument. However, these plant associations were confined to the streambanks and some stock dams in a very narrow distribution pattern. Many individual stands did not meet the project MMU of 0.5 ha. Because stands of riparian shrubs along streams outside of Florissant were very tall, dense, and occured in unbroken bands, the idea that shrub eradication on lands within the Monument was conducted pre-Monument designation was interesting to consider. This could perhaps be considered as a potential artifact of mowing for hay production and would be a good topic for research using historical photographs of Grape Creek and its tributaries.

The upland shrub communities were sparse, occupied predominantly south and west aspects, and often occured in patches less than the project MMU (0.5 ha) in size. In particular, silverberry, yucca, chokecherry, and wax currant shrubs were present in small patches presented as “park specials.” The Mountain Mahogany / Mountain Muhly Shrubland type was the most widely distributed within the Monument; however, small patches were typically interpreted as part of the Ponderosa Pine / Mountain Mahogany Woodland type. Mountain mahogany shrubs were very widely spaced due to dry upper slope habitat. The Fringed Sagewort / Blue Grama Dwarf-shrubland and the Viscid Rabbitbrush – Parry Rabbitbrush Dwarf-shrubland apparently have persisted as a result of colonization, burrow construction, and grazing activity by prairie dogs and other ground squirrels.

Emergent Wetlands

Emergent wetlands were confined to the valleys and were typically described as meadows with graminoid, grass, and forb species. Only one small spring was observed in the east-central portion of the Monument. The herbaceous vegetation type of inundated, saturated, and seasonally moist soils have been subject to beaver, stock, and erosion control dam construction; historic mowing for livestock hay; pipeline and road construction; and exotic species invasion. Consequently, these types were often present as a mosaic of linear stands, sometimes obscured by exotic forbs, including Canada thistle and toadflax. The Beaked Sedge Herbaceous Vegetation type occupies the inundated and saturated soils nearest the streams, while the Baltic Rush Herbaceous Vegetation type occupied the second floodplain terraces and oxbows; these represented the most common of the emergent types. The Aquatic Sedge Herbaceous Vegetation was distributed on organic deposits over gravel soils between the two dominant types, often forming ecotones with the Beaked Sedge Herbaceous type.

Grasslands

An interesting mosaic of grassland types was present, reflecting the topography, soils, and slope exposure, in addition to the over 100-year history of agriculture, livestock grazing, and exotic pasture introduction. Types dominated by little bluestem, needle-and-thread, foxtail barley, western wheatgrass, and the exotics, crested wheatgrass and reed canarygrass, were never observed covering an area equal to or over the project MMU of 0.5 ha. The exotic grasslands dominated by the Smooth Brome Semi-natural Herbaceous Vegetation type covered extensive areas; however, it formed mosaics with dry meadows along the upper floodplain of Grape Creek, becoming more difficult to effectively sample and interpret.

Some native grassland types were predictable in distribution and relatively straightforward to interpret, e.g., Parry Oatgrass Herbaceous Vegetation. Others formed a herbaceous complex, e.g., Slimstem Muhly Herbaceous Vegetation occupied dry hilltops, ridgetops, and a few very dry slopes, and then became subdominant to Arizona fescue on the upper slopes (wider on southern exposures), forming an Arizona Fescue – Slimstem Muhly Herbaceous Vegetation type. On the lower slopes and flats, and on north-facing slopes the grassland dominants were the Arizona Fescue – Mountain Muhly Herbaceous Vegetation type, which transitioned into a Mountain Muhly Herbaceous Vegetation type on higher slopes.

Rock Outcrops

Rock outcrops supported a unique flora with several relict species present. The rock outcrops were easily identified on both true color and infrared aerial photography; however, most were below the MMU. Volcanic outcrops were smaller than were the Pikes Peak granite boulder type, and they supported different species, e.g., mountain mahogany, silverberry, chokecherry, and wax currant. Rock outcrops formed by Pikes Peak granite boulders supported waxflower and boulder raspberry almost exclusively. These outcrops should be the focus of thorough floristic inventories over several years.

Land Use and Exotic Species

Historic land use on portions of the Monument was intensive, eliminating topsoil and soil structure where agricultural fields were tilled and planted, pipelines emplaced and buried, and grazing concentrated. Disturbed sites consisted of granite gravel and were planted to exotic grasses such as smooth brome and crested wheatgrass to provide ground cover (erosion control) and pasturage for livestock. Over the ensuing years, a pattern of replacement of exotic plant species by native species appeared to be emerging on the previously disturbed uplands. By the same token, a pattern of replacement of native species by exotic plant species appeared to be emerging across meadow habitats. However, the most aggressive exotic species management efforts were being undertaken by Florissant staff within meadow habitats, particularly to control Canada thistle and toadflax.

The more mesic sites planted to smooth brome, in particular, were near monocultures. The best examples of nearly pure and robust stands of smooth brome occured on north-facing slopes near the Barksdale Picnic Area (south of Upper Twin Rock Road) and eastern Monument boundary, along the western end of the aqueduct within the Monument and western Monument boundary, and also along Grape Creek, where it parallels CR-1 in the vicinity of the visitor center. Replacement of smooth brome by native species was most prevalent on hill and ridgetops, south-facing exposures, and areas were re-invasion of smooth brome grasslands, by ponderosa pine seedlings and saplings, was occurring.

5.2 VEGETATION MAP PRODUCTION

The use of stereo-photo interpretation to map the vegetation associations posed several challenges. Among the issues addressed were: 1) division of forest types from woodland types, 2) delineation of individual forest associations, and 3) delineation of individual grassland types.

The difference between the forest and woodland associations was based on foliar cover. Forests were generally mapped when the foliar cover was greater than 60% and woodlands were mapped when the foliar cover was between 25-60%. Though these levels of cover can generally be photo interpreted, it was a time-consuming and laborious task. It was also prone to inconsistencies, especially if more than one person was interpreting. For this reason, an automated routine was employed to separate the forests from the woodland for this project (See section 2.3.6).

The different forest associations were difficult to distinguish using photo interpretation alone. This was especially true when trying to separate Colorado Blue Spruce / Common Juniper Forest, Douglas-fir / Common Juniper Forest, and the denser forest-like portions of Ponderosa Pine / Arizona Fescue Woodland. Ultimately, the first two where combined as a map unit, and separated from the Ponderosa Pine Woodland using primarily environmental conditions based on slope, aspect, and relationship to water courses. The shadows cast by the trees on clear areas helped in some areas to distinguish the sharper crowned spruces and firs from the more rounded pines.

The delineation of grassland types posed the greatest challenge for photo interpretation. First the Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation areas were delineated based on ancillary data provided by the park, and the rarer grassland types were deleineated based on field information and environmental conditions. The remaining open areas were then divided between thicker Arizona Fescue – Mountain Muhly types and less dense Arizona Fescue – Slimstem Muhly types. This process was solely based on the brighter imagery signature with a slight influence from the environmental conditions of slope and aspect.

The photo interpretation tasks that were relatively straightforward included:

Wetlands – once the sedge and rush associations were combined, the differentiation of them from the Mountain Willow Association was not difficult.

Aspen Forests – the distinctive color and shape of the clones allowed them to be easily collected.

Rock Outcrops – the boulders had easily interpretable, very bright signatures and often cast shadows.

Upland shrublands – the Mountain Mahogany Association and the Ponderosa Pine / Mountain Mahogany Woodland were readily delineated, since the shrubs have distinctive shapes and colors, especially in the B/W and CIR photography. The only other map unit these map units could be confused with were common juniper shrubs in higher elevations on south-facing slopes.

The USGS-NPS vegetation mapping projects were designed to produce a similar vegetation classification and set of map units; however, there was not always a strict one-to-one relationship between them (Von Loh et al. 2000). Vegetation characteristics that could be identified on aerial photography (based on complex signatures) were not always the same as those observable in the field. Map verification efforts between project ecologists and GIS specialists to develop map units and investigate the inherent variability of each vegetation type versus the photographic signature were necessary..

A basic concern at the Monument was the fact that many distinct plant associations within the Monument were not present above the project MMU of 0.5 ha, e.g., they occured as minor inclusions in more common types. Examples of stands that represent distinct plant associations, but are smaller than the project MMU, included: 1) Bristlecone Pine / Arizona Fescue Woodland, 2) Quaking Aspen Forest Alliance, 3) Quaking Aspen / Common Juniper Forest, 4) Silverberry Shrubland, 5) Waxflower Rock Outcrop Shrubland, 6) Sandbar Willow Temporarily Flooded Shrubland, 7) Nebraska Sedge Herbaceous Vegetation, 8) Water milfoil Herbaceous Vegetation, 9) Duckweed Herbaceous Vegetation, and 10) Little Bluestem Herbaceous Vegetation, among others.

In several cases, these small-area types were observable on the aerial photography and could be delineated and mapped effectively. In many instances, the type observed and sampled in the field was the only known example and could be delineated because of the coordinate information collected. The basic elements contained within this product included:

- NVCS associations represented by a unique photo-signature and topographic position, e.g., Ponderosa Pine / Mountain Mahogany Woodland;
- Multiple NVCS associations that together are represented by a unique signature, e.g., Sedge – Rush Herbaceous Alliance;

- Stands of vegetation that were not addressed by the NVCS, but have management interest for the Monument and could be recognized on the aerial photography, e.g., Balsam Poplar Woodland;
- Wildlife habitat units that were also identified as management concerns, e.g., the prairie dog town complex defined under Fringed Sagewort / Blue Grama Dwarf-shrubland; and
- Land-use mapping units that were not addressed by the NVCS.

5.3 ACCURACY ASSESSMENT

The overall accuracy for the map units was 77%, which was below the program standard of 80%, but was accepted by the Park and Program staff because they felt that it was more important to capture the diversity of vegetation in the Monument, rather than merging map units to meet the program standard. Several map units did not meet the program standard of 80% per class, but again the map accuracy was accepted so the diversity of vegetation communities could be documented.

5.4 CURRENT VEGETATION AND WILDLIFE RESEARCH BENEFITING FROM THIS PROJECT

During the course of this vegetation classification and mapping effort, we were asked to contribute to two vegetation-related research efforts being conducted by others. The first was a research effort being evaluated by the Northern Arizona University, Forestry Department, relating to a paper that examined songbird communities in dwarf mistletoe-infested ponderosa pine at Florissant (Parker, pers. com. 2001) (**Appendix I**). The paper under evaluation presented an emerging hypothesis that: in ponderosa pine woodland with severely mistletoe-infested overstory, understory plant cover and diversity would be greater — and so will overstory diversity, which can affect bird diversity.

The second was a fire management research effort being conducted to support planning on MSP, to the southwest of the Monument (**Appendix I**). This study was being funded by Colorado State Parks and was focused on literature and research related to vegetation in the area and fire effects to habitats and species (Berberian, pers. com. 2002). Specifically, fire effects to native grassland species under consideration for controlled burning to increase grazing capacity for elk was being investigated.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

5.5.1 Vegetation Research

At the beginning of this project, emphasis was placed on recorded field observations and field validation/verification using: 1) a preliminary photointerpretation (laboratory interpretation relying on typical signatures and based on color, tone, height, density, etc.) of the common vegetation signatures, 2) a thorough review and discussion of plant associations between the field ecologist and the photointerpretation/GIS database production team using a reconnaissance-level approach to collect observation point and note data from a large number of sites, and 3) field visits to all previously mapped geologic exposures and regions of the Monument. In addition, photo signatures from the newer true color aerial photography used for database production could be compared to those of older color infrared photos to further refine predictive efforts and enhance the vegetation sampling efforts. In this manner, the data collection was fully integrated with the interpretation effort, with each group being fully informed on the others' needs and findings. It is recommended that a process similar to this be used for future vegetation mapping projects to the extent possible.

Map detail and accuracy for this project could be improved by acquiring new aerial photography and developing a same-year orthophoto base. The use of CIR photography should also be considered, which would allow better delineation of grassland and wetland plant associations. From a strictly botanical point of view, several research projects would be informative for the management of the Monument's vegetation communities. One study could focus on the effects of mistletoe infestation in Ponderosa Pine / Mountain Mahogany Woodland stands, and the secondary effects of porcupine foraging activity in these stands. Another could examine quaking aspen use by elk and the resultant stand size. Perhaps the most interesting research could examine the re-establishment of native plant species onto sites where the soil structure was destroyed and exotic pasture grass species were introduced. Re-establishment of ponderosa pine has been occurring, in addition to native species re-occupying the driest sites of the aqueduct corridor and the potato fields. The small stand of Nailwort Herbaceous Vegetation could be used as a reference site, including a determination of its history of disturbance.

5.5.2 GIS Research

There are three avenues of GIS/remote sensing investigations that would be useful for this Program to pursue. One avenue would be the use of the new high resolution satellite borne commercial multispectral sensors, such as Ikonos which is owned and operated by Space Imaging, or Quick Bird which is owned and operated by DigitalGlobe. These sensors have resolving power that approaches aerial photography with the advantage of containing several spectral bands. The Ikonos has a panchromatic sensor (spectral range: 045 - 0.90 µm) with a resolution of 1.0 meters and a multispectral sensor with four channels (Band 1: Blue: 0.45 - 0.52 µm, Band 2: Green: 0.52 - 0.60 µm, Band 3: Red: 0.63 - 0.69 µm, Band 4: Near IR: 0.76 - 0.90 µm) with a resolution of 4 meters. The Quick Bird has a panchromatic sensor (spectral range: 045 - 0.90 µm) with a pixel size of 0.61 meters and a multispectral sensor with four channels (Band 1: Blue: 0.45 - 0.52 µm, Band 2: Green: 0.52 - 0.60 µm, Band 3: Red: 0.63 - 0.69 µm, Band 4: Near IR: 0.76 - 0.90 µm with a resolution of 2.44 meters. The classification of imagery from these imaging systems (and others that will be available in the near future), using a combination of automated and human classification along with ancillary spatial data sets, such elevation models, hydrography layers, and soil layers, could conceivably increase the efficiency and cost effectiveness of image processing. This approach would be especially fruitful for large parks (50,000 acres and larger).

The second avenue of GIS investigations would be the application of new sensors that collect elevation data (LIDAR and IFSAR). LIDAR (Light Detection And Ranging) sensors are based on laser systems. IFSAR (Interferometric Synthetic Aperture Radar) are based on radar systems. These airborne and satellite sensors emit energy (laser or radar) and measure the time it takes for the energy to return to the sensor, thus measuring the elevation of the reflecting objects (ground, trees, building, etc). The resolution of these sensors is one meter or less, allowing for the resolution of individual trees and shrubs. It is possible to extract information about vegetation structure from these sensors, which can be used to identify vegetation communities, as well as being useful for fire fuels mapping, and wildlife habitat applications.

The third avenue of GIS research is to investigate new, image classification software, such as eCognition, which use object-oriented algorithms to extract information from imagery beyond analysis of spectral reflectance. ECognition was used on a limited basis in this project but further investigation in this area would be warranted.

All three avenues of investigation are intriguing individually and in combination. Advances in remote sensing technology, computer processing ability and speed, and software have made these areas practical to pursue.

6.0 ACRONYMS AND ABBREVIATIONS

AA Accuracy Assessment
Ad Adderton Loam
ANCS Automated National Catalog System (NPS)
BRD Biological Resources Division (USGS)
CBI Center for Biological Informatics (USGS)
CDOW Colorado Division of Wildlife
CD-ROM Compact Disc-Read Only Memory
CIR Color Infrared
cm Centimeter
CNHP Colorado Natural Heritage Program
CO Colorado
CONPS Colorado Native Plant Society
COSHS Colorado State Historical Society
dbh Diameter Breast Height
DEM Digital Elevation Model
ºF Degrees Fahrenheit
DLG Digital Line Graph
DOQQ Digital Orthophoto Quarter Quadrangle
DRG Digital Raster Graphic
FGDC Federal Geographic Data Committee
FLFO Florissant Fossil Beds National Monument
FLV Fourmile-Lymanson-Vabem Complex
GA Guffey-Raleigh Association
GIS Geographic Information System
GPS Global Positioning System
ha Hectare
I&M Inventory & Monitoring (NPS)
ITIS Integrated Taxonomic Information System
km Kilometer
MMU Minimum Mapping Unit (0.5 ha)
mph Miles Per Hour
MSP Mueller State Park
NAD North American Datum
NBII National Biological Information Infrastructure Program
n.d. No Date
NPS National Park Service
NCGIA National Center for Geographic Information and Analysis
NRCS Natural Resources Conservation Service
Nv Cryaquolls
NVCS National Vegetation Classification Standard (System)
Pers. Comm. Personal Communication
PLGR Precision Light-weight GPS Receiver
ppm Parts Per Million

Rl	Raleigh Very Gravelly Sandy Loam
RMMC	Rocky Mountain Mapping Center (USGS)
RMRO	Rocky Mountain Regional Office (NPS)
SCS	Soil Conservation Service
SG	Catamount-Guffey Complex
SH	State Highway
STORET	Storage and Retrieval water quality database management system
SU	Standard Units
TC-1	Teller County Road #1
TCDP	Teller County Division of Parks
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WASO	Washington Office (NPS)
WRD	Water Resources Discipline (USGS)
WRCC	Western Regional Climate Center

7.0 LIST OF CONTACTS AND CONTRIBUTORS

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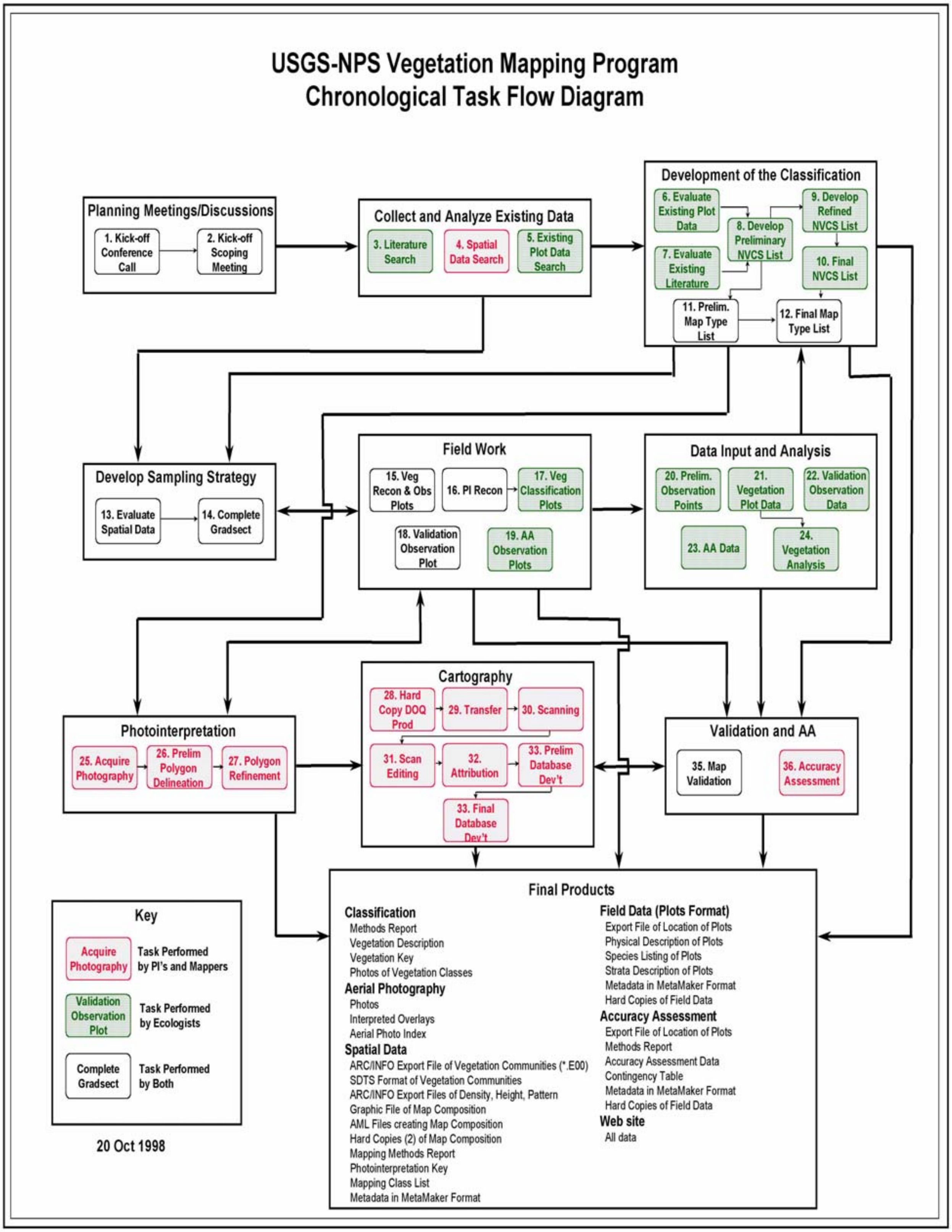
9.0 APPENDICES

Appendices can be found this report

APPENDIX A

FLOW CHART FOR THE UNITED STATES GEOLOGICAL SURVEY / NATIONAL PARK SERVICE VEGETATION MAPPING PROGRAM


USGS-NPS Vegetation Mapping Program
Chronological Task Flow Diagram
Planning Meetings/Discussions
1. Kick-off Conference Call
2. Kick-off Scoping Meeting
Collect and Analyze Existing Data
3. Literature Search
4. Spatial Data Search
5. Existing Plot Data Search
Development of the Classification
6. Evaluate Existing Plot Data
7. Evaluate Existing Literature
8. Develop Preliminary NVCS List
9. Develop Refined NVCS List
10. Final NVCS List
11. Prelim. Map Type List
12. Final Map Type List
Develop Sampling Strategy
13. Evaluate Spatial Data
14. Complete Gradsect
Field Work
15. Veg Recon & Obs Plots
16. PI Recon
17. Veg Classification Plots
18. Validation Observation Plot
19. AA Observation Plots
Data Input and Analysis
20. Prelim. Observation Points
21. Vegetation Plot Data
22. Validation Observation Data
23. AA Data
24. Vegetation Analysis
Photointerpretation
25. Acquire Photography
26. Prelim Polygon Delineation
27. Polygon Refinement
Cartography
28. Hard Copy DOQ Prod
29. Transfer
30. Scanning
31. Scan Editing
32. Attribution
33. Prelim Database Dev't
33. Final Database Dev't
Validation and AA
35. Map Validation
36. Accuracy Assessment
Final Products
Classification
Methods Report
Vegetation Description
Vegetation Key
Photos of Vegetation Classes
Aerial Photography
Photos
Interpreted Overlays
Aerial Photo Index
Spatial Data
ARC/INFO Export File of Vegetation Communities (*.E00)
SDTS Format of Vegetation Communities
ARC/INFO Export Files of Density, Height, Pattern
Graphic File of Map Composition
AML Files creating Map Composition
Hard Copies (2) of Map Composition
Mapping Methods Report
Photointerpretation Key
Mapping Class List
Metadata in MetaMaker Format
Field Data (Plots Format)
Export File of Location of Plots
Physical Description of Plots
Species Listing of Plots
Strata Description of Plots
Metadata in MetaMaker Format
Hard Copies of Field Data
Accuracy Assessment
Export File of Location of Plots
Methods Report
Accuracy Assessment Data
Contingency Table
Metadata in MetaMaker Format
Hard Copies of Field Data
Web site
All data
Key
Acquire Photography
Task Performed by PI's and Mappers
Validation Observation Plot
Task Performed by Ecologists
Complete Gradsect
Task Performed by Both
20 Oct 1998

APPENDIX B

PLANT SPECIES LIST AND LISTS FOR MAMMALS, BIRDS, AMPHIBIANS AND REPTILES

RELATIONAL TABLE OF ITIS DATABASE, PLANTS DATABASE, AND THE COLORADO FLORA: EASTERN SLOPE (WEBER 1990) NOMENCLATURE, WITH THE ACCEPTED DATA ENTRY ACRONYM AND COMMON NAME

Acronym PLANTS ITIS-TSN	Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]	Common Name PLANTS 2001 and ITIS 2002
	ACERACEAE: Maple Family	
ACGL 28742	*Acer glabrum* Torr. [*Acer glabrum* Torr.]	Mountain maple
	AGAVACEAE: Agave Family	
YUGL 43142	*Yucca glauca* Nutt. [*Yucca glauca* Nutt.]	Soapweed yucca, Spanish bayonet
	ALLIACEAE: Onion Family	
ALCE2 42721	*Allium cernuum* Roth. [*Allium cernuum* S. Wats.]	Nodding onion
ALGE 42643	*Allium geyeri* S. Wats. [*Allium geyeri* S. Wats.]	Geyer's onion
	ALSINACEAE: Chickweed Family	
ARFE3 20245	*Arenaria fendleri* Gray [*Eremogene fendleri* (Gray) Ikonnikov]	Fendler's sandwort
ARLA4 20258	*Arenaria lanuginosa* (Michx.) Rohrb. ssp. *saxosa* (Gray) W.A. Weber [*Spergulastrum lanuginosum* Michx. ssp. *saxosum* (Gray) W.A. Weber]	Spreading sandwort
CEARS2 19947	*Cerastium arvense* L. ssp. *strictum* (L.) Ugborogho [*Cerastium strictum* L. *emend*. Haenke]	Field Chickweed, Mouse-ear chickweed
PASE 20346	*Paronychia sessiliflora* Nutt. [*Paronychia sessiliflora* Nutt.]	Creeping nailwort
STLO 20185	*Stellaria longifolia* Muhl. *ex* Willd. [*Stellaria longifolia* Muhl.]	Longleaf starwort, Stitchwort
	AMARANTHACEAE: Amaranth Family	
AMBL 20723	*Amaranthus blitoides* S. Wats. [*Amaranthus blitoides* Wats.]	Mat amaranth, Prostrate pigweed
AMRE 20745	*Amaranthus retroflexus* L. [*Amaranthus retroflexus* L.]	Redroot amaranth, Redroot pigweed

Acronym PLANTS ITIS-TSN	**Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]**	**Common Name PLANTS 2001 and ITIS 2002**
	APIACEAE: Parsley Family	
ALAN3 29572	*Aletes anisatus* (Gray) Theobald & Tseng. [*Aletes anisatus* (Gray) Theobald & Tseng.]	Rocky Mountain Indian parsley
ANAM 29433	*Angelica ampla* A. Nels. [*Angelica ampla* Nels.]	Giant angelica
CIDO 29457	*Cicuta douglasii* (DC.) C. & R. [*Cicuta douglasii* (DC.) C. & R.]	Western water hemlock
COSC2 29471	*Conioselinum scopulorum* (Gray) C. & R. [*Conioselinum scopulorum* (Gray) C. & R.]	Rocky Mountain hemlock parsley
HATR 29668	*Harbouria trachypleura* (Gray) C. & R. [*Harbouria trachypleura* (Gray) C. & R.]	Whiskbroom parsley
HEMA80 502953	*Heracleum maximum* Bartr. [*Heracleum sphondylium* L. ssp. *montanum* (Schleicher) Briquet]	Common cow-parsnip
PSMO 29837	*Pseudocymopterus montanus* (Gray) C. & R. [*Pseudocymopterus montanus* (Gray) C. & R.]	Alpine false spring parsley, Mountain parsley

	APOCYNACEAE: Dogbane Family	
APAN2 30156	*Apocynum androsaemifolium* L. [*Apocynum androsaemifolium* L.]	Spreading dogbane

	ASCLEPIADACEAE: Milkweed Family	
ASHA6 30270	*Asclepias hallii* Gray [*Asclepias hallii* Gray]	Hall's milkvetch

	ASPIDACEAE: Shieldfern Family	
DRF12 17535	*Dryopteris filix-mas* (L.) Schott. [*Dryopteris filix-mas* (L.) Schott.]	Male fern

	ASPLENIACEAE: Spleenwort Family	
ASSE 17361	*Asplenium septentrionale* (L.) Hoffman [*Asplenium septentrionale* (L.) Hoffman]	Grassfern
ASTR2 17364	*Asplenium trichomanes* L. [*Asplenium trichomanes* L.]	Maidenhair spleenwort, Maidenhair fern

	ASTERACEAE: Sunflower Family	
ACMIA 35423	*Achillea millefolium* L. var. *alpicola* (Rydb.) Garrett [*Achillea lanulosa* Nutt.]	Common yarrow
AGAU2 36488	*Agoseris aurantiaca* (Hooker) Greene [*Agoseris aurantiaca* (Hooker) Greene]	Orange agoseris, False dandelion
AGGLD 36490	*Agoseris glauca* (Pursh) Raf. var. *dasycephala* (T.&G.) Jepson	Pale agoseris, False dandelion

Acronym PLANTS ITIS-TSN	**Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]**	**Common Name PLANTS 2001 and ITIS 2002**
	[*Agoseris glauca*)Pursh) Raf. var. *dasycephala* (T.&G.) Jepson]	
ANMI3 185162	*Antennaria microphylla* Rydb. [*Antennaria microphylla* Rydb.]	Littleleaf pussytoes
ANPA4 36749	*Antennaria parvifolia* Nutt. [*Antennaria parvifolia* Nutt.]	Small-leaf pussytoes
ANPU 36751	*Antennaria pulcherrima* Hook. [*Antennaria pulcherrima* (Hook.) Greene ssp. *anaphaloides* (Rydb.) Weber]	Showy pusseytoes
ARBI2 35451	*Artemisia biennis* Wild. [*Artemisia biennis* Wild.]	Biennial wormwood
ARCA12 183748	*Artemisia campestris* L. ssp. *borealis* (Pallas) H.&C. [*Oligosporus campestris* (L.) Cassini ssp. *pacificus* (Nutt.) W.A. Weber]	Field sagewort
ARCA14 35458	*Artemisia carruthii* Wood *ex* Carruth [*Artemisia carruthii* Wood]	Carruth's sagewort
ARDR4 35462	*Artemisia dracunculus* L. [*Oligosporus dracunculus* (L.) Poljacov]	Tarragon
ARFR4 35465	*Artemisia frigida* Wild. [*Artemisia frigida* Wild.]	Prairie sagewort, Silver sagewort
ARLU 35474	*Artemisia ludoviciana* Nutt. [*Artemisia ludoviciana* Nutt.] *Artemisia ludoviciana* Nutt.	White sagebrush, Prairie sagewort
BADI 36794	*Bahia dissecta* (Gray) Britt. [*Bahia dissecta* (Gray) Britt.]	Ragleaf Bahia
BITE 35734	*Bidens tenuisecta* Gray [*Bidens tenuisecta* Gray]	Slimtube beggar's tick, Spanish needles
BRGR 36878	*Brickellia grandiflora* (Hook.) Nutt. [*Brickellia grandiflora* (Hook.) Nutt.]	Tasselflower brickelbush
CANUM2 35787	*Carduus nutans* L. ssp. *macrolepis* (Peterman) Kazmi [*Carduus nutans* L. ssp. *macrolepis* (Peterman) Kazmi]	Nodding plumeless thistle, Musk thistle
CEDE15 565055	*Centaurea dealbata* Wild. []	Whitewash cornflower, Star thistle
CHDO 36987	*Chaenactis douglasii* (Hook.) H.&A. [*Chaenactis douglasii* (Hook.) H.&A.]	Douglas dusty maiden
CHVI8 37090	*Chrysothamnus viscidiflorus* (Hook.) Nutt. [*Chrysothamnus viscidiflorus* (Hook.) Nutt.]	Yellow rabbitbrush, Viscid rabbitbrush
CIAR4 36335	*Cirsium arvense* (L.) Scopoli [*Cirsium arvense* (L.) Scopoli] [*Cirsium incanum* (Gmelin) Fischer]	Canada thistle
CICA11 36350	*Cirsium canescens* Nutt. [*Cirsium canescens* Nutt.]	Prairie thistle
CITIC 36419	*Cirsium tioganum* (Congd.) Petrak var. *coloradensis* (Rydb.) Dorn [*Cirsium coloradense* (Rydb.) Cockerell]	Colorado thistle
CIOC2 36392	*Cirsium ochrocentrum* Gray [*Cirsium ochrocentrum* Gray]	Yellowspine thistle
CRRU3 37203	*Crepis runcinata* James *ex* Torr. [*Psilochenia runcinata* (James) Love & Love]	Fiddleleaf hawksbeard
ERNAN5 507594	*Ericameria nauseosa* (Pallas *ex* Pursh) Nesom & Baird	Rubber rabbitbrush

Acronym PLANTS ITIS-TSN	Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]	Common Name PLANTS 2001 and ITIS 2002
	[*Chrysothamnus nauseosus* (Pallas) Britton]	
ERPAP10 507596	*Ericameria parryi* (Gray) Nesom & Baird [*Chrysothamnus parryi* (Gray) Greene]	Parry rabbitbrush
ERCA4 35835	*Erigeron canus* Gray [*Erigeron canus* Gray]	Hoary fleabane
ERCO4 35843	*Erigeron compositus* Pursh [*Erigeron compositus* Pursh]	Cutleaf daisy fleabane
ERFL 35865	*Erigeron flagellaris* Gray [*Erigeron flagellaris* Gray]	Trailing fleabane
ERFO3 35869	*Erigeron formosissimus* Greene [*Erigeron formosissimus* Greene]	Beautiful fleabane
ERLO 35897	*Erigeron lonchophyllus* Hook. [*Erigeron lonchophyllus* Hook.]	Shortray fleabane
ERSU2 35953	*Erigeron subtrinervis* Rydb. *ex* Porter & Britt. [*Erigeron subtrinervis* Rydb. *ex* Porter & Britt.]	Threenerve fleabane
ERVE2 35970	*Erigeron vetensis* Rydb. [*Erigeron vetensis* Rydb.]	Early bluetop fleabane
GNUL 502816	*Gnaphalium uliginosum* L. [*Filaginella uliginosa* (L.) Opiz]	Marsh cudweed
GRSU 37473	*Grindelia subalpina* Greene [*Grindelia subalpina* Greene]	Subalpine gumweed
GUSA2 37483	*Gutierrezia sarothrae* (Pursh) Britt. & Rusby [*Gutierrezia sarothrae* (Pursh) Britt. & Rusby]	Broom snakeweed, Matchweed
HEPA 37596	*Helianthella parryi* Gray [*Helianthella parryi* Gray]	Parry's dwarf sunflower, Little sunflower
HEAN3 36616	*Helianthus annuus* L. [*Helianthus annuus* L.]	Common sunflower
HEPE 36671	*Helianthus petiolaris* Nutt. [*Helianthus petiolaris* Nutt.]	Prairie sunflower
HEFUE 37665	*Heterotheca fulcrata* (Greene) Shinners [*Heterotheca fulcrata* (Greene) Shinners]	Rockyscree false golden aster, Golden aster
HEVIN 37689	*Heterotheca villosa* (Pursh) Shinners var. *nana* (Gray) Semple [*Heterotheca horrida* (Rydb.) V. Harms]	Hairy false golden aster, Golden aster
HYNE 37770	*Hymenopappus newberryi* (Gray) I.M. Johnston [*Hymenopappus newberryi* (Gray) I.M. Johnston]	Newberry's hymenopappus
HYRIR 37785	*Hymenoxys richardsonii* (Hook.) Cockrell [*Picradenia richardsonii* Hook.]	Colorado rubber plant
LATAP 36610	*Lactuca tatarica* (L.) C.A. Meyer ssp. *pulchella* (Pursh) Stebbins [*Lactuca tatarica* (L.) C.A. Meyer ssp. *pulchella* (Pursh) Stebbins]	Blue lettuce
LYJU 503623	*Lygodesmia juncea* (Pursh) D. Don. [*Lygodesmia juncea* (Pursh) D. Don.]	Rush skeletonplant
MABIB 37980	*Machaeranthera bigelovii* (Gray) Greene [*Machaeranthera pattersonii* (Gray) Greene]	Bigelow tansy aster
MADI6 501470	*Matricaria discoidea* DC. [*Lepidotheca suaveolans* Nutt.]	Disc Mayweed, Pineappleweed
OLAL2 507631	*Oligoneuron album* (Nutt.) Nesom [*Unamia alba* (Nutt.) Rydb.]	Prairie goldenrod
ORPA3 517938	*Oreochrysum parryi* (Gray) Rydb. [*Oreochrysum parryi* (Gray) Rydb.]	Parry's goldenrod
PACA15	*Packera cana* (Hook.) Weber & Love	Woolly groundsel

Acronym PLANTS ITIS-TSN	**Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]**	**Common Name PLANTS 2001 and ITIS 2002**
518142	[*Packera cana* (Hook.) Weber & Love]	
PAFE4 518146	*Packera fendleri* (Gray) Weber & Love [*Packera fendleri* (Gray) Weber & Love]	Fendler's ragwort
PANE7 518151	*Packera neomexicana* (Gray) Weber & Love [*Packera neomexicana* (Gray) Weber & Love]	New Mexico groundsel
PAPS5 518156	*Packera pseudaurea* (Rydb.) Weber & Love *[Packera pseudaurea* (Rydb.) Weber & Love]	Falsegold groundsel
PATR7 518159	*Packera tridenticulata* (Rydb.) Weber & Love [*Packera tridenticulata* (Rydb.) Weber & Love]	Threetooth ragwort
RACO3 38341	*Ratibida columnifera* (Nutt.) Woot. & Standl. [*Ratibida columnifera* (Nutt.) Woot. & Standl.]	Upright prairie coneflower
RUHI2 36765	*Rudbeckia hirta* L. [*Rudbeckia hirta* L.]	Black-eyed Susan
SEBIH 36103	*Senecio bigelovii* Gray var. *hallii* Gray [*Ligularia bigelovii* (Gray) W.A. Weber var. *hallii* (Gray) W.A. Weber]	Hall's ragwort
SEERK 36127	*Senecio eremophilus* Rydb. ssp. *kingii* (Rydb.) Dougl. & Dougl. [*Senecio eremophilus* Rydb. ssp. *kingii* (Rydb.) Dougl. & Ruyle-Dougl.]	King's ragwort
SESP3 36184	*Senecio spartioides* Torr. & Gray [*Senecio spartioides* Torr. & Gray]	Broom senecio
SOCA6 36224	*Solidago canadensis* L. [*Solidago canadensis* L.]	Canada goldenrod
SOMI2 36277	*Solidago missouriensis* Nutt. [*Solidago missouriensis* Nutt.]	Missouri goldenrod
SONA 36280	*Solidago nana* Nutt. [*Solidago nana* Nutt.]	Baby goldenrod
SOSIS3 505288	*Solidago simplex* Kunth [*Solidago spathulata* DC. var. *neomexicana* (Gray) Cronquist]	Goldenrod
SYAS3 522184	*Symphyotrichum ascendens* (Lindl.) Nesom [*Aster adscendens* Lindl. In DC.]	White aster
SYFAF 522205	*Symphyotrichum falcatum* (Lindl.) Nesom [*Virgulus falcatus* (Lindl.) Reveal & Keener]	White prairie aster
SYLA3 522218	*Symphyotrichum laeve* (L.) Love & Love [*Symphyotrichum laeve* (L.) Love & Love]	Smooth blue aster
SYLAH 522219	*Symphyotrichum lanceolatum* (Willd.) Nesom ssp. *hesperium* (Gray) Nesom [*Aster hesperius* Gray]	Aster
SYPO4 522235	*Symphyotrichum porteri* (Gray) Nesom [*Aster porteri* Gray]	Smooth white aster
TAOF 36213	*Taraxacum officinale* G.H. Weber [*Taraxacum officinale* G.H. Weber]	Common dandelion
TECA2 38494	*Tetradymia canescens* DC. [*Tetradymia canescens* DC.]	Spineless horsebrush
TEACC 38508	*Tetraneuris acaulis* (Pursh) Greene var. *caespitosa* Nels. [*Tetraneuris brevifolia* Greene var. *caespitosa* Nels.]	Caespitose four-nerved daisy
TOEX2 505542	*Townsendia exscapa* (Richardson) Porter [*Townsendia exscapa* (Richardson) Porter]	Stemless Townsend daisy, Easter daisy
TRDU	*Tragopogon dubius* Scopoli	Yellow salsify, Goat's beard

Acronym PLANTS ITIS-TSN	**Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]**	**Common Name PLANTS 2001 and ITIS 2002**
38564	[*Tragopogon dubius* Scopoli ssp. *major* (Jacquin) (Vollman)]	
VEEN	*Verbesina encelioides* (Cav.) Benth. & Hook.	Golden crownbeard
38601	[*Ximensia encelioides* Cav.]	

	ATHYRIACEAE: Lady Fern Family	
CYFR2	*Cystopteris fragilis* (L.) Bernh.	Brittle fern
17482	[*Cystopteris fragilis* (L.) Bernh.]	
CYRE15	*Cystopteris reevesiana* Lellinger	Reeve's bladderfern, Lady fern
501960	[*Cystopteris reevesiana* Lellinger]	

	BETULACEAE: Birch Family	
ALINT	*Alnus incana* (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung	Thinleaf alder
19471		
	[*Alnus incana* (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung]	
BEOC	*Betula occidentalis* Hook.	Water birch
19488	[*Betula fontinalis* Sargent]	

	BORAGINACEAE: Borage Family	
CRTH	*Cryptantha thyrsiflora* (Greene) Payson	Calcareous cryptantha
31879	[*Oreocarya thyrsiflora* Greene]	
CRVI4	*Cryptantha virgata* (Porter) Payson	Miner's Candle
31779	[*Oreocarya virgata* (Porter) Greene]	
HAFL2	*Hackelia floribunda* (Lehmann) I.M. Johnston	Many flower stickseed, False forget-me-not
31927	[*Hackelia floribunda* (Lehmann) I.M. Johnston]	
LAOCO	*Lappula occidentalis* (S. Wats.) Greene	Flatspine stickseed
503329	[*Lappula redowskii* (Hornem.) Greene]	
LIMU3	*Lithospermum multiflorum* Torr. *ex* Gray	Many flowered stoneseed
31951	[*Lithospermum multiflorum* Torr.]	
MECI3	*Mertensia ciliata* (James *ex* Torr.) G. Don	Tall fringed bluebells
31668	[*Mertensia ciliata* (James) G. Don]	
MELA3	*Mertensia lanceolata* (Pursh) A. DC.	Prairie bluebells
31681	[*Mertensia lanceolata* (Pursh) DC.]	

	BRASSICACEAE: Mustard Family	
ARHI	*Arabis hirsuta* (L.) Scopoli	Hairy rockcress
184344	[*Arabis hirsuta* (L.) Scopoli]	
ARRU4	*Armoracia rusticana* GMS	Horseradish
23044	[*Armoracia rusticana* GMS]	
BODR	*Boechera drummondii* (Gray) Love & Love	Drummond rockcress
509585	[*Boechera drummondii* (Gray) Love & Love]	
BOFE	*Boechera fendleri* (S. Wats.) W.A. Weber	Fendler rockcress
509586	[*Boechera fendleri* (Wats.) W.A. Weber]	
CAMI2	*Camelina microcarpa* Andrz.	Littlepod false flax
22599	[*Camelina microcarpa* Andrz.]	
CADR	*Cardaria draba* (L.) Desvaux	Whitetop

Acronym PLANTS ITIS-TSN	**Scientific Name/Authority – PLANTS 2001 and ITIS 2002 [Weber, 1990 Nomenclature]**	**Common Name PLANTS 2001 and ITIS 2002**
23072	[*Cardaria draba* (L.) Desvaux]	
DEINI	*Descurainia incana* (Bernh. Ex Fisch. & C.A. Mey) Dorn	Mountain tansy mustard
502003	[*Descurainia richardsonii* (Sweet) O.E. Schulz]	
DEPI	*Descurainia pinnata* (Walter) Britt.	Western tansy mustard
22826	[*Descurainia pinnata* (Walter) Britt.]	
DESO2	*Descurainia sophia* (L.) Webb *ex* Prantl	Herb Sophia
22843	[Descurainia sophia (L.) Webb]	
DRAU	*Draba aurea* M. Vahl. *ex* Hornem.	Golden draba
22863	[*Draba aurea* Vahl.]	
DRNE	*Draba nemorosa* L.	Woodland draba
22894	[*Draba nemorosa* L.]	
DRRE	*Draba rectifructa* C.L. Hitchcock	Mountain draba
22907	[*Draba rectifructa* C.L. Hitchcock]	
DRST4	*Draba streptocarpa* Gray	Pretty draba
22920	[*Draba streptocarpa* Gray]	
ERCA14	*Erysimum capitatum* (Douglas) Greene	Sand dune wallflower
22932	[*Erysimum capitatum* (Douglas) Greene]	
LEALA3	*Lepidium alyssoides* Gray	Mesa peppermint
503372	*[Lepidium montanum* Nutt. ssp. *alyssoides* (Gray) C.L. Hitchcock]	
LERA2	*Lepidium ramosissimum* Nels.	Many-branched pepperweed
22976	[*Lepidium ramosissimum* Nels.]	
LEMO3	*Lesquerella montana* (Gray) S. Wats.	Mountain bladderpod
23210	[*Lesquerella montana* (Gray) S. Wats.]	
ROAL	*Rorippa alpina* (S. Wats.) Rydb.	Alpine yellow cress
504808	[*Rorippa curvipes* Greene var. *alpina* (S. Wats.) Stuckey]	
ROPAH	*Rorippa palustris* (L.) Besser ssp. *hispida* (Desvaux) Jonsell	Hispid yellow cress
23006	[*Rorippa palustris* (L.) Besser ssp. *hispida* (Desvaux) Jonsell]	
ROTE2	*Rorippa teres* (Michaux) Stuckey	Southern marsh yellow
23019	[*Rorippa teres* (Michaux) Stuckey]	
SIAL2	*Sisymbrium altissimum* L.	Tall tumble mustard, Jim Hill mustard
23312	[*Sisymbrium altissimum* L.]	
THAR5	*Thlaspi arvense* L.	Field pennycress, Fanweed
23422	[*Thlaspi arvense* L.]	
THMOM	*Thlaspi montanum* L.	Alpine pennycress, Wild candytuft
23423	[*Noccaea montana* (L.) F.K. Meyer]	

	CACTACEAE: Cactus Family	
OPFR	*Opuntia fragilis* (Nutt.) Haworth	Brittle cactus
19707	[*Opuntia fragilis* (Nutt.) Haworth]	
PESIM	*Pediocactus simpsonii* (Engelmann) B.&R. var. *minor* (Engelmann) Ckll.	Snowball cactus, Mountain ball cactus
19776	[*Pediocactus simpsonii* (Engelmann) B.&R. var. *minor* (Engelmann) Ckll.]	

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	CALLITRICHACEAE: Water Starwort Family	
CAHE2 32057	*Callitriche hermaphroditica* L. [*Callitriche hermaphroditica* L.]	Northern water starwort
CAPA52 501143	*Callitriche palustris* L. [*Callitriche verna* L. emend. Lonnroth]	Vernal water starwort

	CALOCHORTACEAE: Mariposa Family	
CAGU 42849	*Calochortus gunnisonii* S. Wats. [*Calochortus gunnisonii* S. Wats.]	Mariposa lily, Sego lily

	CAMPANULACEAE: Bellflower Family	
CAPA10 34489	*Campanula parryi* Gray [*Campanula parryi* Gray]	Parry's bellflower, Harebell
CARO2 34497	*Campanula rotundifolia* L. [*Campanula rotundifolia* L.]	Bluebell bellflower

	CANNABACEAE: Hops Family	
HULUL 19160	*Humulus lupulus* L. var. *lupuloides* E. Small [*Humulus lupulus* ssp. *americanus* (Nutt.) Love & Love]	Common hop, Wild hops

	CAPPARACEAE: Caper Family	
CLSE 22626	*Cleome serrulata* Pursh [*Cleome serrulata* Pursh]	Rocky Mountain beeplant

	CAPRIFOLIACEAE: Honeysuckle Family	
LIBOA 35314	*Linnaea borealis* L. ssp. *americana* (Forbes) Hulten *ex* Clausen [*Linnaea borealis* L.]	Twinflower
LOIN5 35297	*Lonicera involucrata* Banks *ex* Sprengl [*Distegia involucrata* (Banks *ex* Sprengl) Ckll.]	Twinberry honeysuckle

	CARYOPHYLLACEAE: Pink Family	
SIDRD 20066	*Silene drummondii* Hooker [*Gastrolychnis drummondii* (Hooker) Love & Love]	Drummond's silene, Campion

	CHENOPODIACEAE: Goosefoot Family	
AXAM 20683	*Axyris amaranthoides* L. [*Axyris amaranthoides* L.]	Russian pigweed
CHAL7 20592	*Chenopodium album* L. [*Chenopodium album* L.]	Lamb's quarters
CHAT 20593	*Chenopodium atrovirens* Rydb. [*Chenopodium atrovirens* Rydb.]	Pinyon goosefoot

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CHBE4 20594	*Chenopodium berlandieri* Moquin [*Chenopodium berlandieri* Moquin]	Pitseed goosefoot
CHCA4 20599	*Chenopodium capitatum* (L.) Asch. [*Chenopodium capitatum* (L.) Asch.]	Blite goosefoot, Strawberry blite
CHDE 20604	*Chenopodium desiccatum* Nels. [*Chenopodium desiccatum* Nels.]	Aridland goosefoot
CHFO2 20606	*Chenopodium foliosum* (Moench) Asch. [*Chenopodium foliosum* (Moench) Asch.]	Leafy goosefoot
CHLE4 20616	*Chenopodium leptophyllum* (Moquin) S. Wats. [*Chenopodium leptophyllum* (Moquin) S. Wats.]	Narrowleaf goosefoot
KOSC 20696	*Kochia scoparia* (L.) Schrad. [*Bassia sieversiana* (Pallas) Weber]	Kochia
MONU 20700	*Monolepis nuttalliana* (Schultes) Greene [*Monolepis nuttalliana* (Schultes) Greene]	Povertyweed

	CONVALLARIACEAE: Mayflower Family	
MAST4 503656	*Maianthemum stellatum* (L.) Link [*Maianthemum stellatum* (L.) Link]	Starry false lily of the valley, False Solomon's seal

	CONVOLVULACEAE: Morningglory Family	
COAR4 30705	*Convolvulus arvensis* L. [*Convolvulus arvensis* L.]	Field bindweed, Creeping Jenny

	COPTACEAE: Meadow Rue Family	
THFE 18670	*Thalictrum fendleri* Engelmann *ex* Gray [*Thalictrum fendleri* Engelmann]	Fendler's meadow rue

	CORNACEAE: Dogwood Family	
COSES 501637	*Cornus sericea* L. [*Swida sericea* (L.) Holub]	Red-osier. Red-osier dogwood

	CRASSULACEAE: Stonecrop Family	
SELA 24126	*Sedum lanceolatum* Torr. [*Amerosedum lanceolatum* (Torr.) Love & Love]	Stonecrop

	CUPRESSACEAE: Cypress Family	
JUCO6 194820	*Juniperus communis* L. [*Juniperus communis* L. ssp. *alpina* (J.E. Smith) Celak.]	Common juniper
JUSC2 194872	*Juniperus scopulorum* Sarg. [*Sabina scopulorum* (Sarg.) Rydb.]	Rocky Mountain juniper

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	CYPERACEAE: Sedge Family	
CAAQ 39374	*Carex aquatilis* Wahl. [*Carex aquatilis* Wahl.]	Water sedge, Aquatic sedge
CAAT3 501205	*Carex athrostachya* Olney [*Carex athrostachya* Olney]	Slenderbeak sedge
CAAU3 39445	*Carex aurea* Nutt. [*Carex aurea* Nutt.]	Golden sedge
CADI6 39577	*Carex disperma* Dewey [*Carex disperma* Dewey]	Sedge
CADO2 39578	*Carex douglasii* Boott [*Carex douglasii* F. Boott in Hooker]	Douglas' sedge
CADU6 501216	*Carex duriuscula* C.A. May [*Carex stenophylla* Wahl. ssp. *eleocharis* (Bailey) Hulten]	Needleleaf sedge
CAINH2 39650	*Carex inops* Lamarck ssp. *heliophila* (Mack.) W.A. Weber [*Carex pensylvanica* Lamarck ssp. *heliophila* (Mack.) W.A. Weber]	Sun sedge
CAMI7 39699	*Carex microptera* Mack. [*Carex festivella* Mack. and C. *microptera* Mack.]	Small-wing sedge
CANE2 39711	*Carex nebrascensis* Dewey [*Carex nebrascensis* Dewey]	Nebraska sedge
CAOB4 39725	*Carex obtusata* Liljeblad [*Carex obtusata* Liljeblad]	Obtuse sedge
CAOR 39731	*Carex oreocharis* Holm [*Carex oreocharis* Holm]	Grassyslope sedge
CAPE42 507767	*Carex pellita* Michx. [*Carex lanuginosa* Michx.]	Woolly sedge
CAPI7 39757	*Carex pityophila* Mack. [*Carex pityophila* Mack.]	Loving sedge
CAPR5 39767	*Carex praegracilis* F. Boott [*Carex praegracilis* F. Boott]	Slender sedge
CASI2 39806	*Carex simulata* Mack. [*Carex simulata* Mack.]	Analogue sedge
CAUT 501288	*Carex utriculata* F. Boott [*Carex utriculata* F. Boott]	Northwest Territory sedge, Beaked sedge
ELPA3 40019	*Eleocharis palustris* (L.) R.&S. [*Eleocharis palustris* (L.) R.&S.]	Common spikerush
SCMI2 40235	*Scirpus microcarpus* J.&K. Presl. [*Scirpus microcarpus* J.&K. Presl.]	Small-fruited bulrush

	ELAEAGNACEAE: Oleaster Family	
ELCO 27771	*Elaeagnus commutata* Bernh. *ex* Rydb. [*Elaeagnus commutata* Bernh. *ex* Rydb.]	Silverberry

	EQUISETACEAE: Horsetail Family	
EQAR 17152	*Equisetum arvense* L. [*Equisetum arvense* L.]	Field horsetail, Scouring rush
EQLA	*Equisetum laevigatum* A. Braun	Smooth horsetail, Scouring rush

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17156	[*Hippochaete laevigata* (A. Braun) Farwell]	

	ERICACEAE: Heath Family	
ARUV 23530	*Arctostaphylos uva-ursi* (L.) Spreng. [*Arctostaphylos adenotricha* (Fern. & Macbr.) Love & Love]	Kinnikinnick, Bearberry

	EUPHORBIACEAE: Spurge Family	
CHGL13 501422	*Chamaesyce glyptosperma* (Engelm.) Small [*Chamaesyce glyptosperma* (Engelm.) Small]	Ribseed sandmat
CHSES 501458	*Chamaesyce serpyllifolia* (Pers.) Small [*Chamaesyce serpyllifolia* (Pers.) Small]	Thymeleaf sandmat
EUBR 28049	*Euphorbia brachycera* Engelm. [*Tithymalus montanus* (Engelm.) Small]	Horned spurge
EUES 28064	*Euphorbia esula* L. [*Tithymalus esula* (L.) Scopoli]	Leafy spurge

	FABACEAE: Pea Family	
ASAG2 25405	*Astragalus agrestis* Douglas *ex* G. Don [*Astragalus agrestis* Douglas *ex* G. Don]	Purple milkvetch
ASAL7 25393	*Astragalus alpinus* L. [*Astragalus alpinus* L.]	Alpine milkvetch
ASCRP 25480	*Astragalus crassicarpus* Nutt. var. *paysonii* (Kelso) Barneby [*Astragalus crassicarpus* Nutt. var. *paysonii* (Kelso) Barneby]	Ground plum
ASDR3 25500	*Astragalus drummondii* Dougl *ex* Hook. [*Astragalus drummondii* Dougl. *ex* Hook. var. *oblongifolius* (Rydb.) Cronquist]	Drummond milkvetch
ASHA2 25531	*Astragalus hallii* Gray [*Astragalus hallii* Gray]	Hall's milkvetch
ASLAR 566195	*Astragalus laxmanii* Jacq. var. *robustior* (Hook.) Barneby & Welsh [*Astragalus adsurgens* Pallas var. *robustior* Hook.]	Prairie milkvetch
ASMIO 25584	*Astragalus miser* Dougl. in Hook. var. *oblongifolius* (Rydbg.) Cronquist [*Astragalus miser* Dougl. in Hook. var. *oblongifolius* (Rydbg.) Cronquist]	Timber milkvetch
ASPA13 25624	*Astragalus parryi* Gray [*Astragalus parryi* Gray]	Parry's milkvetch
ASSP5 25686	*Astragalus sparsifolius* Gray [*Astragalus sparsifolius* Gray]	Front Range milkvetch
ASTE5 25696	*Astragalus tenellus* Pursh [*Astragalus tenellus* Pursh]	Looseflower milkvetch
DAPU5 26642	*Dalea purpurea* Ventenat [*Dalea purpurea* Ventenat]	Violet prairie clover
LUKI 26036	*Lupinus kingii* S. Wats. [*Lupinus kingii* S. Wats]	King's lupine

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MELU 503721	*Medicago lupulina* L. [*Medicago lupulina* L.]	Black medic
MESA 183623	*Medicago sativa* L. [*Medicago sativa* L.]	Alfalfa
MEOF 26150	*Melilotus officinalis* (L.) Lamarck [*Melilotus officinalis* (L.) Lamarck]	Yellow sweetclover
OXDEF 529330	*Oxytropis deflexa* (Pallas) DC. var. *foliolosa* (Hook.) Barneby [*Oxytropis deflexa* (Pallas) DC. var. *foliolosa* (Hook.) Barneby]	Nodding locoweed
OXLA3 26175	*Oxytropis lambertii* Pursh [*Oxytropis lambertii* Pursh]	Purple locoweed, Lambert locoweed
OXMU 26176	*Oxytropis multiceps* Nutt. [*Oxytropis multiceps* Nutt.]	Nuttall's oxytrope, Locoweed
OXSE 26182	*Oxytropis sericea* Nutt. [*Oxytropis sericea* Nutt.]	White locoweed
OXSP 26162	*Oxytropis splendens* Dougl. *ex* Hook. [*Oxytropis splendens* Dougl. *ex* Hook.]	Showy locoweed
THDI4 508157	*Thermopsis divaricarpa* Nels. [*Thermopsis divaricarpa* Nels.]	Spreadfruit golden banner
TRHY 26261	*Trifolium hybridum* L. [*Trifolium hybridum* L.]	Alsike clover
TRRE3 26206	*Trifolium repens* L. [*Trifolium repens* L.]	White Dutch clover
VIAM 26331	*Vicia americana* Muhl. *ex* Willd. [*Vicia americana* Muhl. *ex* Willd]	American vetch

	FUMARIACEAE: Fumitory Family	
COAU2 18999	*Corydalis aurea* Willd. [*Corydalis aurea* Willd.]	Scrambled eggs, Golden smoke

	GENTIANACEAE: Gentian Family	
FRSP 502660	*Frasera speciosa* Dougl Ex Griseb. [*Frasera speciosa* Dougl.]	Elkweed, Monument plant
GEAF 29964	*Gentiana affinis* Grisebach [*Pneumonanthe affinis* (Grisebach) Greene]	Pleated gentian, Bottle gentian
GEFR 502742	*Gentiana fremontii* Torr. [*Chondrophylla aquatica* (L.) W.A. Weber]	Moss gentian, Dwarf gentian
GEAMA 30058	*Gentianella amarella* (L.) Boerner ssp. *acuta* (Michaux) J. Gillet [*Gentianella acuta* (Michaux) Hiitonen]	Gentian
SWPE 30118	*Swertia perennis* L. [*Swertia perennis* L.]	Felwort, Star gentian

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	GERANIACEAE: Geranium Family	
ERCI6 29147	*Erodium cicutarium* (L.) L'Her. [*Erodium cicutarium* (L.) L'Her.]	Redstem stork's bill, Crane's bill, Filaree
GEATA 29127	*Geranium atropurpureum* Heller [*Geranium caespitosum* James *ex* Torr. ssp. *atropurpureum* (Heller) W.A. Weber]	Western purple crane's bill
GERI 29118	*Geranium richardsonii* Fischer & Trautv. [*Geranium richardsonii* Fischer & Trautv.]	Richardson's geranium

	GROSSULARIACEAE: Gooseberry Family	
RIAU 24452	*Ribes aureum* Pursh [*Ribes aureum* Pursh]	Golden currant
RICE 24457	*Ribes cereum* Dougl. [*Ribes cereum* Dougl.]	Wax currant
RIIN2 24473	*Ribes inerme* Rydbg. [*Ribes inerme* Rydbg.]	Whitestem gooseberry, Mountain gooseberry

	HALORAGACEAE: Water Milfoil Family	
MYSI 503906	*Myriophyllum sibiricum* Komarov [*Myriophyllum sibiricum* Komarov]	Shortspike water milfoil

	HELLEBORACEAE: Hellebore Family	
ACCO4 18416	*Aconitum columbianum* Nutt. *ex* T. & G. [*Aconitum columbianum* Nutt. *ex* T. & G.]	Monkshood
ACRUA8 18723	*Actaea rubra* (Ait.) Willd. ssp. *arguta* (Nutt. in T.&G.) [*Actaea rubra* (Ait.) Willd. ssp. *arguta* (Nutt. in T. & G.) Hulten]	Red baneberry
AQCA2 565004	*Aquilegia caerulea* James *ex* Torr. [*Aquilegia coerulea* James *ex* Torr.]	Colorado columbine
DERA 18503	*Delphinium ramosum* Rydbg. [*Delphinium ramosum* Rydb.]	Mountain larkspur

	HYDRANGEACEAE: Hydrangea Family	
JAAM 24379	*Jamesia americana* T. & G. [*Jamesia americana* T. & G.]	Fivepetal cliffbush, Waxflower

	HYDROPHYLLACEAE: Waterleaf Family	
PHAL9 31435	*Phacelia alba* Rydb. [*Phacelia alba* Rydbg.]	White phacelia
PHDE2 31484	*Phacelia denticulata* Osterhout [*Phacelia denticulata* Osterhout]	Rocky Mountain phacelia
PHHE2	*Phacelia heterophylla* Pursh	Varileaf phacelia

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504271	[*Phacelia heterophylla* Pursh]	

	HYPERICACEAE: St. Johnswort Family	
HYSC	*Hypericum scouleri* Hook.	St. Johnswort
503143	[*Hypericum formosum* HBK]	

	IRIDACEAE: Iris Family	
IRMI	*Iris missouriensis* Nutt.	Rocky Mountain iris, Wild iris
43221	[*Iris missouriensis* Nutt.]	
SIMO2	*Sisyrinchium montanum* Greene	Blue-eyed grass
43269	[*Sisyrinchium montanum* Greene]	

	JUNCACEAE: Rush Family	
JUBA	*Juncus balticus* Willd.	Baltic rush, Arctic rush
39223	[*Juncus arcticus* Willd. ssp. *ater* (Rydb.) Hulten]	
JUBU	*Juncus bufonius* L.	Toad rush
39227	[*Juncus bufonius* L.]	
JULO	*Juncus longistylis* Torr.	Longstyle rush
503256	[*Juncus longistylis* Torr.]	
LUPA4	*Luzula parviflora* (Erhardt *ex* Hoffman) Desvaux	Wood rush
39347	[*Luzula parviflora* (Erhardt *ex* Hoffman) Lejeune]	

	JUNCAGINACEAE: Arrowgrass Family	
TRPA6	*Triglochin palustre* L.	Marsh arrow grass, Arrow grass
38989	[*Triglochin palustre* L.]	

	LAMIACEAE: Mint Family	
DRPA2	*Dracocephalum parviflorum* Nutt.	American dragonhead
32490	[*Dracocephalum parviflorum* Nutt.]	
MEAR4	*Mentha arvensis* L.	Wild mint, Field mint
32265	[*Mentha arvensis* L.]	
SCBR3	*Scutellaria brittonii* Porter	Britton's skullcap
505096	[*Scutellaria brittonii* Porter]	
SCGA	*Scutellaria galericulata* L.	Marsh skullcap
32798	[*Scutellaria galericulata* L. var. *epilobiifolia* (Hamilton) Jordal]	
STPA	*Stachys palustris* L.	Marsh hedge nettle
32344	[*Stachys palustris* L.]	
STPIP5	*Stachys pilosa* Nutt.	Hedge nettle
521942	[*Stachys palustris* L. ssp. *pilosa* (Nutt.) Epling]	

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	LEMNACEAE: Duckweed Family	
LEMI3 42590	*Lemna minor* L. [*Lemna minor* L.]	Duckweed

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	LINACEAE: Flax Family	
LILE3 29214	*Linum lewisii* Pursh [*Adenolinum lewisii* (Pursh) Love & Love]	Prairie flax, Wild blue flax
	LOASACEAE: Loasa Family	
MERU 503802	*Mentzelia rusbyi* Wooten [*Nuttallia rusbyi* (Wooten) Rydbg.]	Blazing star
MESP4 503806	*Mentzelia speciosa* Osterhout [*Nuttallia speciosa* (Osterhout) Greene]	Jeweled blazing star
	MALVACEAE: Mallow Family	
SINE3 21891	*Sidalcea neomexicana* Gray [*Sidalcea neomexicana* Gray]	Salt spring checkerbloom, Checker mallow
	MELANTHIACEAE: Death Camas Family	
ZIELE 43158	*Zigadenus elegans* Pursh [*Anticlea elegans* (Pursh) Rydb.]	Death camas
	NYCTAGINACEAE: Four-O'Clock Family	
MILI3 19651	*Mirabilis linearis* (Pursh) Heimerl [*Oxybaphuys linearis* (Pursh) B.L. Rob.]	Narrowleag four-o'clock, Umbrellawort
	ONAGRACEAE: Evening Primrose Family	
CHANA2 510756	*Chamerion angustifolium* (L.) Holub [*Chamerion danielsii* D. Love]	Fireweed
EPBR3 27288	*Epilobium brachycarpum* K. Presl. [*Epilobium brachycarpum* K. Presl.]	Tall annual willow herb
EPCIG 27293	*Epilobium ciliatum* Raf. ssp. *glandulosum* (Lehmann) Hock & Raven [*Epilobium ciliatum* Raf.]	Fringed willow herb
EPSA 27323	*Epilobium saximontanum* Haussknecht [*Epilobium saximontanum* Haussknecht]	Rocky Mountain willow herb
GACO5 27646	*Gaura coccinea* Nutt. *ex* Pursh [Gaura coccinea Nutt. *ex* Pursh]	Scarlet beeblossom, Butterfly plant
OECAM3 565328	*Oenothera caespitosa* Nutt. ssp. *macroglottis* (Rydb.) W.L. Wagner	Tufted evening primrose

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	[*Oenothera caespitosa* Nutt. ssp. *macroglottis* (Rydb.) Wagner]	
OECO2 27387	*Oenothera coronopifolia* T. & G. [*Oenothera coronopifolia* T. & G.]	Crownleaf evening primrose, Cutleaf evening primrose
OEFL 27397	*Oenothera flava* (Nels.) Garrett [*Oenothera flava* (Nels.) Garrett]	Yellow evening primrose
OEVIS 27421	*Oenothera villosa* Thunb. ssp. *strigosa* (Rydb.) Dietrich & Raven [*Oenothera villosa* Thunb.]	Hairy evening primrose

	ORCHIDACEAE: Orchid Family	
CABU 43508	*Calypso bulbosa* (L.) Oakes [*Calypso bulbosa* (L.) Reichenbach]	Fairy slipper
PLST4 43439	*Platanthera stricta* Lindl. [*Limnorchis saccata* (Greene) Love & Simon]	Slender bog orchid

	OROBANCHACEAE: Broom-rape Family	
ORFA 34290	*Orobanche fasciculata* Nutt. [*Orobanche fasiculata* Nutt.]	Clustered broomrape

	OXALIDACEAE: Wood Sorrel Family	
OXST 29095	*Oxalis stricta* L. [*Oxalis dillenii* Jacq.]	Tufted yellow wood sorrel
OXVI 29098	*Oxalis violacea* L. [*Oxalis violacea* L.]	Violet wood sorrel

	PARNASSIACEAE: Grass of Parnassus Family	
PAPAP2 24206	*Parnassia palustris* L. var. *parviflora* (DC.) Boivin [*Parnassia parviflora* DC.]	Grass of Parnassus

	PINACEAE: Pine Family	
PIPU 183307	*Picea pungens* Engel. [*Picea pungens* Engel.]	Blue spruce, Colorado blue Spruce
PIAR 183313	*Pinus aristata* Engel. [*Pinus aristata* Engel.]	Bristlecone pine
PICO 183327	*Pinus contorta* Doug. var. *latifolia* (Engel.) Critchfield [*Pinus contorta* Doug. var. *latifolia* (Engel.) Critchfield]	Lodgepole pine
PIED 183336	*Pinus edulis* Engel. [*Pinus edulis* Engel.]	Two-needle pinyon pine
PIFL2 183343	*Pinus flexilis* James [*Pinus flexilis* James]	Limber pine

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PIPOS 183365	*Pinus ponderosa* Doug. *ex* P.&C. Laws. var. *scopulorum* (S. Wats.) W.A. Weber [*Pinus ponderosa* Doug. *ex* P.&C. Laws. var. *scopulorum* (S. Wats.) W.A. Weber]	Ponderosa pine
PSME 183424	*Pseudostuga menziesii* (Mirbel) Franco [*Pseudostuga menziesii* (Mirbel) Franco]	Douglas-fir

	PLANTAGINACEAE: Plantain Family	
PLER 504434	*Plantago eriopoda* Torr. [*Plantago eriopoda* Torr.]	Redwool plantain
PLLA 32874	*Plantago lanceolata* L. [*Plantago lanceolata* L.]	Narrowleaf plantain, English plantain
PLMA2 32887	*Plantago major* L. [*Plantago major* L.]	Common plantain

	POACEAE: Grass Family	
ACRO7 507956	*Achnatherum robustum* (Vasey) Barkworth [*Stipa robusta* (Vasey) Scribn.]	Sleepygrass
AGCR 40371	*Agropyron cristatum* L. [*Agropyron cristatum* (L.) Gertner ssp. *cristatum*]	Crested wheatgrass
AGGI2 40414	*Agrostis gigantea* Roth. [*Agrostis gigantea* Roth.]	Redtop
AGSC5 40424	*Agrostis scabra* Willd. [*Agrostis scabra* Willd.]	Rough bentgrass, Ticklegrass
ALAE 40436	*Alopecurus aequalis* Sobol. [*Alopecurus aequalis* Sobol.]	Shortawn foxtail, Meadow foxtail
ANTE6 508871	*Anisantha tectorum* (L.) Nevski [*Anisantha tectorum* (L.) Nevski]	Cheatgrass
AVFA 41458	*Avena fatua* L. [*Avena fatua* L. var. *sativa* (L.) Hauss.]	Oats
AVSA 41459	*Avena sativa* L. [*Avena fatua* L. var *sativa* (L.) Hauss.]	Oats
BESY 41325	*Beckmannia syzigachne* Steudel [*Beckmannia syzigachne* (Steudel) Fernald ssp. *baicalensis* (Kuznetzow) Koyama & Kuwano]	American sloughgrass
BLTR 41475	*Blepharoneuron tricholepis* (Torr.) Nash [*Blepharoneuron tricholepis* (Torr.) Nash]	Pine dropseed
BOGR2 41493	*Bouteloua gracilis* (Willd. *ex* Kunth) Lag. *ex* Griffiths [*Chondrosum gracile* HBK]	Blue grama
BOHI2 41502	*Bouteloua hirsuta* Lagasca [*Chondrosum hirsutum* (Lagasca) Sweet]	Hairy grama
BOSI2 41507	*Bouteloua simplex* Lagasca [*Chondrosum prostratum* (Lagasca) Sweet]	Matted grama, Annual grama
BRCA5 40481	*Bromus carinatus* Hook. & Arn. [*Ceratochloa carinata* (Hook. & Arn.) Tutin]	California brome, Mountain brome
BRIN2 40502	*Bromus inermis* Leyss. [*Bromopsis inermis* (Leyss.) Holub]	Smooth brome

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BRINP5 40480	*Bromus inermis Leyss.* ssp. *pumpellianus* (Scribner) Wagnon [*Bromopsis pumpelliana* (Scribner) Holub]	Smooth brome
BRPO2 40486	*Bromus porteri* Coulter [*Bromopsis porteri* (Coulter) Nash]	Porter brome, Nodding brome
BRTE 40524	*Bromus tectorum* L. [*Anisantha tectorum* (L.) Nevski]	Cheatgrass
CACA4 40544	*Calamagrostis canadensis* (Michaux.) P. Beauvois [*Calamagrostis canadensis* (Michaux) P. Beauvois]	Bluejoint reedgrass
CAPU 40563	*Calamagrostis purpurascens* R. Brown in Richardson [*Calamagrostis purpurascens* R. Brown]	Purple reedgrass
CAST36 501106	*Calamagrostis stricta* (Timm) Koeler [*Calamagrostis stricta* (Timm) Koeler]	Slimstem reedgrass
CAAQ3 41541	*Catabrosa aquatica* (L.) P. Beauvois [*Catabrosa aquatica* (L.) P. Beauvois]	Water whorlgrass, Brookgrass
DAPA2 41633	*Danthonia parryi* Scribner [*Danthonia parryi* Scribner]	Parry oatgrass
DECA18 40586	*Deschampsia caespitosa* (L.) P. Beauvois [*Deschampsia cespitosa* (L.) P. Beauvois]	Tufted hairgrass
ELMA 502250	*xElyhordeum macounii* (Vasey) Barkworth & D.R. Dewey [*Agrohordeum macounii* (Vasey) Lepage]	*Elymus trachycaulus x Hordeum jubatum*
ELEL5 502264	*Elymus elymoides* (Raf.) Swezey [*Elymus elymoides* (Raf.) Swezey]	Squirreltail
ELELB2 525111	*Elymus elymoides* (Raf.) Swezey ssp. *brevifolius* (J.G. Smith) Barkworth comb. nov. [*Elymus longifolius* (J.G. Smith) Gould]	Ryegrass
ELRE4 512839	*Elymus repens* L. [*Elytrigia repens* (L.) Nevski]	Quackgrass
ELTR7 502282	*Elymus trachycaulus* (Link) Gould *ex* Shinners [*Elymus trachycaulus* (Link) Gould]	Slender wheatgrass
FEAR2 40809	*Festuca arizonica* Vasey [*Festuca arizonica* Vasey]	Arizona fescue
GLGR 502812	*Glyceria grandis* S. Wats. in Gray [*Glyceria grandis* S. Wats. in Gray]	American mannagrass
GLST 40833	*Glyceria striata* Lamarck [*Glyceria striata* (Lamarck) Hitchcock]	Mannagrass
HECO26 507974	*Hesperostipa comata* (Trin. & Rupr.) Barkw. [*Stipa comata* Trin. & Rupr.]	Needle-and-thread
HIHIA 40861	hierochloe hirta (Schrank) Borbas ssp. *arctica* (J. Presl in K. Presl) Weim. [*Hierochloe hirta* (Schrank) Borbas ssp. *arctica* (Presl) Weim.]	Northern sweetgrass
HOBRB2 40875	*Hordeum brachyantherum* Nevski [*Critesion brachyantherum* L.]	Meadow barley
HOJU 40871	*Hordeum jubatum* L. [*Critesion jubatum* (L.) Nevski]	Foxtail barley
KOMA 503284	*Koeleria macrantha* (Ledeb.) Schultes [*Koeleria macrantha* (Ledeb.) Schultes]	Prairie Junegrass
LOPE 40893	*Lolium perenne* L. [*Lolium perenne* L.]	Ryegrass

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MUAN 41884	*Muhlenbergia andina* (Nutt.) Hitchcock [*Muhlenbergia andina* (Nutt.) A.S. Hitchcock]	Foxtail muhly
MUFI 41911	*Muhlenbergia filiculmis* Vasey [*Muhlenbergia filiculmis* Vasey]	Slimstem muhly
MUMO 41927	*Muhlenbergia montana* (Nutt.) Hitchcock [*Muhlenbergia montana* (Nutt.) Hitchcock]	Mountain muhly
MURI 41938	*Muhlenbergia richardsonis* (Trin.) Rydbg. [*Muhlenbergia richardsonis* (Trin.) Rydbg.]	Mat muhly, Scratchgrass
NAVI4 507086	*Nassella viridula* (Trin.) Barkworth [*Stipa viridula* Trin.]	Green needlegrass
PASM 504124	*Pascopyrum smithii* (Rydbg.) Love [*Pascopyrum smithii* (Rydbg.) Love]	Western wheatgrass
PHAR3 41335	*Phalaris arundinacea* L. [*Phalaroides arundinacea* (L.) Rauschert]	Reed canarygrass
PHPR3 41062	*Phleum pratense* L. [*Phleum pratense* L.]	Timothy
POAR3 41109	*Poa arida* Vasey [*Poa arida* Vasey]	Plains bluegrass
POCO 41082	*Poa compressa* L. [*Poa compressa* L.]	Canada bluegrass
POFE 504467	*Poa fendleriana* (Steud.) Vasey [*Poa fendleriana* (Steud.) Vasey]	Mutton bluegrass
POGLR2 524544	*Poa glauca* M. Vahl ssp. *rupicola* (Nash) W.A. Weber [*Poa glauca* Vahl.]	Timberline bluegrass
PONE2 41097	*Poa nervosa* (Hook.) Vasey [*Poa nervosa* (Hook.) Vasey]	Wheeler bluegrass
POPA2 41151	*Poa palustris* L. [*Poa palustris* L.]	Fowl bluegrass, Swamp bluegrass
POPR 41088	*Poa pratensis* L. [*Poa pratensis* L.]	Kentucky bluegrass
PSJU3 504629	*Psathyrostachys juncea* (Fischer) Nevski [*Psathyrostachys juncea* (Fischer) Nevski]	Russian wildrye
PUNU2 41200	*Puccinellia nuttalliana* (J.A. Schultes) A.S. Hitchcock [*Puccinellia airoides* (Nutt.) Wats. & Coult.]	Nuttall's alkaligrass
SCPA 42063	*Schedonnardus paniculatus* (Nutt.) Trelease [*Schedonnardus paniculatus* (Nutt.) Trelease]	Tumblegrass
SCSC 42076	*Schizachyrium scoparium* (Michx.) Nash [*Schizachyrium scoparium* (Michx) Nash]	Little bluestem
SPCR 42132	*Sporobolus cryptandrus* (Torr.) Gray [*Sporobolus cryptandrus* (Torr.) Gray]	Sand dropseed
THIN6 522540	*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey [*Elytrigia intermedia* (Host) Nevski]	Intermediate wheatgrass
TRAE 42237	*Triticum aestivum* L. [*Triticum aestivum* L.]	Wheat

