Plant Associations and Related Botanical Inventory of the Beaverhead Mountains Section, Montana

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Table of Contents

Figures

Tables

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Executive Summary

This project represents a comprehensive effort to identify and document all plant community types present in the Montana portion of the Beaverhead Mountains Ecoregional Section. The study area is an ecoregion defined by R.G. Bailey that extends from the Centennial Mountains south of Red Rock Lakes National Wildlife Refuge in southwestern Montana, west to the Continental Divide along the Beaverhead Mountains and includes the headwaters of the Beaverhead, Madison and Clarks Fork River.

Our goal for this project was to compile ecology plot data, validate and refine existing plant association types and combine them into a new classification following the National Vegetation Classification Standard. We tapped a number of previous and ongoing studies, and conducted extensive plant community surveys during 1998 field season. The result is a classification documenting 273 plant communities in the Beaverhead Mountains Section of southwest Montana.

This classification has three major components. *The first is a* complete list of 273 plant associations with state and global Heritage ranks that reflect their conservation status. The second component is a dichotomous plant association key organized by physiognomic type. The key is arranged according to the National Vegetation Classification, using the concept of forest, woodland, shrubland and herbaceous vegetation, and includes a number of newly identified vegetation types. The third component consists of standardized descriptions for 130 plant associations.

The results of this study underscore the high diversity of plants and vegetation types in this region of Montana. Over half of the 480 plant associations identified for the state of Montana (57%) were documented to occur within the Beaverhead Mountains Section. This is especially impressive, given that the region comprises less than one-tenth of the state's total land area.

Of these 480 plant associations, just over 25% were ranked G3 or higher (some tentatively), indicating rangewide/global rarity or imperilment. The rarest community documented (ranked G1) was *Artemisia cana/Leymus cinereus* shrubland, found in a single location at Big Muddy Creek. Some of the communities ranked as imperiled (G2) occur in bottomlands or riparian areas, and are at greatest risks from certain grazing practices, weeds, and in some cases conversion to agriculture. Others occur as small patches in alpine or high subalpine environments, and are not particularly threatened. Yet another community, *Elymus lanceolatus / Phacelia hastata*, occurs in the Centennial Sandhills and relies on a natural disturbance regime maintained by animal- or fire-induced blowouts. Over time, some communities will decrease in rank, as additional stands are discovered while others may become imperiled and increase in rank due to loss of habitat or the increase of noxious weeds.

In addition to plant communities, this study also identified 130 plant species of global or state special concern that occur in the Beaverhead Mountains Section. This represents 30% of all special concern vascular plant species tracked in Montana, and includes 41% of all those that are globally significant (G1-G3). Most of these occur on at one or more locations on BLM administered public lands. The Beaverhead Section also supports 18 plant species that are endemic to Montana (occur nowhere else); this represents 31% of Montana's endemic plant species. The regions geological diversity, vertical relief, and the unique intersection Pacific and Gulf (of Mexico) storm tracks, as well as the overlap of several floristic elements explain the diversity of plants and vegetation communities.

Finally, six landscapes of exceptional ecological significance were identified, based upon the diversity and conditions of vegetation communities represented, and are described in this report. They include Bannock, Blacktail & Robb-Ledford, Centennial Mountains & Valley, Centennial Sandhills, Johnson Gulch-Deer Canyon Creek, and Morrison Lake Wetlands and Baldy Mountain. Each includes BLM lands, as well as other types of public ownership.

The Beaverhead Mountains Section is the first large ecoregional unit in Montana with a comprehensive Vegetation Classification compiled in a single document. This report reflects our current knowledge, and is by no means exhaustive. Additional survey work is needed to better document the globally imperiled plant communities and to provide better information to assist in their conservation and management. There is also a need for additional inventory and documentation of good quality, representative communities, and significant landscapes. These areas, and the limited resources they support, are of considerable ecological value and are worth managing to maintain their ecological value character.

Introduction

The Beaverhead Mountains Section in southwestern Montana is a complex physical environment supporting a diverse landscape that is reflected in the number and physiognomy of natural plant communities. A classification of these communities gives land managers, researchers and interested citizens a statewide perspective of community distribution and variation. This perspective is crucial when identifying important areas for conservation and for making sound management prescriptions or predictions regarding future desired conditions of Montana's natural heritage. This project publication represents one milestone in the course of developing a comprehensive classification of Montana's plant communities.

This project endeavors to provide a compilation and description of plant communities within the Beaverhead Mountains Section (BVHDMS), in southwest Montana. It constitutes both an update of previous studies and a terminal report for recent plant community and botanical survey work conducted by the Montana Natural Heritage Program (MTNHP). The Beaverhead Mountains Section is an ecoregion defined by R. G. Bailey (1995, McNab and Avers 1994) within the Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow Province. The Montana portion of this section is an area of some 7,050,000 acres. We choose this ecoregion for a pilot effort in developing a comprehensive community classification because 1) an ecoregion is expected to be a meaningful ecological unit for the classification of plant communities, 2) BVHDMS has been intensively sampled for community classification purposes and 3) this area possesses a wealth of plant community diversity and is pivotal to our understanding of the states natural resources.

Several preceding MTNHP efforts have concentrated on the inventory of BLM lands within the Dillon Resource Area (RA), to a lesser extent the Headwaters RA and peripherally the Garnet RA. These efforts have emphasized locating, sampling and describing 1) what appeared to be previously undescribed communities and 2) common communities in good to excellent condition (relatively free of disturbance) 3) habitats expected to harbor sensitive, endangered or threatened plant species. We have also attempted to seek out and include data not generated by the MTNHP, but rather produced by other reliable sources such as the U. S. Forest Service's ECODATA plots (from Region 1 and the Beaverhead National Forest) and plots from classifications already in use, such as those of U. S. Forest Service research personnel, e.g. R. D. Pfister (Pfister et al. 1977) and W. F. Mueggler (Mueggler and Stewart 1980) and the Montana Riparian / Wetland Association (Hansen et al. 1995). In many cases the vegetation types (habitat types or climax plant associations) defined by the Forest Service and other researchers constitute initial attempts at classification; however, these classifications and their imbedded vegetation types have withstood the test of time and been shown to effectively partition the landscape into units of comparable biologic potential.

More recently there has been an impetus to create a national vegetation classification (Loucks 1996), a classification focused more on existing vegetation than on potential natural vegetation (as has been the case in Montana). The initial effort in this regard has been "International classification of ecological communities: Terrestrial vegetation of the United States Volume I. The National Vegetation Classification System: development, status, and applications" Grossman et al. (1998) and Volume 2 "The National Vegetation Classification System: List of types" Anderson et al. 1998. Both these volumes are products of The Nature Conservancy and their stated purpose is to serve as useful implements for making on-the-ground conservation and resource management decisions. The Federal Geographic Data Committee-Vegetation Subcommittee (on which all federal agencies are represented) has produced a document "National Vegetation

Classification Standard, June 1997" which, among other things, subscribes to the TNC National Vegetation Classification, at least accepting all the hierarchical levels that treat physiognomy (structure and appearance of vegetation) and reserving judgement only on the floristically defined levels, alliance and plant association, pending analysis and a report from the Ecological Society of America.

To make a classification useful, a means of somewhat unequivocally and objectively identifying taxonomic units must be provided in the form of a key. In this report we have adopted the National Vegetation Classification hierarchy and its keys, at least down to the Formation level. At the floristic levels (alliance and plant association) we have both adopted, as originally constructed, and modified the keys of preceding ecologists/ researchers. Dichotomous keys are not classifications, but they are the window to the classification and sincere attention has been paid to capturing the classificatory ideals of our predecessors, while simultaneously synthesizing and incorporating insights gained in subsequent sampling. This resulting classification with its accompanying vegetation key and descriptions of plant associations will be useful for the identification of plant community types (referred to more formally by their taxonomic status as plant associations), especially sensitive ones and natural areas where management prescriptions need adjusting to maintain habitat values. An important function of the classification is to serve as a surrogate for the categorization of environmental variation; it also serves as a reference system for baseline monitoring of environmental impacts and vegetation recovery.

Study Area

This report is generated from natural plant communities sampled or in some manner documented to occur within the Montana portion (Figure 1) of the Beaverhead Mountains Section (BVHDMS) and referenced as M332E in Bailey et al. (1994). The Montana portion alone comprises just over 7,000,000 acres and together with an almost equally large expanse in east-central Idaho constitute the largest Section within the Middle Rocky Mountain Steppe - Coniferous Forest- Alpine Meadow Province (M332, Bailey et al. 1994). The Montana portion of BVHDMS encompasses virtually all of Beaverhead and Silver Bow Counties, slightly more than the western half portion of Madison County, the southern half of Powell County, and all but the northernmost portion of Deer Lodge County (Figure 1).

Climate and related parameters

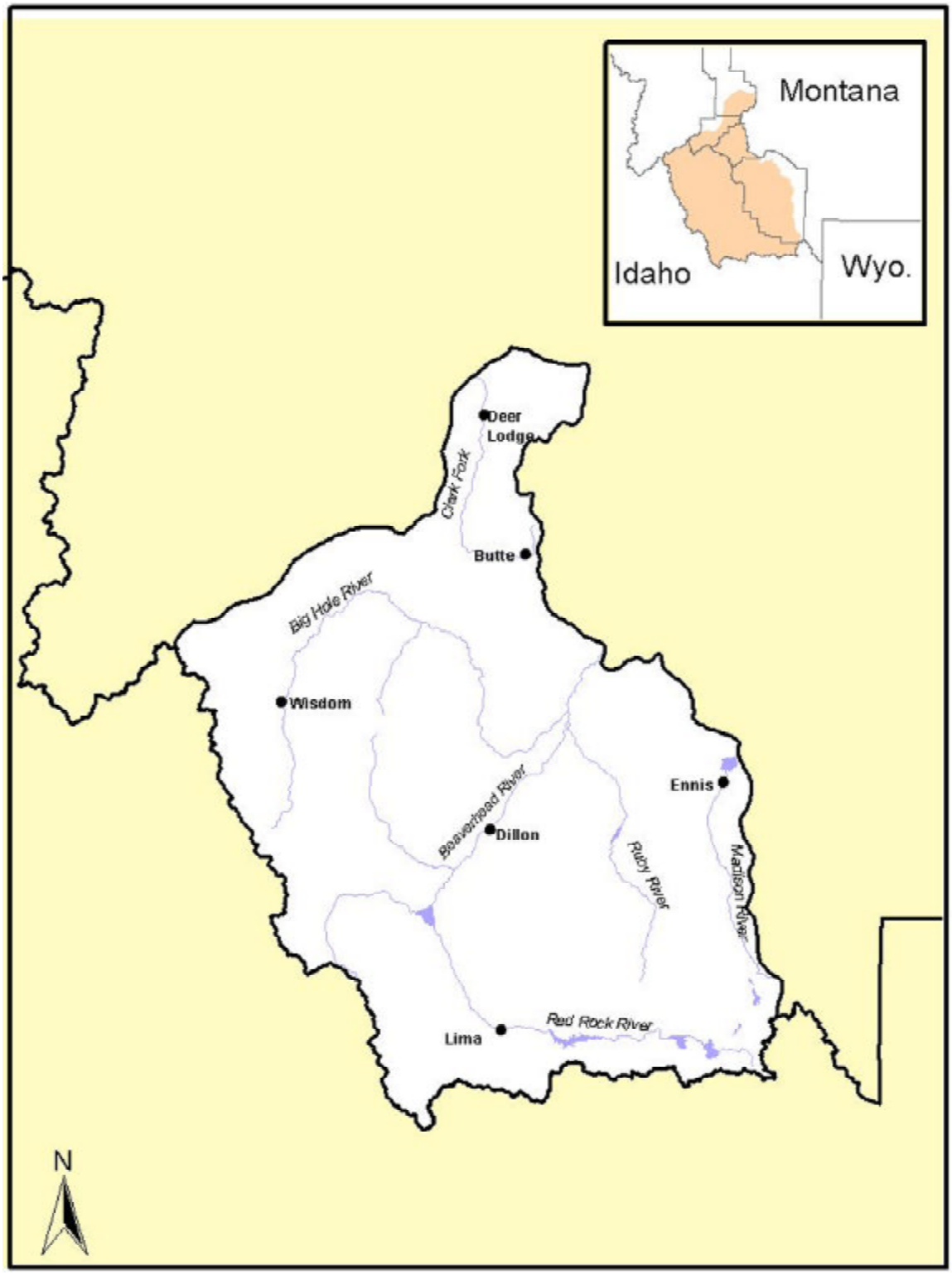
All of the study area experiences, with local variations and permutations, a continental climate with cold, relatively dry winters with the months of greatest precipitation being May and June. It is a cool, dry country where sagebrush-grass communities cover the valleys and forests are restricted to higher elevations. Most of this ecoregion lies in the rainshadow of Oregon's Blue Mountains and central Idaho's high mountain mass, meaning it receives lesser amounts of precipitation from Pacific storm systems than other Montana ecoregions to the north. Average annual precipitation varies from over 50 inches at the Pioneer Mountain's crest to between 8 and 16 inches throughout the bulk of the study area (see sheets 3 and 4 in Ross and Hunter 1976). Summers are relatively dry with orographically generated precipitation events (moisture source often being northward flowing Gulfsteam air masses) having their greatest frequency and impact on anywhere in Montana, in these southwestern mountains. The average length of the freeze-free season varies from less than 30 days to more than 70 days, at highest and lowest elevations, respectively (see Figure 13 in Montagne et al. 1982).

The severity of climate is attested to the relatively narrow forested zone, lower timberline being at 6,000 to 7,500 feet and the upper at 9,300 to 9,500 feet. In fact, the driest of ranges south of Dillon have forest restricted to north-facing slopes and ravines and sagebrush-grass communities extend up through what would conventionally be the forested subalpine zone. The fact that throughout this ecoregion *Pinus ponderosa* (Ponderosa pine) is replaced by *Pseudotsuga menziesii* (Douglas fir) and/or *Pinus flexilis* (limber pine) at lower treeline also attests to a cold climate. The presence of *Larix lyallii* (subalpine larch) at upper treeline in the Anaconda-Pintlar Ranges is quite possibly testimony to the high snow load experienced by these northernmost-ranges within this ecoregion. Other observations could be made with regard to species distribution ostensibly correlated with climatic parameters but the above cited are the most salient in distinguishing this ecoregion.

Physiography and related parameters

The study area encompasses approximately 7,050,000 million acres and ranges in elevation from 4,500 ft. on the Beaverhead River at Silver Star to 11,154 ft. at the summit of Tweedy Mtn. in the East Pioneer Range, encompassing no less than nine distinct mountain ranges. This area's diverse topography, high relief and climatic variability give rise, when overlain on a broad spectrum of parent material types ranging from intrusive and extrusive volcanics, calcareous and non calcareous sedimentary, coarse-grained metamorphic, all textures of valley fill sediment, to an abundance of unique environments. The East Pioneer, Tobacco Root, Pintlar, Beaverhead, Gravelly, Snowcrest, Tendoy and Centennial Ranges have all experienced Pleistocene alpine glaciation (Montagne 1972) and today support extensive alpine communities. Beyond the above observations there is

Figure 1. Beaverhead Mountains Section Study Area, Montana



little that can be said that applies to and distinguishes the whole BVHDMS ecoregion. The incredible diversity of the physical landscape is reflected by the fact that the section contains eleven subsections (Figure 2), more than any other section within the state; the differences among subsections are based largely on geological or geomorphologic criteria, that is, they are comprised of mountain ranges or aggregations thereof and the intervening valleys. This diversity is best addressed by considering the eleven subsections presented below in alphabetical order according to their subsection designations (small case letter trailing the capital E). These brief descriptions have largely been abstracted from Nesser et al. (1997).

This setting also supports high vascular plant species diversity in terms of total numbers, endemism, and biogeographic elements. County floristic information is not available for Beaverhead and adjoining counties, but it is considered likely that the majority of the over 2,200 species and taxa below the species level documented in southwestern Montana occur in the study area. This is based on state floristic information initially compiled by Dorn (1984), augmented below the species level and cross-referenced to state sector by the U.S. Forest Service (Pierce 1997). The list of plants in southwestern counties represents roughly 80% of the vascular plant species in the state.

The diverse flora of the Beaverhead Mountains ecoregion is made up of species that have their centers of distribution in the Rocky Mountain, Great Basin or Great Plains; with fewer species present that are centered in the Snake River Plains, Columbia Plateau, Vancouverian, Boreal, and Arctic regions (Heidel et al. 1993). This does not include the widespread native species with no apparent centers of distribution, and the non-native species. It follows that the high floristic diversity is conducive to producing the notable community diversity found for the ecoregion.

In addition to these widely-distributed species, there are 18 Montana plant species of concern present in this region that are state or regional endemics, i.e., restricted in their worldwide distribution to an area that is half the size of Montana or less. This tally of endemic species is among the highest in the state. It was previously reported that southwestern Montana has the highest levels of endemism in Montana (Lesica1995). While information on the state flora and the Beaverhead Mountains ecoregion are too preliminary for quantitative analysis, the ecoregion has state significance in sheer numbers of species and levels of endemism.

