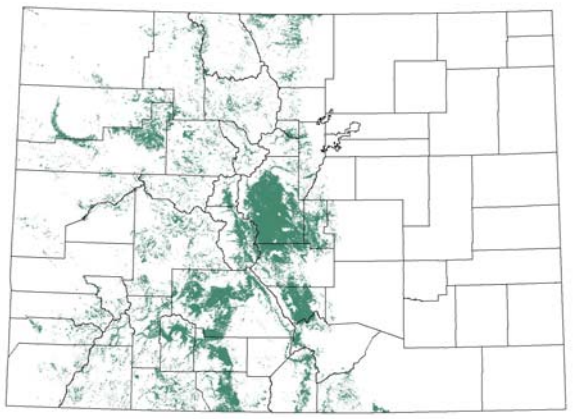
SOUTHERN ROCKY MOUNTAIN MONTANE-SUBALPINE GRASSLAND

D. Culver



Extent exagerated for display

DANTHONIA INTERMEDIA HERBACEOUS ALLIANCE
- *Danthonia intermedia - Solidago multiradiata* Herbaceous Vegetation
- *Danthonia intermedia* Herbaceous Vegetation

DANTHONIA PARRYI HERBACEOUS ALLIANCE
- *Danthonia parryi* Herbaceous Vegetation

DESCHAMPSIA CAESPITOSA SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Deschampsia caespitosa* Herbaceous Vegetation

FESTUCA ARIZONICA HERBACEOUS ALLIANCE
- *Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation
- *Festuca arizonica - Muhlenbergia montana* Herbaceous Vegetation

FESTUCA IDAHOENSIS HERBACEOUS ALLIANCE
- *Festuca idahoensis - Festuca thurberi* Herbaceous Vegetation
- *Festuca idahoensis - Geranium viscosissimum* Herbaceous Vegetation

FESTUCA THURBERI HERBACEOUS ALLIANCE
- *Festuca thurberi - Lathyrus lanszwertii* var. *leucanthus* Herbaceous Vegetation
- *Festuca thurberi* Subalpine Grassland Herbaceous Vegetation

LEYMUS CINEREUS HERBACEOUS ALLIANCE
- *Leymus cinereus* Herbaceous Vegetation

MUHLENBERGIA FILICULMIS HERBACEOUS ALLIANCE
- *Muhlenbergia filiculmis* Herbaceous Vegetation

MUHLENBERGIA MONTANA HERBACEOUS ALLIANCE
- *Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation
- *Muhlenbergia montana* Herbaceous Vegetation

PASCOPYRUM SMITHII HERBACEOUS ALLIANCE
- *Pascopyrum smithii - Bouteloua gracilis* Herbaceous Vegetation

POA FENDLERIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
- *Poa fendleriana* Herbaceous Vegetation

PSEUDOROEGNERIA SPICATA HERBACEOUS ALLIANCE
- *Pseudoroegneria spicata - Poa fendleriana* Herbaceous Vegetation
- *Pseudoroegneria spicata* Herbaceous Vegetation

Overview: This ecological system typically occurs between 2200-3000 m (in the Colorado Rockies) on flat to rolling plains and parks or on lower sideslopes that are dry. These large patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado) they form the "matrix" of high-elevation plateaus. Although the largest occurrences are primarily within Colorado, examples are scattered throughout the region from Wyoming to New Mexico.

Characteristic species: These large patch grasslands are intermixed with forests of spruce-fir, lodgepole, ponderosa pine, mixed conifers, and aspen. Within the subalpine zone, forbs tend to be more prominent at higher elevations, and shrubs at lower elevations (Turner and Paulsen 1976). Associations are variable depending on site factors such as slope, aspect, precipitation, etc., but generally lower elevation montane grasslands are more xeric and dominated by *Muhlenbergia* spp., *Pseudoroegneria spicata, Festuca arizonica*, and *Festuca idahoensis*, while upper montane or subalpine grasslands are more mesic and may be dominated by *Festuca thurberi* or *Danthonia intermedia*. *Danthonia*

parryii is found across most of the elevational range of this system. Montane grasslands in the Colorado Front Range are often dominated by *Leucopoa kingii* or *Muhlenbergia montana* (Peet 1981). In the San Juan Mountains of southwestern Colorado, these grasslands are dominated by *Festuca thurberi* and other large bunch grasses (Jamieson et al. 1996). Grasses of the foothills and piedmont, such as *Bouteloua gracilis, Bouteloua curtipendula, Hesperostipa comata, Koeleria macrantha, Pascopyrum smithii, Poa secunda,* and *Schizachyrium scoparium* may be included in lower elevation occurrences. Higher, more mesic locations may support additional graminoid species including *Agrostis* spp., *Carex* spp., *Festuca brachyphylla, Juncus drummondii, Phleum alpinum, Poa* spp., *or Trisetum spicatum.* Woody species are generally sparse or absent, but occasional individuals from the surrounding forest communities may occur. Scattered dwarf-shrubs may be found in some occurences; species vary with elevation and location. Forbs are more common at higher elevations.