	POLEMONIACEAE: Phlox Family	
COLI2 31041	*Collomia linearis* Nutt. [*Collomia linearis* Nutt.]	Tiny trumpet
GIPI	*Gilia pinnatifida* Nutt. *ex* Gray	Sticky gilia

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31168	[*Gilia pinnatifida* Nutt. *ex* Gray]	
IPAGC 31192	*Ipomopsis aggregata* (Pursh) V. Grant ssp. *candida* (Rydb.) V. & A. Grant [*Ipomopsis aggregata* (Pursh) V. Grant ssp. *candida* (Rydb.) V. & A.Grant]	White gilia
IPAGC2 31192	*Ipomopsis aggregata* (Pursh) V. Grant ssp. *collina* (Greene) Wilken & Allred [*Ipomopsis aggregata* (Pursh) V. Grant ssp. *collina* (Greene) Wilken & Allred]	Scarlet gilia
POFO 31012	*Polemonium foliosissimum* (Gray) Gray [*Polemonium foliosissimum* (Gray) Gray]	Towering Jacob's ladder, Jacob's ladder

	POLYGONACEAE: Buckwheat Family	
ERAC4 21057	*Eriogonum alatum* Torr. [*Pterogonum alatum* (Torr.) Gross]	Winged buckwheat
ERCE2 21090	*Eriogonum cernuum* Nutt. [*Eriogonum cernuum* Nutt.]	Nodding wild buckwheat
POAR11 20872	*Polygonum arenastrum* Jord. Ex Boreau [*Polygonum arenastrum* Jord. Ex Boreau]	Ovalleaf kotweed
POBI6 20879	*Polygonum bistortoides* Pursh [*Bistorta bistortoides* (Pursh) Small]	American bistort, Western bistort
POCO10 20853	*Polygonum convolvulus* L. [*Fallopia convolvulus* (L.) Love]	Black bindweed
POLA4 20860	*Polygonum lapathifolium* L. [*Persicaria lapathifolia* (L.) S. Gray]	Curlytop knotweed
POVI3 20864	*Polygonum viviparum* L. [*Bistorta vivipara* (L.) S. Gray]	Alpine bistort
RHOF 21318	*Rheum officinale* Baillon []	Rhubarb
RUAC3 20934	*Rumex acetosella* L. [*Acetosella vulgaris* (K. Koch) Fourreau]	Common sheep sorrel
RUAQF 504904	*Rumex aquaticus* L. var. *fenestratus* (Greene) Dorn [*Rumex aquaticus* L. ssp. *occidentalis* (S. Wats.) Hulten]	Dock
RUDE2 20953	*Rumex densiflorus* Osterhout [*Rumex densiflorus* Osterhout]	Dense flowered dock
RUSAM 20974	*Rumex salicifolius* Weinm. var. *mexicanus* (Meisn.) C.L. Hitchcock [*Rumex triangulivalvis* (Danser) Rech.]	Willow-leaved dock

	PORTULACACEAE: Purslane Family	
MOCH 20406	*Montia chamissoi* Ledeb. [*Crunocallis chamissoi* (Ledeb. *ex* Sprengl.) Greene]	Western miner's lettuce, Water spring beauty
TAPA3 20453	*Talinum parviflorum* Nutt. *ex* T. & G. [*Talinum parviflorum* Nutt. *ex* T. & G.]	Sunbright, Fameflower

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	POTAMOGETONACEAE: Pondweed Family	
POPUT3 39017	*Potamogeton pusillus* L. ssp. *tenaissimus* (Mert. & Koch) Haynes & C.B. Hellquist [*Potamogeton berchtoldii* Fieber <u>in</u> Berchtold & Fieber]	Small pondweed

	PRIMULACEAE: Primrose Family	
ANSE4 23935	*Androsace septentrionalis* L. [*Androsace septentrionalis* L.]	Rock primrose
DOPU 23945	*Dodecatheon pulchellum* (Raf.) Merrill [*Dodecatheon pulchellum* (Raf.) Merrill]	Darkthroat shooting star
GLMA 23982	*Glanux maritima* L. [*Glaux maritima* L. var. *angustifolia* Boivin]	Sea milkwort

	PYROLACEAE: Wintergreen Family	
ORSE 504066	*Orthilia secunda* (L.) House [*Orthilia secunda* (L.) House]	One-sided wintergreen
PYASA 23753	*Pyrola asarifolia* Michx. [*Pyrola rotundifolia* L. ssp. *asarifolia* (Michx.) Love]	Liverleaf wintergreen

	RANUNCULACEAE: Buttercup Family	
ANMUH2 184123	*Anemone multifida* Poiret var. *hudsoniana* DC. [*Anemone multifida Poiret* var. *globosa* (Nutt.) T.&G.]	Hudson’s anemone, Windflower
CLHI 18699	*Clematis hirsutissima* Pursh [*Coriflora hirsutissima* (Pursh) W.A. Weber]	Hairy clematis, Sugarbowls
CLHIS 527423	*Clematis hirsutissima* Pursh var. *scottii* (Porter & Coulter) Weber [*Coriflora scottii* (Porter & Coulter) Weber]	Scott’s clematis, Sugarbowls
CLLI2 18702	*Clematis ligusticifolia* Nutt. [*Clematis ligusticifolia* Nutt.]	Western white clematis, Virgin’s bower
PUPAM 18801	*Pulsatilla patens* (L.) Miller ssp. *multifida* (Pritzel) Zamels [*Pulsatilla patens* (L.) Miller ssp. *multifida* (Pritzel) Zamels]	Pasque flower
RAAB 18559	*Ranunculus abortivus* L. [*Ranunculus abortivus* L. ssp. *acrolasius* (Fernald) Kapoor & Love]	Small-flowered crowfoot
RACA4 18597	*Ranunculus cardiophyllus* Hooker [*Ranunculus cardiophyllus* Hooker]	Heartleaf buttercup
RACY 18600	*Ranunculus cymbalaria* Pursh [*Halerpestes cymbalaria* (Pursh) Greene ssp. *saximontana* (Fernald) Moldenke]	Shore buttercup
RAHY2 18571	*Ranunculus hyperboreus* Rottboel [*Ranunculus hyperboreus* Rottboel ssp. *intertextus* (Greene) Kapoor & Love]	Floating buttercup
RAIN 18616	*Ranunculus inamoenus* Greene [*Ranunculus inamoenus* Greene]	Graceful buttercup
RAMA2	*Ranunculus macounii* Britton	Macoun buttercup

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18625	[*Ranunculus macounii* Britton]	
RASCS	*Ranunculus sceleratus* L.	Cursed buttercup, Blister buttercup
18576	[*Hecatonia scelerata* (L.) Fourreau]	
RATRT	*Ranunculus trichophyllus* Chaix.	Threadleaf crowfoot, Water crowfoot
18578	[*Batrachium trichophyllum* (Chaix.) v.d. Bosch]	

	ROSACEAE: Rose Family	
ARAN7	*Argentina anserina* (L.) Rydbg.	Silverweed
184598	[*Argentina anserina* (L.) Rydb.]	
CEMO2	*Cercocarpus montanus* Raf.	Alderleaf mountain mahogany, Mountain mahogany
25136	[*Cercocarpus montanus* Raf.]	
CHERN	*Chamaerhodos erecta* (L.) Bunge ssp. *nuttallii* (Pickering *ex* Rydbg.) Hulten	Nuttall's little rose
25144	[*Chamaerhodos erecta* (L.) Bunge ssp. *nuttallii* (Pickering *ex* Rydb.) Hulten]	
DAFL3	*Dasiphora floribunda* (Pursh) Kartesz comb.nov.	Shrubby cinquefoil
565123	[*Pentaphylloides floribunda* (Pursh) Love]	
FRVEB2	*Fragaria vesca* L. ssp. *bracteata* (Heller) Staudt.	Woodland strawberry
24634	[*Fragaria vesca* L. ssp. *bracteata* (Heller) Staudt.]	
FRVIG2	*Fragaria virginiana* P. Miller ssp. *glauca* (S. Wats.) Staudt	Virginia strawberry
24639	[*Fragaria virginiana* P. Miller ssp. *glauca* (S. Wats.) Staudt]	
GEMAP	*Geum macrophyllum* Willd. var. *perincisum* Raup.	Largeleaf avens
24654	[*Geum macrophyllum* Willd. var. *perincisum* Raup.]	
GETR	*Geum triflorum* Pursh	Old man's whiskers, Prairie smoke
24662	[*Erythrocoma triflora* (Pursh) Greene]	
PHMO4	*Physocarpus monogynus* (Torr.) Coulter	Ninebark
25281	[*Physocarpus monogynus* (Torr.) Coulter]	
POCO13	*Potentilla concinna* Richardson	Elegant cinquefoil
24700	[*Potentilla concinna* Richardson]	
POEF	*Potentilla effusa* Dougl. *ex* Lehmann	Branched cinquefoil
24706	[*Potentilla effusa* Dougl. *ex* Lehmann]	
POFI3	*Potentilla fissa* Nutt.	Bigflower cinquefoil
24708	[*Drymocallis fissa* (Nutt.) Rydbg.]	
POHI6	*Potentilla hippiana* Lehmann	Woolly cinquefoil
24718	[*Potentilla hippiana* Lehmann]	
POPE8	*Potentilla pensylvanica* L.	Pennsylvania cinquefoil
24736	[*Potentilla pensylvanica* L.]	
POPL	*Potentilla plattensis* Nutt. *ex* T. & G.	Platte River cinquefoil
24738	[*Potentilla plattensis* Nutt. *ex* T. & G.]	
POPU9	*Potentilla pulcherrima* Lehmann	Beautiful cinquefoil
504586	[*Potentilla pulcherrima* Lehmann]	
POSU5	*Potentilla subjuga* Rydbg.	Colorado cinquefoil
504590	[*Potentilla subjuga* Rydbg.]	
PRVIM	*Prunus virginiana* (L.) P. Miller ssp. *melanocarpa* (Nels.) Sarg.	Chokecherry
24806	[*Padus virginiana* (L.) P. Miller ssp. *melanocarpa* (Nels.) W.A. Weber]	
ROAR3	*Rosa arkansana* Porter	Prairie rose, Arkansas rose
24815	[*Rosa arkansana* Porter]	

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ROWO 24847	*Rosa woodsii* Lindley [*Rosa woodsii* Lindley]	Woods' rose
RUDE 24910	*Rubus deliciosus* Torr. [*Oreobatus deliciosus* (James *ex* Torr.]	Delicious raspberry
RUIDS2 24947	*Rubus idaeus* L. ssp. *strigosus* (Michx.) Focke [*Rubus idaeus* L. ssp. *melanolasius* (Dieck) Focke]	Grayleaf red raspberry, Wild raspberry
	RUBIACEAE: Madder Family	
GABOS 565204	*Galium boreale* L. ssp. *septentrionale* R. & S. [*Galium septentrionale* R. & S.]	Northern bedstraw
GATRS2 34806	*Galium trifidum* L. ssp. *subbiflorum* (Wiegand) Piper [*Galium trifidum* L. spp. *brevipes* (Fern. & Wiegand) Love & Love]	Threepetal bedstraw
GATR3 34933	*Galium triflorum* Michx. [*Galium triflorum* Michx.]	Fragrant bedstraw
	SALICACEAE: Willow Family	
POBA2 22453	*Populus balsamifera* L. [*Populus balsamifera* L.]	Balsam poplar
POTR5 195773	*Populus tremuloides* Michx. [*Populus tremuloides* Michx.]	Quaking aspen
SABR 22510	*Salix brachycarpa* Nutt. [*Salix brachycarpa* Nutt.]	Shortfruit willow
SAEX 22529	*Salix exigua* Nutt. [*Salix exigua* Nutt.]	Coyote willow, Sandbar willow
SALU2 22555	*Salix lutea* Nutt. [*Salix lutea* Nutt.]	Yellow willow, Shining willow
SAMO2 22558	*Salix monticola* Bebb in Coulter [*Salix monticola* Bebb in Coulter]	Park willow, Mountain willow
	SAXIFRAGACEAE: Saxifrage Family	
HEPA11 24366	*Heuchera parvifolia* Nutt. *ex* T. & G. [*Heuchera parvifolia* Nutt. *ex* T. & G.]	Littleleaf alum root
SABRA2 524663	*Saxifraga bronchialis* L. ssp. *austromontana* (Wieg.) Piper [*Ciliaria austromontana* (Wieg.) A. Weber]	Piper matted saxigrage, Spotted saxifrage
SARH2 24294	*Saxifraga rhomboidea* Greene [*Micranthes rhomboidea* (Greene) Small]	Diamondleaf saxifrage, Snowball saxifrage
	SCROPHULARIACEAE: Figwort Family	
BEPL 33498	*Besseya plantaginea* (James) Rydbg. [*Besseya plantaginea* (Benth.) Rydbg.]	White River coraldrops, Kittentails
CAIN14 33131	*Castilleja integra* Gray in Torr. [*Castilleja integra* Gray in Torr.]	Wholeleaf Indian paintbrush, Orange paintbrush
CAMI12 33069	*Castilleja miniata* Dougl. *ex* Hook. [*Castilleja miniata* Dougl. *ex* Hook.]	Giant red Indian paintbrush, Scarlet paintbrush

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LIAQ 33207	*Limosella aquatica* L. [*Limosella aquatica* L.]	Water mudwort
LIVU2 33216	*Linaria vulgaris* P. Miller [*Linaria vulgaris* P. Miller]	Butter and eggs
ORLU2 33437	*Orthocarpus luteus* Nutt. [*Orthocarpus luteus* Nutt.]	Yellow owl's clover
PECAF 524408	*Pedicularis canadensis* L. ssp. *fluviatilis* (Heller) W.A. Weber [*Pedicularis canadensis* L. ssp. *fluviatilis* (Heller) W.A. Weber]	Canada lousewort
PECR 33372	*Pedicularis crenulata* Benth. [*Pedicularis crenulata* Benth.]	Meadow lousewort
PEPR7 504166	*Pedicularis procera* Gray [*Pedicularis procera* Gray]	Giant lousewort, Tall lousewort
PEBAT 33827	*Penstemon barbatus* Torr. ssp. *torreyi* (Benth.) Keck [*Penstemon barbatus* Torr. ssp. *torreyi* (Benth.) Keck]	Torrey's penstemon, Scarlet penstemon
PECR5 33857	*Penstemon crandallii* Nels. [*Penstemon crandallii* Nels.]	Crandall's beard-tongue
PEGL3 33697	*Penstemon glaber* Pursh [*Penstemon glaber* Pursh]	Sawsepal penstemon
PESE11 33991	*Penstemon secundiflorus* Benth. [*Penstemon secundiflorus* Benth.]	Sidebells penstemon
PEUN 34011	*Penstemon unilateralis* Rydb. [*Penstemon virgatus* Gray ssp. *asa-grayi* Crosswhite]	Upright blue beard-tongue
RHMI 504749	*Rhinanthus minor* L. [*Rhinanthus minor* L.]	Little yellow rattle, Yellow rattle
SCLA 34036	*Scrophularia lanceolata* Pursh [*Scrophularia lanceolata* Pursh]	Lanceleaf figwort
VEAM2 33399	*Veronica americana* Schweinitz *ex* Benth. [*Veronica americana* Schweinitz *ex* Benth.]	American speedwell
VEAN2 565594	*Veronica anagallis-aquatica* L. [*Veronica catenata* Pennell]	Speedwell
VEPEX2 524797	*Veronica peregrina* L. ssp. *xalapensis* (Kunth) Pennell [*Veronica peregrina* L. ssp. *xalapensis* (HBK) Pennell]	Purslane speedwell

	SELAGINELLACEAE: Little Clubmoss Family	
SEDE2 17076	*Selaginella densa* Rydb. [*Selaginella densa* Rydb.]	Lesser spikemoss, Little clubmoss
SEUN 17097	*Selaginella underwoodii* Hieronymous [*Selaginella underwoodii* Hieronymous]	Underwood's spikemoss

	SINOPTERIDACEAE: Lip Fern Family	
ARFE5 500965	*Argyrochosma fendleri* (Kuntze) Windham [*Cheilanthes cancellata* Mickel]	Fendler's false cloak fern, Zigzag cloak fern
CHFE2 17442	*Cheilanthes fendleri* Hooker [*Cheilanthes fendleri* Hooker]	Fendler lip fern

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	SOLANACEAE: Potato Family	
SOTR 30461	*Solanum triflorum* Nutt. [*Solanum triflorum* Nutt.]	Cutleaf nightshade

	TYPHACEAE: Cattail Family	
TYLA 42326	*Typha latifolia* L. [*Typha latifolia* L.]	Broadleaf cattail

	URTICACEAE: Nettle Family	
PAPE5 19169	*Parieteria pensylvanica* Muhl. *ex* Willd. [*Parieteria pensylvanica* Muhl. *ex* Willd.]	Pennsylvania pellitory
URDIG 19152	*Urtica dioica* L. ssp. *gracilis* (Ait) Seland [*Urtica gracilis* Ait.]	California nettle, Stinging nettle

	UVULARIACEAE: Bellwort Family	
STAMC 43044	*Streptopus amplexifolius* (L.) DC. var. *chalazatus* Fassett [*Streptopus fassetii* Love & Love]	Tubercle twisted stalk

	VALERIANACEAE: Valerian Family	
VACA3 35351	*Valeriana capitata* Pallas *ex* Link [*Valeriana capitata* Pallas *ex* Link ssp. *acutiloba* (Rydb.) F.G. Meyer]	Tobacco root, Capitate valerian
VAED 35359	*Valeriana edulis* Nutt. *ex* T. & G. [*Valeriana edulis* Nutt. *ex* T. & G.]	Tobacco root, Valerian

	VIOLACEAE: Violet Family	
VIBI2 22048	*Viola biflora* L. [*Viola biflora* L.]	Arctic yellow violet, Twin-flower violet
VIEPR 505711	*Viola epipsila* Ledeb. ssp. *repens* Becker [*Viola epipsiloides* Love & Love]	Dwarf marsh violet, Swamp violet

	VISCACEAE: Mistletoe Family	
ARAM 27887	*Arceuthobium americanum* Nutt. *ex* Engelm. [*Arceuthobium americana* Nutt.]	American dwarf mistletoe, Lodgepole dwarf mistletoe
ARVA 27899	*Arceuthobium vaginatum* Willd. [*Arceuthobium vaginatum* (Willd.) K. Presl. ssp. *cryptopodum* (Engelm.) Hawksworth & Wiens]	Pineland dwarf mistletoe, Ponderosa pine dwarf mistletoe

Acronym **PLANTS** **ITIS-TSN**	**Scientific Name/Authority – PLANTS 2001 and ITIS 2002** **[Weber, 1990 Nomenclature]**	**PLANTS 2001 and ITIS 2002**
	WOODSIACEAE: Woodsia Family	
WOME 17743	*Woodsia mexicana* Fee [*Woodsia mexicana* Fee]	Cliff fern, Woodsia
WOOR 17745	*Woodsia oregana* D.C. Eaton [*Woodsia oregana* D.C. Eaton]	Oregon cliff fern. Woods fern

AMPHIBIANS AND REPTILES KNOWN TO OCCUR WITHIN FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

AMPHIBIANS:	
Tiger salamander	*Ambystoma tigrinum*
Western Chorus frog	*Pseudacris triseriata*
Northern leopard frog	*Rana pipiens*
REPTILES:	
Bullsnake (Gopher snake)	*Pituophis catenifer*
Garter snake	*Thamnophis radix*

MAMMALS KNOWN TO OCCUR WITHIN FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

RODENTIA:	
Least chipmunk	*Tamias minimus*
Richardson's ground squirrel	*Spermophilus richardsonii*
Golden-mantled ground squirrel	*Spermophilus variegatus*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
Abert's squirrel	*Sciurus aberti*
Red squirrel	*Sciurus sp.*
Gunnison's prairie dog	*Cynomys gunnisonii*
Deer mouse	*Peromyscus maniculatus*
Northern pocket gopher	*Thymomys talpoides*
Bushy-tailed woodrat	*Neotoma cinerea*
Montane vole	*Microtus pennsylvanicus*
Common porcupine	*Erithizon dorsatum*
American beaver	*Castor canadensis*
Common muskrat	*Ondatra zibethicus*
LAGOMORPHA:	
Nuttall's cottontail	*Silvilagus nuttallii*
White-tailed jackrabbit	*Lepus townsendii*
Snowshoe hare	*Lepus americanus*
CHIROPTERA:	
Little brown myotis	*Myotis* sp.
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
CARNIVORA:	
American badger	*Taxidea taxus*
Long-tailed weasel	*Mustela frenata*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Mountain lion	*Felis concolor*
Bobcat	*Lynx rufus*
Black bear	*Ursus americanus*
ARTIODACTYLA:	
Elk	*Cerus elaphus*
Mule deer	*Odocoileus hemionus*
Pronghorn antelope	*Antilocapra americana*

SOURCE:: KORER 1997

Birds known to occur within Florissant Fossil Beds National Monument

ARDEIDAE: Herons	
Great blue heron	*Ardea herodias*
ANATIDAE: Geese and Ducks	
Canada goose	*Branta canadensis*
Green-winged teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Blue-winged teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Gadwall	*Anas strepera*
American wigeon	*Anas americana*
Bufflehead	*Bucephala albeola*
Common merganser	*Mergus merganser*
CATHARTIDAE: Vultures	
Turkey vulture	*Cathartes aura*
ACCIPITRIDAE: Eagles and Hawks	
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperi*
Swainson's hawk	*Buteo swainsoni*
Red-tailed hawk	*Buteo jamaicensis*
Ferruginous hawk	*Buteo regalis*
Rough-legged hawk	*Buteo lagopus*
Bald eagle	*Haliaeetus leucocephalus*
Golden eagle	*Aquila chrysaetos*
FALCONIDAE: Falcons	
American kestrel	*Falco sparverius*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
PHASIANIDAE: Grouse and Quail	
Wild turkey	*Meleagris gallopavo*
CHARADRIIDAE: Plovers	
Killdeer	*Charadrius vociferous*
SCOLOPACIDAE: Sandpipers	
Spotted sandpiper	*Actitis macularia*
Common snipe	*Gallinago gallinago*
LARIDAE: Gulls	
Ring-billed gull	
California gull	*Larus californicus*

COLUMBIDAE: Pigeons and Doves	
Mourning dove	*Zenaida macroura*
STRIGIDAE: Owls	
Great-horned owl	*Bubo virginianus*
CAPRIMULGIDAE: Goatsuckers	
Common nighthawk	*Chordeiles minor*
TROCHILIDAE: Hummingbirds	
Broad-tailed hummingbird	*Selasphorus platycerus*
Rufous hummingbird	
ALCEDINIDAE: Kingfishers	
Belted kingfisher	*Ceryle alcyon*
PICIDAE: Woodpeckers	
Williamson's sapsucker	*Sphyrapicus thyroideus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Oicoides villosus*
Northern flicker	*Colaptes auratus*
TYRANNIDAE: Flycatchers	
Olive-sided flycatcher	*Contopus cooperi*
Least flycatcher	*Empidonax minimus*
Hammond's flycatcher	*Empidonax hammondii*
Cordilleran flycatcher	*Empidonax occidentalis*
Western wood peewee	*Contopus sordidulus*
Say's phoebe	*Sayornis saya*
Western kingbird	*Tyrannus verticalis*
HIRUNDINIDAE: Swallows	
Violet-green swallow	*Tachycineta thalassina*
Cliff swallow	*Petrochelidon pyrrhonota*
Barn swallow	*Hirundo rustca*
CORVIDAE: Jays, Crows, Magpies	
Gray jay	*Perisoreus canadensis*
Steller's jay	*Cyanocitta stellari*
Blue jay	*Cyanocitta cristata*
Clark's nutcracker	*Nucifraga columbiana*
Black-billed magpie	*Pica pica*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
PARIDAE: Chickadees	
Mountain chickadee	*Poecile gambeli*

SITTIDAE: Nuthatches Red-breasted nuthatch White-breasted nuthatch Pygmy nuthatch	 *Sitta canadensis* *Sitta carolinensis* *Sitta pygmaea*
CERTHIIDAE: Creepers Brown creeper	 *Certhia americana*
TROGLODYTIDAE: Wrens Rock wren Bewick's wren House wren	 *Salpinctes obsoletus* *Thryomanes bewickii* *Troglodytes aedon*
SYLVIIDAE: Kinglets Ruby-crowned kinglet	 *Regulus calendula*
MUSCICAPIDAE: Thrushes Western bluebird Mountain bluebird Townsend's Solitaire Veery Swainson's thrush Hermit thrush American robin	 *Sialia mexicana* *Sialia currucoides* *Myadestes townsendii* *Catharus fuscescens* *Catharus ustulatus* *Catharus guttatus* *Turdus migratorius*
MIMIDAE: Mockingbirds Northern mockingbird	 *Mimus polyglottos*
LANIIDAE: Shrikes Loggerhead shrike Northern shrike	 *Lanius ludovicianus* *Lanius excubitor*
STURNIDAE: Starlings European starling	 *Sturnus vulgaris*
ALAUDIDAE: Larks Horned lark	 *Eremophila alpestris*
VIREONIDAE: Vireos Solitary vireo Warbling vireo	 *Vireo gilvus*
PARULIDAE: Warblers Yellow warbler Yellow-rumped warbler Wilson's warbler	 *Dendroica petechia* *Dendroica coronata* *Wilsonia pusilla*

THRAUPIDAE: Tanagers	
Western tanager	*Piranga ludoviciana*
FRINGILLIDAE: Towhees, Sparrows	
Green-tailed towhee	*Pipilo chlorurus*
Rufous-sided towhee	
Canyon towhee	*Pipilo fuscus*
American tree sparrow	
Chipping sparrow	*Spizella passerina*
Brewer's sparrow	*Spizella breweri*
Vesper sparrow	*Pooecetes gramineus*
Lark sparrow	*Chondestes grammacus*
Savannah sparrow	*Passerculus sandwichensis*
Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospiza lincolnii*
White-crowned sparrow	*Zonotricia leucophrys*
Dark-eyed junco	*Junco hyemalis*
ICTERIDAE: Blackbirds, Orioles	
Red-winged blackbird	*Agelaius phoeniceus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Brewer's blackbird	*Euphagus cyanocephalus*
Common grackle	*Quiscalus quiscula*
Brown-headed cowbird	*Molothrus ater*
Northern oriole	
FRINGILLIDAE: Finches, Grosbeaks	
Pine siskin	*Carduelis pinus*
American goldfinch	*Carduelis tristis*
Red crossbill	*Loxia curvirostra*
Common redpoll	
Rosy finch	
Cassin's finch	*Carpodacus cassinii*
Evening grosbeak	*Coccothraustes vespertinus*

SOURCE: MUTH AND WEBER N.D.

APPENDIX C

FIELD FORMS FOR PLOTS, OBSERVATION POINTS AND ACCURACY ASSESSMENT

NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM
IDENTIFIERS/LOCATORS

Plot Code. FLFO.________________________________ BPU Code____

Provisional Community Name____

State _CO____ Park Name__FLORISSANT__ Park Site Name____

Quad Name____ Quad Code _______ Quad Code _______ Aerial Photo #_____________________

GPS file name________________ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N
DATUM ________ UTM Zone: 12 Error +/- _______ m 3D Differential? Y / N
Comments/GPS device used:

Survey Date_____________________ Surveyors____

Directions to Plot

Plot Permanent: NO

Plot length(m)______ Azimuth ______ Plot Photos (y/n) __ Roll # __________ Frame # _______

Plot width(m)_____ Diameter if circle_____ Digital camera frame # __________

Photo Comments: Cryptogamic Soils Photos (y/n) __ Roll # __________ Frame # _______

Digital camera frame # __________

Plot representativeness (discuss plot placement and explain non-representativeness)

a. Representativeness of association compared with occurrences outside park (if known):

b. Representativeness of plot in stand:

Elevation: _______________ft / m (circle one) Slope: _____________deg. Aspect: ________________ deg.

Topographic Position (see cheat sheet)

Landform (see cheat sheet)

Surficial Geology (see cheat sheet/map)

ENVIRONMENTAL DESCRIPTION

Cowardin System	Hydrology
____ Upland ____ Palustrine ____ Riverine ____ Lacustrine	Unknown ___ ___Permanently Flooded ___Seasonally Flooded ___Temporarily Flooded ___Semipermanently Flooded ___Saturated ___Intermittently Flooded

Environmental Comments (factors controlling community/plant distribution, seral stage, fire history etc):	Ground Cover: *(please estimate to the nearest percentage. Sum = 100%)* ___ Bare soil ___ Large rocks (>10 cm) ___ Bedrock ___ Lichen ___ Sand (0.1-2 mm) dune /alluvium ___ Wood (>1 cm) ___ Moss ___ Small rocks (0.2-10 cm) ___ Other (describe): ___ Water ___ Litter / duff ___ Cryptogam
Soil Texture (see cheat sheet): ___ sand ___ loamy sand ___ sandy loam ___ loam ___ silt loam ___ silt ___ clay loam ___ silty clay ___ sandy clay ___ clay ___ peat ___ muck	Soil Drainage: ___ Rapidly drained ___ Well drained ___ Moderately well drained ___ Somewhat poorly drained ___ Poorly drained ___ Very poorly drained

	Height Class	Cover Class	Dominant Species (mark Diagnostic species with *)
T1 Emergent	_______	_______	______________________
T2 Canopy	_______	_______	______________________
T3 Sub-canopy	_______	_______	______________________
S1 Tall shrub	_______	_______	______________________
S2 Short Shrub	_______	_______	______________________
S3 Dwarf-shrub	_______	_______	______________________
Ht Herbaceous	_______	_______	______________________
H1 Graminoids	_______	_______	______________________
H2 Forbs	_______	_______	______________________
H3 Ferns	_______	_______	______________________
H4 Tree seedlings	_______	_______	______________________
N Non-vascular	_______	_______	______________________
V Vine/liana	_______	_______	______________________
E Epiphyte	_______	_______	______________________

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Height Scale for Strata	Cover Scale for Strata
<u>Trees and Shrubs</u> __Evergreen __Cold-deciduous __Mixed evergreen-cold-deciduous <u>Herbs</u> ___Annual ___Perennial	___Broad-leaved ___Needle-leaved ___Microphyllous ___Graminoid ___Forb ___Pteridophyte ___Non-vascular ___Mixed (describe)	___Forest ___Woodland ___Shrubland ___Dwarf Shrubland ___Shrub Herbaceous ___Herbaceous ___Nonvascular ___Sparsely Vegetated	01 <0.5 m 02 0.5-1m 03 1-2 m 04 2-5 m 05 5-10 m 06 10-15 m 07 15-20 m 08 20-35 m 09 35 – 50 m 10 >50 m	T 0-1% P >1-5% 1 >5-15% 2 >15-25% 3 >25-35% 4 >35-45% 5 >45-55% 6 >55-65% 7 >65-75% 8 >75-85% 9 >85-95% 10 > 95%

Animal Use Evidence (including scat, browse, burrows, bedding sites, etc)
Natural and Anthropogenic Disturbance Comments (see cheat sheet for examples; describe intensity and effect on the vegetation, also whether disturbance is current, chronic, episodic or historic)
Other Comments/Continuation from previous sections. **Describe surrounding communities and how they relate to the plot**.

Observation Point Form

Plot Code____FLFO____ Polygon Code____

Provisional Community Name____

State ___CO______ Feature Name____ Site Name____

Quad Name____ Quad Code____

GPS File Name____ Field UTM X___ ___ ___ ___ ___ ___ mE Field UTM Y___ ___ ___ ___ ___ ___ mN

Please do not complete the following information when in the field.
Corrected UTM X___ ___ ___ ___ ___ ___ mE Corrected UTM Y___ ___ ___ ___ ___ ___ ___mN UTM Zone_____________________________

Observers_____________________________________ Date____ Photos____

Environmental Description

Elevation _____________________________________ Slope____________________________________ Aspect____

Topographic Position____

Landform____ Geology____

Cowardian Wetalnd Classification System	**Hydrologic Regime –Non Tidal**
____Upland ____Estuarine ____ Riverine ____Palustrine ____Lacustrine	____Permanently Flooded ____Semipermanetly Flooded ____Seasonally / Temporarily Flooded ____Saturated ____ Seasonally Flooded / Saturated ____Intermittenly Flooded

Environmental Comments:	**Unvegetated Surface**: ***(please use the cover scale below)***
	____ Bedrock ____ Bare Soil ____ Rocks > 10 cm ____ Litter, Duff ____ Rocks 0.2-10 cm ____ Wood ____ Sand ____ Other:______________________________

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	**Leaf Type (of dominant stratum)**	**Physiognomic Class**	**Cover Scale for Strata and Unvegetated Surface**
<u>Trees and Shrubs</u> ___ Evergreen ___ Cold-deciduous ___ Drought-deciduous ___ Mixed evergreen/ cold-deciduous Herbs ___ Annual ___ Perennial	___ Broad-leaved ___ Needle-leaved ___ Microphyllous ___ Graminoid ___ Forb ___ Pteridophyte ___ Mixed (describe)	___ Forest ___ Woodland ___ Shrubland ___ Dwarf shrubland ___ Shrub Herbaceous ___ Herbaceous ___ Nonvascular ___ Sparsely vegetated	01 = 0 - 10% 02 = 10 - 25% 03 = 25 - 60% 04 = 60 - 100%

Stratum	**Height**	**Cover Class**	**Dominant species (mark diagnostic spp with a *)**	**% cover**
T1: Emergent	____	____	______________________	____
			______________________	____
			______________________	____
			______________________	____
T2: Canopy	____	____	______________________	____

T3: Sub-canopy ____ ____

S1: Tall shrub ____ ____

S2: Short shrub ____ ____

H: Herbaceous ____ ____

N: Non-vascular ____ ____

V: Vine/liana	____	____	________________________________	____
			________________________________	____
E: Epiphyte	____	____	________________________________	____
				____

Height Scale for strata:				**Cover scale for strata and Unvegetated Surface:**		
01 =	<0.5 m	06 =	10-15m			
02 =	0.5-1m	07 =	15-20m		01 =	0 - 10%
03 =	1-2m	08 =	20-35m		02 =	10 - 25%
04 =	2-5m	09 =	35-50m		03 =	25 - 60%
05 =	5-10m	10 =	>50m		04 =	60 - 100%

June 1998

Accuracy Assessment Form
USGS-NPS Vegetation Mapping Program

1. Plot Number _______ 2. Park Code __________ 3. Date _____________

4. Observer(s)________________________________5. Datum ________ 6. Accuracy ________

7. UTM Coordinates: Easting __ __ __, __ __ __ Northing __, __ __ __, __ __ __

8. UTM Zone _______ 9. Offset from Point: Easting ________m Northing ________m

10. Topographic Description ____

11. Elevation _____________m 12. Aspect ________________

13. Veg Assoc. at Site ____

14. Veg Assoc 2 within 50m of Site ____

15. Veg Assoc 3 within 50m of Site ____

16. Major Species Present (by strata)____

____

____

17. Canopy Closure of Top Layer ______________

18. Rationale for Classification____

____

____

____

19. Comments ____

____

____

Instructions for Accuracy Assessment

The basic document for accuracy assessment is "Accuracy Assessment Procedures", developed by the Program in 1994. The document can be downloaded from the Program web site at http://biology.usgs.gov/npsveg. This accuracy assessment (AA) form is the result of an additional 4 years of field experience. The purpose of this form is to generate concise data to document the accuracy assessment procedure that occurred in the field and to compare it to the mapped data.

All navigation must occur with either a Y-code GPS receiver (e.g. Rockwell PLGR) or in real time differential mode if using other types of receivers. This unit allows the user to navigate to sites within a few meters of their actual locations. The AA sites will be selected using randomly located samples stratified according to the associations. Before beginning each morning, make sure the datum is set to NAD83, and that the projection system is UTM, with the proper zone. A compass is needed to estimate aspect.

The materials you should have before you begin are a 1) plots of the DOQQ's showing the polygon boundaries, but no information on polygon attributes, and the location of the AA sites with numbers, 2) AA site coordinates loaded into your GPS receiver, 3) the field key, and 4) association descriptions.

Once you have navigated to an accuracy assessment site, and the FOM (Figure of Merit) is at 1, if using a PLGR, observe the vegetation within a 50 meter radius of the site. To gauge how far 50 meters is, it is helpful to have the navigator pace 50 meters in one direction. Document what the vegetation community is at the site, and if there are more than one community present within a 50 meter radius, document those as well under Veg Assoc 2 & 3.

Specific Instructions:

1. Plot Number - self explanatory
2. Park Code - the four character code for the park (e.g. Voyageurs is VOYA, Scotts Bluff is SCBL)
3. Date - self explanatory
4. Observor(s) - self explanatory
5. Datum - the reference system for the projection, should be NAD83 (NAR on the PLGR)
6. Accuracy - the distance in meters the GPS receiver displays, if using a PLGR
7. UTM Coordinates - easting and northing in meters
8. UTM Zone - UTM zones in continental US range between 10 (126^0 W longitude on the Pacific Coast) and 19 (66^o W longitude on the Atlantic Coast)
9. Offset from Site - if you are unable to navigate directly to a site due to terrain problems (e.g., rivers, canyons), record the distance from the site displayed on your GPS receiver, record 0 if there is no offset
10. Topographic Description - where you are on the terrain; on the top of a hill, in a small valley, midslope on a south facing slope, etc.
11. Elevation - above sea level in meters
12. Aspect - using a compass estimate the aspect of the whole site, record in degrees of azimuth (0-360)
13. Veg Assoc at Site - use the field key determine the association directly on the AA site
14. Veg Assoc 2 within 50 m of Site - if a second vegetation association is found within 50 meters of the site, record that association.
15. Veg Assoc 3 within 50 m of Site - if a third vegetation association is found within 50 meters of the site, record that association
16. Major Species Present (by strata) - record the major and indicator species present
17. Canopy Closure of Top Layer - estimate canopy closure of top stratum, eliminating the contribution from lower strata.
18. Rationale for Classification - record the logical procedure you used to determine the vegetation association based on indicator species, major species, structure, etc.
19. Comments - all relevant information that does not fit into the fields above. Note such things as multiple associations near the site, indications of artificial influences on the vegetation, such as grazing, logging, animal presence or use, influences of elevation, aspect, water tables, etc

APPENDIX D

PHOTO LOG FOR FIELD PHOTOS

THE IMAGES CAN BE FOUND ON THE DATA CD UNDER FIELD_DATA\FIELD|PHOTOS

FLFO PHOTOGRAPHS

ROLL # 1 Picture Number and date

1-1: ARTFRI Dwarf Shrubland, OBS-001, 7/9/2001
1-2: RIBCER Sparse Shrubland, OBS-002, 7/9/2001
1-3: CERMON Shrubland, OBS-003, 7/9/2001
1-4: CERMON Shrubland, OBS-003, 7/9/2001
1-5: YUCGLA Dwarf Shrubland, 7/9/2001
1-6: DANPAR Grassland, OBS-005, 7/9/2001
1-7: LEMMIN Pond, , 7/9/2001
1-8: CARAQU-JUNBAL Wetland Complex, 7/9/2001
1-9: PICPUN Forest, , 7/9/2001
1-10: BROINE Introduced Grassland, PLOT-001, 7/9/2001
1-11: BROINE Introduced Grassland, PLOT-001, 7/9/2001
1-12: Fossil Sequoia Stump, date unknown
1-13: CIRARV Control by Mowing, date unknown
1-14: LEMMIN/CARUTR Pond, PLOT-002, 7/12/2001
1-15: LEMMIN/CARUTR Pond, PLOT-002, 7/12/2001

ROLL #2

2-1: CARUTR Wetland, PLOT-007, 7/16/2001
2-2: CARUTR Wetland, PLOT-007, 7/16/2001
2-3: PHAARU Wetland, PLOT-008, 7/16/2001
2-4: PHAARU Wetland, PLOT-008, 7/16/2001
2-5: JUNBAL Wetland, PLOT-009, 7/16/2001
2-6: JUNBAL Wetland, PLOT-009, 7/16/2001
2-7: CARUTR Pond, PLOT-010, 7/16/2001
2-8: CARUTR Pond, PLOT-010, 7/16/2001
2-9: CARUTR-AQU Wetland, PLOT-011, 7/17/2001
2-10: CARUTR-AQU Wetland, PLOT-011, 7/17/2001
2-11: CARAQU Wetland, PLOT-012, 7/17/2001
2-12: CARAQU Wetland, PLOT-012, 7/17/2001

ROLL #3

3-1: PICPUN Forest, PLOT-019, 7/17/2001
3-2: PICPUN Forest, PLOT-019, 7/17/2001
3-3: PINPON-PICPUN Forest, PLOT-020, 7/17/2001
3-4: PINPON-PICPUN Forest, PLOT-020, 7/17/2001
3-5: PARPUL Mat Forb, PLOT-021, 7/17/2001
3-6: PARPUL Mat Forb, PLOT-021, 7/17/2001
3-7: BROINE Grassland, PLOT 022, 7/17/2001
3-8: BROINE Grassland, PLOT 022, 7/17/2001
3-9: FESARI-MUHSP Grassland, PLOT-023
3-10: FESARI-MUHSP Grassland, PLOT-023, 7/17/2001
3-11: PINARI Woodland, PLOT-024, 7/18/2001

FLFO PHOTOGRAPHS

1-16: FESARI-MUHSP Grassland, PLOT-003, 7/12/2001
1-17: FESARI-MUHSP Grassland, PLOT-003, 7/12/2001
1-18: Private Land Grazing Affects, date unknown
1-19: SCHSCO Grassland, PLOT-004, 7/16/2001
1-20: SCHSCO Grassland, PLOT-004, 7/16/2001
1-21: CERMON Sparse Shrubland, PLOT-005, 7/16/2001
1-22: CERMON Sparse Shrubland, PLOT-005, 7/16/2001
1-23: PICPUN/BETFON Forest, PLOT- 006, 7/16/2001
1-24: PICPUN/BETFON Forest, PLOT-006, 7/16/2001
1-25: PICPUN/BETFON Forest, PLOT-006, 7/16/2001

2-13: JUNBAL Wetland, PLOT-013, 7/17/2001
2-14: JUNBAL Wetland, PLOT-013, 7/17/2001
2-15: PENFLO Shrubland, PLOT-014, 7/17/2001
2-16: PENFLO Shrubland, PLOT-014, 7/17/2001
2-17: ELACOM Shrubland, PLOT-015, 7/17/2001
2-18: ELACOM Shrubland, PLOT-015, 7/17/2001
2-19: DBH by Michelle Dooley, 7/17/2001
2-20: HORJUB Dry Pond, PLOT-016, 7/17/2001
2-21: HORJUB Dry Pond, PLOT-016, 7/17/2001
2-22: ALNINC Shrubland, PLOT-017, 7/17/2001
2-23: ALNINC Shrubland, PLOT-017, 7/17/2001
2-24: POPTRE Woodland, PLOT-018, 7/17/2001
2-25: POPTRE Woodland, PLOT-018, 7/17/2001
3-13: CARAQU Wetland, PLOT-025, 7/18/2001
3-14: CARAQU Wetland, PLOT-025, 7/18/2001
3-15: PINPON Invasion of BROINE, 7/18/2001
3-16: PINPON Young Stand, PLOT-026, 7/18/2001
3-17: PINPON Young Stand, PLOT-026, 7/18/2001
3-18: PINPON Woodland, PLOT-027, 7/18/2001
3-19: PINPON Woodland, PLO-027, 7/18/2001
3-20: Porcupine, 7/18/2001
3-21: PINPON/CERMON Woodland, PLOT-028, 7/18/2001
3-22: PINPON/CERMON Woodland, PLOT-028
3-23: DANPAR Grassland, PLOT-029
3-24: DANPAR Grassland, PLOT-029

3-12: PINARI Woodland, PLOT-024, 7/18/2001

3-25: DANPAR Grassland, PLOT-029

ROLL #4

4-1: PICPUN Forest, PLOT-030, 7/18/2001
4-2: PICPUN Forest, PLOT-030, 7/18/2001
4-3: PINARI Woodland, PLOT-031, 7/18/2001
4-4: PINARI Woodland, PLOT-031, 7/18/2001
4-5: PENFLO Shrubland, PLOT-032, 7/18/2001
4-6: PENFLO Shrubland, PLOT-032, 7/18/2001
4-7: RO Sparse Shrubland, PLOT-033, 7/18/2001
4-8: RO Sparse Shrubland, PLOT-033, 7/18/2001
4-9: CHRVIS Dwarf Shrubland, PLOT-034, 7/18/2001
4-10: CHRVIS Dwarf Shrubland, PLOT-034, 7/18/2001
4-11: SALMON Shrubland, PLOT-035, 7/19/2001
4-12: SALMON Shrubland, PLOT-035, 7/19/2001
4-13: CHRVIS Dwarf Shrubland, PLOT-036, 7/19/2001
4-14: CHRVIS Dwarf Shrubland, PLOT-036, 7/19/2001
4-15: CHRVIS Dwarf Shrubland, PLOT-037, 7/19/2001
4-16: CHRVIS Dwarf Shrubland, PLOT-037, 7/19/2001
4-17: Accidental photo – discard.
4-18: JUNBAL Wetland, PLOT-038, 7/19/2001
4-19: JUNBAL Wetland, PLOT-038, 7/19/2001
4-20: PENFLO Shrubland, PLOT-039, 7/19/2001
4-21: PENFLO Shrubland, PLOT-039, 7/19/2001
4-22: JUNBAL Wetland, PLOT-040, 7/19/2001
4-23: JUNBAL Wetland, PLOT-040, 7/19/2001
4-24: CIRARV Forbland, PLOT-041, 7/19/2001
4-25: CIRARV Forbland, PLOT-041, 7/19/2001

ROLL #5

5-1: SCHSCO Grassland, PLOT-042, 7/19/2001
5-2: SCHSCO Grassland, PLOT-042, 7/19/2001
5-3: RO Sparse Shrubland, PLOT-043, 7/19/2001
5-4: RO Sparse Shrubland, PLOT-043, 7/19/2001
5-5: PRUVIR Shrubland, PLOT-044, 7/19/2001
5-6: PRUVIR Shrubland, PLOT-044, 7/19/2001
5-7: SALMON Shrubland, PLOT-045, 7/19/2001
5-8: SALMON Shrubland, PLOT-045, 7/19/2001
5-9: PHAARU Wetland, PLOT-046, 7/19/2001
5-10: PHAARU Wetland, PLOT-046, 7/19/2001
5-11: ARTFRI PD Dwarf Shrubland, PLOT-047, 7/19/2001
5-12: ARTFRI PD Dwarf Shrubland, PLOT-047, 7/19/2001
5-13: CARUTR Pond, PLOT-048, 7/19/2001
5-14: CARUTR Pond, PLOT-048, 7/19/2001
5-15: BROINE Grassland, PLOT-049, 7/19/2001
5-16: BROINE Grassland, PLOT-049, 7/19/2001
5-17: Dry Pond, date unknown
5-18: DANPAR Grassland, PLOT-050, 7/21/2001
5-19: DANPAR Grassland. PLOT-050, 7/19/2001
5-20: DANPAR Grassland, PLOT-051, 7/19/2001
5-21: DANPAR Grassland, PLOT-051, 7/19/2001
5-22: FESARI-MUHMON Grassland, PLOT-052, 7/20/2001
5-23: FESARI-MUHMON Grassland, PLOT-052, 7/20/2001
5-24: CARUTR/LEMMIN Pond, PLOT-053, 7/20/2001
5-25: CARUTR/LEMMIN Pond, PLOT-053, 7/20/2001

ROLL #6

6-1: PINPON/CERMON Woodland, PLOT-054, 7/20/2001
6-2: PINPON/CERMON Woodland, PLOT-054, 7/20/2001
6-3: PINPON/Mixed Stand, PLOT-055, 7/20/2001
6-4: PINPON/Mixed Stand, PLOT-055, 7/20/2001
6-5: PSEMEN Forest, PLOT-056, 7/20/2001
6-6: PSEMEN Forest, PLOT-056, 7/20/2001
6-7: BROINE Grassland, PLOT-057, 7/23/2001
6-8: BROINE Grassland, PLOT 057, 7/23/2001,
6-9: MUHFIL Grassland, PLOT-058, 7/23/2001
6-13: PINPON/DANPAR Woodland, PLOT-060, 7/23/2001
6-15: PINPON Woodland, PLOT-061, 7/23/2001
6-16: PINPON Woodland, PLOT 061, 7/23/2001
6-17: PINPON/MUHMON Woodland, PLOT-062, 7/23/2001
6-18: PINPON/MUHMON Woodland, PLOT-062, 7/23/2001
6-19: BECSCY Pond, PLOT-063, 7/23/2001
6-20: BECSCY Pond, PLOT-063, 7/23/2001
6-21: Beaver Ponds, date unknown
6-22: Beaver Ponds, date unknown

6-10: MUHFIL Grassland, PLOT-058, 7/23/2001
6-11: PINPON Woodland, PLOT-059, 7/23/2001
6-12: PINPON Woodland, PLOT-059, 7/23/2001
6-23: FESARI/MUHMON Grassland, PLOT-064, 7/24/2001
6-24: FESARI/MUHMON Grassland, PLOT-064, 7/24/2001

ROLL #7

7-1: PINPON Forest, PLOT-065, 7/24/2001
7-2: PINPON Forest, PLOT-065, 7/24/2001
7-3: SCHSCO Grassland, PLOT-066, 7/24/2001
7-4: SCHSCO Grassland, PLOT-066, 7/24/2001
7-5: SALBRA Shrubland, PLOT-067, 7/24/2001
7-6: SALBRA Shrubland, PLOT-067, 7/24/2001
7-7: CIRARV Forbland, PLOT-068, 7/24/2001
7-8: CIRARV Forbland, PLOT-068, 7/24/2001
7-9: SALEXI Shrubland, PLOT-069, 7/24/2001
7-10: SALEXI Shrubland, PLOT-069, 7/24/2001
7-11: SALEXI Shrubland, PLOT-070, 7/24/2001
7-12: SALEXI Shrubland, PLOT-070, 7/24/2001
7-13: Beaver Pond, 7/24/2001
7-14: Beaver Pond, 7/24/2001
7-15: RO / Waterfall, 7/24/2001
7-16: HESCOM Grassland, 7/24/2001
7-17: HESCOM Grassland, 7/24/2001
7-18: CERMON Shrubland, PLOT-072, 7/24/2001
7-19: CERMON Shrubland, PLOT-072, 7/24/2001
7-20: SALMON Shrubland, PLOT-073, 7/25/2001
7-21: SALMON Shrubland, PLOT-073, 7/25/2001
7-22: POPBAL Woodland, PLOT-074, 7/25/2001
7-23: POPBAL Woodland, PLOT-074, 7/25/2001
7-24: TYPLAT Patch, 7/25/2001
7-25: Pond – Quaking Aspen – Colorado Blue Spruce, 7/25/2001

ROLL #8

8-1: Pike's Peak Granite Formation, 7/25/2001
8-2: POPTRE Forest, PLOT-075, 7/25/2001
8-3: POPTRE Forest, PLOT-075, 7/25/2001
8-4: PSEMEN Forest, PLOT-076, 7/25/2001
8-5: PSEMEN Forest, PLOT-076, 7/25/2001
8-6: CARAQU Wetland, PLOT 077, 7/25/2001
8-7: CARUTR Wetland, PLOT 078, 7/25/2001
8-8: CARUTR Wetland, PLOT 078, 7/25/2001
8-9: ARTFRI Dwarf Shrubland, PLOT-079, 7/25/2001
8-10: ARTFRI Dwarf Shrubland, PLOT-079, 7/25/2001
8-11: ALNINC Shrubland, PLOT-080, 7/25/2001
8-12: ALNINC Shrubland, PLOT-080, 7/25/2001
8-13: PSEMEN/JUNCOM Forest, PLOT-081, 7/24/2001
8-14: PSEMEN/JUNCOM Forest, PLOT-081, 7/24/2001
8-15: POPTRE Forest, PLOT-082, 7/25/2001
8-16: POPTRE Forest, PLOT-082, 7/25/2001
8-17: View to Pike's Peak over POPTRE Forest, PLOT-082, 7/25/2001
8-18: PSEMEN Woodland, PLOT-083, 7/26/2001
8-19: PSEMEN Woodland, PLOT-083, 7/26/2001
8-20: DANPAR Grassland, 7/26/2001
8-21: PINPON/FESARI Woodland, PLOT-084, 7/26/2001
8-22: PINPON/FESARI Woodland, PLOT-084, 7/26/2001
8-23: CERMON Shrubland, PLOT-085, 7/26/2001
8-24: CERMON Shrubland, PLOT-085, 7/26/2001
8-25: HESCOM Grassland, PLOT 086, 7/26/2001

ROLL #9

9-1: HESCOM Grassland, PLOT-086, 7/26/2001
9-2: PICPUN Forest, PLOT-087, 7/26/2001
9-3: PICPUN Forest, PLOT-087, 7/26/2001
9-4: MUHFIL-BOUGRA Grassland, PLOT 088, date unknown
9-5: MUHFIL-BOUGRA Grassland, PLOT 088, date unknown
9-6: PICPUN Forest, PLOT 089, 7/27/2001
9-7: PICPUN Forest, PLOT 089, 7/27/2001
9-8: Pike's Peak View, 7/27/2001
9-9: PINCON Woodland, PLOT-090, 7/27/2001
9-10: PINCON Woodland, PLOT-090, 7/27/2001
9-11: RO Sparse Shrubland, PLOT-091, 7/27/2001
9-12: RO Sparse Shrubland, PLOT-091, 7/27/2001
9-13: YUCGLA Dwarf Shrubland, PLOT-092, 7/27/2001
9-14: YUCGLA Dwarf Shrubland, PLOT-092, 7/27/2001

ROLL #10

10-1: CIRARV Forbland, date unknown
10-11: PSEMEN / CERMON Woodland, PLOT 097, 8/17/2003

10-2: PICPUN / BETFON Forest, PLOT 093, 8/16/2003 10-3: PICPUN / BETFON Forest, PLOT 093, 8/16/2003 10-4: LINVUL Forbland, PLOT 094, 8/17/2003 10-5: LINVUL Forbland, PLOT 094, 8/17/2003 10-6: CARNEB Wetland, PLOT 095, 8/17/2003 10-7: CARNEB Wetland, PLOT 095, 8/17/2003 10-8: CERMON Shrubland, PLOT 096, 8/17/2003 10-9: CERMON Shrubland, PLOT 096, 8/17/2003 10-10: PSEMEN / CERMON Woodland, PLOT 097, 8/17/2003	10-12: CHRVIS Dwarf Shrubland, PLOT 098, 8/17/2003 10-13: CHRVIS Dwarf Shrubland, PLOT 098, 8/17/2003 10-14: YUCGLA Dwarf Shrubland, PLOT 099, 8/17/2003 10-15: YUCGLA Dwarf Shrubland, PLOT 099, 8/17/2003

APPENDIX E

PRELIMINARY DATA ANALYSIS – JACK L. BUTLER, PhD

FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

PRELIMINARY DATA ANALYSIS

Jack Butler, Ph.D.
Central Missouri State University

Data from the 99 vegetation plots collected from Florissant Fossil Beds National Monument (FLFO) during the 2001 field season were entered into the "Plots" database following procedures outlined by the National Vegetation Classification System (Grossman et al. 1998). Species foliar cover values for each plot were then exported into a spreadsheet format and initially arranged into a plot (rows = 228) by species (columns = 99) data matrix. Several of the 228 species recorded in the plots database, primarily trees and shrubs, occupied more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer were subscripted with the strata code (T1, T2, S1, S2, S3, for example). The matrix was then used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix was analyzed several times using TWINSPAN, Cluster Analysis (relative Euclidean distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix was edited prior to analysis by first removing all species that had total cover values (summed over all 99 plots) of $\leq$ 1 percent. Raw foliar cover scores were used in all data analysis procedures. The data matrix was then subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets such as the one used here and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982).

Removing outliers increases the analysis' efficiency and substantially improves the interpretability of the results. The exploratory analysis revealed several major outliers (Plot 16: *Hordeum jubatum* Herbaceous Vegetation [Dried Pond Community]; Plot 41: *Cirsium arvense – Carex utriculata* Disturbed Wetland; and Plot 68 *Cirsium arvense* Forb/Exotic Grasses Vegetation) which were removed prior to further analysis.

The initial analysis of the data revealed two groups that appear to follow natural physiognomic boundaries (Figure 1). The first category appears to include many of the mesic/wetland communities within FLFO while the second grouping contains the majority of forest, woodlands, shrublands, and grasslands (Table 1). The second grouping (Group 2) was then divided into two classes (Group 2A and 2B). The first class (2A) contained the dry forests, savannahs, and grasslands of FLFO while the second class (2B) contained the majority of the forests, woodlands, and shrublands. This somewhat artificial classification was confirmed by an independent, subjective evaluation provided by Jim Von Loh, Senior Biologist, engineering-environmental Management, Inc. (e^2M). The overall goal of these three initial classifications was to reduce the size of the data matrix along natural physiognomic boundaries prior to classification and ordination (McCune and Mefford 1999).

Figure 1. Detrended Correspondence Analysis (DECORANA: McCune and Mefford 1999) Ordination of all 99 Vegetation Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season. (Plots to the right of the drawn line were placed into a mesic/wetland vegetation category for further data analysis.)

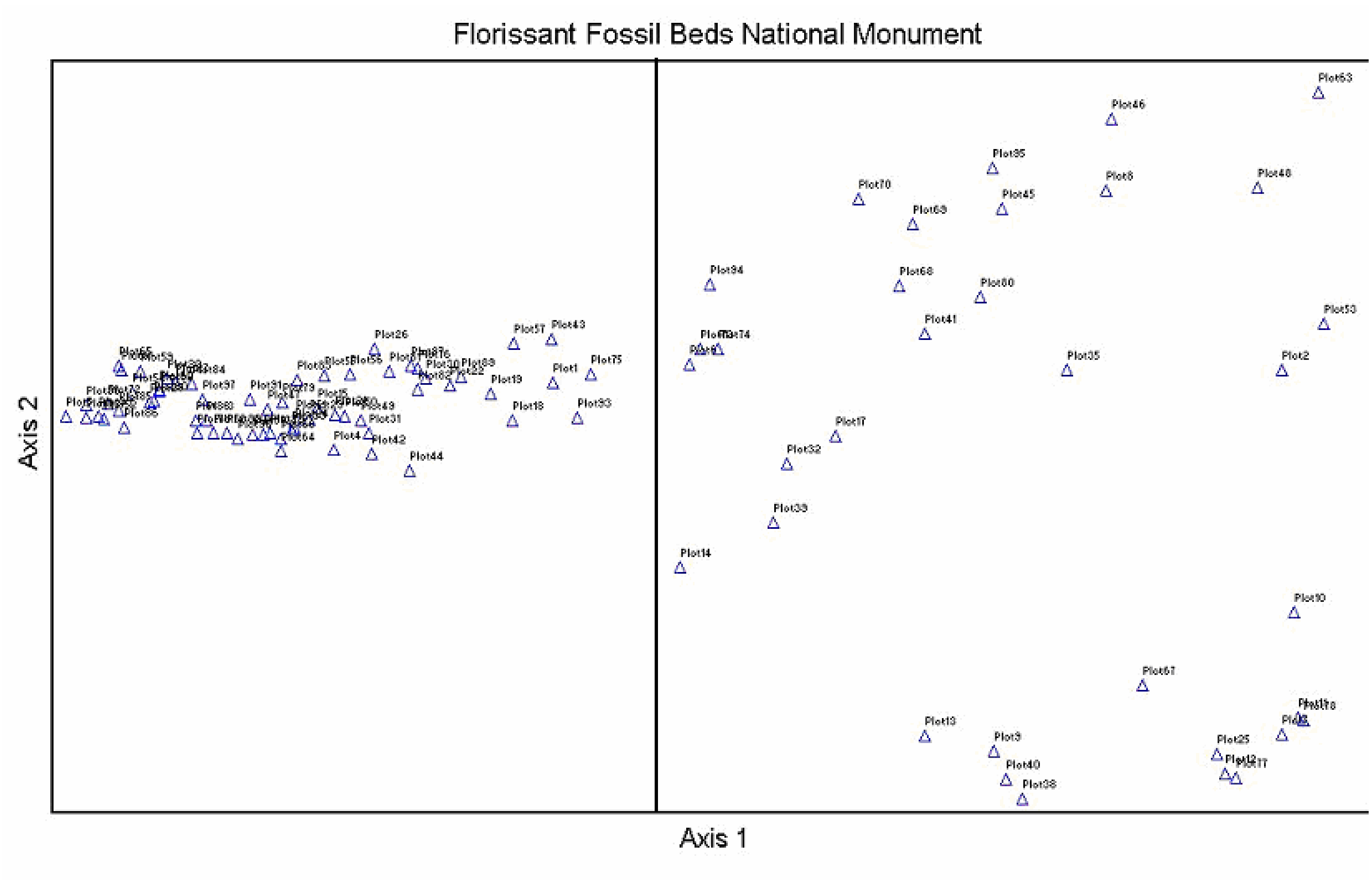


Table 1. Provisional Community Names for 99 Vegetation Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season

Plot	Group	Provisional Community Name
2	1	*Lemna minor* Permanently Flooded Herbaceous Alliance
7	1	*Carex utriculata - Carex aquatilis* Herbaceous Vegetation
8	1	*Phalaris arundinacea* Wetland Meadow
9	1	*Juncus balticus* Herbaceous Vegetation
10	1	*Myriophyllum sibiricum* Herbaceous Vegetation
11	1	*Carex utriculata Herbaceous Vegetation*
12	1	*Carex aquatilis* Herbaceous Vegetation
13	1	*Juncus balticus Herbaceous Vegetation*
14	1	*Dasiphora floribunda* Shrubland
17	1	*Alnus incana - Salix (monticola, lucida, ligulifolia)* Shrubland
25	1	*Carex aquatilis Herbaceous Vegetation*
32	1	*Dasiphora floribunda Shrubland*
35	1	*Salix monticola / Carex utriculata* Shrubland
38	1	*Juncus balticus* Wetland Meadow
39	1	*Dasiphora floribunda Shrubland*
40	1	*Juncus balticus Herbaceous Vegetation*
41	1	*Cirsium arvense - Carex utriculata* Disturbed Wetland
45	1	*Salix monticola / Carex utriculata* Shrubland
46	1	*Phalaris arundinacea* Wetland Meadow
48	1	*Myriophyllum sibiricum* Herbaceous Vegetation
53	1	*Myriophyllum sibiricum* Herbaceous Vegetation
63	1	*Myriophyllum sibiricum* Herbaceous Vegetation
67	1	*Salix brachycarpa* / *Carex aquatilis* Shrubland
68	1	*Cirsium arvense* Forb / Exotic Grasses Vegetation
69	1	*Salix exigua* Mesic Graminoids Shrubland
70	1	*Salix exigua* Mesic Graminoids Shrubland
73	1	*Salix lutea - S. exigua S. monticola* Shrubland
77	1	*Carex aquatilis* Herbaceous Vegetation
78	1	*Carex utriculata* Herbaceous Vegetation
80	1	*Alnus incana - Salix (monticola, lucida, ligulifolia)* Shrubland
95	1	*Salix monticola* Mesic Graminoids Shrubland
1	2A	*Bromus inermis* Semi-Natural Herbaceous Vegetation
4	2A	*Schizachyrium scoparium* Grassland
6	2A	*Betula occidentalis/Picea pungens/Populus tremuloides* Riparian Woodland
18	2A	*Populus tremuloides / Juniperus communis*Woodland
22	2A	*Bromus inermis* Semi-Natural Herbaceous Vegetation
26	2A	*Pinus ponderosa* Young Woodland Savanna
29	2A	*Danthonia parryii* Herbaceous Vegetation
42	2A	*Schizachyrium scoparium* Grassland
43	2A	*Ribes cereum - Rubus deliciosus - Jamesia Americana* Sparse Shrubland
44	2A	*Prunus virginiana* Shrubland
50	2A	*Danthonia parryii* Herbaceous Vegetation
51	2A	*Danthonia parryii* Herbaceous Vegetation

Plot	Group	Provisional Community Name
57	2A	*Bromus inermis* Semi-natural Herbaceous Vegetation
66	2A	*Schizachyrium scoparium* / *Yucca* Grassland
74	2A	*Populus balsamifera* Forest
75	2A	*Populus tremuloides* Tall Forbs Forest
86	2A	*Hesperostipa comata* Herbaceous Vegetation
93	2A	*Picea pungens - Populus tremuloides* Forest
94	2A	*Linaria vulgaris* Herbaceous Vegetation
3	2B	*Festuca arizonica - Muhlenbergia montana* Herbaceous Vegetation
5	2B	*Cercocarpus montanus / Muhlenbergia montana* Shrubland
15	2B	*Elaeagnus commutata S*hrubland
16	2B	*Hordeum jubatum* Herbaceous Vegetation [Dried Pond Community]
19	2B	*Picea pungens / Juniperus communis* Forest
20	2B	*Pinus ponderosa / Juniperus communis* Forest
21	2B	*Paronychia sessiliflora* Herbaceous Community on Disturbed Surface
23	2B	*Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation
24	2B	*Pinus aristata / Festuca arizonica* Woodland
27	2B	*Pinus ponderosa - Populus tremuloides* Forest
28	2B	*Pinus ponderosa / Cercocarpus montanus* Woodland
30	2B	*Picea pungens / Juniperus communis* Forest
31	2B	*Pinus aristata / Festuca arizonica* Woodland
33	2B	*Ribes cereum - Rubus deliciosus - Jamesia Americana* Pikes Peak Granite Outcrop Shrubland
34	2B	*Chrysothamnus viscidiflorus – Ericameria parryi* Herbaceous Vegetation
36	2B	*Chrysothamnus viscidiflorus – Ericameria parryi* Herbaceous Vegetation
37	2B	*Chrysothamnus viscidiflorus – Ericameria parryi* Herbaceous Vegetation
47	2B	*Artemisia frigida* Disturbed Prairie Dog Town
49	2B	*Bromus inermis Semi-Natural Herbaceous Vegetation*
52	2B	*Festuca arizonica - Muhlenbergia montana* Grassland
54	2B	*Pinus ponderosa / Cercocarpus montanus Woodland*
55	2B	*Pseudotsuga menziesii / Juniperus communis* Forest
56	2B	*Pseudotsuga menziesii / Juniperus communis* Forest
58	2B	*Muhlenbergia filiculmus - Bouteloua gracilis* Sparse Forb Herbaceous Vegetation
59	2B	*Pinus ponderosa / Juniperus communis* Forest
60	2B	*Pinus ponderosa / Festuca arizonica* (*Muhlenbergia montana*) Woodland
61	2B	*Pinus ponderosa* Sparse Understory Woodland
62	2B	*Pinus ponderosa / Festuca arizonica* (*Muhlenbergia montana*) Woodland
64	2B	*Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation
65	2B	*Pinus ponderosa* Sparse Understory Woodland
71	2B	*Muhlenbergia filiculmus / Hesperostipa comata* Herbaceous Vegetation
72	2B	*Pinus ponderosa / Cercocarpus montanus* Woodland
76	2B	*Pseudotsuga menziesii / Juniperus communis* Forest
79	2B	*Artemisia frigida* Disturbed Prairie Dog Town
81	2B	*Pseudotsuga menziesii / Juniperus communis* Forest
82	2B	*Populus tremuloides Tall Forbs Forest*
83	2B	*Pseudotsuga menziesii / Muhlenbergia montana* Woodland
84	2B	*Pinus ponderosa / Festuca arizonica* (*Muhlenbergia montana*) Woodland
85	2B	*Cercocarpus montanus* Shrubland

Plot	Group	Provisional Community Name
87	2B	*Pseudotsuga menziesii* / Bryophyte Understory Forest
88	2B	*Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation
89	2B	*Picea pungens / Juniperus communis* Forest
90	2B	*Pinus ponderosa – P. contarta* Woodland
91	2B	*Ribes cereum - Rubus deliciosus - Jamesia Americana* Pikes Peak Granite Outcrop Shrubland
92	2B	*Yucca glauca / Muhlenbergia montana* Sparse Dwarf Shrubland
96	2B	*Cercocarpus montanus / Pinus ponderosa / Muhlenbergia montana* Shrubland
97	2B	*Cercocarpus montanus / Pseudotusga menziesii* Shrubland
98	2B	*Chrysothamnus viscidiflorus – Ericameria parryi* Herbaceous Vegetation
99	2B	*Yucca glauca / Muhlenbergia montana* Sparse Dwarf Shrubland

In Table 1 and in Figures 3, 6, and 9, species that occupy the same stratum are separated by a hyphen (–), while those occurring in different strata are separated by a slash (/) (Grossman et al. 1998). Species that are enclosed in parentheses are those that occur infrequently in the association. Forests are defined as vegetation types dominated by tree species with overlapping canopies of 60–100 percent cover (Grossman et al. 1998). Woodlands are considered more open stands of trees that exhibit non-overlapping canopies with 25–60 percent cover. The association is the finest level of the National Vegetation Classification System hierarchy. At this level, the plant community exhibits a definitive species composition and uniform physiognomy (Grossman et al. 1998). Alliances are one level higher than the association level and are characterized by one or more diagnostic species.

Mesic/Wetland Communities

Preliminary classification of this group using Cluster Analysis (relative Euclidean distance and the Ward's group linkage method; McCune and Mefford 1999) identified several groups of plots that exhibited considerable similarity (Figure 2). The plots were then subjected to classification using TWINSPAN (Figure 3). The final classification matrix was then analyzed using DECORANA (McCune and Mefford 1999; Figure 4), which had the effect of spreading out the plots in a two-dimensional space that may represent important environmental gradients.

The results of the classification process (Figure 2 – Cluster Analysis and Figure 3 – TWINSPAN) produced several large and predictable groups that are provisionally classified at the association level using NVCS nomenclature. However, several sampled stands characterized by *Phalaris arundinacea* or *Dasiphora floribunda* could not be assigned into any of the preliminary NVCS associations that were provided.

It was possible to identify three possible sedge associations dominated by *Carex aquatilis, C. utriculata*, or a combination of the two species (Figures 2, 3, and 4). The plots collected from representative stands of these communities demonstrated considerable similarity. Two possible associations included the *Carex utriculata* Herbaceous Vegetation (plots 11 and 78) and the *C. aquatilis* Herbaceous Vegetation (plots 12, 25, and 77) association. Cover values for the respective dominant sedge species ranged from 70 to 90 percent in the sampled stands.

Figure 2. Dendrogram Produced from Cluster Analysis (McCune and Mefford 1999; relative Euclidean distance with Ward's group linkage method) of 29 Mesic/Wetland Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season

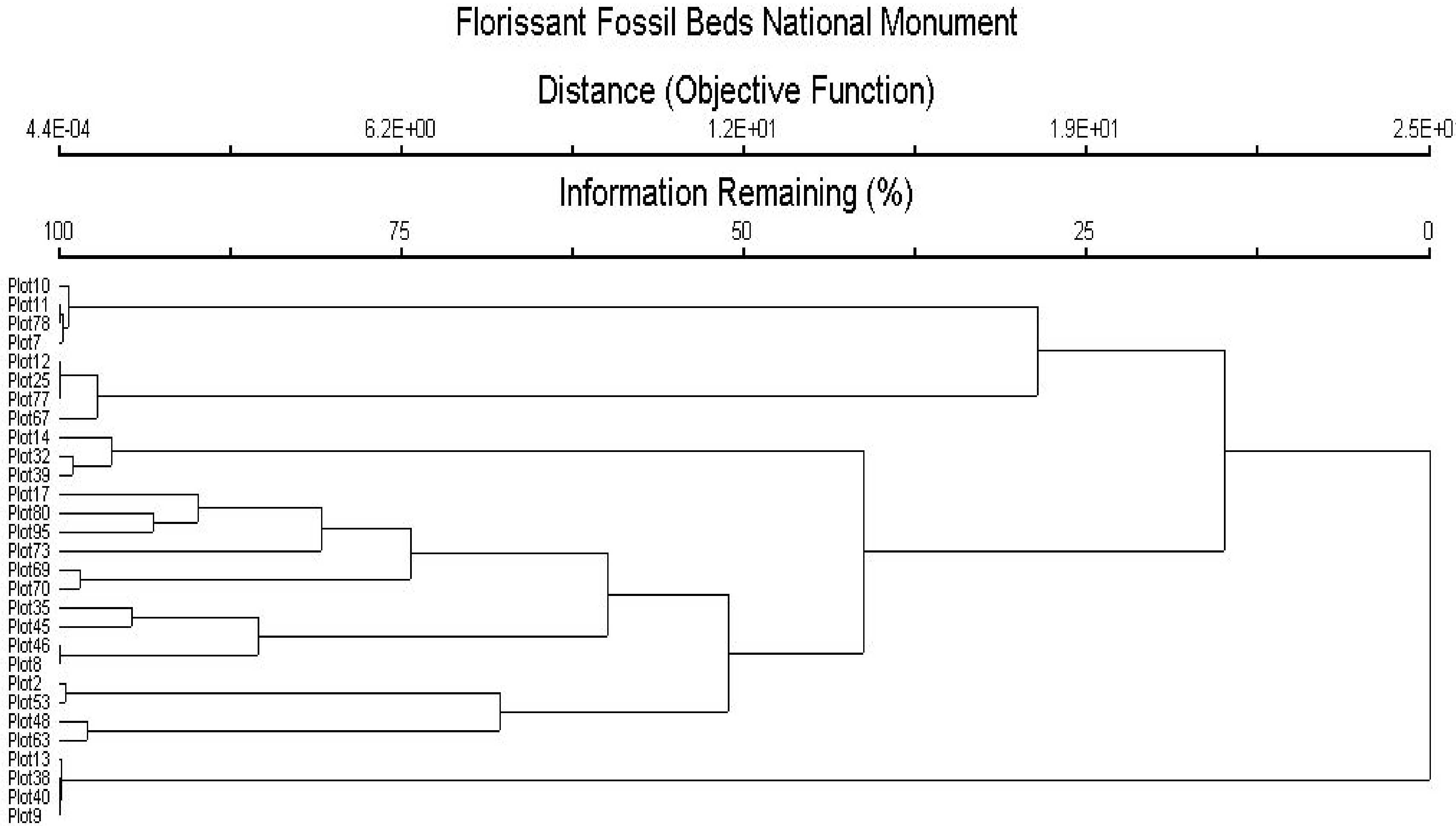


Figure 3. TWINSPAN (McCune and Mefford 1999) Dendrogram, with Indicator Species, of 29 Mesic/Wetland Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season

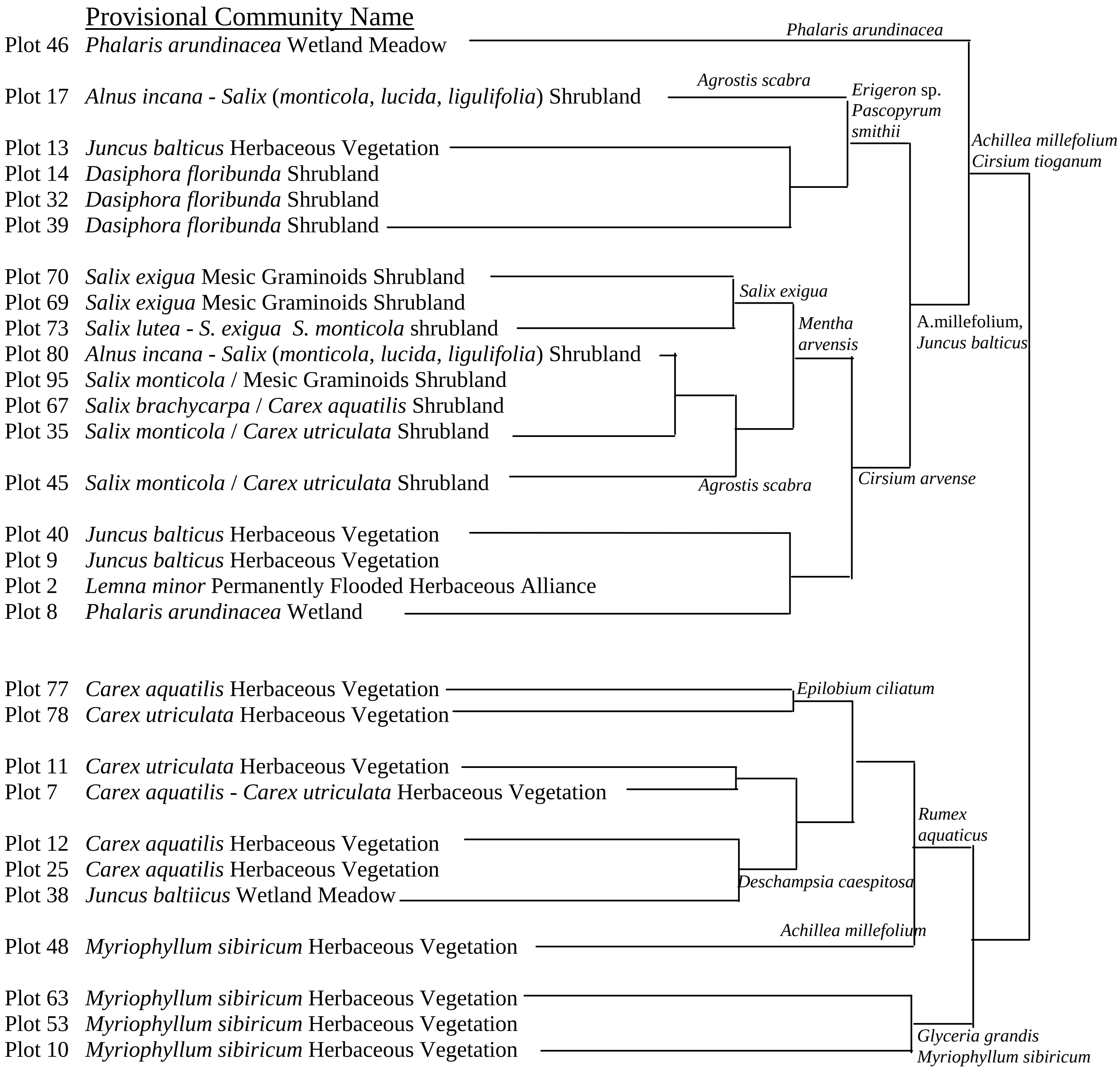
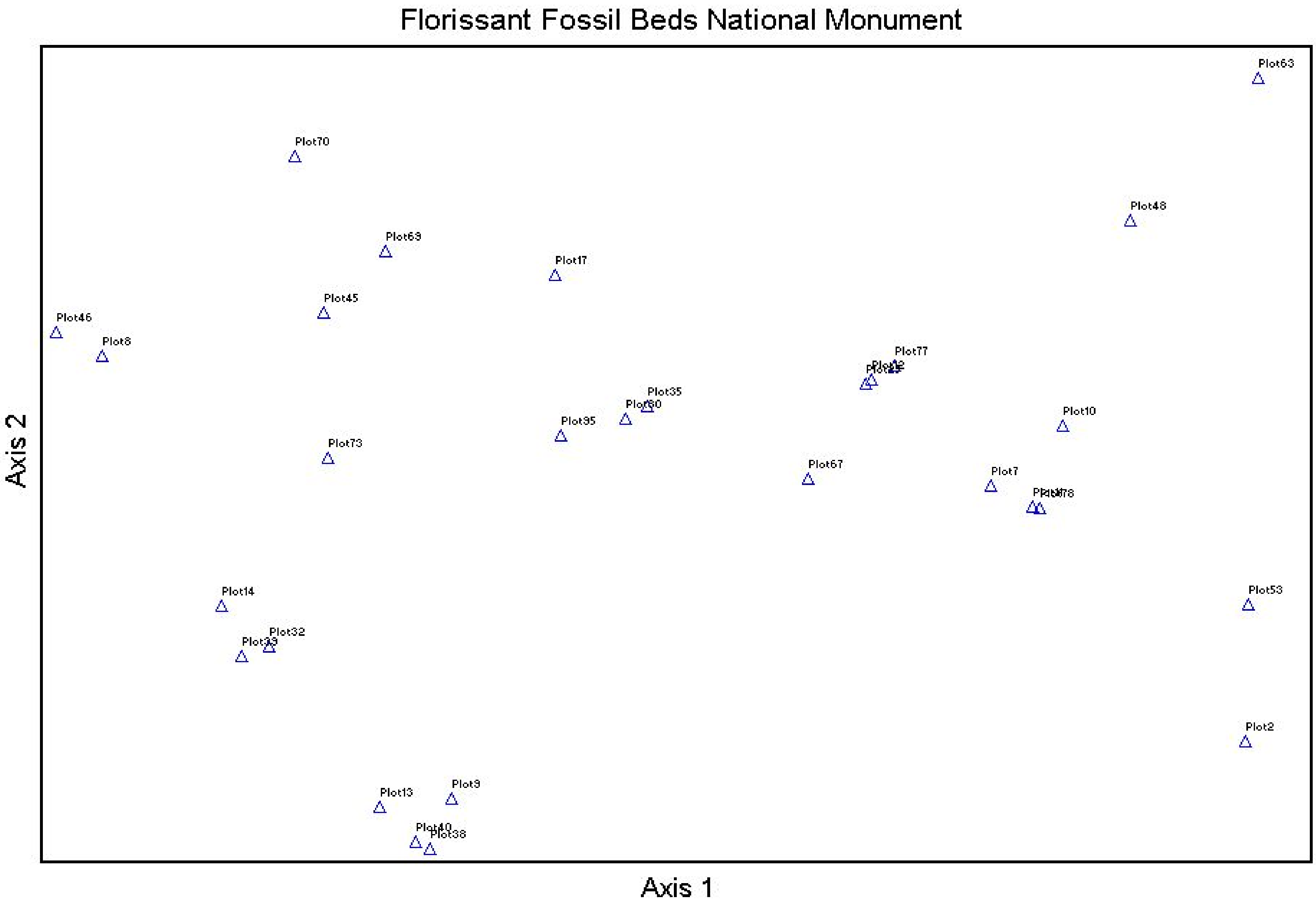


Figure 4. Detrended Correspondence Analysis (DECORANA: McCune and Mefford 1999) Ordination of 29 Mesic/Wetland Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season



The second sedge species was consistently present in the sample plots with cover values of about 2.5 percent. A third possible sedge community type includes the *C. aquatilis – C. utriculata* Herbaceous Vegetation (plot 7) association. In this plot, cover values for *C. utriculata* and *C. aquatilis* were 70 and 20 percent, respectively.