Subsection Descriptions

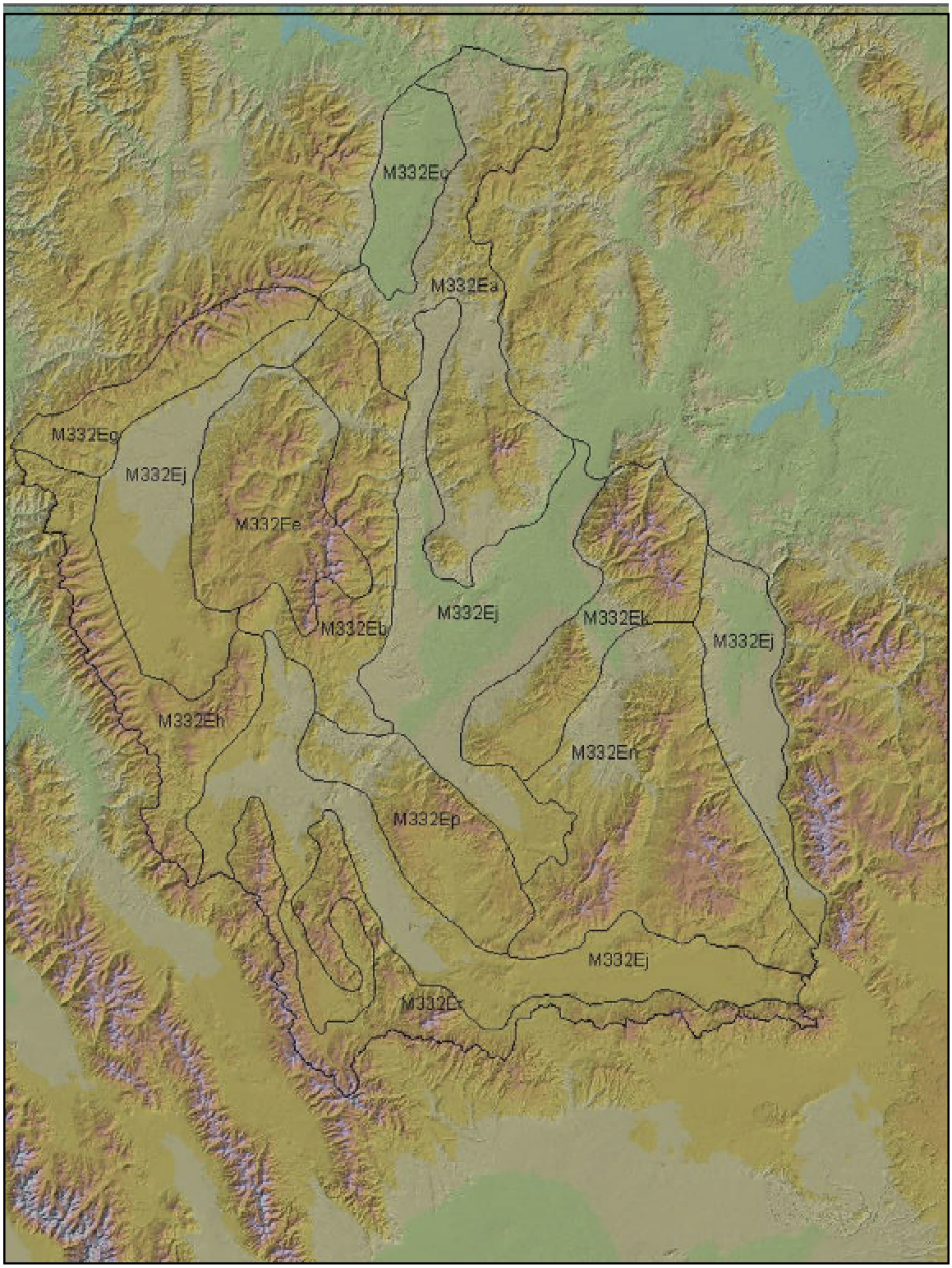
M332Ea Continental Divide Uplands

This subsection is composed of block faulted mountains (the Beaverhead Mountains of the Bitterroot Range) comprised of a variety of igneous sedimentary and metasedimentary rocks, including those of the Boulder Batholith. Elevations range from 5,300 to 10,200 feet whereas precipitation evidences about a three-fold range, from 10 to 30 inches. The potential vegetation ranges from foothill prairie at lowest elevations, to *Pseudotsuga menziesii* (Douglas fir) forest (currently mostly *Pinus contorta*-dominated), to alpine meadows and barrens. The primary natural disturbances are fire and mass wasting. Land use is varied, divided among livestock grazing, mining, timber harvest, recreational use and development.

M332Eb East Pioneer Mountains

Mostly calcareous substrates (largely limestone) comprise the block-faulted mountains at the southern end whereas at northern end intrusive volcanics, mostly granitics, predominate. This subsection encompasses the most vertical relief (from 6,000 to 11,150 feet), the highest elevations and the most area within the alpine zone (elevations above approximately 9,400 feet). Mean annual precipitation varies from 10 to 40+ inches. Potential vegetation is dominated by Douglas fir and Western spruce-fir forests with abundant alpine meadows and barrens at the highest elevations; fragments of foothill prairie extend upslope as park-like inclusions in a mostly forested landscape. Fire

Figure 2. Beaverhead Mountains Section and Subsection Boundaries, Montana



is the primary natural disturbance and the current dominant land use is livestock grazing, followed by timber harvest and recreation.

M332Ec Deerlodge Valley

This intermontane valley has formed in Tertiary sedimentary rocks and been subsequently filled with both Tertiary and Quaternary deposits. Elevations range from basins at approximately 4,400 feet, where salt-affected vegetation types are notable, to 6,000 feet where potential vegetation is sagebrush steppe (predominantly mountain big sagebrush-dominated) and foothills prairie (including remnant rough fescue [*Festuca campestris*] prairie). Mean annual precipitation ranges from 11 to 16 inches. Agriculture and livestock grazing are the predominant land uses with urban/suburban development growing in importance.

M332Ee West Pioneer Mountains

This mountain mass has considerably less vertical relief (5,500 to 9,500 feet) and appears as a dissected planar surface rather than jagged peaks when compared to M332Eb. It is notable for its lithological diversity, including volcanics (granitics), metamorphic (gneiss and phyllite), sedimentary and metasedimentary parent material. Potential vegetation ranges from mountain big sagebrush-dominated steppe on the lower slopes to Douglas-fir at montane elevations to Western spruce-fir forest at the highest elevations; elevations within this subsection are insufficient to support alpine vegetation.

M332Eg Anaconda Mountains

This subsection is characterized by block faulted mountains composed primarily of granular plutonic rock, mostly monzonite and granodiorite and altered by alpine glaciation, which has created numerous classic U-shaped valleys mantled with glacial till and drift. Elevations range from 6,000 to 10,900 feet, with the highest portions of the range receiving in excess of 40 inches annual precipitation. Potential vegetation is primarily Douglas-fir in the lower montane and Western spruce-fire forest in the upper montane and subalpine zones with diverse alpine communities represented. Past wildfires have left most of the range cloaked with seral lodgepole pine (*Pinus contorta*) forests. Among BVHDMS subsections this one is notable for both extensive heath-dominated alpine communities, (reflecting the subsection's acidic parent materials and high precipitation) and numerous stands of *Larix lyallii* (subalpine larch) at the highest forested elevations, generally on rocky, exposed substrates.

M332Eh Beaverhead Mountains

This subsection, which takes it name from the spine of mountains that traverse its length, is to a greater degree than other sections comprised of metasedimentary rocks (mostly argillite) that have been block faulted and subsequently modified by alpine glaciation. Elevations range from 6,800 to 10,600. As with the other sections, potential vegetation ranges from Douglas-fir forests in the montane to Western spruce-fir in the montane to subalpine zone to alpine meadows and barrens above approximately 9,5000 feet. It differs from other subsections in having greater annual precipitation (20 to 40 plus inches) and consequently a preponderance of the landscape is forested. The primary natural disturbance is fire. Timber harvest and, to a lesser extent, livestock grazing and mining are the primary land uses.

M332Eh Southwest Montana Intermontane Basins and Valleys

This landscape is characterized by intermontane basins and broad valleys that have formed in alluvium, glacial deposits and Tertiary volcanic materials. Elevations range from 4,700 to 7,600 feet and the drainage density is low. Mean annual precipitation ranges from 9 to 21 inches, about 10% of which falls as snow. Much of the Red Rocks Basin and Big Hole Valley have cryic temperature regimes because of their high base elevations and cold air ponding; this is in distinction to the remainder of the section where the temperature regime is simply frigid. The predominant potential vegetation is sagebrush steppe (any of the three subspecies of *Artemisia tridentata* as well as *A. tripartita, A. nova, A. arbuscula* and *A. cana*) and steppe (dominated by *Festuca idahoensis* [Idaho fescue] and *Pseudoroegneria spicata*

[bluebunch wheatgrass]). The primary natural disturbances are flooding and fire. Anthropogenic influences are livestock grazing, agriculture and urban/suburban development with hay production probably constituting the single largest replacement of native vegetation with introduced species and greatest alteration of the landscape.

M332Ek Ruby / Tobacco Root Mountains

Both ranges comprising this landscape are fault block mountains, however the lower (to 9,400 feet), unglaciated Ruby Range is primarily limestone with some quartzite whereas the higher (to 10,600) glacially sculpted and more dissected Tobacco Root Range has a broader spectrum of rock exposed, including gneiss, granite, sandstone, quartzite, and limestone. For the subsection as a whole annual precipitation ranges from 13 to 35 inches. Judging by vegetation patterns alone, the Ruby Range is considerably drier than the Tobacco Root Range with steppe vegetation extending higher up its flanks, having *Artemisia nova* (black sagebrush) as a significant shrub steppe component and having a greater extent of subalpine parks and virtually no subalpine fir (*Abies lasiocarpa*) represented. The Tobacco Root Range has abundant alpine meadow and barrens above 9,500 feet as well as extensive Western spruce–fir subalpine forests and at lower elevations Douglas-fir forests. The primary natural disturbance is fire. Past land use centered on mining and timber harvest but today livestock grazing and recreation are preeminent.

M332En Gravelly / Snowcrest Mountains

Both ranges are characterized by block faulted mountains composed of a variety of deposited materials, including shale, siltstone and sandstone; extrusive volcanics are very localized. Both ranges have also been significantly modified by glaciation and mass wasting. The terrain at the crest of the Gravelly Range is very gentle for a mountainous setting and supports the most extensive and accessible alpine terrain within the Section. Elevations range from 5,800 to 10,600 feet. Mean annual precipitation ranges from 14 to 30 plus inches. Both ranges lie in rainshadows of mountains to the west so that lower timberline is relatively elevated and mountain grasslands and shrublands are well represented on warmer aspects that would be forested in wetter climatic regimes. Potential forest vegetation is Douglas-fir at lower timberline which gives way to Western spruce-fir forest at higher elevations. Nearly pure stands of whitebark pine (*Pinus albicaulis*) are not uncommon on warmer-drier exposures at upper treeline. The primary natural disturbances are fire and mass wasting (slump landforms are abundantly evident in the sedimentary portion of the Gravelly Range). Livestock grazing and mining are the predominant land uses.

M332Ep Blacktail Mountains

This block faulted range is comprised of a variety of igneous, sedimentary and metamorphic rocks; alpine glaciation has impacted only the range's highest points. Elevations range from 6,900 to 9,500 feet. This is a comparatively dry subsection attributable to its rainshadow position in the lee of higher mountains to the west and southwest; mean annual precipitation ranges from 14 to 20 inches, about 50% falling as snow. The xeric nature of this subsection is borne out in the vegetation, which is predominantly grassland and shrub steppe on all but north-facing slopes of higher elevations. Potential forest vegetation is Douglas-fir or limber pine, except at the highest elevations on cool exposures where Western spruce-fir forests are found. Alpine turf and cushion plant communities are very limited, found on the highest ridgelines. Land use is predominantly livestock grazing with timber harvest and mining considered ancillary.

M332Er Southern Beaverhead Mountains

Sedimentary, metamorphic (especially quartzite) and igneous rocks that have been block faulted characterize this subsection comprised of the Centennial, Tendoy and Southern Beaverhead Mountains and Lima Peaks (considered part of the Tendoy Range by some). Alpine glaciation and extensive mass wasting have significantly altered the land-

scape (slumps and earth flows are especially evident in sedimentary materials on the flanks of the Centennial Range). Elevations range from 7,000 feet at the upper fringes of valleys within subsection M332Ej to almost 11,200 feet at Eighteen Mile Peak in the Beaverhead Mountains. Much of the landscape is characterized by mountain grasslands (*Festuca idahoensis*-dominated, Idaho fescue) and shrublands (*Artemisia tridentata* ssp. *vaseyana*-dominated, mountain big sagebrush) with elevations above approximately 9,400 feet characterized by alpine grasslands and turf, cushion plant communities and extensive fellfields and barrens. The extensive limestone substrates are droughty, tending not to support forest. Douglas-fir and limber pine (*Pinus flexilis*) constitute the potential forest series at lower elevations and on drier sites. Western spruce-fir forest predominate at higher elevations and Engelmann spruce (*Picea engelmannii*) seems to be favored over *Abies lasiocarpa* on the extensive calcareous substrates. This subsection, primarily on aeolian deposits and other substrates on the flanks of the Centennial Mountains, boasts the most extensive development of aspen (*Populus tremuloides*). The primary natural disturbances are fire and mass wasting. Livestock grazing and recreation constitute the major land uses.

Methods

Community Ecology: Data Collection

Original field sampling by the Montana Natural Heritage Program was conducted in three phases; an initial phase was centered on ten areas with acreage varying from 50 to 2,400 acres, selected by personnel of the Bureau of Land Management and sampled by R. DeVelice (1992). General descriptions of each of these ten sites included assessment of their biodiversity significance, current and past land use and suggested conservation management needs. A second phase of field sampling was conducted by S. Cooper and P. Lesica (intensive in 1994, very limited in 1995 and 1996) based on reconnaissance information collected by Lesica, J. Vanderhorst and B. Heidel in the course of inventorying for threatened and endangered species in the Centennial Valley and the Tendoy Range and surrounding valley lands. A third field season was undertaken in 1998 to explore those remaining sites or landscapes that has not received coverage in the preceding years and to increase the sampling of under documented plant associations.

In each of these areas sampling centered on putative rare or previously undescribed communities and on common communities in good to excellent condition (based on standard range criteria). To minimize the confounding influence of disturbance (man-induced) on vegetation patterns, areas intensively grazed, herbicide treated, mechanically disturbed, artificially seeded or irrigated were not sampled. Plots were established within portions of stands that appeared homogeneous, both in vegetation composition and site factors. Within a given area an attempt was made to sample the vegetation characteristic of different landscape positions or at least capture the communities distinctly different in composition occurring within a circumscribed topography. Plot selection focused on existing stands of vegetation with the objective of describing the composition of seral, as well as mature vegetation; however, bias toward more mature stages is implicit through the selection of undisturbed sites.

Within each 375 m^2 (used through 1992) or 1/10 acre plot (radii respectively of 35.8 ft and 37.3 ft.) all vascular species were recorded and their height and canopy cover (Daubenmire 1959) estimated using a 12 class scale. Abiotic site information, including elevation, aspect, slope, parent material, landform, slope position and erosion characteristics, was also recorded for all plots. Only the initial 52 plot sample of DeVelice (1992) systematically collected information necessary to determine soil subgroup and water holding capacity from a 20-inch deep reconnaissance soil pit.

All plot information was collected on Community Survey Forms and entered into E.C.A.D.S (Ecological Classification And Description System), the evolutionary descendent of ECODATA (USDA 1987), a USDA Forest Service community sampling package. In the course of the 1998 field season, 108 new plots were added to the ECADS database.

Community Ecology: Data Analysis

Plot data was acquired from US Forest Service Region 1 and combined with the MTNHP plot data. Species composition and cover data for each plot was then compared to existing classification schemes to determine the community type assignment. A number of plots did not fit any existing plant association description within Montana or elsewhere, in which case they were set aside for consideration as representing new or unique communities. Plot data were not subjected to rigorous objective (multivariate) analysis. Though this is not a scientifically rigorous process, for the limited number of plots that did not fit, this constituted an efficient approach. The various iterations in the software and database structure (variations of ECODATA and ECADS) as well as the changing plant

synonymy and its bearing on the database presented a logistic impasse at this time; we were unable to marshall all the plot data and produce synthesis and constancy/cover tables for all the plant associations with good plot data. Instead, we have produced these tables for the plot data collected in field season 1998. The following section describes the process we have followed in the past for analyzing our plot database.

Analysis constituted a combination of ordination, to describe general patterns of communities in relation to environmental gradient, and classification to ascertain and describe community types.