Environment: These are typically grasslands of forest openings and park-like expanses in the montane and subalpine coniferous forests. Although smaller montane grasslands are scattered throughout the Southern Rocky Mountains ecoregion, the largest occurrence by far (over a million acres) is on the valley floor of South Park in central Colorado. This ecological system typically occurs between 2,200 and 3,000 m (7,200 and 10,000 feet) on gentle to steep slopes, parks, or on lower sideslopes that are dry, but it may extend up to 3,350 m (11,000 ft) on warm aspects.

The general climate in the range of this ecological system is typically montane to subalpine, characterized by cold winters and relatively cool summers, although temperatures are more moderate at lower elevations. Precipitation patterns differ between the east and west sides of the Continental Divide. In general, these grasslands experience long winters, deep snow, and short growing seasons. Average annual precipitation ranges between 20 to 40 inches, and the majority of this falls as snow (Turner and Paulsen 1976). Snowcover in some areas can last from October to May, and serves to insulate the plants beneath from periodic subzero temperatures. Other areas are kept free from snow by wind. Rapid spring snowmelt usually saturates the soil, and, when temperatures rise plant growth is rapid. Precipitation during the growing season is highly variable, but provides less moisture than snowmelt. Growing seasons are short, typically from June through August at intermediate locations, although frost can occur at almost any time.

The geology of the Southern Rocky Mountains is extremely complex. Not surprisingly, soils are also highly variable, depending on the parent materials from which they were derived and the conditions under which they developed. Podzolic soils have developed on most high mountain areas as a result of cool to cold temperatures, relatively abundant moisture, and the dominant coniferous forest vegetation. In the intermingled parks and open treeless slopes or ridges, grassland soils have developed. Soil texture is important in explaining the existence of montane-subalpine grasslands (Peet 2000). These grasslands often occupy the fine-textured alluvial of colluvial soils of valley bottoms, in contrast to the coarse, rocky material of adjacent forested slopes (Peet 2000). Soils are often similar to prairie soils, with a dark brown A-horizon that is rich in organic matter, well drained, and slightly acidic (Turner and Paulsen 1976). Other factors that may explain the absence of trees in this system are soil moisture (too much or too little), competition from established herbaceous species, cold air drainage and frost pockets, high snow accumulation, beaver activity, slow recovery from fire, and snow slides (Daubenmire 1943, Knight 1994, Peet 2000). Where grasslands occurr intermixed with forested areas, the less pronounced environmental differences mean that trees are more likely to invade (Turner and Paulsen 1976).

Dynamics: A variety of factors, including fire, wind, cold-air drainage, climatic variation, soil properties, competition, and grazing have been proposed as mechanisms that maintain open grasslands and parks in forest surroundings. Observations and repeat photography studies in sites throughout the southern Rocky Mountains indicate that trees do invade open areas, but that the mechanisms responsible for this trend may differ from site to site. Anderson and Baker (2005) discounted fire suppression as the cause of tree invasions in Wyoming's Medicine Bow Mountains, concluding that edaphic conditions were the most likely factor limiting tree establishment. In the San Juan Mountains of southeastern Colorado, Zier and Baker (2006) also found that the probability of tree

invasion varied with forest type. Climatic variation, fire exclusion, and grazing appear to interact with edaphic factors to facilitate or hinder tree invasion in these grasslands (Zier and Baker 2006). In the Gunnison Basin, Schauer et al. (1998) identified seedling mortality as the primary factor preventing invasions of Engelmann spruce, but did not determine if this was due to competition from established grassland plants, or to edaphic conditions. The work of Coop and Givnish (2007) in the Jemez Mountains of northern New Mexico suggests that both changing disturbance regimes and climatic factors are linked to tree establishment in some montane grasslands. Pocket gophers (*Thomomys* spp.) are a widespread source of disturbance in montane-subalpine grasslands. The activities of these burrowing mammals result in increased aeration, mixing of soil, and infiltration of water, and are an important component of normal soil formation and erosion (Ellison 1946). In addition, Cantor and Whitham (1989) found that below-ground herbivory of pocket gophers restricted establishement of aspen to rocky areas in Arizona mountain meadows. The interaction of multiple factors indicates that management for the maintenance of these montane and subalpine grasslands may be complex.

Grazing by domestic livestock may act to override or mask whatever natural mechanism is responsible for maintaining a occurrence. Montane-subalpine grasslands were first grazed by domestic livestock beginning in the late 1800's (Turner and Paulsen 1976). After lower-elevation, more accessible rangelands were overstocked in the 1870's and 1880's, use of montane and subalpine grasslands increased dramatically. By the turn of the century nearly all grazable land was being utilized, and much was already overgrazed (Turner and Paulsen 1976). As National Forests were established following the Organic Administration Act of 1897, regulation of grazing on these high elevation grasslands was instituted. Use levels peaked near the end of the first World War, and current use levels are substantially lower than the highest previous level (Turner and Paulsen 1976).