Four plots (plots 9, 13, 38, and 40) were sampled that may represent the *Juncus balticus* Herbaceous Vegetation association. The remaining mesic/wetland plots exhibited much more variability among stands. Other possible herbaceous community types include the *Lemna minor* Permanently Flooded Herbaceous Alliance (plot 2) and the *Myriophyllum sibiricum* Herbaceous Vegetation association (plots 10, 48, 53, and 68).

Stands containing *Alnus incana* were likely representative of the *Alnus incana – Salix* (*monticola, lucida, ligulifolia*) Shrubland association (plots 17 and 80). Cover values for *Alnus incana* in each sampled plot were 20 percent. Composition and cover of the secondary species varied between the two stands. Other possible shrubland communities included the *Salix monticola / Carex utriculata* Shrubland association (plots 35 and 45), the *Salix monticola* / Mesic Graminoids Shrubland (plot 95) (alternatively, plot 95 may be the *S. monticola* / *Calamagrostis canadensis* Shrubland), and the *Salix brachycarpa* / *Carex aquatilis* Shrubland (plot 67). Plot 73 appeared to be a mixed *Salix* type, while plots 69 and 70 were provisionally classified as a *Salix exigua* Mesic Graminoids Shrubland.

Ordination of the 29 plots revealed possible environmental conditions that appear to reflect differences in moisture and temperature conditions influenced by slope, aspect, elevation, and soils. For example, a possible moisture gradient appears to be illustrated by the location of the pond communities at one end of the first axis of the ordination, with the mesic shrublands in the middle, and the drier shrublands at the opposite end. The second axis of the ordination may represent the presence of flowing water at the surface and the type of substrate. For example, stands characterized by flowing water in gravel and dominated by *Salix exigua* (plots 69 and 70) are found toward the upper end of the second ordination axis. *Salix monticola* and *S. brachycarpa* stands found on flowing water with a peat substrate were ordinated just below the *S. exigua* stands. Mesic drainages without surface water flows present are characterized by *Dasiphora floribunda* shrublands.

Dry Forests, Savannas, and Grasslands

Stands dominated by *Schizachyrium scoparium* and *Danthonia parryii* appeared to be the most floristically consistent vegetation types within this group of plots (Figure 5). Possible NVCS associations for these stands include *Danthonia parryii* Herbaceous Vegetation and *Schizachyrium scoparium* Herbaceous Vegetation (Figure 6). Several plots were sampled that may characterize the *Bromus inermis* Semi-natural Introduced Grassland association. The *Hesperostipa comata – Bouteloua gracilis* Herbaceous Vegetation association may also occur on the Monument; however, this type is represented by only one plot (plot 86). A variety of plots were sampled that potentially may characterize several forest, woodland, and shrubland associations.

Figure 5. Dendrogram Produced from Cluster Analysis (McCune and Mefford 1999; relative Euclidean distance with Wards's group linkage method) of 22 Upland Herbaceous Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season

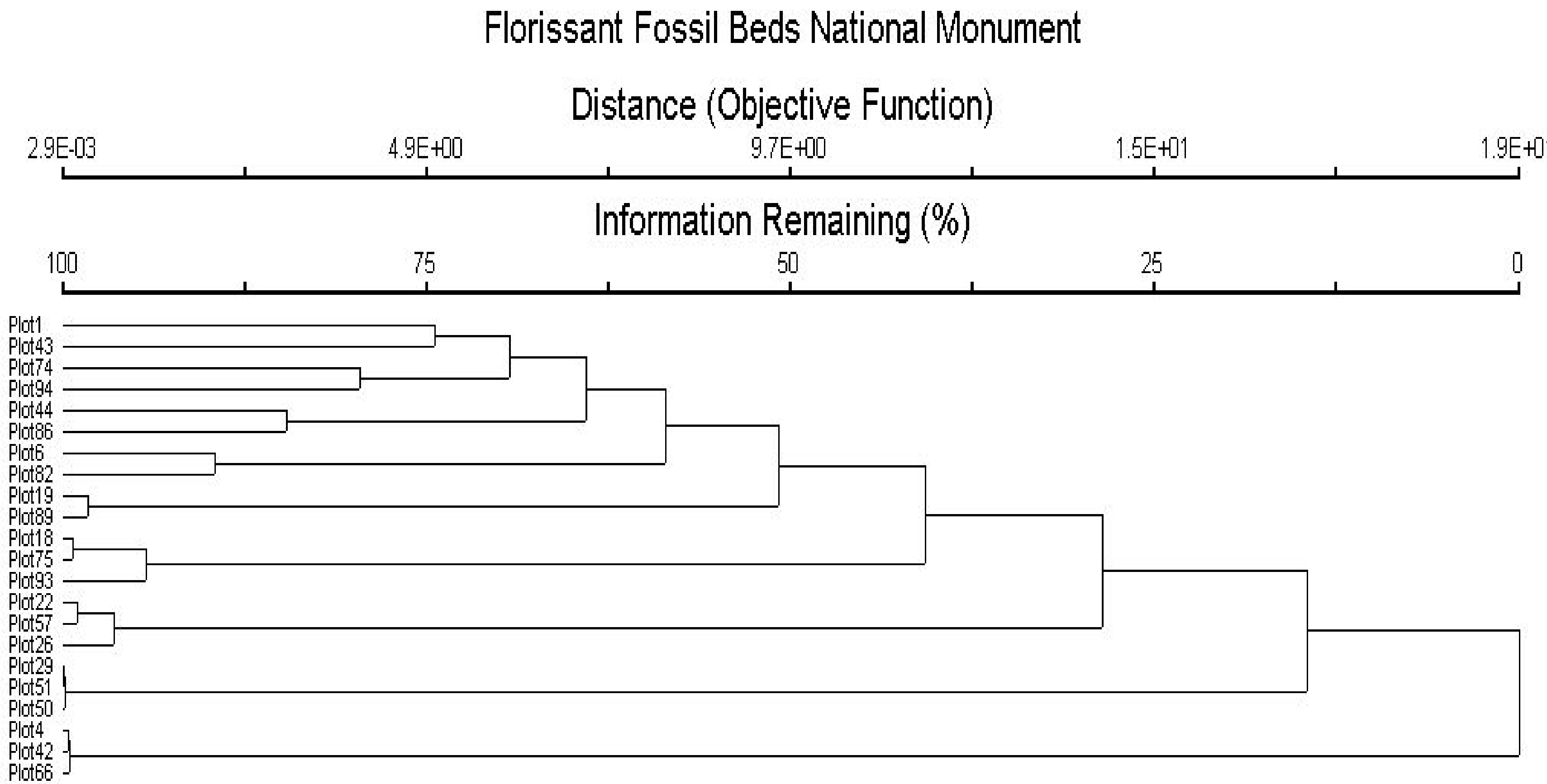
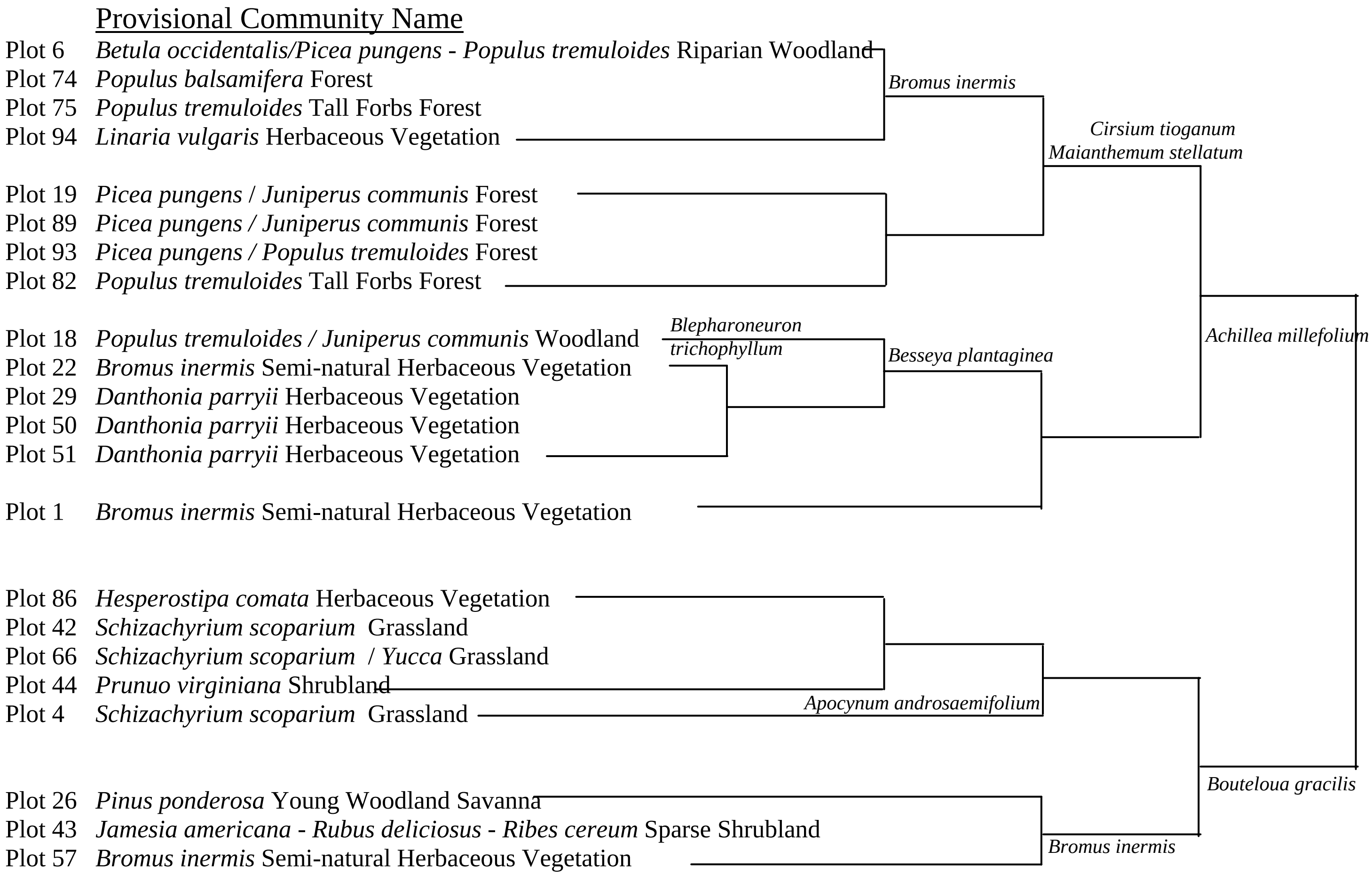


Figure 6. TWINSPAN (McCune and Mefford 1999) Dendrogram with Indicator Species of 22 Plots Collected from Upland Vegetation Types within Forissant Fossil Beds National Monument During the 2001 Field Season



The initial classification and ordination analyses placed the plots representative of the *Picea pungens* / *Juniperus communis* Forest (plots 19 and 89), *Populus balsamifera* Forest (plot 74), and the *Populus tremuloides* Tall Forbs Forest (plot 82) associations within the upland vegetation group (Group 2A). However, ordination of this group suggested that these stands are probably more appropriately placed into the forest, woodland, and shrubland types (Group 2B).

Consequently, the plots were removed from Group 2A and placed into Group 2B for further analyses.

Ordination of the remaining plots within Group 2A placed several of the grassland types dominated by *Hesperostipa comata* and *Schizachyrium scoparium* at one end of the first axis (Figure 7). These stands are located on moderately steep to steep, southfacing slopes (10 – 27 percent slopes). Stands located at the opposite end of the ordination axis tend to either occur on moderately steep northwestern slopes (plots 29 and 50 characterized by *Danthonia parryii*) or mesic drainages (plots 6, 18, 75, and 93 characterized by either *Populus tremuloides, Picea pungens, Betula occidentalis,* or some combination of all three species). Stands located within the center of the ordination appear to occur on drier ridges, mid-slopes, or disturbed sites.

Forest, Woodland, and Shrubland Vegetation Types

Cluster analysis of the 45 plots in this group (Group 2B) consistently produced several primary forest or woodland types (Figures 8, 9, and 10). Stands dominated by *Pinus ponderosa* appeared to be similar in vegetation structure and composition. It may be possible to delineate several ponderosa pine NVCS associations that include *Pinus ponderosa / Cercocarpus montanus* Woodland (plot 28), *P. ponderosa / Festuca arizonica* Woodland (plots 60 and 62), and *P. ponderosa / Muhlenbergia montana* Woodland associations. The composition and cover within several plots (plots 30, 55, 56, 76, and 81) dominated by *Pseudotsuga menziesii* appeared consistent with the *Pseudotsuga menziesii / Juniperus communis* Forest association. The stand represented by plot 83 may illustrate the *P. menziesii / Muhlenbergia montana* Forest association.

Several stands (plots 24 and 31) that may represent the *Pinus aristota* / *Festuca arizonica* Woodland association were sampled during the 2001 field season. Plots 19, 30, and 89 may represent the *Picea pungens / Juniperus communis* Forest association. Several shrubland types characterized by *Chrysothamnus, Cercocarpus montanus, Ribes,* and *Artemisia frigida* may also be delineated within the project area.

Figure 7. Detrended Correspondence Analysis (DECORANA: McCune and Mefford 1999) Ordination of 18 Upland Herbaceous Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season

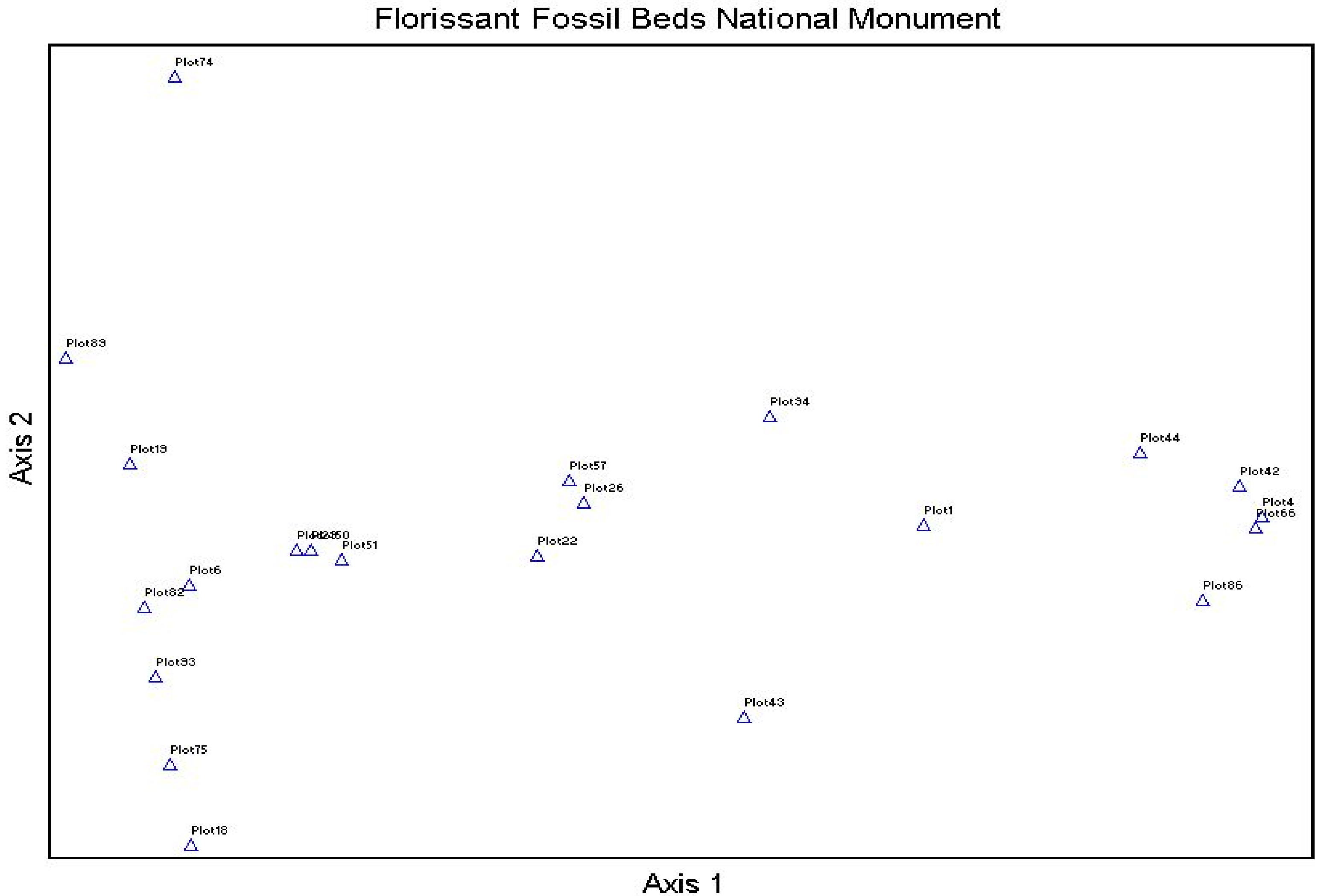


Figure 8. Dendrogram Produced from Cluster Analysis (McCune and Mefford 1999; relative Euclidean distance with Ward's group linkage method) of 48 Forest, Woodland, and Shrubland Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season

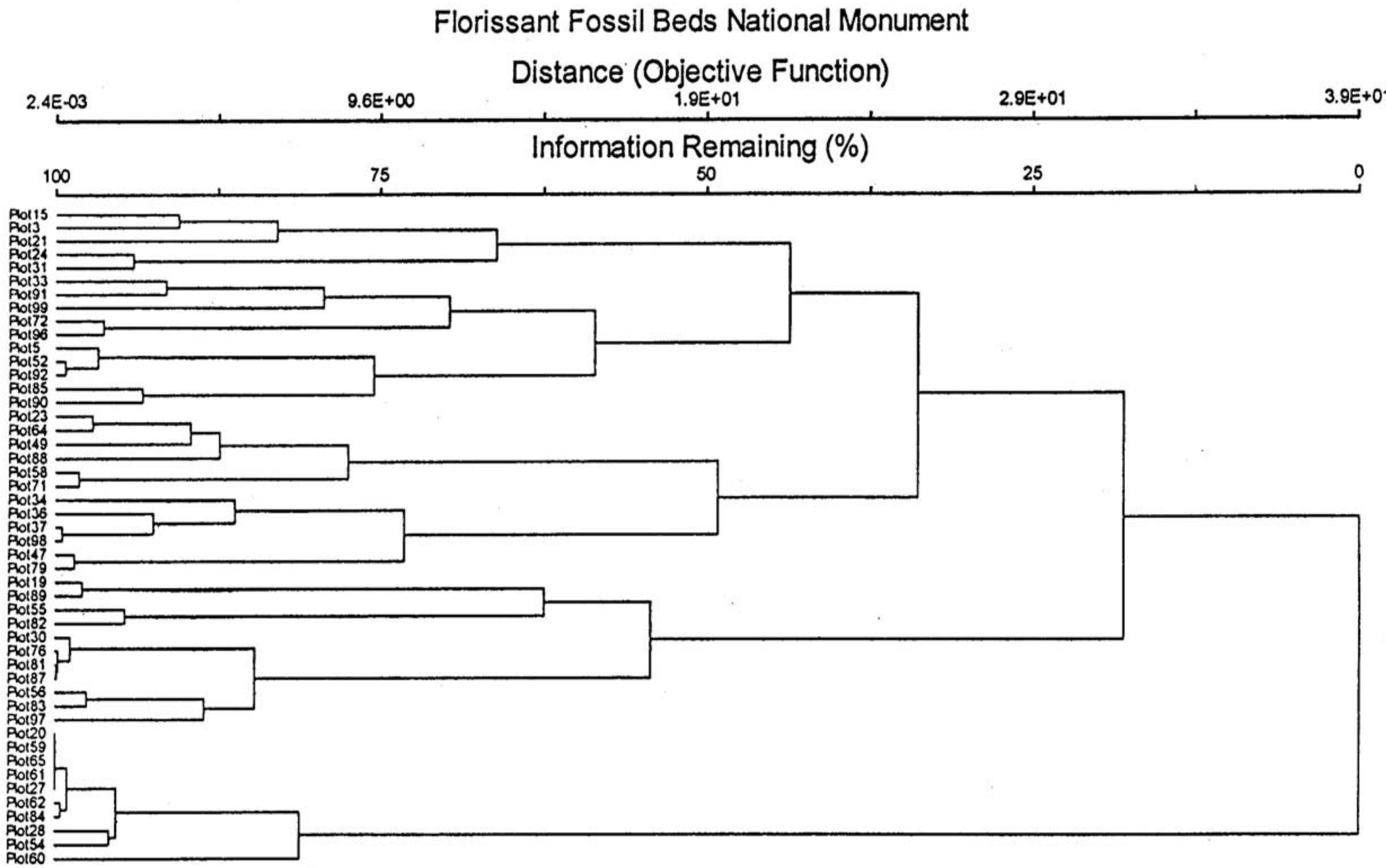
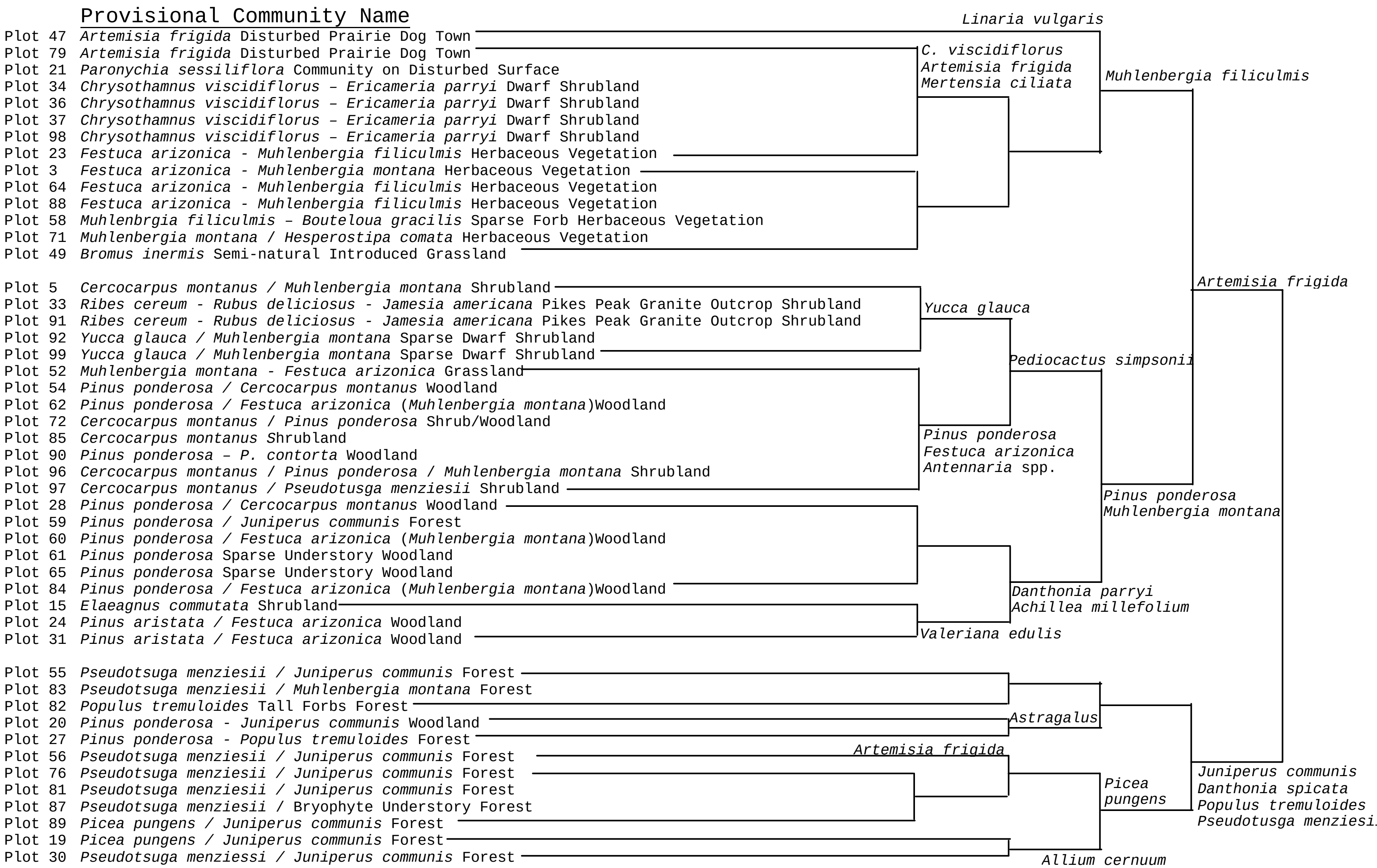
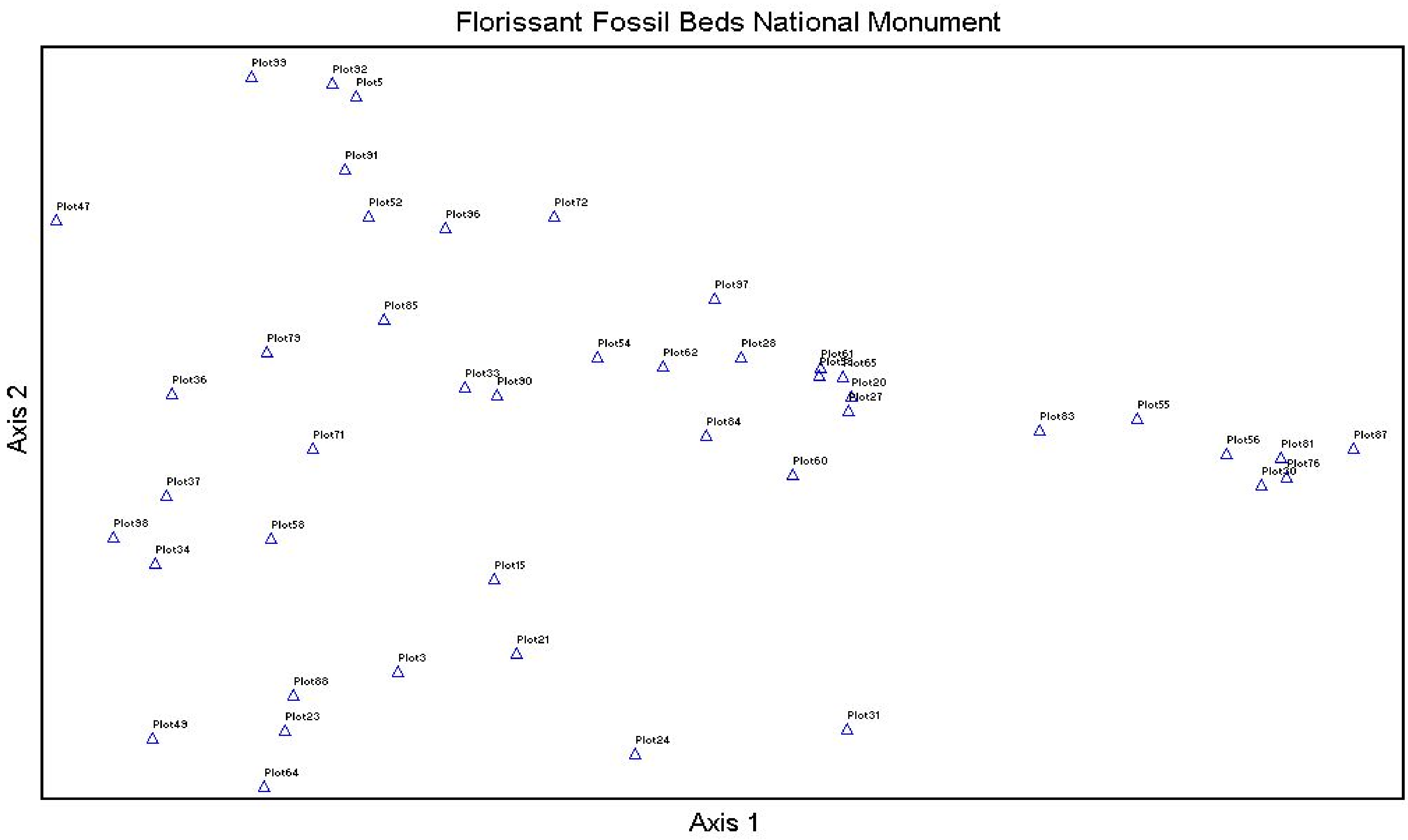


Figure 9. TWINSPAN (McCune and Mefford 1999) Dendrogram, with Indicator Species, of 48 Forest Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season



Ordination of the 45 stands revealed several predictable trends in community distribution that likely reflect a temperature and moisture gradient that is influenced by a combination of elevation, slope, and aspect (Figure 10). *Pseudotsuga menziesii* and *Picea pungens* stands are toward one end of the gradient (Axis 1). These stands tend to occur on elevations greater than 8,700 feet and/or on relatively steep northfacing slopes. Plots characterized by *Pinus ponderosa* tend to occur on elevations less than 8,600 feet and/or moderately steep south or west facing slopes. A variety of mixed shrubs and grasslands represent the lower end of the gradient. The environmental gradient demonstrated by Axis 2 may reflect patterns in soil texture. The distribution of *Yucca glauca* stands toward the upper end with *Festuca arizonica* stands on Axis 2 would tend to indicate such a relationship.

Figure 10. Detrended Correspondence Analysis (DECORANA: McCune and Mefford 1999) Ordination of 48 Forest, Woodland, and Shrubland Plots Collected from Florissant Fossil Beds National Monument During the 2001 Field Season



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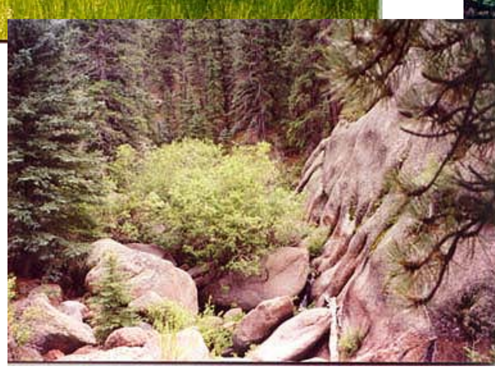
DRAFT ILLUSTRATED KEY TO THE PLANT ASSOCIATIONS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

A diverse assemblage of plant associations or vegetation types were observed and characterized during the summer of 2001 under the National Park Service, Vegetation Mapping Program. To assist in the accurate field identification of 42 plant associations described for Florissant Fossil Beds National Monument during vegetation map production, this dichotomous key, illustrated with images taken during the vegetation sampling effort, has been prepared. It is the intent of the key to allow identification of plant associations with one or a combination of dominant species. For sites that occupy ecotones (areas where dominant species intermix between plant associations), it may be difficult to determine a definitive association name. This illustrated key also allows the user to crosswalk plant associations directly to the Florissant Fossil Beds National Monument vegetation map so that all research can have a common focal point, relative to the baseline year of aerial photography (1996) and field data (2001).

HOW TO USE THIS KEY:

The key approaches plant association identification at two levels. The first level is physiognomic, allowing the user to determine which major group is being evaluated, i.e., forest, woodland, tall shrubland, shrubland, dwarf shrubland, graminoid, or forb. The second level allows identification to plant association based on dominant species foliar cover.



KEY I.

A KEY TO THE MAJOR PHYSIOGNOMIC GROUPS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

1) Vegetation woody or appearing woody; predominantly trees, shrubs, or shrub-like herbs (includes the suffrutescent perennial Artemisia frigida) (2)

1) Vegetation non-woody; predominantly grasses, grass-like herbs (graminoids), and broad-leaf herbs (forbs), which may be quite tall and coarse (3)

2) Vegetation of forest (predominantly of interlocking tree canopies) or woodland (predominantly non-interlocking tree canopies) (Key IIA - Page 5)
Characteristic genera include: Picea, Pseudostuga, Pinus, Populus

2) Vegetation of tall shrub, shrub, dwarf shrub, or shrub-like herbs, canopies may interlock but are more commonly less dense (Key IIB - Page 11)
Characteristic genera include: Betula, Alnus, Salix, Dasiphora, Cercocarpus, Chrysothamnus, Ericameria, Yucca, Artemisia

3) Vegetation of tall and dense, exotic forbs; low-growing and sparse caespitose forbs; or floating and/or submerged aquatic forbs (Key IIC – Page 18)
Characteristic genera include: Cirsium, Linaria, Paronychia, Lemna, Myriophyllum, Ranunculus

3) Vegetation of grasses and graminoids (4)

4) Vegetation of graminoids, growing in wet or moist soils (Key IID - Page 21)
Characteristic genera include: Carex, Juncus

4) Vegetation of grasses, growing in moist to dry soils and on gravel (Key IIE – Page 23)
Characteristic genera include: Agropyron, Bouteloua, Bromus, Danthonia, Festuca, Hesperostipa, Hordeum, Muhlenbergia, Nassella, Pascopyrum, Phalaris, Schizachyrium

KEY II.

KEYS TO THE MAJOR PLANT ASSOCIATIONS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

Typical Landscapes of Florissant Fossil Beds National Monument.

Figure 1. Forest and Woodland Vegetation Types (Key IIA)
Figure 2. Shrubland Vegetation Types (Key IIB)
Figure 3. Forbland Vegetation Types (Key IIC)
Figure 4. Graminoid Vegetation Types (Key IID)
Figure 5. Grassland Vegetation Types (Key IIE)

Figure 1. Forest and Woodland Vegetation Type

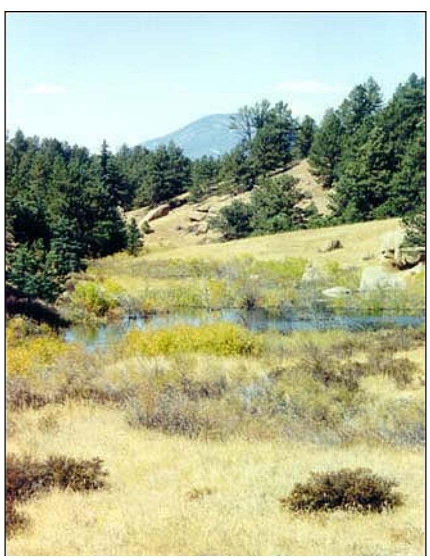


Figure 2. Shrubland Vegetation Type

Figure 3. Forbland Vegetation Type

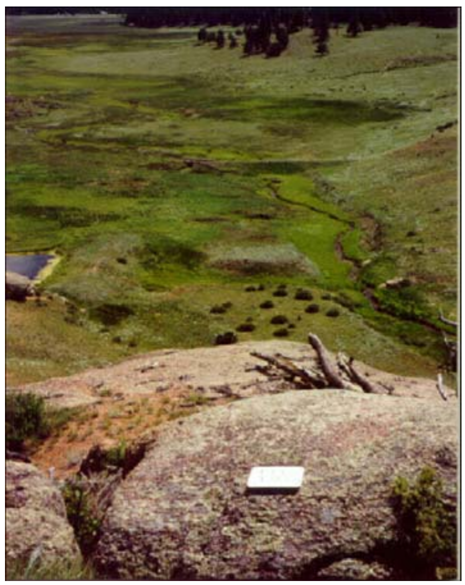


Figure 4. Graminoid Vegetation Type

Figure 5. Grassland Vegetation Type

KEY IIA.

A KEY TO THE FOREST AND WOODLAND ASSOCIATIONS OF FLORISSANT FOSSIL BEDS

1) Forest associations of evergreen or deciduous trees with interlocking canopies, generally providing 60% or greater foliar cover and occupying northern exposures or moist drainages with many exposures (2)

1) Woodland associations of mostly evergreen trees, with canopy openings, generally providing 25-60% foliar cover, often with scattered sapling trees or shrubs present in openings, and occupying southern and western exposures or hill and ridge tops (6)

2) Forest association of deciduous trees growing adjacent to moist drainages, on moist slopes, or along mesic toeslopes. Tree stands dominated by quaking aspen in the overstory and shrub, forb, or grass species in the understory (3)

2) Forest associations of evergreen trees, often with scattered quaking aspen trees present (4)

3) *Populus tremuloides* understory dominated by low-growing shrubs – *Populus tremuloides / Juniperus communis* (Quaking aspen / Common juniper) Forest [Mapping Unit # 11]

3) *Populus tremuloides* understory dominated by graminoids and/or forbs – *Populus tremuloides* (Quaking aspen) Forest [Mapping Unit # 11]

4) Forest association of *Pseudostuga menziesii* trees with the needles attached directly to the branch, cones with exserted, three-pronged scales, understory includes common juniper shrubs, stands occupy north- to east-facing slopes and drainage sides with several aspects – *Pseudostuga menziesii / Juniperus communis* (Douglas-fir / Common juniper) Forest [Map Units # 3 or 4]

4) Forest association of *Picea pungens* trees, with sharp-pointed needles attached to a short peg on the branch and cones with papery bracts, understory usually includes common juniper shrubs, stands occupy north- to east-facing slopes and drainage bottoms – *Picea pungens / Juniperus communis* (Colorado blue spruce / Common juniper) Forest [Map Units # 3 or 4]

6) Woodland association of deciduous trees along a perennial stream (canopy closure in stand may exceed 60%) – *Populus balsamifera* (Balsam Poplar) Woodland [Map Unit # 10]

6) Woodland associations of evergreen trees (7)

7) Woodland association of small- to medium-size *Pinus aristata* trees, characterized by five thin needles per fascicle or group, with visible drops of resin, stands occupy steep, northwest-facing slopes – *Pinus aristata / Festuca arizonica* (Bristlecone Pine / Arizona Fescue) Woodland [Map Unit # 5]

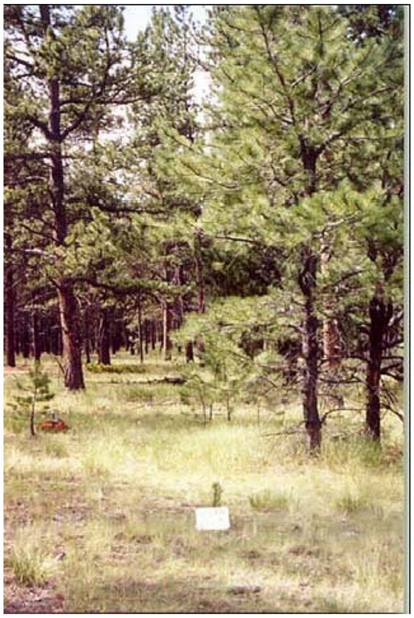
7) Woodland associations of large, single-needle *Picea pungens* along drainages or small to large *Pinus ponderosa* trees, characterized by three thick and long needles per fascicle or group, with no resin on the needles, stands occupy south, east, and west-facing slopes, hilltops, and ridgetops (8)

8) Woodland association of single-needle *Picea pungens* trees emerging from a Betula occidentalis riparian shrubland *Picea pungens / Betula occidentalis* (Colorado blue spruce / River birch) Woodland [Not Mapped - below MMU]

8) Woodland association of three-needle *Pinus ponderosa* trees emerging from an upland shrubland or grassland (9)

9) Woodland association of young *Pinus ponderosa* trees becoming established on an exotic, Bromus inermis grassland (former pasture) – *Pinus ponderosa / Bromus inermis* (Ponderosa pine / Smooth brome) Semi-natural Woodland [Map Unit # 9]

9) Woodland association of mature *Pinus ponderosa* trees (some seedlings or saplings may be present but are not dominant), occupying south, east, and west-facing slopes, hilltops, and ridgetops (10)



10) Woodland association of *Pinus ponderosa* mixed with openings of grass species. Canopy closure may exceed 60% on some north-facing slopes – *Pinus ponderosa / Festuca arizonica* (Ponderosa pine / Arizona fescue) Woodland [Map Unit # 7]

10) Woodland association of *Pinus ponderosa* with openings supporting *Cercocarpus montanus* shrubs and grass understory species – *Pinus ponderosa / Cercocarpus montanus* (Ponderosa pine / Mountain mahogany) Woodland [Map Unit # 8]

KEY IIB.

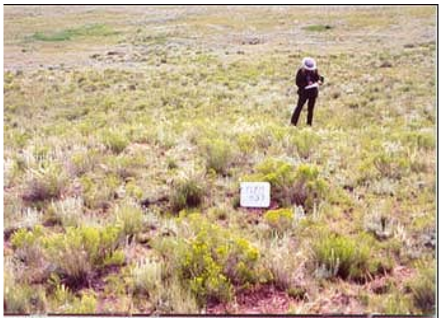
A KEY TO THE SHRUBLAND ASSOCIATIONS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

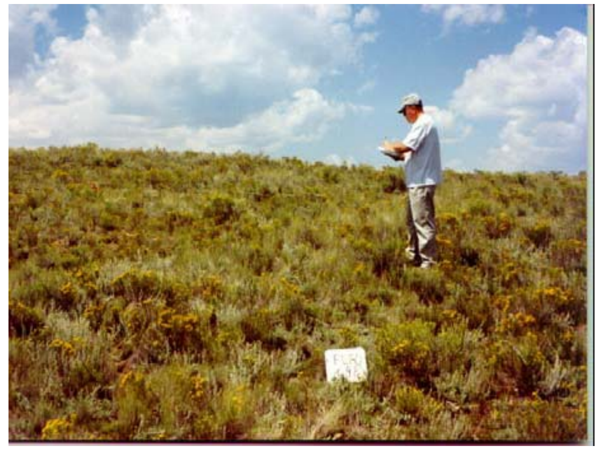
1) Plant associations of dwarf shrubs, less than 0.5 m tall, occupying dry sites of southern exposures (2)

1) Plant associations of shrubs greater than 0.5m tall, occupying a variety of sites and exposures (4)

2) Dwarf shrub association resulting from heavy grazing by prairie dogs, prairie dog burrows and mounds present, typically located on nearly flat slopes (1-5%) and deep soils – *Artemisia frigida / Bouteloua gracilis* (Fringed Sage-wort / Blue Grama) Dwarf-shrubland [Map Unit # 15]

2) Dwarf shrub associations typically located on steeper slopes (5-20%) and shallow soils, low density prairie dog burrows and mounds may be present (3)





3) Dwarf shrub association of deciduous shrubs growing on low-elevation hill-slopes and ridge-slopes (5-10%), at the lowest monument elevations, a few prairie dog burrows and mounds may be present — *Chrysothamnus viscidiflorus* — *Ericameria parryi* (Viscid Rabbitbrush — Parry Rabbitbrush) Shrub Herbaceous Vegetation [Not Mapped - below minimum mapping unit]

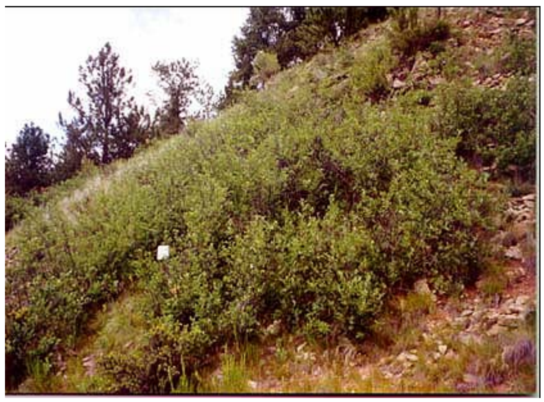
3) Dwarf shrub association of evergreen shrubs with spiny leaves, growing on mid- to upper-elevation gravel slopes (10-30%) — *Yucca glauca* / *Muhlenbergia montana* (Soapweed / Mountain muhly) Shrubland [Map # 31]

4) Shrub associations of moderate-stature plants growing on dry, upland sites, e.g., slopes and rock outcrops (5)

4) Shrub associations of moderately tall to tall plants growing on mesic to saturated sites of swales and drainages (8)

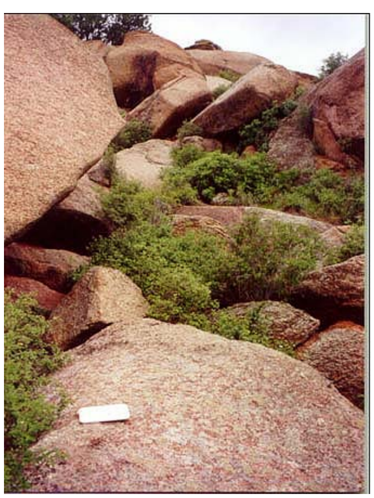
5) Shrub associations growing from the crevices and around the base of large rocks and boulders or from platy, volcanic rocks (6)

5) Shrub associations growing from dry-slopes and hilltops of gravel and thin soil (7)



6) Shrub association growing from platy volcanic rocks, exposed on steep slopes adjacent to upper Grape Creek – *Prunus virginiana - (Prunus americana)* (Chokecherry - (American Plum)) Shrubland [Not Mapped-below MMU]

6) Shrub association growing from joints, cracks, or around the base of Pikes Peak granite boulders, exposed on steep slopes, or occurring as jumbles of boulders on toeslopes – *Jamesia americana* (Waxflower) Rock Outcrop Shrubland [Map Unit # 18]




7) Shrub association consisting of one stand of *Elaeagnus commutata* growing from a west-facing slope on volcanic rock and soil – *Elaeagnus commutate* (Silverberry) Shrubland [Not Mapped - below MMU]

7) Shrub association growing from gravelly soils of hillslopes and ridgeslopes, often in canopy openings of Pinus ponderosa woodlands – *Cercocarpus montanus / Muhlenbergia montana* (Mountain Mahogany / Mountain Muhly) Shrubland [Map Unit # 16]




8) Shrub association of rounded plants from 0.5-1m tall, growing in mesic swales and along perennial streams – *Dasiphora fruticosa* (Shrubby Cinquefoil) Temporarily Flooded Shrubland Alliance [Map Unit # 17]

8) Shrub association of tall plants of the genera *Alnus* and *Salix*, from 2-5m tall, growing along perennial streams or around beaver ponds (9)

9) Shrub association of small, linear stands of *Alnus incana* growing along perennial streams – *Alnus incana* / Mesic Graminoids (Speckled Alder / Mesic Graminoids) Shrubland [Map Unit # 14]

9) Shrub associations of linear stands of Salix growing along perennial streams (10)

10) Shrub association of medium to tall *Salix* with long (6-8 cm), linear leaves – *Salix exigua* (Sandbar / Coyote Willow) Temporarily Flooded Shrubland [Map Unit # 20]

10) Shrub associations of various heights, willows with broader and shorter leaves than described above (11)

11) Shrub association of medium-tall (2-3 m tall) *Salix* with brown to purple-colored stems, growing with aquatic sedge – *Salix brachycarpa / Carex aquatilis* (Short-fruit Willow / Aquatic Sedge) Shrubland [Map Unit # 19]

11) Shrub association of tall (3-5m tall) *Salix* with yellow-colored stems (12)

12) Shrub association of tall (3-5m tall) *Salix* with large bracts at the base of the leaves, growing with a *Carex utriculata* or mesic graminoid understory (13)

12) Shrub association of tall (3-5m tall) *Salix* without large bracts at the base of the leaves, growing with a variety of graminoids and forbs – *Salix lutea* (Yellow Willow) Shrubland [Not Mapped - below MMU]

13) *Salix monticola* shrubs with an understory of predominantly *Carex utriculata* - *Salix monticola / Carex utriculata* (Mountain Willow / Beaked Sedge) Shrubland [Map Unit # 21]

13) *Salix monticola* shrubs with an understory of mixed grasses / sedges, and rushes - *Salix monticola* / Mesic graminoids (Mountain Willow / Mesic graminoids) Shrubland [Map Unit # 21]

KEY IIC.

A KEY TO THE FORB ASSOCIATIONS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

1) Floating or submerged aquatic plants of beaver ponds and historic livestock ponds (2)

1) Forb associations of moist or dry soils, but never floating or submerged aquatics (3)

2) Aquatic plants, bright green to gray-green in color, floating on the water surface creating a mat – *Lemna* spp. (Duckweed) Permanently Flooded Herbaceous Vegetation [Map Unit # 23]

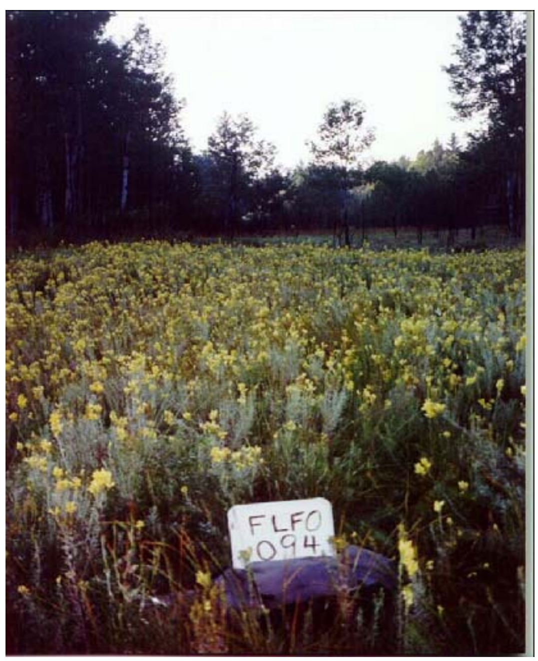
2) Aquatic plants, dark green, submerged beneath the water surface and rooted in the bottom substrate – *Myriophyllum sibiricum* (Water Milfoil) Herbaceous Vegetation [Map Unit # 23]

3) Forb association mostly native, caespitose (mat or cushion plants) perennials occupying a dry upland excavation – *Paronychia sessilflora* (Nailwort) Herbaceous Vegetation [Not Mapped - below MMU]

3) Forb associations mostly exotic, rhizomatous (growing in patches, plants connected by underground stems), perennials occupying moist and deep floodplain or swale soils (4)

4) Forbs 0.5-1 m tall, flower color lavender to purple, leaves prickly, greater than 1 cm wide – *Cirsium arvense* (Canada Thistle) Herbaceous Vegetation [Map Unit # 22]

4) Forbs 0.5-1 m tall, flower color yellow, leaves smooth, less than 1 cm wide – *Linaria vulgaris* (Toadflax or Butter-and-Eggs) Herbaceous Vegetation [Map Unit # 24]



KEY IID.

A KEY TO THE GRAMINOID ASSOCIATIONS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

1) Graminoid associations of saturated soils and standing water, growing along stream channels and on saturated peat (quaking bogs) (2)

1) Graminoid associations of saturated to moist soils, but slightly higher within the floodplain (not immediately adjacent to the stream channel) or on the outermost portion of the floodplain (3)

2) Sedge association a patch or small stand of tall (0.5-1 m), blue-green sedge growing adjacent to the stream channel – *Carex nebrascencis* (Nebraska Sedge) Herbaceous Vegetation [Not Mapped - below MMU]

2) Sedge association a linear stand of tall (0.5-1 m), yellow-green sedge growing adjacent to the stream channel or broader stands on first terraces growing from saturated soils – *Carex utriculata* (Beaked Sedge) Herbaceous Vegetation [Map Unit # 26]

3) Sedge association a linear to broad stand of tall (0.5-1 m), blue-green sedge with pale blue leaf tips, growing on saturated soil or peat on the outer first-terrace of the stream floodplain – *Carex aquatilis* (Aquatic Sedge) Herbaceous Vegetation [Map Unit # 26]

3) Rush association a linear to broad stand of tall (0.5-1 m), dark green rush, growing on moist to saturated soils along the outer floodplain margins – *Juncus balticus* (Baltic or Arctic Rush) Herbaceous Vegetation [Map Unit # 26]

KEY IIE.

A KEY TO THE GRASSLAND ASSOCIATIONS OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

1) Grassland association of an annual, exotic bunchgrass, occupying dried ponds – *Hordeum jubatum* (Foxtail Barley) Herbaceous Vegetation [Map Unit # 29]

1) Grassland associations of perennial, exotic or native species, occupying a variety of habitats (2)

2) Grassland associations of exotic grasses, occupying moist or dry, previously disturbed habitats and soils (3)

2) Grassland associations of native grasses, occupying moist or dry, relatively undisturbed habitats and soils (5)

3) Grassland association of uplands, dominated by the bunchgrass *Agropyron cristatum*, introduced for erosion control and livestock forage on the water pipeline (aqueduct) corridor, on old fields leveled and terraced for seed potato production, and as a pasture grass – *Agropyron cristatum—(Pascopyrum smithii, Hesperostipa comata)* (Crested Wheatgrass - (Western Wheatgrass, Needle-and-Thread)) Semi-natural Herbaceous Vegetation [Not Mapped]

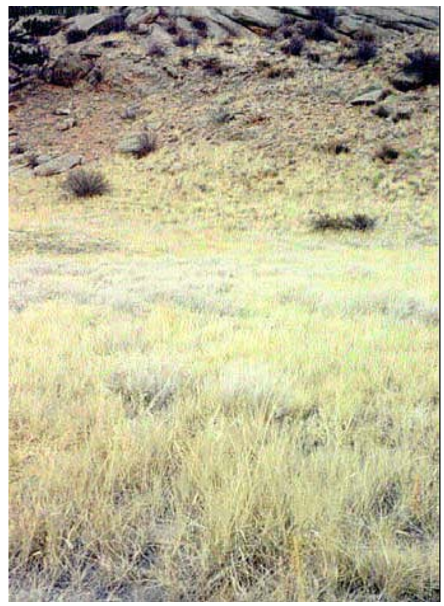
3) Plant association of uplands or of more mesic sites, dominant grasses rhizomatous (4)

4) Grassland association of upland to mesic sites, dominated by the tall (0.5-1 m) *Bromus inermis*, introduced for erosion control and vegetative cover in road rights-of-way, within drainages and floodplains, on the water pipeline (aqueduct) corridor, on old fields leveled and terraced for seed potato production, and as a pasture grass – *Bromus inermis - (Pascopyrum smithii)* (Smooth Brome - (Western Wheatgrass)) Semi-natural Herbaceous Vegetation [Map Unit # 25]

4) Grassland association on saturated wetland soils in the Boulder and Grape Creek drainages, dominated by the robust (1-2 m tall) *Phalaris arundinacea*, introduced for livestock forage or as a contaminant of imported livestock forage – *Phalaris arundinacea* (Reed Canarygrass) Western Herbaceous Vegetation [Not Mapped - below MMU]

5) Grassland associations predominantly of rhizomatous or stoloniferous grass species (6)

5) Grassland associations predominantly of bunch grass species (8)



6) Grassland association dominated by a medium-tall (0.25-0.5 m tall) cool-season grass species of deep, mesic floodplain terrace soils – *Pascopyrum smithii – Nassella viridula* (Western Wheatgrass – Green Needlegrass) Herbaceous Vegetation [Not Mapped - below MMU]

6) Grassland association dominated by short (0.10-0.25 m tall) warm-season grass species of thin, dry hilltop, slope, and ridgetop soils (7)

7) Grassland association of deeper (to 10 cm) soils of slopes of drier hills and ridges the dominant species taller than 10 cm - *Muhlenbergia montana* (Mountain Muhly) Herbaceous Vegetation [Map Unit # 28]

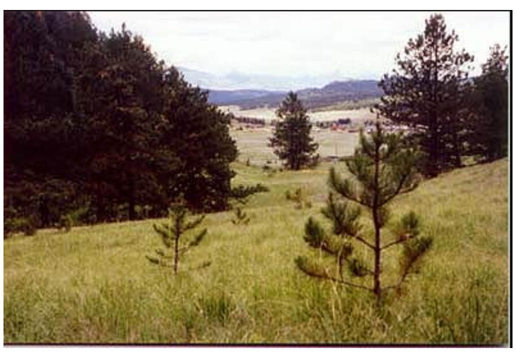
7) Grassland association of thinner soils atop hills and ridges, the dominant species typically shorter than 10 cm - *Muhlenbergia filiculmis* (Slimstem Muhly) Herbaceous Vegetation [Map Unit # 30]

8) Grassland associations of nearly monotypic stands of bunchgrass (9)

8) Grassland associations with a diverse bunchgrass community (10)

9) Grassland association located on dry gravels of steep (10-30%) slopes with southern exposures - *Schizachyrium scoparium* (Little Bluestem) Herbaceous Vegetation [Map Unit # 31]

9) Grassland association located on mesic soils of moderate (5-10%) slopes with northern exposures - *Danthonia parryi* (Parry Oatgrass) Herbaceous Vegetation [Map Unit # 27]



10) Grassland association rare, covering small patches on gravelly toeslopes of south- facing ridges on the north side of Boulder Creek, differing from the next plant association by the presence of *Hesperostipa comata*, a cool season bunchgrass - *Muhlenbergia montana - Hesperostipa comata* (Mountain Muhly—Needle-and- thread) Herbaceous Vegetation [Not Mapped - below MMU]

10) Grassland association common, forming dense stands dominated by *Festuca arizonica* on hills and ridges and in swales and valleys of lower to middle elevations and less dense stands dominated by *Muhlenbergia montana* or *Muhlenbergia filiculmis* on open ridges, slopes, and hilltops of higher elevations (11)

11) Grassland association located on flats and on slopes of hills and ridges – *Festuca arizonica - Muhlenbergia montana* (Arizona Fescue - Mountain Muhly) Herbaceous Vegetation [Map Unit # 28]

11) Grassland association located on hilltops, ridgetops, and upper slopes, below the crown - *Festuca arizonica - Muhlenbergia filiculmis* (Arizona Fescue – Slimstem Muhly) Herbaceous Vegetation [Map Unit # 30]

APPENDIX G

DETAILED DESCRIPTIONS OF THE NVCS VEGETATION ASSOCIATIONS AT FLFO

Table of Contents

I. FOREST

I.A.8.N.c. Conical-crowned temperate or subpolar needle-leaved evergreen forest

I.A.8.N.c.30. PICEA PUNGENS FOREST ALLIANCE
Blue Spruce Forest Alliance

PICEA PUNGENS / JUNIPERUS COMMUNIS FOREST

Blue Spruce / Common Juniper Forest

ELEMENT CONCEPT

GLOBAL SUMMARY: These forests occur at middle elevations (1800-3300 m) of the central and southern Rocky Mountains, usually in moist, concave topographic positions. These communities often occupy sites that are protected from extreme sun and wind, within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. These forests are typically most common on north-facing slopes, which can be gentle to steep. These forests are characterized by the dominance of *Picea pungens* in the forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Pseudotsuga menziesii*, *Abies lasiocarpa,* and *Pinus ponderosa.* *Populus tremuloides* is the only widespread hardwood associate. The shrub layer is usually of only moderate cover and dominated by ericaceous or cold-deciduous species, with the latter group increasing with soil moisture or proximity to watercourses. Common species include *Arctostaphylos uva-ursi, Juniperus communis, Mahonia repens,* and *Rubus parviflorus*. Due to favorable soil moisture, the herbaceous layer is usually a diverse mixture of forbs and graminoids, including *Packera cardamine (= Senecio cardamine), Fragaria virginiana, Linnaea borealis, Pseudoroegneria spicata, Erigeron eximius, Thalictrum fendleri, Maianthemum stellatum*, and *Achillea millefolium*. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands. This association is closely aligned with *Picea pungens / Arctostaphylos urva-ursi* Forest [CEGL000385] and *Picea pungens / Mahonia repens* Forest [CEGL000395]. The presence and abundance of *Arctostaphylos urva-ursi* keys to the former, while a lack of *Juniperus communis* and presence of *Mahonia repens* keys to the later.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: These forest stands occupy moderate to steep drainages, toeslopes, and midslopes (11–43%) throughout the monument. The slope exposures are generally northeast through northwest (5°–312°), however, some exposures that range into the southeast and southwest are possible because of drainage orientation. Stands receive the maximum amount of snow accumulation in winter, due to the location, stand height, and stand density, however, drainage from these stands is rapid during snowmelt or rainfall events. Although rapid drainage occurs because of the steep slopes, the forest floor is covered by thick leaf and woody litter, and moisture retention within the stand was considered to be high.

Global Environment: These forests occur at middle elevations (1800-3300 m) of the central and southern Rocky Mountains, usually in moist, concave topographic positions. Precipitation averages 46-60 cm annually, with the majority falling as growing season rainfall. The temperature regime is continental and winters are moderately severe. Soils are variable, but usually young and derived from glacial or alluvially deposited materials. The pH is neutral to slightly alkaline. Youngblood and Mauk (1985) suggest a preference by these forests for non-igneous parent materials. These communities often occupy sites that are protected from extreme sun and wind, within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. These forests are typically most common on north-facing slopes, which can be gentle to steep. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Stands are uniformly tall (30-35 m) and dense (60–65% or greater foliar cover), characterized by canopies of *Picea pungens*, *Pseudotsuga menziesii*, *Pinus ponderosa*, and *Populus tremuloides* trees. *Picea pungens* usually provides nearly all of the canopy cover present with only minor contributions from the other tree species. The forest subcanopy consists of the same tree species as above, and occasionally *Pinus flexilis*. Subcanopy trees are typically 15–20 m tall and provide approximately 15–20% foliar cover. Trunk diameters were very consistent between species on an average, e.g., *Picea pungens* = 22 cm dbh, *Pseudotsuga menziesii* = 24 cm dbh, and *Populus tremuloides* = 21 cm dbh. The largest trunk diameters recorded in sampled stands were *Picea pungens* = 36.3 cm, *Pseudotsuga menziesii* = 40.3 cm, *Pinus flexilis* = 28.0 cm, and *Populus tremuloides* = 29.5 cm. The shrub layers support seedlings and saplings of the dominant tree species in addition to *Juniperus communis, Dasiphora fruticosa*, *Ribes cereum*, *Arctostaphylos uva-ursi*, and *Rosa woodsii*, among others. Tall shrubs are 2–4 m in height and provide less than 10% foliar cover. Short shrubs are 0.5–2 m tall and provide less than 5% foliar cover, an exception occurring at one sample site where *Juniperus communis* provided approximately 20% foliar cover. Graminoids and forbs contribute little (less than 5%) to the foliar cover values because of the dense shading on the ground surface and the presence of thick litter and downed wood. The most common graminoids present where minor canopy openings allow light penetration include *Danthonia parryi, Festuca arizonica*, and species of *Carex*. The forbs are characterized by *Fragaria virginiana* and *Fragaria vesca, Thalictrum fendleri, Maianthemum stellatum*, and *Solidago* sp. Ground cover was typically divided between litter and downed wood. Some sites visited contained 100% cover by litter, and others were nearly evenly divided (50% each) between herbaceous and woody litter on the ground surface. Both moss and lichen species were present (up to 15% cover in some stands), and foliose lichens were common on tree trunks and branches.

This forest type provides a very dark aerial photo signature, consistent on both true color and CIR photos. Stands typically exceed the minimum mapping unit, but confusion could result with interpretation of this type from forests dominated by *Pseudotsuga menziesii*.

Global Vegetation: These forests are characterized by the dominance of *Picea pungens* in the forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Pseudotsuga menziesii, Abies lasiocarpa,* and *Pinus ponderosa.* *Populus tremuloides* is the only widespread hardwood associate. The shrub layer is usually of only moderate cover and dominated by ericaceous or cold-deciduous species, with the latter group increasing with soil moisture or proximity to watercourses. Common species include *Quercus gambelii, Amelanchier alnifolia, Acer glabrum, Arctostaphylos uva-ursi, Juniperus communis, Mahonia repens*, and *Rubus parviflorus*. Due to favorable soil moisture, the herbaceous layer is usually a diverse mixture of forbs and graminoids, including *Carex siccata (= Carex foenea), Festuca arizonica, Arnica cordifolia, Packera cardamine (= Senecio cardamine), Fragaria virginiana, Linnaea borealis, Pseudoroegneria spicata, Erigeron eximius,* and *Achillea millefolium*. This association is closely aligned with *Picea pungens / Arctostaphylos urva-ursi* Forest [CEGL000385] and *Picea pungens / Mahonia repens* Forest [CEGL000395]. The presence and abundance of *Arctostaphylos urva-ursi* keys to the former, while a lack of *Juniperus communis* and presence of *Mahonia repens* keys to the later.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Picea pungens, Pseudotsuga menziesii, Pinus ponderosa, Populus tremuloides*
Shrub	*Juniperus communis*
Graminoid	*Danthonia parryi*
Forb	*Thalictrum fendleri, Fragaria virginiana*

Global

Stratum	Species
Tree	*Picea pungens, Pseudotsuga menziesii*
Shrub	*Juniperus communis, Arctostaphylos uva-ursi*
Graminoid	*Carex siccata, Festuca arizonica*
Forb	*Arnica cordifolia*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Picea pungens, Pseudotsuga menziesii, Pinus ponderosa, Populus tremuloides*
Shrub	*Juniperus communis*
Graminoid	*Danthonia parryi*
Forb	*Thalictrum fendleri, Fragaria virginiana, Maianthemum stellatum*

Global

Stratum	Species
Tree	*Picea pungens*
Shrub	*Juniperus communis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

- *Picea pungens / Arctostaphylos urva-ursi* Forest (CEGL000385) Note: Juncom is present in most stands, but has less than 5% cover, while Aruv averages >20%
- *Picea pungens / Mahonia repens* Forest (CEGL000395) Note: Aruv and Juncom are generally not present in this type.

SYNONYMY:

- DRISCOLL FORMATION CODE:I.A.9.c. (Driscoll et al. 1984) B
- *Picea pungens/Juniperus communis* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4G5.
Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This forest type was observed on the toeslope of north-facing ridges, hills, and drainage sides and was recorded from approximately 8280-8880 feet in elevation within the monument. In the higher elevations of the southeastern portion of the monument, this type also occupies perennial and intermittent drainages in the headwaters of Grape Creek.

Global Range: This association is known from the Colorado Plateau and southern Rocky Mountains in Utah and Colorado, and may occur in Arizona.

Nations: US
States/Provinces: AZ? UT CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 19, 89
Classification Confidence: 2 **Identifier:** CEGL000392
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Kerr and Henderson 1979, Roberts et al. 1992, Youngblood and Mauk 1985.

I.A.8.N.c.22. PSEUDOTSUGA MENZIESII FOREST ALLIANCE
Douglas-fir Forest Alliance

PSEUDOTSUGA MENZIESII / JUNIPERUS COMMUNIS FOREST
Douglas-fir / Common Juniper Forest

ELEMENT CONCEPT

GLOBAL SUMMARY: This forest association occurs in central and eastern Idaho, southwestern Montana, western Wyoming and north-central Colorado. These forests occupy moderate to steep slopes (11–51%), on exposed rocky slopes and ridgetops, at lower to mid elevations of the forested zone, from 6500-9300 elevation. *Pseudotsuga menziesii* is the dominant tree species in the overstory and often in the understory as well. *Pinus flexilis, Pinus contorta,* or *Pinus albicaulis* are occasionally present on drier sites, *Populus tremuloides* on moister sites. The low-shrub layer is dominated by near-continuous to large patches of *Juniperus communis*. Other shrubs include *Symphoricarpos oreophilus, Shepherdia canadensis, Mahonia repens, Ribes* spp., and *Juniperus horizontalis.* The herbaceous cover is generally depauperate, with less than 10% cover of grasses or forbs. Forb species typically provide less than 5% cover and include *Arnica cordifolia, Astragalus miser, Packera streptanthifolia (= Senecio streptanthifolius),* and *Achillea millefolium var. occidentalis (= Achillea lanulosa).* Grass species also contribute less than 5% herb canopy cover and include *Muhlenbergia montana, Danthonia parryi, Bouteloua gracilis,* or *Festuca arizonica.*

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: These forests occupy moderate to steep slopes (11–51%), merging into *Pinus ponderosa / Festuca arizonica* Woodland (CEGL000856) on upper stand margins and *Picea pungens / Juniperus communis* Forest (CEGL000392) on lower stand margins. Very little soil is exposed in this type and consists of gravel eroded from Pikes Peak granite bedrock. A few granite boulders are exposed; however, they are largely encrusted or covered with lichens and mosses. Stands of Douglas-fir / Common Juniper Forest typically occupy the entire slope, from the upper toeslope to the ridge or hill shoulder. *Pseudotsuga menziesii / Juniperus communis* Woodland (CEGL000439) stands are uncommon within the monument and are related to logging and/or fire opening the tree canopy through removal of individual Douglas-fir trees. The upper slope topographic position represents a drier habitat, thus contributing to the sparse foliar cover for trees in the stand. It is unlikely that these stands are large enough to meet the minimum mapping unit for the project. Some woodland sites contained large Pikes Peak granite boulders and quantities of downed wood (15–30%).

Global Environment: These forests occupy moderate to steep slopes (11–51%), on exposed rocky slopes and ridgetops, at lower to mid elevations of the forested zone, from 6500-9300 elevation. Bare rock can be as much as 40% , often encrusted with lichens; litter depth is usually less than 6 cm.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This forest type is relatively uniform in canopy height, from 20–25 m tall, with only occasional emergent trees. Foliar cover of the canopy layer ranges from 60–75% with approximately 35–65% of the cover value contributed by *Pseudotsuga menziesii*. Other tree species observed in the canopy layer included *Picea pungens* and *Populus tremuloides*. Trunk diameters for *Pseudotsuga menziesii* averaged 25 cm dbh (the largest recorded was 54 cm), for *Picea pungens* 26 cm dbh (the largest recorded was 42 cm), for *Populus tremuloides* 17 cm dbh (the largest recorded was 20 cm), and one *Pinus ponderosa* (14 cm dbh) were present in sampled plots. A tree understory or subcanopy, including the tall-shrub layer, is almost always present and is composed of sapling *Pseudotsuga menziesii*, *Picea pungens*, *Pinus ponderosa*, and *Populus tremuloides*. The subcanopy accounts for approximately 5% foliar cover within a stand. Common shrubs within stands are typically from 0.5-1.0 m tall and include *Juniperus communis, Arctostaphylos uva-ursi, Ribes cereum*, and *Rosa woodsii*. Short shrubs contribute approximately 5–20% to the stand foliar cover, with *Juniperus communis* the most common short shrub present. Graminoids are under 0.5 m in height, provide less than 5% foliar cover, and are dominated by *Danthonia parryi*, *Muhlenbergia montana*, and *Bouteloua gracilis*. Forbs are also under 0.5 m tall and provide less than 5% foliar cover for a stand. The more common forb species identified include *Thalictrum fendleri*, *Maianthemum stellatum*, *Oxytropis lambertii*, and *Solidago* sp. Ground cover was typically 60–80% herbaceous litter and from 15–40% downed wood. One mesic stand had developed a layer of moss and lichen that covered approximately 35% of the ground surface.

A few drier sites supported small stands of *Pseudotsuga menziesii / Juniperus communis* Woodland (CEGL000439), which were included in this description, in the following paragraph. *Pseudotsuga menziesii / Juniperus communis* Woodland (CEGL000439) stands are uncommon, because most sites supporting Douglas-fir are more mesic and are placed in a forest category (greater than 60% foliar cover by tree species). Douglas-fir, to approximately 20 m tall, provide approximately 25–30% foliar cover within woodland stands. Associated canopy trees are typically *Pinus ponderosa, Pinus flexilis,* and *Populus tremuloides*; however, only *Pinus ponderosa* contributed significantly to foliar cover (approximately 5–15%). Douglas-fir within the woodland stands sampled averaged 21 cm dbh, ponderosa pine averaged 30 cm dbh, and quaking aspen averaged 15 cm dbh. The largest tree was a ponderosa pine (43 cm dbh) and large, cut stumps of both Douglas-fir and ponderosa pine were present from historic logging activity. The tall shrubs (from 2–3 m) within the woodland stands were sapling Douglas-fir and ponderosa pine and contributed less than 5% foliar cover. *Juniperus communis* is the dominant short shrub (0.5–1.0 m tall), providing foliar cover of approximately 10% in one stand and up to 40% in another. The persistence of *Juniperus communis* in the understory suggests the former site condition of a forest canopy prior to logging activity. Other shrubs present in the understory, but contributing less than 5% foliar cover, include *Arctostaphylos uva-ursi* and *Ribes cereum*. Graminoids are also sparse providing from 5–10% foliar cover and included *Muhlenbergia montana, Danthonia parryi*, and *Festuca arizonica*. Forbs provide from 2–3% foliar cover and were represented by *Geranium caespitosum, Hymenoxys richardsonii*, and *Antennaria* sp. Ground cover ranged from 50–95% herbaceous litter and up to 30% woody litter. Large cut stumps of Douglas-fir and ponderosa pine were common, and exposed gravel accounted for approximately 15% ground cover at two sample sites.

Stands of this forest will be difficult to interpret from stands of *Picea pungens / Juniperus communis* Forest (CEGL000392) growing on slopes above drainages. In many cases there is almost an even mix of the two species within a stand, in terms of canopy height, tree density, and dbh. Aerial photo signatures are dark green for both associations on true color, and similar signatures appear on CIR. Aerial photo signatures are similar between the forest and woodland types, particularly when slope exposure and position on the slope is considered.