Objective classification was accomplished using two-way indicator species analysis (TWINSPAN, Hill 1979b) whereas STRATA (USDA Forest Service) was employed to subjectively allocate plots to community types based on vegetation similarity values as well as subjectively perceived similarities and differences in site factors and treatments. Ordination was performed using detrended correspondence analysis (DECORANA, Hill 1979a). Species cover values for each plot constituted the input data. Both TWINSPAN and DECORANA are based on the mathematical strategy (i.e., reciprocal averaging; Hill 1979a, b) and thus afford direct comparison between the results of the two techniques. No data transformations were employed and all default options in TWINSPAN algorithm were used, except that pseudospecies cut levels were set at 0, 5 and 20 percent cover. All default options were employed when running the ordination algorithms. To reduce variation (beta diversity) when running ordinations datasets were stratified by lifeform with 10 percent combined cover of trees or shrubs sufficient to place plots within these lifeform groups. Forb-dominated plots were not separated from graminoid-dominated. Further reduction in beta diversity and resulting clarity of vegetation patterns was achieved by separating the obviously moist to wet-site plots from those of uplands.

Given the existence of numerous accepted classifications and not wanting to create unnecessary confusion, we were conservative in recognizing new community types. TWINSPAN was particularly effective in pointing to particular plots that were placed in TWINSPAN classes that differed significantly from those categories they would be placed in existing classifications or following existing keys. TWINSPAN is also efficiently employed in constructing keys, i.e. looking for diagnostic species and defining appropriate cover values at which to make the breaks between community types. Ordination, in addition to helping refine the classification, assisted in describing and interpreting general patterns of vegetation communities and environment. For example, DECORANA extracts the dominant compositional gradient from the species data matrix. The environmental controls of these compositional gradients are then interpreted based on comparisons with the abiotic site data.

Botany: Plant Species of Special Concern

Locations of Plants of Special Concern previously documented within Beaverhead Mountains Section were queried from the Heritage Program Biological Conservation Database (BCD) and their biological diversity significance summarized. Key elements of plant species biodiversity significance were identified in three categories:

1. Globally imperiled or vulnerable vascular plant species, including state and regional endemics and species otherwise vulnerable on a rangewide basis. This corresponds with global ranks G1-G3 used by The Nature Conservancy and network of natural heritage programs.

2. Vascular plant elements that occur in this region of Montana to the exclusion of all other regions in the state. These are species for which the Beaverhead Mountains Section ecoregion represents their only conservation opportunities in Montana.

3. Montana plant species of special concern occurring in aggregates within the region regardless of their global rank or state distribution, a third level of conservation priority. These are species that occur in patterns of overlapping distribution, collectively reflecting conservation priorities.

We did not conduct new fieldwork but drew heavily from secondary sources to synthesize available botanical literature, species documentation, and many years of study into a cohesive landscape picture. Areas within the Beaverhead Mountains Section have been the center of many plant surveys since the start of the Montana Natural Heritage Program and the start of the botany program in the Bureau of Land Management – Montana Office. Results from these studies have already been processed as element occurrence data, and synthesized as species status and biology information in BCD, as well as cross-referenced in a supporting bibliographic database.

Each species is ranked by a standardized set of criteria. Each place where a Montana plant species of special concern has been documented is referred to as an element occurrence record, and many of these are ranked in considering such factors as population numbers and threats. The point is that all of this information provides a basis for weighing the species and occurrences together, between agencies, and with other ecoregions.

Taxonomic Considerations

Plant scientific names used in this report generally correspond to those found in manuals of the Montana flora (Booth 1950, Booth and Wright, Dorn 1984) or the regional manual of high repute "Flora of the Pacific Northwest" (Hitchcock and Cronquist 1976). However, where there is a discrepancy between any of these references and Kartesz (1994) we have incorporated the Kartesz taxonomic treatment to maintain consistency with other states and current taxonomic research. This has resulted in incorporating unfamiliar-sounding names for some dominant and indicator species, particularly the grasses of the Triticeae (*Agropyron* and *Elymus* in the traditional sense). Thus, western wheatgrass, listed as *Agropyron smithii* in Hitchcock and Cronquist (1976) and as *Elymus smithii* in Dorn (1984), has become *Pascopyrum smithii* (Kartesz 1994). Use of common names may be preferable for such controversial or mercurial groups, especially for ease of communication in informal situations. Table 1 presents the synonymy for common dominant and indicator species encountered in the Beaverhead Mountains Section; we have also tried to consistently list synonyms in the vegetation keys but have removed them from the headings of the plant association descriptions. Synonymy is also provided in the Beaverhead Mountains Section floristic list (Appendix A).

Table 1. Synonymy of dominant and indicator plant species for the Beaverhead Mountains. Section Arranged by lifeform (tree, shrub, graminoid and forbs) and alphabetically by scientific name in column 2.

Common Name	Hitchcock & Cronquist (1976)	Dorn (1984)	Kartesz (1994)
black cottonwood	*Populus trichocarpa*	*P. balsamifera*	*P. balsamifera ssp. trichocarpa*
Sitka alder	*Alnus sinuata*	*Alnus viridis*	*A. viridis ssp. sinuata*
low sagebrush	*Artemisia arbuscula v. arbuscula*	*A. arbuscula*	*A. arbuscula ssp. arbuscula*
early low sagebrush	*Artemisia arbuscula v. arbuscula*	*A. longiloba*	*A. arbuscula ssp. longiloba*
black sagebrush	*Artemisia arbuscula v. nova*	*A. nova*	*A. nova*
Gardner's saltsage	*Atriplex nuttallii*	*Atriplex gardneri*	*A. gardneri*
bog birch	*Betula glandulosa*	*B. glandulosa*	*Betula nana*
red-osier dogwood	*Cornus stolonifera*	*C. stolonifera*	*Cornus sericea*
shrubby cinquefoil	*Potentilla fruticosa*	*Pentaphylloides floribunda*	*P. floribunda*
Booth willow (billberry willow)	*Salix myrtillifolia*	*Salix boothii*	*S. boothii*
bearded wheatgrass	*Agropyron caninum*	*Elymus trachycaulus*	*E. trachycaulus*
thick-spiked wheatgrass	*Agropyron dasystachyum*	*Elymus lanceolatus*	*E. lanceolatus*
western wheatgrass	*Agropyron smithii*	*Elymus smithii*	*Pascopyrum smithii*
bluebunch wheatgrass	*Agropyron spicatum*	*Elymus spicatus*	*Pseudoroegneria spicata*
long-stolon or sun sedge	*Carex pensylvanica*	*C. pensylvanica*	*Carex inops ssp. heliophila*
beaked sedge	*Carex rostrata*	*C. rostrata*	*Carex utriculata*
inland saltgrass	*Distichlis stricta*	*D. stricta*	*Distichlis spicata*
few-flowered spike-rush	*Eleocharis pauciflora*	*E. pauciflora*	*Eleocharis quinqueflora*
giant or basin wildrye	*Elymus cinereus*	*E. cinereus*	*Leymus cinereus*
rough fescue	*Festuca scabrella*	*F. scabrella*	*Festuca campestris*
spike fescue	*Leucopoa kingii*	*Hesperochloa kingii*	*Festuca kingii*
smooth woodrush	*Luzula hitchcockii*	*Luzula glabrata*	*L. glabrata v. hitchcockii*
Sandberg's bluegrass	*Poa sandbergii*	*Poa secunda*	*P. secunda*
alkali bluegrass	*Poa juncifolia*	*P. juncifolia*	*Poa secunda*
slender-flowered scurf-pea	*Psoralea tenuiflora*	*P. tenuiflora*	*Psoralidium tenuiflorum*
softstem bulrush	*Scirpus validus*	*S. validus*	*Scirpus tabernaemontani*
bottlebrush squirreltail	*Sitanion hystrix*	*Elymus elymoides*	*E. elymoides*
false spikenard	*Smilacina racemosa*	*S. racemosa*	*Maianthemum racemosum*
starry Solomon-plume	*Smilacina stellata*	*S. stellata*	*Maianthemum stellatum*
green needlegrass	*Stipa viridula*	*S. viridula*	*Nasella viridula*

Results and Discussion

Community Ecology

Of the 480 plant associations identified for the whole of Montana, over half (57%) occur within the Beaverhead Mountains Section (see Appendix A). Given that this Section comprises less than one tenth of the state's total land area, this concentration of community diversity is very high. There are two major reasons for this. First, the Beaverhead Mountains Section has received greater attention in terms of field sampling, of both plants and vegetation, than any other section in Montana; when more environments are explored, more community types are documented. Secondly, as noted in the description of the study area, this region exhibits the greatest geological diversity in the state, the most vertical relief, and the unique intersection of Pacific and Gulf (of Mexico) storm tracks, as well as the overlap of several floristic elements. The further effects of glaciation and periglacial climates have resulted in strong environmental gradients that drive species sorting and produce a high diversity of communities. This is exemplified by upland shrubland (or dwarf-shrubland) types. Shrublands types are more diverse here than elsewhere in Montana because of the many sagebrush taxa present as community dominants or indicators (all subspecies of *Artemisia tridentata* as well as *A. tripartita*, *A. arbuscula*, *A. arbuscula* ssp. longiloba, *A. nova*, *A. cana*, *A. pedatifida*, *A. frigida*, and *A. scopulorum).*

The Montana Natural Heritage Program tracks the diversity of plants, animals and natural communities (plant associations) at both state and global scales. Species and communities are given status ranks that reflect their conservation status based on rarity/extent, condition, trends and threats. Appendix B gives an explanation of the Natural Heritage Global Ranks. Table 2 illustrates the distribution of global ranks in the Beaverhead section by lifeform group.

Just over 25% of the plant associations in the Beaverhead Section are ranked G3 and higher, indicating rangewide vulnerability or imperilment. Many of these rankings are considered uncertain (denoted "?") because they are based on limited information. As more surveys are conducted, some will likely prove to be less rare than current data indicate. Other types will likely prove more imperiled, as we come to better understand stresses and threats to them.

The single plant association ranked G1 is the *Artemisia cana / Leymus cinereus* shrubland. This association was documented from a single location at Big Muddy Creek in the BVHDMS on an elevated landform above a seep-spring area at 6620 ft elevation. *Elymus trachycaulus* and *Poa nevadensis* are also found in the shrub understory.

Seven percent (19) of the 277 associations are ranked G2 (including G2? and G2G3) or higher. A number of G2 plant associations occur as small or large patch communities. This rank is justified, not so much on number of occurrences, but on threats. Communities particularly under threat from grazing practices include, among others, *Artemisia cana / Leymus cinereus, A. tridentata* ssp. *vaseyana / Leymus cinereus, A. tridentata* spp. *tridentata / L. cinereus, Artemisia tripartita / Pseudoroegneria spicata, Artemisia arbuscula* ssp. *longiloba / Elymus lanceolatus* and *Bromus carinatus – B. anomalus*. These same communities also bear lesser threats from cultivation (type conversion), noxious weeds, and roads.

For example, livestock and associated agricultural practices have demonstrably reduced the acreage of some riparian shrublands such as *Artemisia tridentata* ssp. *tridentata / Leymus cinereus*. The deep-soiled riparian terraces and valley bottom landforms that support this plant association have received enormous past livestock pressure. Much of the area has been converted to agricultural crops. These same productive bottomlands are prime habitat for a host of alien and native increasers; the most aggressive among which are *Poa pratensis*

Table 2. Distribution of community types by lifeform group and global rank.

Lifeform Group (Subclass level of the NVC, based on growth form and leaf phenology)	**Global Ranks** from rarest (low numerical value) to common and demonstrably secure (high numerical value). Ranks are defined in Appendix B.									
	G1	G2 G2? G2Q	G2G3 G2G3? G2G4	G3 G3? G3Q	G3G4 G3G4? G3G5	G4 G4? G4Q	G4G5	G5 G5?	G?	**Total by lifeform**
Deciduous Forest and Woodland				1		4		2	5	12
Evergreen Forest		3		5	2	20	1	24		55
Evergreen Woodland		1	1	6	1	11	1	9		30
Shrubland	1	2	2	20	4	24	1	8	13	75
Dwarf-shrublands		3	2	5	1	1	1	2	1	16
Herbaceous		4	1	22	1	27		12	17	85
Total by G-rank	**1**	**13**	**6**	**59**	**9**	**87**	**4**	**57**	**36**	**273**

(Kentucky bluegrass), *Poa palustris* (fowl bluegrass), *Phleum pratense* (timothy), *Bromus inermis* (smooth brome) and *Juncus balticus* (Baltic rush).

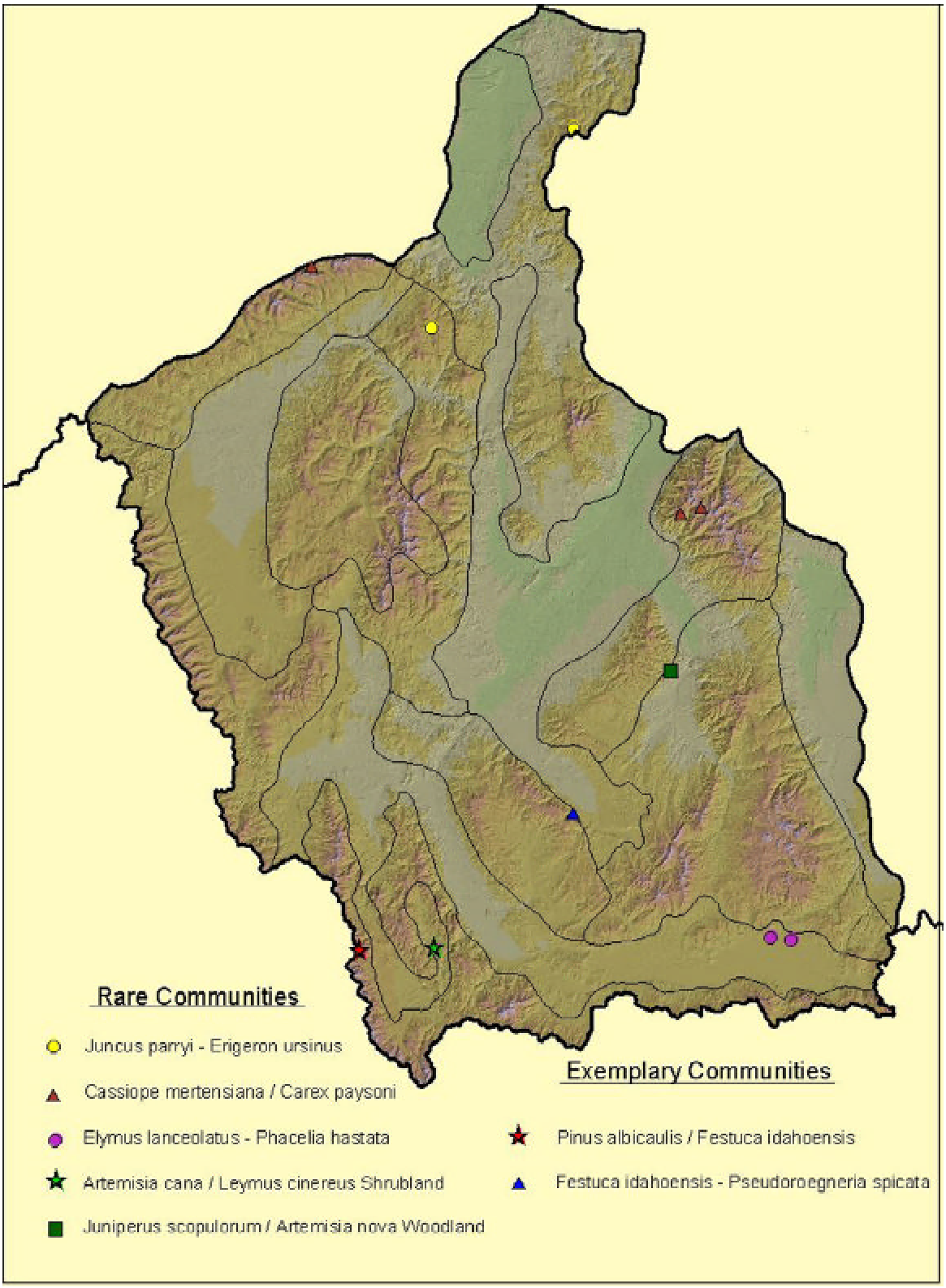
While weeds are considered perhaps the greatest threat to biodiversity within this ecoregion (and throughout the western U. S.), none of these species are considered weeds, although it is clear that they have significantly and irreversibly reduced biodiversity within this ecosystem. *Poa pratensis* is perhaps the most serious threat to native communities, as it possesses broad ecological amplitude, is very aggressive and tolerates intensive grazing. It even threatens some of the most broadly distributed and seemingly secure communities, particularly those of mesic environments where, for instance, *Deschampsia cespitosa* (tufted hairgrass) is currently a dominant or indicator species.