Floristic composition in these grasslands is influenced by both environmental factors and grazing history. Grazing is generally believed to lead to the replacement of palatable species with less palatable ones more able to withstand grazing pressure (Smith 1967, Paulsen 1975, Brown 1994, but see Stohlgren et al. 1999). In general, palatable grasses are replaced by nonpalatable forbs or shrubs under cattle grazing (Smith 1967), while palatable forbs are characteristically absent from grasslands with a long history of sheep use (Turner and Paulsen 1976). Annual species are uncommon except on heavily disturbed areas.

Variation: Montane and subalpine grasslands are generally interspersed in forest communities as park-like openings that vary in size from a few to several thousand acres. A few exceptional occurrences are much larger, and should be considered separately from the majority of occurrences.

P. Lyon

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Rank:	A	*B*	*C*	D
① CONDITION				
Community structure	Native bunch grasses are dominant. If trees or shrubs are present, they are widely scattered and mature. Species richness is often high and includes several native grasses and a diverse forb component. Plant vigor is high.	Native bunch grasses are dominant. If trees or shrubs are present, they are widely scattered and mature. Species richness is often high and native bunchgrasses are dominant,	Native bunchgrasses present but may be nearly equal in canopy cover to non-native species. Trees and shrubs may have seedlings, juveniles, or saplings present. Alteration is extensive but potentially restorable over several decades.	Non-native species are dominant, native species have less than 10% canopy cover and 20% relative cover. Alteration is extensive and restoration potential is low.
Invasive exotics with major potential to alter structure and composition (e.g., non-native	Absent	May be present, but <1% cover	May be prominent in small and discrete patches	Present

thistle, *Bromus inermis, Poa pratensis, Bromus tectorum)*				
Other non-native spp.	<3% canopy cover	<10%, native species dominant	>20%	Dominant
Native increaser spp. *(Koelaria micrantha, Artemisia frigida)*	< 3%	<10%	Co-dominant or dominant	May be dominant
Disturbance	Fires are still part of this system. Livestock grazing, if present, is light and seasonally compatible.		Fire frequency may have been altered, although easily restored. Vehicle use or livestock grazing disturbance, if present, is extensive and significant enough to have notable impact on species composition, soil compaction and stability.	Fire frequency may be greatly altered and difficult to restore. Vehicle use or livestock grazing disturbance, if present, is extensive and significant enough to have notable impact on species composition, soil compaction and stability. System remains fundamentally compromised despite restoration of some processes.
Ground cover & soils	Drainages are natural stable channels with no signs of unnatural erosion. The soil surface should show slight to no evidence of rills, wind scoured areas, or pedestaled plants. Plant cover is adequate to protect from excess soil erosion. Soils have a distinct A-horizon and are very stable (low erosion rate). Soils are not compacted.	Water flow patterns nearly match what is expected for the site; erosion is minor. Soil surface loss or degradation is moderate in plant interspaces with some degradation beneath plant canopies. Slight active pedestalling. Bare areas are of moderate size and sporadically connected. Litter buildup may be present in some areas, Soil structure is degraded and soil organic matter content is significantly reduced. Soil compaction moderately widespread.	Deposition and cut areas common; occasionally connected. Soil surface resistance to erosion significantly reduced in most plant canopy interspaces and moderately reduced beneath plant canopies. Moderately active pedestalling. Bare ground is moderate to much higher than expected for the site. Bare areas are large and often connected. Soil surface loss or degradation may be severe throughout the site. Soil compaction may be widespread.	Water flow patterns unstable with active erosion. Soil surface resistance to erosion may be extremely reduced throughout the site. Abundant active pedestalling and numerous terracettes. Bare ground is much higher than expected for the site. Bare areas are large and generally connected. Soil compaction is extensive throughout the occurrence.
② LANDSCAPE CONTEXT				
Connectivity	No unnatural barriers present. Connectivity of adjacent systems allows natural ecological processes, e.g., fire to occur.	Few non-natural barriers present. development not directly adjacent to the occurrence. Limited or minor human-caused alteration of landscape. Adjacent systems surrounding occurrence have moderate urban or agricultural alteration (60-90% natural) but retaining much connectivity.	Adjacent systems surrounding occurrence are fragmented by alteration (20 – 60% natural), with limited connectivity. Some non-natural barriers are present.	Connectivity is severely hampered
Surrounding land	At least 90% native and unaltered landscape with very little to no urban development or agriculture, and little to no industrial forestry	Surrounding landscape composed of at least 75% natural or semi-natural vegetation, with any urban development not directly adjacent to the occurrence.	Surrounding landscape is a mosaic of agricultural or semi-developed areas with >50% natural or semi-natural vegetation. Some non-natural barriers are present. Significant disturbance, but easily restorable.	Major human-caused alteration of surrounding landscape. Adjacent systems surrounding occurrence are mostly converted to agricultural or urban uses.
③SIZE				
Acres South Park	>500 >5000	50-500 2000-5000	25-50 1000-5000	< 25 < 1000