Global Vegetation: *Pseudotsuga menziesii* is the dominant tree species in the overstory and often in the understory as well. *Pinus flexilis, Pinus contorta,* or *Pinus albicaulis* are occasionally present on drier sites, *Populus tremuloides* on moister sites. The low-shrub layer is dominated by near-continuous to large patches of *Juniperus communis.* Other shrubs include *Symphoricarpos oreophilus, Shepherdia canadensis, Mahonia repens, Ribes* spp., and *Juniperus horizontalis.* The herbaceous cover is generally depauperate, with less than 10% cover of grasses or forbs. Forb species typically provide less than 5% cover and include *Arnica cordifolia, Astragalus miser, Packera streptanthifolia (= Senecio streptanthifolius), Achillea millefolium var. occidentalis (= Achillea lanulosa), Galium boreale (= Galium septentrionale), Geranium caespitosum, Hymenoxys richardsonii, Antennaria* spp., *Thalictrum fendleri, Maianthemum stellatum, Oxytropis lambertii*, or *Solidago* sp. Grass species also contribute less than 5% herb canopy cover and include *Muhlenbergia montana, Danthonia parryi, Bouteloua gracilis,* or *Festuca arizonica.*

Global Dynamics: *Juniperus communis* is easily eliminated by fire (Steele et al. 1981).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Pseudotsuga menziesii, Picea pungens, Pinus ponderosa*
Shrub	*Juniperus communis, Arctostaphylos uva-ursi*
Graminoid	*Danthonia parryi, Muhlenbergia montana*
Forb	*Thalictrum fendleri, Maianthemum stellatum*, Goldenrod (*Solidago* sp.), *Geranium caespitosum*

Global

Stratum	Species
Tree	*Pseudotsuga menziesii*
Shrub	*Juniperus communis*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Pseudotsuga menziesii, Picea pungens, Pinus ponderosa*
Shrub	*Juniperus communis, Ribes cereum, Arctostaphylos uva-ursi*
Graminoid	*Danthonia parryi, Muhlenbergia montana*
Forb	*Thalictrum fendleri, Maianthemum stellatum, Solidago* sp., *Fragaria virginiana, Geranium caespitosum*

Global

Stratum	Species
Tree	*Pseudotsuga menziesii*
Shrub	*Juniperus communis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:

- DRISCOLL FORMATION CODE:I.A.9.c. (Driscoll et al. 1984) B
- *Pseudotsuga menziesii/Juniperus communis* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Pseudotsuga menziesii / Juniperus communis* Forest occurs on north- and west-facing slopes (256°–358°), in drainages, along ridges, and other mesic sites within the monument. Most stands occur at mid to high elevations (8525–8875 feet were recorded). Open, woodland stands occur sporadically within the monument, possibly due to historic logging activity coupled with relatively dry site conditions, resulting in a more open canopy. All sampled woodland sites were located on moderately steep (10–24%) upper slopes and aspects from 10^{o}-256^{o}.

Global Range: This forested association occurs in central and eastern Idaho, southwestern Montana, western Wyoming and north-central Colorado.

Nations: US
States/Provinces: CO ID MT WY

ELEMENT SOURCES
Florissant Fossil Beds NM Inventory Notes: Plots 30, 55, 56 ,76, 81, 83, 87
Classification Confidence: 1 **Identifier:** CEGL000439
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Giese 1975, Johnston 1987, Murphy 1982, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Vories 1974.

I.B.2.N.b. Montane or boreal cold-deciduous forest

I.B.2.N.b.10. POPULUS TREMULOIDES FOREST ALLIANCE
Quaking Aspen Forest Alliance

ALLIANCE CONCEPT
Summary: Forests in this alliance are found on rolling topography such as the glacial moraines in Minnesota or the Turtle Mountains and Pembina Hills of North Dakota, often occurring between grasslands and other forest types. The soils are usually deep, well-developed, and loamy. Stands in this alliance often originate following disturbance. This alliance is widespread in the western United States, the northern Great Plains, and extends into the western Great Lakes area. The dominant species of the canopy is *Populus tremuloides*. In the midwestern United States, *Quercus macrocarpa* and *Betula papyrifera* are common associates and can even be codominant in some stands. The shrub layer can be made up of several shrubs common to the Great Plains, including *Corylus cornuta, Corylus americana, Prunus virginiana, Symphoricarpos occidentalis, Amelanchier alnifolia,* and *Rubus* spp. In wetter stands *Cornus* spp. and *Salix* spp. may also be present. The herbaceous layer may contain *Aralia nudicaulis, Carex pensylvanica, Maianthemum canadense, Maianthemum stellatum, Viola* spp., and *Thalictrum dioicum*. In the western United States common associates include *Acer glabrum, Amelanchier alnifolia, Symphoricarpos oreophilus, Bromus carinatus, Calamagrostis rubescens, Thalictrum fendleri, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii,* and *Hesperostipa comata (= Stipa comata)*. In the Dakotas and Wyoming, these stands may remain successionally stable for many dozens of years, while in the more mesic, eastern portion of the range, *Populus tremuloides* forests succeed to other community types much more quickly. *Populus tremuloides* (the species) reaches Texas, Virginia, and West Virginia, but it is unclear whether *Populus tremuloides* communities occur in any of these states. Stands of *Populus tremuloides* in the Trans-Pecos of western Texas occur in ravines and on open talus slopes above 2134 m (7000 feet) elevation; they may best be treated as *Populus tremuloides* communities, or merely as other communities with a component of aspen. Texas stands of *Populus tremuloides* are of limited extent and variable in structure.

Environment: Forests included in this alliance occur extensively in the western U.S., northern Great Plains and extend into the western Great Lakes area. Elevations range from 900-3350 m. Climate is temperate with a relatively long growing season, typically cold winters and often deep snow. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm, except in semi-arid environments where stands are restricted to mesic microsites such as seeps or large snow drifts. Distribution of these forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Topography is variable, sites range from level to steep slopes. Aspect varies according to the limiting factors. Stands at high elevations or northern latitudes are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations or southern latitudes stands are restricted by lack of moisture and are found on cooler north aspects and mesic microsites. The soils are typically deep and well-developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loams. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).

Geography strongly influences this type. In the western U.S., stands occur on mesic upland sites and stream terraces above the floodplain. In the Rocky Mountains, a band of this type occurs at the lower treeline from the plains to toe slopes and slumps. In the Great Basin and southwestern U. S. and the annual precipitation is typically low and stands are found in areas where subsurface soil moisture accumulates or where temperature and evaporation rates are lower such as in swales and canyons, below seeps, and on north aspects of slopes at higher elevations. Stands of *Populus tremuloides* in the Trans-Pecos of western Texas occur in ravines and on open talus slopes above 2135 m. In the northern Great Plains, these forests are typically found on rolling topography such as the glacial moraines in Minnesota or the Turtle Mountains and Pembina Hills of North Dakota (Potter and Moir 1961, MNNHP 1993). They are often on the prairie-forest border between grasslands and other forest types from northern Minnesota to Iowa (Hoffman and Alexander 1987, MNNHP 1993).

Vegetation: Vegetation included in this widespread forest alliance occurs in the western U.S., northern Great Plains and extends into the western Great Lakes area. Stands a have a somewhat closed to closed canopy of trees to 5-20 m tall, that is dominated or codominated by the cold-deciduous broad-leaved tree *Populus tremuloides*. Other broad-leaved trees such as *Populus balsamifera ssp. trichocarpa, Quercus macrocarpa*, and *Betula papyrifera* may be present to codominant depending on geography and topography. Several species of conifer trees may also be present in the tree canopy. Conifers include *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus ponderosa*, and *Pseudotsuga menziesii*. Conifer species may contribute up to 25% of the tree canopy before the stand is reclassified as a mixed stand. Because of the open growth form of *Populus tremuloides* enough light can penetrate for lush understory development. Depending on available soil moisture and other factors like disturbance, the understory structure may be complex with multiple shrub and herbaceous layers, or simple with just a herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs.

In the western U.S. common tree associates include *Populus balsamifera ssp. trichocarpa* in the northern Rocky Mountains (Cooper and Heidel 1997). Scattered conifer trees such as *Pseudotsuga menziesii* and species of *Pinus, Picea, Abies* may also be present. Common shrubs include *Acer glabrum, Amelanchier alnifolia, Artemisia tridentata, Juniperus communis, Prunus virginiana, Rosa woodsii, Shepherdia canadensis, Symphoricarpos oreophilus* and the dwarf-shrubs *Mahonia repens* and *Vaccinium myrtillus*. The herbaceous layers may be lush and diverse. Common graminoids may include *Bromus carinatus, Calamagrostis rubescens, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii, Elymus glaucus, Elymus trachycaulus, Festuca thurberi*, and *Hesperostipa comata (= Stipa comata)*. Associated forbs may include *Achillea millefolium, Eucephalus engelmannii (= Aster engelmannii), Delphinium X occidentale, Geranium viscosissimum, Heracleum sphondylium, Ligusticum filicinum, Lupinus argenteus, Osmorhiza berteroi (= Osmorhiza chilensis), Pteridium aquilinum, Rudbeckia occidentalis, Thalictrum fendleri, Valeriana occidentalis, Wyethia amplexicaulis* and many others. Exotic grasses such as the perennial *Poa pratensis* and the annual *Bromus tectorum* are often common in stands disturbed by grazing.

In the midwestern United States, these forests are found along the prairie-forest border from northern Minnesota to Iowa. *Quercus macrocarpa* and *Betula papyrifera* are common associates and are codominant in some stands. Scattered *Fraxinus pennsylvanica, Populus balsamifera, Quercus ellipsoidalis, Tilia americana*, and *Ulmus americana* may also be present. The shrub layer can be made up of several shrubs common to the Great Plains, including *Corylus cornuta, Corylus americana, Prunus virginiana, Symphoricarpos occidentalis, Amelanchier alnifolia, Viburnum opulus var. americanum (= Viburnum trilobum)*, and *Rubus* spp. In wetter stands *Cornus* spp. and *Salix* spp. may also be present. The herbaceous layer may contain *Aralia nudicaulis, Carex pensylvanica, Maianthemum canadense, Maianthemum stellatum, Sanicula marilandica, Oryzopsis asperifolia, Schizachne purpurascens, Viola* spp., and *Thalictrum dioicum*.

Populus tremuloides (the species) reaches Texas, Virginia, and West Virginia, but it is unclear whether *Populus tremuloides* communities occur in any of these states. Texas stands of *Populus tremuloides* are of limited extent and variable in structure. More study is needed to determine this.

Dynamics: Stands in this alliance often originate, and are likely maintained, by stand-replacing disturbances such as crown fire, disease and windthrow, or clear-cutting by man or beaver. The stems of these thin-barked, clonal trees are easily killed by ground fires, but they can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). The stems are relatively short-lived (100-150 years), and the stand will succeed to longer-lived conifer forest if undisturbed. Stands are favored by fire in the conifer zone (Mueggler 1988). With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because of the long moist conditions required to establish are rare in the extant habitats. Superficial soil drying will kill seedlings (Knight 1994). In the Dakotas and Wyoming, these stands may remain successionally stable for many dozens of years (Girard et al. 1989). In the more mesic areas of the eastern segment of its range, they succeed to other community types much more quickly (MNNHP 1993).

Comments: This alliance is floristically similar to other forest alliances that are dominated by *Populus tremuloides* alone or in combination with *Betula papyrifera*. Among these are I.B.2.N.e *Populus tremuloides - Betula papyrifera* Forest Alliance (A.269), I.B.2.N.d *Populus tremuloides* Temporarily Flooded Forest Alliance (A.300), and I.C.3.N.a *Picea glauca - Abies balsamea - Populus* spp. Forest Alliance (A.418). Stands in Texas may best be treated as *Populus tremuloides* communities or merely as other communities with a component of aspen. Texas stands of *Populus tremuloides* are of limited extent and variable in structure. Further information is needed. Stands in Nevada, described by Blackburn et al. (1968a, 1968b, 1971), are restricted to stream terraces, do not have enough tree canopy cover to be classified as forests, and would be better classified as woodlands. More study is needed especially if these sites have a flood regime. Stands in California need association-level description.

ALLIANCE DISTRIBUTION

Range: Forests included in the alliance have been described from across the western United States, northern Great Plains, extend into the western Great Lakes area as far east as Michigan and Iowa. Its northern extent is in Canada in Saskatchewan, Manitoba, and Ontario. Associations need to be described in California, Arizona, western Texas. It may also occur in West Virginia and Virginia.
Nations: CA US
States/Provinces: AB? AZ? CA? CO IA ID MB MN MT ND NM NV ON OR SD SK TX? UT WA WI WY

ALLIANCE SOURCES

Authors: A.S. WEAKLEY 2-96, MOD. K, JT, WCS **Identifier:** A.274
REFERENCES: Alexander 1986, Bader 1932, Baker 1982b, Baker and Kennedy 1985, Blackburn et al. 1968b, Blackburn et al. 1968c, Blackburn et al. 1969b, Blackburn et al. 1969d, Blackburn et al. 1971, Bond 1959, Boyce 1977, Bunin 1975a, Bunin 1975c, Coenenberg and Depuit 1979, Cooper and Heidel 1997, Cooper and Pfister 1981, Costello 1954, Cox 1968, Crouch 1983, Curry 1962, DeByle 1985, DeByle 1989, DeByle and Winokur 1985, Dick-Peddie 1993, Dorn 1969, Eyre 1980, Faber-Langendoen et al. 1996, Ferchau 1973, Giese 1975, Girard et al. 1989, Hansen et al. 1988a, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Hoffman and Alexander 1987, Holland 1986b, Johnston 1987, Johnston and Hendzel 1985, Keammerer and Peterson 1981, Keammerer and Stoecker 1975, Keammerer and Stoecker 1980, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999, Knight 1994, Komarkova et al. 1988a, Komarkova et al. 1988b, Langenheim 1962, Lewis 1975, Lynn et al. n.d., MNNHP 1993, MTNHP n.d., Marr et al. 1973a, Marr et al. 1973b, Morgan 1969, Mueggler 1988, Mueggler and Campbell 1982, Mueggler and Campbell 1986, Murphy 1982, Mutel 1976, Palmer 1929, Paulsen 1969, Peet 1975, Peet 1981, Plumb 1988, Potter and Moir 1961, Powell 1988a, Reed 1971, Richard et al. 1996, Rominger and Paulik 1983, Sawyer and Keeler-Wolf 1995, Severson and Thilenius 1976, Shepherd 1975, Shepperd 1990, Terwilliger et al. 1979a, Wasser and Hess 1982, Williams and Lillybridge 1983, Youngblood and Mueggler 1981

FLORISSANT FOSSIL BEDS NM STAND DESCRIPTION

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: The *Populus tremuloides* Forest occupies mesic sites such as heads of drainages, moist slopes along the margins of stands of *Picea pungens* and *Pseudotsuga menziesii*, and some shallow drainages. *Populus tremuloides* trees persist following invasion of clones by conifer trees through succession. Slopes upon which *Populus tremuloides* established were shallow to moderately steep with 2–20% recorded. The aspects varied a great deal, but stands were more common on northeast to northwest exposures. The bark of quaking aspen trees was heavily browsed by elk, up to 3 m high on the trunk.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Populus tremuloides* Forest stands, or clones are relatively small within the monument, rarely exceeding 1.0–1.5 ha. Tree height is related to the age of the clone, where trees in a medium-aged clone were estimated to be approximately 30–35 m tall and a young clone was estimated to have trees measuring from 15–20 m tall. Clone maturity also relates to trunk diameter, as sampled stands averaged 19 cm dbh and 18 cm dbh. The bark of quaking aspen trees was heavily browsed and used for antler-polishing by elk, leaving the lower portion of the trunk roughened and black in color. Many root-sucker shoots were also heavily browsed. Foliar cover for the quaking aspen canopy, of sampled stands, ranged from approximately 60–70%. The associated shrubs were typically from 1–2 m tall, e.g., *Juniperus communis, Dasiphora fruticosa, Ribes inerme,* and *Salix* spp., provided from 5–10% foliar cover. Graminoids ranged from 0.5–1 m in height, and contributed from 5–10% foliar cover. The most common graminoids present included *Bromus porteri, Danthonia parryi, Blepharoneuron tricholepis*, and the exotics *Bromus inermis, Poa pratensis*, and *Agrostis scabra*. Forbs rarely contributed more than 5% foliar cover under quaking aspen canopies. The most common forbs present included *Thalictrum fendleri, Vicia americana,* and *Fragaria* spp, and the monument-rare Colorado columbine (*Aquilegia caerulea*) was recorded within one quaking aspen clone. Ground cover was predominantly herbaceous litter, ranging from values of 75–80%, with the remaining cover provided by downed wood.

Populus tremuloides Forest clones are small and rarely if ever exceed the project minimum mapping unit (0.5 ha). They are, however, easily interpreted from both true color and CIR aerial photography and could be considered as a Park Special for mapping purposes.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Populus tremuloides*
Shrub	*Juniperus communis, Dasiphora fruticosa*
Graminoid	*Danthonia parryi, Bromus porteri, Festuca arizonica, Poa pratensis, Bromus inermis*
Forb	*Thalictrum fendleri, Vicia americana, Taraxacum officinale*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Populus tremuloides*
Shrub	*Juniperus communis, Dasiphora fruticosa*
Graminoid	*Danthonia parryi, Bromus porteri, Poa pratensis, Bromus inermis*
Forb	*Thalictrum fendleri, Vicia americana, Fragaria virginiana*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Aquilegia caerulea, Heracleum maximum, Urtica dioica, Oxytropis lambertii*

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Populus tremuloides* Forest stands are present along mesic drainages, on moist sites within swales, and at the moist fringe of dense *Picea pungens* and *Pseudotsuga menziesii* stands. Individual and small clones of quaking aspen are intermixed into many other forest and woodland types in the monument. The elevation range occupied includes that of the monument, from approximately 8,450 feet to 8,765 feet for sampled stands. The largest of these stands are located adjacent to the monument on private land.

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 18, 75

POPULUS TREMULOIDES / JUNIPERUS COMMUNIS FOREST

Quaking Aspen / Common Juniper Forest

ELEMENT CONCEPT

GLOBAL SUMMARY: This association is known from the mountains of Colorado, Wyoming and Montana, where it occurs in two differing environments: (1) warm, dry sites near the margin of bunchgrass meadows and (2) swales, broad benches or dry flats acting as frost pockets, or where subject to cold-air drainage. This association occurs on nearly all exposures, gentle to moderate slopes (10-18%), and elevations from 9000 to 9720 feet. Stands have a somewhat closed to closed canopy of trees 5-20 m tall, that is dominated or codominated by the cold-deciduous, broad-leaved tree *Populus tremuloides*. Scattered conifer trees such as *Pseudotsuga menziesii* and species of *Pinus, Picea,* and *Abies* may also be present. Common shrubs include *Juniperus communis, Acer glabrum, Mahonia repens (= Berberis repens), Dasiphora fruticosa, Arctostaphylos uva-ursi, Paxistima myrsinites, Rosa woodsii, Symphoricarpos oreophilus,* and dwarf-shrubs *Mahonia repens* and *Vaccinium myrtillus*. The herbaceous layer is not abundant.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This forest type occupies mesic sites such as heads of drainages, moist slopes along the margins of stands of *Picea pungens* and *Pseudotsuga menziesii*, and some shallow drainages. Slopes upon which *Populus tremuloides* has established are shallow to moderately steep with 10–12% recorded. Aspects vary a great deal, but stands were more common on northeast to northwest exposures. The bark of quaking aspen trees was heavily browsed by elk, up to 3 m high on the trunk.

Global Environment: Distribution of these forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). This forest type occurs in two differing environments: (1) warm, dry sites near the margin of bunchgrass meadows and (2) swales, broad benches or dry flats acting as frost pockets, or where subject to cold-air drainage. It occurs on nearly all exposures, gentle to moderate slopes (10-18%), and elevations from 9000 to 9720 feet.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: These forest stands or clones are relatively small within the monument, rarely exceeding 1.0–1.5 ha. Tree height is related to the age of the clone, where trees in a very mature clone were estimated to be approximately 40–45 m tall, and medium-aged clones were estimated to have trees approximately 20–35 m tall. Trunk diameters were recorded for the mature clone, which averaged 27 cm dbh, and the largest dbh recorded was 38 cm. The bark of quaking aspen trees was heavily browsed by elk, leaving the lower portion of the trunk roughened and black in color. Foliar cover for the quaking aspen canopy, of sampled and observed stands, ranged from approximately 60–80%. The associated shrubs were typically from 1–2 m tall, e.g., *Juniperus communis*, *Dasiphora fruticosa*, *Ribes inerme*, and *Rosa woodsii*, provided from 5–50% foliar cover. The higher value was related to dense understories of *Juniperus communis* in more mature stands of quaking aspen. Graminoids ranged from 0.5–1 m in height and contributed from 5–10% foliar cover. The most common graminoids present included *Bromus porteri, Danthonia parryi*, and the exotics *Bromus inermis* and *Poa pratensis*. Forbs rarely contributed more than 5% foliar cover under these forest canopies. The most common forbs present included *Thalictrum fendleri, Vicia americana, Taraxacum officinale,* and *Achillea millefolium.* Ground cover is predominantly herbaceous litter, ranging from values of 75–95%, with the remaining cover provided by downed wood.

Clones rarely exceed the project minimum mapping unit. They are, however, easily interpreted from both true color and CIR aerial photography and could be considered as a Park Special for mapping purposes.

Global Vegetation: Stands have a somewhat closed to closed canopy of trees 5-20 m tall, that is dominated or codominated by the cold-deciduous, broad-leave tree *Populus tremuloides*. Scattered conifer trees such as *Pseudotsuga menziesii* and species of *Pinus*, *Picea*, and *Abies* may also be present. Common shrubs include *Juniperus communis*, *Acer glabrum, Mahonia repens (= Berberis repens), Dasiphora fruticosa, Arctostaphylos uva-ursi, Paxistima myrsinites, Rosa woodsii, Symphoricarpos oreophilus,* and the dwarf-shrubs *Mahonia repens* and *Vaccinium myrtillus*. The herbaceous layer is not abundant. Common graminoids may include *Bromus porteri, Danthonia parryi, Elymus trachycaulus, Elymus glaucus, Bromus carinatus, Calamagrostis rubescens, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii, Festuca thurberi,* and *Hesperostipa comata*. The most common forbs present include *Thalictrum fendleri, Vicia americana*, *Taraxacum officinale, Achillea millefolium, Astragalus flexuosus, Fragaria virginiana, Pseudocymopterus montanus, Thermopsis divaricarpa, Campanula rotundifolia,* and *Arnica cordifolia.* Exotic grasses such as the perennial *Poa pratensis, Bromus inermis* and the annual *Bromus tectorum* are often common in stands disturbed by grazing.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Populus tremuloides*
Shrub	*Juniperus communis, Dasiphora fruticosa*
Graminoid	*Danthonia parryi, Bromus porteri, Poa pratensis, Bromus inermis*
Forb	*Thalictrum fendleri, Vicia americana, Taraxacum officinale*

Global

Stratum	Species
Tree	*Populus tremuloides*
Shrub	*Juniperus communis,*
Graminoid	*Poa pratensis, Bromus inermis*
Forb	*Achillea millefolium, Thalictrum fendleri, Vicia americana, Taraxacum officinale*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Populus tremuloides*
Shrub	*Juniperus communis, Dasiphora fruticosa*
Graminoid	*Danthonia parryi, Bromus porteri, Poa pratensis, Bromus inermis*
Forb	*Thalictrum fendleri, Vicia americana, Fragaria virginiana*

Global

Stratum	**Species**
Tree	*Populus tremuloides*
Shrub	*Juniperus communis*
Graminoid	*Carex siccata*
Forb	*Thalictrum fendleri, Fragaria virginiana*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pseudotsuga menziesii, Pinus ponderosa*

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:I.B.3.b. (Driscoll et al. 1984) B
- *Populus tremuloides/Juniperus communis* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Populus tremuloides / Juniperus communis* Forest stands are present along mesic drainages, on moist sites within swales, and at the moist fringe of dense *Picea pungens* and *Pseudotsuga menziesii* stands. Individual and small clones of quaking aspen are intermixed into many other forest and woodland types in the monument. The elevation range occupied includes that of the monument, from approximately 8450-8765 feet for sampled and observed stands.

Global Range: This association is known from the mountains of Colorado, Wyoming and Montana.

Nations: US
States/Provinces: CO MT? WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 82
Classification Confidence: 2 **Identifier:** CEGL000587
REFERENCES: Bourgeron and Engelking 1994, Curry 1962, Driscoll et al. 1984, Johnston 1987, Marr et al. 1973b, Murphy 1982, Peet 1975, Peet 1981, Powell 1988a, Shepherd 1975, Youngblood and Mueggler 1981.

II. WOODLAND

II.A.4.N.a. Rounded-crowned temperate or subpolar needle-leaved evergreen woodland

II.A.4.N.a.39. PINUS ARISTATA WOODLAND ALLIANCE
Bristlecone Pine Woodland Alliance

PINUS ARISTATA / FESTUCA ARIZONICA WOODLAND

Bristlecone Pine / Arizona Fescue Woodland

ELEMENT CONCEPT

GLOBAL SUMMARY: This is an association confined to exposed, wind-swept ridges and steep slopes in the upper montane and subalpine zones of the southern Rocky Mountains. These open to moderately closed woodlands occur on all aspects, but are most common on drier south- and west-facing slopes. Slopes are typically moderate to steep, but may also be gentle. Soils are typically well-drained, shallow, and skeletal. Stands have an open to moderately closed canopy typically 5-15 m tall that is solely dominated or codominated by *Pinus aristata*. Individual trees may reach 20 m. In some stands trees are clumped with grassy patches interspersed. Other tree species that may be present to codominant vary geographically within its range. *Picea engelmannii* and *Pseudotsuga menziesii* are the most common. *Pinus flexilis* has also been reported as an associate in some stands. *Abies lasiocarpa* and *Populus tremuloides* may be scattered in some stands, but are generally restricted to more mesic sites and are typically absent in the drier southern extent of this association. The understory vegetation ranges from moderately dense to sparse (typically) because sites are dry and often have large amounts of rock cover. The sparse to moderately dense herbaceous layer often dominates the understory. The most common species are typically graminoids, especially species of *Festuca*. This association differs from the *Pinus aristata / Trifolium dasyphyllum* Woodland [CEGL000762] by having a higher and more consistant cover of perennial grasses.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: These woodland stands occupy steep, erosive slopes (22–28%) that are at least partially composed of volcanic rock and soil weathered from volcanic rock. The soils are a gritty, silty clay under the stand on Fossil Stump Hill and gravelly under the eastern stand. Stands of bristlecone pine grow from the toeslope to the slope shoulder, where they intermix with *Pinus ponderosa* and *Pseudotsuga menziesii*. The slope exposure is predominantly west to northwest (255–310 degrees), and the elevation is approximately 8350 feet for the two stands known in the monument.

Global Environment: This woodland association occurs on semi-xeric sites in the subalpine zone in the southern Rocky Mountains. Elevations range from 2600-3670 m (8500-12,050 feet). Climate is semi-arid, cold temperate with cool summers. Annual precipitation patterns and amounts vary with latitude, but locally the sites are typically xeric on exposed, wind-swept rocky slopes and ridges. These open to moderately closed woodlands occur on all aspects, but are most common on drier south- and west-facing slopes. Slopes are typically moderate to steep, but may also be gentle. Soils are typically well-drained, shallow, skeletal and coarse-textured such as gravelly, sandy loams or loams. Stands occur most frequently on igneous, metamorphic and volcanic substrates such as andesite, granite, gneiss, breccia, tuff, conglomerate, but also occur on sedimentary rocks like sandstone. Exposed bedrock is common. Soil pH is 4.5-6.9, acid to slightly acid.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Two stands are dominated by *Pinus aristata / Festuca arizonica* Woodland within the monument and are characterized by canopy trees that are approximately 15 m in height and subcanopy trees to approximately 10 m tall. The stand on Fossil Stump Hill occupies much drier soils and is located on a physically smaller hill than the eastern stand, consequently, it is more depauperate in terms of understory species. The largest *Pinus aristata* tree recorded for a sampling plot on Fossil Stump Hill measured 61.6 cm dbh, and the largest tree in the easternmost stand measured 33.7 cm. Both stands are reproducing, with seedling and sapling *Pinus aristata* trees present on the slopes. Some trees were showing chlorosis and browning of needles (possibly normal leaf drop conditions for this species), and signs of historic logging (axe-cut stumps) were observed. Crown cover for both stands was approximately 25–30% for both the canopy and subcanopy trees. Foliar cover for shrubs in all layers, e.g., *Pinus aristata* saplings, *Ribes cereum*, *Dasiphora fruticosa*, and *Artemisia frigida*, averages less than 5% within a stand. Graminoids provide foliar cover of approximately 10%, with *Festuca arizonica*, *Danthonia parryi*, *Muhlenbergia montana*, and *Koeleria macrantha* the most commonly observed species. A number of forb species are present within these stands, but the contribution to foliar cover is less than 5%. The most common forbs include *Besseya plantaginea*, *Maianthemum stellatum*, *Geranium caespitosum*, and *Achillea millefolium*. Ground cover is predominantly herbaceous litter under one stand (85%) and small gravel and herbaceous litter under the other (55% and 35% respectively). Lichens are present, providing up to 10% ground cover.

The two stands of *Pinus aristata / Festuca arizonica* Woodland are relatively small, but are close to the project minimum mapping unit. Some signature confusion with dense ponderosa pine may occur with true color aerial photos; however, the location of both stands is known which will guide interpretation.

Global Vegetation: Stands have an open to moderately closed canopy typically 5-15 m tall that is solely dominated or codominated by the long-lived evergreen, needle-leaved tree *Pinus aristata*. Individual trees may reach 20 m. In some stands trees are clumped with grassy patches interspersed. Other tree species that may be present to codominant vary geographically within its range. *Picea engelmannii* and *Pseudotsuga menziesii* are the most common. *Picea pungens* is common in the southern extent where stands occur at high elevations, and *Pinus flexilis* has also been reported as an associate in some stands. *Abies lasiocarpa* and *Populus tremuloides* may be scattered in some stands, but are generally restricted to more mesic sites and are typically absent in the drier southern extent of this association.

The understory vegetation ranges from moderately dense to typically sparse because sites are dry and often have large amounts of rock cover. The sparse to moderately dense herbaceous layer often dominates the understory. The most common species are typically graminoids, especially species of *Festuca*. Common species may include *Calamagrostis purpurascens, Carex* spp., *Danthonia parryi, Festuca arizonica, Festuca brachyphylla, Festuca idahoensis, Festuca thurberi, Koeleria macrantha, Muhlenbergia filiculmis, Muhlenbergia montana, Poa fendleriana,* and *Trisetum spicatum*. Forbs are generally sparse, but *Trifolium dasyphyllum* may reach 10% cover. Other scattered forbs may include species of *Achillea, Antennaria, Artemisia, Arenaria, Arnica, Astragalus, Campanula, Erigeron, Hymenoxys, Penstemon, Polemonium, Sedum, Senecio,* and *Thalictrum*. This association differs from the *Pinus aristata / Trifolium dasyphyllum* Woodland [CEGL000762] by having a higher and more consistant cover of perennial grasses.

Global Dynamics: *Pinus aristata* is a slow-growing, extremely long-lived tree (Brunstein and Yamaguchi 1992). Several individuals over 2000 years old have been found in Colorado. DeVelice et al. (1986) observed that it occurs in open park-like stands and on steep rocky slopes where *Picea engelmannii - Abies lasiocarpa* stands are excluded by drought. Fire is important in the grass-dominated stands but is rarely intense enough to result in tree-killing crown fires (DeVelice et al. 1986). In some stands, suppression of grass fires has allowed encroachment of the trees into meadows (Larson and Moir 1987). Forage production is good in some stands, but rarely utilized by livestock because stands are steep and generally remote which makes access difficult.

Peet (1978b, 1981) noted that *Pinus aristata* is dominant at higher elevations in much of the southern Rocky Mountains, where *Pinus flexilis* is restricted to lower elevations. This is attributed to apparent competitive exclusion, because *Pinus flexilis* is dominant at high elevations in northern Colorado, Wyoming and Montana.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus aristata*
Shrub	*Ribes cereum*
Graminoid	*Festuca arizonica, Danthonia parryi*
Forb	*Besseya plantaginea*

Global

Stratum	**Species**
Tree	*Pinus aristata*
Shrub	*Ribes cereum*
Graminoid	*Festuca* spp.

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus aristata, Pinus ponderosa*
Shrub	*Ribes cereum, Dasiphora fruticosa, Artemisia frigida*
Graminoid	*Festuca arizonica, Danthonia parryi*

Forb	*Besseya plantaginea, Maianthemum stellatum*

Global

Stratum	**Species**
Tree	*Pinus aristata*
Shrub	*Ribes cereum*
Graminoid	*Festuca* spp.

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Muhlenbergia montana*

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
- *Pinus aristata / Trifolium dasyphyllum* Woodland [CEGL000762]

SYNONYMY:
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) B
- *Pinus aristata/Festuca arizonica* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4.
Global Classification Comments: This association differs from the *Pinus aristata / Trifolium dasyphyllum* Woodland [CEGL000762] by having a higher and more consistant cover of perennial grasses.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Pinus aristata / Festuca arizonica* Woodland occurs as only two stands, one on the northwest-facing slope of Fossil Stump Hill and the other on the northwest-facing slope of the large hill east of the Visitor Center. A small clump (8 to 10 individuals) of *Pinus aristata* trees are present on the downstream portion of a livestock pond and dam, just south of Lower Twin Rocks Road. Individual *Pinus aristata* trees are occasionally observed in other woodland types within the monument, primarily on the large hill east of the Visitor Center.

Global Range: This association is known from the southern Rocky Mountains and from the Colorado Plateau regions of Colorado and New Mexico.

Nations: US
States/Provinces: CO NM

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 24, 31
Classification Confidence: 2 **Identifier:** CEGL000759
REFERENCES: Bourgeron and Engelking 1994, Brunstein and Yamaguchi 1992, DeVelice 1983, DeVelice et al. 1986, Driscoll et al. 1984, Johnston 1987, Komarkova et al. 1988a, Larson and Moir 1987, Peet 1978b, Peet 1981, Shepherd 1975, Stewart 1940

II.A.4.N.a.32. PINUS PONDEROSA WOODLAND ALLIANCE

Ponderosa Pine Woodland Alliance

PINUS PONDEROSA / BROMUS INERMIS SEMI-NATURAL WOODLAND

Ponderosa Pine / Smooth Brome Semi-natural Woodland

ELEMENT CONCEPT

GLOBAL SUMMARY: This is a woodland of native *Pinus ponderosa* with an exotic grass understory. While currently reported from the Colorado Front Range and southwestern Utah, it undoubtably is more widespread in the West. *Bromus inermis* has been seeded in thousands of hectares as pasture grass throughout the western U.S. It requires some sort of subirrigation or moisture, so is found escaped into riparian areas, draws and hollows. In some places the seeding took place beneath mature *Pinus ponderosa* trees, and in other locations, *P. ponderosa* is slowly invading the *Bromus inermis* pasture. Stands are dominated by *Bromus inermis* with 30-40% foliar cover, with an open, park-like structure to the overstory canopy of trees, either mature or young sapling size, contributing around 20% canopy cover.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Native grasslands, formerly converted to exotic pasture grasses, predominantly *Bromus inermis*, are being invaded by young *Pinus ponderosa* trees. The young trees occupy the pasture area adjacent to established woodland and forest stands, as an extension of those stands on slopes of approximately 5%. Stands of young ponderosa pine trees grow on all aspects at elevations around 8500 feet. Stands growing from previously disturbed soils, resulting from potato and small grain farming, are rooted in a gravel substrate derived from Pikes Peak granite bedrock, with little or no soil development.

Global Environment: Stands growing from previously disturbed soils, resulting from potato and small grain farming, are rooted in a gravel substrate derived from granite or sandstone bedrock, with little or no soil development. It occurs on gently sloping drainages on moderately well-drained sandy loam soil. Elevation is 6700 to 8500 feet. In one stand the young trees occupy the pasture area adjacent to established woodland and forest stands, as an extension of those stands on slopes of approximately 5%. In other stands, mature trees are the overstory canopy.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Young ponderosa pine trees invading former pastures supporting exotic grasses are approximately 2–5 m tall and average approximately 13 cm dbh. These trees are probably between 15 and 25 years of age. Foliar cover provided by *Pinus ponderosa* was approximately 20% for the stand sampled. Graminoids contribute approximately 40% foliar cover with most provided by the exotic *Bromus inermis*. Native grasses invading this site include *Muhlenbergia filiculmis* (approximately 10% foliar cover), *Festuca arizonica, Koeleria macrantha, Elymus elymoides*, and *Bouteloua gracilis*. Forbs are diverse, but account for less than 5% foliar cover. The most abundant forb was the exotic *Convolvulus arvensis*, along with *Hymenoxys richardsonii, Oxytropis lambertii, Gaura coccinea*, and *Heterotheca fulcrata (= Chrysopsis fulcrata)*. Ground cover consisted of predominantly herbaceous litter (approximately 55% cover) and gravel and bare soil (approximately 40% cover). These soils were disturbed historically to seed the smooth brome pasture, and it is also possible that some site leveling occurred, disturbing the soil structure.

These woodland stands are often small, below the minimum mapping unit for the project. They are readily identifiable on both true color and CIR aerial photographs.

Global Vegetation: *Pinus ponderosa* comprises the tree canopy with over 20% cover as young, invading trees into the grassland or as mature, very tall trees. These soils were disturbed historically to seed *Bromus inermis* pastures, and it is also possible that some site leveling occurred, disturbing the soil structure. Graminoids contribute approximately 40% foliar cover with most provided by the exotic *Bromus inermis* and presence of *Poa pratensis*. Native grasses invading these stands include *Muhlenbergia filiculmis* (approximately 10% foliar cover), *Festuca arizonica*, *Koeleria macrantha, Elymus elymoides*, and *Bouteloua gracilis*. Forbs are diverse, but account for less than 5% foliar cover. The most abundant forb was the exotic *Convolvulus arvensis*, *Heterotheca villosa, Lupinus argenteus, Lotus utahensis*, *Achillea millefolium*, along with *Hymenoxys richardsonii*, *Oxytropis lambertii*, *Gaura coccinea*, and *Heterotheca fulcrata (= Chrysopsis fulcrata)*.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Artemisia frigida*
Graminoid	*Bromus inermis, Muhlenbergia filiculmis*
Forb	*Convolvulus arvensis*

Global

Stratum	**Species**
Tree	*Pinus ponderosa*
Graminoid	*Bromus inermis*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Artemisia frigida*
Graminoid	*Bromus inermis, Muhlenbergia filiculmis, Festuca arizonica*
Forb	*Convolvulus arvensis, Hymenoxys richardsonii*

Global

Stratum	**Species**
Tree	*Pinus ponderosa*
Graminoid	*Bromus inermis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Agropyron cristatum*

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GW

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Young stands of *Pinus ponderosa / Bromus inermis* Woodland are invading native and exotic grasslands throughout the monument, due to moist climatic conditions conducive to tree establishment and fire suppression. The most extensive young tree stands occur north of the Boulder Creek drainage and west of the Hornbek Homestead. *Pinus ponderosa* invasion of historic, terraced potato fields may present a conflict with interpretive programs.

Global Range: This association has been described from southern Utah and central Colorado, and is likely to occur anywhere within the Ponderosa Pine belt where *Bromus inermis* has been seeded as hay pasture.

Nations: US
States/Provinces: UT CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 26
Classification Confidence: 3 **Identifier:** CEGL002943
REFERENCES:

PINUS PONDEROSA / CERCOCARPUS MONTANUS WOODLAND

Ponderosa Pine / Mountain-mahogany Woodland

ELEMENT CONCEPT

GLOBAL SUMMARY: This woodland occurs on the driest aspects that support coniferous woodlands of *Pinus ponderosa* in the southern Rocky Mountains. Typically, this association occurs on dry rocky hillsides just above the shrubland zone, on shallow, rocky loam soils. Aspects are predominately south, southeast and southwest, on ridgetops and adjacent upper slopes that are moderate to steep (18-60%), at 5570-8900 feet elevation. This is an open woodland with scattered trees, generally with less than 50% cover of

Pinus ponderosa. *Juniperus scopulorum* and *Pseudotsuga menziesii* individuals may be present. The community is open in appearance with a matrix of shrubs, predominantly *Cercocarpus montanus* and *Ribes cereum*. Other shrubs present may include *Artemisia frigida, Purshia tridentata, Yucca glauca,* and *Quercus gambelii*. Herbaceous cover ranges from 10-70%. Grasses are typically more abundant than forbs and commonly include one or more of the following species: *Bromus tectorum, Elymus albicans, Festuca arizonica, Carex rossii, Elymus lanceolatus, Hesperostipa comata, Bouteloua gracilis, Muhlenbergia montana,* and *Koeleria macrantha (= Koeleria cristata)*. Forb species include *Artemisia ludoviciana, Geranium* spp., *Heterotheca fulcrata (= Chrysopsis fulcrata), Grindelia subalpina, Argentina anserina, Cryptantha thyrsiflora,* and *Eriogonum umbellatum*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This woodland type occupies slopes comprised of predominantly Pikes Peak granite bedrock-derived gravel, rocks, and occasional boulders. One stand differed in that the bedrock was volcanic, a welded tuff, but still with a gravel, rock, and boulder substrate. Sites occupied by this type may be found monument-wide, because it was sampled from approximately 8400–8900 feet in elevation. This type occurs on south, east, and west exposures, ridgetops and adjacent upper slopes, and hilltops with a past logging history. The trees on these sites are heavily infested with mistletoe (*Arceuthobium americanum*), which leads to stunting and abnormal needle development. Slope exposures along ridgelines, on ridgetops, and hillslopes can vary from east and south to west; the recorded stands occupied moderately steep (7–21%) slopes oriented at 141 to 260 degrees.

Global Environment: This woodland occurs on the driest aspects that support coniferous woodlands of *Pinus ponderosa* in the southern Rocky Mountains. Typically, this association occurs on dry rocky hillsides just above the shrubland zone, on shallow, rocky loam soils. Aspects are predominately south, southeast and southwest, on ridgetops and adjacent upper slopes that are moderate to steep (18-60%), at 5570-8900 feet elevation.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This woodland type is characterized by 10–15 m tall ponderosa pine trees providing approximately 15–25% foliar cover. A sparse subcanopy or tall-shrub layer of sapling ponderosa pine may also be present, but generally contributes less than 5% foliar cover. Ponderosa pine trees measure an average of 24 cm dbh in this type, and the largest tree measured was 38 cm dbh. The shrubs present are generally short, from 1–2 m tall, and provide approximately 5–15% foliar cover within the stand. The common shrub species present include *Cercocarpus montanus, Ribes cereum,* and the dwarf-shrubs *Artemisia frigida* and *Yucca glauca*. Graminoids provide approximately 5–10% foliar cover and include *Festuca arizonica, Bouteloua gracilis, Muhlenbergia montana, Koeleria macrantha, Carex inops,* and *Elymus elymoides*. Forbs provide only sparse foliar cover, from 2–3% in most stands. The more common forbs include *Heterotheca fulcrata (= Chrysopsis fulcrata), Geranium caespitosum, Grindelia subalpina, Argentina anserina,* and *Cryptantha thyrsiflora*. Ground cover for the stands is predominantly gravel eroded from Pikes Peak granite bedrock, e.g., 35–50% cover from gravel was recorded in sampled stands. Herbaceous litter provided from 20–50% ground cover, and on one site approximately 30% cover from downed wood was present. A few *Pinus contorta* trees were present in a small stand in the southern portion of the monument and two or three questionable stands scattered in the northern portion. In the southern stand, trees that have typical *Pinus contorta* features, e.g., 2-needle, shorter than those of *Pinus ponderosa* and smallish bristle-tipped cone scales, are present. However, the stand also contains mistletoe-infested *Pinus ponderosa* trees that have both 2- and 3-needle fascicles, and some of the needles are shorter than normal due to the stress of the mistletoe and dryness of the site. The canopy *Pinus contorta* averaged 17 cm dbh.

This type may be interpreted and mapped as part of a woodland alliance that includes the associations mentioned above. It is distinguishable from *Pinus ponderosa / Festuca arizonica* Woodland (CEGL000856) on both true color and CIR aerial photography because of the presence of sparse shrubs.

Global Vegetation: This woodland type comprises dry foothill vegetation with scattered trees, generally with less than 50% cover of *Pinus ponderosa*. *Juniperus scopulorum* and *Pseudotsuga menziesii* individuals may be present. The community is open in appearance with a matrix of shrubs, predominantly *Cercocarpus montanus* and *Ribes cereum*. Other shrubs present may include *Artemisia frigida, Purshia tridentata, Yucca glauca,* and *Quercus gambelii*. Herbaceous cover ranges from 10-70%. Grasses are typically more abundant than forbs and commonly include one or more of the following species: *Bromus tectorum, Elymus albicans, Festuca arizonica, Carex rossii, Elymus lanceolatus, Hesperostipa comata, Bouteloua gracilis, Muhlenbergia montana,* and *Koeleria macrantha (= Koeleria cristata)*. Forb species include *Artemisia ludoviciana, Geranium* spp., *Heterotheca fulcrata (= Chrysopsis fulcrata), Grindelia subalpina, Argentina anserina, Cryptantha thyrsiflora,* and *Eriogonum umbellatum*.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Cercocarpus montanus, Ribes cereum, Artemisia frigida, Yucca glauca*
Graminoid	*Festuca arizonica, Bouteloua gracilis, Muhlenbergia montana*
Forb	*Heterotheca fulcrata, Grindelia subalpina, Argentina anserina*

Global

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Cercocarpus montanus, Ribes cereum*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Cercocarpus montanus, Ribes cereum, Artemisia frigida*
Graminoid	*Festuca arizonica, Bouteloua gracilis, Muhlenbergia montana, Koeleria macrantha, Elymus elymoides*
Forb	*Heterotheca fulcrata, Grindelia subalpina, Argentina anserina*

Global

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Cercocarpus montanus, Ribes cereum*
Graminoid	*Festuca arizonica, Bouteloua gracilis, Muhlenbergia montana, Koeleria macrantha*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus contorta*
Forb	*Allium cernuum, Pediocactus simpsonii*

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) B
- *Pinus ponderosa/Cercocarpus montanus* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Pinus ponderosa / Cercocarpus montanus* Woodland occupies moderately steep slopes of 8–16% on ridges and hills within the monument. The aspect is southerly or westerly, ranging from 98–196 degrees and 213–231 degrees. This vegetation type is readily observable on the hill east of the Visitor Center and the hill north of Hornbek Homestead.

Global Range: This association is known primarily from the Colorado Rocky Mountains. It is thought to occur as far north as the Black Hills of Wyoming and South Dakota.

Nations: US
States/Provinces: CO WY? SD?

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 28, 54, 72, 90

Classification Confidence: 1 **Identifier:** CEGL000851
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hess and Alexander 1986, Hess and Wasser 1982, Johnston 1987, Kahler 1973, Lynn et al. n.d., Peet 1975, Peet 1981, Thilenius 1971, Thilenius 1972

PINUS PONDEROSA / FESTUCA ARIZONICA WOODLAND

Ponderosa Pine / Arizona Fescue Woodland

ELEMENT CONCEPT

GLOBAL SUMMARY: This association occurs on all aspects and landscape positions within an elevational range of 2100-2900 m (7200-9500 feet), in locations throughout the mountains of the southwestern U.S. and western Texas. Slopes are gentle to very steep. This association is the coolest and wettest of grassy *Pinus ponderosa* types, and soils are typically deeper than other related *Pinus* types. This woodland has an open park-like character with scattered trees with not more then 50% cover and abundant herbaceous understory. Shrub cover is sparse. *Pinus ponderosa* is the dominant tree and the climax overstory species. *Pseudotsuga menziesii* is occasionally present. Dominance by grasses and sometimes forbs is diagnostic for this type. *Festuca arizonica* and *Muhlenbergia montana* are consistently present. *Bouteloua gracilis* and *Danthonia parryi* can be very abundant in relatively dry or wet stands, respectively. In the southern portion of its range other species may be present in the canopy, including *Pinus edulis*, *Pinus cembroides*, and *Pinus strobiformis*. Shrubs are scarce but are often present; species vary with latitude and include *Quercus gambelii*, *Artemisia tridentata, Chrysothamnus depressus, Ribes cereum, Ceanothus fendleri, Symphoricarpos oreophilus,* and *Mahonia repens*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Slopes supporting a graminoid understory for stands are moderate to steep (approximately 10–40%) and mostly oriented to the southeast and southwest (164–240 degrees). The soils are predominantly gravel eroded from Pikes Peak granite bedrock, although an extensive herbaceous litter layer is usually present. A dense *Pinus ponderosa / Festuca arizonica* Forest occupies northeast- to northwest-facing (77 to301 degrees) slopes of small hills and ridges, growing on the mid- to the toeslope with moderate to steep (8–33%) slopes. On larger hills and ridges, the same midslope habitat would be occupied by *Pseudotsuga menziesii / Juniperus communis* Forest (CEGL000439), and the toeslope would likely support *Picea pungens / Juniperus communis* Forest (CEGL000392).

Global Environment: This association occurs on all aspects and landscape positions within an elevational range of 2100-2900 m (7200-9500 feet). Slopes are gentle to very steep. Soils are predominantly Borolls, with low coarse fragments. The habitat is the coolest and wettest of grassy *Pinus ponderosa* types, and soils are typically deeper than other related *Pinus* types.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This type consists of sparse stands on south-facing slopes and dense stands on north-facing slopes and hillsides. This sparse woodland type is characterized by ponderosa pine trees averaging from 15–20 m tall, but sparse, only contributing approximately 20% foliar cover for the stand. Since these trees are growing with little competition, they are larger, averaging 32 cm dbh. The largest *Pinus ponderosa* measured in a sample plot was 52 cm dbh for this type. A few *Pinus ponderosa* saplings are present as subcanopy trees or tall shrubs, but contribute 5% or less foliar cover. Short or dwarf-shrubs, including *Ribes cereum, Juniperus communis, Cercocarpus montanus*, and *Artemisia frigida,* also provide less than 5% foliar cover for the type. Graminoids present include *Festuca arizonica, Muhlenbergia montana, Bouteloua gracilis, Danthonia parryi, Schizachyrium scoparium, Koeleria macrantha, Elymus elymoides,* and *Carex inops*. The graminoids rarely contribute more than 2% foliar cover individually and from 5–15% foliar cover among all the graminoids present. Forbs rarely exceed 1% foliar cover by individual species, and are typically less than 5% foliar cover in a sample plot. The most common and abundant forbs present include *Heterotheca fulcrata (= Chrysopsis fulcrata), Geranium caespitosum, Argentina anserina, Hymenoxys richardsonii*, and *Allium cernuum*. Ground cover is typically high, with approximately 90–95% related to pine needles and mast, and most of the remainder downed woody litter. For one site sampled, only 50% of the ground cover was herbaceous litter; most of the remainder was gravel derived from Pikes Peak granite bedrock. Lichens and mosses are typically present and may contribute up to 5% ground cover for a plot. Relatively dense stands provide from 60–75% foliar cover over a depauperate understory. The trees of one stand were estimated to be 15 m tall and in another, approximately 25–30 m tall. The trees were very uniform in age, averaging 19 cm dbh for both stands and for all trees measured (66 individuals). The largest *Pinus ponderosa* tree encountered in sampled stands measured 32 cm dbh. *Pinus ponderosa* is the only tree species present in both the canopy and in the subcanopy of dense stands (less than 5% foliar cover). No shrubs were recorded for vegetation plots sampled in this association, although scattered *Juniperus communis* and *Ribes cereum* shrubs were noted to be nearby one sample plot. Graminoids provided less than 5% foliar cover and included *Danthonia parryi, Bouteloua gracilis, Festuca arizonica, Koeleria macrantha,* and *Elymus elymoides*, among other grass species. Forbs provided less than 2% foliar cover within the sample plots and included *Besseya plantaginea, Geranium caespitosum, Argentina anserina, Cerastium arvense ssp. strictum (= Cerastium strictum),* and *Solidago* sp. Ground cover associated with these forest stands was 95% litter, to 10 cm deep, with the remainder of downed wood.

Pinus ponderosa / Festuca arizonica Woodland (CEGL000856) is similar to *Pinus ponderosa / Cercocarpus montanus* Woodland (CEGL000851) on south-facing slopes in the monument. It will be possible to interpret from both true color and CIR aerial photographs, due to the lack of shrub cover within canopy openings. However, the units or polygons may be below the project minimum mapping unit and combining with ponderosa pine / mountain mahogany stands may be required. Dense *Pinus ponderosa / Festuca arizonica* Woodland occupies habitat normally attributed to stands of *Pseudotsuga menziesii / Juniperus communis* Forest (CEGL000439), except that the physical structural features, e.g., hills and ridges, are smaller. Aerial photo signatures for both of these associations are similar on true color and on CIR.

Global Vegetation: *Pinus ponderosa* is the dominant tree and the climax overstory species. *Pseudotsuga menziesii* is occasionally present. Dominance by grasses and sometimes forbs is diagnostic for this type. Shrubs, when present never exceed 5% cover. *Festuca arizonica* and *Muhlenbergia montana* are consistently present. *Bouteloua gracilis* and *Danthonia parryi* can be very abundant in relatively dry or wet stands, respectively. At high elevations in the Trans-Pecos mountains of Texas and on sky islands of Arizona, other species may be present in the canopy, including *Pinus edulis, Pinus cembroides*, and *Pinus strobiformis*. Shrubs are scarce but are often present; species vary with latitude and include *Quercus gambelii*, *Artemisia tridentata*, and *Chrysothamnus depressus*. The understory is densely grassy with medium-tall grasses, including *Piptochaetium fimbriatum, Piptochaetium pringlei, Achnatherum lobatum (= Stipa lobata), Bothriochloa barbinodis (= var. barbinodis), Schizachyrium scoparium var. scoparium (= Schizachyrium scoparium ssp. neomexicanum), Muhlenbergia rigida, Muhlenbergia montana, Elymus elymoides*, and *Panicum bulbosum*. Other species include *Allium cernuum, Campanula rotundifolia, Silene laciniata*, and *Ageratina rothrockii (= Eupatorium rothrockii).*

Global Dynamics: The heavy grass cover in the understory favors surface fires; the absence of fire would tend to result in denser tree canopy cover and subsequently reduced grass cover (DeVelice et al. 1986). Overgrazing has been widespread and has reduced, and in many cases even eliminated, *Festuca arizonica* from stands. Weedy species such as *Bromus tectorum, Tetraneuris acaulis, Poa pratensis, Taraxacum officinale,* and *Gutierrezia sarothrae* indicate overgrazing. Burning can stimulate *Ceanothus fendleri* on some sites in northern New Mexico and central Arizona.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Pinus ponderosa*
Shrub	*Ribes cereum, Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia montana, Danthonia parryi*
Forb	*Heterotheca fulcrata, Geranium caespitosum, Argentina anserina, Besseya plantaginea*

Global

Stratum	Species
Tree	*Pinus ponderosa*
Graminoid	*Festuca arizonica, Muhlenbergia montana*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Pinus ponderosa*
Shrub	*Ribes cereum, Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia montana, Bouteloua gracilis, Carex inops ssp. heliophila*
Forb	*Heterotheca fulcrata, Geranium caespitosum, Argentina anserina*

Global

Stratum	Species
Tree	*Pinus ponderosa*
Graminoid	*Festuca arizonica, Muhlenbergia montana*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	Species
Forb	*Pediocactus simpsonii*

Global
Stratum **Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- *Pinus ponderosa/Festuca arizonica* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) B

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Pinus ponderosa / Festuca arizonica* Woodland occupies slopes, from toeslope to upper slope, on hills and ridges at mid-elevations (8265-8600 feet) within the monument. Dense stands occupy the north-facing slopes of low hills and ridges, a habitat normally occupied by *Pseudotsuga menziesii / Juniperus communis* Forest (CEGL000439) on larger topographic features. Forest stands of ponderosa pine were observed at the northern and southern ends of the monument at approximately 8375 feet elevation and approximately 8600 feet elevation.

Global Range: This association is known from mountains in Colorado, New Mexico, Arizona and the Trans-Pecos Mountains (Mt. Livermore in the Davis Mountains) of Texas.

Nations: US
States/Provinces: AZ CO NM TX

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 20, 27, 59, 60, 61, 62, 65, 84
Classification Confidence: 1 **Identifier:** CEGL000856
REFERENCES: Alexander et al. 1987, Bourgeron and Engelking 1994, Clary 1978, Clary and Pearson 1969, Costello 1944a, Costello 1954, Costello and Schwan 1946, DeVelice 1983, DeVelice and Ludwig 1983a, DeVelice et al. 1986, Diamond 1993, Driscoll et al. 1984, Fitzhugh et al. 1987, Hanks et al. 1983, Johnson 1945, Johnson 1953, Johnson 1956a, Johnson and Klipple 1946, Johnson and Niederhof 1941, Johnson and Reid 1958, Johnson and Reid 1964, Johnston 1987, Komarkova et al. 1988a, Larson and Moir 1987, Merkle 1962, Moir and Ludwig 1979, Nichol 1937, Shepherd 1975, Smith 1967, Swift 1974, USFS 1983b

II.A.4.N.d. Temporarily flooded temperate or subpolar needle-leaved evergreen woodland

II.A.4.N.d.7. PICEA PUNGENS TEMPORARILY FLOODED WOODLAND ALLIANCE
Blue Spruce Temporarily Flooded Woodland Alliance

PICEA PUNGENS / BETULA OCCIDENTALIS WOODLAND
Blue Spruce / Water Birch Woodland

ELEMENT CONCEPT

GLOBAL SUMMARY: This association is known from Colorado and possibly northern New Mexico. It is a cool, moist riparian woodland occurring in deep, narrow canyons in the foothills and at lower montane elevations of 2200-2700 m. *Betula occidentalis* forms a thick band in deep, subirrigated soils along narrow floodplains, streambanks and terraces, with branches overhanging the stream. Mature *Picea pungens* dominates the canopy (10-60% cover), though *Populus tremuloides* may be present as well. *Betula occidentalis* is always present in the shrub understory (20-40% cover), often joined by *Alnus incana*. Other shrubs include *Salix exigua*, *Salix bebbiana*, and *Cornus sericea*. *Equisetum arvense* is always present in the sparse or dense herbaceous layer. Common associates may include forbs such as *Rudbeckia laciniata*, *Heracleum maximum*, *Fragaria virginiana*, *Mertensia ciliata*, and the graminoid *Calamagrostis canadensis*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This woodland type is found along low to moderately sloped drainages (3–10%) with narrow floodplains. The drainages are oriented to the west and to the north. The substrate within the streambed tends to be rocky or gravelly and covered by herbaceous and woody litter under stands.

Global Environment: This association is a cool, moist riparian woodland occurring in deep, narrow canyons in the foothills and at lower montane elevations (2200-2700 m) in Colorado and possibly northern New Mexico. *Betula occidentalis* forms a thick band in deep, subirrigated soils along narrow floodplains, streambanks and terraces.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: These woodlands are dominated both in the emergent and canopy layers by *Picea pungens* with significant foliar cover provided by *Populus tremuloides*. As emergent trees, these species may reach from 30–35 m in height. In the canopy layer, they are typically in the 20–25 m height class. The subcanopy layer was dominated by these tree species, and also by 8–10 m tall *Betula occidentalis* shrubs. The emergent trees provide approximately 10% foliar cover in sampled stands, while the canopy trees provide approximately 35% (one sampled stand had only 5% canopy cover). Subcanopy trees provide approximately 30% foliar cover, however, one site recorded only 8% foliar cover in the subcanopy. Tree diameters in sampled stands ranged from an average of 15–26 cm for *Populus tremuloides* to 21-24 cm for *Picea pungens*. The largest trees sampled were a 47 cm dbh *Picea pungens* and a 42 cm dbh *Populus tremuloides*. Tall shrubs, dominated by *Betula occidentalis* (6-10 m tall), provided foliar cover from 10–30%, while short shrubs (1–2 m tall), e.g., *Juniperus communis*, *Dasiphora fruticosa*, and *Betula occidentalis,* were estimated to cover approximately 5% of the stand floor. Graminoids provided from 35–50% foliar cover, with *Calamagrostis canadensis, Agrostis scabra, Bromus inermis,* and *Poa pratensis* the most common grasses observed. Forbs provided approximately 20% foliar cover, with *Thalictrum fendleri, Equisetum arvense, Cirsium scariosum (= Cirsium tioganum)*, and *Fragaria virginiana*, the most abundant among many other species. Ground cover was predominantly herbaceous litter, from 85–95% and approximately 15% downed wood.

This woodland will be difficult to interpret separately from Colorado blue spruce forest stands, except for the identified locations. The identified locations represent the only stands of this type observed during the study. The few *Betula occidentalis* shrubs that do appear in the open resemble tall willow species such as *Salix monticola* and will likely be indistinguishable from them on aerial photography.

Global Vegetation: *Picea pungens* dominates the canopy with 10-60% cover. Other trees that may be present include *Populus tremuloides* (5-30% cover). The shrub canopy is dominated by *Betula occidentalis* with 20-40% cover. Other shrubs that may be present include *Alnus incana* (10-35% cover), *Salix exigua* (10-30%), *Salix bebbiana* (10%), and *Cornus sericea* (10%). The herbaceous undergrowth can be dense to open. Forb species that may be present include *Rudbeckia laciniata* (1-15%), *Heracleum maximum* (1-15%), *Fragaria virginiana* (1-5%), *Mertensia ciliata* (1-5%), and *Equisetum arvense* (1-10% cover). Graminoid species that may be present include *Calamagrostis canadensis* (1-40%), *Agrostis scabra*, *Bromus inermis*, and *Poa pratensis*

Global Dynamics: This plant association appears to be stable and late-seral. In deep, narrow canyons with swift-moving streams and narrow floodplains and benches, *Picea pungens* appears to be a climax riparian species. *Picea pungens* will remain until removed or damaged by a catastrophic flood. *Picea pungens* is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. *Betula occidentalis* can tolerate flooding but not permanent inundation (Hansen et al. 1988). Fire disturbance results in *Betula occidentalis* resprouting and the replacement of this type with an early-seral plant association such as *Populus tremuloides / Betula occidentalis*.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Picea pungens, Populus tremuloides*
Shrub	*Betula occidentalis*
Graminoid	*Calamagrostis canadensis, Agrostis scabra*
Forb	*Equisetum arvense, Achillea millefolium*

Global

Stratum	**Species**
Tree	*Picea pungens, Populus tremuloides*
Shrub	*Betula occidentalis*
Forb	*Equisetum arvense*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Picea pungens, Populus tremuloides*
Shrub	*Betula occidentalis*
Graminoid	*Calamagrostis canadensis*
Forb	*Equisetum arvense*

Global

Stratum	**Species**
Tree	*Picea pungens, Populus tremuloides*
Shrub	*Betula occidentalis*
Forb	*Equisetum arvense*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Dasiphora fruticosa*
Forb	*Cirsium scariosum*

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
- *Pseudotsuga menziesii / Betula occidentalis* Woodland (CEGL002639)
- *Picea pungens / Equisetum arvense* Woodland (CEGL000389)

SYNONYMY:
- Conifer/*Equisetum arvense* community type (Padgett et al. 1989) B

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G2.

Global Classification Comments: Classification is based on 7 quantitative plots. Two closely related communities include *Pseudotsuga menziesii / Betula occidentalis* Woodland (CEGL002639), which lacks *Picea pungens* and *Picea pungens / Equisetum arvense* Woodland (CEGL000389), where the shrub layer is sparse and does not have significant cover of *Betula occidentalis*. The conifer/*Equisetum arvense* community type (Padgett et al. 1989) has *Picea pungens* and *Betula occidentalis*, but not consistantly.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Picea pungens / Betula occidentalis* Woodland is found in a drainage west of the Visitor Center, at the bridge crossing for a footpath (approximately 8365 feet elevation), and also in two mesic drainages in the southeast corner of the monument (approximately 8800 feet elevation and 8900 feet elevation).

Global Range: This plant association is known from the central portion of the southern Rockies eastern slope in Colorado and is expected to occur throughout the southern Rocky Mountains in Colorado and probably New Mexico.

Nations: US
States/Provinces: CO NM?

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 6, 93
Classification Confidence: 1 **Identifier:** CEGL002637
REFERENCES: Burns and Honkala 1990a, Hansen et al. 1988, Johnston 1987, Kittel et al. 1997, Kittel et al. 1999, Manning and Padgett 1995, Padgett et al. 1989

II.B.2.N.b. Temporarily flooded cold-deciduous woodland

II.B.2.N.b. POPULUS BALSAMIFERA TEMPORARILY FLOODED WOODLAND ALLIANCE

Balsam Poplar Temporarily Flooded Woodland Alliance

POPULUS BALSAMIFERA WOODLAND

Balsam Poplar Woodland

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This temporarily flooded woodland occupies a reach of an unnamed, perennial drainage of only 2% slope. It occupies the stream channel on a small gravel deposit or bar, and both banks for nearly 0.5 km. This drainage is incised up to three meters, which may expose/deposit the substrate necessary for balsam poplar to root sprout and spread.

Global Environment: Not applicable.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This type was sampled near the older part of the stand. Consequently the tree height for balsam poplar approached 20 m, the diameters averaged approximately 15 cm, and the largest diameter recorded was 24.4 cm. The largest tree within the plot was a Colorado blue spruce that was only approximately 20 m tall due to crown die-back, but was 73.1 cm in diameter. Tree canopy cover was approximately 75%, with 39 trees over 10 cm dbh present in a 400 m^2 plot. Foliar cover provided by the shrub layer was approximately 40% for the stand, with *Populus balsamifera, Dasiphora fruticosa, Salix monticola*, and *Salix lucida* the more common shrubs present. Graminoids provided less than 5% foliar cover, most of this from *Carex aquatilis, Carex nebrascensis*, and the exotic *Bromus inermis*. Forbs also provided less than 5% foliar cover; the most common were *Heracleum maximum* and *Equisetum arvense*. The balsam poplar stand was extremely species-rich with 41 species recorded. Ground cover was predominantly herbaceous and woody litter (approximately 40% and 50%, respectively), and surface water from the streambed (approximately 5%).

The balsam poplar stand is very linear but may approach the minimum mapping unit for the project. This stand of balsam poplar will resemble quaking aspen in terms of the aerial photo signature presented. This signature is dark green to black on true color and light pink to red on CIR.

Global Vegetation: Not applicable.

Global Dynamics: Not applicable.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Tree	*Populus balsamifera*
Shrub	*Populus balsamifera, Alnus incana, Dasiphora fruticosa*
Graminoid	*Carex aquatilis, Carex nebrascensis, Bromus inermis*
Forb	*Heracleum maximum, Mertensia ciliata, Equisetum arvense*

Global

Stratum	Species
Not applicable.	

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Populus balsamifera, Picea pungens*
Shrub	*Alnus incana, Salix monticola, Dasiphora fruticosa*
Graminoid	*Carex aquatilis, Carex nebrascensis, Bromus inermis*
Forb	*Heracleum maximum, Mertensia ciliata, Equisetum arvense*

Global

Stratum	**Species**

Not applicable.

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**

None.

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS: Not applicable.

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G?.

Global Classification Comments: Not applicable.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Only one stand of balsam poplar was observed and sampled on the monument. This stand occupies the drainage south of the footpath and east of the bridge comprising the trail in the northeastern portion of the monument.

Global Range: Not applicable.

Nations: Unknown
States/Provinces: **CO**

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 74
Classification Confidence: **Identifier:**
REFERENCES:

III. SHRUBLAND

III.B.2.N.a. Temperate cold-deciduous shrubland

III.B.2.N.a.3. CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE

Mountain-mahogany Shrubland Alliance

CERCOCARPUS MONTANUS / MUHLENBERGIA MONTANA SHRUBLAND

Mountain-mahogany / Mountain Muhly Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This shrubland occupies gravelly substrate and rocky sites on the dry, upper slopes of hills and ridges. These slopes are typically oriented between approximately 125° and 190°, although a few ridges are more westerly trending. The slopes are steep, from 7-22% and are rapidly drained. *Cercocarpus montanus* shrubs are scattered on these sites, e.g., the canopies rarely overlap, unlike very dense stands that grow at lower elevations in Colorado and nearby states. The gravelly substrate, resulting from the weathering of Pikes Peak granite bedrock, also supported stands of *Yucca glauca* dwarf-shrubland, and sparse woodlands dominated by ponderosa pine and rarely Douglas-fir.

Global Environment: Not applicable.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Cercocarpus montanus* is the dominant shrub, along with a few *Ribes cereum* on most sites. Since the type occupies canopy breaks or is occasionally invaded by ponderosa pine trees, it is not unusual to have some foliar cover provided by tree canopies. Ponderosa pine trees associated with mountain-mahogany stands usually show stress, often in the form of mistletoe infestations, short stature, dead branches, etc. In addition, many of the stands are relatively sparse in the shrub layer and are actually dominated by graminoids, particularly *Muhlenbergia montana*, *Festuca arizonica*, and *Bouteloua gracilis*. Total vegetative cover for *Cercocarpus montanus* stands was estimated from 40–70%, dependent on the amount of understory herbaceous growth. Mountain-mahogany and wax currant shrubs are typically from 1–2 m tall and provide foliar cover ranging from 10–30%. Dwarf-shrubs, typically *Yucca glauca, Artemisia frigida,* and young *Cercocarpus montanus,* are present, but usually provide less than 5% foliar cover. Graminoids typically provide the dominant foliar cover in a site (from 20–45%), particularly *Muhlenbergia montana*, *Festuca arizonica*, and *Bouteloua gracilis*. Other graminoids observed in mountain-mahogany shrublands included *Muhlenbergia filiculmis*, *Carex inops*, *Blepharoneuron tricholepis, Koeleria macrantha*, and *Elymus elymoides*. Forbs rarely contribute greater than 5% foliar cover, and the more common species include *Chenopodium leptophyllum*, *Euphorbia spathulata (= Tithymalus montanus), Ipomopsis aggregata, Cryptantha thyrsiflora, Hymenoxys richardsonii*, *Lithospermum multiflorum*, and *Grindelia subalpina*. Ground cover varies from site to site, i.e., those with smaller amounts of herbaceous cover have from 40–90% bare ground and small rocks (mostly granite gravel), while other sites may have litter values from approximately 10–35%. One stand sampled contained approximately 70% ground cover by herbaceous litter, predominantly from ponderosa pine needles and mast.

These stands are readily observable on true color and CIR photographs, due largely to the size of the shrubs. Many stands are less than the minimum mapping unit, and the more sparse stands may actually be mapped as herbaceous types. On some slopes the stands of mountain-mahogany intermix with stands of bunch grasses and sparse ponderosa pine woodland, which may require delineation as a complex.

Global Vegetation: Not applicable.

Global Dynamics: Not applicable.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Tree	*Pinus ponderosa*
Shrub	*Cercocarpus montanus, Ribes cereum*
Dwarf-shrub	*Yucca glauca, Artemisia frigida*
Graminoid	*Muhlenbergia montana, Festuca arizonica, Bouteloua gracilis*
Forb	*Hymenoxys richardsonii, Grindelia subalpina*

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Cercocarpus montanus, Ribes cereum*
Dwarf-shrub	*Yucca glauca, Artemisia frigida*
Graminoid	*Muhlenbergia montana, Festuca arizonica, Bouteloua gracilis*
Forb	*Allium cernuum, Hymenoxys richardsonii, Grindelia subalpina, Lithospermum multiflorum*

Global
Stratum **Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	Species
Forb	*Pediocactus simpsonii*

Global
Stratum **Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: Not applicable.

Global Classification Comments: Not applicable.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Cercocarpus montanus / Muhlenbergia montana* Shrubland occupies southern, eastern, and western exposures on the upper slopes of hills and ridges at mid and higher elevations throughout the monument. Often these stands occur within canopy breaks among ponderosa pine woodland stands of the same exposures. One unusual mountain-mahogany stand occurs among Douglas-fir, west of the Visitor Center.

Global Range: Not applicable.

Nations: US
States/Provinces:

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 5, 85, 96, 97
Classification Confidence: 3 **Identifier:** To be determined
REFERENCES:

III.B.2.N.a.26. PRUNUS VIRGINIANA SHRUBLAND ALLIANCE
Choke Cherry Shrubland Alliance

PRUNUS VIRGINIANA - (PRUNUS AMERICANA) SHRUBLAND
Choke Cherry - (American Plum) Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: This community has a wide distribution, being reported from states primarily in the northwestern United States, including the northwestern Great Plains, but also in Nevada. In Colorado, this riparian shrubland occurs as small pockets on higher terraces or as narrow bands along the high-water mark of steep banks and incised channels. It can also grow at the base of cliffs adjacent to rivers and streams where it forms impenetrable thickets. Stands have a dense, medium-tall (1.5-2 m) shrub canopy that is almost impossible to walk through. This vegetation is dominated by *Prunus virginiana* and grows at the interface between the riparian areas and the adjacent upland.

At Wind Cave National Park in South Dakota, this type is characterized by moderate to dense shrub cover, typically in the 25-75% range. Shrub cover is generally greater in drainage bottoms and on lowermost slopes, and less on slopes. *Prunus virginiana* may be the dominant shrub species, but often other species are codominant or dominant, especially on slopes, including *Rhus trilobata*, *Amorpha canescens*, *Symphoricarpos occidentalis*, and *Toxicodendron pubescens*. Stands dominated by *Prunus americana* may be a variant of this type. In drainage bottom situations, herbaceous cover is usually sparse, less than 10%. On slopes, the shrubs typically occur in some grassland type, and graminoid cover can be greater than 75%.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This shrubland is unusual and is known for only one site within the monument as a pure stand. At two other sites it is codominant or subdominant to *Ribes cereum*. For all stands, however, outcrops of rhyolite in the form of plate-like rubble provide the substrate. These outcrops appear more moist than the adjacent gravels derived from eroding Pikes Peak granite and are steep (28% slope) with rapid drainage.

Global Environment: This association grows at the interface between the riparian areas and the adjacent upland. Stands usually occur as small pockets on higher terraces or as narrow bands along the high water mark of steep banks and incised channels. It can also grow at the base of cliffs adjacent to rivers and streams where it forms impenetrable thickets (CONHP pers. comm. 1998). In southwestern South Dakota, stands are found in a variety of habitats. Slope varies from flat to very steep, with variable aspect. Stands are commonly found in the bottoms of draws and drainages. This type also occurs associated with rock outcrops (H. Marriott pers. comm. 1999, Von Loh et al. 1999).

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: The rhyolite outcrops and thus the stands of this shrubland are small, covering only 100–200 m^2. The individual shrubs are relatively short, averaging from 1–2 m in height. Within these small chokecherry stands, foliar cover of *Prunus virginiana* is approximately 40% in the densest stand to as little as 5% in a stand codominated by *Ribes cereum*. All stands averaged approximately 55% foliar cover, with approximately 45–50% of this cover provided by shrubs, e.g., *Prunus virginiana, Ribes cereum, Dasiphora fruticosa*, and *Rubus deliciosus*. Common grass species within the stands were *Bouteloua gracilis* and *Muhlenbergia montana* (with foliar cover values from 5–10%), and the common forbs included *Grindelia subalpina, Galium boreale*, and *Allium cernuum* (with foliar cover values less than 5%). Ground cover in these small stands was predominantly large rocks (65–95% cover) and litter (15–30% cover). The large rocks were flat plates of rhyolite, a volcanic rock rarely outcropping in the area.

These small stands appear as light spots with pebbly dots on true color aerial photographs. They are below the minimum mapping unit; however, they are unique for the monument.

Global Vegetation: In Colorado, this community type is a medium-height (1.5-2 m) shrubland with dense vegetation that is almost impossible to walk through (CONHP pers. comm. 1998). In southwestern South Dakota, this type is characterized by moderate to dense shrub cover, typically in the 25-75% range. Shrub cover is generally greater in drainage bottoms and on lowermost slopes, and less on slopes. *Prunus virginiana* may be the dominant shrub species, but often other species are codominant or dominant, especially on slopes, including *Prunus americana, Rhus trilobata, Amorpha canescens, Symphoricarpos occidentalis* and *Toxicodendron pubescens*. In drainage bottom situations, herbaceous cover is usually sparse, less than 10%. On slopes, the shrubs typically occur in some grassland type, and graminoid cover can be greater than 75%.

Global Dynamics: Some stands on slopes are the result of recent fire that killed the overlying canopy, converting *Pinus ponderosa / Prunus virginiana* Forest (CEGL000192) to this *Prunus virginiana* shrubland type.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Prunus virginiana, Dasiphora fruticosa, Ribes cereum*
Graminoid	*Bouteloua gracilis, Muhlenbergia montana*

Global

Stratum	Species
Short Shrub	*Prunus virginiana*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Prunus virginiana, Ribes cereum*
Graminoid	*Bouteloua gracilis, Muhlenbergia montana*

Global

Stratum	Species
Short Shrub	*Prunus virginiana*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**
Short Shrub	*Prunus americana*, *Symphoricarpos occidentalis*
Graminoid	*Pascopyrum smithii*, *Poa pratensis*

GLOBAL SIMILAR ASSOCIATIONS:
Fraxinus pennsylvanica - Ulmus americana / Prunus virginiana Woodland (CEGL000643)

SYNONYMY:
- DRISCOLL FORMATION CODE:III.B.3.a. (Driscoll et al. 1984) B
- *Prunus virginiana* (Bourgeron and Engelking 1994) =
- *Prunus virginiana* community type (Hansen et al. 1995) =
- *Prunus virginiana* Dominance Type (Jones and Walford 1995) =
- *Prunus virginiana / Rosa woodsii* community type (Manning and Padgett 1995) F

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4Q.
Global Classification Comments: The *Prunus virginiana / Rosa woodsii* (common chokecherry / wild rose) community type (Manning and Padgett 1995) is closely related but does not include any *Symphoricarpos occidentalis*.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Prunus virginiana* dominated one stand on a west-facing slope of Grape Creek southeast of the maintenance shop. This stand and two small south- and west-facing stands west of the Hornbek Homestead, where *Prunus virginiana* is codominant with *Ribes cereum*, occupy steep slopes of plate-like rhyolite outcrops.

Global Range: This shrubland is found primarily in the northern Great Plains and northwestern Rocky Mountain regions of the United States, but may extend into the Great Basin.