Another group of communities considered imperiled (G2 and greater) those of alpine and high subalpine environments, which occur only in restricted environments. Examples include *Salix arctica / Polygonum bistortoides*, *Juncus parryi / Erigeron ursinus*, *Festuca idahoensis - Festuca kingii* and *Cassiope mertensiana / Carex paysonis* (Figure 3). These communities occur as small patches in habitats that are highly restricted, at least in Montana. Given the difficulty of access, inventory of these types is still limited. These communities are not especially threatened, though livestock grazing, particularly sheep with their preference for forbs could adversely impact community composition.

One globally imperiled (G2) community that is known from relatively thorough surveys is *Elymus lanceolatus / Phacelia hastata*. This is a seral community that occurs only in the Centennial Sandhills (Figure 4), where it is sustained by animal- and/or fire-induced blowouts at regular intervals. Without this disturbance regime, the community would succeed to *Artemisia tridentata* spp. *tridentata / Stipa comata* or *A. tridentata* ssp. *vaseyana / Festuca idahoensis*, and its complement of sensitive species could be lost from the ecosystem (Lesica and Cooper 1998).

Many other community types in the Beaverhead Section are ranked "G?" indicating that no rank has yet been assigned. This group is made up of several shrubland types that we propose elevating to a trinomial name (*Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Geranium viscosissimum*

Figure 3. Locations of Select globally rare and exemplary plant associations, Beaverhead Mountains Section



Shrubland), as well as a few newly defined community types (*Bromus carinatus - Bromus anomalus* Herbaceous Vegetation) and a couple of anthroprogenic communities (*Poa pratensis* Herbaceous Vegetation).

The high global ranks assigned to some communities are probably outdated and need revision. Examples include *Alnus viridis* ssp. *sinuata* (Sitka alder), *Salix arctica / Polygonum bistortoides* and *Artemisia tripartita / Festuca idahoensis*, all of which are broadly distributed (across several states) and are under no particular threat. For instance, surveys have shown *A. viridis* ssp. *sinuata* p. a. to be a very conspicuous, long-persisting mostly seral community type in northwestern Montana, occurring in the subalpine zone where logging operations have caused soil compaction. Although it is considerably less common type in the BVHDMS, it is not imperiled on a state or global basis.

The Montana Natural Heritage Program also assigns state ranks to community types, applying the factors in Appendix B. at a state level. Appendix A includes a complete list of current state ranks for communities in the Beaverhead section. The following rank qualifiers are used with S-ranks only: **A**- Accidental or casual in the state; infrequent and outside usual range, **E**- Exotic established in the state and community named for said exotic, **P**- Potential that element (plant community) occurs in the state but no extant or historic occurrences reported, **R**- Reported to occur in the state but without a basis for accepting or rejecting the report.

In our analysis of plot records for this project, we identified three plant communities thought to be in Montana, but which had not previously been documented. These are *Artemisia tridentata* spp. *tridentata* / *Festuca idahoensis*, *Artemisia tridentata* spp. *tridentata* / *Pseudoroegneria spicata* and *Purshia tridentata / Pseudoroegneria spicata*. These types can now be given state ranks.

Six globally significant community types (G1-G3 ranks) have a state rank of S? These *include Puccinellia nuttalliana, Festuca idahoensis - Danthonia intermedia, Pseudoroegneria spicata - Oryzopsis hymenoides, Salix brachycarpa / Carex aquatilis, Artemisia tripartita / Pseudoroegneria spicata,* and *Artemisia cana / Leymus cinereus.* For these types our in-state knowledge of the status and distribution is fragmentary and we recommend additional efforts to locate occurrences, both to better document their distribution and status, and to assist in their conservation.

For community types that are considered rare in Montana (S1-S3) but widespread and secure globally (G4-G5), the Heritage Program seeks to document locations where they exist in exemplary, high quality condition. Some of these locations, as well as those supporting excellent stands or assemblages of globally significant types, are discussed below.

Landscapes of Significant Ecological Interest

The identification of landscapes harboring concentrations of plants, animals and communities of high conservation value facilitates conservation planning by bringing attention to areas of representative or unique characteristics. The Nature Conservancy is currently pursuing "ecoregional planning" for the Middle Rockies-Blue Mountain Ecoregion that includes the Beaverhead Mountains Section. This planning effort relies on computer models and actual biological data to parsimoniously select a portfolio of potential conservation sites. The goal of this planning is to protect biological diversity through conservation planning. The portfolio of sites will be screened by outside experts (agencies, academia, etc.) to detect errors of omission and commission. When the TNC efforts are complete a number of potential conservation sites within the Beaverhead Mountains Section will have been identified and shared with agencies to facilitate future consideration of these sites.

Observations and field studies by The Montana Natural Heritage Program have elevated the importance of natural landscapes in the BVHDMS. This brief sketch of landscapes

and their biodiversity significance is an initial effort calling attention to priority landscapes in the BVHDMS. These landscapes serve as a focus for conducting further site studies and may provide the impetus for future conservation easements, or special agency designations such as Area of Critical Environmental Concern (ACEC) or Botanical Interest Area. These landscape areas, some of which are already managed for special purposes e.g. State Game Management Area, provide a broadened perspective to managers and land owners as to the biological treasures they have under their aegis and may promote appreciation and appropriate stewardship.

Bannack Landscape

Location: The landscape encompasses the undeveloped ridge systems and Grasshopper Creek valley in and adjoining Bannack State Park, the historic capital of Montana Territory, located about 20 miles southwest of Dillon. It is made up of Bureau of Land Management (BLM) lands, and state lands that are managed by BLM.

Environment: Bannack lies at the heart of one of the major limestone/dolomite formations, or Madison group formations, in southern Montana. The contact zones between this sedimentary group of formations and igneous intrusions are often rich in precious minerals, and the historical Bannack settlement on Grasshopper Creek marked Montana's first major gold discovery. The valley was the hub of past placer mining, and is an area of concentrated pit mining activity today. Most of the surrounding uplands are made up of Tertiary basin sediments.

Bannack is surrounded by a major north-south ridge valley system at the southern end of the Pioneer Mountains, nestled in the steeply dissected Grasshopper Creek valley. There is over 1,000 foot relief within the 1,000 acre Park, and the surrounding uplands rise hundreds of feet higher along the ridge to the north and south. They are all part of extensive foothills made up of jagged outcrops, rugged hills and rolling plains.

Vegetation/Other Biological Features: Outstanding examples of the widespread *Cercocarpus ledifolius/ Pseudoroegneria spicata* shrubland (mountain mahogany/ / bluebunch wheatgrass) cover the valley slopes. Limber pines are scattered along the ridge outcrops and Douglas fir woodland covers the highest spine of the ridges. Sagebrush steppe prevails throughout most of the area, dominated by *Artemisia tridentata var. vaseyana / Pseudoroegneria spicata* shrubland *(*mountain big-sage / bluebunch wheatgrass). At the Park entrance, coarse alluvial deposits are dominated by *Stipa comata* (needle and thread grass) and *Pseudoroegneria spicata (*bluebunch wheatgrass).

This rugged landscape provides habitat for one of highest concentration of state and regional endemic plant species in southwestern Montana, including some of the largest known populations for four of them (Table 3). None of these globally rare plants have sites that are protected in Montana, and their low-elevation populations as found in the Bannack area are vulnerable. We note that some of them are no longer tracked but have been moved to the watch list - they are relatively secure in the state thanks to places like Bannack. The majority of Bannack's endemic species are located in the mountain mahogany shrubland, at the valley's edge.

There is also a historic record of *Penstemon lemhiensis* (Lemhi Penstemon) from the Grasshopper Valley in the Bannack area, but it is possibly extirpated. Two more species that are peripheral Great Basin species that were once considered rare in Montana are present in the Bannack area: *Arenaria kingii* and *Pediocactus simpsonii*.

The full scope of biological significance hinges on boundary delimitation. The Bannack area is assumed to include at least one mile to the north and northeast of the Park. The Cold Spring Creek to the east and Henneberry Ridge to the southeast represent two of the larger occurrences of *Astragalus scaphoides* (Bitterroot Milkvetch) in Montana. The Microwave Tower to the north represents the

Table 3. State and regional endemic plant species in the Bannack Landscape

Species	Common name	Species Status Comments	Distribution and abundance comments
Astragalus scaphoides	Bitterroot Milkvetch	Regional endemic	Center of species' distribution in Montana; large populations east of Bannack
Astragalus terminalis	Railhead Milkvetch	Regional endemic	East of Bannack
Lesquerella pulchella	Beautiful Bladderpod	State endemic	One of largest low elevation populations
Lomatium attenuatum	Taper-tip Desert-parsley	Regional endemic	One of largest low elevation populations
Phacelia incana	Hoary Phacelia	Regional endemic	One of largest low elevation populations
Sphaeromeria argentea	Chicken Sage	Regional endemic	One of largest populations
Delphinium bicolor ssp. Calcicola	Limestone Larkspur	State endemic - no longer tracked	One of largest populations
Mimulus suksdorfii	Suksdorf's Monkeyflower	Possibly a regional endemic - no longer tracked	Present at Bannack
Oryzopsis contracta	Contracted Ricegrass	Regional endemic - no longer tracked	One of largest populations in Montana

only sensitive plant conservation site on the Dillon Area of BLM, with an exclosure around part of a *Penstemon lemhiensis* (Lemhi Penstemon) population representing another regional endemic.

All of the species found in the Bannack area occur elsewhere on the landscape, but the Bannack area represents the highest concentration, and significant large populations for four of the tracked endemic species.

Condition/Conservation Value: Despite its history as an early hub for exploration and settlement in Montana, the ridges outside of the townsite and mining sites are surprisingly intact. The proximity of high biodiversity significance neighboring a historic settlement, ghost town, and state park; with all of its contemporary recreation and interpretive values, offers special education opportunities on top of the conservation value.

The Grasshopper Valley is among the few places where spotted knapweed (*Centaurea maculosa*) , a species that could spread throughout the landscape, is present in Beaverhead County. Diligent weed control efforts have been effective to date. Noxious weed invasion from the valley and from spread by vehicles or stock poses a major potential threat to all of the globally rare plant species in this area.

The majority of inventory work has been concentrated on plant species in Bannack State Park based on a study for Montana Department of Fish, Wildlife and Parks (Vanderhorst 1995). Status survey work for the BLM conducted on some of the regional endemic species has entailed visits to this and adjoining areas. We note that plant information is incomplete, and that information on animals and on plant communities still needs to be addressed to assess conservation values.

Blacktail & Robb-Ledford Landscape

Location: Alkali Creek and the East Fork of Blacktail Creek watersheds imprecisely define this landscape boundary. It covers the benchlands and foothills on the west flank of the Snowcrest Range to include all of the Blacktail State Wildlife Management Areas (SWMA) and approximately the southern half of Robb-Ledford (SWMA); hence the place name.

Environment: This landscape is comprised of rolling benchlands, mostly mantled with

ancient alluvium and underlain by sedimentary formations, with abrupt ridges and hogbacks more prominent approaching the Snowcrest Range. There are also outcrops, configured into prominent spires in places, of erosion resistant, unique sedimentary materials. Proper functioning first, second and third order steams, along with numerous seeps and springs, are also found in this landscape.

Vegetation/Other Biological Features: This landscape came to our attention through simple reconnaissance; driving through we noted localized areas that appeared at a distance to be weedy monocultures or planted introduced grasses. Upon closer inspection we found exceedingly productive grasslands dominated by highly palatable native graminoids such as *Stipa richardsonii* (Richardson's needlegrass), *Stipa occidentalis* (western needlegrass), *Bromus carinatus* (mountain brome), *B. anomalus* (nodding brome), and *Elymus trachycaulus* (bearded wheatgrass). These grasslands repeat in landscape positions where accumulation, either moisture (snow or groundwater), aeolian materials or both are deposited along toeslopes in lees of hills and north- and east facing slopes of ravines and draws. Soils are deep and nearly rock-free. The composition of these rich grasslands is unique in a landscape where grasslands are nearly always dominated by *Festuca idahoensis* (Idaho fescue), *Pseudoroegneria spicata* (bluebunch wheatgrass) and *Pascopyrum smithii* (western wheatgrass) or *Elymus lanceolatus,* (thickspike wheatgrass). It appeared that livestock grazing was of low intensity in the vicinity of these grasslands, though livestock grazing is by no means totally absent on these SWMA lands.

Besides those grasslands previously mentioned, this landscape includes a wide diversity of types, the majority of which appear to be in high ecological condition. Other grasslands range from *Pascopyrum smithii* (western wheatgrass) and *Elymus trachycaulus* (bearded wheatgrass) found on heavy soils at lower slope positions to *Stipa comata*, *Pseudoroegneria spicata* and *Calamagrostis montanensis* (plains reedgrass) found on sandy, thin-soil, or rocky and warm aspects.

Shrublands within this landscape are less diverse but include high quality occurrences of *Artemisia tridenta*ta ssp. *vaseyana* dominated communities as well as some uncommon state communities including Artemisia *tridentata* ssp. *vaseyana - Symphoricarpos oreophilus / Bromus carinatus* and *A. tridentata* ssp. *vaseyana - S. oreophilus / Festuca idahoensis* and *A. tridentata* ssp. *vaseyana - S. oreophilus / Elymus trachycaulus*. These three shrublands are not rare, but are rarely found north of ID or NV. Scattered *Populus tremuloides* (trembling aspen) groves are also found, but grazing had significantly impacted the few examined. The quality and composition of the riparian stringers has not been examined but willows appear healthy and not overly browsed.

Condition/Conservation Values: This landscape is notable for its representation of relatively intact grassland-shrubland ecosystems that are highly characteristic for this ecoregion and predominantly in good to excellent ecological condition. The area has a few road and agricultural impacts, such as the creation of scattered introduced-grass hay meadows. Although our reconnaissance was minimal, riparian vegetation seemed little impacted by livestock. Habitats found in this landscape are replicated in numerous places across the ecoregion, yet this landscape has both unique communities, not found elsewhere in Montana and communities that have reached their northernmost extension. We suspect that past management is the unique aspect of this landscape and that these communities owe their presence to managing for game rather than strictly livestock.

Centennial Mountains / Valley Diversity Gradient

Location: This landscape is described as a 1-2 mile-wide swath that extends from the south shore of Upper Red Rock Lake southward and upslope to the Continental Divide at the crest of the Centennial Range. It includes lands managed as wilderness by the Red Rock Lakes National Wildlife Refuge and an 85-acre Research Natural Area (RNA) also under USFWS management. A portion of the area

managed by the Bureau of Land Management is designated as the Centennial Mountains Wilderness Study Area. Experimental grazing units are administered by the Agricultural Research Service.

Environment: This landscape spans an enormous environmental gradient from aquatic beds on the south shore of Upper Red Rock Lake to alpine tundra on sedimentary substrates in the vicinity of Taylor and Sheep Mountains. This south face of the Centennial Range is largely composed of calcareous substrates (predominantly Madison limestone) with some outcrops of quartzite and extrusive volcanics as well. Annual precipitation of 20.1 inches at a nearby valley location (Lakeview at 6,700 feet) would make this the wettest of BVHDMS valleys. Near the crest of the range annual precipitation is expected to exceed 50 inches.

Natural fire, in the form of underburns in the *Populus tremuloides*-dominated stands and stand-replacing in the upslope forested landscape, is the major natural disturbance with avalanches running a close second on this steep and snowy terrain. Windthrow is possibly a factor in the lower-elevation wetland forests around the lake's margin.

Vegetation/Other Biological Features: The diversity of communities encompassed by this gradient would be among the greatest in the state and most of the inventoried portion is known to be in good condition. At the lowest elevations along the south shore of Upper Red Rocks Lake, there are unexplored aquatic beds in the shallow waters (personal communication John Pierce) followed by emergent *Carex utriculata* (beaked sedge) and *C. aquatilis* (water sedge). Sites lacking prolonged inundation are dominated by *Calamagrostis canadensis* (bluejoint reedgrass) and *C. stricta* (narrow-spiked reedgrass) which quickly give way to *Salix* (willow)-dominated communities and *Populus tremuloides* (trembling aspen) groves. The undergrowth of *P. tremuloides*-dominated stands range from wetland-associated graminoids (including all the above-cited) to mesic and wetland associated shrubs (*Cornus sericea* [red-osier dogwood], *Salix boothii* [Booth willow], *S. geyeriana* [Geyer willow]. Even species characteristic of uplands, *Calamagrostis rubescens* (pine grass), *Carex geyeri* (elk sedge) and *Symphoricarpos albus* (common snowberry) can be found in the undergrowth of *P. tremuloides*–dominated stands. Well-developed stands of subirrigated *Picea engelmannii* (Engelmann spruce) are also found just inland from the lake's margin. The elevation gradient then ascends through sagebrush-dominated communities, principally *Artemisia tridentata* ssp. *vaseyana / Festuca idahoensis* (mountain big sagebrush / Idaho fescue) found just below lower treeline.