Nations: US
States/Provinces: CO ID MT NV? OR SD WA WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 44
Classification Confidence: 2 **Identifier:** CEGL001108
REFERENCES: Bourgeron and Engelking 1994, Caicco and Wellner 1983n, Copeland 1980a, Driscoll et al. 1984, Evans 1989a, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Kittel et al. 1996, Kittel et al. 1999, Manning and Padgett 1995, Von Loh et al. 1999

III.B.2.N.d. Temporarily flooded cold-deciduous shrubland

III.B.2.N.d.9. ALNUS INCANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Speckled Alder Temporarily Flooded Shrubland Alliance

ALNUS INCANA / MESIC GRAMINOIDS SHRUBLAND
Speckled Alder / Mesic Graminoids Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: This shrubland association is a widespread community of limited extent in the western states of Idaho, Colorado, Utah, Wyoming, and Nevada. Stands occur in narrow to moderately wide floodplains on stream benches, in association with abandoned meanders, on islands and pointbars, and on hillside seeps. These shrublands are characterized by stands of medium-tall and tall, deciduous shrubs and a thick herbaceous undergrowth of wetland-indicator grasses, and little to no overstory tree canopy. Total shrub cover is usually over 50% and is dominated by *Alnus incana*, the diagnostic shrub. Other shrubs includes *Salix* spp., *Betula occidentalis,* and *Cornus sericea*. The understory of undisturbed stands has a dense herbaceous cover including *Glyceria* spp., *Calamagrostis canadensis, Elymus glaucus, Carex* spp., and *Equisetum* spp. Heavily disturbed stands have abundant non-native grasses. In Nevada, Utah, southeastern Idaho, and Wyoming, this type is considered a grazing-induced community derived from *Alnus incana* / Mesic Forbs Shrubland (CEGL001147). However, several stands in Colorado are undisturbed and the undergrowth is dominated by native graminoid cover.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This shrubland occupies two small, west-flowing drainages at moderate elevations in the monument. The drainages differ in that the northernmost drainage and upper southernmost are low-gradient and support stands of sedge and willow, while the lower portion of the southernmost drainage is steep, narrow, and incising (approximately 4–5 m deep through loose gravel alluvium). The stand of *Alnus incana* located in the incised drainage portion is showing stress from drought and fire, e.g., stunted growth, many dead stems/shrub bases, and many new root sprouts, while those of more mesic sites appear healthy. The more stressed stand also exhibited chewing and other bark damage from elk, much like that observed in quaking aspen stands.

Global Environment: Stands occur in narrow to moderately wide floodplains on stream benches, in association with abandoned meanders, on islands and pointbars, and on hillside seeps. *Alnus incana* tends to dominate narrow streambanks where stream gradients are relatively steep, or on more cobbly substrates than their willow neighbors in broad floodplain settings. Stream channels can be steep and straight to highly sinuous (Rosgen's Channel Type: A3, A4, F3) or moderately steep and sinuous (Rosgen's Channel Type: B2, B3, B4, B6) (Rosgen 1996). Where this association occurs on point bars, stream channels are low gradient (<1% gradient) and highly sinuous (Rosgen's Channel Type: C5) (Rosgen 1996). Soils are mostly coarse alluvium, but characteristically have silt loams or sandy clay loams at the surface with a high percentage of organic matter. Soils are shallow to moderately deep, 15-30 inches (35-62 cm), and become increasingly skeletal with depth. Most profiles have 10-50% mottles at 7-10 inches (18-25 cm) depth. One profile had gleyed, mineral soils indicating saturated conditions.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This shrubland occurs in small patches and linear stands (stringers along drainages) that are less than 15 m wide and from 25–75 m in length. The stands are associated with species of willow (*Salix exigua*, *Salix monticola*, and *Salix ligulifolia*) and water birch (*Betula occidentalis*) providing a total shrub cover of approximately 35–45%. The shrubs may be quite tall, from 5–15 m depending on the stand health and site location. Stands located on mesic sites with sedge species in the understory appeared healthier and more robust than those of the drier, incised drainage reach. The oldest individual *Alnus incana* stems were associated with the upper portion of the driest site, in association with a quaking aspen stand, and trunk diameters up to 16.5 cm were recorded for the large alders. Graminoids associated with *Alnus incana* stands were tall, from 1–2 m and provided from 40–50% foliar cover. The most common graminoid species present included *Carex nebrascensis, Carex utriculata, Carex aquatilis*, and *Juncus balticus* and the exotics *Poa pratensis* and *Phalaris arundinacea*. Forbs associated with *Alnus incana* stands also ranged from 1–2 m in height and contributed approximately 20% foliar cover. The most common forbs present included *Heracleum maximum, Mertensia ciliata, Mentha arvensis*, and *Cirsium scariosum (= Cirsium tioganum)*. Ground cover consisted of predominantly herbaceous litter (60–90%), which was very thick (up to 10 cm at some locations) and litter in the form of wood (approximately 8–20%).

The patches and stands of this shrubland are less than the project minimum mapping unit and are typically associated with willow shrubs. The signature of this association is the same as that for willow stands, i.e., black to dark green for true color and bright pink to red for CIR.

Global Vegetation: These shrublands are characterized by stands of medium-tall and tall, deciduous shrubs and a thick herbaceous undergrowth of wetland-indicator grasses, and little to no overstory tree canopy. Total shrub cover is usually over 50% and is dominated by *Alnus incana*, the diagnostic shrub. *Alnus incana ssp. tenuifolia* dominates the upper canopy with 10-90% cover. Other shrubs occasionally present include *Salix exigua*, *Salix monticola, Rubus deliciosus*, *Salix bebbiana*, *Salix drummondiana*, *Rosa woodsii,* and *Cornus sericea*. Occasionally, trees may be scattered throughout the shrubland, or occur along one edge. Tree species include *Populus deltoides ssp. monilifera* and *Salix fragilis*.

The undergrowth is a thick carpet of grasses. Native graminoids include *Calamagrostis canadensis*, *Carex utriculata*, *Glyceria striata*, *Carex aquatilis*, *Carex lanuginosa*, and *Festuca rubra*. Heavily disturbed stands are dominated by introduced, non-native grasses including *Poa pratensis*, *Agrostis stolonifera*, and *Bromus inermis*. Forb cover is usually low relative to the amount of graminoid cover, but can include a high variety of species, including *Mertensia ciliata*, *Mentha arvensis*, *Cardamine cordifolia*, and *Caltha leptosepala*.

Global Dynamics: *Alnus incana ssp. tenuifolia* is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining (Viereck 1970, Van Cleve et al. 1971, Chapin et al. 1994, Hansen et al. 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop (Padgett et al. 1989).

Alnus incana is shade-intolerant (Viereck 1970, Chapin et al. 1994), and many mature stands in Colorado are restricted to stream bank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen et al. 1988b, Padgett et al. 1989).

Undisturbed *Alnus incana* stands may become dominated by *Salix* (willow) species or conifer stands (Hansen et al. 1989). In Alaska, thick stands of alders inhibit succession by competing with spruce for nutrients and light (Chapin et al. 1994). In Utah, *Acer negundo* (box-elder) often becomes the dominant canopy species on more xeric sites (Padgett et al. 1989).

Alnus incana fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankenia* and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder species ranges from 10 to 150 times the amount deposited by atmospheric precipitation alone (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen rich detritus is an important source of nutrients for the aquatic ecosystem as well.

In Nevada, Utah, southeastern Idaho, Montana, and Wyoming, the *Alnus incana*/mesic graminoid type is considered a grazing-induced community, derived from the *Alnus incana*/mesic forb plant association (Padgett et al. 1989, Manning and Padgett 1995, Jones 1992c). In Colorado, most stands of this plant association appear to be disturbed by improper grazing and have an abundance of non-native graminoid species. A few stands, however, appear undisturbed and have an undergrowth dominated by native grasses.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Alnus incana*
Graminoid	*Carex nebrascensis, Phalaris arundinacea*
Forb	*Cirsium scariosum, Iris missouriensis*

Global

Stratum	Species
Shrub	*Alnus incana*
Graminoid	*Calamagrostis canadensis, Carex* spp., and *Equisetum* spp.
Forb	*Mertensia ciliata, Achillea millefolium, Taraxacum officinale*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Alnus incana, Salix monticola, Salix exigua*
Graminoid	*Carex nebrascensis, Phalaris arundinacea, Poa pratensis*
Forb	*Mertensia ciliata, Heracleum maximum, Cirsium scariosum*

Global

Stratum	Species
Shrub	*Alnus incana,*
Graminoid	*Calamagrostis canadensis, Carex* spp., and *Equisetum* spp.
Forb	*Mertensia ciliata, Achillea millefolium, Taraxacum officinale*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:III.B.3.c. (Driscoll et al. 1984) B
- *Alnus incana*/Mesic graminoid (Bourgeron and Engelking 1994) =
- *Alnus incana* / Mesic forbs (Padgett et al. 1989). a grazing-induced sere.
- *Alnus incana* / Mesic forbs (Manning and Padgett 1995). a grazing-induced sere.
- *Alnus incana / Glyceria elata*. Oregon.
- *Alnus incana / Calamagrostis canadensis*. Oregon.
- *Alnus incana / Scirpus microcarpus*. Oregon.
- *Alnus incana / Carex amplifolia*. Oregon.
- *Alnus incana / Carex pellita*. Oregon.

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3.

Global Classification Comments: Classification is based on data collected from throughout the range of the association. Some classifications have considered this a grazing-induced sere of the *Alnus incana* / Mesic Forbs Shrubland (CEGL001147) (Padgett et al. 1989, Manning and Padgett 1995). High-quality stands with a native understory are uncommon, but are reported in Colorado and Idaho, and are suspected in Wyoming. In Oregon, five *Alnus incana* plant associations (*Alnus incana / Glyceria elata*, *Alnus incana / Calamagrostis canadensis*, *Alnus incana / Scirpus microcarpus*, *Alnus incana / Carex amplifolia*, and *Alnus incana / Carex pellita)* were described and one or more may belong in this association.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Stands of *Alnus incana* / Mesic Graminoids Shrubland occur only in two minor drainages tributary to Grape Creek. Both drainages are on the eastern portion of the monument above 8500 feet elevation (8520–8550 feet) in nearly flat to moderately steep topography (1–12%). As a result, the stands are poorly drained to moderately well-drained. The northernmost drainage lies adjacent to the trail running along the northeastern monument boundary; the southernmost is near the southeastern monument boundary.

Global Range: This plant association is a minor riparian type in Idaho, Colorado, Utah, Wyoming, and Nevada.

Nations: US
States/Provinces: CO ID NV UT WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 17, 80
Classification Confidence: 2 **Identifier:** CEGL001148
REFERENCES: Binkley 1986, Bourgeron and Engelking 1994, Bowman and Steltzer n.d., Chapin et al. 1994, Driscoll et al. 1984, Hansen et al. 1988b Hansen et al. 1989, Jones 1992b, Jones 1992c, Kettler and McMullen 1996, Kittel et al. 1996, Kittel et al. 1999, Manning and Padgett 1995, Padgett et al. 1989, Richard et al. 1996, Rosgen 1996, Van Cleve et al. 1971, Viereck 1970

III.B.2.N.d.17. DASIPHORA FRUTICOSA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Shrubby-cinquefoil Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: This shrubland alliance is highly variable, occupying various landforms in the foothills, montane, and subalpine regions in the Rocky Mountain region. Sites include glacial depressions, terraces along meandering streams, slopes near springs and seeps, steep scree slopes, or broad mountain meadows. Typically, stands occur on broad, gently sloping valley bottoms and floodplains or along the drier edges of isolated wetlands and fens. Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface. The soils are typically sandy loams over sand and gravel layers. Peat accumulation is common in stands located on fens. Soil texture can be fine-textured with occasional mottling and gleying. This alliance is dominated by *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)*. Associates include *Artemisia cana* and *Deschampsia caespitosa* and *Trifolium longipes* on wetter sites. Other graminoids present in the wetter sites may include *Poa secunda, Festuca rubra, Carex aquatilis, Carex buxbaumii, Carex microptera, Carex pachystachya, Juncus balticus*, and *Muhlenbergia filiformis*. The drier sites typically are composed of a dense graminoid layer that includes *Festuca idahoensis, Festuca campestris, Schizachyrium* *scoparium*, and *Andropogon gerardii*. Diagnostic of this alliance is the dominance of *Dasiphora fruticosa ssp. floribunda* in a shrub layer with over 25% cover.

Environment: Plant associations within this alliance are highly variable, occupying various landforms in the foothills, montane, and subalpine regions. They range in elevation from 860 m in Montana to 3000 m in Colorado. These communities can occupy sites adjacent to glacial depressions, terraces along meandering streams, slopes near springs and seeps, steep scree slopes, or broad mountain meadows. Typically, stands occur on broad, gently sloping valley bottoms and floodplains or along the drier edges of isolated wetlands and fens. Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface.

Parent materials for sites supporting stands of this alliance are either alluvial-glacial or organic. The soils are typically sandy loams over sand and gravel layers. Peat accumulation is common in stands located on fens. Soil texture can be fine-textured with occasional mottling and gleying. *Salix wolfii, Salix boothii*, or *Betula nana (= Betula glandulosa)* communities can be in the adjacent riparian areas.

Vegetation: Plant associations within this alliance are classified as temporarily flooded, cold-deciduous shrublands. *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)* dominates the overstory with a range of 10-60% cover in all stands. *Artemisia cana* and *Deschampsia caespitosa* typically occur with *Dasiphora fruticosa ssp. floribunda* in wetter sites. Other graminoids present in the wetter sites can include *Poa secunda, Festuca rubra, Carex buxbaumii, Carex microptera, Carex pachystachya, Muhlenbergia filiformis*, and *Juncus balticus*. Colorado stands in excellent condition (i.e., not grazing-induced) have high cover of *Carex aquatilis* and *Trifolium longipes*.

The drier sites typically are composed of a dense graminoid layer, up to 75% cover, that includes *Festuca idahoensis, Festuca campestris, Schizachyrium scoparium*, and *Andropogon gerardii*. *Dasiphora fruticosa ssp. floribunda* is a common understory shrub for associations dominated by the following montane trees *Pinus pungens* or *Pinus flexilis*. Riparian stands that include *Dasiphora fruticosa ssp. floribunda* as an understory can include *Betula occidentalis* or *Betula pumila*. In the Pacific Northwest, common overstory species can include *Larix laricina, Acer rubrum*, or *Myrica gale*.

Dynamics: *Dasiphora fruticosa ssp. floribunda* is an opportunistic species and as such occurs on a variety of habitats. Many of the communities dominated by this species appear to be controlled by disturbance. Komarkova (1986) reports stands on subalpine scree slopes that have relatively rapidly moving fine materials or snow.

Heavily grazed sites may support *Dasiphora*-dominated communities as well (Komarkova 1986, Padgett et. al. 1989). *Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa* Shrubland (CEGL001107) in this alliance is a mid-seral stage of secondary succession as a result of heavy grazing. With improper grazing, *Dasiphora fruticosa ssp. floribunda* will increase in abundance because it is unpalatable to livestock. Other species that increase with grazing in this association are *Poa pratensis, Juncus balticus*, and *Taraxacum officinale* (Padgett et al. 1989). Extended grazing may cause this plant association to convert to a *Dasiphora fruticosa ssp. floribunda / Poa pratensis* plant association.

Similar Alliances:
- DASIPHORA FRUTICOSA SSP. FLORIBUNDA SHRUB HERBACEOUS ALLIANCE (A.1534)

Similar Alliance Comments: The *Dasiphora fruticosa ssp. floribunda* Shrub Herbaceous Alliance (A.1534) occurs at lower elevations and on drier sites than this alliance.

SYNONYMY:
- *Pentaphylloides floribunda* Series (Johnston 1987)

ALLIANCE DISTRIBUTION

Range: This alliance has been described from scattered locations throughout the Rocky Mountains, from Montana west into Oregon, and south into Nevada, Colorado and New Mexico. *Dasiphora fruticosa ssp. floribunda* is widespread throughout North America. It occurs from Alaska east to Newfoundland, Canada, south to California, New Mexico, Iowa, and New Jersey (Welsh et al. 1987). This alliance could potentially occur in the neighboring states of Washington and the higher elevations of Arizona.

Nations: CA? US
States/Provinces: CO ID MT NM NV OR UT WY

ALLIANCE SOURCES

Authors: D. CULVER, WCS **Identifier:** A.958

REFERENCES: Baker 1980a, Baker 1983a, Crowe and Clausnitzer 1997, Hansen et al. 1991, Hansen et al. 1995, Johnston 1987, Jones 1992b, Kettler and McMullen 1996, Kittel et al. 1999, Komarkova 1986, Lee and Jonkel 1980, Loope 1969, Mutz and Graham 1982, Padgett et al. 1988b, Padgett et al. 1989, Sanderson and March 1996, Welsh et al. 1987, Youngblood et al. 1985a, Youngblood et al. 1985b

FLORISSANT FOSSIL BEDS NATIONAL MONUMENT STAND DESCRIPTION

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This shrubland is found along the margins of emergent wetlands growing from saturated soil and other moist soil sites, and *Dasiphora fruticosa* is an understory shrub in mesic forest types. The sites sampled are of low to moderate gradient (from 2–7% slopes), are considered somewhat poorly drained to moderately well-drained, and occur on any aspect if the moisture regime is adequate. These stands probably increased to their present level of density and abundance under past heavy grazing pressure.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Dasiphora fruticosa* is the common shrub of this type, growing along upper wetland margins and in moist drainages, predominantly. This is a zone of mixing or an ecotone between wetland and upland plant associations, therefore *Dasiphora fruticosa* may be associated with obligate wetland species such as *Salix monticola, Carex aquatilis, Carex utriculata*, or *Juncus balticus*, or drier species such as *Bromus porteri* or *Pascopyrum smithii* and the exotics *Poa pratensis, Bromus inermis*, and *Linaria vulgaris*. *Dasiphora fruticosa* is a rounded shrub, less than 1 m in height, and typically provides from 40–65% foliar cover in a stand. *Dasiphora fruticosa* is also a minor component of other mesic sites including willow-dominated wetlands and shaded sites, particularly as understory to *Populus tremuloides* and *Picea pungens*. The associated graminoids are typical of moist to mesic sites, e.g., *Juncus balticus, Deschampsia caespitosa, Poa pratensis, Pascopyrum smithii*, and *Carex utriculata*, and typically contribute from 40–50% foliar cover. Forbs are diverse in this type, but rarely provide more than 10% foliar cover and usually provide less than 5%. The more common forbs present include *Achillea millefolium, Cirsium tioganum*, and *Iris missouriensis*. Ground cover varies from 80–100% litter for most sites, to as little as 25% litter in a gravel drainage. Small gravel provided ground cover up to 60% on a site where alluvium was exposed by flows and aggradation in an intermittent drainage.

This type has a characteristic signature on true color aerial photography, a dark green color and pebbly texture. It is more pronounced on CIR photography with an associated maroon color and pebbly texture.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Dasiphora fruticosa*
Graminoid	*Juncus balticus, Poa pratensis*
Forb	*Iris missouriensis, Achillea millefolium, Cirsium tioganum*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Dasiphora fruticosa*
Graminoid	*Juncus balticus*
Forb	*Iris missouriensis, Achillea millefolium, Cirsium tioganum*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	Species
Forb	*Linaria vulgaris*

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Dasiphora fruticosa* Shrubland is limited to drainage bottoms, moist swale bottoms, margins of livestock watering ponds, quaking aspen woodland understory, and the perimeter of emergent wetland types. The type is located throughout the monument at low to mid-elevations in moist-shaded to saturated conditions.

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 14, 32, 39

III.B.2.N.d.15. ELAEAGNUS COMMUTATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE

American Silverberry Temporarily Flooded Shrubland Alliance

ELAEAGNUS COMMUTATA SHRUBLAND

American Silverberry Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This shrubland is unusual and is known from only one site with a steep, rapidly drained slope (37%) and northwestern, western, and southeastern aspects because it wraps around the head of a ridge at midslope. This slope contains a band of outcropping volcanic material (welded tuff), volcanic talus, and small pieces of shale surrounded by Pikes Peak granite bedrock above and granite alluvium in the lower, adjacent drainage.

Global Environment: Not applicable.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Elaeagnus commutata* shrubs are of relatively short stature, between 1 and 2 m tall, and sparse, providing approximately 20% vegetative cover. The silverberry association lies between *Pinus ponderosa / Cercocarpus montanus* Woodland (CEGL000851) upslope and *Festuca arizonica - Muhlenbergia montana* Herbaceous Vegetation (CEGL001606) that occupies the alluvial deposits of the adjacent valley side. The secondary species therefore represent the dominants in adjacent plant associations, with the exception of *Apocynum androsaemifolium*. It is unknown if this stand is a relict or if it is a relatively new introduction for the area. Vegetative cover for this stand totals approximately 50% and consists of approximately 5% for *Pinus ponderosa* trees, 25% for shrubs, including *Elaeagnus commutata* and *Ribes cereum*, and 20% for herbaceous species, particularly *Festuca arizonica, Bouteloua gracilis, Muhlenbergia montana, Grindelia subalpina, Galium boreale,* and *Allium cernuum*. The plot was diverse, e.g., 38 species were observed in a 400 m^2 plot. Volcanic outcrops are unusual for the monument, and the vegetation types supported are quite different than the more widespread associations occupying Pikes Peak granite exposures. Ground cover for this silverberry stand consists of approximately 55% bare soil, 40% litter, and 5% exposed volcanic rock and large boulders.

Only one stand of silverberry is extant in the monument, and is below the minimum mapping unit for the project. The aerial photo signature is light pink to white on CIR, because of the reflectance from exposed rocks. For true color aerial photography, the signature is light tan.

Global Vegetation: Not applicable.

Global Dynamics: Not applicable.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Elaeagnus commutata, Ribes cereum*
Dwarf-shrub	*Artemisia frigida, Apocynum androsaemifolium*
Graminoid	*Festuca arizonica*
Forb	*Grindelia subalpina, Galium boreale, Allium cernuum*

Global

Stratum	Species

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Elaeagnus commutata, Ribes cereum*
Dwarf-shrub	*Artemisia frigida, Apocynum androsaemifolium*
Graminoid	*Festuca arizonica, Bouteloua gracilis, Muhlenbergia montana*

Forb *Grindelia subalpina, Galium boreale, Allium cernuum*

Global
Stratum **Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global
Stratum **Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: Not applicable.

Global Classification Comments: Not applicable.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Only one stand is present, south of Lower Twin Rock Road on a west-facing slope adjacent to a tributary to Grape Creek.

Global Range: Not applicable

Nations: US
States/Provinces:

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 15
Classification Confidence: 3 **Identifier:**
REFERENCES:

III.B.2.N.d.6. SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE
(Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

SALIX EXIGUA TEMPORARILY FLOODED SHRUBLAND
Coyote Willow Temporarily Flooded Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: This willow shrubland community is found throughout the northwestern United States and Great Plains. This type is an early successional stage that occurs along rivers and streams at lower elevations, on recently flooded riparian areas, and in moist swales and ditches that are frequently disturbed. Stands occur most commonly on alluvial sand, but silt, clay, or gravel may also be present. *Salix exigua* is the dominant canopy species (*Salix interior* or intermediates of the two willow species may be present in the eastern part of the range). It can form dense stands up to 4 m tall, but there are often patches where the shrub layer is absent. Seedlings and small saplings of *Populus deltoides* and *Salix amygdaloides* may be present. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Species present include *Cenchrus longispinus*, *Polygonum lapathifolium*, *Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima*, and *Xanthium strumarium*. The composition of this community, especially the herbaceous layer, varies from year to year with succession or renewed disturbance.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This temporarily flooded shrubland is distributed along Grape Creek for only a short distance of approximately one km and at the lowest monument elevations (between 8150-8225 feet). Sandbar willow stands occupy a nearly flat gradient of 1–3% and are poorly drained. They are confined to the gravel and sand substrate of the creek and expand upstream, only because beaver ponds have been constructed in the drainage bottom. This type rapidly transitions to the *Salix monticola* temporarily flooded shrublands where beaver ponds are actively maintained and the drainage narrows into a small canyon.

Global Environment: This community is found on recently deposited or disturbed alluvial material. The parent material is alluvial sand, although silt, clay, or gravel may be present. Soil development is poor to absent.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Grape Creek appears to be aggrading due to accumulation of gravelly alluvium and finer sediments in the portion between the northern boundary fenceline and the lower beaver ponds. This probably results from lower velocity flows after passing through the beaver pond area, providing the substrate conducive to the growth of *Salix exigua*. The sandbar willow shrubs near the boundary fenceline are quite tall, approximately 5–8 m, and are reproducing by root sprouts (2–3 m in height). They have shorter stature around the beaver ponds (from 2–4 m tall) likely due to younger growth from root sprouts, resulting from foraging by beaver and drowning of older stems. At both stands sampled, *Salix exigua* provided approximately 50% foliar cover, while *Salix monticola* provided from 5–25% foliar cover, and *Dasiphora fruticosa* consistently provided approximately 3% foliar cover. With the exception of *Juncus balticus* and *Eleocharis palustris* (approximately 2% foliar cover each), most graminoids within the stands sampled are exotics, e.g., *Elymus repens (= Elytrigia repens), Poa pratensis, Phleum pratense*, *Agrostis scabra*, and *Bromus inermis* (in the aggregate, they contribute approximately 5–8% foliar cover). Commonly associated forbs, providing approximately 5–10% foliar cover, included *Heracleum maximum*, *Achillea millefolium*, *Solidago* sp., *Equisetum arvense*, and the exotic *Linaria vulgaris*. Ground cover ranged from 60–80% litter, 5–20% woody litter, 1–10% open water, and the remainder was small gravel. The large amount of woody litter and open water is the result of beaver dam construction and ponded water behind these structures.

This stand probably approaches the minimum mapping unit in size, although it is difficult to tell with certainty because of the long and linear nature. Its aerial photograph signature is identical to other willow associations in the monument, e.g., dark green to nearly black on true color and bright pink on CIR.

Global Vegetation: This community is dominated by shrubs generally between 2 and 4 m tall. The most common of these is *Salix exigua* (*Salix interior* or intermediates of the two willow species may be present in the eastern part of the range). *Salix irrorata* and saplings of *Populus deltoides* or *Salix amygdaloides* are also frequently found in the shrub layer in lower elevation stands. This stratum can have moderate to high stem density in the community as a whole. The species in the shrub layer do not form a closed canopy, allowing significant light to reach the ground layer. There are often patches where the shrub layer is absent. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Older stands and places with less competition from the shrubs have greater herbaceous cover. The composition of the herbaceous layer can vary greatly. Species that are often found in this community are *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima*, *Xanthium strumarium, Juncus balticus*, *Eleocharis palustris, Elymus repens (= Elytrigia repens), Poa pratensis, Phleum pratense, Agrostis scabra, Bromus inermis*, *Heracleum maximum, Achillea millefolium, Solidago* sp., *Equisetum arvense*, and *Linaria vulgaris*.

Global Dynamics: This type originates after flash floods that create new deposits or scour existing alluvial material. This community is a primary or early secondary community and requires floods to create new areas on which it can develop. Once established, without further flooding disturbance and sediment deposition, this community may not exist for more than 10-20 years before it is replaced by a later seral stage.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix exigua, Salix monticola*
Graminoid	*Juncus balticus, Poa pratensis, Eleocharis palustris*
Forb	*Heracleum maximum, Achillea millefolium, Linaria vulgaris*

Global

Stratum	Species
Shrub	*Salix exigua*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Salix exigua, Salix monticola*
Graminoid	*Juncus balticus*
Forb	*Heracleum maximum*

Global

Stratum	**Species**
Shrub	*Salix exigua*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

- *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203)--This type may be essentially the same, or this type is a later successional stage.
- *Salix interior - Salix eriocephala* Sandbar Shrubland (CEGL005078)--of the Great Lakes states/provinces.

SYNONYMY:

- DRISCOLL FORMATION CODE:III.B.3.c. (Driscoll et al. 1984) B
- *Salix exigua* (Bourgeron and Engelking 1994) =
- R4B3cI2a. *Salix exigua* (Foti et al. 1994)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G5.

Global Classification Comments: This type may be an early successional shrubland that develops into *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203), or the two types may be essentially synonymous. This plant association occupies a wide geographic range. The range of this type was reviewed and it was split into eastern, *Salix interior* Temporarily Flooded Shrubland (CEGL008562), and western components. The western stands may all be composed of *Salix exigua* (*sensu stricto*) and Great Plains stands may contain either *Salix exigua*, *Salix interior*, or intermediates of the two willow species, the *Salix interior* being an entirely Great Plains and eastwardly distributed species (Kartesz 1999).

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Stands of *Salix exigua* Temporarily Flooded Shrubland are present along Grape Creek, in a patchy distribution from the northern boundary fenceline to a series of beaver ponds, approximately 1 km upstream from the boundary. Extensive stands of this type are present north of the monument, along Grape Creek as it meanders across private land, along Twin Creek, and also along the South Platte River west of the town of Florissant. All off-monument stands are heavily grazed.

Global Range: This sandbar willow shrubland community is found along rivers and streams at lower elevations throughout the northwestern United States and Great Plains, ranging sporadically from Oklahoma northwest to the Dakotas and Manitoba, and west to Washington. Part of this type's former range in the Great Plains and eastward is actually occupied, at least in part, by *Salix interior* [see *Salix interior* Temporarily Flooded Shrubland (CEGL008562)].

Nations: CA US
States/Provinces: ID MB MT ND NE OK OR SD WA WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 69, 70
Classification Confidence: 1 **Identifier:** CEGL001197
REFERENCES: Bellah and Hulbert 1974, Bourgeron and Engelking 1994, Driscoll et al. 1984, Evenden 1990, Foti et al. 1994, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998c, Hoagland 2000, Kartesz 1999, Kittel and Lederer 1993, Kovalchik 1987, Phillips 1977, Steinauer 1989, Steinauer and Rolfsmeier 2000, Wilson 1970

III.B.2.N.d.37. SALIX LIGULIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Strapleaf Willow Temporarily Flooded Shrubland Alliance

SALIX LIGULIFOLIA SHRUBLAND
Strapleaf Willow Shrubland

ELEMENT CONCEPT

Summary: This plant association is a medium to tall (5-15 feet, 1.5-3 m) willow shrubland occurring in saturated areas at montane elevations (6700-10,800 feet) of Colorado. It occurs in the wettest part of the riparian area, usually adjacent to the channel on low point bars, islands, and overflow channels. The higher elevation distribution of *Salix ligulifolia* in Colorado occurs in relatively broad valley bottoms along low terraces and floodplains, and along streambanks of narrower reaches. Soils are saturated sandy loams and clay loams with a high organic matter content in the upper layers. *Salix ligulifolia* is found in mixed stands with other willows such as *Salix monticola, Salix geyeriana,* and *Salix drummondiana*. *Salix ligulifolia* is the key diagnostic species, other willows may have equal cover, but in general do not exceed that of *Salix ligulifolia*. The herbaceous undergrowth can be dense in undisturbed stands with *Carex utriculata* (1-40%), *Carex nebrascensis* (1-5%), *Carex lanuginosa* (1-3%), *Juncus balticus* (1-20%), and *Calamagrostis canadensis* (1-27%). Forb cover is generally low. *Salix exigua - Salix ligulifolia* Shrubland (CEGL002655) is a closely related association occurring in the Colorado foothills at lower elevations.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: The *Salix ligulifolia* Shrubland is unusual within the monument and was growing along a small, low-gradient (approximately 2% slope) drainage that is tributary to Grape Creek. The floodplain associated with this drainage was saturated to the surface and flowing water approximately one meter wide was present. This stand occurred at approximately 8410 feet in elevation.

Global Environment: This association occurs in moderately wide valleys along low terraces and floodplains, and stream banks of narrower reaches. The plant association occurs along reaches with vegetated islands between multiple channels below an active beaver pond (Rosgen's Channel Type: D3), along slightly sinuous broad channels (Rosgen's Channel Type: B2, B4), along more sinuous channels with well-developed floodplains (Rosgen's Channel Type: C4), and along steep narrow gullies (Rosgen's Channel Type: G3) (Rosgen 1996). Soils are saturated sandy loams and clay loams with a high organic matter content in the upper layers.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Only one stand of this shrubland type was observed and sampled near the northeastern monument boundary. The stand was linear (less than 15 m wide), growing on both banks of a narrow and incised drainage for approximately 20 m. *Salix ligulifolia* was the dominant shrub (approximately 60% foliar cover) at a height of 4–5 m. An additional 5–10% foliar cover within the stand was provided by the shrubs *Salix exigua, Dasiphora fruticosa, Ribes inermis,* and *Rosa woodsii*. Herbaceous cover for this shrubland type was approximately 20%, but no forbs or graminoids individually provided greater than 2–3% herbaceous cover. Graminoids common to this type included the natives *Carex nebrascensis* and *Juncus balticus* and the exotics *Bromus inermis, Poa pratensis,* and *Agrostis stolonifera*. Common forbs included *Heracleum maximum, Maianthemum stellatum, Equisetum arvense, Mertensia ciliata*, and the exotic *Cirsium arvense*. Because a steep cutbank was adjacent to the plot established, some cover was recorded for upland species present. Ground cover at this site was predominantly litter, approximately 90%, with most of the remainder comprised of flowing water.

This small stand is below the minimum mapping unit for the project, but because of its known location could be mapped as a park special. Its aerial photograph signature is identical to other willow associations in the monument, e.g., dark green to nearly black on true color and bright pink to dull red on CIR.

Global Vegetation: This association has a canopy dominated by 15-66% cover of *Salix ligulifolia* usually mixed with several other willow species. *Salix ligulifolia* is the key diagnostic species, other willows may have equal cover, but in general do not exceed that of *Salix ligulifolia*. Other willows that may be present include: *Salix monticola* (3-43% cover), *Salix geyeriana* (1-12% cover), *Salix bebbiana* (3% cover), *Salix lucida* ssp. *lasiandra* (1-20% cover), *Salix exigua* (1-10% cover), *Salix wolfii* (11% cover), and *Salix planifolia* (8% cover). Additional shrubs that may be present include *Alnus incana* (3-10% cover), *Cornus sericea* (21%), and *Dasiphora fruticosa ssp. floribunda* (1-9% cover). The herbaceous undergrowth can be dense in undisturbed stands with *Carex utriculata* (1-40%), *Carex nebrascensis* (1-5%), *Carex lanuginosa* (1-3%), *Juncus balticus* (1-20%), and *Calamagrostis canadensis* (1-27%). Forb cover is generally low, but some species are abundant: *Taraxacum officinale* (1-10%), *Achillea millefolium* (1%), *Thalictrum fendleri* (1-19%), and *Fragaria virginiana* (1-12%).

Global Dynamics: *Salix ligulifolia* is highly palatable to livestock, therefore, season long grazing, especially late summer and early fall browsing, should be avoided in order to maintain the vigor of woody species (Hansen *et al.* 1995). Overuse by livestock may cause the site to dry and become dominated by introduced grass species such as *Poa pratensis* or *Bromus inermis* (Manning and Padgett 1995). With continued overuse, the willow species will decline and eventually become eliminated from the site (Hansen *et al*. 1995). Beaver can be important in maintaining this plant association. Beaver dams raise the water table, which is beneficial to willow and sedge species as well as other hydrophytic plants. Beaver dams also help control bank erosion, channel downcutting, and the loss of sediment downstream (Hansen *et al*. 1995).

Prescribed fires may be useful for rejuvenating *Salix ligulifolia* since this willow vigorously sprouts after burning, especially in wetter areas (Hansen *et al*. 1995). Willow roots provide stream bank stability and should be considered by managers for stream bank restabilization projects and revegetation purposes (Hansen *et al.* 1995, Padgett *et al.* 1989).

This association appears to be long-lived mid to late-seral type since the stands are associated with beaver activity and saturated soils throughout the growing season.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix ligulifolia*
Graminoid	*Carex nebrascensis, Juncus balticus, Poa pratensis*
Forb	*Heracleum maximum, Mertensia ciliata, Equisetum arvense*

Global

Stratum	Species
Shrub	*Salix ligulifolia*
Graminoid	*Carex nebrascensis, Juncus balticus, Poa pratensis*
Forb	*Heracleum maximum, Mertensia ciliata, Equisetum arvense*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix ligulifolia, Salix exigua*
Graminoid	*Carex nebrascensis, Juncus balticus*
Forb	*Equisetum arvense, Heracleum maximum*

Global

Stratum **Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum **Species**

GLOBAL SIMILAR ASSOCIATIONS:

- *Salix exigua - Salix ligulifolia* Shrubland (CEGL002655)—found at lower elevations in the Colorado Front Range foothills.

SYNONYMY:

- DRISCOLL FORMATION CODE:III.B.3.c. (Driscoll et al. 1984) B
- *Salix ligulifolia* (Bourgeron and Engelking 1994) =
- *Salix eriocephala* var. *ligulifolia*/mesic graminoid plant association (Kittel *et al.* 1996) =
- *Salix ligulifolia-Salix monticola* plant association (Richard *et al*. 1996) =
- *Salix ligulifolia-Cornus sericea* plant association (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G2G3.

Global Classification Comments: The stand at Florissant Fossil Beds National Monument is boarder-line between the foothills *Salix exigua – Salix ligulifolia* Shrubland (CEGL002655) and the montane *Salix ligulifolia* Shrubland (CEGL001218) in Colorado. The overwhelming abundance of *Salix ligulifolia* (60%) to relatively low cover of *Salix exigua* (<10%), and the elevation (8400 feet) place it in the upper elevation, *Salix ligulifolia* Shrubland.

Dorn (1995) has combined *Salix lutea* and *Salix ligulifolia* (as used in Colorado literature) into *Salix eriocephala*. Nearly all Colorado specimens called *Salix lutea* and *Salix ligulifolia* have been placed into *Salix eriocephala var. ligulifolia*. *Salix lutea* specimens found in the extreme northwestern part of Colorado (north of Dinosaur National Monument) have been renamed *Salix eriocephala var. watsonii*, and *Salix lutea* specimens from extreme northeastern Colorado (along the South Platte River near Julesberg) have been renamed *Salix eriocephala var. famelica*. Kartesz (1999) accepts *Salix lutea* and *Salix ligulifolia* as valid species. Colorado specimens of *Salix lutea*, *Salix ligulifolia*, and *Salix eriocephala var. ligulifolia* are called *Salix ligulifolia* by the Kartesz (1999) treatment.

Several closely related *Salix lutea*-dominated community types occur in Montana (Hansen et al. 1995), eastern Wyoming and western Idaho (Youngblood et al. 1985a), and in Nevada (Manning and Padgett 1995). These communities would be dominated by *Salix eriocephala var. watsonii*, if we apply Dorn's (1995) nomenclature.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Only one stand of *Salix ligulifolia* Shrubland growing along an unnamed drainage in the northeastern portion of the monument was observed and sampled. This stand was approximately 50 m west of a hiking trail that crosses the drainage on a wooden foot bridge.

Global Range: This association occurs in the mountains of Colorado, where it has a fairly broad range. This association is known from the San Juan National Forest, Rio Grande National Forest, Pike-San Isabel National Forest, and the Arapaho-Roosevelt National Forest.

Nations: US
States/Provinces: CO NM?

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 73
Classification Confidence: 2 **Identifier:** CEGL001218
REFERENCES: Baker 1989b, Bourgeron and Engelking 1994, Dorn 1995, Dorn 1997, Driscoll et al. 1984, Hansen et al. 1995, Kartesz 1999, Kittel and Lederer 1993, Kittel et al. 1996, Kittel et al. 1999, Manning and Padgett 1995, Padgett et al. 1989, Richard et al. 1996, Rosgen 1996, Youngblood et al. 1985a

III.B.2.N.d.40. SALIX MONTICOLA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Mountain Willow Temporarily Flooded Shrubland Alliance

SALIX MONTICOLA / CAREX UTRICULATA SHRUBLAND
Mountain Willow / Beaked Sedge Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: This plant association is found throughout the southern Rocky Mountains ecoregion in Colorado. It occurs on and along wet banks and terraces of low-gradient, subalpine streams (2500-3100 m, 8300-10,240 feet) in broad valley bottoms, commonly near beaver ponds. Soils are heavy (clay loam, sandy clay loam, heavy silty clay textures), often with significant organic matter. This plant association is a tall (1.5-2.5 m, 5-8 feet), deciduous shrubland with an open canopy of willows and a thick understory of grasses and sedges. Willows establish on higher hummocks while *Carex utriculata* establishes at the water margins and in wet swales between willow hummocks. The willow canopy is dominated by *Salix monticola* (10-80% cover), although other species (with percent cover) may include *Salix geyeriana* (4-40%), *Salix brachycarpa* (2-28%), *Salix drummondiana* (1-20%), *Salix ligulifolia (= Salix eriocephala var. ligulifolia)* (1-11%),and *Salix boothii* (1%). The undergrowth is dominated by patches of *Carex utriculata* (1-44% cover), but *Carex aquatilis* (1-11% cover), *Deschampsia caespitosa*, and *Calamagrostis canadensis* are often present as well. Total forb cover is generally <10% cover, and may include *Cardamine cordifolia, Mertensia ciliata*, and *Heracleum maximum*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This shrubland is one of the most common willow types within the monument, occupying narrow, low-gradient streams of 2–3% slopes. The stands are linear, growing in saturated gravel and peat substrates immediately adjacent to the flowing water, thus serving to anchor streambanks resulting in drainage incision up to 1.5 m. Along the middle reach of Grape Creek there are many beaver dams and ponds within this vegetation type. Mountain willow shrubs grow along the edge of the floodplain, on the margins of the beaver ponds, and persist as shorter and younger shrubs than in other areas. These shrubs undoubtedly began as root sprouts following foraging and dam-building activities by the beaver.

Global Environment: This association occurs along wet banks and terraces of low-gradient, subalpine streams (2500-3100 m, 8300-10,240 feet) in broad valley bottoms, commonly near beaver ponds. Soils are heavy (clay loam, sandy clay loam, heavy silty clay textures), often with significant organic matter. Willows establish on higher hummocks while *Carex utriculata* establishes at the water margins and in wet swales between willow hummocks. It can form very wide and thick shrublands in broad valley bottoms, or it can occur as a narrow strip of linear vegetation along smaller streams in narrow, constricted tributaries.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Stands of this shrubland are linear, the willow shrubs growing immediately adjacent to the flowing water of each stream. *Salix monticola* was the dominant shrub, attaining heights of 2-5 m and providing foliar cover from 40-65% in individual plots and stands. Associated shrubs included *Dasiphora fruticosa ssp. floribunda* and *Ribes aureum* which never provided foliar cover greater than 1% for the stands sampled. Graminoid species provided foliar cover of 40–75%. *Carex utriculata* was the dominant native graminoid (approximately 15–50% foliar cover). Other graminoids common to these stands included *Carex aquatilis* and *Deschampsia caespitosa*. Forbs contributed from 5–25% foliar cover, the most abundant was *Heracleum maximum* (approximately 20% cover on one plot). Common forbs present in the type included *Mertensia ciliata, Mentha arvensis, Achillea millefolium*, and *Equisetum arvense*. Ground cover within sampled stands was predominantly litter (approximately 60–95%); one stand had an abundance of woody litter, approximately 30%.

Linear stands of this shrubland often are below the project minimum mapping unit. Along some stream reaches, however, these stands are mappable from a dark green to nearly black signature on true color aerial photos and bright pink on CIR photography.

Global Vegetation: This plant association is a tall (1.5-2.5 m, 5-8 feet), deciduous shrubland with an open canopy of willows and a thick understory of grasses and sedges. The willow canopy is dominated by *Salix monticola* (10-80% cover), although other species (with percent cover) may include *Salix geyeriana* (4-40%), *Salix brachycarpa* (2-28%), *Salix drummondiana* (1-20%), *Salix ligulifolia (= Salix eriocephala var. ligulifolia)* (1-11%), and *Salix boothii* (1%). *Ribes* spp. are often present in low abundance. The undergrowth is dominated by patches of *Carex utriculata* (1-44% cover), but *Carex aquatilis* (1-11% cover), *Deschampsia caespitosa*, and *Calamagrostis canadensis* are often present as well. Total forb cover is generally <10% cover and may include *Cardamine cordifolia*, *Mertensia ciliata*, and *Heracleum maximum*.

Global Dynamics: *Salix monticola* appears to be less tolerant of browsing pressure than other tall montane willow species. It responds to heavy browsing pressure in the same way that *Salix geyeriana* does; it forms the classic "mushroom" shape with over browsing by deer and cattle (Hansen et al. 1995). *Carex* species can be heavily grazed by livestock in narrow riparian areas in mid-elevation rangelands. Improper grazing by livestock in this plant association can dry sites, increase non-native cover, and reduce the vigor of willow root structure. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Changes in the physical environment, brought on by flooding or other disturbance, can initiate successional shifts in species composition. Sediment deposition on the floodplain raises the surface higher above the water table. As aggradation, or build up, of the floodplain proceeds, the site becomes drier and the dominant graminoid understory changes. Thus *Carex aquatilis*-dominated stands (regardless of any overstory canopy) may shift toward *Calamagrostis canadensis*-dominated stands.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix monticola, Dasiphora fruticosa*
Graminoid	*Carex utriculata, Carex aquatilis*
Forb	*Heracleum maximum, Equisetum arvense, Mertensia ciliata*

Global

Stratum	**Species**
Shrub	*Salix monticola*
Graminoid	*Carex utriculata*
Forb	*Heracleum maximum, Equisetum arvense, Mertensia ciliata*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Salix monticola, Dasiphora fruticosa*
Graminoid	*Carex utriculata, Carex aquatilis*
Forb	*Equisetum arvense, Heracleum maximum, Mertensia ciliata*

Global

Stratum	**Species**
Shrub	*Salix monticola*
Graminoid	*Carex utriculata*
Forb	*Heracleum maximum*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
- *Salix monticola* / *Carex aquatilis* Shrubland (CEGL002656)
- *Salix monticola* / *Calamagrostis canadensis* Shrubland (CEGL001222)

SYNONYMY:
- *Salix drummondiana-Salix monticola/Calamagrostis canadensis-Carex utriculata* (Baker 1989b) B

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3.

Global Classification Comments: Classification is based on 13 quantitative plots in Colorado, the only known area of occurrence. In the understory *Carex utriculata* is either the clear dominant or is most consistently present throughout the stand. This distinguishes this association from *Salix monticola / Carex aquatilis* Shrubland (CEGL002656) and *Salix monticola / Calamagrostis canadensis* Shrubland (CEGL001222).

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Salix monticola / Carex utriculata* Shrubland is present at scattered localities along Grape Creek and its tributary drainages within the monument. The elevations are relatively low in the monument, from approximately 8250-8450 feet

Global Range: This plant association is found throughout the southern Rocky Mountains ecoregion in Colorado.

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 35, 45
Classification Confidence: 1 **Identifier:** CEGL002657
REFERENCES: Baker 1989b, Cooper and Cottrell 1990, Hansen et al 1995, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999, Richard et al. 1996

SALIX MONTICOLA / MESIC GRAMINOIDS SHRUBLAND

Mountain Willow / Mesic Graminoids Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: This association is known only from Colorado but may occur in the mountains of New Mexico and Utah. It dominates broad, swift mountain streams (2400-3100 m, 7800-10,200 feet) with active floodplains. Stands usually occur 0.5 m (2 feet) above the bankfull channel up to 15 m (50 feet) away from the stream edge in both narrow and wide valleys (20-120 m, 65-400 feet wide). The soils are fine-textured loams, and the ground surface is usually undulating due to past flooding or beaver activity. *Salix monticola* is either the dominant or most abundant species in a variable canopy (15-80% total cover). Other shrubs present at higher elevations include *Salix planifolia* (10-40% cover), *Salix geyeriana* (2-20% cover), and *Salix brachycarpa*. Species present at lower elevations include *Salix irrorata* (45% cover), *Salix lucida ssp. caudata (= Salix lasiandra ssp. caudata)* (1-25% cover), *Alnus incana* (4-19% cover), *Ribes aureum* and *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)*. The herbaceous undergrowth is diverse, with a variety of graminoid (grass and grass-like) and forb species. This association is distinguished from *Salix monticola* / Mesic Forbs Shrubland (CEGL002658) by having a higher cover of graminoid species. Stands with predominantly non-native graminoid species in the undergrowth are considered grazing-induced.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This shrubland is present as patches within the monument, occupying narrow, low-gradient streams of 2–3% slopes. The stands are linear, growing in saturated gravel and peat substrates immediately adjacent to the flowing water, thus also serving to anchor streambanks resulting in drainage incision up to 1.5 m.

Global Environment: Stands usually occur 0.5 m (2 feet) above the bankfull channel up to 15 m (50 feet) away from the stream edge in both narrow and wide valleys (20-120 m, 65-400 feet wide). The soils are fine-textured loams, and the ground surface is usually undulating due to past flooding or beaver activity.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Stands of this shrubland are linear, the willow shrubs growing immediately adjacent to the flowing water of the stream. *Salix monticola* was the dominant shrub, attaining heights of 2-5 m and providing foliar cover from 40-45%. Associated shrubs included *Ribes aureum*, but never provided foliar cover greater than 1% for the stands sampled. Graminoid species provided foliar cover in excess of 50%. At one site, the exotic *Phalaris arundinacea* (approximately 45% foliar cover) was the dominant mesic graminoid. Other graminoids common to these stands included *Carex utriculata*, *Bromus inermis*, and *Poa pratensis*. Forbs contributed approximately 25% foliar cover, the most abundant was *Heracleum maximum* (approximately 20% cover). Common forbs present in the type included *Mertensia ciliata, Mentha arvensis, Achillea millefolium*, and *Equisetum arvense*. Ground cover within sampled stands was predominantly litter (approximately 60%); one stand had an abundance of woody litter, approximately 30%.

Linear stands of this shrubland often are below the project minimum mapping unit. Along some stream reaches, however, these stands are mappable from a dark green to nearly black signature on true color aerial photos and bright pink on CIR photography.

Global Vegetation: *Salix monticola* is either the dominant or most abundant species in a variable canopy (15-80% total cover). Other shrubs present at higher elevations include *Salix planifolia* (10-40% cover), *Salix geyeriana* (2-20% cover), and *Salix brachycarpa*. Species present at lower elevations include *Salix irrorata* (45% cover), *Salix lucida ssp. caudata (= Salix lasiandra ssp. caudata)* (1-25% cover), *Alnus incana* (4-19% cover), *Ribes aureum*, and *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)*. The herbaceous undergrowth is diverse, with a variety of graminoid (grass and grass-like) and forb species. This association is distinguished from *Salix monticola* / Mesic Forbs Shrubland (CEGL002658) by having a higher cover of graminoid species, including *Calamagrostis canadensis, Carex utriculata, Carex aquatilis*, and *Poa pratensis*. Stands with predominantly non-native graminoid species in the undergrowth are considered grazing-induced.

Global Dynamics: This shrubland association appears to be a stable, long-lived community. Stands with an abundance of *Poa pratensis* or *Agrostis stolonifera* may be a grazing-induced disclimax. Stands with abundant *Salix planifolia* may indicate a transition between higher elevational sites dominated by *Salix planifolia* and lower elevational sites where *Salix monticola* is more abundant.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix monticola, Ribes aureum*

Graminoid	*Phalaris arundinacea, Carex utriculata, Bromus inermis*
Forb	*Heracleum maximum, Equisetum arvense, Mertensia ciliata*

Global

Stratum	**Species**
Shrub	*Salix monticola, Ribes aureum*
Graminoid	*Calamagrostis canadensis, Carex utriculata, Carex aquatilis*
Forb	*Mertensia ciliata, Achillea millefolium, Taraxacum officinale*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Salix monticola*
Graminoid	*Phalaris arundinacea, Carex utriculata*
Forb	*Heracleum maximum, Equisetum arvense, Mertensia ciliata*

Global

Stratum	**Species**
Shrub	*Salix monticola*
Graminoid	*Calamagrostis canadensis, Carex utriculata, Carex aquatilis*
Forb	*Mertensia ciliata, Achillea millefolium, Taraxacum officinale*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

- *Salix monticola* / Mesic Forbs Shrubland (CEGL002658)

SYNONYMY:

- *Salix monticola-Salix planifolia*/Mesic forb (Kittel et al. 1995) I

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3.

Global Classification Comments: Classification is based on 14 quantitative plots in the Gunnison and South Platte river basins as well as the San Juan National Forest in Colorado.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Salix monticola /* Mesic Graminoids Shrubland is present at scattered localities along Grape Creek and its tributary drainages within the monument. The elevations are relatively low in the monument, from approximately 8250-8450 feet

Global Range: This association is known only from Colorado but may occur in the mountains of New Mexico and Utah.

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: No quantitative plot taken. Description is from qualitative observations of stands in the park.
Classification Confidence: 1 **Identifier:** CEGL002659
REFERENCES: Kittel et al. 1995, Kittel et al. 1997, Kittel et al. 1999, Richard et al. 1996

III.B.2.N.e. Seasonally flooded cold-deciduous shrubland

III.B.2.N.e.13. SALIX BRACHYCARPA SEASONALLY FLOODED SHRUBLAND ALLIANCE

Short-fruit Willow Seasonally Flooded Shrubland Alliance

SALIX BRACHYCARPA / CAREX AQUATILIS SHRUBLAND

Short-fruit Willow / Aquatic Sedge Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: This association is known from the upper montane zones of the Rocky Mountains. Specifically it is known from the upper South Platte River Basin, the Rio Grande National Forest, and the San Juan National Forest in southwestern Colorado. It is likely to occur in Utah. *Salix brachycarpa* is an abundant low-stature (1-3 feet, 0.3-1 m) willow of first and second-order streams of subalpine elevations (9200-10,200 feet) in Colorado. It is unusual for *Salix brachycarpa* to occur with *Carex aquatilis* since *Salix brachycarpa* typically grows on drier sites. This association occurs on low floodplains immediately adjacent to the stream channel. Stream reaches are broad, low gradient, and meandering or braided. The water table can be within the first 8 inches (20 cm) of soil early in the season. Since *Salix brachycarpa* is typically not associated with *Carex aquatilis*, this plant association may indicate that a site was once wetter and is now becoming drier allowing *Salix brachycarpa* to establish. *Salix brachycarpa* is the dominant shrub with 15-20% cover. Other shrubs present include *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Salix wolfii*, and *Salix monticola*. The understory is a thick carpet of grasses and grass-like plants dominated by 15-30% cover of *Carex aquatilis*. Forb cover is sparse. In Colorado, occurrences of this plant association also have *Dasiphora fruticosa ssp. floribunda* and *Juncus balticus var. montanus* which increase in abundance under persistent heavy livestock grazing. These sites may be shifting from wetter plant associations to drier *Dasiphora fruticosa ssp. floribunda* or *Salix brachycarpa* associations.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This shrubland association is unusual within the monument; only one stand was observed on a small tributary drainage to Grape Creek. This drainage was flowing down a 3% gradient, and the associated floodplain was saturated to the surface. The stand occupied both edges of the flowing stream at the base of outwash or toeslope sediments from an adjacent ridge.

Global Environment: This association occurs on low floodplains immediately adjacent to the stream channel. Stream reaches are broad, low-gradient, and meandering or braided. The water table can be within the first 20 cm (8 inches) of soil early in the season. Since *Salix brachycarpa* is typically not associated with *Carex aquatilis*, this plant association may indicate that a site was once wetter and is now becoming drier allowing *Salix brachycarpa* to establish.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Only one stand of this shrubland was observed and sampled, near the northern monument boundary. The stand is linear, not more than 15 m wide and less than 100 m long. *Salix brachycarpa* was the dominant shrub at a height of 1–2 m and provided approximately 20% foliar cover. An additional 5–7% foliar cover was provided by the tall (2–5 m) shrub *Salix monticola* and short-stature *Dasiphora fruticosa, Ribes inerme*, and *Rosa woodsii*. *Carex aquatilis* was the dominant graminoid, providing approximately 40% foliar cover, with *Carex utriculata, Juncus balticus, Deschampsia caespitosa, Calamagrostis canadensis*, and the exotic grasses *Bromus inermis* and *Poa pratensis* contributing approximately 10% foliar cover. Forbs common to this stand included *Mertensia ciliata, Potentilla plattensis, Achillea millefolium, Mentha arvensis*, and *Cirsium scariosum (= Cirsium tioganum)*, in addition to several other species; they contributed approximately 5% foliar cover. Ground cover within the stand was approximately 90% litter, in addition to standing/flowing water and woody litter.

This small stand is below the minimum mapping unit for the project, but because of its known location could be mapped as a park special. It is part of the patchy distribution of willow shrubs within the monument. Its aerial photograph signature is identical to other willow associations in the monument, e.g., dark green to nearly black on true color and bright pink on CIR.

Global Vegetation: *Salix brachycarpa* is the dominant shrub with 15-70% cover. Other shrubs present include *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Salix wolfii*, and *Salix monticola*. The understory is a thick carpet of grasses and grass-like plants dominated by 15-30% cover of *Carex aquatilis*. Other graminoids that may be present include *Carex utriculata* (2-15%), *Juncus balticus var. montanus* (1-22%), *Carex scopulorum* (21%), *Carex interior* (2-10%), and *Deschampsia caespitosa* (3-10%). Forb cover is generally sparse to occasionally lush and usually diverse. Forb species include *Thermopsis divaricarpa, Maianthemum stellatum*, and *Potentilla* spp.

Global Dynamics: *Salix planifolia*, *Salix brachycarpa*, and *Salix wolfii* are abundant low-statured (1-3 feet, 0.3-1 m) willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix brachycarpa* grows on lateral moraines, coarse-textured streambanks, ridgetops and on small hummocks (Kittel 1994).

It is unusual for *Salix brachycarpa* to occur with *Carex aquatilis* since *Salix brachycarpa* typically grows on drier sites. Soil data indicate that occurrences of this plant association are perennially wet or have been in the past. It is possible that with heavy grazing and recreational use, these sites have begun to dry out and *Salix brachycarpa* is becoming established. In the South Platte River Basin, occurrences of this plant association also have abundant *Pentaphylloides floribunda* and *Juncus balticus var. montanus* which are increaser species under persistent heavy livestock grazing. These sites may be shifting from wetter *Salix monticola* or *Salix planifolia* associations to drier *Pentaphylloides floribunda* or *Salix brachycarpa* associations (Kittel et al. 1997).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix brachycarpa, Salix monticola, Dasiphora fruticosa*
Graminoid	*Carex aquatilis, Carex utriculata, Juncus balticus*
Forb	*Mertensia ciliata, Potentilla plattensis*

Global

Stratum	Species
Shrub	*Salix brachycarpa, Dasiphora fruticosa*
Graminoid	*Carex aquatilis, Carex utriculata, Juncus balticus*
Forb	*Cardamine cordifolia*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Salix brachycarpa*
Graminoid	*Carex aquatilis, Carex utriculata*
Forb	*Mertensia ciliata*

Global

Stratum	Species
Shrub	*Salix brachycarpa*
Graminoid	*Carex aquatilis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:III.B.3.d. (Driscoll et al. 1984) B
- *Salix brachycarpa/Carex rostrata* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G2G3.
Global Classification Comments: The *Salix brachycarpa / Carex aquatilis* and the *Salix brachycarpa / Calamagrostis canadensis* plant associations were previously described by Bierly (1972) from Rocky Mountain National Park, Colorado. However, researchers studying wetlands in the same site as Beirly have since determined that *Salix brachycarpa* was misidentified, and that in fact *Salix wolfii* is the dominant willow at that site (Cooper 1990).

This community type is not described elsewhere in the literature (Padgett et al. (1989) mention it as a miscellaneous community type), and is known only from four plots. It consists of an odd combination of mesic and less mesic habitat demanding plant species, suggesting it may be limited to ecotonal habitats, an unusual set of environmental parameters, or sites in a relatively short-lived successional transition between wetter and drier habitats.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: One small, linear stand (<100 m long) of *Salix brachycarpa / Carex aquatilis* Shrubland was observed and sampled on a tributary drainage to Grape Creek, near the northern monument boundary.

Global Range: This association is known from the upper montane zones of the Rocky Mountains. Specifically it is known from the upper South Platte River Basin, the Rio Grande National Forest, and the San Juan National Forest in southwestern Colorado. It is likely to occur in Utah.

Nations: US
States/Provinces: CO UT?

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 67
Classification Confidence: 2 **Identifier:** CEGL001244
REFERENCES: Bierly 1972, Bourgeron and Engelking 1994, CONHP n.d., Cooper 1990, Driscoll et al. 1984, Kittel 1994, Kittel et al. 1997, Kittel et al. 1999, Padgett et al. 1989

V. HERBACEOUS VEGETATION

V.A.5.N.c. Medium-tall sod temperate or subpolar grassland

V.A.5.N.c.20. SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE

Little Bluestem - Sideoats Grama Herbaceous Alliance

SCHIZACHYRIUM SCOPARIUM HERBACEOUS VEGETATION

Little Bluestem Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Soils associated with stands and patches of *Schizachyrium scoparium* Herbaceous Vegetation are thin and consist mostly of coarse gravel deposits lying over Pikes Peak Granite bedrock on toe- and midslopes of large hills. Slopes supporting this community are steep, rapidly drained, and ranged from 23–35%. Aspects were southerly and ranged from 165^{o} to 217^{o} for the stands sampled.

Global Environment: Not applicable.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Schizachyrium scoparium* is the dominant species and is usually less than 0.5 m in height within the hillslope stands and patches. Late-season observations of little bluestem in the upper Boulder Creek drainage indicated that some plants in more sheltered areas were between 0.5 and 1.0 m tall. In general, foliar cover ranged from 40–55% for sampled stands, and the majority of the cover value was from *Schizachyrium scoparium*. *Yucca glauca* did not exceed 5% foliar cover on these sites, and *Muhlenbergia montana* was a minor secondary species. Occasional *Pinus ponderosa* trees are scattered within these stands.

Fire probably played a major role in this type, whereby periodic fires would increase graminoid production and deter tree growth. This type occurs on variable aspects throughout its range, but appears restricted to south- and west-facing slopes at the elevation and latitude limits of its distribution in the monument. Von Loh et al. (2000; 1999), Cogan, et al. (1999), McAdams, et al. (1998), and Hansen et al. (1984) report this type on southerly aspects for western South Dakota and southwestern North Dakota.

Global Vegetation: Not applicable.

Global Dynamics: Not applicable.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Yucca glauca*
Graminoid	*Schizachyrium scoparium, Muhlenbergia montana*

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Yucca glauca*
Graminoid	*Schizachyrium scoparium*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: Not applicable.

Global Classification Comments: Not applicable.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This community is found on hills within the monument in small stands and as patches (<0.5 ha) on steep toe- and midslopes that are south- and west-facing. The soils are coarse-textured Pikes Peak granite that exhibit settling around the little bluestem bunches.

Global Range: Not applicable

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 4, 42, 66
Classification Confidence: **Identifier:**
REFERENCES:

V.A.5.N.d. Medium-tall bunch temperate or subpolar grassland

V.A.5.N.d.402. AGROPYRON CRISTATUM SEMI-NATURAL HERBACEOUS ALLIANCE

Crested Wheatgrass Semi-natural Herbaceous Alliance

AGROPYRON CRISTATUM - (PASCOPYRUM SMITHII, HESPEROSTIPA COMATA) SEMI-NATURAL HERBACEOUS VEGETATION

Crested Wheatgrass - (Western Wheatgrass, Needle-and-Thread) Semi-natural Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This crested wheatgrass type occurs most commonly in the northern Great Plains of the United States and Canada. Stands occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and rangelands. The vegetation is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Agropyron cristatum*, a naturalized species from Europe. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (*= *Stipa comata)*, as well as others. Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Two small, nearly pure stands of this herbaceous vegetation were observed in the monument. The larger stand is dominated by *Agropyron cristatum* and occurs as a nearly pure stand on the edge of a swale in the northeastern corner of the monument. This stand occupies the margins of an active prairie dog colony and is heavily grazed. A smaller stand was observed near the western monument boundary, south of the water pipeline. Elsewhere, *Agropyron cristatum* was included in a seed mix with, and is subdominant to, *Bromus inermis* and was used to revegetate ground disturbed by historic water pipeline construction and seed potato agricultural fields. The species may also have been planted to attempt to enhance forage production for livestock and to provide erosion control.

Global Environment: This type can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and rangelands.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This exotic grassland is characterized by an almost pure stand of *Agropyron cristatum*, a medium-tall bunchgrass providing approximately 55% vegetative cover and standing less than 0.5 m in height. The litter layer is dense, although the clumps were widely enough spaced to expose nearly 30% bare soil and gravel surfaces. Only a few small stands and patches occurred as near mono-cultures within the monument, and these were located on dry ridges and slopes of Pikes Peak granite gravel and silty clay soil that had been disturbed historically by ranching and farming activities. Native species found within these stands are all disturbance-oriented and include *Artemisia frigida*, *Grindelia subalpina*, and *Oenothera coronopifolia*.

Global Vegetation: The vegetation is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Agropyron cristatum*, a naturalized species from Europe. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (*= *Stipa comata)*, as well as others.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Agropyron cristatum, Pascopyrum smithii, Nassella viridula, Bouteloua gracilis*
Forb	*Grindelia subalpina, Oenothera coronopifolia, Linaria vulgaris*

Global

Stratum	**Species**
Graminoid	*Agropyron cristatum*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Agropyron cristatum, Pascopyrum smithii, Nassella viridula*
Forb	*Artemisia frigida*

Global Stratum	**Species**
Graminoid	*Agropyron cristatum, Pascopyrum smithii*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GW.

Global Classification Comments: Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This semi-natural herbaceous vegetation is represented well at two sites. The first is located along the trail that leads to the northeastern corner of the monument, where the purest stand of *Agropyron cristatum* occurs approximately 200 m from the northern boundary fenceline. The second is represented south of the water pipeline corridor, near the western monument boundary.

Global Range: This type occurs most commonly in the northern Great Plains of the United States and Canada.

Nations: CA US
States/Provinces: MB MT ND SD SK WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: *Pascopyrum smithii* is reported to be planted at FLFO.
Classification Confidence: 3 **Identifier:** CEGL005266
REFERENCES: Hansen et al. 1984

V.A.5.N.d.400. BROMUS INERMIS SEMI-NATURAL HERBACEOUS ALLIANCE
Smooth Brome Semi-natural Herbaceous Alliance

BROMUS INERMIS - (PASCOPYRUM SMITHII) SEMI-NATURAL HERBACEOUS VEGETATION
Smooth Brome - (Western Wheatgrass) Semi-natural Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: NOTE: This is the closest association in the NVC to that which occurs at Florissant Fossil Beds National Monument. It may not be the same association, but the authors include it as an informational reference.

This smooth brome grassland type occurs widely throughout the northern Great Plains and on relatively mesic sites in the semi-arid interior western United States, and perhaps more widely in the midwestern U.S. and Canada. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. The type is also widely planted for revegetating disturbed land, pasture, and hay fields, and has escaped into a variety of habitats including prairie, riparian grasslands, and mesic mountain meadows. In Montana, this community types occurs on elevation ranges from 1100-2050 m (3590-6700 feet) with best examples on mesic alluvial terraces. This grass grows best on moist, well-drained, finer-textured loam and clay loams and does not tolerate prolonged flooding. The vegetation is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Bromus inermis*, a naturalized species from Eurasia, that forms moderately dense to dense stands that often develop into mono-cultures. Other weedy species such as *Cirsium arvense* may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie and montane meadow grasses, such as *Pascopyrum smithii*, *Deschampsia caespitosa*, and *Hesperostipa comata (= Stipa comata)* and sparse, scattered mesic shrubs such as *Symphoricarpos* spp. as well as many others. However, the native species are not conspicuous enough to identify the native plant association that could occupy the site or the stand would be typed as such.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This semi-natural herbaceous vegetation forms nearly pure stands along Teller County 1, southern Grape Creek, slopes across from the parking lot entrance on Lower Twin Rocks Road, along the southern fenceline near a series of livestock ponds, and along the westernmost portion of the water pipeline corridor. It was certainly introduced in a seed mix used to revegetate ground disturbed by historic water pipeline construction, road construction, and seed potato field restoration. The species was likely planted to attempt to enhance forage production for livestock in addition to erosion control. These stands are relatively dense on upper floodplain terraces, but are sparse on the old agricultural fields and portions of the water pipeline.

Global Environment:

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This exotic grassland is characterized by nearly pure stands of *Bromus inermis*, a medium-tall rhizomatous grass. Dense stands occurred on mesic sites along the monument roads and in sites used as grass hay fields until recently; these are found near the eastern monument boundary at Lower Twin Rock Road, at the southern monument boundary near a series of stock ponds, and at the western monument boundary adjacent to the water pipeline corridor. On sites that were more recently hayed and mesic sites, *Bromus inermis* cover values ranged from approximately 55–70%. Commonly associated species included the exotic *Poa pratensis* and *Agropyron cristatum* in more mesic pastures and swales. Older stands that had been planted on historic seed potato fields and on dry hilltops, ridges, and flats are reverting to native, disturbance-oriented species. Where moisture collects along terraces within historic potato fields, *Bromus inermis* is dominant; however, on dry lands between terraces, *Bromus inermis* cover was approximately 15%, and *Muhlenbergia filiculmis* had a cover value of approximately 25%. Within dense stands of *Bromus inermis*, the ground cover value for litter exceeds 95%, however, on drier sites bare soil and gravel provide approximately 70–80% of the ground cover.

An effort to revegetate the water pipeline corridor with native grassland species is being planned and seed is being collected from the monument to provide local genetic stock.

Global Vegetation:

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Bromus inermis, Agropyron cristatum, Poa pratensis, Muhlenbergia filiculmis, Koeleria macrantha*

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Bromus inermis, Agropyron cristatum, Muhlenbergia filiculmis*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank:

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This semi-natural herbaceous vegetation occurs on disturbed sites and in moist drainages throughout the monument. The purest stands lie adjacent to Lower Twin Rock Road, south of the parking lot entrance, adjacent to Teller County 1, and in drainages and on slopes adjacent to the water pipeline corridor near the western edge of the monument.

Global Range:

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 1, 22, 49, 57
Classification Confidence: **Identifier:** CEGL005264
REFERENCES:

V.A.5.N.d.2. FESTUCA ARIZONICA HERBACEOUS ALLIANCE

Arizona Fescue Herbaceous Alliance

FESTUCA ARIZONICA - MUHLENBERGIA FILICULMIS HERBACEOUS VEGETATION

Arizona Fescue - Slim-stem Muhly Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This is an arid mixed-grass meadow association found on steep southwest slopes between 8000 and 10,120 feet elevation. Known only from south-central mountains of Colorado, it appears to be restricted to dry, rocky south-facing steep slopes. Dominant grasses are *Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis, Elymus elymoides*, and *Koeleria macrantha*. Total herbaceous cover is 25-50%. Forbs consist of less than 5% foliar cover. Few scattered dwarf-shrubs may be present such as *Artemisia frigida, Chrysothamnus viscidiflorus*, and *Ericameria parryi*, but these species rarely exceed 5% foliar cover. The main distinction between this grassland and *Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001780) is the presence to nearly equal cover of *Festuca arizonica*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Thin, gravelly soils support this herbaceous vegetation. This grassland type occupies upper hill and ridge slopes and low hill and ridgetops within the monument. It is occasionally observed on lower slopes with southern exposures.

Global Environment: This is an arid mixed-grass meadow association found on steep southwest slopes between 8000 and 10,120 feet elevation. Rocks and boulders can be abundant, but bare ground and litter are the predominate ground cover. Slope ranges from 5-31 degrees (5.5-34%), with southwest slopes most common, on upper hill and ridge slopes and lower hill and ridgetops.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation is present but scattered within the monument. It is common to find a few dwarf-shrubs in the type, particularly *Artemisia frigida, Chrysothamnus viscidiflorus*, and *Ericameria parryi*, but these species rarely exceed 5% foliar cover within a stand. The dominant and common graminoids include *Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis, Elymus elymoides*, and *Koeleria macrantha*. The foliar cover estimated for graminoids ranged from approximately 25% to as much as 45%, depending on exposure. Forbs are diverse within this association and typically provide from 1–5% foliar cover. The more common forb species include *Heterotheca fulcrata (= Chrysopsis fulcrata), Oxytropis lambertii, Geranium caespitosum, Antennaria parvifolia*, and *Besseya plantaginea*. Ground cover consisted of 50–75% litter and 20–50% gravel for most stands sampled. The ground cover provided by mosses and lichens may be significant, ranging from 20–35%. On one site, approximately 25% cover by the cryptogam *Selaginella densa* was recorded.

This herbaceous community has a fairly consistent signature, both on true color and CIR aerial photos.

Global Vegetation: This arid grassland has total cover ranging from 31-70% foliar cover. Dominant graminoids are *Muhlenbergia filiculmis, Festuca arizonica, Bouteloua gracilis,* and *Koeleria macrantha.* A few dwarf-shrubs can occur scattered throughout the stand, including *Artemisia frigida, Chrysothamnus viscidiflorus*, and *Ericameria parryi*, but these species rarely exceed 5% foliar cover. Moss and lichen cover ranges from 3-35%, depending on the aspect of the site.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis*

Global

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis, Elymus elymoides, Koeleria macrantha*
Forb	*Oxytropis lambertii, Besseya plantaginea, Antennaria parvifolia, Hymenoxys richardsonii*

Global

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
Muhlenbergia filiculmis (CEGL001780) very similar to this association

SYNONYMY:
- DRISCOLL FORMATION CODE:V.B.4.b. (Driscoll et al. 1984) B
- *Festuca arizonica-Muhlenbergia filiculmis* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GU.

Global Classification Comments: The differences between this association, *Festuca arizonica – Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001605), and *Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001780) are minor. The species composition is very similar (forbs varying the most). At Florissant Fossil Beds National Monument, plots of the later were taken well within stands of the former. These stands were described as round or oval in shape. This is due to the landscape position on the tops of small hills and low ridges. The growth form of *Muhlenbergia filiculmis* is also interesting. One might consider it a large clone with various grasses growing in the inner circle, part of the natural variability of the grassland as a whole, rather than as its own plant association.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Festuca arizonica – Muhlenbergia filiculmis* Herbaceous Vegetation is present sporadically within the monument. This type occupies the hill and ridgetops and some slopes throughout the lower and middle elevations.

Global Range: This grassland is known only from south-central Colorado mountains: the northern low hills of the San Luis Valley, the upper Rio Grande valley near Creede, and from Florissant Fossil Beds National Monument.

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 23, 64, 88
Classification Confidence: 3 **Identifier:** CEGL001605
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Shepherd 1975, Stewart 1940

FESTUCA ARIZONICA - MUHLENBERGIA MONTANA HERBACEOUS VEGETATION

Arizona Fescue - Mountain Muhly Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This association occurs from 2135-3050 m (7000-10,000 feet) in elevation on gently to steeply sloping rocky sites at all aspects in forest openings or on mesa tops in Colorado, Texas, and possibly New Mexico and Arizona. This grassland community is dominated by *Festuca arizonica* and *Muhlenbergia montana*. Open *Pinus ponderosa* woodlands with similar understory species composition often occur adjacent to this association. Common graminoids and forbs present in lower abundance are *Bouteloua gracilis, Muhlenbergia filiculmis, Koeleria macrantha, Schizachyrium scoparium, Hymenoxys richardsonii, Antennaria parvifolia*, and *Arenaria fendleri*. *Festuca arizonica, Muhlenbergia montana*, and *Schizachyrium scoparium* are preferentially grazed and will be replaced by *Bouteloua gracilis, Artemisia frigida*, and *Hymenoxys richardsonii* with repeated heavy grazing. This association can be differentiated from *Muhlenbergia montana* Herbaceous Vegetation (CEGL001646) by the presence and often near equal abundance of *Festuca arizonica*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Deep soils, to 10 cm thick, support this herbaceous vegetation. This common bunchgrass grassland occupies flats, gentle to steep slopes, hills, ridges, and drainage sides within the monument. The more mesic of these exposures support *Festuca arizonica* and the drier exposures favor *Muhlenbergia montana*.

Global Environment: This association occurs from 2135-3050 m (7000-10,000 feet) in elevation on gently to steeply sloping rocky sites at all aspects in forest openings or on mesa tops. In Florissant Fossil Beds National Monument it occupies deep soils (10 cm) on flats, gentle to steep slopes, hills, ridges, and drainage sides. More mesic exposures support *Festuca arizonica* and the drier exposures favor *Muhlenbergia montana*.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation association is common within the monument. Typically a few dwarf-shrubs are present in the type, particularly *Artemisia frigida, Chrysothamnus viscidiflorus*, and *Ericameria parryi*, but these species rarely exceed 5% foliar cover. The dominant and common graminoids include *Festuca arizonica, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis, Elymus elymoides*, and *Koeleria macrantha*. The foliar cover estimated for graminoids was over 50%. Forbs are diverse within this association and typically provide from 5–10% foliar cover. The more common forb species include *Heterotheca fulcrata (= Chrysopsis fulcrata), Oxytropis lambertii, Geranium caespitosum, Antennaria parvifolia*, and *Besseya plantaginea*. Ground cover consisted of 60% litter and 25% *Selaginella densa* for one stand sampled. The ground cover provided by mosses and lichens may also be significant.

This is a common herbaceous community within the monument and has a fairly consistent signature, both on true color and CIR aerial photos.

Global Vegetation: This grassland community is dominated by *Festuca arizonica* and *Muhlenbergia montana*. Open *Pinus ponderosa* woodlands with similar understory species composition often occur adjacent to this association. A few dwarf-shrubs may be present, particularly *Artemisia frigida, Chrysothamnus viscidiflorus*, and *Ericameria parryi*, but these species rarely exceed 5% foliar cover. Common graminoids and forbs present in lower abundance are *Bouteloua gracilis, Muhlenbergia filiculmis, Koeleria macrantha, Schizachyrium scoparium, Hymenoxys richardsonii, Antennaria parvifolia*, and *Arenaria fendleri*. *Festuca arizonica, Muhlenbergia montana*, and *Schizachyrium scoparium* are preferentially grazed and will be replaced by *Bouteloua gracilis, Artemisia frigida*, and *Hymenoxys richardsonii* with repeated heavy grazing.