At lower elevations, late seral to old-growth forests are dominated by *Pseudotsuga menziesii* (Douglas-fir) with *Pinus flexilis* (limber pine) *and Picea engelmannii* as primary associates. The putative climax tree species on all but the very lowest elevations is *Abies lasiocarpa* (subalpine fir). Given the current intensive moose browsing on this tree species and the fire return interval, it will never become an important component of these stands. Particularly notable for their extreme age (>300 years) and characteristic open structure are old-growth stands of *Pinus flexilis* on warm exposures. On highly exposed sites with thin soils, good condition *Pseudoroegneria spicata* (bluebunch wheatgrass) stands dominate the grassland habitat. The very highest points in the gradient have received only cursory examination but are reputed to harbor good examples of alpine turf with *Carex rupestris* (curly sedge) and *Carex elynoides* (Kobresia-like sedge) communities. The alpine also includes fellfields of *Silene acaulis* [moss campion] and *Phlox pulvinata* [cushion phlox] and snowbed communities where *Sibbaldia procumbens* [creeping sibbaldia] and *Carex nigricans* [black alpine sedge] are important components.

The only known extant occurrence of Whipple's beardtongue (*Penstemon whippleanus*) has been documented from avalanche chute runout areas in this area (Culver 1993). This area's abundant avalanche chutes and talus slopes are potential habitat for dwarf goldenweed (*Haplopappus nanus*),

which is known only from an historical collection on slopes south of Red Rock Lakes.

Condition/Conservation Value: Past timber cutting has been sporadic, largely constituting high grading of large Douglas-fir for building. Grazing has occurred at varying intensities at the lower elevations and may have caused some compositional modification to *Artemisia*-dominated stands. The condition of lands under ARS management is unknown, but it might be assumed that an excellent record of use could be obtained.

The extremely broad gradient of mostly high-condition communities represented by this landscape gradient constitutes a superlative example of southwestern Montana environments and the communities they support. There is no comparable gradient now under protection of any kind.

Centennial Sandhills

Location: The Centennial Sandhills occur in the northeast corner of the Centennial Valley, a broad trough at the head of the Red Rock River. The valley floor lies at 6,500 to 6,600 feet with the Centennial Mountains abruptly rising to ca. 10,000 feet on the south and grading more gently into the Gravelly and Snowcrest Ranges on the north. The Centennial Sandhills are found in a band 1-2 miles wide and ca. 9 miles long on the north side of the Upper and Lower Red Rocks Lakes. The ownership is divided among private, Bureau of Land Management and US Fish and Wildlife Service with the first two named holding most of the land. In terms of a conservable landscape it might be prudent to include the adjacent wetlands (to the edge of lake) on the Red Rock Lakes National Wildlife Refuge. This land is both fragile and probably constitutes primary or alternative habitat for some species and supports unique wetland communities as well.

Environment: The sandhills are small, generally stabilized dunes that formed when sands deposited in the basins of Red Rocks Lakes, probably in the late Pleistocene (ca.10,000-12,000 BP). At this time with the waning of cold and pluvial climates the lakes retreated, exposing shorelines. Prevailing winds from the southwest have blown finer materials far to the east and drifted the less-mobile sand to the northeast where it has formed primary dunes with low ridges running southwest-northeast, paralleling the prevailing winds. Superimposed on these older ridges are blowout or parabolic dunes that are ellipsoidal to elongate U-shaped and 30-60 feet high. Leeward slopes are steep (30-60% slope), while windward slopes are more gently sloping and often bowl-, crater-, or trough-shaped. Shapes of individual dunes are modified from parabolic shapes by strong cross winds and differential growth of stabilizing vegetation.

Vegetation/Other Biological Features: The Centennial Sandhills are unique for having a concentration of both sensitive plant species and plant communities. The highly ranked community types include those that comprise the long-term stable or climax vegetation such as *Artemisia tridentata* ssp. *tridentata / Stipa comata* [basin big sagebrush / needle-and-thread], *A. tridentata* ssp. *tridentata / Festuca idahoensis* [basin big sagebrush / Idaho fescue], *Artemisia tripartita / F. idahoensis* [three-tip sagebrush / Idaho fescue] and *A. tripartita / Stipa comata* [three-tip sagebrush / needle-and-thread]. The Sandhills also include highly distinctive seral communities, including *Chrysothamnus viscidiflorus / Stipa comata* [green rabbitbrush / needle-and-thread] and *Elymus lanceolatus / Phacelia hastata* [western wheatgrass / silverleaf phacelia] and *Leymus flavescens* (yellow wildrye) herbaceous vegetation. The dominance of *A. tridentata* ssp. *tridentata* (along with variable amounts of *A. tridentata* ssp. *vaseyana*) on upland settings, such as the stabilized dunes is a unique situation not seen elsewhere in Montana. *A. tridentata* ssp. *tridentata* in Montana and most of the Intermountain West is almost invariably confined to drainageways and alluvial flats.

Four plant species considered rare in Montana occur in the Centennial Sandhills (Lesica and Shelly 1991). *Astragalus ceramicus var. apus* (painted milk-vetch, G4T3/S1) and *Oenothera*

pallida var. idahoensis (Idaho pale evening-primrose, G5T4Q/S1) occur only in the Centennial Sandhills and the sandhills of southeastern Idaho. *Cryptantha fendleri* (Fendler's cryptantha, G4/S1) is sparsely distributed across much of western North America, but is known from only two Montana locations. *Leymus flavescens* (yellow wildrye, G4/S1) occurs in sandy soil in general across the northwestern U. S., but in Montana occurs only in the Centennial Sandhills.

Zoological rarities found only here in Montana or recorded as new to the Centennial Valley, but occurring more commonly to the south include the Great Basin pocket mouse, black-tailed jackrabbit and Preble's shrew.

Condition/Conservation Values: This is a unique site by virtue of the combination of geology and highly ranked biological features. Though this is the second largest sand dune complex in the state, after the Medicine Lake Sandhills, in terms of its generally good to excellent range condition, abundance of elements and lack of threats the Centennial Sandhills landscape has a significantly higher ranking as a conservation site. Noxious weed threats are at this time virtually nil and the natural processes (fire and grazing of both large and diminutive herbivores) that maintained the seral conditions necessary for the perpetuation of various species and communities are present and capable of being manipulated for conservation purposes. The most significant threat to this landscape would be landscape fragmentation and the cessation of fire or mechanical disturbance that would allow successional processes to proceed to their endpoint and eliminate the sensitive seral species and communities.

Johnson Gulch-Deer Canyon Creek, Prairie to Peak Gradient (Tendoy Mountains)

Location: The boundaries of this landscape are currently ill-defined but encompasses a watershed-based area that stretches from near the roadhead in T11S, R12W, Section 13 to the crest of the Tendoy Mountains in the vicinity T12S, R10W, Section 7. It would include Bureau of Land Management as well as private lands at lowest elevations, with state parcels at mid elevations and US Forest Service holdings on the higher ridges and crests.

Environment: This elevation transect rises from 6,200 feet at the confluence of an ephemeral stream draining lower Johnson Gulch with Medicine Lodge Creek to approximately 9,390 at the crest of the Tendoy Mountains. This transect spans predominantly calcareous parent materials (limestone), including calcareous alluvial and colluvial fill materials. Situated in the rainshadow of the Beaverhead Mountains to the west, this country is very dry, receiving between 8 and 20 (25) inches of precipitation per year, but is very typical in terms of climate, as well as geological substrate and geomorphology, of much of the BVHDMS.

Vegetation/Other Biological Features: The vegetation elements encompassed by this landscape are primarily upland range communities (grassland and shrubland) and woodland with forested types (*Pseudotsuga menziesii*-dominated) restricted to moderate to steep north-facing slopes. The rangeland communities are the elements of focus; they are predominantly in good or better ecological condition. At lowest elevations there are high quality examples of *Artemisia tridentata* ssp. *vaseyana*- and *A. tripartita* dominated communities on the gentle to steep sideslopes. *A. tridentata* ssp. *tridentata* is found in drainageways and other alluvial positions. In some locations *Leymus cinereus* has been exhibiting a trend of increasing coverage, both in association with basin big sagebrush and as a grassland co-dominant or indicator species (trend ostensibly due to deferred grazing when it is most vulnerable [personal communication, Brian Hockett]). A very incomplete reconnaissance has not as yet revealed *A. nova* communities, but they are expected. At mid to the highest reaches of the subalpine was found a nearly complete array of the community types involving *Festuca idahoensis* and *A. tridentata* ssp. *vaseyana* as dominants/diagnostic species; the more mesic, collecting positions supported

excellent examples of *F. idahoensis / Elymus trachycaulus*, A. *tridentata* ssp. *vaseyana* / *F. idahoensis / Geranium viscosissimum*, A. *tridentata ssp. vaseyana / F. idahoensis / Elymus trachycaulus and F. idahoensis / Carex scirpoidea*. Excellent examples of alpine turf, mostly *Calamagrostis purpurascens - Carex rupestris* and *Carex elynoides* associations, cap the crest of the range. High quality examples of *Cercocarpus ledifolius*-dominated communities are present, including the somewhat rare (G3) *C. ledifolius / F. idahoensis*. An old-growth (>300 years) *Pinus flexilis* (limber pine) stand (predominately *P. flexilis / Juniperus communis*) occupies the west-facing slopes in Section 35 and on the north-facing slopes within this same Section are excellent examples of late seral stands potentially dominated by *Picea engelmannii* (Engelmann spruce).

Condition/Conservation Values: This is a prime landscape for representing a wide diversity of high-quality rangeland communities, including grasslands, shrublands, and woodlands. The elevational range represented encompasses all but the most xeric of southwestern Montana plant communities and includes a significant amount of subalpine grasslands and alpine turf (bighorn sheep populations are noted to frequent these high-elevation grasslands). Grazing intensity reduction or change in timing of use on some of the encompassed allotments has ostensibly resulted in recovery in some community types such as the resurgence of *Leymus cinereus* (basin wild rye) in some drainageway locations.

Morrison Lake Wetlands to Baldy Mountain Transect (Beaverhead Mountains)

Location: This landscape encompasses major portions of Sections 21, 22, 23 and 24 of Range 12 West and Township 14 South and could incorporate portions of adjoining sections if watershed boundaries are used to define the site. It stretches from the Morrison Lake Wetlands, embedded in the flats east of the Beaverhead Range, to the crest of the range at Baldy Mountain. Ownership is primarily by the U. S. Forest Service with basal plain acreage under Bureau of Land Management control. By including private lands within Section 19 a greater diversity of shrublands could be encompassed.

Environment: This transect represents, with the exception of the Morrison Lake Wetlands, a landscape in relatively good condition and highly typical of the BVHDMS ecoregion. The Morrison Lake Wetlands are somewhat atypical because southwestern Montana has relatively few wetlands (only those of Centennial Valley/Red Rock Lakes could be considered extensive). From the calcareous colluvial and alluvial fill of the gently rolling flats at 8,200 feet the transect rises abruptly to 10,773 at Baldy Mountain on the Continental Divide. This whole transect is set in calcareous parent material, predominantly limestone and lying to the east of the Continental Divide it is in somewhat of a rainshadow of the Beaverhead Mountains. Combining a substrate that weathers to shallow, well-drained soils with a dry climatic regime fosters an extremely dry environment as denoted by a strongly compressed or truncated forested zone. The Morrison Lake Wetlands are comprised of a group of alkaline fens, marshes, meadows and temporary ponds interspersed in a matrix of shrub-steppe. Many of the wetlands are less than an acre. Morrison Lake supports no emergent vegetation, only aquatics, however, just east of the lake is a spring-fed mire with a floating-mat peatland.

Vegetation/Other Biological Values: This landscape transect has been inventoried in piecemeal fashion, the Morrison Lake Wetlands having been documented by Lesica (1990) and the alpine communities having received a one-day sampling by S. V. Cooper and P. Lesica (Cooper and Lesica 1997). Cooper and Lesica also documented some riparian and upland vegetation in the vicinity of Indian Creek as it passes through Section 24. The above-cited botanical/ecological explorations support this landscape as a prime representation of the western portion of BVHDMS. The alpine-subalpine plant associations include

excellent examples of Carex *elynoides* (Kobresia-like sedge), *Festuca idahoensis – Carex scirpoidea* (Idaho fescue / Canadian single-spike sedge), *Dryas octopetala / Carex rupestris* (white dryas / curly sedge) dwarf-shrub herbaceous, *D. octopetala / Polygonum viviparum* (white dryas / alpine bistort) dwarf-shrubland herbaceous, *Salix arctica / Polygonum bistortoides* (Arctic willow / American bistort) dwarf-shrubland and *Salix glauca* (glaucous willow) dwarf-shrubland.

The limited portion of upslope landscape with trees dominant appeared to be old-growth woodland stands with *Pseudotsuga menziesii* (Douglas-fir) dominant and *Pinus flexilis* (limber pine) well represented as a seral species. The higher elevation sites were only cursorily noted and appeared to be quite open with *Picea engelmannii* (Engelmann spruce) dominant and scattered *Pinus albicaulis* (whitebark pine). A complete reconnaissance of the forested portion is necessary and would be expected to produce old-growth stands of *P. albicaulis* (given that old-growth *P. menziesii* exists at lower elevations). *Pseudotsuga*-dominated old-growth forest vegetation on the flats to the west of Morrison Lake is classified as *Picea engelmannii / Senecio streptanthifolius* (Engelmann spruce / Rocky Mountain butterweed), a common forest type of calcareous substrates only found in south-western Montana.

Lesica (1990) coined new community names, largely based on dominance by layer, for wetland/aquatic community types found in the Morrison Lakes Wetland. These communities, their names and/or composition, have not been subsequently crosswalked to the NVCS or Hansen et al. (1995). Lesica described the following communities: *Carex utriculata – Deschampsia cespitosa* (beaked sedge – tufted hairgrass), C. *utriculata / Potamogeton pectinatus* (beaked sedge / fennel-leafed pondweed), *Pentaphylloides floribunda / Juncus balticus* (shrubby cinquefoil / Baltic rush), *Salix brachycarpa / Carex scirpoidea* (short-fruited willow / Canadian single-spike sedge), *Eleocharis palustris – Carex athrostachya* (common spikesedge – slender-beaked sedge), *Eleocharis palustris / Potamogeton gramineus* (common spikesedge / grass-leaved pondweed), *Alopecurus aequalis / Hippuris vulgaris* (short-awn foxtail / common mare's tail), and *Myriophyllum spicatum - Ranunculus aquatilis* (spiked water-milfoil – white water-buttercup, an aquatic type). Several of the above-named communities have not been documented to occur elsewhere in the ecoregion and are quite possibly constitute unique community elements.

The shrub-steppe uplands are moderately to heavily grazed and characterized by *Artemisia tridentata* ssp. *vaseyana*-dominated types, predominantly *A. tridentata* ssp. *vaseyana / Festuca idahoensis* (mountain big sagebrush / Idaho fescue) with minor inclusions of *Artemisia arbuscula* ssp. *longiloba / F. idahoensis* (early low sagebrush / Idaho fescue) and quite possibly other shrub steppe types. In the riparian environment *Leymus cinereus* (basin wildrye) appeared to be making a comeback in *A. tridentata* ssp. *tridentata* stands where protected from grazing. Willow communities were not classified to type but appeared to have received past hard use by both domestic stock and wild ungulates.

Within this landscape only the Morrison Lake Wetlands were explicitly inventoried for species ranked as sensitive by MTNHP and the following were found; *Aquilegia formosa, Astragalus argophyllus, Astragalus leptaleus, Carex parryana* ssp. *idahoa, Gentiana aquatica, Senecio debilis*, and *Thalictrum alpinum*.

Condition/Conservation Values: The lower elevations of this transect have been livestock grazed for decades causing most damage to the wetlands where drawdown zones have been trampled and compacted and weedy species introduced, including *Poa pratensis* (Kentucky bluegrass), *Taraxacum officinale* (dandelion) and the noxious weed *Cirsium canadense* (Canada thistle). Grazing intensities were very high at the time of wetland site visitation and continued abuse could result in lowered species diversity and the introduction and facilitation of exotics. Grazing could have a direct delete-

rious impact on the rare *C. parryana* ssp. *idahoa* because it is both highly palatable and susceptible to grazing. We have not checked the grazing records from the U. S. Forest Service for insights as to how the mountain grasslands may have been impacted; from cursory examination they appeared to not to have been adversely impacted. The considerable diversity of vegetation types and sensitive species present and under threat from grazing gives impetus for considering this an important conservation site. While there might possibly be more appropriate landscapes for conservation, this one was forwarded at this time because it has relatively more existing information.

Plant Species of Special Concern

The Beaverhead Mountains Section harbors 41% (19) of all the globally rare Montana vascular plant species that are tracked by the Montana Natural Heritage Program. These species are listed in Table 4 (below) and their distributions shown in Figure 4. This concentration of globally rare plants is among the highest in the state and includes several state or regional endemics. The Beaverhead Mountains Section has among the highest levels of plant endemism in the state; 18 of the 57 taxa (31% percent) are of conservation concern.

In addition to the Montana plant species of special concern that are listed below, there are several more regional endemics (e.g., *Sphaeromeria capitata, Stanleya tomentosa, and Townsendia nuttallii*) on the state "watch" list. These are found primarily or only in this area of Montana and are of limited distribution but not officially tracked by the Montana Natural Heritage Program.

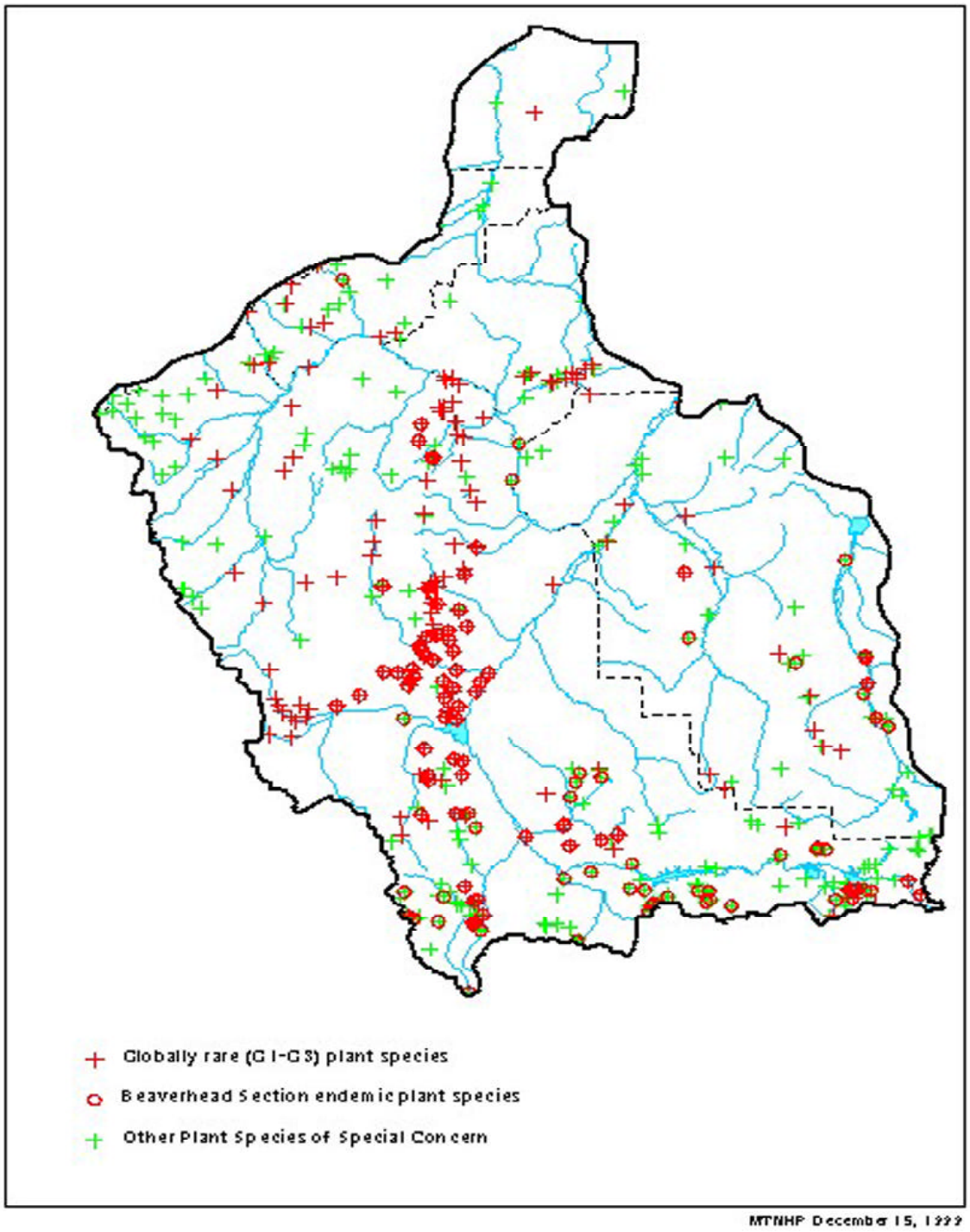
What is the conservation status of these globally rare species? Almost all are on agency sensitive species lists. Four species are restricted to alpine or subalpine habitats without identifiable threats (*Chrysothamnus parryi* ssp. *montanus, Draba globosa, Draba ventosa,* and *Saxifraga tempestiva*). Two species are known only from historic records (*Primula alcalina, Thelypodium paniculatum*),

Table 4. Globally rare plant species in the Beaverhead Mountains section

SCIENTIFIC NAME[1]	COMMON NAME	GRANK	SRANK
*Arabis fecunda**	Sapphire Rockcress	G2	S2
Astragalus ceramicus var. apus*	Painted Milkvetch	G4T3	S1
Astragalus scaphoides*	Bitterroot Milkvetch	G3	S2
Astragalus terminalis*	Railhead Milkvetch	G3	S2
Carex parryana ssp. idahoa*	Idaho Sedge	G4T2	S2
Carex stenoptila	Small-winged Sedge	G3?	S2
Chrysothamnus parryi ssp montanus	Centennial Rabbitbrush	G5T1	S1
Draba globosa	Round-fruited Draba	G3	S1
Draba ventosa	Wind River Draba	G3	S1
Lesquerella pulchella*	Beautiful Bladderpod	G2	S2
Lomatium attenuatum*	Taper-tip Desert-parsley	G3	S2
Penstemon lemhiensis*	Lemhi Beardtongue	G3	S2
Phacelia incana*	Hoary Phacelia	G3	S2
Primula alcalina	Idaho Primrose	G1	SX
Saxifraga tempestiva	Storm Saxifrage	G2	S2
Sphaeromeria argentea*	Chicken Sage	G3?	S2
Spiranthes diluvialis	Ute Ladies' Tresses	G2	S2
Thelypodium paniculatum	Northwestern Thelypody	G2G3	SH
Thlaspi parviflorum	Small-flowered Pennycress	G3	S2

[1] Species that are bold-faced are known from extant populations at elevations below alpine and subalpine and are relatively vulnerable. Species that are asterisked have a significant number (over 33%) of total occurrence numbers on BLM-administered lands.

Figure 4. Locations of Plant Species of Special Concern, Beaverhead Mountains Section



and focused surveys are recommended in the areas from which they were originally known (Monida area, Alaska Basin area). The remaining 13 globally rare species (bold-faced in Table 4) stand as the most important conservation priorities for this Section. Ten of these species have at least 1/3 of all their Montana records on BLM holdings (asterisked in Table 4).

Twenty-eight species that are globally rare occur on BLM-administered lands in this area (bold-faced in Tables 4 and 5). All of the globally rare species on the watch list are also on BLM lands. Fortunately, some or many are not under immediate threats. This is not to say that no conservation is needed. Continued vigilance for noxious weeds is an immediate and far-reaching need for maintaining plant diversity in general.

Many of the globally rare species we are reporting here for the Beaverhead Section represent newly documented additions to the state flora, some of them discovered as recently as last year. New species discoveries are added to the Montana plant species of special concern list if they are a native species known from fewer than 5 locations, in natural habitat, without evidence of adventive behavior indicated by increasing under unnatural conditions. Many of the new records are from lower elevations, so the remoteness of the species' habitat is inadequate explanation for their not having been discovered earlier. The relatively large number of new species reflects the floristic diversity as well as the incompleteness of basic floristic survey.

There are also a high number of State-rare plants that are restricted to this area of Montana. Ten percent (33) of all Montana vascular plant species of special concern occur exclusively in this region and no other parts of the state (Table 5, Figure 4). This includes 10 of the globally rare species noted above.

What is the conservation status of the state-rare species restricted to this area? Again, this question can be answered only indirectly. Many are on agency sensitive species lists. Only three of the species are restricted to alpine or subalpine habitat *(Braya humilis, Erigeron leiomerus, and Oxytropis parryi*) where threats are generally low. Three are known only from historic records *(Calochortus bruneaunis, Haplopappus nanus, Phacelia scopulina*), and therefore cannot be protected. Focused surveys for these three species are recommended in conjunction with conservation and management activities taking place in the three areas from which they were originally known (Red Rock Valley south of Lima, Centennial Mountains, and Big Hole Valley near Melrose). The remaining 22 species (bold-faced in Table 5) represent the secondary conservation priorities for this region. Eighteen of these 22 species have at least one-third of their Montana records on BLM-administered lands.

Altogether, a total of about 130 Montana plant species of special concern occur in the Beaverhead Mountains. This includes globally rare species, state-rare species that are restricted to this portion of Montana, and state-rare species that are more broadly distributed in the state. Their presence may represent well-developed habitat, habitat extremes, rare habitat, or undocumented habitat. In some measure, these species act as a surrogate for identifying unusual plant associations and exceptionally high quality conditions.

The 680 known occurrences of these species are not randomly distributed across the landscape but are very restricted (Figure 4). The patterns of aggregation fall into general categories by elevation range and habitat structure: valley wetland, foothills-montane wetland, sand dunes, and foothills-montane grasslands and shrublands. These "aggregates" of rare species, and the specific habitat conditions that represent, suggest a third set of conservation priorities for this region.

By analyzing the distribution of all the rare species describe for this section, it would be possible to identify places on BLM lands where their co-occurrence would provide opportunities to protect many species in aggregate. This analysis could emphasize those groups of higher conservation priority, and

would focus on occurrences known to be of high quality (represented by an A or B quality rank). It could also include lands managed by other agencies, to yield a regional map of priority sites for rare plant conservation.

Finally, while there has been extensive botany work over large areas of the Beaverhead Mountains ecoregion, it is not exhaustive and provides no more than an initial data set and preliminary information for management and conservation of this extremely diverse landscape. This region, because of its high contribution to plant diversity at both the global and state scales, merits significant effort toward better understanding both the distribution and conservation needs of the rare flora.

Table 5. State or globally rare plants known ONLY from the Beaverhead Mountains Section

SCIENTIFIC NAME	COMMON NAME	GRANK	SRANK
*Agastache cusickii**	Cusick's Horse-mint	G3G4	S1
Aquilegia formosa	Sitka Columbine	G5	S1
Astragalus ceramicus var. apus*	Painted Milkvetch	G4T3	S1
Astragalus scaphoides*	Bitterroot Milkvetch	G3	S2
Astragalus terminalis*	Railhead Milkvetch	G3	S2
Balsamorhiza hookeri	Hooker's Balsam-root	G5	S1
Braya humilis	Low Braya	G4	S1
Calochortus bruneaunis	Bruneau Mariposa Lily	G5	SH
Chrysothamnus parryi ssp montanus	Parry's Mountain	G5T1	S1
Elymus flavescens*	Sand Wildrye	G4	S1
Erigeron leiomerus	Smooth Fleabane	G4	S1
Erigeron tener	Slender Fleabane	G4	S1
*Eriogonum caespitosum**	Mat Buckwheat	G5	S1
Haplopappus nanus	Dwarf Goldenweed	G5	S1
Ipomopsis congesta ssp crebrifolia*	Ballhead Gilia	G5T4?	S2
Kochia americana*	Red Sage	G5	S1
Lesquerella pulchella*	Beautiful Bladderpod	G2	S2
Lomatium attenuatum*	Taper-tip Desert-parsley	G3	S2
Lomatogonium rotatum*	Felwort	G5	S1
Oenothera pallida var. idahoensis*	Pale Evening-primrose	G5T4Q	S1
Oxytropis parryi	Parry's Crazyweed	G5	S1
Phacelia scopulina	Dwarf Phacelia	G4	SH
Phacelia incana*	Hoary Phacelia	G3	S2
Primula alcalina	Mealy primrose	G4G5	S2
Puccinellia lemmonii*	Lemmon's Alkaligrass	G4	S1
Ranunculus hyperboreus	High-arctic Buttercup	G5	S1
Ribes velutinum	Desert Gooseberry	G5	S1
Sphaeralcea munroana*	White-stemmed Globe-	G4	S1
Sphaeromeria argentea*	Chicken Sage	G3?	S2
Stellaria jamesiana	James Stitchwort	G5	S1
Stephanomeria spinosa*	Spiny Skeletonweed	G4	S1
Thelypodium paniculatum	Northwestern Thelypody	G2G3	SH
Townsendia florifer*	Showy Townsendia	G5	S1

Conclusions and Recommendations

This is the first ecoregion section in Montana to have a comprehensive Vegetation Classification assembled into a single document. This project provides a snapshot of plant communities in the Beaverhead Mountains Section and their status. It reflects our current knowledge and is by no means exhaustive. While there is potential to utilize the dataset for more advanced and comprehensive analyses of the vegetation community, we now have a satisfactory vegetation community classification for management, monitoring and conservation objectives.

The project goal was to compile ecology plot data, validate and refine existing plant association types and combine into a new classification following the National Vegetation Classification Standard. The classification has three major components: 1) a list of Plant Associations for Beaverhead Mountains Section in Montana, 2) the Key to Plant Associations, and, 3) Plant Association descriptions.

The MTNHP acquired all known ecology plot data sets, except for that of the Montana Wetland and Riparian Research Program, and utilized the material for this analysis. All plots that could be substantiated by a legal location descriptor were assigned to a plant association type and mapped into Geographic Information System. Other plant associations were added to the Beaverhead list based on distribution descriptions completed by other authors, primarily Hansen et al. (1995).

The Key to Plant Associations is a dichotomous key that identifies physiognomic vegetation types using the new National Vegetation Classification. The key includes every major vascular plant group or lifeform encountered in the BVHDMS. The key in combination with the plant association descriptions provides a very powerful tool for the identification of plant communities.

The MTNHP prepared 130 plant association descriptions and included in this classification. This project provided the raw material to develop dozens of new community descriptions (Characterization Abstracts) and to standardize over 100 of our older descriptions, all of which will be maintained as part of the Montana Natural Heritage Program data system. These community descriptions provide the basis for crosswalking with other classification efforts, such as rangeland sites currently employed by the BLM and NRCS. The process of examining plot data, reviewing, editing and preparing new plant community descriptions has provided the framework for our future revision of community ranks.

In the future we plan to develop a Web-based field guide that can produce current plant association distribution maps along with community descriptions and their conservation values. Such products should be valuable in conservation planning when one needs a spatial representation of rare or high quality community elements. Such map products could well serve land managers as they deal with landscape diversity and pinpoint opportunities to manage for, or promote, community diversity, as well as protecting existing landscapes with concentrations of valuable (rare) elements, including communities, plant and animal species. The prospect for producing online locations of sample plots on US Geological Survey 1:24,000 scale maps (or meaningful aggregations, such as 1:250,000 quadrangles) is in sight.

Our next phase of community ecology in Beaverhead Mountains Section will benefit from this analysis. Additional survey to better locate and identify conservation opportunities for the globally imperiled plant communities is needed. There is additional need to inventory for good quality, representative communities, and significant landscapes. Exemplary communities and landscapes of significant ecological interest are important heritage for Montana and worth managing to retain their natural character.

The Classification: concepts and assumptions

The National Vegetation Classification

The list of plant associations for Beaverhead Mountains Section, their descriptions and the accompanied vegetation key is a product of the Montana Natural Heritage Program. The Heritage program network has worked cooperatively with The Nature Conservancy (TNC) by first developing a National Vegetation Classification Standard (reworked UNESCO 1973 and Driscoll et al. 1984) that was accepted as the framework to be used by all federal agencies (FGDC 1997). The National Vegetation Classification Standard (NVCS) is hierarchical and combines floristics at the lowest levels (associations and alliances) and physiognomy and broad ecological modifiers at the highest levels of the hierarchy. Physiognomy pertains to the physical features of the vegetation i.e. forest vs. herbaceous vegetation. This approach allows the characteristics of vegetation patterns to be referenced at multiple spatial scales. The upper levels of the hierarchy were adopted as a national standard by Secretary of the Interior, Bruce Babbit in 1997. The floristic levels of the Vegetation Classification in the United States is currently in a review draft phase.

The physiognomic/structural levels of the NVCS have proven useful in mapping the natural and semi-natural vegetation of the U. S. in order to assess the conservation status of species and their habitats as part of the USGS Gap Analysis Program (GAP). The floristically based units, alliances and plant associations, have proven much more difficult to define, both conceptually and individually, for example, what constitutes the defining parameters of the *Abies lasiocarpa / Vaccinium scoparium* forest plant association? There are several concepts and assumptions worth mentioning here. Although we have set out to conform to the conventions of the NVCS and its approach to classification there is one very significant point in the approach which has not been incorporated to any extent in our work or that of our predecessors; that is to describe existing vegetation, rather than potential vegetation. Most of the vegetation types treated within our work and those of our predecessors were considered potential natural vegetation types (habitat types *sensu* Daubenmire 1969) and named for the climax plant association. This remains a distinct drawback or handicap to the MTNHP.