Global Dynamics: Many occurrences have been degraded by heavy livestock grazing. *Festuca arizonica, Muhlenbergia montana*, and *Schizachyrium scoparium* are preferentially grazed and will be replaced by *Bouteloua gracilis, Artemisia frigida*, and *Hymenoxys richardsonii* with repeated heavy grazing. Much of the non-forested rangeland on the Rio Grande National Forest in Colorado (where the association is not uncommon) is considered to be in mid-seral stage or less. Some stands may have converted to nearly closed-canopy coniferous forests with fire suppression and/or heavy grazing.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis*

Global

Stratum	Species
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Festuca arizonica, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis, Elymus elymoides, Koeleria macrantha*
Forb	*Heterotheca fulcrata, Oxytropis lambertii, Besseya plantaginea, Antennaria parvifolia*

Global

Stratum	Species
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Festuca arizonica, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:
Festuca arizonica-Muhlenbergia filiculmis (CEGL001605)

SYNONYMY:
- DRISCOLL FORMATION CODE:V.B.4.b. (Driscoll et al. 1984)
- *Festuca arizonica-Muhlenbergia montana* (Bourgeron and Engelking 1994)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3.

Global Classification Comments: The classification is based on quantitative data from several classification and range analysis studies, and recent qualitative data.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Festuca arizonica – Muhlenbergia montana* Herbaceous Vegetation is the common grassland type within the monument. This type occupies flats, swales, hills, ridges, and slopes within the lower and middle elevations.

Global Range: The association is reported from Texas and southern Colorado, and possibly occurs in northern New Mexico with isolated localities in central New Mexico, and in northern and eastern Arizona.

Nations: US
States/Provinces: AZ? CO NM? TX

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 3
Classification Confidence: 1 **Identifier:** CEGL001606

REFERENCES: Bourgeron and Engelking 1994, Clary 1978, Currie 1975, Driscoll et al. 1984, Johnson 1953, Johnson 1956a, Johnson and Niederhof 1941, Johnson and Reid 1958, Johnson and Reid 1964, Johnston 1987, Komarkova 1986, Shanks 1977, Shepherd 1975, Smith 1967, Soil Conservation Service 1978, Stewart 1940, Trlica and Hackney 1977

V.A.5.N.d.17. MUHLENBERGIA MONTANA HERBACEOUS ALLIANCE
Mountain Muhly Herbaceous Alliance

MUHLENBERGIA MONTANA - HESPEROSTIPA COMATA HERBACEOUS VEGETATION
Mountain Muhly - Needle-and-Thread Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This association has been described from north-central and central Colorado, in the northeastern portion of the Roosevelt National Forest and Florissant Fossil Beds National Monument. The association may also occur in Rocky Mountain National Park in the Mummy Range. Sites where the association is found are typically xeric forest openings in the ponderosa pine zone, on south-facing slopes and ridgetops. Elevations range from 2286 to 2590 m (7500-8500 feet), and the slopes are moderately steep. Occasionally the association occupies rolling parklands. Strong, westerly winds probably result in removal of snow cover from the open sites and increased desiccation of plants. Soils are moderately deep Mollisols, with high coarse fragment content, sandy loam textures, and a distinct clay horizon. Parent materials are primarily colluvium of granitic and gneiss origins. Bare soil, exposed gravels, and small rocks account for as much as 30% of the ground surface area. This grassland association is strongly dominated by the perennial bunch grasses *Muhlenbergia montana* and *Hesperostipa comata (= Stipa comata)*, averaging 11% and 22% cover, respectively. Several other graminoids are commonly present, including *Carex duriuscula (= Carex eleocharis), Pascopyrum smithii, Koeleria macrantha, Danthonia parryi, Muhlenbergia filiculmis*, and *Poa secunda*. Total graminoid cover averages 45%. Forb species are much less abundant, totaling <10% cover. The most important include *Allium geyeri, Antennaria rosea, Arenaria fendleri, Harbouria trachypleura, Mertensia lanceolata*, and *Penstemon secundiflorus*. Shrubs are absent or scarce, except for the suffrutescent *Artemisia frigida*, with 5% average cover. This association can be distinguished from *Muhlenbergia montana* Herbaceous Vegetation (CEGL001646) by the abundance to co-dominance of *Hesperostipa comata.*

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Only one dense stand of this herbaceous vegetation, covering approximately 200 m^2 on a Pikes Peak granite-derived gravel toeslope, was observed north of Boulder Creek. The remaining stands were smaller and less dense, not much more than patches, but in a similar topographic position, e.g., on toeslopes or ridges. The aspect ranged from 164-227 degrees, and the slopes are moderately steep, from 14–17%. Stands occur between approximately 8250 feet to 8450 feet in elevation within the Boulder Creek valley.

Global Environment: This type occurs in a mountainous region subject to a continental climate regime, with warm summers and cold winters. Precipitation patterns differ between the eastern and western sides of the Continental Divide, but the overall difference is warmer and drier winters on the east slope of the Front Range. Sites where found are typically xeric forest openings in the ponderosa pine zone, on south-facing slopes and ridgetops. Elevations range from 2286 to 2590 m (7500-8370 feet), and the slopes are moderately steep. Occasionally the association occupies rolling parklands. Strong, westerly winds probably result in removal of snow cover from the open sites and increased desiccation of plants. Parent materials are primarily colluvium of granitic and gneiss origins. Soils are moderately deep Mollisols, with high coarse-fragment content, sandy loam textures, and a distinct clay horizon. Bare soil, exposed gravels, and small rocks account for as much as 30% of the ground surface area.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: A small stand and patches of this herbaceous vegetation are present north of Boulder Creek, on toeslopes and midslopes of ridges and small hills. *Hesperostipa comata* is a medium-height bunchgrass, from 0.5–1.0 m tall and provides from 2–5% foliar cover in most patches. However, in one relatively dense stand, needle-and-thread provided approximately 30% foliar cover. Total foliar cover for this stand ranged from 55–70%, with most provided by grass species, particularly *Muhlenbergia montana, Bouteloua gracilis*, and *Muhlenbergia filiculmis* in addition to *Hesperostipa comata*. *Artemisia frigida* was present in one stand, at less than 5% foliar cover. Forb species common to the stand included *Geranium caespitosum* and *Grindelia subalpina*. The ground cover was evenly split between Pikes Peak granite-derived gravel and litter.

The small stand is well below the minimum mapping unit and resembles *Festuca arizonica - Muhlenbergia montana* stands on aerial photographs.

Global Vegetation: This grassland association is strongly dominated by the perennial bunch grasses *Muhlenbergia montana* and *Hesperostipa comata (= Stipa comata)*, averaging 11% and 30% cover, respectively. Several other graminoids are commonly present, including *Carex duriuscula (= Carex eleocharis), Pascopyrum smithii, Koeleria macrantha, Danthonia parryi, Muhlenbergia filiculmis*, and *Poa secunda*. Total graminoid cover ranges from 55-70%. Forb species are much less abundant, totaling <10% cover. The most important include *Allium geyeri, Antennaria rosea, Arenaria fendleri, Harbouria trachypleura, Mertensia lanceolata, Geranium caespitosum, Grindelia subalpina*, and *Penstemon secundiflorus*. Shrubs are absent or scarce, except for the suffrutescent *Artemisia frigida*, with 5% average cover.

Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Hesperostipa comata, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis*
Forb	*Geranium caespitosum, Grindelia subalpina*

Global

Stratum	**Species**
Graminoid	*Hesperostipa comata, Koeleria macrantha, Muhlenbergia montana, Pascopyrum smithii Poa secunda*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Hesperostipa comata, Muhlenbergia montana, Muhlenbergia filiculmis, Bouteloua gracilis, Carex inops* ssp. *heliophylla*
Forb	*Geranium caespitosum*

Global

Stratum **Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum **Species**

GLOBAL SIMILAR ASSOCIATIONS:

Muhlenbergia montana - Heterotheca villosa Herbaceous Vegetation (CEGL002938)
Muhlenbergia montana Herbaceous Vegetation (CEGL001646)

SYNONYMY:

- DRISCOLL FORMATION CODE: V.B.4.b. (Driscoll et al. 1984)
- *Muhlenbergia montana-Stipa comata* (Bourgeron and Engelking 1994)
- UNESCO FORMATION CODE: V.B.5b (UNESCO 1973)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G1G2.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: The *Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation stand is extremely small and only observed on south-facing rides and toeslopes along the north side of Boulder Creek, west of the Hornbek Homestead.

Global Range: Association described from north-central Colorado, primarily within the northern portion of the Front Range in Larimer County and farther south along the Front Range in Teller County.

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 86
Classification Confidence: 2 **Identifier:** CEGL001647
REFERENCES: Baumann 1978a, Bourgeron and Engelking 1994, Buttery 1955, Driscoll et al. 1984, Fish 1966, Hess 1981, Mutel 1976, UNESCO 1973

MUHLENBERGIA MONTANA HERBACEOUS VEGETATION

Mountain Muhly Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This plant association has been described from meadows in the mountains, plateaus and foothills of Colorado, Arizona and Utah. Sites are typically xeric forest openings or parks in the Ponderosa Pine zone with southern aspects on moderately steep slopes and ridgetops. Occasionally the stands occupy rolling parklands or volcanic cinder fields. The xeric nature of sites appears to be an important environmental factor. Substrates are shallow to moderately deep, rocky, sand to sandy loam-textured soils. Bare soil, exposed gravels, and small rocks account for as much as 50% of the ground surface area. The vegetation is characterized by a moderately dense herbaceous layer that is typically dominated by the warm-season, perennial bunchgrass *Muhlenbergia montana*, but may be codominated by *Blepharoneuron tricholepis* or *Trisetum spicatum (= Trisetum montanum)* (in New Mexico). The typically sparse forb layer often consists of *Allium geyeri*, *Antennaria rosea*, *Arenaria fendleri*, *Eriogonum umbellatum, Heterotheca villosa,* and *Phlox diffusa*. Except for the abundant dwarf-shrub *Artemisia frigida*, scattered *Ericameria nauseosa* shrub, or occasional *Pinus ponderosa* trees, woody species are very sparse or absent. The exotic grasses *Poa pratensis* and *Bromus tectorum* are common in some of these stands. Diagnostic of this grassland association is the dominance of *Muhlenbergia montana* in the herbaceous layer and low cover of *Festuca arizonica*. This association can be distinguished from *Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation (CEGL001647) by the very low cover or lack of *Hesperostipa comata.*

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Soils are typically thin consisting of Pikes Peak granite gravel on relatively steep slopes. A few stands formed in deeper soils, to 10 cm thick along the middle slopes of small drainages, these stands contained small amounts of *Hesperostipa comata*. This bunchgrass grassland typically occupies middle and upper slopes of hills and ridges within the monument. The aspects ranged from 155 (SE) -–227 (SW) degrees.

Global Environment: This plant association has been described from meadows in the mountains, plateaus and foothills of Colorado, Arizona and Utah. Elevation ranges from 2300-2800 m (7540-9200 feet). Sites are typically xeric forest openings or parks in the Ponderosa Pine zone with southern aspects on moderately steep slopes and ridgetops. Occasionally the stands occupy rolling parklands or volcanic cinder fields. The xeric nature of sites appears to be an important environmental factor. Substrates are shallow to moderate deep, rocky, sand to sandy loam textured soils sometimes with a distinct clay horizon. Parent materials are primarily colluvium derived from granite and gneiss or cinder. Bare soil, exposed gravels, and small rocks account for as much as 50% of the ground surface area.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation is present on the slopes of hills and ridges, and to a lesser extent adjacent to small drainages in the monument. It is associated with a few dwarf-shrubs in the type, particularly *Artemisia frigida*, that rarely exceeds 5% foliar cover. The dominant and common graminoids include *Muhlenbergia montana, Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis, Elymus elymoides,* and *Koeleria macrantha*. The foliar cover estimated for graminoids ranged from approximately 25% to as much as 40%. Forbs are diverse within this association but typically provide less than 5% foliar cover. The more common forb species include *Heterotheca fulcrata (= Chrysopsis fulcrata), Orthocarpus luteus, Geranium caespitosum,* and *Antennaria parvifolia*. Ground cover consisted of 55–95% litter and approximately 40% gravel for most stands sampled. The ground cover provided by mosses and lichens may be significant, ranging from 5–35%.

This is one of the less common herbaceous communities within the monument but has a fairly consistent signature, both on true color and CIR aerial photos.

Global Vegetation: This association is characterized by a moderately dense herbaceous layer that is typically dominated by the warm-season, perennial bunchgrass *Muhlenbergia montana*, but may be codominated by *Blepharoneuron tricholepis* or *Trisetum spicatum (= Trisetum montanum)* (in New Mexico). Other associated graminoids include *Bouteloua curtipendula, Bouteloua gracilis, Carex duriuscula (= Carex eleocharis), Danthonia parryi, Elymus albicans (= Elymus lanceolatus ssp. albicans), Festuca brachyphylla, Festuca arizonica, Hesperostipa comata, Koeleria macrantha, Muhlenbergia filiculmis, Pascopyrum smithii, Poa secunda,* and *Schizachyrium scoparium*. The typically sparse forb layer often consists of *Allium geyeri, Antennaria rosea, Arenaria fendleri, Eriogonum umbellatum, Harbouria trachypleura, Heterotheca villosa, Mertensia lanceolata, Opuntia polyacantha, Penstemon secundiflorus,* and *Phlox diffusa*. Except for the abundant dwarf-shrub *Artemisia frigida*, scattered *Ericameria nauseosa* shrubs, or occasional *Pinus ponderosa* trees, woody species are very sparse or absent. The exotic grasses *Poa pratensis* and *Bromus tectorum* are common in some of these stands. Diagnostic of this grassland association is the dominance of *Muhlenbergia montana* in the herbaceous layer and low cover of *Festuca arizonica*.

Global Dynamics: *Muhlenbergia montana* often grows in association with montane conifer forests, especially ones dominated by *Pinus ponderosa*, and has developed a tolerance for relatively frequent fire regimes. Although *Muhlenbergia montana* resprouts after burning, it may take a few years to recover to pre-burn density (Fischer and Bradley 1987). These grasslands may be considered seral or an edaphic climax depending on whether there are environmental factors, such as aridity, that are preventing establishment of trees. Historically, much of the area where this association occurs was heavily grazed by livestock, primarily sheep and cattle (Shepherd 1975). Season of use is important in stands with both *Hesperostipa comata* and *Muhlenbergia montana*; fall grazing will favor *Hesperostipa comata* over the later-blooming *Muhlenbergia montana* (Clary 1978). The reverse is true if grazing is always limited to summer. Overgrazing will reduce or eliminate *Hesperostipa comata, Muhlenbergia montana,* and the other palatable species, leaving the more grazing-tolerant *Bouteloua gracilis* and less palatable plants such as *Hymenoxys, Artemisia* and *Chrysothamnus* species to dominate the site Clary (1978).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Muhlenbergia montana, Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis*

Global

Stratum	Species
Graminoid	*Muhlenbergia montana, Blepharoneuron tricholepis, Trisetum spicatum*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Muhlenbergia montana, Festuca arizonica, Muhlenbergia filiculmis, Bouteloua gracilis Elymus elymoides, Koeleria macrantha*
Forb	*Heterotheca fulcrata, Orthocarpus luteus, Antennaria parvifolia*

Global

Stratum	Species
Graminoid	*Muhlenbergia montana, Blepharoneuron tricholepis, Trisetum spicatum*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:

Festuca arizonica - Muhlenbergia montana Herbaceous Vegetation (CEGL001606)
Muhlenbergia montana - Hesperostipa comata Herbaceous Vegetation (CEGL001647)
Muhlenbergia montana - Heterotheca villosa Herbaceous Vegetation (CEGL002938)

SYNONYMY:

- DRISCOLL FORMATION CODE:V.B.4.b. (Driscoll et al. 1984) B
- *Muhlenbergia montana* (Bourgeron and Engelking 1994) =
- *Bouteloua gracilis-Muhlenbergia montana-Poa* (Loveless 1967)
- *Muhlenbergia montana/Blepharoneuron tricholepis* Plant association (Johnston 1987)

- Kaibab Basin and Dry Park Meadows (Merkle 1962)
- *Muhlenbergia-Comandra* and *Muhlenbergia-Aragallus* Societies (Ramaley 1916a)
- *Muhlenbergia-Comandra* and *Muhlenbergia-Aragallus* Societies Ramaley 1916b
- Rangeland Group H68 (Shanks 1977)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3G4.
Global Classification Comments: Diagnostic of this grassland association is the dominance of *Muhlenbergia montana* in the herbaceous layer and low cover of *Festuca arizonica*. This association can be distinguished from *Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation (CEGL001647) by the very low cover or lack of *Hesperostipa comata.*

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Muhlenbergia montana* Herbaceous Vegetation is present within the monument, occupying lower and middle slopes along small drainages within the lower to mid-elevations.

Global Range: This plant association forms meadows in the mountains and foothills of Colorado, Arizona and Utah.
Nations: US
States/Provinces: AZ CO UT

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 52, 71
Classification Confidence: 2 **Identifier:** CEGL001646
REFERENCES: Bourgeron and Engelking 1994, Clary 1978, Driscoll et al. 1984, Fischer and Bradley 1987, Loveless 1963, Loveless 1967, McIntosh 1923, Merkle 1962, Ramaley 1915, Ramaley 1916a, Ramaley 1916b, Reid 1974, Shanks 1977, Shepherd 1975, Terwillinger et al. 1979b, USFS 1983b

V.A.5.N.e. Short sod temperate or subpolar grassland

V.A.5.N.e.15. MUHLENBERGIA FILICULMIS HERBACEOUS ALLIANCE

Slim-stem Muhly Herbaceous Alliance

MUHLENBERGIA FILICULMIS HERBACEOUS VEGETATION

Slim-stem Muhly Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This association occurs in Colorado on xeric grassland sites of higher elevations (2700-3085 m, 8860-10,120 feet) in areas of scant rainfall. In the San Juan Mountains and Rampart Ranges, it occurs primarily on volcanically derived soils, and on the Rio Grande River it is found on alluvial benches. In the San Juan Mountains, Tertiary volcanic rocks overlying Precambrian crystalline and sedimentary rocks are the predominant parent materials and surface rocks for this association. Fifty percent or more of the ground surface can be exposed rock. The dominant species, *Muhlenbergia filiculmis*, tends to form rings or cushions averaging 2-8 inches or more in diameter. In Florissant Fossil Beds National Monument, this grassland is observed to occur in rings or ovals on ridge and hilltops. *Bouteloua gracilis* is abundant, and several other grasses, including *Festuca arizonica* and *Koeleria macrantha*, are found in scattered patches. Commonly associated forbs include *Artemisia frigida*, *Hymenoxys richardsonii*, and *Arenaria fendleri*. Drier sites within the association tend to have an even greater abundance of *Muhlenbergia filiculmis* than more mesic sites. *Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001605) occurs in the same area but on steeper more south-facing slopes, and has a much higher amount of *Festuca arizonica*.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This herbaceous vegetation occupies the tops of ridges and hills within more extensive *Festuca arizonica – Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001605) and *Festuca arizonica – Muhlenbergia montana* Herbaceous Vegetation (CEGL001606). These sites are nearly flat (1–3% slopes) and generally lie on eastern or southern exposures. It is likely that less moisture is available on the ridges and hills to support the more robust bunch grasses of the more common types on deeper soils. The soils are composed of silty clay and small gravel that are also encrusted with lichens and mosses. Runoff is rapid, and evaporation is high from these sites.

Global Environment: Found in a region of high-elevation (>2130 m, 7000 feet), intermountain parks and Front Range foothills, surrounded by montane and subalpine forest slopes. In general, these parks are dominated by grasslands. In Florissant National Monument, it occurs in small patches, roughly circular in shape on hilltops and ellipsoid on ridges. The region has a semi-arid to arid, continental climate. Average annual precipitation is low, <10 inches, with a summer peak in July and August. January is the coldest and driest month, and April is the month of greatest snow accumulation. The region is often subjected to strong northerly and westerly winds, which can remove snow cover and subject plants to severe desiccation. This association is found from 2560 to 2930 m (8400-9700 feet) elevation, on slopes with southerly to southwest aspects. Slopes vary from gentle to somewhat steep, and rocks or boulders can be abundant, especially on steeper slopes. Soils are derived from volcanic parent materials, and are dry, well-drained, shallow and coarse-textured (sandy and gravelly). The ground surface is generally bare soil (35% to 40% cover), with rocks common.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation occurs in small patches, roughly circular in shape on hilltops and ellipsoid on ridges. The dominant vegetation is very short, typically less than 10 cm tall. The association is dominated by *Muhlenbergia filiculmis*, *Bouteloua gracilis*, and *Festuca arizonica*, which provide approximately 40% foliar cover. Other graminoids common to this type include *Koeleria macrantha*, *Elymus elymoides*, and *Carex inops* ssp. *heliophila*. Forb species are diverse and typically provide approximately 20–30% foliar cover. The more common forb species include *Hymenoxys richardsonii, Geranium caespitosum, Antennaria* sp., *Cryptantha thyrsiflora*, and the dwarf-shrub *Artemisia frigida*. Lichens and mosses are common to this type and provide from 20% to as much as 65% ground cover. The litter layer is variable and covers from as little as 25% to as much as 65% of the ground surface.

The stands of this herbaceous vegetation are typically small and round or narrow, and are likely to be below the minimum mapping unit for the project (0.5 ha). Their topographic position and height would make them distinguishable during interpretation of true color or CIR photographs.

Global Vegetation: This is a grassland association, dominated by a perennial sod grass *Muhlenbergia filiculmis*, typically short in stature (<0.5 m height). Other associated grasses include *Bouteloua gracilis, Festuca arizonica, Koeleria macrantha, Elymus elymoides*, and the perennial sedges *Carex obtusata* and *Carex inops ssp. heliophila*. Total graminoid cover averages 23%, but can be as high as 40%. Perennial forbs are not typically abundant. Dwarf shrub and forb species can include *Artemisia frigida, Hymenoxys richardsonii, Eriogonum umbellatum, Arenaria fendleri, Geranium caespitosum, Antennaria* sp., *Cryptantha thyrsiflora,* and *Castilleja integra*. Total forb cover averages 4%. In Florissant Fossil Beds National Monument, forb cover was 20-30%. A sparse shrub layer is occasionally present (averaging 4% cover), composed primarily of the evergreen species *Ericameria nauseosa (= Chrysothamnus nauseosus)* and *Ericameria parryi (= Chrysothamnus parryi)*. Lichens are typically common, with 3% to over 9% (and as high as 65% in Florissant Fossil Beds NM) cover of the ground surface.

Global Dynamics: Wind and fire are likely the driving disturbances maintaining these grasslands. Wind blows away any winter snow accumulation, keeping sites dry. Periodic fires maintain the open structure by killing invading conifer seedlings. *Hymenoxys richardsonii, Artemisia frigida*, and *Lappula occidentalis* are known to increase in abundance in this grassland while *Muhlenbergia filiculmis* decreases with persistent overgrazing. High-quality stands will have no to very low cover of these forbs and abundant *Muhlenbergia filiculmis*. *Festuca arizonica* appears to do better in more protected or mesic areas.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Muhlenbergia filiculmis, Bouteloua gracilis*
Forb	*Hymenoxys richardsonii, Geranium caespitosum*

Global

Stratum	Species
Graminoid	*Bouteloua gracilis, Muhlenbergia filiculmis*
Forb	*Artemisia frigida, Hymenoxys richardsonii*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Muhlenbergia filiculmis, Bouteloua gracilis, Festuca arizonica, Carex inops ssp. heliophila*
Forb	*Hymenoxys richardsonii, Geranium caespitosum, Artemisia frigida*

Global

Stratum	**Species**
Graminoid	*Muhlenbergia filiculmis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
Festuca arizonica - Muhlenbergia filiculmis Herbaceous Vegetation (CEGL001605) occurs in the same area but on steeper, more south-facing slopes and has a much higher amount of *Festuca arizonica*.

SYNONYMY:
- DRISCOLL FORMATION CODE: V.C.5.a. (Driscoll et al. 1984)
- *Muhlenbergia filiculmis* (Bourgeron and Engelking 1994)
- UNESCO FORMATION CODE: V.C.7a (UNESCO 1973)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G2.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Muhlenbergia filiculmis* Herbaceous Vegetation occupies south- and west-facing dry hilltops, ridgetops, and some dry slopes within the lower to middle elevations of the monument.

Global Range: This association is known only from Mineral, Saguache, and Teller counties, Colorado. It has only been found in the northeastern slopes of the San Juan Mountains, the margins of the San Luis Valley, on the plateaus of the Trickle Mountain area in the Cochetopa Hills, and on dry ridgetops and hilltops in Florissant Fossil Beds National Monument.

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 58
Classification Confidence: 2 **Identifier:** CEGL001780
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Ramaley 1942, Shepherd 1975, Stewart 1940, UNESCO 1973

V.A.5.N.h. Short alpine or subalpine dry bunch grassland

V.A.5.N.h.5. DANTHONIA PARRYI HERBACEOUS ALLIANCE

Parry's Oatgrass Herbaceous Alliance

DANTHONIA PARRYI HERBACEOUS VEGETATION

Parry's Oatgrass Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This plant association most commonly occurs in forest openings, in montane meadows or parks in the Colorado Rocky Mountains and in adjacent parts of Wyoming. Stands occur from 2260-3350 m (7400-11,000 feet) in elevation. The soils are more moist than those of adjacent grasslands dominated by *Festuca arizonica* and are composed of a silty clay with granitic gravel. Stands are usually less than 50 acres, but occasionally are reported to be up to 600 acres in size. Ungrazed or lightly grazed stands of this association are characterized by dense stands of *Danthonia parryi*. Other common species include *Festuca arizonica, Festuca idahoensis, Koeleria macrantha, Muhlenbergia montana, Poa pratensis, Elymus trachycaulus* and *Carex inops ssp. heliophila*. *Muhlenbergia montana* may be more abundant on drier sites or those impacted by livestock grazing.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This native bunchgrass forms nearly pure stands on moist soils of the middle and higher elevations (8400–8600 feet) within the monument. This herbaceous vegetation is distributed predominantly on north- and northwest-facing exposures on slopes, in narrow mesic drainages, and on hilltops where mesic conditions occur. Stands occupy bands 10-25 m wide at the base of mesic forests, and forms a broad understory in relatively open, mesic woodlands composed primarily of *Pseudotsuga menziesii*, *Populus tremuloides*, and *Pinus ponderosa*. *Danthonia parryi* persists following invasion by tree species as a dense to sparse understory, dependent on the age of the stand and amount of canopy closure.

Global Environment: Stands occur from 2260-3350 m (7400-11,000 feet) in elevation, in forest openings, montane meadows and parks. The soils are more moist than those of adjacent grasslands dominated by *Festuca arizonica* and are composed of a silty clay with granitic gravel.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation is characterized by strong dominance of *Danthonia parryi*, but good species diversity exists within stands. It is a relatively short grassland type, less than 0.5 m in height, and the foliar cover ranges from 60-90%. The ground cover consists of dense litter ranging from 95-100% cover and up to 5 cm thick. Commonly associated graminoids are other bunch grasses, including *Festuca arizonica*, *Muhlenbergia montana*, and *Bromus porteri*. For some stands, *Bromus porteri* is relatively dense on the outer, drier edge of the stand, providing an ecotone with *Festuca arizonica* grassland types. Forbs are also common in these stands, particularly *Besseya plantaginea, Achillea millefolium var. occidentalis (= Achillea lanulosa)*, and *Geum macrophyllum*. These stands range from approximately 0.25 hectare to over 10 hectares in size. The soils are more moist than those of adjacent grasslands dominated by *Festuca arizonica* or the exotic *Bromus inermis* and are composed of a silty clay among small Pikes Peak granite gravel. It appears that in the absence of fire, this herbaceous vegetation is invaded by *Picea pungens, Pseudotsuga menziesii*, and *Pinus ponderosa* trees.

This type has a distinct signature on CIR aerial photography with a smooth, pink color located next to very tall stands of mesic forest species. On true color aerial photography, the signature is a dark grayish brown.

Global Vegetation: Ungrazed or lightly grazed stands of this association are characterized by dense stands of *Danthonia parryi*. Other common species include *Festuca arizonica, Festuca idahoensis, Koeleria macrantha, Muhlenbergia montana, Poa pratensis, Poa secunda*, *Poa fendleriana*, *Elymus trachycaulus*, and *Carex inops ssp. heliophila*. *Muhlenbergia montana* may be more abundant on drier sites or those impacted by livestock grazing. Forbs are diverse but contribute little cover (usually less than 10%) and include *Besseya plantaginea, Achillea millefolium var. occidentalis (= Achillea lanulosa), Geum macrophyllum*, *Antennaria rosea, Eriogonum umbellatum, Gaillardia aristata, Gentiana* spp., *Mertensia lanceolata, Penstemon* spp., and *Potentilla hippiana*. The dwarf-shrub *Artemisia frigida* is often scattered through these stands.

Global Dynamics: Fire has been suggested as a management tool in some cases where pine is encroaching into the grassland meadows. *Danthonia parryi* is considered to be very palatable to livestock, and overgrazing has been reported in some stands which reduces the abundance of *Danthonia parryi*.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Danthonia parryi, Festuca arizonica, Muhlenbergia montana, Bromus porteri*
Forb	*Besseya plantaginea, Achillea millefolium, Geum macrophyllum*

Global

Stratum	**Species**
Graminoid	*Danthonia parryi, Festuca arizonica, Muhlenbergia montana, Bromus porteri*
Forb	*Besseya plantaginea, Achillea millefolium, Geum macrophyllum*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Danthonia parryi, Festuca arizonica, Muhlenbergia montana, Bromus porteri*
Forb	*Besseya plantaginea, Achillea millefolium, Geum macrophyllum*

Global

Stratum	**Species**
Graminoid	*Danthonia parryi, Festuca arizonica, Muhlenbergia montana, Bromus porteri*
Forb	*Besseya plantaginea, Achillea millefolium, Geum macrophyllum*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:V.C.5.b. (Driscoll et al. 1984)
- *Danthonia parryi* (Bourgeron and Engelking 1994)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3.

Global Classification Comments: The classification is based on plot data and recently collected qualitative data. *Danthonia parryi* is reported to form dense communities on windy slopes and ridges in Canada but no data were presented. It is not understood how this plant community reported in Canada may relate to the *Danthonia parryi* plant association in Colorado and Wyoming.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This is an association of moist soils, located on predominantly north- and northwest-facing slopes, and growing in a band adjacent to *Picea pungens*, *Pseudotsuga menziesii*, and *Populus tremuloides* forest stands. These sites receive additional moisture due to accumulation of snowfall and are shaded for at least a portion of the day by the tall trees, often in excess of 30 m in height. Stands of *Danthonia parryi* are distributed at the middle to higher elevations of the monument.

Global Range: This association is reported from the southern Rocky Mountains in Colorado, mainly from the South Platte, Arkansas, and Rio Grande River drainages, but with a few reports from the Colorado River drainage. The association also occurs in southern Wyoming.

Nations: US
States/Provinces: CO WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 29, 50, 51
Classification Confidence: 1 **Identifier:** CEGL001795
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hess 1981, Looman 1983, Reid and Love 1951, Robbins 1918, Ueckert 1968.

V.A.5.N.k. Seasonally flooded temperate or subpolar grassland

V.A.5.N.k.42. CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE

(Swollen-beak Sedge, Beaked Sedge) Seasonally Flooded Herbaceous Alliance

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CAREX UTRICULATA HERBACEOUS VEGETATION

Beaked Sedge Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This wetland association is found throughout much of the western U.S. Stands occur in montane and subalpine areas around the edges of lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains. Sites are flat to undulating, often with a hummocky microtopography. The water table is usually near the surface for most of the growing season. There are a wide variety of soil types for this association ranging from saturated organics or fine silty clays to clays over cobbles and alluvium to fine-loamy and sandy-skeletal. Mottling often occurs near the surface because of the high water table. The vegetation is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex utriculata* (20-99% cover). Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* species present include *Carex lenticularis, Carex aquatilis,* and *Carex microptera*, but usually with low cover. Other graminoid species that may be present include *Calamagrostis canadensis*, *Glyceria striata*, and *Juncus balticus*. Sparse forb cover can include *Geum macrophyllum, Mentha arvensis*, and *Mimulus guttatus*. Scattered *Salix* spp. shrubs may be present because these riparian shrublands are often adjacent. *Salix* species vary depending on elevation and geography. It is distinguished from *Carex aquatilis – Carex utriculata* Herbaceous Vegetation (CEGL001803) by the dominance of *Carex utriculata. Carex aquatilis*, if present, is not more than 1/3 of the total cover.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This herbaceous vegetation occupies the saturated to inundated zone adjacent to flowing streams and on groundwater swells, where groundwater collects under vegetation and elevates it, creating a quaking bog. The elevation of these drainages lies between 8250-8600 feet.

Global Environment: This wetland association is found throughout much of the western U.S. Elevation ranges from 1060-2950 m (3500-9680 feet). Stands occur in montane and subalpine areas around the edges of lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains (Kittel et al. 1999). Sites are flat to undulating, often with a hummocky microtopography (Kovalchik 1993). The water table is usually near the surface for most of the growing season. There are a wide variety of soil types for this association ranging from saturated organics or fine silty clays to clays over cobbles and alluvium to fine-loamy and sandy-skeletal. Mottling and gleying often occur near the surface because of the high water table.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation occurs as nearly monotypic stands with *Carex utriculata* providing from 70–90% of the foliar cover. Beaked sedge is tall, from 0.5–1.0 m high, and typically grows from 100% litter ground cover that is up to 10 cm deep. The litter layer is often riddled with small mammal tunnels. Associated species rarely provide more than 5% foliar cover and include *Carex aquatilis, Juncus balticus, Deschampsia caespitosa, Rumex aquaticus, Galium trifidum, Mentha arvensis*, and *Lemna minor*, a floating aquatic species present in small standing water pockets.

This herbaceous vegetation is very similar and probably indistinguishable from *Carex aquatilis* Herbaceous Vegetation (CEGL001802) when interpreting true color and CIR aerial photographs.

Global Vegetation: This plant association is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex utriculata* (20-99% cover). Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* species present include *Carex aquatilis*, *Carex lenticularis, Carex microptera*, *Carex nebrascensis*, and *Carex scopulorum*, but usually with low cover. Other graminoid species that may be present include *Calamagrostis canadensis*, *Deschampsia caespitosa, Glyceria striata*, and *Juncus balticus*. Sparse forb cover may include *Epilobium* spp., *Geum macrophyllum, Mentha arvensis, Mimulus guttatus*, *Polemonium occidentale, Galium trifidum,* and *Lemna minor*, a floating aquatic species. Scattered *Salix* spp. shrubs may be present because these riparian shrublands are often adjacent. *Salix* species vary depending on elevation and geography. *Salix monticola, Salix drummondiana, Salix geyeriana, Salix planifolia,* and *Salix exigua* are common species.

Global Dynamics: *Carex utriculata* is a widespread species that colonizes recently formed pond edges and seasonally flooded areas near streams. Once established it is long-lived and will dominate sites unless disturbed with changes in site hydrology. Soil development (over time) may decrease soil moisture and allow other species to replace it (Manning and Padgett 1995).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Carex utriculata, Carex aquatilis, Juncus balticus*
Forb	*Rumex aquaticus, Galium trifidum*

Global

Stratum	Species
Graminoid	*Carex utriculata*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Carex utriculata, Carex aquatilis, Juncus balticus*
Forb	*Rumex aquaticus, Galium trifidum*

Global

Stratum	**Species**
Graminoid	*Carex utriculata*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
Carex aquatilis – Carex utriculata Herbaceous Vegetation (CEGL001803)

SYNONYMY:
- DRISCOLL FORMATION CODE:V.B.4.a. (Driscoll et al. 1984) B
- *Carex rostrata* (Bourgeron and Engelking 1994) =
- Wet Meadows (Andrews 1983) B
- *Carex rostrata* Association (Benedict 1983) =
- *Carex rossii* community (Franklin and Dyrness 1973) =
- *Carex rostrata* Habitat Type (Hall and Hansen 1997) B
- *Carex rostrata* Habitat Type (Hansen et al. 1995) B
- *Carex utriculata* Herbaceous Vegetation (Kittel et al. 1996) =
- *Carex utriculata* Herbaceous Vegetation (Kittel et al. 1999) =
- Beaked Sedge Association (Kovalchik 1987) =
- *Carex utriculata* Association (Kovalchik 1993) =
- *Carex rostrata* Community Type (Manning and Padgett 1995) =
- *Carex rostrata* Habitat Type, *Carex rostrata* Phase (Mattson 1984) =
- *Carex rostrata* Community Type (Mutel 1973)
- Natural Wet Meadows (Mutel 1976) B
- *Carex rostrata* Transitions Community Type (Mutz and Graham 1982) B
- *Carisetum rostratae* Association (Nachlinger 1985) =
- *Carex rostrata* Community Type (Norton et al. 1981)
- *Carex rostrata* Community Type (Padgett et al. 1988b) =
- *Carex rostrata* Community Type (Padgett et al. 1989) =
- *Carex rostrata-Carex aquatilis* Community Type (Tuhy and Jensen 1982) B
- *Carex rostrata* Community Type (Youngblood et al. 1985a)
- *Carex rostrata* Community Type (Youngblood et al. 1985b)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G5.

Global Classification Comments: *Carex rostrata var. utriculata* (Boott) Bailey was recognized as a distinct species from *Carex rostrata* Stokes and named *Carex utriculata* Boott (Kartesz 1999). This taxonomic change has led to confusion in some of the earlier vegetation classification literature because no distinction was made between the subspecies. However, *Carex utriculata* Herbaceous Vegetation (CEGL001562) is known only from the western U.S. and, according to Kartesz (1999), *Carex rostrata* is reported from only Montana, Idaho, and Washington in the western U.S., and for now, *Carex rostrata* communities are known only from the midwestern U.S. and Canada. Additional survey work will help clarify this.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Carex utriculata* Herbaceous Vegetation occupies the area immediately adjacent (first terrace) to the flowing water of Grape and Boulder creeks and their tributary drainages. These are low-gradient sites of 2% or less and the aspect is that of the stream or drainage.

Global Range: This wetland association is found at montane and subalpine elevations throughout much of the western U.S.

Nations: US
States/Provinces: AZ? CA CO ID MT NM NV OR UT WA WY

ELEMENT SOURCES
Florissant Fossil Beds NM Inventory Notes: Plots: 7, 10, 11, 41, 78
Classification Confidence: 1 **Identifier:** CEGL001562
REFERENCES: Andrews 1983, Baker 1983a, Benedict 1983, Bourgeron and Engelking 1994, Driscoll et al. 1984, Franklin and Dyrness 1973, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess and Wasser 1982, Kartesz 1999, Kerr and Henderson 1979, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kovalchik 1987, Kovalchik 1993, Looman 1982, Mattson 1984, Mutel 1973, Mutel 1976, Mutel and Marr 1973, Mutz and Graham 1982, Mutz and Queiroz 1983, Nachlinger 1985, Norton et al. 1981, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley and Robbins 1909, Schlatterer 1972, Seyer 1979, Tuhy 1981, Tuhy and Jensen 1982, Youngblood et al. 1985a, Youngblood et al. 1985b

V.A.5.N.k.43. CAREX AQUATILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Aquatic Sedge Seasonally Flooded Herbaceous Alliance

CAREX AQUATILIS HERBACEOUS VEGETATION
Aquatic Sedge Herbaceous Vegetation

ELEMENT CONCEPT
GLOBAL SUMMARY: This common, widespread herbaceous vegetation occurs as large, mesic meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations throughout the western U.S. It occurs in a variety of environmental settings in the montane and subalpine zones. Some of the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. Presence of *Carex aquatilis* typically indicates wet soils with high organic matter or histic epipedons. A clear dominance by *Carex aquatilis* and low cover of *Carex utriculata* or *Pedicularis groenlandica* sets this plant association apart from closely related types.

ENVIRONMENTAL DESCRIPTION
USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This herbaceous vegetation occupies low-gradient sites (from 1–4% slopes) along streams where the soil (peat formation is typically present) is saturated to the surface or shallow standing water is present. The aspect is that of the stream, normally, so most exposures are to the north and west. The distribution of *Carex aquatilis* is zonal, with *Carex utriculata* occupying the most inundated sites immediately adjacent to the drainage and *Juncus balticus* occupying the drier margin at the higher elevation. There are ecotones formed at both zone margins and can be quite broad.

Global Environment: This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. Presence of at least 25% cover of *Carex aquatilis* typically indicates wet soils with high organic matter or histic epipedons.

VEGETATION DESCRIPTION
Florissant Fossil Beds NM Vegetation: Total foliar cover in these stands typically exceeded 70% to approximately 80%, for graminoids between 0.5–1.0 m tall. Most of the foliar cover was attributable to *Carex aquatilis,* and small amounts of foliar cover, typically 2–3%, was contributed by *Carex utriculata, Juncus balticus, Deschampsia caespitosa, Hordeum brachyantherum,* and *Poa pratensis* as associated graminoids. The forbs that occupy these stands also provide less than 2–3% foliar cover and include *Rumex aquaticus, Mentha arvensis, Potentilla plattensis, Chamerion angustifolium ssp. circumvagum,* and the exotic *Cirsium arvense*. Ground cover consists entirely of litter, typically up to 10 cm thick. There are many small mammal tunnels through the bed of litter. Some of these sites are underlain by peat and may “quake” when walked upon.

The aerial photo signatures for stands of this herbaceous vegetation are similar to those for *Carex utriculata* and *Juncus balticus*. It may not be possible to separate the dark green to black color that appears on true color aerial photos and the pink to red color of CIR photography.

Global Vegetation: This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (10-80% cover), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (1-40%) or *Deschampsia caespitosa* (1-16%). *Eleocharis quinqueflora* can be abundant on organic substrates (1-49% cover) at high elevations. *Carex utriculata* (1-20% cover) may be present. When present, *Carex utriculata* is usually not more than one-third the cover of *Carex aquatilis* cover. If it is more than that, the stand may be classified as *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803) or *Carex utriculata* Herbaceous Vegetation (CEGL001562). Forbs are often present, although sometimes inconspicuous (generally <10%, but can be as high as 40%). Species include *Epilobium* spp., *Pedicularis groenlandica*, *Caltha leptosepala*, *Cardamine cordifolia*, and *Mertensia ciliata*.

Global Dynamics: Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of root structure. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because if there are adjacent willows, they are vulnerable to pruning damage due to limited regrowth before the end of the growing season (Hansen et al. 1995, Kovalchik and Elmore 1992).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, streambank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex utriculata* and *Carex aquatilis*. However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after burning. This is necessary in order to keep livestock from damaging young, palatable regrowth and to allow for root reserve build up. Prescribed burning is also an effective method of rejuvenating decadent clumps of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow-burning fires can actually damage the plants (Hansen et al. 1995).

Presence of *Carex utriculata* may indicate that the site has progressed from the more wet *Carex utriculata* community to the current less mesic conditions, and may become dominated by *Salix planifolia* or *Salix wolfii* (Youngblood et al. 1985a). Wilson (1969) reports that *Carex aquatilis* associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession, and a plant association dominated by *Carex utriculata* takes over on these sites (Wilson 1969).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Carex aquatilis, Carex utriculata, Juncus balticus*
Forb	*Rumex aquaticus, Mentha arvensis*

Global

Stratum	Species
Graminoid	*Carex aquatilis*
Forb	*Epilobium* spp., *Pedicularis groenlandica*, *Caltha leptosepala*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Carex aquatilis, Carex utriculata, Juncus balticus, Deschampsia caespitosa, Hordeum brachyantherum*
Forb	*Rumex aquaticus, Mentha arvensis*

Global

Stratum	**Species**
Graminoid	*Carex aquatilis*
Forb	*Epilobium* spp.

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:

- DRISCOLL FORMATION CODE:V.C.6.a. (Driscoll et al. 1984)
- *Carex aquatilis* (Bourgeron and Engelking 1994)
- *Carex aquatilis* Association (Kovalchik 1993) =. (p.168)
- *Carex aquatilis* Association (Crowe and Clausnitzer 1997) =. (p.174)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G5.

Global Classification Comments: *Carex aquatilis* Herbaceous Vegetation (CEGL001802) is distinguished from *Carex aquatilis – Carex utriculata* Herbaceous Vegetation (CEGL001803) and *Carex aquatilis - Pedicularis groenlandica* Herbaceous Vegetation (CEGL001804) by the dominance of *Carex aquatilis*. If *Carex utriculata* is present, it is no more than 1/3 of the total cover.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Carex aquatilis* Herbaceous Vegetation is found on the first terrace adjacent to the Grape Creek channel and in its major tributary drainages, particularly Boulder Creek, within the monument. These drainages lie between approximately 8350-8650 feet elevation.

Global Range: This association is common and located throughout the western U.S. and Canada.

Nations: US
States/Provinces: AZ? CA CO ID MT NM NV OR UT WA WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 12, 25, 77
Classification Confidence: 1 **Identifier:** CEGL001802
REFERENCES: Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bierly 1972, Bourgeron and Engelking 1994, Briggs and MacMahon 1983, Bunin 1975c, Cox 1933, Crowe and Clausnitzer 1997, Driscoll et al. 1984, Giese 1975, Hall 1971, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess and Wasser 1982, Johnson 1932a, Johnson 1932b, Johnson 1936, Johnson 1939, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1995, Kittel et al. 1996, Komarkova 1976, Kovalchik 1993, Kovalchik and Elmore 1992, Lewis 1970, Manning and Padgett 1995, Mattson 1984, Norton et al. 1981, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley 1920, Robbins 1918, Sanderson and Kettler 1996, Terwilliger et al. 1979a, Tuhy 1981, Tuhy and Jensen 1982, Wilson 1969, Youngblood et al. 1985a, Youngblood et al. 1985b

V.A.5.N.k.56. CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Nebraska Sedge Seasonally Flooded Herbaceous Alliance

CAREX NEBRASCENSIS HERBACEOUS VEGETATION
Nebraska Sedge Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: These minor wetlands occur on the western Great Plains and throughout much of the western U.S. Elevation ranges from 1000-2800 m (3300-9200 feet). Stands form open meadows that occur along the margins of streambanks, flat floodplains, and lakes often forming a band along the alluvial terrace, or on marshy areas surrounding springs and below seeps on lower hillslopes. This association is often found on well-developed soil, but occurs on a wide variety of soil types that tend to be fine-textured alluvium, or clay to organic and are typically gleyed and mottled near the surface because of the high water table most of the growing season. The vegetation is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex nebrascensis.* Other graminoid species may be present such as *Carex praegracilis, Calamagrostis stricta, Deschampsia caespitosa, Eleocharis palustris, Glyceria striata, Juncus balticus, Schoenoplectus pungens (= Scirpus pungens),* or *Triglochin maritima*. Forb cover is generally low, but can be high in moist locations.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This herbaceous vegetation forms nearly pure, small stands only in the northeastern corner of the monument. The stands are interspersed with clumps of *Salix monticola* and may be more appropriately described as a variation of that vegetation type for the monument.

Global Environment: This wetland plant association occurs on the western Great Plains and throughout much of the western U.S. Elevation ranges from 1000-2800 m (3300-9200 feet). Stands form open meadows that occur along the margins of streambanks, flat floodplains, and lakes often forming a band along the alluvial terrace. Stands have also been sampled from marshy areas surrounding springs and below seeps on lower hillslopes. This association is often found on well-developed soil, but occurs on a wide variety of soil types ranging from saturated organics to Mollisols to Entisols. Soils tend to be fine-textured alluvium, ranging from sandy, silty loam, clay loam, or clay to organic and are typically gleyed and mottled near the surface because of the high water table most of the growing season.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This herbaceous vegetation is characterized by tall *Carex nebrascensis* (from 0.5–1.0 m in height) growing in flowing water from 3–12 cm deep. The stands or patches are small, less than 200 m^2, and very dense, with approximately 105% vegetation cover including the overstory shrub cover. The small stands occupied the entire, open drainage bottom and also grew under *Salix monticola* and *Salix brachycarpa* shrubs (approximately 20% vegetative cover). The most abundant associated herbaceous species were *Calamagrostis canadensis* (approximately 4% vegetative cover), *Heracleum maximum*, *Mentha arvensis,* and the exotic forb *Cirsium arvense* (approximately 5% vegetative cover in the aggregate). The ground cover was in excess of 90% for litter, and the remainder was flowing water exposed in a narrow channel, approximately 1 m wide. The sampled stand has become established adjacent to the foot of a steep cutbank, approximately 3 m in height.

This type is rare within the monument and has an aerial photo signature that is nearly black on true color aerial photography in the narrow drainage occupied. This sedge is perhaps better described within the variation of *Salix monticola /* Mesic Graminoids Shrubland (CEGL002659).

Global Vegetation: These wetlands are characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex nebrascensis* (25-99% cover), that generally forms small- to medium-sized meadows. Stands often are nearly pure *Carex nebrascensis,* but a variety of other graminoid species may be present such as *Carex praegracilis, Calamagrostis stricta, Calamagrostis canadensis, Deschampsia caespitosa, Eleocharis palustris, Glyceria striata, Juncus balticus, Schoenoplectus pungens (= Scirpus pungens),* or *Triglochin maritima*. Forb cover is generally low, but can be high in moist locations. Common forbs include *Eurybia integrifolia (= Aster integrifolius), Geum macrophyllum, Mentha arvensis, Mimulus glabratus, Heracleum maximum,* and *Ranunculus cymbalaria*. Introduced species *Poa pratensis, Poa palustris*, *Cirsium arvense,* and *Melilotus officinalis* may also be common.

In Nebraska, common species include *Agrostis stolonifera, Carex hystricina, Carex pellita (= Carex lanuginosa), Eleocharis erythropoda, Equisetum* spp., *Juncus balticus, Schoenoplectus pungens (= Scirpus pungens),* and *Triglochin* spp. (Steinauer and Rolfsmeier 2000).

Global Dynamics: In Montana, the *Carex nebrascensis* Community Type is considered a grazing-disclimax. Under season-long grazing, *Carex nebrascensis* increases in abundance, replacing former dominant species (Hansen et al. 1995). However, under extreme grazing conditions and a resulting drop in the water table, *Juncus balticus* or *Poa pratensis* can eventually replace *Carex nebrascensis*. In Nevada, sites dominated by *Carex nebrascensis* are considered the Potential Natural Community (Manning and Padgett 1995), which appears to be the case in undisturbed stands in Colorado.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Carex nebrascensis, Calamagrostis canadensis*

Global

Stratum	**Species**
Graminoid	*Carex nebrascensis*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Carex nebrascensis*, *Calamagrostis Canadensis*

Global

Stratum	**Species**
Graminoid	*Carex nebrascensis*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:V.C.6.a. (Driscoll et al. 1984) B
- *Carex nebrascensis* (Bourgeron and Engelking 1994) =
- *Carex nebrascensis-Catabrosa aquatica-Juncus arcticus ssp. ater* Spring Wetland (Baker 1982b) =
- *Carex nebrascensis* Association (Cooper and Cottrell 1990) =
- Wet Meadow (Hall 1973) B
- *Carex nebrascensis* Community Type (Hall and Hansen 1997)
- *Carex nebrascensis* Community Type (Hansen et al. 1995)
- Nebraska Sedge (*Carex nebrascensis*) Community (Jones and Walford 1995) =
- *Carex nebrascensis* Herbaceous Vegetation (Kittel et al. 1994)
- *Carex nebrascensis* Herbaceous Vegetation (Kittel et al. 1996)
- *Carex nebrascensis* Herbaceous Vegetation (Kittel et al. 1999) =
- Nebraska Sedge Community Type (Kovalchik 1987) =
- *Carex nebrascensis* Community Type (Manning and Padgett 1995) =
- *Carex nebrascensis* Herbaceous Vegetation (Marriott and Faber-Langendoen 2000) =
- *Carex nebrascensis* Community Type (Padgett et al. 1988b)
- *Carex nebrascensis* Community Type (Padgett et al. 1989) =
- *Carex nebrascensis* Community Type (Youngblood et al. 1985a) =
- *Carex nebrascensis* Community Type (Youngblood et al. 1985b)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G4.

Global Classification Comments: In the Black Hills, classification of stands was problematic due to identification problems with *Carex nebrascensis* and *Carex aquatilis*. The two are difficult to distinguish based on available keys and written descriptions (Marriott and Faber-Langendoen 2000).

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Carex nebrascensis* Herbaceous Vegetation is best represented along the trail that leads to the northeastern corner of the monument. The purest stand occurs at the foot bridge crossing of the unnamed creek.

Global Range: This sedge meadow type is widely distributed from the western Great Plains into the western mountains of the United States, ranging from South Dakota and Montana to possibly as far west as Washington, south to California and east to New Mexico.

Nations: US
States/Provinces: AZ CA CO ID MT NE NM? NV OR SD UT WA? WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Present as very small stands.
Classification Confidence: 1 **Identifier:** CEGL001813
REFERENCES: Baker 1982b, Bourgeron and Engelking 1994, Cooper and Cottrell 1990, Driscoll et al. 1984, Hall 1973, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Jones 1992b, Jones and Walford 1995, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999, Kovalchik 1987, Manning and Padgett 1995, Marriott and Faber-Langendoen 2000, Mutz and Queiroz 1983, Padgett et al. 1988b, Padgett et al. 1989, Steinauer and Rolfsmeier 2000, Youngblood et al. 1985a, Youngblood et al. 1985b

V.A.5.N.k.13. JUNCUS BALTICUS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Baltic Rush Seasonally Flooded Herbaceous Alliance

JUNCUS BALTICUS HERBACEOUS VEGETATION
Baltic Rush Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: The Baltic rush wet meadow community is found widely throughout the western United States. This wet meadow vegetation occurs as small, dense patches on flat stream benches, along overflow channels, and near springs. Soils are usually sandy clay loam or fine sands and mottled or gleyed. Stands are characterized by a dense sward of *Juncus balticus* and often minor cover of *Carex* species, including *Carex aquatilis, Carex praegracilis, Carex nebrascensis*, or *Carex utriculata*. Other common species include *Deschampsia caespitosa, Distichlis spicata, Glyceria striata, Hordeum jubatum, Muhlenbergia asperifolia, Phleum alpinum*, and *Sporobolus airoides*. The introduced perennial sod grasses *Poa pratensis* or *Agrostis stolonifera* codominate some stands. Forb cover is generally low and includes wetland species like *Caltha leptosepala, Rumex aquaticus* and *Dodecatheon pulchellum. Iris missouriensis* can be common in heavily grazed stands. Shrubs are not common. This association is often considered to be a grazing-induced community since it increases with disturbance.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: *Juncus balticus* is a rhizomatous, perennial graminoid that forms extensive stands on the upper (usually second) floodplain terrace. Species of sedge dominate saturated soils of the first terrace, which is usually inundated adjacent to the flowing water. On the second terraces, groundwater is from 30 cm to 1.5 m below the ground surface, except during spring snowmelt and runoff, when it is nearer the surface. This herbaceous vegetation is persistent, often occupying floodplain terraces, even after streams have incised and the groundwater table has dropped significantly as evidenced by prairie dog colonies forming in Baltic rush terrace stands west of the Hornbek Homestead. At this site, Grape Creek has incised approximately 4–5 m deep.

Global Environment: This widespread herbaceous wetland community is found throughout western North America. Elevation ranges from 1420-3500 m. Stands usually occur as small, dense patches on flat to gently sloping sites near seeps and streams. Stream channels are highly variable in size and type ranging from narrow to moderately wide, and deeply entrenched to very sinuous (Kittel et al. 1999). Soils are also variable and range from alluvial sandy and well-drained, to poorly drained silty clay loam, to organic; however, soils tend to be finer-textured, alkaline and may be saline (Brotherson and Barnes, Kittel et al. 1999, Padgett et al. 1989). Cobbles and gravel are common on many sites, and gleyed and mottled horizons are often present because of flooding or high water tables (Kittel et al. 1999).

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Juncus balticus* is a medium-tall graminoid (0.5-1.0 m in height) that forms nearly monotypic stands on second terraces of stream floodplains within the monument. It is a component of several other moist soil plant associations dominated by sedge, forb and grass species. When the soil is moist to saturated, low hummocks are present within a stand. The stands are dense, with the graminoid component providing foliar cover of from 65-90%. The ground cover was typically 100% litter, to 10 cm deep. Commonly associated graminoids included *Deschampsia caespitosa*, the exotic *Poa pratensis, Iris missouriensis*, and *Hordeum brachyantherum*. Several forbs, including *Rumex aquaticus, Cirsium scariosum (= Cirsium tioganum), Achillea millefolium, Potentilla plattensis*, *Polygonum bistortoides*, and the exotic *Cirsium arvense*, are present but rarely contribute more than 2–5% to the foliar cover. The habitat is usually riddled with small mammal burrows within the thick litter layer.

Juncus balticus Herbaceous Vegetation has a dark green to black signature on true color aerial photography. This signature is dull to bright red for CIR aerial photos. Drier sites are becoming invaded by *Cirsium arvense* and *Linaria vulgaris* at some locations.

Global Vegetation: This association is characterized by a low (<50 cm), dense graminoid layer dominated by the rhizomatous perennial *Juncus balticus*. Minor cover of *Carex* species, including *Carex aquatilis, Carex praegracilis, Carex nebrascensis* or *Carex utriculata*, is often present. Other common graminoids include *Deschampsia caespitosa*, *Distichlis spicata*, *Glyceria striata*, *Hordeum jubatum, Muhlenbergia asperifolia, Phleum alpinum*, and *Sporobolus airoides*. Forb cover is generally low but may include *Caltha leptosepala, Glaux maritima, Maianthemum stellatum, Rumex aquaticus, Cirsium scariosum (= Cirsium tioganum), Achillea millefolium, Potentilla plattensis*, *Polygonum bistortoides*, *Dodecatheon pulchellum,* and *Iris missouriensis*. Shrubs are not common, but occasional *Salix* spp. may occur. Some stands may be codominated by the introduced perennial sod grasses *Poa pratensis* or *Agrostis stolonifera*. Other introduced species, such as *Taraxacum officinale*, *Trifolium* spp., *Cirsium arvense, Lactuca serriola, Phleum pratense*, and *Thinopyrum intermedium*, may occur in disturbed stands.

Global Dynamics: This association is considered by some to be a grazing-induced community because *Juncus balticus* is tolerant of grazing (low palatability when mature) and increases with grazing disturbance (Hansen et al. 1995, Padgett et al. 1989). Nearly pure stands of *Juncus balticus* may indicate that the site was heavily grazed in the past (Hansen et al. 1995). However, this association also occurs as a stable, late-seral community in areas with low disturbance (Kittel and Lederer 1993).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Juncus balticus, Deschampsia caespitosa, Poa pratensis*
Forb	*Rumex aquaticus, Cirsium scariosum, Achillea millefolium*

Global

Stratum	**Species**
Graminoid	*Juncus balticus*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Juncus balticus, Deschampsia caespitosa*
Forb	*Rumex aquaticus, Cirsium scariosum*

Global

Stratum	**Species**
Graminoid	*Juncus balticus*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
- *Eleocharis palustris - Juncus balticus* Herbaceous Vegetation (CEGL001835)
- *Juncus balticus - Carex rossii* Herbaceous Vegetation (CEGL001839)

SYNONYMY:
- DRISCOLL FORMATION CODE: V.C.6.a. (Driscoll et al. 1984)
- *Juncus balticus* (Bourgeron and Engelking 1994)
- *Juncus balticus* Wetland Plant Association (Baker 1984a) =
- Saline Meadow (Brotherson and Barnes 1984) =
- *Juncus balticus* Community Type (Hansen et al. 1995) =
- *Juncus balticus* Community Type (Hall and Hansen 1997) =
- Baltic Rush (*Juncus balticus)* Dominance Type (Jones and Walford 1995) =
- *Juncus arcticus/Carex* spp. Plant Association (Johnston 1987) =
- *Juncus balticus* Herbaceous Vegetation Association (Kittel et al. 1999) =
- Baltic Rush Alliance (Muldavin et al. 2000a) B. includes 5 similar *Juncus balticus* community types.
- *Juncus balticus* Vegetation Type (Mutz and Graham 1982) =
- *Juncus balticus/Carex* spp. Habitat Subtype (Olson and Gerhart 1982) =
- *Juncus balticus* Community Type (Padgett et al. 1989) =
- *Juncus balticus* dominated (Zone 3) (Shupe et al. 1986) =. Zone 3 is the outer zone of the Great Basin playa.
- *Juncus balticus* Community Type (Tuhy and Jensen 1982)

- *Juncus balticus/Carex* spp. Habitat Type (Wasser and Hess 1982)
- *Juncus balticus* Community Type (Youngblood et al. 1985a) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G5.

Global Classification Comments: This association is often considered to be a grazing-induced community since it increases with grazing disturbance.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Juncus balticus* Herbaceous Vegetation occupies floodplain terraces of nearly every flowing stream (Grape and Boulder creeks and tributaries) and are also present in the bottoms of moist drainages and swales. This limits the type to the lowest elevations of the monument.

Global Range: This Baltic rush wet meadow community is found widely throughout the western United States, ranging from South Dakota and Montana west to Washington, south to possibly California, and east to New Mexico.

Nations: US
States/Provinces: CA? CO ID MT NM NV OR SD UT WA WY

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 9, 13, 38, 40, 94
Classification Confidence: 1 **Identifier:** CEGL001838
REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bunin 1985, Driscoll et al. 1984, Faber-Langendoen 2001, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Johnston 1987, Jones and Walford 1995, Kartesz 1994, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999, Komarkova 1986, Manning 1988, Muldavin et al. 2000a, Mutel 1973, Mutz and Graham 1982, Olson and Gerhart 1982, Padgett 1982, Padgett et al. 1989, Rector 1979, Richard et al. 1996, Shupe et al. 1986, Stewart 1940, Thompson 2001, Tuhy and Jensen 1982, Von Loh 2000, Wasser and Hess 1982, Youngblood et al. 1985a

V.A.5.N.k.20. PHALARIS ARUNDINACEA SEASONALLY FLOODED HERBACEOUS ALLIANCE

Reed Canary Grass Seasonally Flooded Herbaceous Alliance

PHALARIS ARUNDINACEA WESTERN HERBACEOUS VEGETATION

Reed Canary Grass Western Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This association is reported from throughout Washington, Colorado, Nebraska, Montana, Idaho, and into northeastern Utah, and is likely more widespread in the western United States. Its distribution as a natural type is complicated because this native species is widely cultivated as a forage crop and has escaped and established in wetlands and riparian areas, displacing the local flora. Elevations range from near sea level to 1700 m. Stands are found along riparian areas, pond and lake margins, wet meadows, and intermittent drainages. Soils are commonly fine-textured and may be flooded for brief to extended periods. The vegetation is characterized by a dense, tall herbaceous layer (often >80% canopy cover and 1.5-2 m tall) that is dominated by *Phalaris arundinacea*, which tends to occur in mono-cultures. Associated species may include *Equisetum arvense, Muhlenbergia asperifolia, Mentha arvensis*, *Schoenoplectus acutus (= Scirpus acutus)*, and many other species in trace amounts where disturbed. Introduced species such as *Lepidium latifolium, Cirsium arvense, Sonchus oleraceus, Euphorbia esula*, and *Phleum pratense* are common in some stands.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: This herbaceous vegetation is an exotic mesic grassland restricted to drainages with flowing water and/or high groundwater tables. *Phalaris arundinacea* was apparently introduced historically to revegetate a disturbed water pipeline corridor and subsequently invaded adjacent riparian and wetland sites. Reed canarygrass may also have been introduced historically to provide streambank protection and/or to enhance forage production for livestock on these once, private ranch lands.

Global Environment: This association is reported from throughout Washington, Colorado, Nebraska, Montana, Idaho, and into northeastern Utah, and is likely more widespread in the western United States. Elevations range from near sea level to 1700 m. Stands are found along riparian areas, pond and lake margins, wet meadows, and intermittent drainages. Sites are flat to rolling. Soils are commonly fine-textured, but can be coarser in texture. Subsoil is often mottled and gleyed (Crawford 2001). Sites are generally flooded during the growing season, but flooding can vary from brief to extended periods.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This mesic grassland is characterized by almost pure stands of *Phalaris arundinacea* from 1.0-1.5 m in height and in excess of 75% foliar cover. The litter layer is extremely dense, to 10 cm thick, and is riddled by small mammal tunnels. There are generally only a few native species associated with this type, occupying the drier margins of the stand, including *Juncus balticus* and *Cirsium scariosum (= Cirsium tioganum)*. Other exotic forbs such as *Cirsium arvense* and graminoids such as *Poa pratensis*, *Hordeum brachyantherum,* and *Bromus inermis* were observed along the stand margins and in adjacent, drier habitats. Only a few large stands or patches of this association were present in Boulder and Grape creeks, and small patches occurred along drainages and on moist sites within the floodplain of these and other creeks.

These stands are apparently stable once established, showing no signs of invasion by surrounding native and/or other exotic species. Should the type be restored to non-invasive species, it would likely support stands of *Juncus balticus, Carex utriculata*, and *Carex aquatilis*.

Global Vegetation: This association is characterized by a dense, tall herbaceous layer (often >90% canopy cover and 1.5-2 m tall) that is dominated by *Phalaris arundinacea*, which tends to occur in monocultures. Associated species such as *Equisetum arvense, Muhlenbergia asperifolia, Mentha arvensis, Schoenoplectus acutus (= Scirpus acutus), Polygonum amphibium, Solidago canadensis, Urtica dioica*, and many other species may be present in trace amounts especially where disturbed. Occasional *Populus tremuloides, Salix exigua, Rubus idaeus*, or *Symphoricarpos albus* may be present in some stands. Introduced species such as *Lepidium latifolium, Cirsium arvense, Sonchus oleraceus, Euphorbia esula, Poa pratensis*, and *Phleum pratense* are common in some disturbed stands.

Global Dynamics: *Phalaris arundinacea* produces abundant herbage and is planted for livestock forage. It is tolerant of moderate grazing by livestock, although heavy grazing will reduce density (Hansen et al. 1995). *Phalaris arundinacea* is a threat to riparian and wetland areas because it spreads rapidly from rhizomes, dominating the sites, and is extremely difficult to remove once established (Hansen et al. 1995). Fire has been used with limited success to control the spread of *Phalaris arundinacea,* but the high water table where it grows makes it difficult to burn during the growing season (Hansen et al. 1995).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Phalaris arundinacea*

Global

Stratum	Species
Graminoid	*Phalaris arundinacea*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Phalaris arundinacea, Juncus balticus*
Forb	*Cirsium scariosum*

Global

Stratum	Species
Graminoid	*Phalaris arundinacea*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:
- *Calamagrostis canadensis - Phalaris arundinacea* Herbaceous Vegetation (CEGL005174)
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044)

SYNONYMY:
- DRISCOLL FORMATION CODE:V.A.4.a. (Driscoll et al. 1984)
- *Phalaris arundinacea* (Bourgeron and Engelking 1994)
- *Phalaris arundinacea* Habitat Type (Hansen et al. 1995)
- *Phalaris arundinacea* Habitat Type (Hall and Hansen 1997)
- *Phalaris arundinacea* Association (Crawford 2001)
- *Phalaris arundinacea* Monotype (Muldavin et al. 2000a)

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G5.

Global Classification Comments: Other natural associations included in this alliance are found throughout the northeastern United States, but this western association's distribution as a natural type is not clear because of extensive planting as a forage crop (Hansen et al. 1995, Hall and Hansen 1997). Further work is required to resolve the natural versus introduced nature of this type in western North America.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Phalaris arundinacea* Western Herbaceous Vegetation is best represented in linear stands occupying Boulder and Grape creeks. These creeks are controlled by a series of dams constructed for historic livestock watering ponds.

Global Range: This association is reported from throughout Washington, Colorado, Nebraska, Montana and Idaho and into northeastern Utah and is likely more widespread in the western United States. Its distribution as a natural type is complicated because this native species is widely cultivated as a forage crop and has escaped and established in many wetlands and riparian areas.

Nations: US
States/Provinces: CO ID MT NE NM UT WA

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 8, 46
Classification Confidence: 1 **Identifier:** CEGL001474
REFERENCES: Bourgeron and Engelking 1994, Cooper et al. 1995, Crawford 2001, Driscoll et al. 1984, Hall and Hansen 1997, Hansen et al. 1995, Kittel et al. 1999, Muldavin et al. 2000a, Von Loh 2000

V.A.7.N.e. Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer

V.A.7.N.e.4. CHRYSOTHAMNUS VISCIDIFLORUS SHRUB HERBACEOUS ALLIANCE
Green Rabbitbrush Shrub Herbaceous Alliance

CHRYSOTHAMNUS VISCIDIFLORUS – ERICAMERIA PARRYI SHRUB HERBACEOUS VEGETATION [PROVISIONAL]
Green Rabbitbrush – Parry Rabbitbrush Shrub Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This shrub herbaceous vegetation occupies decomposing Pikes Peak granite gravels with fine silt and clay soil particles interspersed. Stand exposure ranged from northeast to southeast (60^{o}-165^{o}), and the slopes are moderately steep, from 5–11%. The sites are considered well-drained to rapidly drained. On similar sites elsewhere in the monument, this location would support an Arizona Fescue – Slimstem Muhly Grassland. Green Rabbitbrush – Parry Rabbitbrush Shrub

Herbaceous Vegetation may become established because of a combination of disturbance by mammals historically and the dry soils of these exposures.

Global Environment: Not applicable.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Stands are less than 0.5 m tall and provide from 25–55% foliar cover for all species. The dominant dwarf-shrubs, e.g., *Chrysothamnus viscidiflorus* and *Ericameria parryi, Artemisia frigida*, and *Gutierrezia sarothrae,* typically provide from 20–35% foliar cover. Grass species common to dwarf rabbitbrush stands include *Bouteloua gracilis*, *Muhlenbergia filiculmis*, *Festuca arizonica*, *Elymus elymoides*, and *Koeleria macrantha*, and they provide from 15–25% foliar cover. Foliar cover by forbs was less than 5% for all stands sampled and typically was in the range of 2–4%. The more common forbs observed included *Hymenoxys richardsonii, Geranium caespitosum*, and *Besseya plantaginea*. Ground cover in the form of bare soil and small gravel derived from Pikes Peak granite typically averaged from approximately 60–70%. The remainder of ground cover for each stand was litter, covering from 30-40% of the unvegetated surface. Some burrowing activity by prairie dogs, other ground squirrels, and pocket gophers was observed on nearly every stand sampled, and it is possible that this plant association requires such disturbance/foraging activity to persist.

This association has a distinct dark gray aerial photo signature when viewing true color photography, and a dull pink photo signature on CIR.

Global Vegetation: Not applicable.

Global Dynamics: Not applicable.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Chrysothamnus viscidiflorus, Ericameria parryi, Artemisia frigida, Gutierrezia sarothrae*
Graminoid	*Bouteloua gracilis, Muhlenbergia filiculmis, Festuca arizonica*
Forb	*Hymenoxys richardsonii, Besseya plantaginea*

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Chrysothamnus viscidiflorus, Ericameria parryi, Artemisia frigida, Gutierrezia sarothrae*
Graminoid	*Bouteloua gracilis, Muhlenbergia filiculmis*
Forb	*Besseya plantaginea*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: Not applicable.

Global Classification Comments: Not applicable.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Chrysothamnus viscidiflorus - Ericameria parryi* Shrub Herbaceous Vegetation is present on the slopes of low hills and ridges at the lower elevations (approximately 8325–8450 feet) within the monument.

Global Range: Not applicable

Nations: US
States/Provinces:

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 34, 36, 37, 98
Classification Confidence: **Identifier:** To be determined.
REFERENCES:

V.A.7.N.h. Medium-tall temperate grassland with a sparse xeromorphic (often thorny) shrub layer

V.A.7.N.h.2. YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE

Soapweed Yucca Shrub Herbaceous Alliance

YUCCA GLAUCA / MUHLENBERGIA MONTANA SHRUBLAND

Soapweed Yucca / Mountain Muhly Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This shrubland is found on gravelly substrate on steep south- to southeast-facing slopes (130^o–136^o were recorded) of ridges and hills. This gravelly substrate resulting from the weathering of Pikes Peak granite bedrock also supported *Schizachyrium scoparium* grasslands, sparse stands of *Cercocarpus montanus* shrublands, sparse *Pinus ponderosa* woodlands, and relatively dense stands of *Muhlenbergia montana*.

Global Environment: Not applicable.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Yucca glauca* is the dominant dwarf-shrub of this association, but the stands are typically dominated by an herbaceous species, particularly *Muhlenbergia montana* and/or *Bouteloua gracilis*. *Yucca glauca* typically provides foliar cover of approximately 15%, although one stand on the northern boundary fenceline covered an estimated 40% of the ground surface. Individual *Yucca glauca* shrubs are small, less than 0.5 m in height, and have a small crown diameter but are usually quite dense when present as stands. *Yucca glauca* dwarf-shrubs are also minor components of other plant associations found on south-facing and steep slopes, including those dominated by *Cercocarpus montanus, Pinus ponderosa, Muhlenbergia montana, Bouteloua gracilis,* and *Schizachyrium scoparium*. Commonly associated species in stands include *Muhlenbergia montana* and *Bouteloua gracilis*, which provided more foliar cover (15%–40% in two stands sampled) than does *Yucca glauca*. Only *Grindelia subalpina* provided foliar cover over 1% for forbs present in this type. Ground cover ranged from 50-70% small gravel derived from eroding Pikes Peak granite boulders and 30-50% litter, to approximately one cm deep on these rapidly drained sites.

This type will probably be indistinguishable on aerial photography from *Festuca arizonica* and *Muhlenbergia montana* herbaceous types because the yucca shrubs are small and usually associated with grasses.

Global Vegetation: Not applicable.

Global Dynamics: Not applicable.

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Shrub	*Cercocarpus montanus*

Dwarf-shrub	*Yucca glauca, Artemisia frigida*
Graminoid	*Muhlenbergia montana, Bouteloua gracilis*
Forb	*Grindelia subalpina*

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Yucca glauca*
Graminoid	*Muhlenbergia montana, Bouteloua gracilis*
Forb	*Grindelia subalpina*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: Not applicable.

Global Classification Comments: Not applicable.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Yucca glauca / Muhlenbergia montana* Shrubland occupies south-facing, moderately steep to steep, rapidly drained slopes (16%–29%) on the larger hills and ridges within the monument. The elevation range for the type was recorded between 8400 feet and 8650 feet, and the stands occupied decomposing Pikes Peak granite gravels. Individual *Yucca glauca* shrubs may be found at higher elevations, but still on south-facing slopes.

Global Range: Not applicable

Nations: US
States/Provinces: MT

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 92, 99
Classification Confidence: **Identifier:** To be determined.
REFERENCES:

V.C.2.N.a. Permanently flooded temperate or subpolar hydromorphic rooted vegetation

V.C.2.N.a.7. LEMNA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE

Duckweed species Permanently Flooded Herbaceous Alliance

LEMNA SPP. PERMANENTLY FLOODED HERBACEOUS VEGETATION

Duckweed species Permanently Flooded Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This aquatic association of floating vegetation is known to occur throughout North America. *Lemna* spp. are the sole or dominant plants floating on the water surface. *Lemna*-dominated aquatic vegetation occupies wetlands that are permanently flooded, semipermanently flooded to seasonally flooded. Water chemistry is fresh. The standing water habitat is relatively shallow, generally less than 2-4 m (6.6-13.1 feet) and occurs as ponds, lakes, ditches, stock ponds, and backwater sloughs of river and stream channels. Standing water for much or most of the growing season is characteristic. Depth of the water is of no consequence to floating plants; they occur where the wind pushes them. *Potamogeton* spp., *Sagittaria* spp., or *Persicaria* spp. may also be present in Rocky Mountain ponds. While these later species are rooted submerged species, and technically not part of the strictly floating community, they do intermingle. Ponds in California may also include *Spirodela* spp., *Azolla* spp., and *Wolffiella* spp. Community composition may change hour to hour, yet the environment, only the top few centimeters of water, is homogeneous. Biomass can be abundant under eutrophic conditions.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: Historic livestock watering ponds are formed behind dams constructed of gravel; much of the gravel was mined from borrow areas on uplands above the drainages. Many of the dams are massive and oversized for the drainages they occupy, have overflow channels installed and a culvert to control water depth. A few are equipped with an outlet gate that could possibly be closed to fill the pond to a higher level than the invert. Along Grape Creek, west of Hornbek Homestead, beaver have constructed many dams and ponds on the creek. The deeper, standing water provides habitat for both rooted and floating aquatic vegetation, and the shallow water and saturated shoreline supports emergent wetland species. A few ponds become dry during the course of the summer season and may exist as barren flats, or may vegetate to a *Hordeum jubatum* herbaceous type.

Global Environment: *Lemna*-dominated aquatic vegetation occupies wetlands that are permanently flooded, semi-permanently flooded to seasonally flooded. Water chemistry is fresh. The standing water habitat is relatively shallow, generally less than 2-4 m (6.6-13.1 feet) and occurs as ponds, lakes, ditches, stock ponds, and backwater sloughs of river and stream channels. Standing water for much or most of the growing season is characteristic. Depth of the water is of no consequence to floating plants; they occur where the wind pushes them. Community composition may change hour to hour, yet the environment, only the top few centimeters of water, is homogeneous. Biomass can be abundant under eutrophic conditions.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Ponds supporting the floating aquatic *Lemna minor* are small, typically less than 200 m^2. Depths for most ponds are estimated to be from 1–2 m in the deepest portion. The foliar cover value for *Lemna minor* may be as little as 5%, but more typically it falls in the 40–80% range. *Lemna minor* is present across the surface of many ponds, because of the wind protection provided by the dam, drainage sides, and the tall vegetation growing from the shallow water and saturated soils surrounding the pond. The shoreline vegetation consists of emergent wetland species, particularly *Carex utriculata, Eleocharis palustris, Glyceria grandis, Cirsium scariosum (= Cirsium tioganum), Mentha arvensis*, and the exotic species *Phalaris arundinacea* and *Cirsium arvense*. The shoreline emergent wetland stands are dense (approximately 90–100% foliar cover within the stand) and provide foliar cover of approximately 25% for the entire pond. Bottom substrates consist of gravel and muck. Litter for each pond typically approaches approximately 20–25% and is associated with the dense shoreline growth from shallow water, to 0.5 m deep.