To illustrate: A very common plant association (climax) in western Montana is *Abies lasiocarpa / Clintonia uniflora*; seldom is the forest canopy dominated by *A. lasiocarpa*. The most common seral overstory dominant (often monospecific) for this type is *Pinus contorta*. At this point in time there has never been a *P. contorta / C. uniflora* plant association recognized. Rather, foresters/ecologists have treated this condition as a *P. contorta* cover type of the *A. lasiocarpa / C. uniflora* habitat type (recognizing the sites potential to support *A. lasiocarpa*, this being the diagnostic species for the series level) and applied a structural descriptor (say pole or mature size class). They have also recognized the site's potential to support a variety of undergrowth dominants, using the presence of *C. uniflora* as an indicator of a particular environmental regime. The NVCS would create a new plant association based on existing *Pinus contorta*-dominated stands; in this case one would have to envision an association named *P. contorta / C. uniflora*.

There are many significant points to be addressed in classifying seral forest vegetation if we are to adhere to describe existing vegetation only: 1) do we consider all stages of a sere and assign each a plant association name, or describe seral communities with structural and compositional labels, such as seedling/sapling stage with *Acer glabrum* dominant in the tallest layer of a potential

Abies lasiocarpa / Vaccinium scoparium p. a., 2) how does one discriminate among canopy species (for purposes of assigning type name) when there is no clear expressed dominance? is the choice based on dominance or the specie's indicator value?, and 4) given that succession is a complex function of many interacting variables that determine what "pathway" a disturbed stand will take, and that for a given environment, vegetation will more or less converge to a dynamic stable endpoint, do we continue to track what this endpoint might be when we collect information on seral plots?

Also worth noting is that the NVCS separates shrubland from shrub herbaceous types by distinguishing a shrub type as having shrub cover greater than 25%. While this is an artificial distinction, it creates some confusion because our local shrubland classifications, principally Mueggler and Stewart (1980), recognize shrubland types as having cover sufficient to convey a "shrubby aspect", which they conceived of as being 5% or greater canopy cover. In this report we have treated most of the *Artemisia tridentata*-dominated types as shrublands (as was done by Mueggler and Stewart), but in fact almost none of the sampled stands meet the NVCS shrubland criteria.

Another classification quandary was what to do with vegetation units, termed "phases" by various researchers (Pfister et al. 1977, Mueggler and Stewart 1980, Hansen et al. 1995, Cooper et al. 1987) and **"not tracked by the Heritage Programs in the NVC units."** Considerable information concerning environment-vegetation relationships could be forfeited by not recognizing phases of plant associations. Thus, within this manuscript, we have elevated phases to plant associations where information is sufficient to do so. (In the vegetation keys that follow some phases have been designated and their characteristics are described within the plant association of which they are a component. A prime example (from northwestern Montana) of the information that would be obscured by not tracking phases is to consider selected phases of *the Abies lasiocarpa / Clintonia uniflora* plant association. The *Menziesia ferruginea* and *Xerophyllum tenax* phases are environmentally distinct, the *M. ferruginea* phase occurring on cool aspects at higher elevations and the *X. tenax* phase occurring on southerly aspects and extending from the lowest to highest elevations at which *C. uniflora* co-occurs. The *Aralia nudicaulis* phase occurs on very distinct positions in the landscape, bottomlands and toe-slope seepage areas. These different phases not only have distinct flora, but differ significantly in their productivity (based on tree site index), the tree species that are expected to be major seral dominants, fuel models and fire regime. Thus we would propose that the three phases named above be treated as three distinct plant associations; *A. lasiocarpa / C. uniflora – Aralia nudicaulis, A. lasiocarpa / M. ferruginea / C. uniflora*, and *A. lasiocarpa / C. uniflora – X. tenax*.

A natural question is why, if phases represent distinct floristic compositions and environments, they were not treated as plant associations in the first place. These classifications were initially promoted as a boon to management and the researchers intuited that managers would not want a lot of complexity (too many habitat types or plant associations recognized) and phases were, at that time, a way of tracking the complexity of vegetation/environment relationships. Occasionally phases have been created to recognize regional floristic permutations of a common type. It should be noted that the environmental range of one of the phases of *A. lasiocarpa / C. uniflora* may be just as great as that encompassed by a particular plant association with no phases, say *A. lasiocarpa / Galium triflorum* or *A. lasiocarpa / Vaccinium cespitosum*. It is exceedingly difficult to measure all the physical parameters of a vegetation type's environment, which is precisely why habitat types or plant associations have been embraced as surrogate indicators of environment.

Plant Associations of the Beaverhead Mountains Section: Vegetation key and descriptions

We have developed a dichotamous key to the vegetation types and prepared written descriptions for approximately 50% of the plant associations (total of 273) occurring in the Beaverhead Head Mountains Section. The approach of the Montana Natural Heritage Program has been to incorporate the classifications or type descriptions of other researchers into our more encompassing classification; this is because the work of our predecessors has been peer reviewed and found to be scientifically rigorous as well as eminently applicable by managers. Usually, but not always, these classifications of regional and/or physiognomic types (e.g. Pfister et al. 1977 of forested types on national forest holdings) have been crosswalked with those of neighboring states or provinces so that a west-wide and eventually national classification can be constructed. Though a purported national classification of plant associations has been published, "International classification of ecological communities: Terrestrial vegetation of the United States" Anderson et al. (1998, Volume II), it is important to note that this is more a listing of types at the plant association level and not a formal taxonomy. Without a formal taxonomy (key to plant associations) there is no consistent way one can identify a piece of vegetation on the ground. One can go to all the disparate original sources for a type's description but often even these sources do not always have a "working key" that can be conveniently and consistently employed to differentiate one vegetation type from another.

One of the critical points of a community's description is how it differs from those communities to which it is most closely related (either floristically or environmentally). Vegetation keys at the alliance and plant association levels are shorthand means of discriminating among vegetation types. Though the TNC claims to have produced a national vegetation classification (Anderson et al. 1998) in fact at the alliance and plant association levels it is nothing more than a laundry list with no convenient way of identifying the vegetation with which one is dealing and for this reason cannot be effectively employed. Thus, we deemed it imperative that vegetation keys be developed for this report so that users of the classification would not feel stymied in trying to put names on and understand vegetation types. However, these keys are perhaps a weak link in this report because they have not enjoyed a critical analysis but rather have been pieced together, incorporating first those keys from original sources. These keys have also not been tested, except with existing plot data in an office setting. It should be appreciated that some fraction of the vegetation extant on the landscape will not key to a particular plant community type. This is because the type may be unique, tied to a particular substrate type for example, and was not sampled in the inventory process. For efficiency, sampling is stratified by major environmental parameters leaving literally hundreds, if not thousands, of square miles of this ecoregion unvisited. Alternatively, leads in the key could have inadvertently left gaps through which certain types have fallen.

The key to the various physiognomic types was designed to be in accord with the National Vegetation Classification (NVC) and its concepts of forest, woodland, shrubland, etc. In other words, above the floristically based Alliance and Plant Association levels, we have largely subscribed to the NVC treatment of structure and cover to define units from the highest levels (Order) all the way down to Formation.

The keys within various physiognomic types, say woodlands or shrublands, are based on floristic composition. The floristic composition is weighted by canopy cover as defined by Daubenmire (1959), regardless of the life form being tallied. Daubenmire's canopy cover is conceived to be the vertical projection of a imaginary polygon about the outermost perimeter of a plant's canopy and expressed as a fraction of the total plot area sampled; this concept of cover has largely been

accepted in the western US, particularly in Montana.

We have tried to capture the insights and good science of our predecessors who have constructed keys to various components (e. g. just forest or alpine types) of the vegetation of southwestern Montana, basing our keys on theirs to the extent possible. A significant number of plant associations have been newly described or identified since these preceding keys were written. We have intercalated these plant associations not treated by previous works into our keys based on the principles that guided our predecessor's key construction (at least as we interpreted their efforts).

In general, keys written for Montana vegetation, regardless of the dominant lifeform, have been structured to identify first the wettest or most environmentally unique sites (as reflected in their unique flora), or the most shade tolerant (in the case of forested alliances). The order progresses to associations successively drier, or less tied to specific site conditions or supporting less shade tolerant tree species.

The vegetation key is a tool that functions best when combined with a vegetation description. A formalized and highly reviewed description of a plant association in a global context is referred to as a Community Characterization Abstract (CCA). The production of carefully edited CCAs is critical in turn to producing useful floristic level classifications. Very few of these abstracts have been produced to date and we have provided the few CCAs that are applicable to the BVHDMS. The plant association descriptions within this report constitute an important source of information for the future synthesis of CCAs.

Use of the vegetation key

Instructions

1) Seek a homogenous site. Homogeneity (environment and history of use) and the vegetation cover are primary considerations in plot location selection. The plot being inventoried and classified should be representative of the stand as a whole, if not, then relocate the plot and re-estimate plant cover (thoroughly reconnoiter a stand before taking a plot sample).

a) Note that environmental gradients are often steep and that the size of homogeneous vegetation types may be extremely restricted (< $10m^2$), espe cially in alpine environments.

b) Homogeneity is most easily appraised as an area supporting a particular suite of dominants and subordinate indicator species.

2) Accurately identify and estimate canopy cover for all indicator species used in the key. In the following key and main body of text the canopy coverage (c.c.) concept employed is that of Daubenmire (1959); a vertical projection about the outermost perimeter of a plant's canopy expressed as a fraction of the area sampled. The following terms are applied when referring to species in the leads of the vegetation keys.

Present: trace to 100% canopy coverage (c.c.) versus **Absent:** 0% c.c.

Common: species with 1% or more c.c. versus **Scarce:** having less than 1% c.c.

Well represented: species with at least 5% c.c. versus **Poorly represented:** less than 5% c.c.

Abundant: species having 25% or greater c.c. versus **Not Abundant:** species having less than 25% c.c.

Reproducing Successfully: Generally at least 10 seedlings or saplings per acre and not confined to microsites.

3) On sites where the vegetation is obviously depauperate (unusually sparse) due to heavy grazing, browsing, or closed canopy stage of forest vegetation succession adjust the key downward to reflect the reduced canopy cover (e.g." well represented" would become "common").

4) If severely disturbed or early seral conditions are encountered, the p. a. (at least as regards potential vegetation, especially forested conditions) is best determined by extrapolating from the nearest relatively undisturbed mature stand with similar site conditions (slope, aspect, elevation, and soils).

5) The following key is dichotomous; all criteria for one of the two choices of each couplet must be satisfied to obtain a correct determination. (NOTE: There are many couplets where one on the choices leads to an "undefined" or "undescribed" vegetation type. There are several reasons for this, the most obvious one being it that not all the landscape has been inventoried and there exist many permutations of site and vegetation composition that have not been described.)

6) Identify the lifeform group using "**KEY TO PHYSIOGNOMIC TYPES (LIFEFORM CATEGORIES)**."

7) Within the correct lifeform follow the key literally to identify a) in the case of forest and woodland vegetation the series (or alliance) level and then progress to the plant association (p. a.) level; b) in the case of other lifeforms (shrublands, grasslands, etc.) the key will identify plant associations directly.

8) Consult the table of contents to obtain the page number for the physiognomic types. Plant associations are ordered alphabetically within lifeform (e.g. forest shrubland, dwarf shrubland, etc.).

Caveats when using keys

1) This key is generally structured to identify, within lifeform types, the wettest sites first and progresses to successively drier sites.

2) In applying the key to actual field conditions the cover definitions cited above might need adjusting to the next lower coverage class, e.g. "well represented" becomes "common." This may be necessary when the closed canopy stage of forest succession obtains, or when grazing pressure has altered community composition.

3) In the case of early successional stages, particularly with regard to potentially forested sites, the current stand composition may not "key out" to a described plant association; this is because the keys are intended for use with relatively mature vegetation. It is the intention of the National Vegetation Classification Standard (NVC) to treat all existing vegetation types, including seral stages, as discrete plant associations, but this intention has not been realized for any appreciable area in the western US. See Arno et al. (1985, 1986), Steele (1988) or Hansen et al. (1995) for approaches dealing with classification and description of seral vegetation; Hansen et al. (1995, pages 24-27 and Figure 3) is particularly helpful in explaining terminology such as plant association versus community type and habitat type.

4) To discriminate shrublands (including dwarf-shrublands) from "non-shrublands" we have included the NVC approach in normal typeface but in boldface type we have included an alternative set of leads which <u>should be followed at this time</u>. The boldface leads are necessary because of the significant discrepancy between the NVC criteria for a shrubland (at least 25% canopy cover of shrubs) versus the criteria employed by Mueggler and Stewart (1980), the most authoritative guide to rangeland types in Montana and the source whose key the Montana Natural Heritage Program has adhered to in the past. Mueggler and Stewart (1980) distinguish a "shrubland aspect" which they define as having woody plants common, with at least 5% canopy cover. It should be

noted that, based on average canopy cover of the shrub component, none of the shrubland types classified by Mueggler and Stewart would qualify as shrublands by NVC criteria. In other words, virtually all the upland shrublands would be classified by the NVC as shrub herbaceous (i. e. a temperate or subpolar grassland with a sparse shrub layer). We have insufficient resources at this time to follow the NVC model which would distinguish between, for example, an *Artemisia tridentata / Festuca idahoensis* Shrubland and an *A. tridentata / F. idahoensis* Shrub Herbaceous type; the only difference between these types might be the canopy cover of *A. tridentata*. We indicate in the written description for the plant association whether it is considered a shrubland or shrub herbaceous type by the NVC.

5) The keys and plant association type descriptions are arranged by decreasing size of the dominant lifeform and within lifeform the upland sites are placed first followed by wetland/riparian types. The order of presentation of plant association descriptions is alphabetical within dominant lifeforms.

6) Once a stand has been keyed to plant association, **the description of said association may not exist in this document, but references to the association, including the best sources for its description, will be found in Appendix D.**

7) Some plant associations will key out in both upland and wetland keys because a) their habitat conditions are known to span that range, b) field personnel may be unfamiliar with the fine points of ascertaining wetland criteria so that by including some essentially wetland associations (that to the uninitiated appear as upland types) in the upland key, these types will be correctly identified to plant association.

8) **The dichotomous key is only a convenience for identifying plant associations / community types; it is not the classification! Validate your determinations by comparing vegetation/site characteristics with parameters of plant association descriptions; be especially aware that vegetation composition and environmental conditions described come from sampled sites and personal observation and almost certainly do not include all the sites (the total range of environments) over which the type is found.**

KEY TO PHYSIOGNOMIC TYPES (LIFEFORM CATEGORIES)

The leads below are slightly altered or reworded from the National Vegetation Classification (NVC) with the following exception: **To discriminate shrublands (including dwarf-shrublands) from "non-shrublands" we have included the NVC approach in normal typeface but in boldface type we have included an alternative set of leads which <u>should be followed at this time</u> (see #4 under "Caveats when using keys" for a complete explanation).**

The ultimate NVC classification unit designated in the physiognomic key below is subclass; once physiognomic type is determined continue with the Series or Alliance Level Keys for forests and woodlands and for the shrublands, etc. go directly to the plant association keys which are arranged in the following order; shrublands, dwarf-shrublands, grasslands, perennial forb vegetation, nonvascular vegetation)

1. Trees (deciduous or evergreen) dominant with at least 25% canopy cover, or rarely less than 25%, if the cover of other life forms (shrub, dwarf-shrub, herb, nonvascular) is less than 25% and tree cover exceeds the combined cover of these other lifeforms 2
1. Trees not dominant, their cover less than 25% and if less than 25% then the combined cover of other lifeforms is greater than that of the canopy trees 3

2. Tree crowns at least partially overlapping, forming 60 to 100% canopy cover ..... **FOREST**

   a. Evergreen trees (non-deciduous conifers) present and reproducing successfully (10 trees per acre, minimum) and not confined to microsites (note that at closed canopy stage there may be no evidence of reproduction by any conifer species)..... **EVERGREEN FOREST**
   b. Evergreen trees absent **or**, if present, then restricted to microsites and not reproducing successfully (unthrifty specimens, generally < 10 trees / acre)..... **DECIDUOUS FOREST**

2. Tree crowns usually not touching, forming 25 to 60% canopy cover ..... **WOODLAND** (see a & b below)

   a. Evergreen trees (non-deciduous conifers) present and reproducing successfully (10 trees per acre, minimum) and not confined to microsites (note that at "closed canopy" stage there may be no evidence of reproduction by any conifer species) ..... **EVERGREEN WOODLAND**
   b. Evergreen trees absent **or**, if present, then restricted to microsites and not .reproducing successfully (unthrifty specimens, generally < 10 trees / acre)..... **DECIDUOUS WOODLAND**

3. Shrubs generally greater than 0.5 m tall with individuals not touching to overlapping and canopy cover greater than 25%; shrub canopy cover (uncommonly) may be less than 25% if the canopy cover of other life forms (dwarf-shrub, herbs, nonvasculars) is less than 25% and exceeded by that of the shrubs [N.B., 1) by following this lead only shrub communities with a size potential greater than that of dwarf-shrubs will be found, 2) some types considered shrublands prior to NVC will now be found in shrub herbaceous vegetation; a list of dwarf-shrub species used to define plant associations will be found in the following lead, #4] ..... **SHRUBLAND (NVC DEFINITION)**