All ponds within the monument are less than the minimum mapping unit (0.5 ha), however, they are easily identified on both true color and CIR photography, e.g., black for open water and pink to dark red for emergent wetland vegetation.

Global Vegetation: *Lemna* spp. are the sole or dominant plants floating on the water surface. *Potamogeton* spp., *Sagittaria* spp., or *Persicaria* spp. may also be present in the Rocky Mountains. While these later species are rooted submerged species, and technically not part of the strictly floating community, they do intermingle. Ponds in California may also include *Spirodela* spp., *Azolla* spp., and *Wolffiella* spp. (Windell et al. 1986).

Global Dynamics: Because the biomass of floating organisms is generally not great, they do not have an important influence on the accumulation of organic matter on the pond bottom. However, a study comparing Rocky Mountain with Illinois pond communities found that similar types in Illinois ponds have twice the number of species and biomass found in Colorado ponds (Fuller 1930).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Forb	*Lemna minor, Myriophyllum sibiricum, Ranunculus trichophyllus*
Graminoid	*Carex utriculata, Juncus balticus, Glyceria grandis, Eleocharis palustris, Beckmannia syzigachne, Phalaris arundinacea*

Global

Stratum	**Species**
Forb	*Lemna minor*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Lemna minor*
Graminoid	*Carex utriculata*

Global

Stratum	**Species**
Forb	*Lemna minor*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G3?.

Global Classification Comments: *Lemna* spp. and other characteristic wetland taxa that comprise floating, submerged and aquatic rooted associations are not well reported in the literature, but they are known to occur in the field.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Lemna* spp. Permanently Flooded Herbaceous Vegetation occupies small livestock watering and some beaver-created ponds located on Grape and Boulder creeks and their tributary drainages. The ponds occur at the lowest elevations within the monument.

Global Range: *Lemna minor* is a cosmopolitan species (except South America), and only occurs as a community of floating vegetation. Therefore it is a widespread association, known to occur, if not documented as a community, throughout the United States, Canada, and in suitable habitats worldwide.

Nations: US
States/Provinces: CA CO IL

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 2, 53
Classification Confidence: 2 **Identifier:** CEGL003059
REFERENCES: Fuller 1930, Sawyer and Keeler-Wolf 1995, Windell et al. 1986

V.C.2.N.a.21. MYRIOPHYLLUM SIBIRICUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE

Siberian Water-milfoil Permanently Flooded Herbaceous Alliance

MYRIOPHYLLUM SIBIRICUM HERBACEOUS VEGETATION

Siberian Water-milfoil Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This association has been described only from Colorado mountain lakes and ponds at roughly 2539 m (8300 feet) elevation. This association occurs in small ponds supporting submerged aquatic vegetation, typically less than 200 m^2. Depths for most ponds are estimated to be from 1–2 m in the deepest portion. The total cover value for *Myriophyllum sibiricum* may be as little as 5%, but more typically it falls in the 40–80% range. Water can be quite saline and the plants heavily encrusted with lime salts. Ponds typically have concentric rings, or zones of vegetation, *Myriophyllum sibiricum* occupying the deepest portion of relatively shallow ponds. Concentric zones include bands of *Schoenoplectus tabernaemontani (= Scirpus validus)*, *Carex* spp., and *Salix* spp.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: PALUSTRINE

Florissant Fossil Beds NM Environment: Historic livestock watering ponds are formed behind dams constructed of gravel, much of the gravel was mined from borrow areas on uplands above the drainages. Many of the dams are massive and oversized for the drainages they occupy, have overflow channels installed and a culvert to control water depth. A few are equipped with an outlet gate that could possibly be closed to fill the pond to a higher level than the invert. Along Grape Creek, west of Hornbek Homestead, beaver have constructed many dams and ponds on the creek. The deeper, standing water provides habitat for both rooted and floating aquatic vegetation, and the shallow water and saturated shoreline supports emergent wetland species. A few ponds become dry during the course of the summer season and may exist as barren flats, or may vegetate to a *Hordeum jubatum* herbaceous vegetation type.

Global Environment: Ponds supporting *Myriophyllum sibiricum* tend to be smaller and shallower (maximum depth of 2 m), than lakes supporting *Stuckenia filiformis (= Potamogeton filiformis)*, for example. Generally these are small ponds supporting submerged aquatic vegetation, typically less than 200 m^2. Depths for most ponds are estimated to be from 1–2 m in the deepest portion. Hence it is most typically found in stock ponds and shallow ends of deeper, stagnant pools.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Ponds supporting the submerged aquatic *Myriophyllum sibiricum* are small, typically less than 200 m^2. Depths for most ponds are estimated to be from 1–2 m in the deepest portion. The foliar cover value for *Myriophyllum sibiricum* may be as little as 5%, but more typically it falls in the 40–80% range. The shoreline vegetation consists of emergent wetland species, particularly *Carex utriculata, Eleocharis palustris, Glyceria grandis, Cirsium scariosum (= Cirsium tioganum), Mentha arvensis*, and the exotics *Phalaris arundinacea* and *Cirsium arvense*. The shoreline emergent wetland stands are dense (approximately 90–100% foliar cover within the stand) and provide foliar cover of approximately 25% for the entire pond. Bottom substrates consist of gravel and muck. Litter for each pond typically approaches approximately 20–25% and is associated with the dense shoreline growth from shallow water, to 0.5 m deep.

All ponds within the monument are less than the minimum mapping unit, however, they are easily identified on both true color and CIR photography, e.g., black for open water and pink to dark red for emergent wetland vegetation.

Global Vegetation: The foliar cover value for *Myriophyllum sibiricum* may be as little as 5%, but more typically it falls in the 40–80% range. The shoreline vegetation consists of emergent wetland species, particularly *Carex utriculata, Eleocharis palustris, Glyceria grandis, Cirsium scariosum (= Cirsium tioganum), Mentha arvensis*, occasionally *Schoenoplectus tabernaemontani (= Scirpus validus)*, and the exotics *Phalaris arundinacea* and *Cirsium arvense*. The shoreline emergent wetland stands are dense (approximately 90–100% cover within the stand) and provide cover of approximately 25% for the entire pond. Bottom substrates consist of gravel and muck. Litter for each pond typically approaches approximately 20–25% and is associated with the dense shoreline growth from shallow water to 0.5 m deep.

Global Dynamics: The growth of submersed vegetation, as time goes by, has a marked effect upon the habitat of shallow ponds. Material is washed into the lake, is deposited around the plants and gradually slows down the water currents. When the submersed and half-submersed plants die organic matter is formed and the lake bottom humus layer becomes greater. Plant remains build up on the bottom and cause a shallowing of the water. This changes the water depth, water temperatures and amount of light penetration to the lake bottom. Conditions change and become favorable for other species to colonize (Johnson 1936).

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Forb	*Myriophyllum sibiricum, Ranunculus trichophyllus, Lemna minor*
Graminoid	*Carex utriculata, Juncus balticus, Glyceria grandis, Eleocharis palustris, Beckmannia syzigachne, Phalaris arundinacea*

Global

Stratum	Species
Forb	*Myriophyllum sibiricum*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Myriophyllum sibiricum, Ranunculus trichophyllus, Lemna minor*
Graminoid	*Carex utriculata*

Global

Stratum	**Species**
Forb	*Myriophyllum sibiricum*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

SYNONYMY:
- DRISCOLL FORMATION CODE:V.E.1.b. (Driscoll et al. 1984) B
- *Myriophyllum exalbescens* (Bourgeron and Engelking 1994) =

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GUQ.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Myriophyllum sibiricum* Herbaceous Vegetation occupies small livestock watering and some beaver-created ponds located on Grape and Boulder creeks and their tributary drainages. The ponds occur at the lowest elevations within the monument.

Global Range: This association has been described only from Colorado mountain lakes and ponds over 2440 m (8000 feet) in elevation.

Nations: US
States/Provinces: CO WY?

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 48, 63
Classification Confidence: 3 **Identifier:** CEGL002000
REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Johnson 1936, Johnson 1939, Johnson 1941

X.X.X.X.X. Hierarchy Placement Undetermined: Park specials & provisional types

IV.B.2.N.? ARTEMISIA FRIGIDA DWARF SHRUBLAND ALLIANCE?

Fringed Sagewort Dwarf-shrubland Alliance

ARTEMISIA FRIGIDA / BOUTELOUA GRACILIS DWARF-SHRUBLAND

Fringed Sagewort / Blue Grama Dwarf-shrubland [Park Special?]

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: Within the monument, this dwarf-shrubland is located on deeper soils that are typically deposited in drainages, swales (interfluves), and along lower hillslopes. The soil must be of a consistency (silty-clay and clay) that will support burrowing activity in terms of both depth and cohesiveness. This type is found at the lower and mid-elevations (8350–8650 feet) predominantly, within the monument. The slopes ranged from 2–7% and were considered moderately well-drained. *Artemisia frigida* is a common, but rarely dominant, component of all herbaceous, shrub, and woodland communities that occur on upland sites within the monument. Adjacent to the monument, this dwarf-shrubland occupies prairie dog towns but also heavily grazed pastures in the vicinity of livestock watering ponds.

Global Environment: Not applicable

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This dwarf-shrubland becomes established on sites disturbed by prairie dogs. *Artemisia frigida* is an increaser under livestock grazing regimes and is evidently unpalatable or less palatable to prairie dogs, as well. The age of the colony determines to what extent *Artemisia frigida* dominates the site, and the following description covers sites that have been used by prairie dogs for several years. Prairie dog colonies that are densely occupied typically have vegetative cover values less than 40%. The foliar cover for *Artemisia frigida* ranges from 20–40% and other dwarf-shrubs, i.e., *Ericameria parryi, Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae, Rosa acicularis*, and a species of *Solidago,* contribute from 5–20% foliar cover on some sites. The most abundant graminoid is *Bouteloua gracilis,* which is an increaser under light to moderate grazing regimes. Blue grama contributes approximately 5–10% foliar cover on sites that are moderate to heavily-grazed. Other graminoids present on established prairie dog towns include *Schedonnardus paniculatus, Poa fendleriana*, and *Nassella viridula*. They rarely contribute greater than 5% foliar cover, unless it is a less densely populated colony, then the cover values increase for these species. Forbs generally contribute less than 5% to the foliar cover; those species commonly associated with these disturbed sites include *Argentina anserina, Melilotus officinalis*, *Antennaria* sp., and *Achillea millefolium*. Ground cover is typically 60–90% bare soil and small gravel, with the remainder in herbaceous litter.

Prairie dog colonies supporting fringed sagewort disturbed vegetation show a high level of reflectance and appear as white or light areas on aerial photography, with a pattern of stippling where the hole density is moderate to high. It is likely that most colonies fall below the project minimum mapping unit (0.5 ha) in size; however, some very large colonies occur immediately adjacent to the northern monument boundary and long the South Platte River drainage outside the monument.

Global Vegetation: Not applicable

Global Dynamics: Not applicable

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Bouteloua gracilis*
Forb	*Achillea millefolium, Antennaria* sp.

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida, Chrysothamnus viscidiflorus*
Graminoid	*Bouteloua gracilis, Nassella viridula*
Forb	*Argentina anserine*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank:

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Artemisia frigida – Bouteloua gracilis* Dwarf-shrubland is the result of disturbance by prairie dogs, and it is distributed according to soils appropriate for burrowing activity. These soils are deeper and are located in stream valleys, drainages, swales, and gentle slopes within the monument. Dwarf-shrub density is typically related to the age (permanence) of the colony at a particular site. On private land adjacent to the southern monument boundary, an increase in this dwarf-shrubland resulted from livestock grazing pressure.

Global Range: Not applicable

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 47, 79
Classification Confidence: 3 **Identifier:** To be determined.
REFERENCES:

III.B.2.N.?. JAMESIA AMERICANA ROCK OUTCROP SHRUBLAND ALLIANCE

Waxflower Rock Outcrop Shrubland Alliance

JAMESIA AMERICANA ROCK OUTCROP SHRUBLAND

Waxflower Rock Outcrop Shrubland

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This rock outcrop shrubland occupies nearly every outcrop, regardless of size. Many of these sites are small, but the best examples grow from very large cliff faces on the upper shoulders of large hills. The slopes are steep (30–60%) and a few appear vertical. The aspect is predominantly southerly, but a few western exposures occur (150^o-270^o). The exposures are large Pikes Peak granite boulders that have sometimes weathered and cracked. The common shrubs grow within the cracks on the rocks and around the base of the rocks where accumulations of small gravel and soil occur.

Global Environment: Not applicable

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This shrubland is relatively sparse because of the large boulders that are strewn on the landscape or appear as outcropping bedrock. Often, the lichens covering these rocks provide large amounts of foliar cover, at times from 30–60%. Typically, the dominant shrubs are from 1–2 m in height and provide foliar cover from approximately 10–25% across the rock outcrops. *Jamesia americana*, *Rubus deliciosus*, and *Ribes cereum* shrubs are always present, and lesser amounts of *Prunus virginiana*, *Cercocarpus montanus*, and *Dasiphora fruticosa* are sometimes observed. Common graminoids associated with these dry exposures include *Muhlenbergia montana* and *Bouteloua gracilis*, which provide foliar cover from 5–10% on most outcrops. Because the rock outcrops shed water and direct runoff to small drainages and protected sites, it is not unusual to have some more mesic graminoid species present, including *Deschampsia caespitosa*, *Bromus inermis*, and *Poa pratensis*. A few moist, protected sites support ferns, e.g., *Woodsia* spp. and *Dryopteris filix-mas*. Forbs rarely contribute more than 1–2% foliar cover on the rock outcrop formations and a variety are present. Non-vegetative cover within rock outcrops is typically that of boulders, small rock, and bare soil, which approach 55–95% ground cover values. *Jamesia americana* shrubs often grow at the base of some boulders and drape around the sides much like a curtain, resulting in only a minor foliar cover value for the shrub.

Rock outcrops are readily observable as light or white spots on the aerial photography, both true color and CIR, because of reflectance. Many of the outcrops are small, not much more than one to several boulders, and under the minimum mapping unit (0.5 ha).

Global Vegetation: Not applicable

Global Dynamics: Not applicable

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Jamesia americana, Rubus deliciosus, Ribes cereum*
Graminoid	*Muhlenbergia montana, Bouteloua gracilis*
Forb	*Argentina anserine*

Global

Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Shrub	*Jamesia americana, Rubus deliciosus, Ribes cereum, Prunus virginiana, Cercocarpus montanus*
Graminoid	*Muhlenbergia montana, Bouteloua gracilis, Festuca arizonica*
Forb	*Argentina anserina, Phacelia heterophylla*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Stratum	**Species**

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: G?.

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: *Jamesia americana* Rock Outcrop Shrubland occupies Pikes Peak granite boulder fields exposed on south- and west-facing slopes of large hills. The most prominent of these occur on the hill north of the Hornbek Homestead and the hill east of the visitors center. The recorded elevation range for the type was approximately 8300-8750 feet on very steep, rapidly drained slopes (30–60%).

Global Range: Not applicable

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plots 33, 43, 91
Classification Confidence: 3 **Identifier:** To be determined
REFERENCES:

V.?.5.N.?. HORDEUM JUBATUM SEMI-NATURAL HERBACEOUS ALLIANCE

Foxtail Barley Semi-natural Herbaceous Vegetation Alliance

HORDEUM JUBATUM SEMI-NATURAL HERBACEOUS VEGETATION

Foxtail Barley Semi-natural Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

Florissant Fossil Beds NM Environment: This exotic grass forms a nearly pure stand only in a dried livestock pond on a Grape Creek tributary, south of Lower Twin Rock Road, in the southeastern portion of the monument. *Hordeum jubatum* otherwise persists as scattered individual plants along the margins of emergent wetlands.

Global Environment: Not applicable

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This sparse, exotic grassland occupied a dried livestock pond, where *Hordeum jubatum* and *Beckmannia syzigachne*, both less than 0.5 m tall, provided approximately 5% vegetative cover. Two species of *Chenopodium (leptophyllum, album)* account for approximately 10% vegetative cover, and *Amaranthus retroflexus, Taraxacum officinale, Polygonum lapathifolium (= Persicaria lapathifolia),* and *Glaux maritima* are also present and provide an additional 10% vegetative cover. The ground cover consisted of bare soil within the bottom of the pond, possibly sediments carried in from upland pastures and agricultural land.

This dry livestock pond represents the only stand of *Hordeum jubatum* observed within the monument; another dry pond just west of the Lower Twin Rock Road junction with Teller County 1 was unvegetated. The aerial photo signature was black, because the pond was holding water at the time of the overflight.

Global Vegetation: Not applicable

Global Dynamics: Not applicable

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Hordeum jubatum*
Forb	*Chenopodium leptophyllum, Glaux maritima*

Global

Stratum	Species

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	Species
Graminoid	*Hordeum jubatum, Beckmannia syzigachne*
Forb	*Chenopodium leptophyllum, Glaux maritime*

Global

Stratum	Species

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	Species

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank:

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: Only one stand of *Hordeum jubatum* was observed growing in the bottom of a dried livestock pond, within a Grape Creek tributary south of Lower Twin Rock Road, in the southeastern portion of the monument.

Global Range: Not applicable

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 16.
Classification Confidence: 3 **Identifier:** Not determined.
REFERENCES:

V.A.5.N.?.??. PASCOPYRUM SMITHII – NASSELLA VIRIDULA HERBACEOUS VEGETATION ALLIANCE [PROVISIONAL]

Western Wheatgrass – Green Needlegrass Herbaceous Vegetation Alliance

PASCOPYRUM SMITHII – NASSELLA VIRIDULA HERBACEOUS VEGETATION [PROVISIONAL]

Western Wheatgrass – Green Needlegrass Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: The largest, nearly pure stand of this type occupies the deeper, silty clay soils of the Grape Creek floodplain, second terrace. Elsewhere, it is subdominant to introduced species such as *Bromus inermis*, *Poa pratensis*, and *Linaria vulgaris*, or it is intermixed with native species, including *Juncus balticus* and *Festuca arizonica*. These sites occur along upper floodplain terraces, in moist swales, and on toeslopes of hills and ridges where silty clay soils occur.

Global Environment: Not applicable

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: This potentially introduced grassland of native species is characterized by mixed stands of *Pascopyrum smithii, Nassella viridula, Bouteloua gracilis*, and *Artemisia frigida*. Only a portion of the community along Grape Creek northwest of the Hornbek Homestead site consists of a nearly pure stand of *Pascopyrum smithii*, however, it is very short (less than 0.5 m tall), while the associated *Nassella viridula* is between 0.5–1.0 m tall. Vegetative cover was between 60-70%, and litter completely covered the ground surface in the floodplain terrace stand sampled. At other locations, the *Pascopyrum smithii* and *Nassella viridula* stands are very small and often interspersed with other species, including *Bromus inermis, Linaria vulgaris*, and *Juncus balticus*. This association occupies the deeper silty clay soils of swales and on floodplain terraces.

This association occurred naturally within Badlands National Park in South Dakota on silty clay soils of plains, small ridges, and south-facing slopes (Von Loh et al. 1999).

Global Vegetation: Not applicable

Global Dynamics: Not applicable

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Dwarf-shrub	*Artemisia frigida*
Graminoid	*Pascopyrum smithii, Nassella viridula, Bouteloua gracilis, Agropyron cristatum*
Forbs	*Linaria vulgaris*

Global

Stratum	**Species**
Graminoid	*Pascopyrum smithii, Nassella viridula*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Graminoid	*Pascopyrum smithii, Nassella viridula*
Dwarf-shrub	*Artemisia frigida*

Global

Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
Pascopyrum smithii – Nassella viridula Herbaceous Vegetation

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GW

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This association is best represented on the floodplain terrace (second terrace) of Grape Creek, northwest of the Hornbek Homestead site. This site contained the largest stand observed (approximately 0.1 ha); it was thought to be introduced within the monument (Edwards and Weber 1990). Smaller stands occur in swales and along upper wetland margins, but these are rarely pure stands, rather they are mixed with other native and introduced species.

Global Range: Not applicable

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: *Pascopyrum smithii* is reported to be planted at FLFO.
Classification Confidence: **Identifier:** Not determined
REFERENCES: Von Loh, J., D. Cogan, J. Butler, D. Faber-Langendoen, D. Crawford, and M. Pucherelli. 1999. USGS-NPS Vegetation Mapping Program, Badlands National Park, South Dakota. USBR Technical Service Center, Technical Memorandum No. 8260-00-02. Denver, CO.

V.B.2.N.a. CIRSIUM ARVENSE / MIXED GRAMINOIDS HERBACEOUS VEGETATION [PROVISIONAL]

Canada Thistle / Mixed Graminoids Herbaceous Vegetation Alliance

CIRSIUM ARVENSE – WEEDY FORBS HERBACEOUS VEGETATION

Canada Thistle - Weedy Forbs Exotic Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: This Canada thistle type is widely naturalized in the northern United States and Canada. Stands occur on a variety of open disturbed habitats, including pastures, ditches, bottomlands, and waste areas. The vegetation is dominated by medium-tall (0.5-1 m) forbs. The dominant forb is *Cirsium arvense*, a naturalized species from Eurasia. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (= Stipa comata)*, as well as others.

Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

Florissant Fossil Beds NM Environment: Patches of *Cirsium arvense* occur throughout the monument, occupying floodplain terraces, bottoms of moist swales, livestock watering pond margins, and depressions remaining from breached livestock watering ponds. Most stands invaded sites with human or natural disturbance, and are continually disturbed by pocket gopher activity in extant stands. The monument is making extensive efforts to control the spread and eliminate current stands of *Cirsium arvense* by mowing and applying herbicides, among other management activities.

Global Environment: Stands occur on a variety of open disturbed habitats, including ditches, bottomlands, waste areas, and similar sites.

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: Stands or patches of *Cirsium arvense* are dense and grow to 0.5–1.0 m tall. They occupy nearly flat slopes in mesic sites of all aspects. *Cirsium arvense* contributes from 55–80% vegetative cover within the type, which contains a high litter value of 95–100%. Most stands support from 75–100% total vegetative cover. On most sites pocket gopher activity was moderate to high, continually disturbing the soil within the patches. The most common native species found in the dense Canada thistle stands are *Juncus balticus* and *Achillea millefolium*, which typically contribute from 1–5% herbaceous cover. In one palustrine wetland stand, *Carex utriculata* contributed approximately 40% aerial cover and the stand was classified under *Carex utriculata* Herbaceous Vegetation. Typically associated exotic species include *Poa pratensis, Bromus inermis, Elymus repens (= Elytrigia repens), Thlaspi arvense*, and *Linaria vulgaris*. At least some of the stands of *Cirsium arvense* appear to occupy areas with historic intense livestock use, as is observed around watering tanks, salt blocks, and holding pens.

Cirsium arvense stands are being actively managed at Florissant Fossil Beds NM, by mowing and herbicide application. The aerial photo signature ranges from dark green to black on true color images.

Global Vegetation: The type is dominated by medium-tall (0.5–1.0 m) forbs. The dominant forb is *Cirsium arvense*, a naturalized species from Eurasia. Other exotic weedy species may also occur in the stands, but native species are generally less than 10% herbaceous cover.
Global Dynamics:

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Cirsium arvense, Linaria vulgaris*
Graminoids	*Juncus balticus, Poa pratensis*

Global

Stratum	**Species**
Forb	*Cirsium arvense*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Cirsium arvense, Achillea millefolium*
Graminoid	*Juncus balticus, Poa pratensis*

Global

Stratum	**Species**
Forb	*Cirsium arvense*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
Cirsium arvense – Weedy Forb Great Plains Herbaceous Vegetation

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GW

Global Classification Comments: The stands at Florissant most closely fit this association that has been described for the midwestern United States. At Florissant native and introduced graminoid species co-occur with the *Cirsium*, but these communities are very similar to those found throughout the Midwestern U. S. and into Colorado.

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This type is generally distributed as patches and small stands along creeks and mesic swales throughout the monument, especially along Grape Creek. It usually occurs as small patches, <0.25 ha, on floodplain terraces, moist swale bottoms, and around old livestock watering ponds.

Global Range: This type is widely naturalized in the northern United States and Canada.
Nations: US
States/Provinces: ND, SD, CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 68
Classification Confidence: **Identifier:** CEGL005260
REFERENCES: Von Loh, J., D. Cogan, J. Butler, D. Faber-Langendoen, D. Crawford, and M. Pucherelli. 2000. USGS-NPS Vegetation Mapping Program, Theodore Roosevelt National Park, North Dakota. USBR Technical Service Center, Technical Memorandum No. 8260-00-04. Denver, CO.

V.B.2.N.a. LINARIA VULGARIS, CIRSIUM ARVENSE – MIXED FORBS HERBACEOUS ALLIANCE

Butter-and-Eggs / Mixed Graminoids Semi-natural Herbaceous Vegetation Alliance [Provisional]

LINARIA VULGARIS / MIXED GRAMINOIDS SEMI-NATURAL HERBACEOUS VEGETATION [PROVISIONAL]

Butter-and-Eggs / Mixed Graminoids Semi-natural Herbaceous Vegetation [Provisional]

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

Florissant Fossil Beds NM Environment: *Linaria vulgaris* forms dense stands or patches, typically less than 0.25 ha in size, on upper floodplain terraces of flowing streams and in the bottom of moist swales. Groundwater is usually present within 25–50 cm of the soil surface. The distribution of *Linaria vulgaris* is generally at the lower elevations in drainages throughout the monument, where it occurs sporadically in patches with *Dasiphora fruticosa, Juncus balticus, Bromus inermis,* and *Cirsium arvense*.

Global Environment: Not applicable

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: *Linaria vulgaris* forms dense, but small, stands in association with *Dasiphora fruticosa*, *Juncus balticus*, *Bromus inermis*, and *Cirsium arvense*, among others. It is easily observed later in the growing season because of its medium-yellow-colored flowers. This exotic forb is between 0.5 and 1 m tall and may provide foliar cover from 50–55% in each patch. It is usually a component of another moist soil plant community. In one stand sampled, *Juncus balticus* was present at approximately 40% foliar cover and *Bromus inermis* at approximately 5% foliar cover; the plot was assigned to *Juncus balticus* Herbaceous Vegetation (CEGL001838). The ground cover is typically dense with litter, usually from 90–100% and up to 5 cm thick. Stands occur on nearly flat slopes of floodplain terraces and at nearly all aspects. Stands of *Linaria vulgaris* are being actively managed by monument staff, using a combination of mowing and herbicide application to stress the stands and to reduce seed production.

The aerial photo signature for stands of *Linaria vulgaris* are dark gray to black on true color photos.

Global Vegetation: Not applicable

Global Dynamics: Not applicable

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Short Shrub	*Dasiphora fruticosa*
Forb	*Linaria vulgaris*
Graminoid	*Juncus balticus, Bromus inermis*

Global

Stratum	**Species**
Forb	*Linaria vulgaris*

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Linaria vulgaris, Cirsium arvense*
Graminoid	*Juncus balticus, Bromus inermis, Elymus repens*

Global

Stratum	**Species**
Forb	*Linaria vulgaris*

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global

Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:
Cirsium arvense Mixed Forbs Herbaceous Alliance

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank: GW

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: This association is represented by small stands or patches along several drainages and moist swales in the monument, particularly along Grape Creek and its tributaries. The small stands occupy upper floodplain terraces, particularly oxbow bends, to the ecotone with upland vegetation.

Global Range: Not applicable

Nations: US
States/Provinces: CO

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: This was represented by one stand.
Classification Confidence: **Identifier:** Not determined
REFERENCES:

V.B.2.N.?. PARONYCHIA SESSILIFLORA HERBACEOUS ALLIANCE [PROVISIONAL]

Nailwort Herbaceous Vegetation Alliance

PARONYCHIA SESSILIFLORA HERBACEOUS VEGETATION [PROVISIONAL]

Nailwort Herbaceous Vegetation

ELEMENT CONCEPT

GLOBAL SUMMARY: Not applicable

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Upland

Florissant Fossil Beds NM Environment: This community occupies a shallow, northwest-facing (294^{o}) scrape, covering approximately 0.25 hectare on a moderate slope of approximately 6%. The scrape was sufficiently deep to remove the topsoil, a dark gray layer supporting *Festuca arizonica* grassland around the disturbed site. The depth of the scrape ranged from a few centimeters to approximately 1m deep, and it contained fossilized tree fragments, broken pieces of shale, and crushed granite, in addition to gravelly soil.

Global Environment: Not applicable

VEGETATION DESCRIPTION

Florissant Fossil Beds NM Vegetation: The nailwort community is sparse, with approximately 10% vegetative cover. It is a collection of native, pioneering plants growing from coarse gravel subsoil exposed by excavation a number of years ago. It is unique, representing the only example of this land-use type observed, and it may provide a key to succession in similar areas for the most pioneering forb, dwarf-shrub, grass, and tree species. A few small *Pinus ponderosa* trees are present along with *Ericameria parryi, Artemisia frigida,* and *Gutierrezia sarothrae* dwarf-shrubs scattered across the scrape. The cespitose plants *Paronychia sessiliflora, Hymenoxys richardsonii, Cryptantha thyrsiflora,* and *Antennaria* sp. were scattered but common across the site. The grasses *Festuca arizonica, Koeleria macrantha, Elymus elymoides,* and *Bouteloua gracilis* were also present, but sparse. All of the dwarf-shrubs, forbs, and bunch grasses exhibit pedestaling, an indication of on-going erosion from the site, principally from raindrop splash and sheet run-off.

The aerial photo signature is white, from reflectance off of exposed soil.

Global Vegetation: Not applicable

Global Dynamics: Not applicable

MOST ABUNDANT SPECIES

Florissant Fossil Beds NM

Stratum	Species
Dwarf-shrub	*Ericameria parryi*
Forb	*Paronychia sessiliflora, Hymenoxys richardsonii, Oxytropis splendens*
Graminoid	*Festuca arizonica*

Global
Stratum	**Species**

CHARACTERISTIC SPECIES

Florissant Fossil Beds NM

Stratum	**Species**
Forb	*Paronychia sessiliflora, Hymenoxys richardsonii, Oxytropis splendens*
Graminoid	*Festuca arizonica*
Dwarf-shrub	*Ericameria parryi*
Tree	*Pinus ponderosa*

Global
Stratum	**Species**

OTHER NOTEWORTHY SPECIES

Florissant Fossil Beds NM

Global
Stratum	**Species**

GLOBAL SIMILAR ASSOCIATIONS:

GLOBAL STATUS AND CLASSIFICATION COMMENTS

Global Conservation Status Rank:

Global Classification Comments:

ELEMENT DISTRIBUTION

Florissant Fossil Beds NM Range: The nailwort community was found on only one site, in close proximity to the water pipeline corridor, west of CR1. A shallow scrape that had been excavated historically was present, presumably in a search to find fossil rocks, possibly to remove a fossil trunk, or simply a gravel borrow pit.

Global Range: Not applicable

Nations:
States/Provinces:

ELEMENT SOURCES

Florissant Fossil Beds NM Inventory Notes: Plot 21
Classification Confidence: **Identifier:** Not determined.
REFERENCES:

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APPENDIX H:
Photo Interpretation Visual Key

USGS-NPS Vegetation Mapping Program
Florissant Fossil Beds National Monument, Colorado

Introduction

This document is a photo interpretation and visual key to map units for the Florissant Fossil Beds National Monument Vegetation Mapping Project. Its purpose is to:

- Provide ground photo images for each map unit;
- Describe the link between each map unit and the U.S. National Vegetation Classification (USNVC);
- Provide visual examples of each map unit with aerial photographs and delineated overlays;
- Provide descriptions for the visual examples;
- Provide an area report for each map unit;
- Provide accuracy assessment results for each map unit.

This key does not attempt to show an exhaustive representation for all variations within each map unit; only the most common or significant representations are included. These should be sufficient to give the user a feel for the imagery and an understanding of the relationships between classification and mapping.

Organization of the Photo Interpretation Visual Key

This key presents descriptions and illustrations for most map units used in the Florissant Fossil Beds National Monument Vegetation Mapping Project. Some map units that only exist below the 0.5-hectare minimum mapping unit have been omitted. Each map unit section begins with a presentation of the map unit name and representative ground photos of the map unit. A paragraph describes the link between the map unit and the vegetation association(s) within the USNVC. A general description is given of the vegetation association(s).

Several images of aerial photograph follow. The images are predominantly scanned portions of the natural color source photograph prints with the matching interpreted overlays. Where appropriate, ancillary color infrared (CIR) and black-and-white aerial photograph prints have also been included. These photographic images result in an approximate scale of 1: 9000 for the natural color and CIR photographic prints, and 1:6000 for the black-and-white photographic prints, when printed using an 8.5 x 11-inch format. Each image reveals the photo interpreter’s polygon outlines and the map code of the referenced map unit. An accompanying map shows the image’s approximate geographic location. With each image, a short explanation describes the map unit of the featured polygon. This description includes color(s) and texture(s), and when applicable, the coverage density and pattern, and height of the vegetation. Other information about the map unit or the polygon is also presented if it adds to better understanding or recognition of that particular map unit.

Lastly, each map unit has an area report and results of the accuracy assessment. The area report includes the number of polygons, hectares, acres, and the average size. Accuracy assessment results for producers’ and users’ accuracy and the confidence intervals are also given.

SDF - Colorado Blue Spruce - Douglas-fir Forest (Map Unit 3)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Colorado Blue Spruce - Douglas-fir Forest Map Unit (SDF, Map Unit 3) represents a combination of the *Picea pungens / Juniperus communis* (Colorado Blue Spruce / Common Juniper) Forest Association and the *Pseudostuga menziesii / Juniperus communis* (Douglas-fir / Common Juniper) Forest Association.

Picea pungens / Juniperus communis (Colorado Blue Spruce / Common Juniper) Forest Association - These forest stands occupy moderate to steep drainages, toeslopes, and midslopes throughout the monument at approximately 8280-8880 feet in elevation. The slope exposures are generally northeast through northwest; however, some exposures that range into the southeast and southwest are possible because of drainage orientation. Stands receive the maximum amount of snow accumulation in winter, due to the location, stand height, and stand density, however, drainage from these stands is rapid during snowmelt or rainfall events.

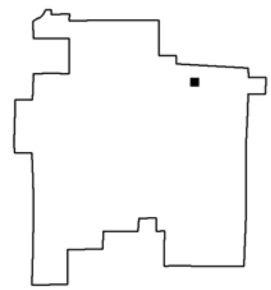
Pseudostuga menziesii / Juniperus communis (Douglas-fir / Common Juniper) Forest Association - These forests occupy moderate to steep slopes, merging into *Pinus ponderosa / Festuca arizonica* (Ponderosa Pine / Arizona Fescue) Woodland on upper stand margins and *Picea pungens / Juniperus communis* (Colorado Blue Spruce / Common Juniper) Forest on lower stand margins. They are found on north- and west-facing slopes, in drainages, along ridges, and other mesic sites within the monument. Most stands occur at mid to high elevations (8525–8875 feet) and typically occupy the entire slope, from the upper toeslope to the ridge or hill shoulder.

SDF - Colorado Blue Spruce - Douglas-fir Forest (Map Unit 3)

Photo Signatures

The Blue spruce / common juniper Forest and Douglas fir/ common juniper associations are difficult to distinguish from one another. In many cases there is almost an even mix of the two species within a stand, in terms of canopy height and tree density. In the natural color aerial photography, SDF appears as dark green with a medium to coarse mottled texture. The canopy is 60-75% closed and of varying dispersion with occasional small openings. The tree heights are 20-35 meters. Photo SDF-1 was taken in September 1996 and SDF-2 was taken in August 1995.

Photo SDF-1



Location of **SDF-1** within National Monument

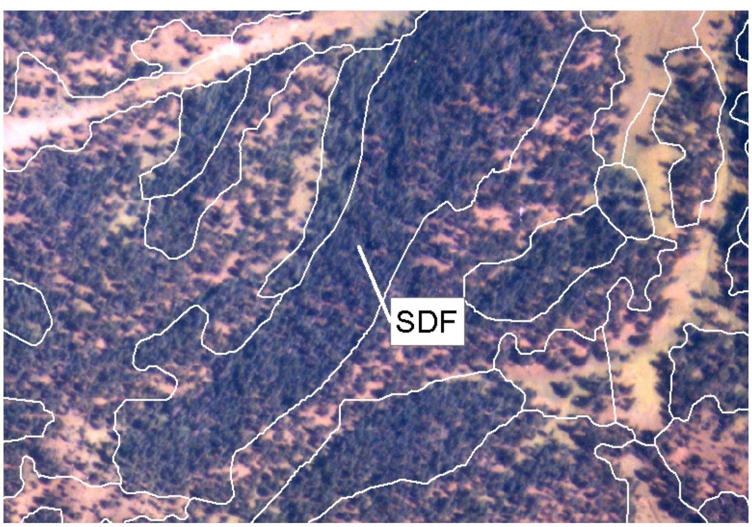
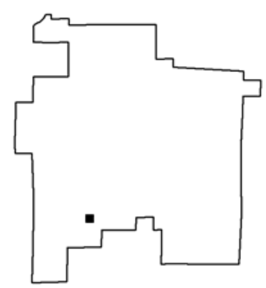


Photo SDF-2



Location of **SDF-2** within National Monument

SDF - Colorado Blue Spruce - Douglas-fir Forest (Map Unit 3) Continued

Area Report for SDF Map Unit
Number of Polygons: 69
Number of Hectares: 291.6
Number of Acres: 720.3
Average Size: 4.2 hectares, 10.4 acres

Accuracy Assessment Results for SDF Map Unit
The Colorado Blue Spruce - Douglas-fir Forest Map Unit was assessed at 75% for producers' accuracy (confidence interval 66-84%) and at 92% users' accuracy (confidence interval 85-98%).

SDAF – Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest (Map Unit 4)

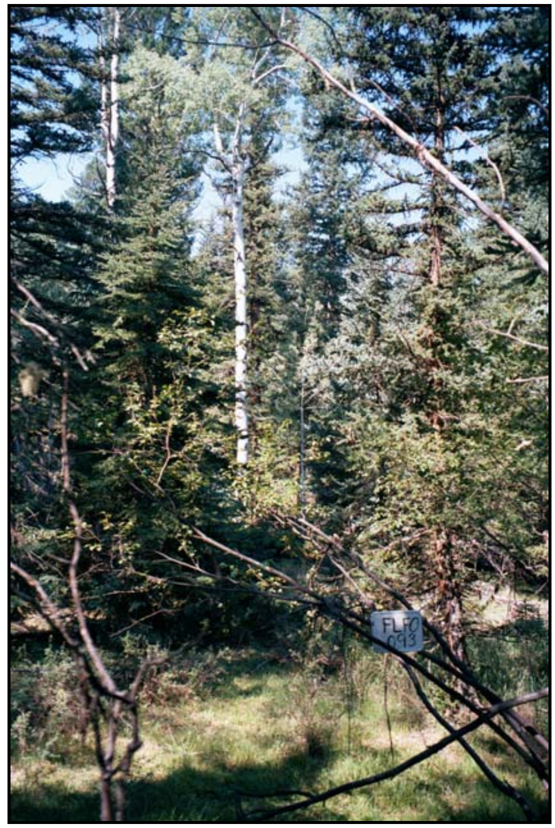


Photo credit: Jim Von Loh **Photo credit: Jim Von Loh**

The Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest (SDAF, Map Unit 4) represents a combination of the *Picea pungens / Juniperus communis* (Colorado Blue Spruce / Common Juniper) Forest Association, the *Pseudostuga menziesii / Juniperus communis* (Douglas-fir / Common Juniper) Forest Association, the *Populus tremuloides* (Quaking Aspen) Forest Alliance, and the *Populus tremuloides / Juniperus communis* (Quaking Aspen / Common Juniper) Forest Association.

This map unit occupies the north-facing sides of the intermittent and perennial drainages in the extreme southeastern part of the monument and increases in area outside the monument's boundaries to the east. The elevations range from 8680-8860 feet. It differs from the Colorado Blue Spruce - Douglas-fir Forest (SDF, Map Unit 3) and the Quaking Aspen Forest (AF, Map Unit 11) in the fact that there is a more even distribution of the coniferous and deciduous trees in SDAF. The other two map units are dominated by one or the other of the tree types.

SDAF – Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest (Map Unit 4) Continued

Photo Signatures

The associations are evenly mixed, although it is easy to distinguish the Quaking Aspen Forests from the Colorado Blue Spruce - Douglas-fir Forests. In the natural color aerial photography, the Quaking Aspen part of the SDAF appears as light green and the Colorado Blue Spruce - Douglas-fir part is dark green. In the color infrared aerial photography, the Quaking Aspen areas appear as dark red and the Colorado Blue Spruce - Douglas-fir areas appear as blue-black. In both types of photography, all associations have a coarse mottled texture. The canopy is nearly 100% closed and the tree heights are 20-35 meters. Photo SDAF-1 (natural color) was taken in September 1996 and SDAF-2 (color infrared) was taken in August 1983. Both photos are of the same location.

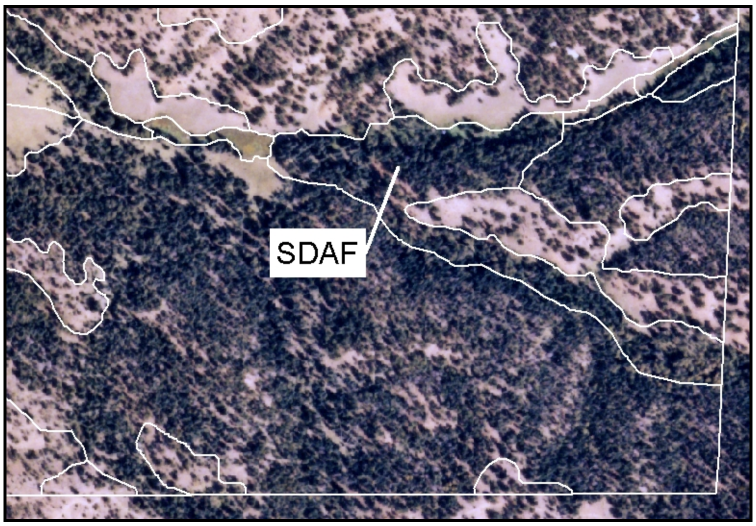
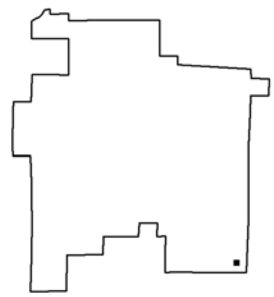


Photo SDAF-1



Location of **SDAF-1** within National Monument

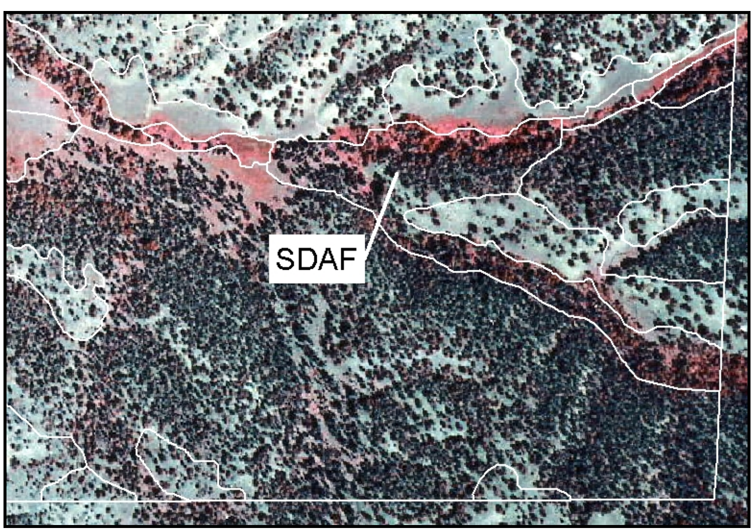
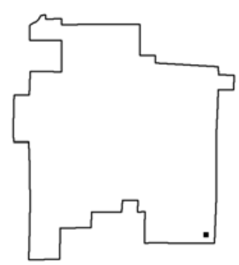


Photo SDAF-2



Location of **SDAF-2** within National Monument

SDAF – Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest (Map Unit 4) Continued

Area Report for SDAF Map Unit
Number of Polygons: 2
Number of Hectares: 4.1
Number of Acres: 10.1
Average Size: 2.1 hectares, 5.1 acre

Accuracy Assessment Results for SDAF Map Unit
The Colorado Blue Spruce - Douglas-fir - Quaking Aspen Forest Map Unit was assessed at 100% for producers' accuracy and at 100% users' accuracy.

BPW – Bristlecone Pine / Arizona Fescue Woodland (Map Unit 5)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Bristlecone Pine / Arizona Fescue Woodland (BPW, Map Unit 5) represents the *Pinus aristata / Festuca arizonica* (Bristlecone Pine / Arizona Fescue) Woodland Association.

This woodland occurs as only two stands, one on the northwest-facing slope of Fossil Stump Hill and the other on the northwest-facing slope of the large hill east of the Visitor's Center. A small clump (8 to 10 individuals) is present on the downstream portion of a livestock pond and dam, just south of Lower Twin Rocks Road. Individual trees are occasionally observed in other woodland types within the monument, primarily on the large hill east of the Visitor's Center.

These woodland stands occupy steep, erosive slopes that are at least partially composed of volcanic rock and soil weathered from volcanic rock. Stands grow from the toeslope to the slope shoulder, where they intermix with *Pinus ponderosa / Festuca arizonica* (Ponderosa Pine / Arizona Fescue) Woodland. The exposure is predominantly west to northwest, and the elevation is approximately 8350 feet for the two stands known in the monument.

BPW – Bristlecone Pine / Arizona Fescue Woodland (Map Unit 5) Continued

Photo Signatures

In the natural color aerial photography, BPW appears as dark green with a coarse mottled texture. The canopy is 25-30% closed and the tree heights are 10-15 meters. The signature closely resembles the Ponderosa Pine Woodland (PPW, Map Unit 7). The stands are relatively small and are considered a Park Special, so they are mapped even if below the minimum mapping unit of 0.5 hectares. Photo BPW-1 was taken in September 1996.

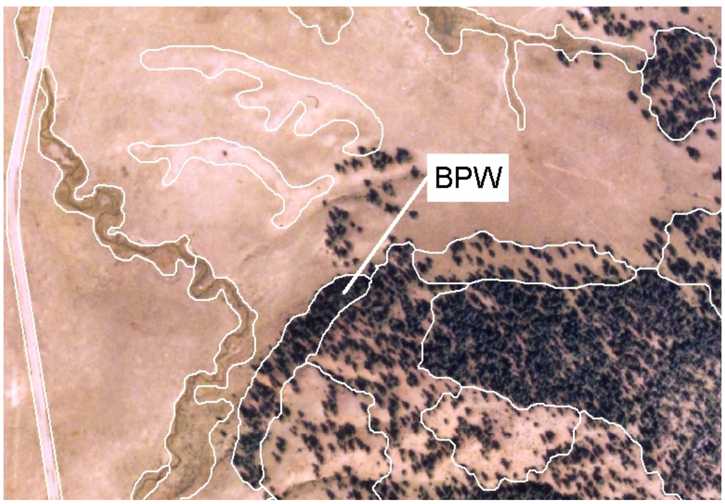
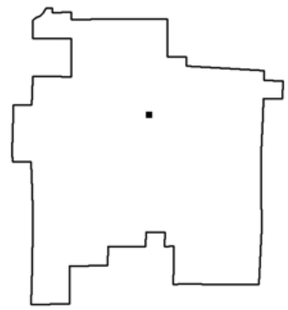


Photo BPW-1



Location of **BPW-1** within National Monument

Area Report for BPW Map Unit
Number of Polygons: 2
Number of Hectares: 1.2
Number of Acres: 3.0
Average Size: 0.6 hectares, 1.5 acres

Accuracy Assessment Results for BPW Map Unit
The Bristlecone Pine / Arizona Fescue Woodland Map Unit was assessed at 100% for producers' accuracy and at 100% users' accuracy.

PPW – Ponderosa Pine Woodland
(Map Unit 7)

Forest-like PPW **Photo credit: Jim Von Loh**

Forest-like PPW **Photo credit: Jim Von Loh**

The Ponderosa Pine Woodland (PPW, Map Unit 7) represents a combination of the *Pinus ponderosa / Festuca arizonica* (Ponderosa Pine / Arizona Fescue) Woodland Association and the *Pinus ponderosa / Cercocarpus montanus* (Ponderosa Pine / Mountain Mahogany) Woodland Association.

Woodland-like PPW **Photo credit: Jim Von Loh**

Woodland-like PPW **Photo credit: Jim Von Loh**

Pinus ponderosa / Festuca arizonica (Ponderosa Pine / Arizona Fescue) Woodland Association – This association is found on moderate to steep slopes that are at mid-elevations (8265-8600 feet). Open woodland-like stands are mostly oriented to the southeast and southwest. Dense forest-like stands occupy northeast- to northwest-facing slopes of small hills and ridges, ranging from the mid-slope to the toeslope. On larger hills and ridges, the same midslope habitat would be occupied by *Pseudotsuga menziesii / Juniperus communis* Forest, and the toeslope would likely support *Picea pungens / Juniperus communis* Forest.

PPW – Ponderosa Pine Woodland
(Map Unit 7) Continued

Pinus ponderosa / Cercocarpus montanus (Ponderosa Pine / Mountain Mahogany) Woodland Association –
This association occupies moderately steep slopes with south, east, and west exposures, ridgetops and adjacent upper slopes, and hilltops with a past logging history. It occurs from approximately 8400–8900 feet in elevation. The trees on these sites are heavily infested with mistletoe (*Arceuthobium americanum*), which leads to stunting.

Photo Signatures

In the forest-like part of the PPW, in the natural color aerial photography, the trees of appear as dark green with a coarse mottled texture. They are 15-20 m tall and have a canopy of nearly 100% closed.

In the woodland-like part of the PPW with a Festuca arizonica understory, in the natural color aerial photography, the trees appear as medium dark green dots with a coarse texture. They are 15-20 m tall, have a canopy of 20% closed, and form a random pattern of fairly evenly dispersed dots. The background grasses and ground appears as tan with a smooth texture.

In the woodland-like part of the PPW with a Cercocarpus montanus understory, in the natural color aerial photography, the trees appear as medium dark green dots with a coarse texture. Sometimes there is a slight gray cast in the heavily stressed areas. They are 10–15 m tall, have a canopy of 15–25% closed, and form a random pattern of fairly evenly dispersed dots. The shrubs appear as small gray dots with a medium texture. They are 1–2 m tall, have a canopy of 5–15% closed, and also form a random pattern of fairly evenly dispersed dots. The background grasses and ground appears as tan with a smooth texture.

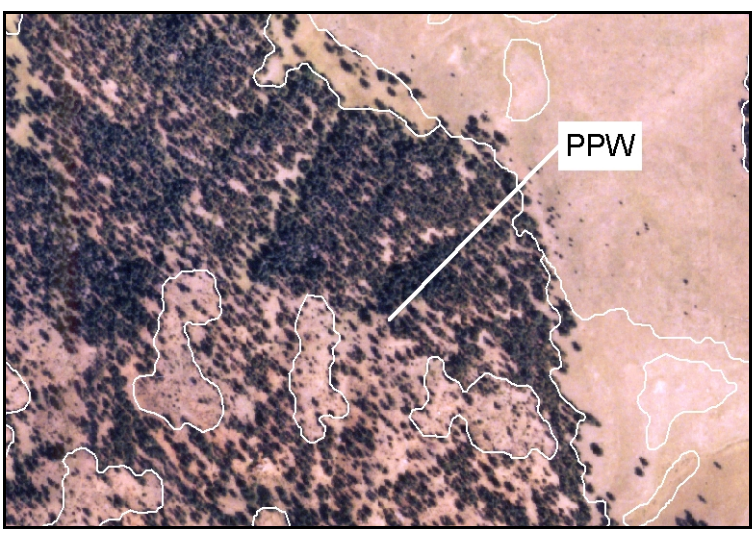
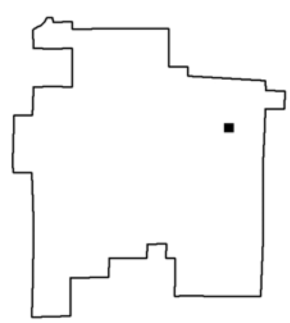


Photo PPW-1



Location of **PPW-1** within National Monument

Photo PPW-1 was taken in September 1996. It contains the forest-like PPW in the northern portion and the woodland-like PPW with a Cercocarpus montanus understory in the southern portion.

PPW – Ponderosa Pine Woodland (Map Unit 7) Continued

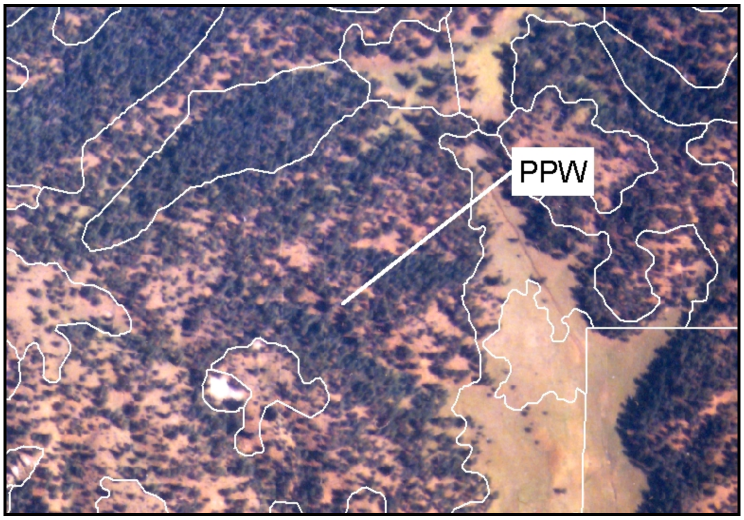
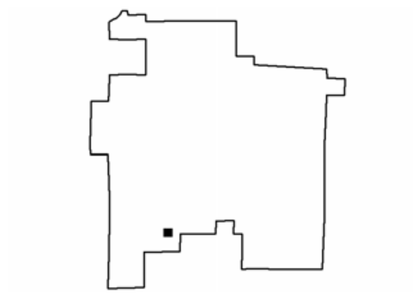


Photo PPW-2



Location of **PPW-2** within National Monument

Photo PPW-2 was taken in August 1995. It contains a mix of the forest-like PPW, the woodland-like PPW with a Festuca arizonica understory, and the woodland-like PPW with a Cercocarpus montanus understory.

Area Report for PPW Map Unit
Number of Polygons: 109
Number of Hectares: 915.5
Number of Acres: 2261.3
Average Size: 8.4 hectares, 20.7 acres

Accuracy Assessment Results for PPW Map Unit
The Ponderosa Pine Woodland Map Unit was assessed at 73% for producers' accuracy (confidence interval 67-80%) and at 85% users' accuracy (confidence interval 79-91%).

PPSBW – Ponderosa Pine / Smooth Brome Semi-natural Woodland (Map Unit 9)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Ponderosa Pine / Smooth Brome Semi-natural Woodland (PPSBW, Map Unit 9) represents the *Pinus ponderosa / Bromus inermis* (Ponderosa Pine / Smooth Brome) Semi-natural Woodland Association.

This map unit consists of native grasslands, formerly converted to exotic pasture grasses, predominantly *Bromus inermis*, that are being invaded by young *Pinus ponderosa* trees. The young trees occupy the pasture area adjacent to established woodland and forest stands, as an extension of those stands on slopes of approximately 5%. Stands of young ponderosa pine trees grow on all aspects at elevations around 8500 feet. The most extensive young tree stands occur north of the Boulder Creek drainage and west of the Hornbek Homestead.

PPSBW – Ponderosa Pine / Smooth Brome Semi-natural Woodland (Map Unit 9) Continued

Photo Signatures

In the natural color aerial photography, the trees of PPSBW appear as small dark green dots with a coarse texture. The background grasses appear as light green with a smooth texture. The trees form a random pattern of fairly evenly dispersed dots. The canopy is approximately 20% closed and the tree heights are 2-5 meters. These areas were disturbed historically to seed the smooth brome pasture, and it is also possible that some site leveling occurred. Photo PPSBW-1 was taken in August 1995.

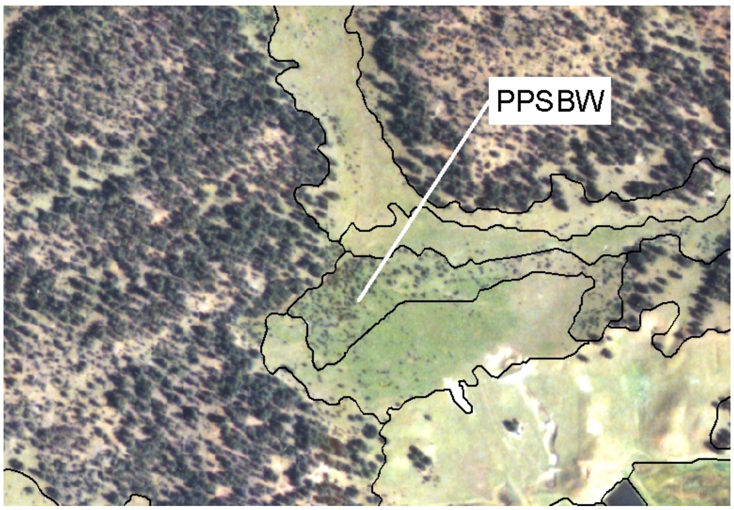
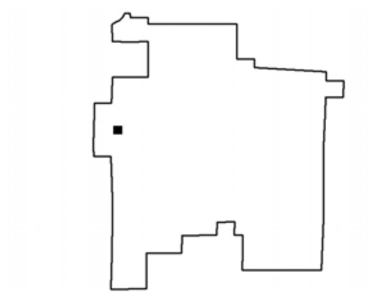


Photo PPSBW-1



Location of **PPSBW-1** within National Monument

Area Report for PPSBW Map Unit
Number of Polygons: 2
Number of Hectares: 3.5
Number of Acres: 8.6
Average Size: 1.8 hectares, 4.3 acres

Accuracy Assessment Results for PPSBW Map Unit
The Ponderosa Pine / Smooth Brome Semi-natural Woodland Map Unit was assessed at 67% for producers' accuracy and at 100% users' accuracy.

BAPW – Balsam Poplar Woodland (Map Unit 10)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Balsam Poplar Woodland (BAPW, Map Unit 10) represents the *Populus balsamifera* (Balsam Poplar) Woodland Park Special.

Only one very linear stand of this temporarily flooded woodland was observed in the monument. It occupies a reach of an unnamed, perennial drainage south of the footpath and east of the bridge on the trail in the northeastern portion of the monument. It is found in the stream channel on a small gravel deposit or bar of only 2% slope, and along both banks for nearly 500 meters.

BAPW – Balsam Poplar Woodland (Map Unit 10) Continued

Photo Signatures

In the natural color aerial photography, BAPW appears as light green, and in the color infrared aerial photography it appears as dark red. In both types of photography it has a medium mottled texture and a linear shape. The canopy is approximately 75 % closed and the tree heights range up to 20 meters. The signature closely resembles the Quaking Aspen Forest (AF, Map Unit 11). BAPW is considered a Park Special. Photo BAPW-1 (natural color) was taken in September 1996 and BAPW-2 (color infrared) was taken in August 1983. Both photos are of the same location.

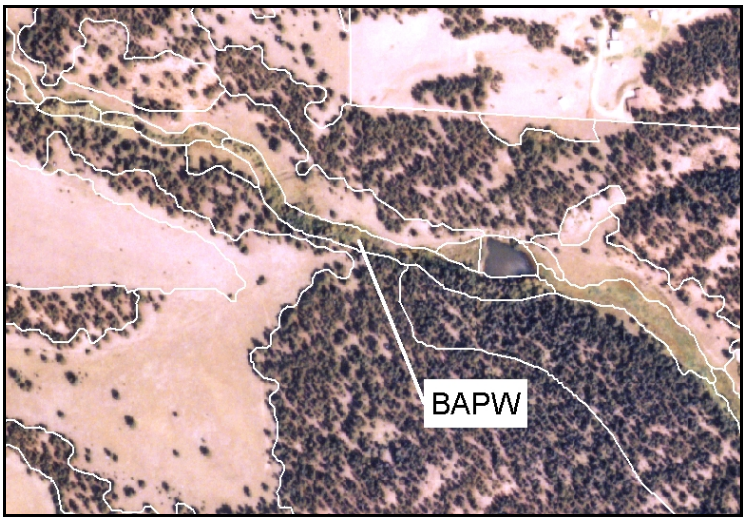
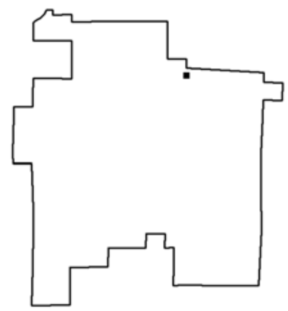


Photo BAPW-1



Location of **BAPW-1** within National Monument

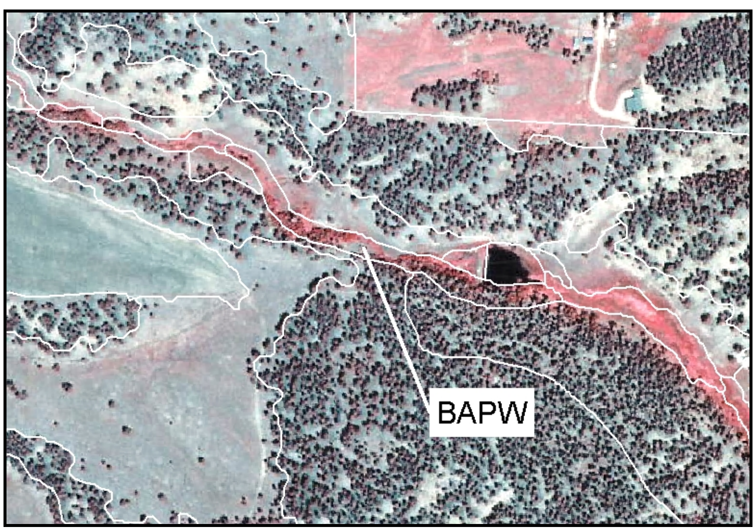
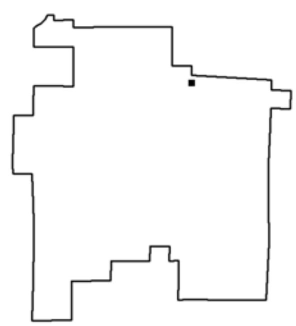


Photo BAPW-2



Location of **BAPW-2** within National Monument

BAPW – Balsam Poplar Woodland
(Map Unit 10) Continued

Area Report for BAPW Map Unit
Number of Polygons: 1
Number of Hectares: 0.9
Number of Acres: 2.2
Average Size: 0.9 hectares, 2.2 acres

Accuracy Assessment Results for BAPW Map Unit
The Balsam Poplar Woodland Map Unit was assessed at 100% for producers' accuracy and at 100% users' accuracy.

AF – Quaking Aspen Forest (Map Unit 11)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Quaking Aspen Forest (AF, Map Unit 11) represents a combination of *Populus tremuloides* (Quaking Aspen) Forest Alliance and the *Populus tremuloides* / *Juniperus communis* (Quaking Aspen / Common Juniper) Forest Association.

This map unit occupies mesic sites such as the heads of drainages, moist slopes along the margins of stands of *Picea pungens / Juniperus communis* (Colorado Blue Spruce / Common Juniper) Forest and *Pseudostuga menziesii / Juniperus communis* (Douglas-fir / Common Juniper) Forest, and some shallow drainages. Slopes are shallow to moderately steep. The aspects vary a great deal, but stands are more common on northeast to northwest exposures. Individual and small clones of quaking aspen are intermixed into many other forest and woodland types in the monument. The elevation range occupied includes that of the monument, from approximately 8450 feet to 8765 feet.

AF – Quaking Aspen Fprest (Map Unit 11) Continued

Photo Signatures

The Quaking aspen Forest Alliance and Quaking aspen / common juniper Forest Association are nearly impossible to distinguish from one another. In the natural color aerial photography, AF appears as light green, and in the color infrared aerial photography it appears as dark red. In both types of photography, it has a medium mottled texture. The canopy is 60-80% closed and the tree heights vary widely from 15-45 meters. The stands tend to have a rounded or oblong shape, and are relatively small. They are considered a Park Special and are mapped even if below the minimum mapping unit of 0.5 hectares. Photo AF-1 (natural color) was taken in September 1996 and AF-2 (color infrared) was taken in August 1983. Both photos are of the same location

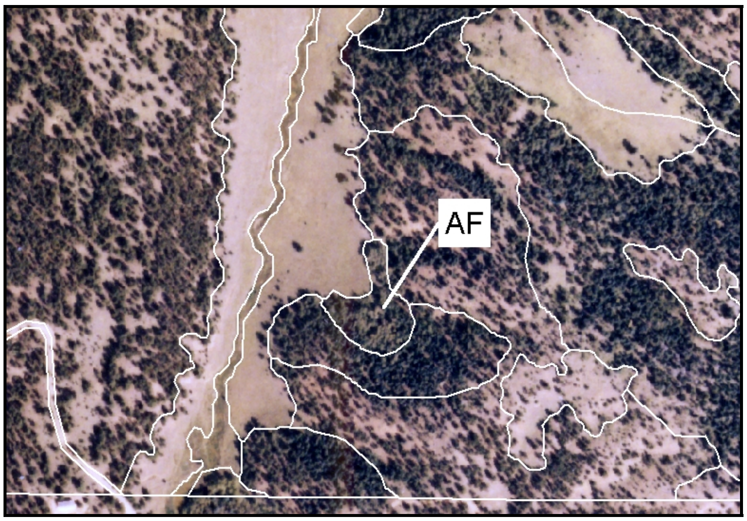
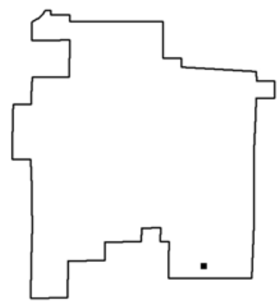


Photo AF-1



Location of **AF-1** within National Monument

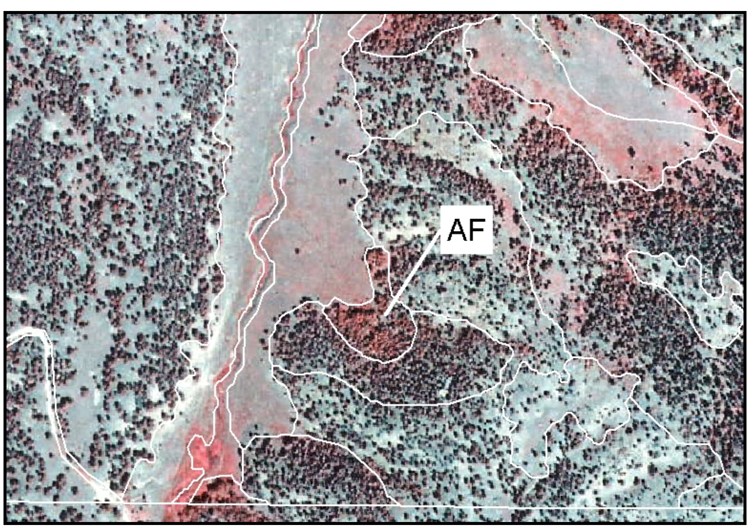
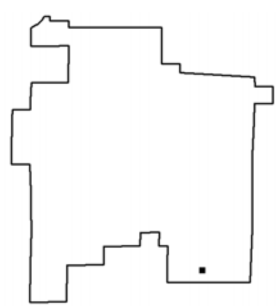


Photo AF-2



Location of **AF-2** within National Monument

AF – Quaking Aspen Forest (Map Unit 11) Continued

Area Report for AF Map Unit
Number of Polygons: 55
Number of Hectares: 28.0
Number of Acres: 69.1
Average Size: 0.5 hectares, 1.3 acres

Accuracy Assessment Results for AF Map Unit
The Quaking Aspen Forest Map Unit was assessed at 100% for producers' accuracy and at 77% users' accuracy (confidence interval 63-91%).

TAS – Thinleaf Alder Shrubland (Map Unit 14)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Thinleaf Alder Shrubland (TAS, Map Unit 14) represents the *Alnus incana* / Mesic Graminoids (Thinleaf Alder / Mesic Graminoids) Shrubland Association.

This shrubland occurs in small patches and linear stands (25–75 m in length) in only two minor drainages tributary to Grape Creek. Both drainages are on the eastern portion of the monument above 8500 feet. The drainages differ in that the northernmost drainage and upper southernmost are low-gradient and support stands of sedge and willow, while the lower portion of the southernmost drainage is steep, narrow, and incising. The stand located in the incised drainage portion is showing stress (stunted growth, many dead stems/shrub bases, and many new root sprouts), while those of more mesic sites appear healthy.

TAS – Thinleaf Alder Shrubland (Map Unit 14) Continued

Photo Signatures

In the natural color aerial photography, TAS appears as medium to dark green, and in color infrared aerial photography it appears as medium red. In both types of photography it has a medium texture and a linear shape. The shrubs are 5-15 meters in height, depending on the stand health and site location, and have a foliar cover of 35-45%. The signature closely resembles the Mountain Willow Shrubland (MWS, Map Unit 21). Photo TAS-1 (natural color) shows a healthy site and was taken in September 1996. TAS-2 (color infrared) was taken in August 1983. Both photos are of the same location.

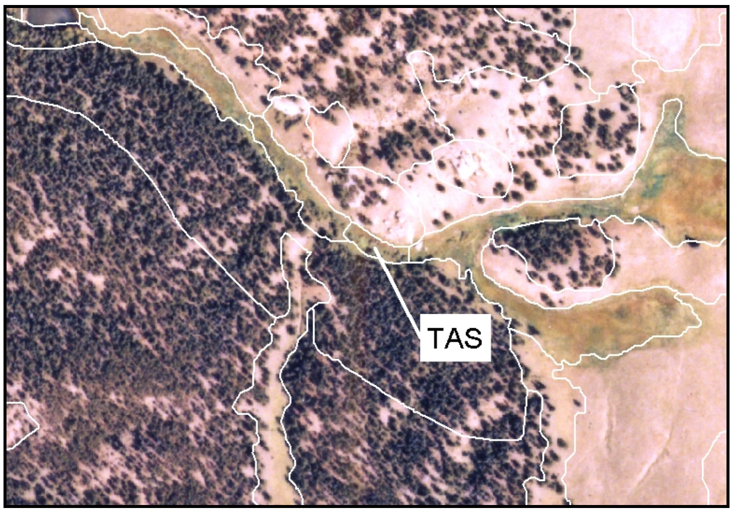
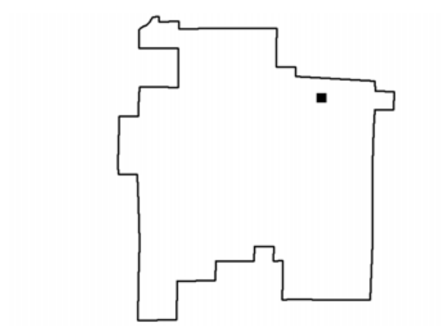


Photo TAS-1



Location of **TAS-1** within National Monument

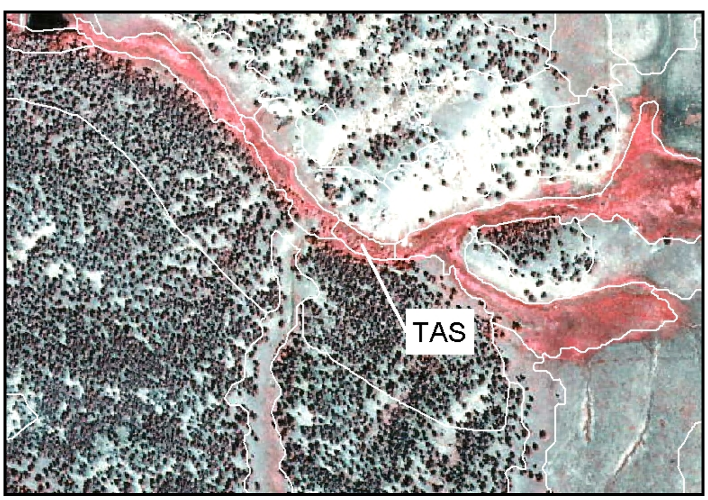
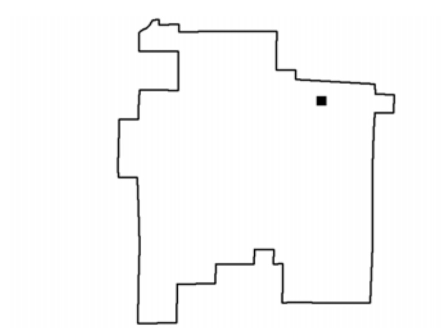


Photo TAS-2



Location of **TAS-2** within National Monument

TAS – Thinleaf Alder Shrubland (Map Unit 14) Continued

Area Report for TAS Map Unit
Number of Polygons: 3
Number of Hectares: 0.4
Number of Acres: 1.0
Average Size: 0.1 hectares, 0.3 acres

Accuracy Assessment Results for TAS Map Unit
The Thinleaf Alder Shrubland Map Unit was assessed at 100% for producers' accuracy and at 67% users' accuracy.

SSS – Silver Sagewort Dwarf-shrubland (Map Unit 15)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Silver Sagewort Dwarf-shrubland (SSS, Map Unit 15) represents the *Artemisia frigida / Bouteloua gracilis* (Silver Sagewort / Blue Grama) Dwarf-shrubland Association.

This association is the result of grazing and disturbance by prairie dogs as *Artemisia frigida* is unpalatable or less palatable. It is distributed according to soils appropriate for burrowing activity. These deeper soils are typically deposited in drainages, swales (interfluves), and along lower hill slopes, which are found at the lower and mid-elevations (8350–8650 feet) within the monument. The slopes are gentle and moderately well drained. The dwarf-shrub density is typically related to the age (permanence) of the colony at a particular site. Adjacent to the monument, this dwarf-shrubland not only occupies prairie dog towns, but also heavily grazed pastures in the vicinity of livestock watering ponds.

SSS – Silver Sagewort Dwarf-shrubland (Map Unit 15) Continued

Photo Signatures

This association is not distinctive in the natural color or color infrared aerial photography due to their coarser resolution and smaller scale. However, it can be distinguished using the black and white aerial photography. The disturbed soil next to the prairie dog burrows appears as small white dots against a light to medium gray background. The dots form a random pattern and are fairly evenly dispersed. The texture of all features is smooth. Prairie dog colonies that are densely occupied typically have vegetative cover values less than 40%. The majority of the ground cover is either bare or herbaceous litter. The dwarf-shrubs have a foliar cover of 20–40% and other low vegetation contributes only 5-40%. Photo SSS-1 and SSS-2 (both black and white) were taken in October 1997.

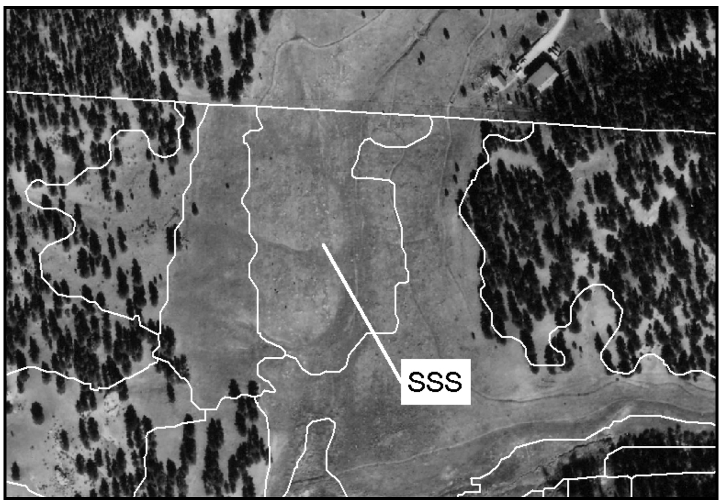
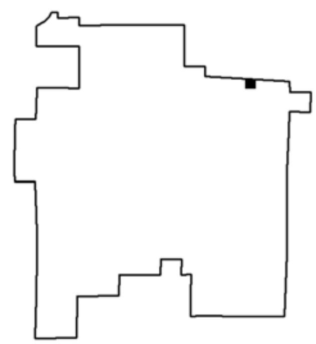


Photo SSS-1



Location of **SSS-1** within National Monument

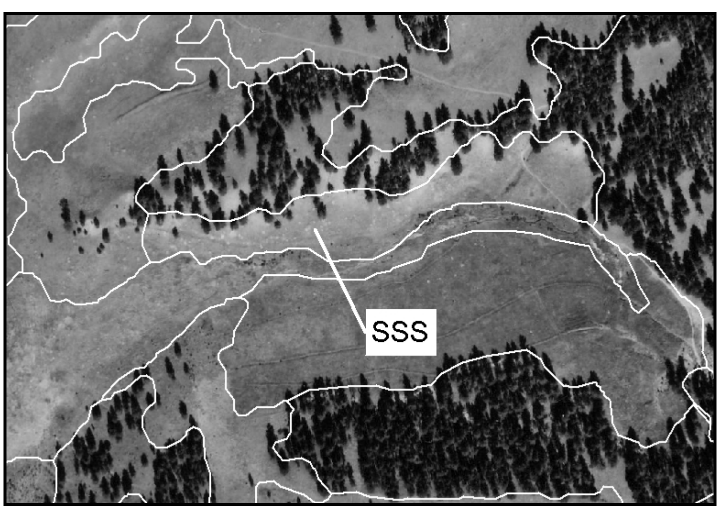
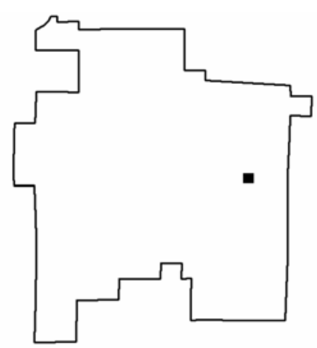


Photo SSS-2



Location of **SSS-2** within National Monument

SSS – Silver Sagewort Dwarf-shrubland (Map Unit 15) Continued

Area Report for SSS Map Unit
Number of Polygons: 10
Number of Hectares: 8.3
Number of Acres: 20.5
Average Size: 0.8 hectares, 2.1 acres

Accuracy Assessment Results for SSS Map Unit
The Silver Sagewort Dwarf-shrubland Map Unit was assessed at 87% for producers' accuracy (confidence interval 69-100%) and at 54% users' accuracy (confidence interval 35-73%).

MMS – Mountain Mahogany / Mountain Muhly Shrubland (Map Unit 16)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Mountain Mahogany / Mountain Muhly Shrubland (MMS, Map Unit 16) represents the *Cercocarpus montanus / Muhlenbergia montana* (Mountain Mahogany / Mountain Muhly) Shrubland Association.

This shrubland occupies gravelly substrate and rocky sites on the dry, upper slopes of hills and ridges at mid and high elevations throughout the monument. These slopes are steep, drain rapidly, and are typically oriented south to southeast, although a few ridges are more westerly trending. *Cercocarpus montanus* shrubs are scattered on these sites and the canopies rarely overlap. Often these stands occur within canopy breaks among ponderosa pine woodland stands of the same exposures.

MMS – Mountain Mahogany / Mountain Muhly Shrubland (Map Unit 16) Continued

Photo Signatures

In the natural color photography, the shrubs of MMS appear as small gray dots and in color infrared photography, they appear as small red dots. In both types of photography, they have a medium texture. They are 1–2 m tall, have a foliar cover of 10-30%, and form a random pattern of fairly evenly dispersed dots. In the natural color photography, the background grasses and ground appears as tan with a smooth texture. In color infrared photography, they appear as white to gray with a smooth texture. Photo MMS-1 (natural color) was taken in September 1996 and MMS-2 (color infrared) was taken in August 1983. Both photos are of the same location.

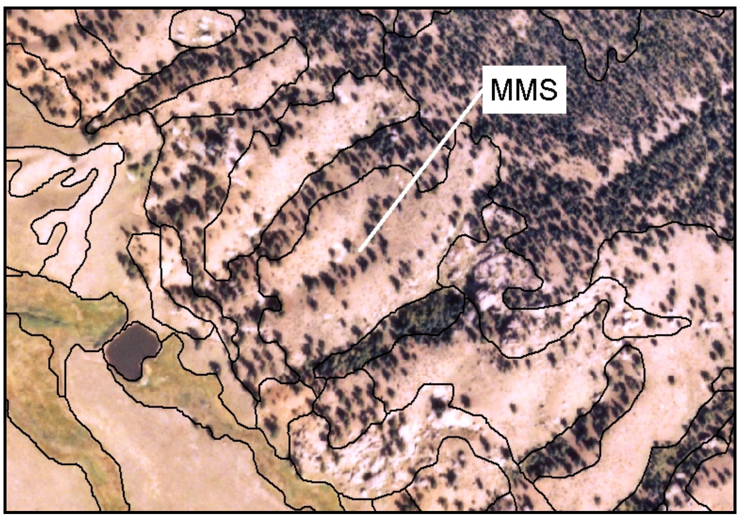
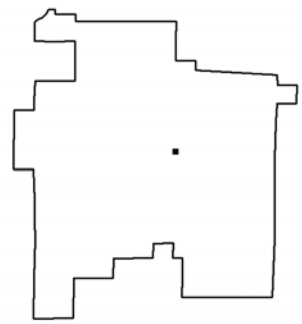


Photo MMS-1



Location of **MMS-1** within National Monument

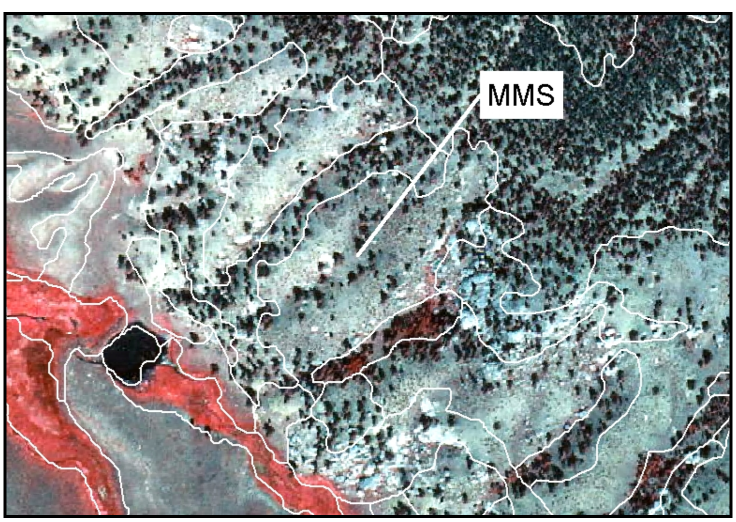
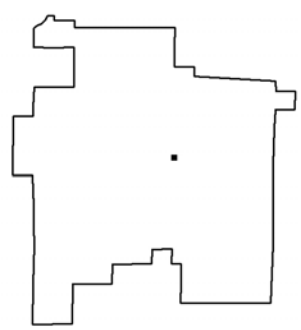


Photo MMS-2



Location of **MMS-2** within National Monument

MMS – Mountain Mahogany / Mountain Muhly Shrubland (Map Unit 16) Continued

Area Report for MMS Map Unit
Number of Polygons: 52
Number of Hectares: 93.5
Number of Acres: 231.0
Average Size: 1.8 hectares, 4.4 acres

Accuracy Assessment Results for MMS Map Unit
The Mountain Mahogany / Mountain Muhly Shrubland Map Unit was assessed at 87% for producers' accuracy (confidence interval 69-100%) and at 36% users' accuracy (confidence interval 21-51%).

SCS – Shrubby Cinquefoil Shrubland (Map Unit 17)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Shrubby Cinquefoil Shrubland (SCS, Map Unit 17) represents the *Dasiphora fruticosa* (Shrubby Cinquefoil) Shrubland Alliance.

This association is limited to drainage bottoms, moist swale bottoms, margins of livestock watering ponds, and the margins of emergent wetlands. It occurs in areas of low to moderate gradient and at any aspect if the moisture regime is adequate. It is located throughout the monument at low to mid-elevations in moist to saturated conditions. This is a zone of mixing or an ecotone between wetland and upland plant associations.

SCS – Shrubby Cinquefoil Shrubland (Map Unit 17) Continued

Photo Signatures

In the natural color aerial photography, SCS appears as dark brown-green, and in color infrared aerial photography it appears as dark red. In both types of photography it has a smooth texture. The shrubs are less than 1 meter in height and have a foliar cover of 40-65%. Photo SCS-1 (natural color) was taken in September 1996 and SCS-2 (color infrared) was taken in August 1983. Both photos are of the same location.

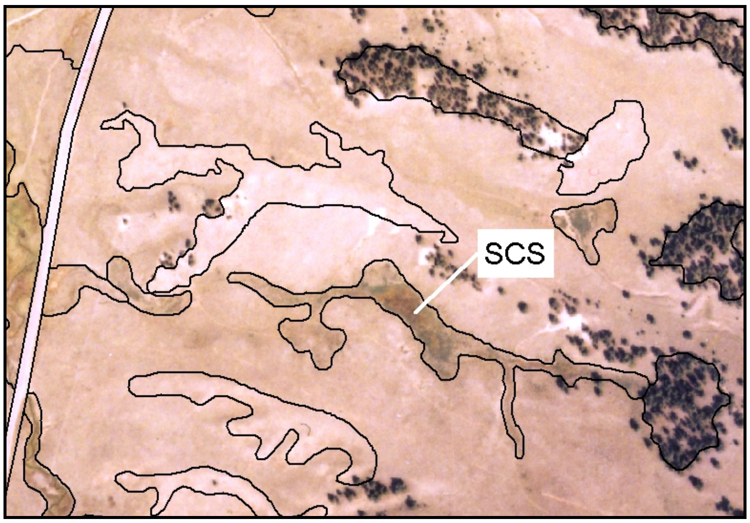
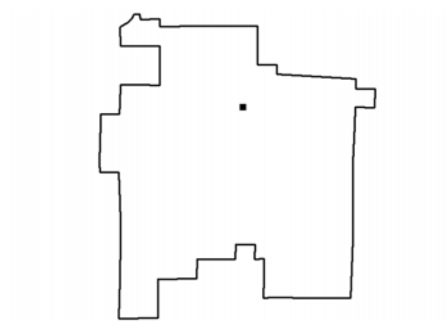


Photo SCS-1



Location of **SCS-1** within National Monument

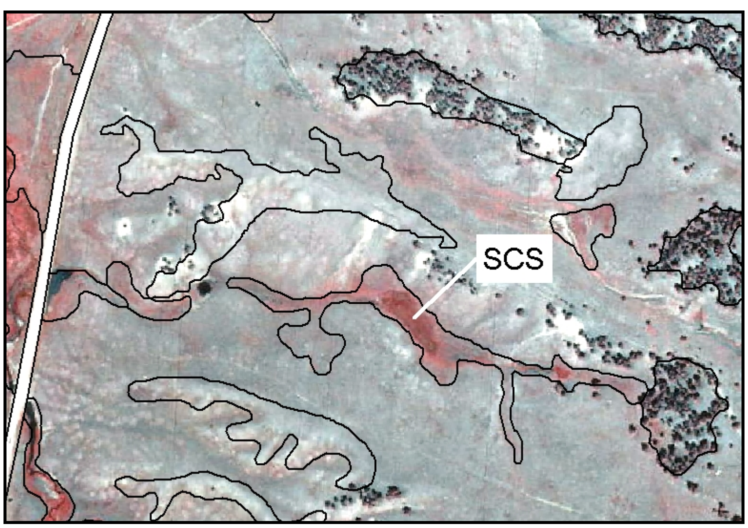
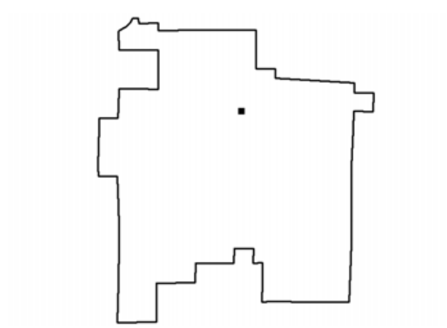


Photo SCS-2



Location of **SCS-2** within National Monument

SCS – Shrubby Cinquefoil Shrubland (Map Unit 17) Continued

Area Report for SCS Map Unit
Number of Polygons: 34
Number of Hectares: 13.7
Number of Acres: 33.8
Average Size: 0.4 hectares, 1.0 acre

Accuracy Assessment Results for SCS Map Unit
The Shrubby Cinquefoil Shrubland Map Unit was assessed at 100% for producers' accuracy (confidence interval 98-100%) and at 76% users' accuracy (confidence interval 62-90%).

WROS – Waxflower Rock Outcrop Shrubland (Map Unit 18)

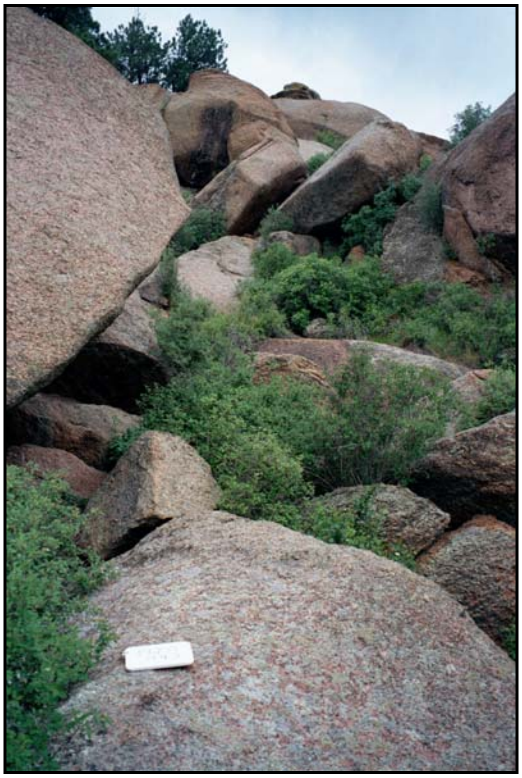


Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Waxflower Rock Outcrop Shrubland (WROS, Map Unit 18) represents the *Jamesia americana* (Waxflower) Rock Outcrop Shrubland Association.

The vegetation of this association is relatively sparse because of the large Pikes Peak granite outcrops and boulders that are strewn on the landscape. It occupies nearly every outcrop, regardless of size. Many of these sites are small, but the best examples are found on very large cliff faces on the upper shoulders of large hills. The most prominent instances occur in the far northeastern part of the monument and on the hill east of the Visitor's Center. The slopes are steep and a few are close to vertical. The aspects are predominantly south-facing, but there are a few western exposures. The elevation range for the association is approximately 8300-8750 feet.

WROS – Waxflower Rock Outcrop Shrubland (Map Unit 18) Continued

Photo Signatures

In the natural color aerial photography, WROS appears as very light to white (rocks), some dark areas (shadows of rocks), and a trace of light green (vegetation). The texture of the rocks is very coarse. The shrubs are from 1–2 meters in height and provide foliar cover of 10–25%. The outcropping bedrock, boulders, small rock, and bare soil approach 55–95% of the ground cover. Photo WROS-1 was taken in September 1997 and WROS-2 was taken in September 1996.

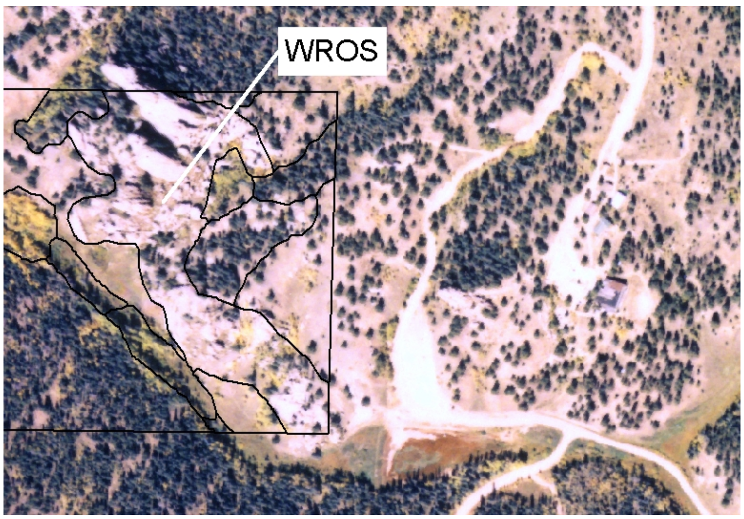
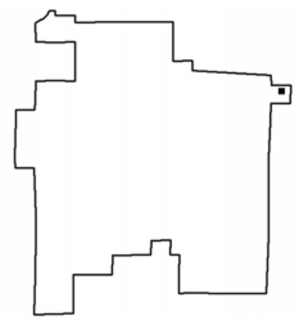


Photo WROS-1



Location of **WROS-1** within National Monument

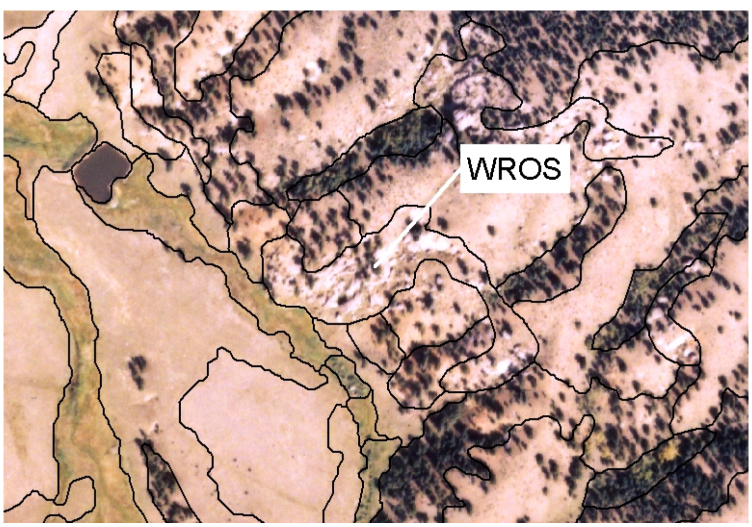
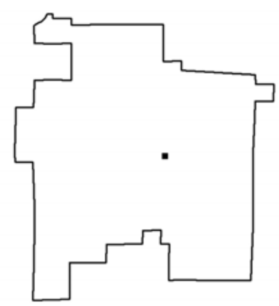


Photo WROS-2



Location of **WROS-2** within National Monument

WROS – Waxflower Rock Outcrop Shrubland (Map Unit 18) Continued

Area Report for WROS Map Unit
Number of Polygons: 19
Number of Hectares: 14.9
Number of Acres: 36.8
Average Size: 0.8 hectares, 1.9 acres

Accuracy Assessment Results for WROS Map Unit
The Waxflower Rock Outcrop Shrubland Map Unit was assessed at 95% for producers' accuracy (confidence interval 84-100%) and at 76% users' accuracy (confidence interval 60-92%).

SBWS – Sandbar Willow Temporarily Flooded Shrubland (Map Unit 20)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Sandbar Willow Temporarily Flooded Shrubland (SBWS, Map Unit 20) represents the *Salix exigua* (Sandbar Willow) Temporarily Flooded Shrubland Association.

This temporarily flooded *s*hrubland occurs in a patchy distribution for about 1000 meters along Grape Creek from the northern boundary fence line upstream to a series of beaver ponds. This area has the lowest monument elevations of between 8150-8225 feet, occupies a nearly flat gradient, and is poorly drained. Sandbar willow stands are confined to the gravel and sand substrate of the creek and expand upstream, rapidly transitioning to the *Salix monticola / Carex utriculata* (Mountain Willow / Beaked Sedge) Shrubland and *Salix monticola* / Mesic Graminoids (Mountain Willow / Mesic Graminoids) Shrubland.

SBWS – Sandbar Willow Temporarily Flooded Shrubland (Map Unit 20) Continued

Photo Signatures

In the natural color aerial photography, SBWS appears as medium green with a medium texture and a linear shape. The shrubs are 5-8 meters in height near the fence line and are shorter (2-4 meters) near the beaver ponds. They have a foliar cover of 55-75%. The signature closely resembles the Mountain Willow Shrubland (MWS, Map Unit 21). Photo SBWS-1 was taken in August 1995. At the time of the color infrared aerial photography (August 1983) this association had not yet developed to any appreciable size, so no example is given.

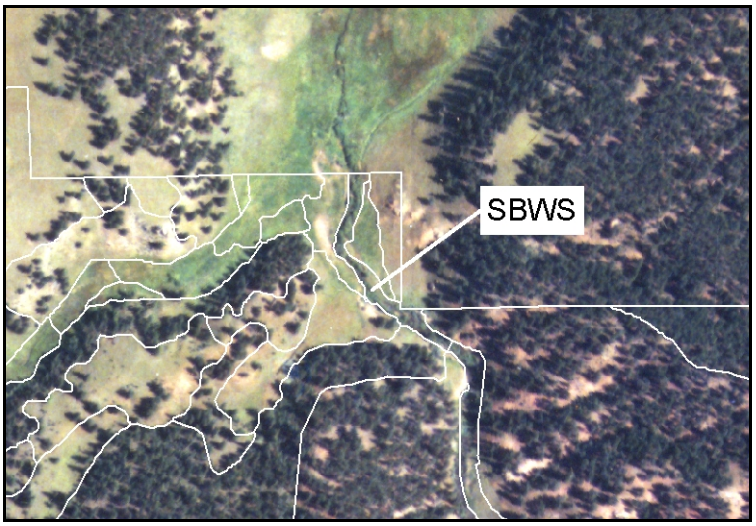
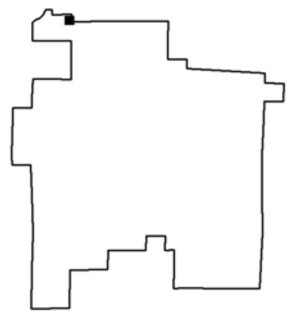


Photo SBWS-1



Location of **SBWS-1** within National Monument

Area Report for SBWS Map Unit
Number of Polygons: 1
Number of Hectares: 0.4
Number of Acres: 1
Average Size: 0.4 hectares, 1.0 acre

Accuracy Assessment Results for SBWS Map Unit
The Sandbar Willow Temporarily Flooded Shrubland Map Unit was assessed at 33% for producers' accuracy and at 100% users' accuracy.

MWS – Mountain Willow Shrubland (Map Unit 21)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Mountain Willow Shrubland (MWS, Map Unit 21) represents a combination of the *Salix monticola / Carex utriculata* (Mountain Willow / Beaked Sedge) Shrubland Association and the *Salix monticola* / Mesic Graminoids (Mountain Willow / Mesic Graminoids) Shrubland Association.

This map unit is the most common willow type within the monument. It is present at scattered localities along Grape Creek and its tributary drainages occupying narrow, low-gradient streams. The elevations are relatively low, from approximately 8250-8450 feet within the monument. The stands are linear, growing in saturated gravel and peat substrates immediately adjacent to the flowing water. Along the middle reach of Grape Creek there are many beaver dams and ponds within this vegetation type. Mountain willow shrubs grow along the edge of the floodplain, on the margins of the beaver ponds, and persist as shorter and younger shrubs than in other areas.

MWS – Mountain Willow Shrubland (Map Unit 21) Continued

Photo Signatures

The Mountain Willow / Beaked Sedge Shrubland Association and Mountain Willow / Mesic Graminoids Shrubland Association are difficult to distinguish from one another. In the natural color aerial photography, MWS appears as medium to dark green, and in color infrared aerial photography it appears as medium red. In both types of photography it has a medium texture and a linear shape. The shrubs are 2-5 meters in height and have a foliar cover of 40-65%. Photo MWS-1 (natural color) was taken in September 1996 and MWS-2 (color infrared) was taken in August 1983. Both photos are of the same location.

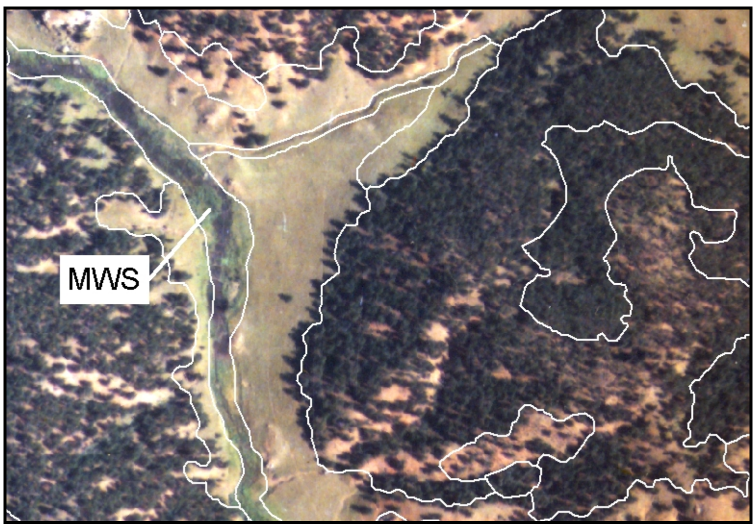
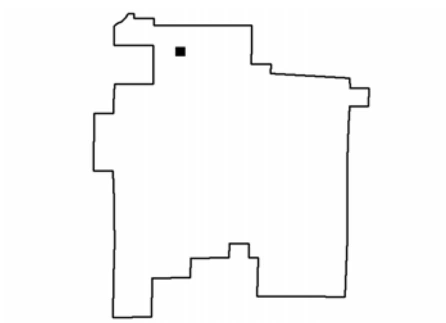


Photo MWS-1



Location of **MWS-1** within National Monument

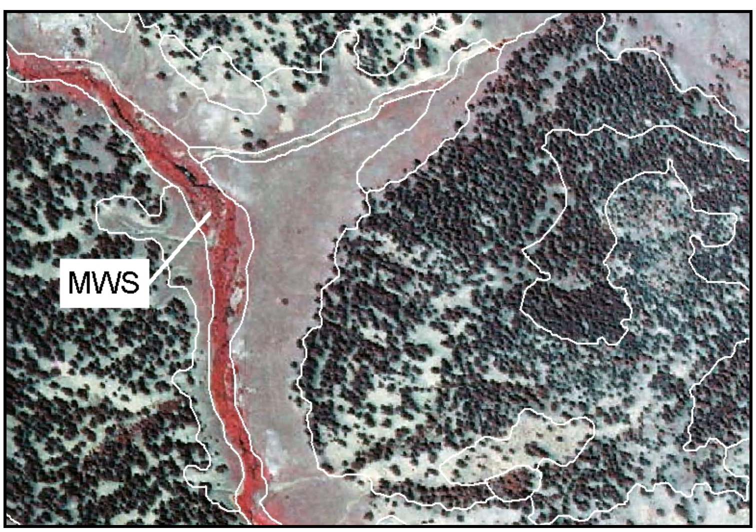
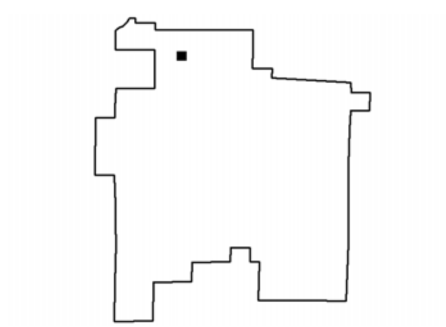


Photo MWS-2



Location of **MWS-2** within National Monument

MWS – Mountain Willow Shrubland (Map Unit 21) Continued

Area Report for MWS Map Unit
Number of Polygons: 13
Number of Hectares: 7.4
Number of Acres: 18.3
Average Size: 0.6 hectares, 1.4 acres

Accuracy Assessment Results for MWS Map Unit
The Mountain Willow Shrubland Map Unit was assessed at 90% for producers' accuracy (confidence interval 78-100%) and at 83% users' accuracy (confidence interval 67-98%).

DHV – Duckweed Permanently Flooded Herbaceous Vegetation (Map Unit 23)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Duckweed Permanently Flooded Herbaceous Vegetation (DHV, Map Unit 23) represents a combination of the *Lemna* spp. (Duckweed) Permanently Flooded Herbaceous Vegetation Park Special and the *Myriophyllum sibiricum* (Water Milfoil) Herbaceous Vegetation Park Special.

Both the Duckweed Permanently Flooded Herbaceous Vegetation Park Special and the Water Milfoil Herbaceous Vegetation Park Special occupy historic small livestock watering ponds that are formed behind dams constructed of gravel. They are located on Grape and Boulder creeks and their tributary drainages, and occur at the lowest elevations. Many of the dams are oversized for the drainages they occupy, and have a culvert or outlet gate to control water depth. Along Grape Creek, west of the Hornbek Homestead, beaver have constructed many dams and ponds. The deeper, standing water provides habitat for both rooted and floating aquatic vegetation. A few ponds become dry during the course of the summer season and may exist as barren flats, or may vegetate to a *Hordeum jubatum* herbaceous type.

DHV – Duckweed Permanently Flooded Herbaceous Vegetation (Map Unit 23) Continued

Photo Signatures

These two associations are difficult to distinguish from one another. In the natural color aerial photography, the open water appears as dark gray-green to almost black, and the floating vegetation, if present, appears as light green. In color infrared aerial photography, the open water appears as very dark blue to black, and there is no visible floating vegetation. In both types of photography, the water and vegetation have an extremely smooth texture. The pond's shape often has a straight edge along the side facing the dam and the remainder conforms to the depression and drainage. They are typically less than 200 square meters. The shoreline vegetation consists of emergent wetland species with 90-100% foliar cover. Photo DHV-1 (natural color) was taken in September 1996 and DHV-2 (color infrared) was taken in August 1983. Both photos are of the same location and show a pond with little floating vegetation. DHV-3 (natural color) was taken in September 1996 and shows a pond with a large amount of floating vegetation forming a ring around its edge.

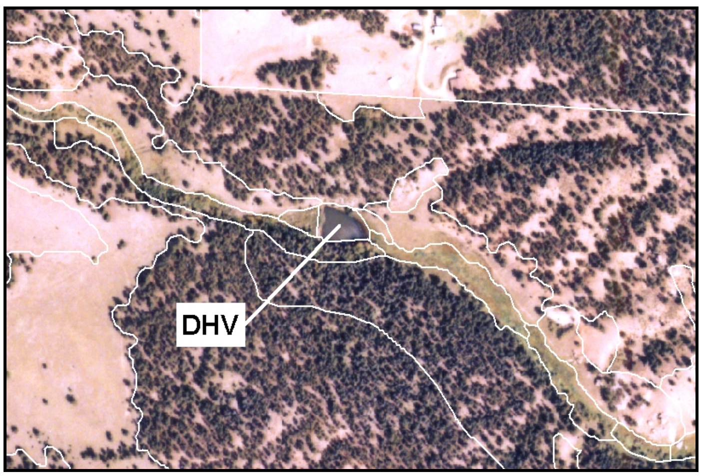
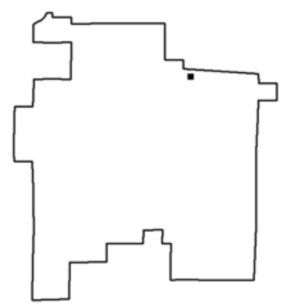


Photo DHV-1



Location of **DHV-1** within National Monument

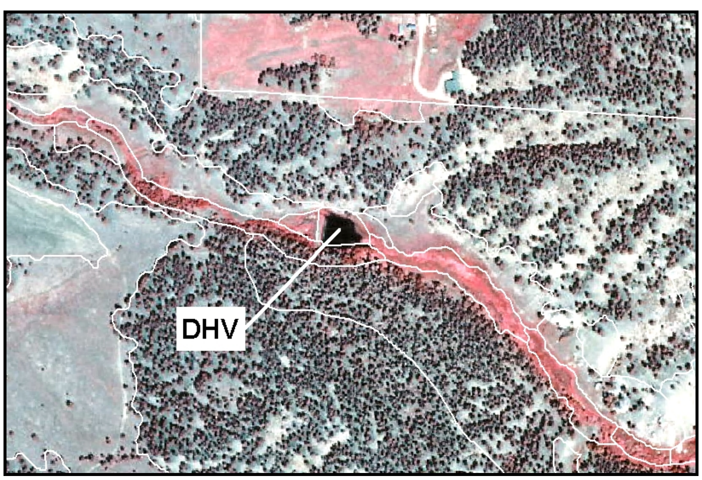
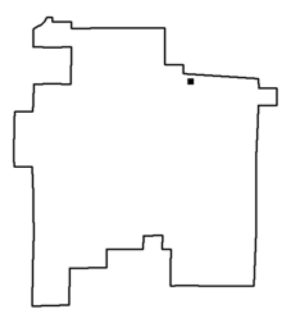


Photo DHV-2



Location of **DHV-2** within National Monument

DHV – Duckweed Permanently Flooded Herbaceous Vegetation (Map Unit 23) Continued

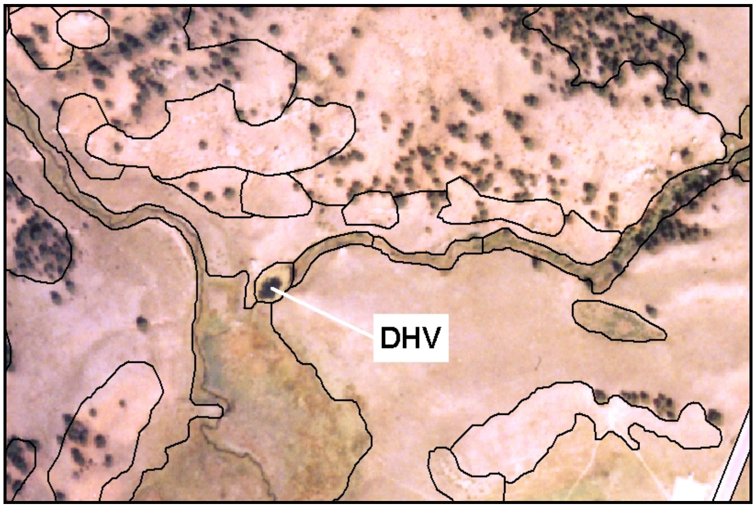
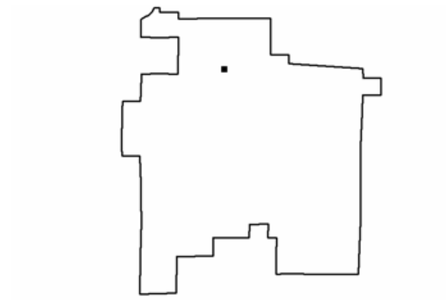


Photo DHV-3



Location of **DHV-3** within National Monument

Area Report for DHV Map Unit
Number of Polygons: 10
Number of Hectares: 2.0
Number of Acres: 4.9
Average Size: 0.2 hectares, 0.5 acres

Accuracy Assessment Results for DHV Map Unit
The Duckweed Permanently Flooded Herbaceous Vegetation Map Unit was assessed at 100% for producers' accuracy and at 71% users' accuracy.

SBHV – Smooth Brome Semi-natural Herbaceous Vegetation (Map Unit 25)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Smooth Brome Semi-natural Herbaceous Vegetation (SBHV, Map Unit 25) represents the *Bromus inermis* – (*Pascopyrum smithii*) Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation Association.

This semi-natural herbaceous vegetation occurs on disturbed sites and in moist drainages throughout the monument. The purest stands occurred on mesic sites along the monument roads and in sites used as grass hay fields until recently. Some of these are found near the eastern monument boundary at Lower Twin Rock Road, at the southern monument boundary near a series of stock ponds, and at the western monument boundary adjacent to the water pipeline corridor. It was certainly introduced to revegetate ground disturbed by construction and in seed potato field restoration. These stands are relatively dense on upper floodplain terraces, but are sparse on the old agricultural fields and portions of the water pipeline.

SBHV – Smooth Brome Semi-natural Herbaceous Vegetation (Map Unit 25) Continued

Photo Signatures

In the natural color aerial photography, SBHV appears as light green to tan, and in color-infrared aerial photography it appears as light red to medium gray-red. In both types of photography it has a smooth texture. It is a relatively short grassland type, and the foliar cover ranges from 20%, up to 70% on the dense sites. The signature resembles Parry Oatgrass Herbaceous Vegetation (Map Unit 27) and Arizona Fescue – Mountain Muhly Herbaceous Vegetation (Map Unit 28). Photo SBHV-1 (natural color) was taken in September 1996. SBHV-2 (color infrared) was taken in August 1983. Both photos are of the same location.

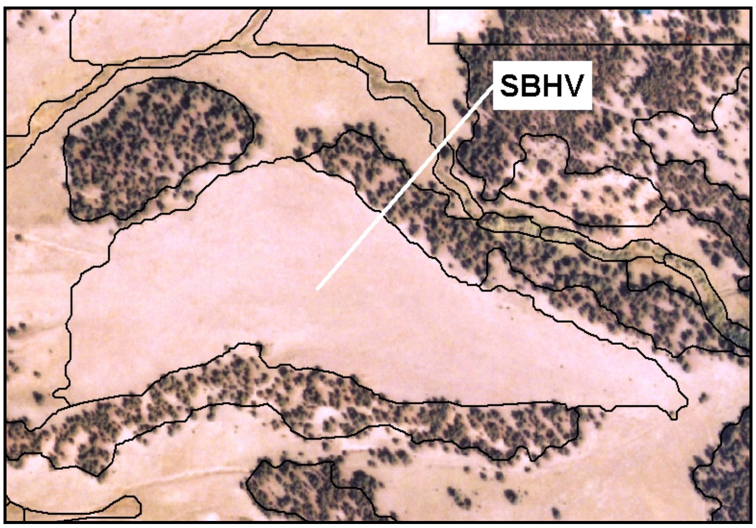
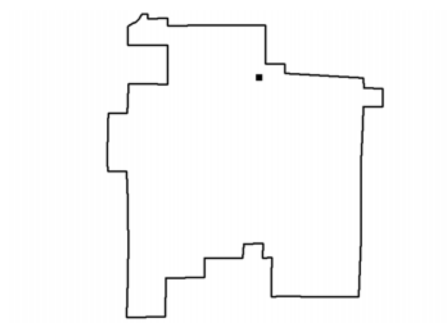


Photo SBHV-1



Location of **SBHV-1** within National Monument

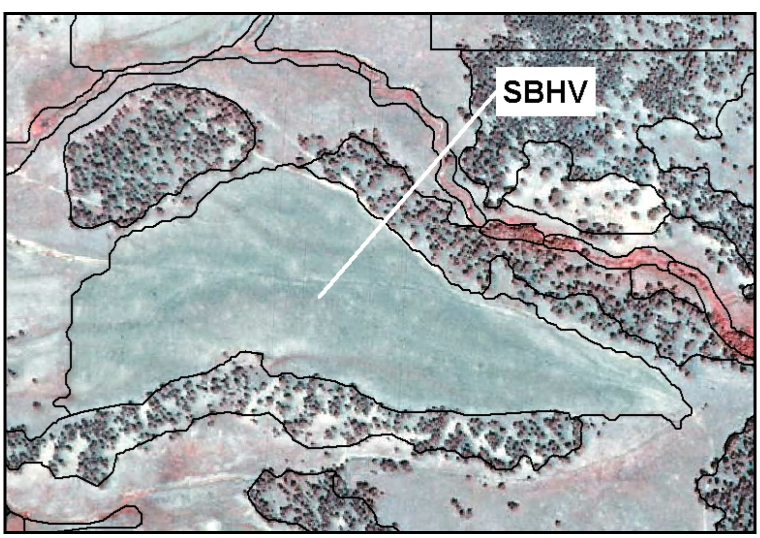
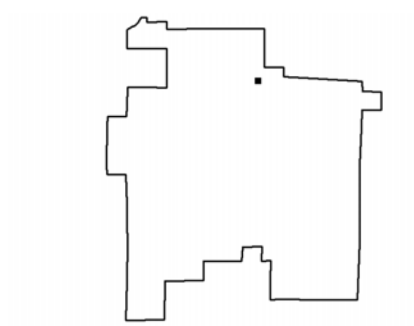


Photo SBHV-2



Location of **SBHV-2** within National Monument

SBHV – Smooth Brome Semi-natural Herbaceous Vegetation (Map Unit 25) Continued

Area Report for SBHV Map Unit
Number of Polygons: 36
Number of Hectares: 157.5
Number of Acres: 389.0
Average Size: 4.4 hectares, 10.8 acres

Accuracy Assessment Results for SBHV Map Unit
The Smooth Brome Semi-natural Herbaceous Vegetation Map Unit was assessed at 71% for producers' accuracy (confidence interval 59-83%) and at 97% users' accuracy (confidence interval 91-100%).

SRHV – Aquatic Sedge – Beaked Sedge – Baltic Rush Herbaceous Vegetation (Map Unit 26)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Aquatic Sedge – Beaked Sedge – Baltic Rush Herbaceous Vegetation (SRHV, Map Unit 26) represents a combination of the *Carex aquatilis* (Aquatic Sedge) Herbaceous Vegetation Association, the *Carex urticulata* (Beaked Sedge) Herbaceous Vegetation Association, and the *Juncus balticus* (Baltic Rush) Herbaceous Vegetation Association.

SRHV – Aquatic Sedge – Beaked Sedge – Baltic Rush Herbaceous Vegetation (Map Unit 26) Continued

Carex aquatilis (Aquatic Sedge) Herbaceous Vegetation Association –
This herbaceous vegetation occupies low-gradient sites along streams where the soil is saturated to the surface or shallow standing water is present. The distribution of *Carex aquatilis* is zonal, with *Carex utriculata* occupying the most inundated sites immediately adjacent to the drainage and *Juncus balticus* occupying the drier margin at the higher elevation. *Carex aquatilis* Herbaceous Vegetation is found on the first terrace adjacent to the Grape Creek channel and in its major tributary drainages, particularly Boulder Creek. These drainages lie between approximately 8350-8650 feet elevation.

Carex urticulata (Beaked Sedge) Herbaceous Vegetation Association -
This herbaceous vegetation occupies the saturated to inundated zone adjacent to flowing streams and on groundwater swells, where groundwater collects under vegetation and elevates it, creating a quaking bog. The elevation of these drainages lies between 8250-8600 feet. *Carex utriculata* Herbaceous Vegetation occupies low-gradient sites immediately adjacent (first terrace) to the flowing water of Grape and Boulder creeks and their tributary drainages.

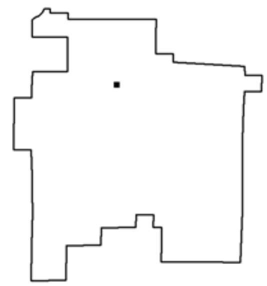
Juncus balticus (Baltic Rush) Herbaceous Vegetation Association -
Juncus balticus forms extensive stands on the upper (usually second) floodplain terrace where groundwater is usually from 30 cm to 1.5 m below the ground surface. This herbaceous vegetation is persistent, often occupying floodplain terraces, even after streams have incised and the groundwater table has dropped significantly. *Juncus balticus* Herbaceous Vegetation occupies floodplain terraces of nearly every flowing stream (Grape and Boulder creeks and tributaries) and are also present in the bottoms of moist drainages and swales. This limits the type to the lowest elevations of the monument.

SRHV – Aquatic Sedge – Beaked Sedge – Baltic Rush Herbaceous Vegetation (Map Unit 26) Continued

Photo Signatures

These three associations (Aquatic Sedge Herbaceous Vegetation Association, Beaked Sedge Herbaceous Vegetation Association, and Baltic Rush Herbaceous Vegetation Association) are difficult to distinguish from one another. In the natural color aerial photography, SRHV appears as a complex mix of light green to dark green to brown to dark brown, and in color infrared aerial photography it appears as a complex mix of light to very dark red. In both types of photography, it has a smooth texture and complex patterning. The shapes are linear along narrow drains and oblong in wider drainages. The graminoids are 0.5-1.0 meters in height and have a foliar cover of 65-90%. Photo SRHV-1 (natural color) was taken in September 1996 and SRHV-2 (color infrared) was taken in August 1983. Both photos are of the same location.

Photo SRHV-1



Location of **SRHV-1** within National Monument

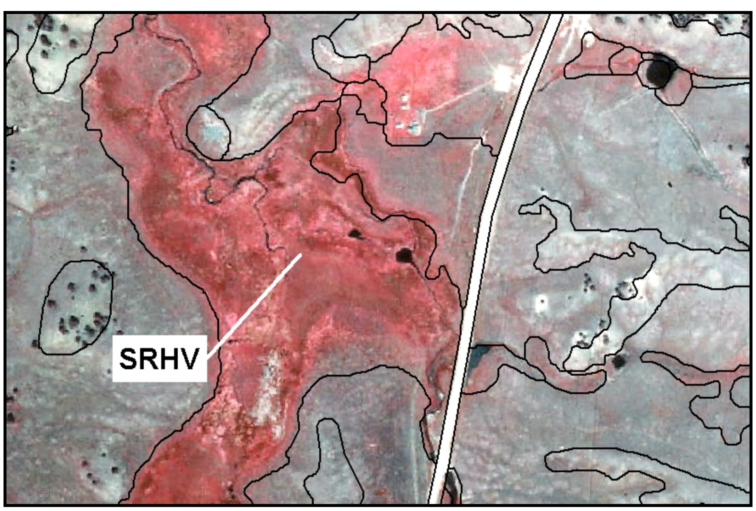
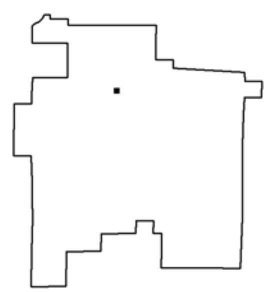


Photo SRHV-2



Location of **SRHV-2** within National Monument

SRHV – Aquatic Sedge – Beaked Sedge – Baltic Rush Herbaceous Vegetation (Map Unit 26) Continued

Area Report for SRHV Map Unit
Number of Polygons: 41
Number of Hectares: 90.6
Number of Acres: 223.8
Average Size: 2.2 hectares, 5.4 acres

Accuracy Assessment Results for SRHV Map Unit
Accuracy Assessment Results for SRHV Map Unit
The Aquatic Sedge – Beaked Sedge – Baltic Rush Herbaceous Vegetation Map Unit was assessed at 77% for producers' accuracy (confidence interval 65-89%) and at 86% users' accuracy (confidence interval 75-97%).

POHV – Parry Oatgrass Herbaceous Vegetation (Map Unit 27

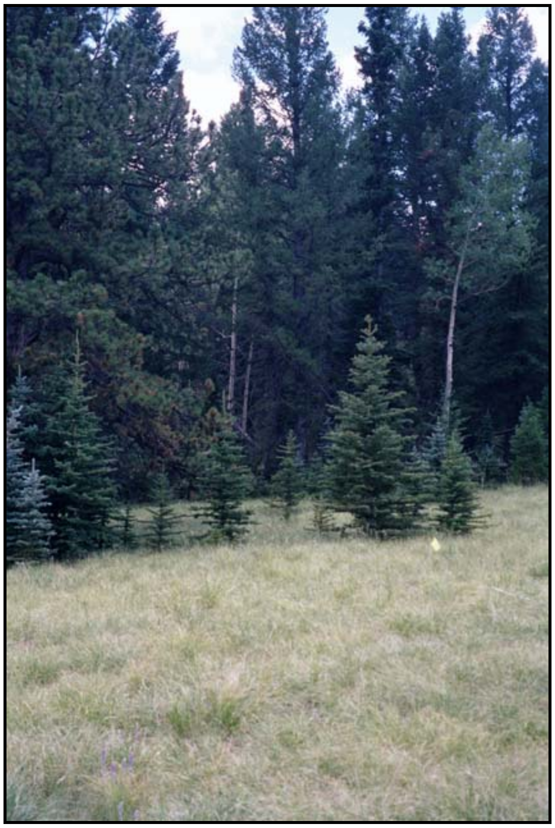


Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Parry Oatgrass Herbaceous Vegetation (POHV, Map Unit 27) represents the *Danthonia parryi* (Parry Oatgrass) Herbaceous Vegetation Association.

This native bunchgrass forms nearly pure stands on moist soils of the middle and higher elevations (8400–8600 feet). It occurs predominantly on north- and northwest-facing exposures on slopes, in narrow mesic drainages, and on hilltops where mesic conditions occur. Stands occupy bands 10-25 m wide at the base of the *Picea pungens / Juniperus communis* (Colorado Blue Spruce / Common Juniper) Forest Association, the *Pseudostuga menziesii / Juniperus communis* (Douglas-fir / Common Juniper) Forest Association, the *Populus tremuloides* (Quaking Aspen) Forest Alliance, and the *Populus tremuloides / Juniperus communis* (Quaking Aspen / Common Juniper) Forest Association. These sites receive additional moisture due to accumulation of snowfall and are shaded for at least a portion of the day by the tall trees, often in excess of 30 m in height.

POHV – Parry Oatgrass Herbaceous Vegetation (Map Unit 27 Continued

Photo Signatures

In the natural color aerial photography, POHV appears as greenish-tan, and in color-infrared aerial photography it appears as light reddish-gray. In both types of photography it has a smooth texture. It is a relatively short grassland type, less than 0.5 m in height, and the foliar cover ranges from 60-90%. The signature resembles Smooth Brome Semi-natural Herbaceous Vegetation (Map Unit 25) and the more mesic stands of the Arizona Fescue – Mountain Muhly Herbaceous Vegetation (Map Unit 28). Photo POHV-1 (natural color) was taken in September 1996. POHV-2 (color infrared) was taken in August 1983. Both photos are of the same location.

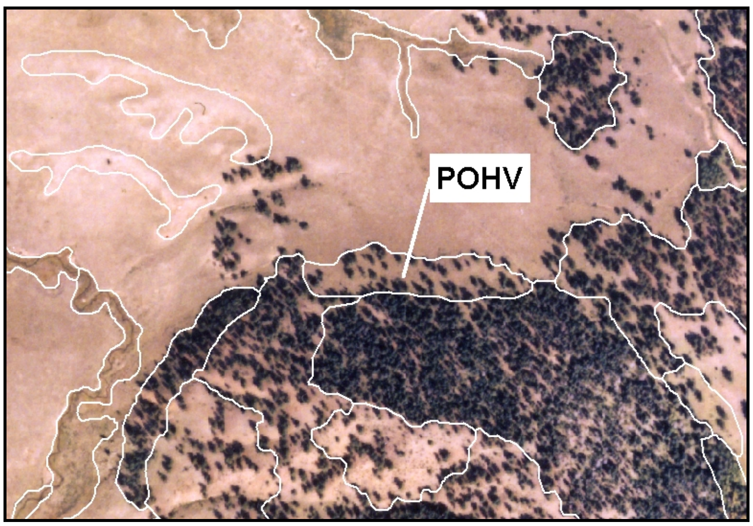
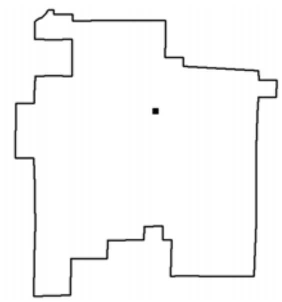


Photo POHV-1



Location of **POHV-1** within National Monument

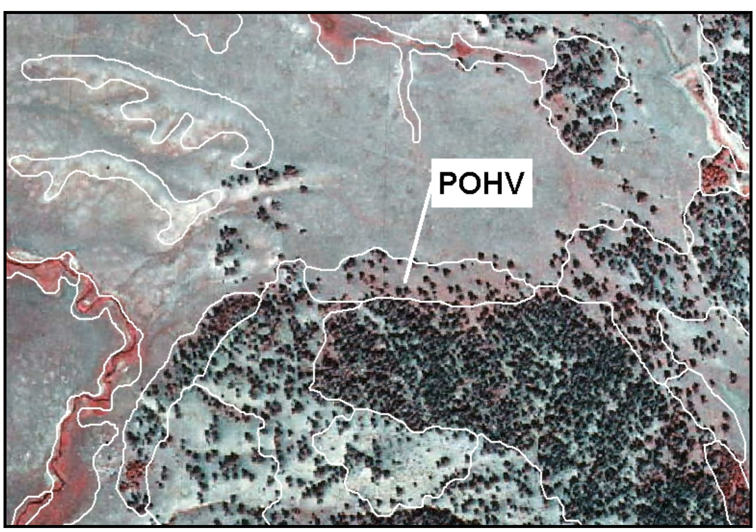
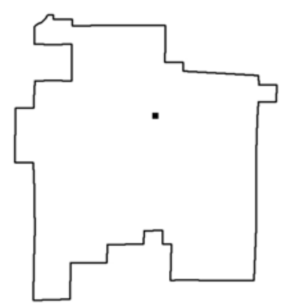


Photo POHV-2



Location of **POHV-2** within National Monument

POHV – Parry Oatgrass Herbaceous Vegetation (Map Unit 27 Continued

Area Report for POHV Map Unit
Number of Polygons: 26
Number of Hectares: 32.2
Number of Acres: 79.5
Average Size: 1.2 hectares, 3.1 acres

Accuracy Assessment Results for POHV Map Unit
The Parry Oatgrass Herbaceous Vegetation Map Unit was assessed at 83% for producers' accuracy (confidence interval 66-100%) and at 68% users' accuracy (confidence interval 50-87%).

AFMMHV – Arizona Fescue – Mountain Muhly Herbaceous Vegetation (Map Unit 28)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Arizona Fescue – Mountain Muhly Herbaceous Vegetation (AFMMHV, Map Unit 28) represents a combination of the *Festuca arizonica – Muhlenbergia montana* (Arizona Fescue – Mountain Muhly) Herbaceous Vegetation Association and the *Muhlenbergia montana* (Mountain Muhly) Herbaceous Vegetation Association.

Festuca arizonica – Muhlenbergia montana (Arizona Fescue – Mountain Muhly) Herbaceous Vegetation Association – This common grassland occupies deep soils on flats, gentle to steep slopes, hills, ridges, and drainage sides within the lower and middle elevations.

Muhlenbergia montana (Mountain Muhly) Herbaceous Vegetation Association -
This grassland typically occupies the steeper middle and upper slopes of hills and ridges at aspects ranging from southeast to southwest. Stands are found within the lower to mid-elevations, and on thin soils consisting of Pikes Peak granite gravel.

AFMMHV – Arizona Fescue – Mountain Muhly Herbaceous Vegetation (Map Unit 28) Continued

Photo Signatures

These two associations (Arizona Fescue – Mountain Muhly Herbaceous Vegetation Association and Mountain Muhly Herbaceous Vegetation Association) are difficult to distinguish from one another. In the natural color aerial photography, AFMMHV appears as very light green to tan to light tan, with a smooth texture. The tones are darker in drain bottoms, and lighter on ridge tops and south-facing slopes. Foliar cover of the grasses is over 50% for Arizona Fescue – Mountain Muhly, and 25-40% for Mountain Muhly. The signature closely resembles the Smooth Brome Semi-natural Herbaceous Vegetation (Map Unit 25). Photo AFMMHV-1 was taken in September 1996 and AFMMHV-2 was taken in August 1995.

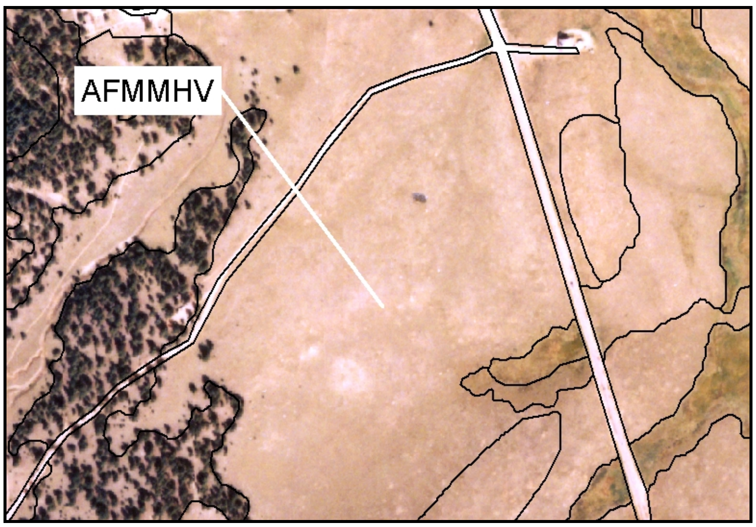
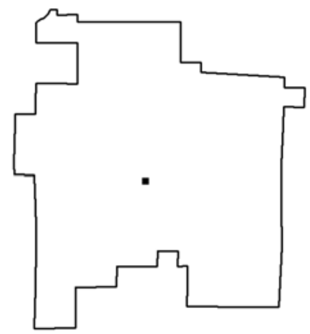


Photo AFMMHV-1



Location of **AFMMHV-1** within National Monument

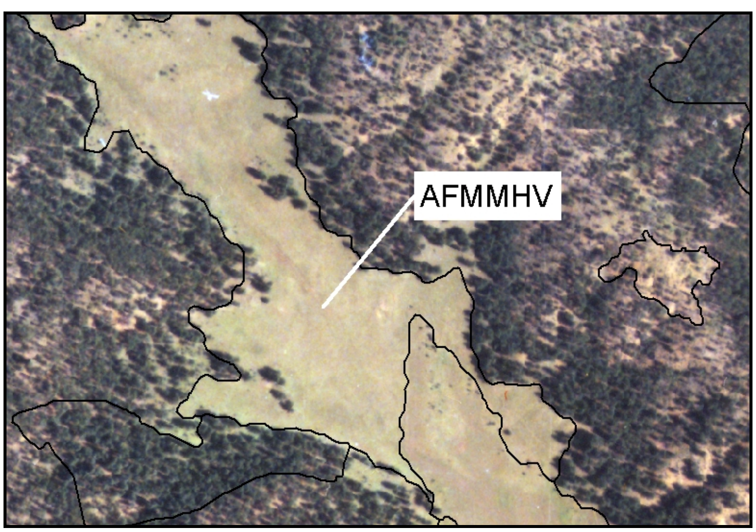
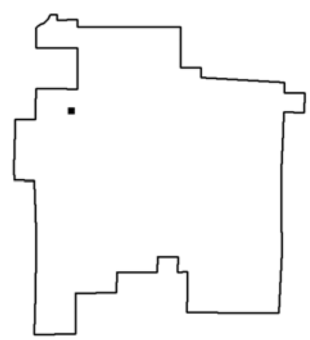


Photo AFMMHV-2



Location of **AFMMHV-2** within National Monument

AFMMHV – Arizona Fescue – Mountain Muhly Herbaceous Vegetation (Map Unit 28) Continued

Area Report for AFMMHV Map Unit
Number of Polygons: 113
Number of Hectares: 687.8
Number of Acres: 1698.9
Average Size: 6.1 hectares, 15.0 acres

Accuracy Assessment Results for AFMMHV Map Unit
The Arizona Fescue – Mountain Muhly Herbaceous Vegetation Map Unit was assessed at 52% for producers' accuracy (confidence interval 40-64%) and at 82% users' accuracy (confidence interval 69-94%).

AFSMHV – Arizona Fescue – Slimstem Muhly Herbaceous Vegetation (Map Unit 30)

Photo credit: Jim Von Loh

Photo credit: Jim Von Loh

The Arizona Fescue – Slimstem Muhly Herbaceous Vegetation (AFSMHV, Map Unit 30) represents a combination of the *Festuca arizonica – Muhlenbergia filiculmis* (Arizona Fescue – Slimstem Muhly) Herbaceous Vegetation Association and the *Muhlenbergia filiculmis* (Slimstem Muhly) Herbaceous Vegetation Association.

Festuca arizonica – Muhlenbergia filiculmis (Arizona Fescue – Slimstem Muhly) Herbaceous Vegetation Association – This grassland type occupies upper hill and ridge slopes and low hill and ridgetops with thin, gravelly soils. It is occasionally observed on lower slopes with southern exposures. It is found at lower and middle elevations.

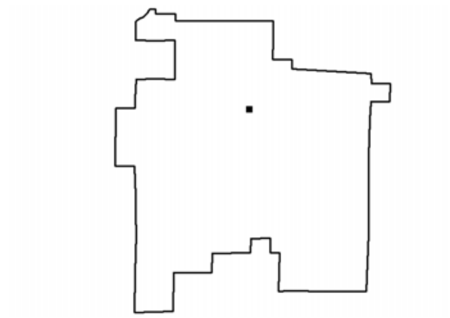
Muhlenbergia filiculmis (Slimstem Muhly) Herbaceous Vegetation Association – This herbaceous vegetation occupies thin soils on the tops of ridges and hills within more extensive *Festuca arizonica – Muhlenbergia filiculmis* (Arizona Fescue – Slimstem Muhly) Herbaceous Vegetation and *Festuca arizonica – Muhlenbergia montana* (Arizona Fescue – Mountain Muhly) Herbaceous Vegetation. These sites are nearly flat, generally lie on south- and west-facing exposures, and occur at the lower to middle elevations.

AFSMHV – Arizona Fescue – Slimstem Muhly Herbaceous Vegetation (Map Unit 30) Continued

Photo Signatures

These two associations are difficult to distinguish from one another. In the natural color aerial photography, AFSMHV appears as light tan to almost white, with a smooth texture. The tones are slightly darker in lower portions. The stands are typically circular/ellipsoid or narrow following the ridgetops. Foliar cover of the grasses is 25-70%, with the remainder being gravel, litter, or mosses and lichens. The signature closely resembles the drier portions of the Arizona Fescue – Mountain Muhly Herbaceous Vegetation (Map Unit 28) and the Smooth Brome Semi-natural Herbaceous Vegetation (Map Unit 25). Photo AFSMHV-1 and AFSMHV-2 were taken in September 1996.

Photo AFSMHV-1



Location of **AFSMHV-1** within National Monument

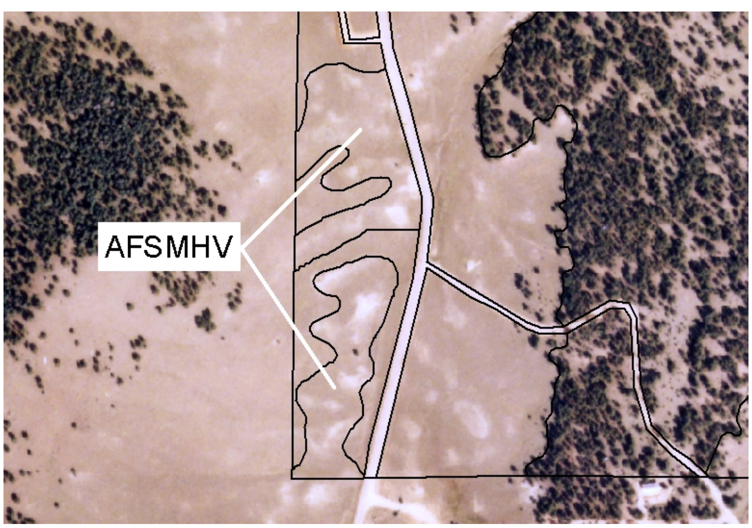
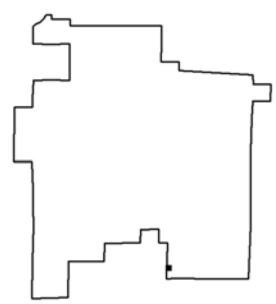


Photo AFSMHV-2



Location of **AFSMHV-2** within National Monument

AFSMHV – Arizona Fescue – Slimstem Muhly Herbaceous Vegetation (Map Unit 30) Continued

Area Report for AFSMHV Map Unit
Number of Polygons: 25
Number of Hectares: 34.2
Number of Acres: 84.5
Average Size: 1.4 hectares, 3.4 acres

Accuracy Assessment Results for AFSMHV Map Unit
The Arizona Fescue – Slimstem Muhly Herbaceous Vegetation Map Unit was assessed at 68% for producers' accuracy (confidence interval 51-85%) and at 81% users' accuracy (confidence interval 64-97%).

LBY – Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland (Map Unit 31)

Photo credit: Jim Von Loh

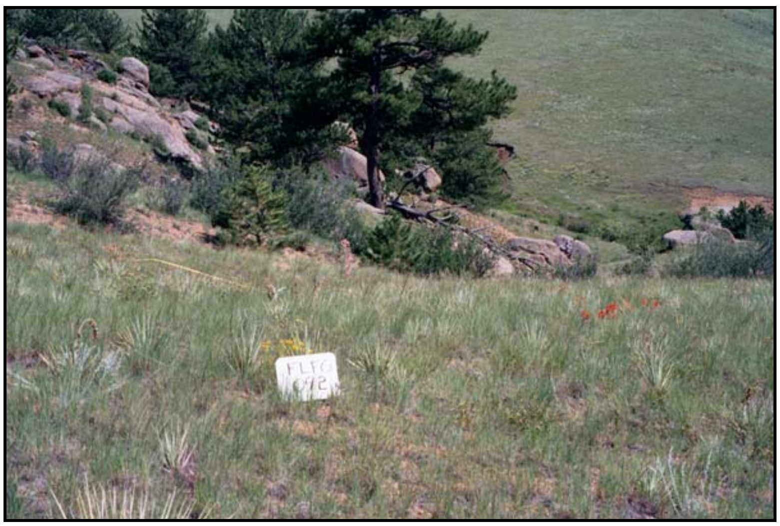


Photo credit: Jim Von Loh

The Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland (LBY, Map Unit 31) represents a combination of the *Schizachyrium scoparium* (Little Bluestem) Herbaceous Vegetation Park Special and the *Yucca glauca / Muhlenbergia montana* (Yucca / Mountain Muhly) Dwarf-shrubland Park Special.

Schizachyrium scoparium (Little Bluestem) Herbaceous Vegetation Park Special – This grassland is found in small stands and as patches (<0.5 ha.) It occurs where soils are thin and consist mostly of coarse gravel deposits lying over Pikes Peak Granite bedrock on toe- and midslopes of large hills. Slopes are steep, south- and west-facing, and drain rapidly.

Yucca glauca / Muhlenbergia montana (Yucca / Mountain Muhly) Dwarf-shrubland Park Special - This *s*hrubland occupies south-facing, moderately steep, rapidly drained slopes on the larger hills and ridges at elevations of 8400-8650 feet. It is found on gravelly substrate resulting from the weathering of Pikes Peak granite bedrock.

LBY – Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland (Map Unit 31) Continued

Photo Signatures

These two associations are difficult to distinguish from one another, due to similar photo signatures and environmental conditions. In the natural color aerial photography, LBY appears as very light green to light tan with a smooth texture. The shrubs and grass are usually less than 0.5 m in height. Foliar cover ranges from 40-55% for the *Schizachyrium scoparium* patches, and 15-40% for the *Yucca glauca / Muhlenbergia montana* patches. Individual *Pinus ponderosa* trees are often interspersed in these stands. Photo LBY-1 was taken in August 1995 and LBY-2 was taken in September 1996.

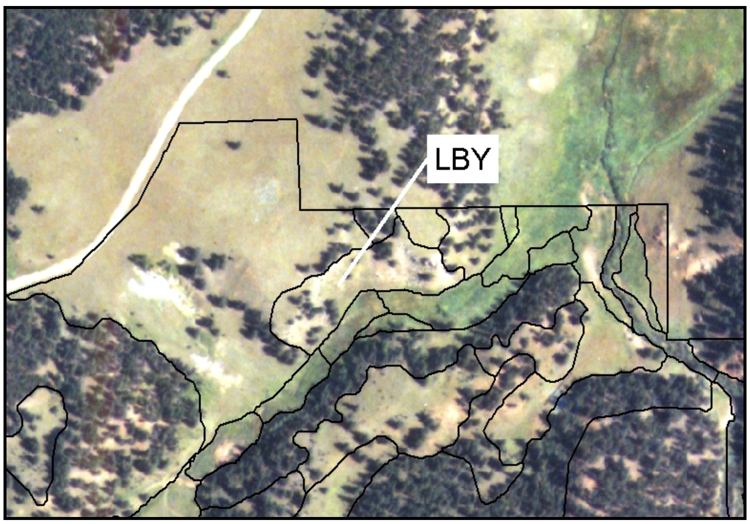
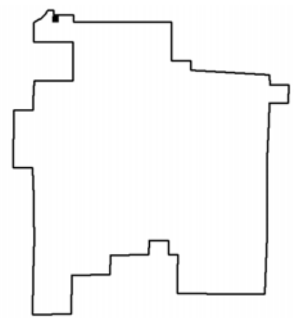


Photo LBY-1



Location of **LBY-1** within National Monument

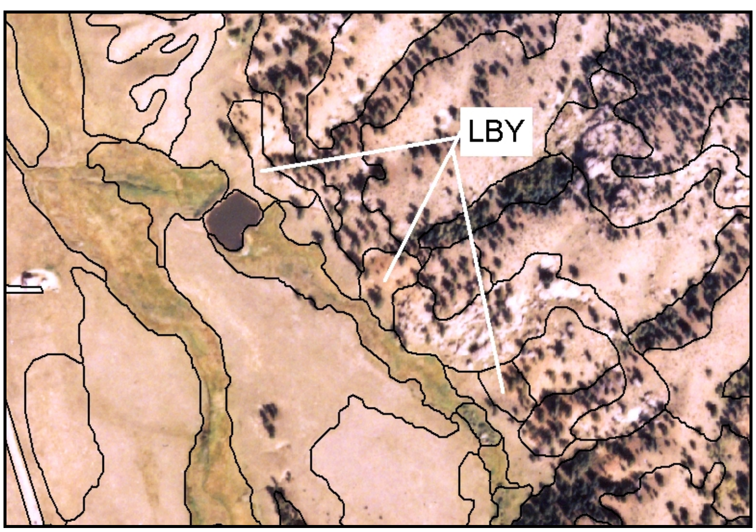
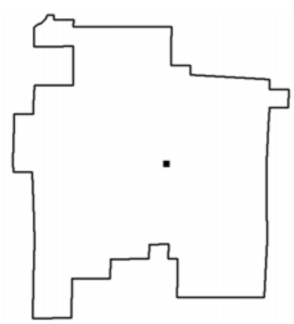


Photo LBY-2



Location of **LBY-2** within National Monument

LBY – Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland (Map Unit 31) Continued

Area Report for LBY Map Unit
Number of Polygons: 20
Number of Hectares: 7.5
Number of Acres: 18.5
Average Size: 0.4 hectares, 0.9 acres

Accuracy Assessment Results for LBY Map Unit
The Little Bluestem Herbaceous Vegetation / Yucca Dwarf-shrubland Map Unit was assessed at 78% for producers' accuracy (confidence interval 59-97%) and at 52% users' accuracy (confidence interval 34-70%).

APPENDIX I

Research Currently Being Conducted on or near Florissant Fossil Beds National Monument, Benefiting from this Vegetation Classification and Mapping Project

Parker, Tom. 2001. Northern Arizona University, School of Forestry

Berberian, Rita. 2002. Colorado State Parks, Mueller State Park

Appendix J. Soils of Teller County, Colorado.

Source: USDA-NRCS 2001.

Map Symbol	Soil Name
AC	Typic Cryaquepts and Cryaquolls, 0-1% slopes, frequently flooded.
Ad	Adderton Loam, 2-6% slopes, rarely flooded.
BCA	Betemer-Typic Haplocryolls-Haplocryalfs Association, 10-45% slopes.
Bf	Frisco Cobbly Loam, 15-55% slopes.
BL	Betemer-Gebson Complex, 3-20% slopes.
Bn	Brinkert Gravelly Loam, 3-15% slopes.
BO	Bushvalley-Rock Outcrop Complex, 40-60% slopes.
Br	Heath Loam, 5-25% slopes.
Bt	Betemer Very Gravelly Loam, 3-40% slopes.
Bv	Bushvalley Very Gravelly Loam, 10-40% slopes.
BW	Bushvalley-Seitz Association, 15-50% slopes
Ca	Cathedral Very Gravelly Sandy Loam, 20-50% slopes.
CaR	Cathedral-Rock Outcrop Complex, 25-70% slopes.
CbA	Cablon Sandy Loam, 0-2% slopes.
CbC	Cablon Gravelly Sandy Loam, 3-12% slopes.
CC	Unnamed-Rawah Complex, 8-45% slopes.
CF	Unnamed-Fifer Loams, 1-10% slopes.
CH	Bushvalley-Rock Outcrop Complex, 10-40% slopes.
CI	Adderton-Bushvalley Complex, 2-40% slopes.
CI	Cathedral Very Gravelly Sandy Loam, Cool, 20-55% slopes.
Cm	Chittum-Woosley Sandy Loams, 5-20% slopes.
CO	Corpening-Martinsdale Complex5-25% slopes.
CQ	Adderton-Cryaquolls Complex, 0-6% slopes.
CR	Cathedral-Rock Outcrop Complex, 40-60% slopes.
CX	Calcic Cryaquepts, 0-1% slopes.
CY	Halaquepts, 0-1% slopes.
DC	Dewville-Cablon Complex, 0-2% slopes.
DT	Dredge Tailings.
EB	Quander-Bushvalley Very Gravelly Loams, 5-40% slopes.
Fa	Cathedral Very Gravelly Sandy Loam, 3-15% slopes.
FLV	Fourmile-Lymanson-Vabem Complex, 2-30% slopes.
Fo	Fourmile Very Gravelly Coarse Sandy Loam, 3-20% slopes.
FtC	Plome Family, 3-15% slopes.
GA	Guffey-Raleigh Association, 5-50% slopes.
Gb	Gebson Sandy Loam, Saline, 0-4% slopes.
Ge	Gebson Sandy Loam, 2-10% slopes.
Gh	Gothic Gravelly Loam, 8-40% slopes.

Gk	Gebson Gravelly Sandy Loam, 5-25% slopes.
GkS	Haplocryolls, 15-30% slopes.
GL	Youga Sandy Loam, 3-10% slopes.
GP	Gravel Pit.
GW	Gothic-Cowdrey Association, 8-25% slopes.
HaB	Hodden Gravelly Loam, 3-8% slopes.
HaE	Hodden Very Gravelly Loam, 10-40% slopes.
HB	Typic Haplustolls, 3-8% slopes.
HbA	Hartbuckle Fine Sandy Loam, 0-1% slopes.
HbW	Hartbuckle Loam, 0-1% slopes.
Hd	Hoodle Gravelly Loam, 5-15% slopes.
HdB	Hodden Loam, 1-5% slopes.
HdE	Hoodle Very Cobbly Loam, 10-40% slopes, stony.
HdF	Hodden Very Cobbly Sandy Loam, 20-60% slopes, Very Stony.
HG	Ustic Haplocryolls, 5-20% slopes.
HGS	Hodden-Gebson-Sawfork Complex, 10-45% slopes.
HN	Herbman-Legault Association, 5-40% slopes.
HoB	Hodden Sandy Loam, 1-5% slopes.
HoC	Hodden Gravelly Sandy Loam, 4-15% slopes.
HoD	Hodden Very Cobbly Sandy Loam, 3-25% slopes, very stony.
Hp	Highpark Very Gravelly Sandy Loam, 5-40% slopes, very stony.
HR	Herakle-Rock Outcrop Complex, 15-45% slopes.
HT	Herbman Gravelly Sandy Loams, 5-40% slopes.
Ig	Bushvalley Very Gravelly Loam, 8-40% slopes, stony.
Jl	Unnamed Peat, 0-1% slopes.
Jr	Heath Loam, 3-10% slopes.
Js	Unnamed-Typic Cryaquolls Complex, 0-1% slopes.
La	Lanswick Loam, 1-5% slopes.
Lb	Libeg Sandy Loam, 1-5% slopes.
LeC	Gebson Loam, 1-9% slopes.
Lh	Lakehelen Very Gravelly Sandy Loam, 20-55% slopes, very stony.
Ln	Levenmile Sandy Loam, 3-8% slopes.
LU	Pendant Extremely Gravelly Sandy Loams, 5-40% slopes.
Mc	Medrick Sandy Loam, 3-10% slopes.
Md	Martinsdale Loam, 3-10% slopes.
MH	Martinsdale-Highpark Complex, 3-15% slopes.
MN	Morset-Unnamed Gravelly Loams, 3-20% slopes.
MP	Medrick-Pannfield Sandy Loams, 3-10% slopes.
Mr	Morset Loam, 3-15% slopes.
Ms	Morset Gravelly Loam, 2-6% slopes.
MT	Gebson-Tomichi-Like Complex, 1-10% slopes.
Mu	Unnamed Silty Clay Loam, 0-3% slopes.
Nv	Cryaquolls, 0-1% slopes.

NvH	Histic Cryaquolls, 0-1% slopes.
Or	Orthents, Mine Land
Pc	Lanswick Fine Sandy Loam, 1-4% slopes.
PD	Permission Denied.
PdA	Pedge Loam, 0-1% slopes.
Ph	Lanswick Loam, 0-3% slopes.
Pl	Lanswick Loam, Saline, 0-2% slopes.
PM	Plome-Pimsby-Pimsby North Facing Complex, 5-40% slopes.
Po	Polich Clay Loam, 1-3% slopes.
Pr	Unnamed Loam, 1-6% slopes.
PS	Pedge Loam, Sodic, 0-1% slopes.
Pw	Penceway Sandy Loam, 1-6% slopes.
PY	Platdon-Cryaquolls, Hummocky Association, 0-1% slopes.
QB	Quander Family-Frisco Complex, 15-50% slopes.
Qr	Quander Family Extremely Cobbly Sandy Loam, 15-55% slopes, very stony
Ra	Unnamed Gravelly Sandy Loam, 3-18% slopes.
RC	Rock Outcrop-Cathedral Complex, 35-70% slopes, extremely stony.
Re	Rogert Very Gravelly Sandy Loam, Cool, 10-40% slopes.
Rg	Rogert Very Gravelly Sandy Loam, 15-40% slopes.
RgR	Rogert-Rock Outcrop Complex, 20-60% slopes.
Rh	Polich Variant Silt Loam, 2-6% slopes.
Rl	Raleigh Very Gravelly Sandy Loam, 5-55% slopes.
ROCn	Rock Outcrop-Catamount Complex, 20-70% slopes.
Rs	Redspoon Fine Sandy Loam, 2-10% slopes.
Rt	Roster Very Gravelly Sandy Loam, 15-45% slopes.
Rw	Rawah Fine Sandy Loam, 5-20% slopes.
SG	Catamount-Guffey Complex, 15-40% slopes.
SI	Ivywild-Catamount Very Gravelly Sandy Loams, 30-70% slopes.
SID	Silvercliff Very Gravelly Sandy Loam, Dry, 5-20% slopes.
SLB	Merino, Cool-Lakehelen-Rock Outcrop Complex, 15-55% slopes.
SpA	Spinth Loam, 0-1% slopes.
Sg	Merino-Rock Outcrop Complex, 5-55% slopes.
St	Jodero Loam, 2-6% slopes.
Sw	Sawfork Very Cobbly Loam, 20-50% slopes.
Sz	Seitz Very Gravelly Loam, 20-50% slopes.
TA	Temdille-Levenmile Sandy Loams, 1-3% slopes.
TA	Mine Tailings.
TC	Temdille-Levenmile Sandy Loams, 3-12% slopes.
Te	Tellura gravelly loam, 25-50% slopes.
Th	Thiel Gravelly Loam, 2-8% slopes.
Tl	Teaspoon Very Gravelly Sandy Loam, 10-40% slopes.
TR	Teaspoon-Rock Outcrop Complex, 5-45% slopes, very stony.
TS	Tellura-Seitz Complex, 10-30% slopes.

UC UW	Martinsdale-Cathedral-Corpening Complex, 5-40% slopes. Ula Variant-Unnamed Complex, 15-40% slopes.
VR VV	Vorsid-Rock Outcrop Complex, 3-10% slopes. Vorsid-Roster-Sawcreek-Like Complex, 3-20% slopes.
W Wh WR	Water UW Unnamed Channery Loam, 5-15% slopes. Unnamed-Rock Outcrop Complex, 15-50% slopes.