3*. Shrubs generally greater than 0.5 m tall and presenting, in the aggregate, a shrubland aspect with <u>at least 5%</u> canopy cover..... SHRUBLAND (Definition currently used by MTNHP)

3. Not as above, i. e. shrubs either less than 0.5 m tall or their combined cover less than 25% 4

3*. Not as above (3*); shrubs either less than 0.5 m tall or in the aggregate not presenting a shrubland aspect, their canopy cover less than 5%..... 4

4. Dwarf-shrubs (as individuals or clumps with a potential height less than 0.5 m) generally forming 25% or greater canopy cover [taxa include *Artemisia arbuscula* (low sagebrush), *A. arbuscula ssp. longiloba* (early low sagebrush), *A. nova* (black sagebrush), *A. pedatifida* (birdfoot sagebrush), *A. tridentata ssp. wyomingensis* (Wyoming big sagebrush), *A. tripartita* (three-tip sagebrush), *Atriplex gardneri* (Gardner's saltbush), *Cassiope mertensiana* (Mertens' mountain heather), *Dryas octopetala* (white dryas), *Kalmia*

microphylla (small-leaved laurel)*, Phyllodoce empetriformis* (red mountain-heath)*, P. glanduliflora* (yellow mountain-heath), *Pentaphylloides floribunda* (shrubby cinquefoil)*, Salix arctica* (alpine willow), *S. candida* (hoary willow), *S. barratiana* (Barratt willow)*, S. brachycarpa* (short-fruited willow)*, S. glauca* (glaucous willow), *S. planifolia* var*. monica* (dwarf planeleaf willow), *S. reticulata* (snow willow)]; though an uncommon condition, dwarf-shrub cover may be less than 25% but exceeding the combined cover of the other lifeforms present (shrubs, herbs, nonvasculars) which is less than 25%..... ..... **DWARF-SHRUBLAND (NVC definition)**

4*. Dwarf-shrubs (as individuals or clumps with a potential height less than 0.5 m) forming a shrubland aspect with at least 5% canopy cover (see list of dwarf-shrub species in lead 4 above) ..... DWARF-SHRUBLAND (Definition currently used by MTNHP)

4. Not as above; dwarf-shrub cover less than 25%; graminoids, forbs or nonvasculars constitute the dominant canopy cover, though trees and shrubs may be present and have to 25% canopy cover..... 5

4*. Not as above (4*); dwarf-shrub cover insufficient to present a shrubland aspect, canopy cover less than 5% 5

5. Herbs (graminoids, forbs, ferns) dominant, usually constituting at least 25% canopy cover; in the unusual case where herb canopy cover is less than 25% it still exceeds the cover of each of the other lifeforms present 6

5. Herbs not dominant, in the aggregate constituting less than 25% canopy cover..... 7

6. Perennial graminoid vegetation constitutes at least 50% of the total herbaceous canopy cover..... ..... **GRASSLANDS**

6. Of the total herbaceous cover perennial graminoids constitute less than 50% and conversely perennial forbs (including biennials and ferns) constitute more than 50% canopy cover .... **PERENNIAL FORB VEGETATION**

7. Nonvascular vegetation (bryophytes, lichens, algae) generally comprise at least 25% canopy cover; in unusual instances nonvascular canopy cover may be less than 25% where it exceeds the cover of each of the other lifeforms present; areas dominated by crustose lichens should be placed in the Sparsely Vegetated Class ..... **NONVASCULAR VEGETATION**

7. Not as above..... 8

8. Vegetation is scattered or nearly absent; total vegetation cover (excluding crustose lichens the cover of which often far exceeds 10%) is generally 1-10%..... ..... **SPARSE VEGETATION**

8. Vegetation cover is less than 1%..... **NON-VEGETATED**

KEY TO EVERGREEN FORESTS AND WOODLANDS [INCLUDES UPLAND AND WETLAND TYPES]

Key to Series Level

[**series are arranged alphabetically following this key**; key based largely on Pfister et al. (1977), Steele et al. (1983), Hansen et al. (1995)]; series comparable to NVC Alliance Level if only potential vegetation were addressed]

1. *Abies lasiocarpa* (subalpine fire) present and reproducing successfully; not confined to microsites..... .....***Abies lasiocarpa* Series**
1. *A. lasiocarpa* absent or not reproducing successfully and if present, confined to microsites 2

2. *Picea* (spruce) spp. [mostly *P. engelmannii* (Engelmann spruce), but including hybrid swarms of *P. engelmannii* x *P. glauca* (white spruce)] present and reproducing successfully..... ***Picea* spp. Series**
2. *Picea* spp. absent or not reproducing successfully or confined to microsites 3

3. *Pinus albicaulis* (whitebark pine) present and reproducing successfully; *A. lasiocarpa* (subalpine fir)and *Picea* (spruce) spp. may be present with more than 10 seedlings/saplings but they are stunted, unthrifty specimens..... ***Pinus albicaulis* Series**
3. P*. albicaulis absent* or not reproducing successfully..... 4

4. *Pinus flexilis* (limber pine) present and reproducing successfully (though episodically) and often sharing this status with *Pseudotsuga menziesii* (Douglas-fir) ..... ***Pinus flexilis* Series**
4. *P. flexilis* absent or not reproducing successfully..... 5

5. *Pseudotsuga menziesii* (Douglas-fir) present and reproducing successfully..... ..... **P*seudotsuga menziesii* Series**
5. *P. menziesii absent* or not reproducing successfully..... 6

6. *Pinus contorta* (lodgepole pine) occurring in virtually pure stands, not necessarily reproducing, lacking evidence as to climax potential..... ***Pinus contorta* Series**
6. *P. contorta* absent or not reproducing successfully..... 7

7. *Pinus ponderosa* (ponderosa pine) present, reproducing successfully (though mainly episodically), not accidental or confined to microsites ..... **Pinus ponderosa Series**
7. *P. ponderosa* absent or accidental 8

8. *Juniperus scopulorum* (Rocky Mountain juniper) the indicated site dominant, having canopy cover greater than or equal to that of *Cercocarpus ledifolius* (curl-leaf mountain mahogany)..... ..... ***Juniperus scopulorum* Series**
8. *J. scopulorum* not the indicated site dominant 9

9. *Cercocarpus ledifolius** (curl-leaf mountain mahogany) the indicated site dominant..... ..... ***Cercocarpus ledifolius* Series**
9. *C. ledifolius* not the indicated site dominant ..... **Forest or woodland Series (Alliance) as yet unrecognized for the Beaverhead Mountains Section**

**Cercocarpus ledifolius* is considered a shrub in most floras, but those with experience in the Great Basin may consider it a tree; we have included it in both the woodland and forest key and the shrubland key.

Abies lasiocarpa (subalpine fir) Series
Key to Plant Associations

1. Sites at or above the cold limits of *Pseudotsuga menziesii* (Douglas-fir) and also meeting one of following criteria;
   a. *Pinus albicaulis* (whitebark pine) well represented as either seral or climax component;
   b. *Luzula hitchcockii* (smooth woodrush) present, not related to microsites;
   c. *Ribes montigenum* (mountain gooseberry) present;
   d. Stands at upper timberline, growth stunted, tree height not much exceeding 50 ft.;
      UPPER SUBALPINE & TIMBERLINE HABITATS ..... lead #15
1. Not as above 1

2. *Ledum glandulosum* (Labrador tea) well represented (at least 5% canopy cover), ... ***Abies lasiocarpa / Ledum glandulosum* p. a.**
   a. One, or any combination of, the following species well represented: *Calamagrostis canadensis* (bluejoint reedgrass), *C. stricta* (narrow-spiked reedgrass), *Senecio triangularis* (arrowleaf groundsel) ..... ***Calamagrostis canadensis* phase**
   b. Not as above; *C. canadensis, C. stricta, S. triangularis* poorly represented; undergrowth may be variously dominated by *Vaccinium scoparium* (grouse whortleberry), *V. cespitosum* (dwarf huckleberry), *Linnaea borealis* (twinflower), *Cornus canadensis* (bunchberry), *Calamagrostis rubescens* (pinegrass), or *Carex geyeri* (elk sedge) .... ***Ledum glandulosum* phase**

2. *L. glandulosum* poorly represented 3

3. *Calamagrostis canadensis* (bluejoint reedgrass) or *C. stricta* (narrow-spike reedgrass), alone or in combination, well represented ..... ***Abies lasiocarpa / Calamagrostis canadensis* p. a.**
   a. *Vaccinium cespitosum* (dwarf huckleberry) common ..... ***Vaccinium cespitosum* phase**
   b. *V. cespitosum* scarce ..... ***Calamagrostis canadensis* phase**
3. C. canadensis and *C. stricta*, singly or their combined cover poorly represented 4

4. *Streptopus amplexifolius* (twisted stalk), *Senecio triangularis* (arrowleaf groundsel), *Mitella pentandr*a (five-stamened mitrewort) common, either individually or their combined cover (and not confined to microsites) ..... ***Abies lasiocarpa / Streptopus amplexifolius* p. a.**
   a. *Menziesia ferruginea* (fool's huckleberry) well represented ..... ***Menziesia ferruginea* phase**
   b. *M. ferruginea* poorly represented ..... ***Streptopus amplexifolius* phase**
4. The above-listed forbs, alone or their combined cover, having less than 1% cover 5

5. *Galium triflorum* (sweetscented bedstraw) and *Actaea rubra* (baneberry) either singly or their combined canopy cover at least 1% ..... ***Abies lasiocarpa / Galium triflorum* p. a.**
5. *G. triflorum* and *A. rubra*, singly or combined cover, less than 1% 6

6. *Menziesia ferruginea* (fool's huckleberry) well represented ..... ***Abies lasiocarpa / Menziesia ferruginea* p.a.**
6. *M. ferruginea* poorly represented 7

7. *Linnaea borealis* (twinflower) common ..... ***Abies lasiocarpa / Linnaea borealis* p.a.**
7. *L. borealis* scarce 8

8. *Vaccinium cespitosum* (dwarf huckleberry) common .. ***Abies lasiocarpa / Vaccinium cespitosum* p.a.**
8. *V. cespitosum* scarce 9

9. *Alnus viridis* ssp. *sinuata* (Sitka alder) well represented ..... ***Abies lasiocarpa / Alnus viridis* ssp. *sinuata* p.a.**
9. *A. viridis* ssp. *sinuata* poorly represented 10

10. *Xerophyllum tenax* (beargrass) common..... ***Abies lasiocarpa / Xerophyllum tenax* p.a.**
10. *X. tenax* scarce 11

11. *Vaccinium membranaceum* [big huckleberry, formerly *V. globulare* (globe huckleberry) in western Montana and northern Idaho] well represented..... ***Abies lasiocarpa / Vaccinium globulare* p.a.**
11. *V. membranaceum* poorly represented 12

12. *Vaccinium scoparium* [grouse whortleberry, including *V. myrtillus* (dwarf bilberry)] well represented..... ..... ***Abies lasiocarpa / Vaccinium scoparium* p.a.**
12. *V. scoparium* (and *V. myrtillus*) poorly represented` 13

13. *Thalictrum occidentale* (western meadowrue) or *T. fendleri* (Fendler's meadowrue) well represented.. ..... ***Abies lasiocarpa / Thalictrum occidentale* p.a.**
13. *T. occidentale* poorly represented 14

14. *Clematis columbiana* var. *columbiana* (formerly *C. pseudoalpina*, Rocky Mountain clematis) or *C. columbiana* var. *tenuiloba* (formerly *C. tenuiloba*, matted purple virgin's-bower) present or *Pinus flexilis* (limber pine) common (sites invariably with calcareous substrates) .... ***Abies lasiocarpa / Clematis columbiana* var. *columbiana* p.a.**
14. *C. columbiana* var. *columbiana* and *C. columbiana* var. *tenuiloba* absent and *P. flexilis* scarce..... 15

15. *Calamagrostis rubescens* (pine grass) well represented..... ..... ***Abies lasiocarpa / Calamagrostis rubescens* p.a.**
15. *C. rubescens* poorly represented 16

16. *Carex geyeri* (elk sedge) well represented ..... ***Abies lasiocarpa / Carex geyeri* p.a.**
16. *C. geyeri* poorly represented 17

17. *Arnica cordifolia* (heartleaf arnica) undergrowth dominant.....***Abies lasiocarpa / Arnica cordifolia* p.a.**
17. *A. cordifolia* not the undergrowth dominant .... **Undefined plant associations within *Abies lasiocarpa* Series**

18. *Abies lasiocarpa* (subalpine fir) and *Picea* (spruce) spp. scarce or, if common, then unthrifty specimens; *Pinus albicaulis* (whitebark pine) the indicated dominant tree at projected longterm stable state ..... ***Pinus albicaulis* Series**
18. Not as above..... 19

19. Timberline habitats; *Abies lasiocarpa* (subalpine fir) and *Picea* (spruce) spp. stunted, *Pinus contorta* (lodgepole pine) scarce, *Menziesia ferruginea* (fool's huckleberry) absent .... ***Pinus albicaulis - Abies lasiocarpa* p.a.**
19. Not as above, forest environments with *A. lasiocarpa* at least 50 ft. at maturity..... 20

20. *Luzula glabrata* var. *hitchcockii* (smooth woodrush, formerly *L. hitchcockii*) common .... ***Abies lasiocarpa / Luzula glabrata* var. *hitchcockii* p.a.**
20. *L. glabrata* var. *hitchcockii* scarce, confined to snow deposition microsites..... 21

21. *Vaccinium scoparium* (grouse whortleberry, including *V. myrtillus*, dwarf bilberry) well represented; *Pinus albicaulis* (whitebark pine) persisting, even reproducing, well into longterm stable state due to open canopy nature of stand structure .... ***Abies lasiocarpa - Pinus albicaulis / Vaccinium scoparium* p.a.**
21. Not as above..... 22

22. *Ribes montigenum* (mountain gooseberry) present and not relegated to microsites..... ..... ***Abies lasiocarpa / Ribes montigenum* p.a.**
22. *R. montigenum* absent..... **Undefined plant associations within *Abies lasiocarpa* Series**

Cercocarpus ledifolius (curl-leaf mountain mahogany) Series
Key to Plant Associations

1. *Festuca idahoensis* (Idaho fescue) well represented or the dominant graminoid ..... ***Cercocarpus ledifolius / Festuca idahoensis* p. a.**
1. *F. idahoensis* poorly represented and not the dominant graminoid 2

2. *Pseudoroegneria spicata* (bluebunch wheatgrass) or *Oryzopsis hymenoides* (Indian ricegrass), their individual or combined cover, constitute the dominant graminoids ..... ***Cercocarpus ledifolius / Pseudoroegneria spicata* p. a.**

2. *P. spicata* and *O. hymenoides*, individually or their combined cover, not the dominant graminoids ..... **Undefined *Cercocarpus ledifolius*-dominated plant association / community type**

Juniperus scopulorum (Rocky Mountain Juniper) Series
Key to Plant Associations

1. Cottonwood (*Populus* spp.) species well represented or *Cornus sericea* (red-osier dogwood), *Poa pratensis* (Kentucky bluegrass) or *Agrostis stolonifera* (redtop, also A. alba) singly or combined cover, common; riparian sites ..... ***Juniperus scopulorum / Cornus stolonifera* p. a.**
1. Cottonwood (*Populus* spp.) species poorly represented and *C. stolonifera*, *P. pratensis*, and *A. stolonifera* , singly or their combined cover, scarce 2

2. *Cercocarpus ledifolius* (curl-leaf mountain mahogany) well represented ..... ***Juniperus scopulorum / Cercocarpus ledifolius* p. a.**
2. *C. ledifolius* poorly represented 3

3. *Artemisia nova* (black sagebrush) well represented ..... ***Juniperus scopulorum / Artemisia nova* p. a.**
3. *A. nova* poorly represented 4

4. *Artemisia tridentata* (big sagebrush, usually subspecies *vaseyana* or *tridentata*) well represented ..... ***Juniperus scopulorum / Artemisia tridentata* p.a.**
4. *A. tridentata* poorly represented 5

5. *Pseudoroegneria spicata* (formerly *Agropyron spicatum*, bluebunch wheatgrass) well represented or the dominant graminoid ..... ***Juniperus scopulorum / Pseudoroegneria spicata* p. a.**
5. *P. spicata* poorly represented or not the dominant graminoid ..... **Undefined plant association(s) within the *Juniperus scopulorum* Series**

Picea (spruce) spp. [predominantly *P. engelmanni*i (Engelmann spruce) and *P. engelmannii* x *P. glauca* (white spruce) hybrids] Series
Key to plant associations

1. *Equisetum arvense* (field horsetail) abundant ..... ***Picea* spp. / *Equisetum arvense* p. a.**
1. *E. arvense* not abundant 2

2. *Carex disperma* (soft-leaved sedge) well represented ..... ***Picea* spp. / *Carex disperma* p. a.**
2. *C. disperma* poorly represented 3

3. *Calamagrostis canadensis* (bluejoint reedgrass), *C. stricta* (narrow-spiked reedgrass), or *Senecio triangularis* (arrowleaf groundsel) common, either alone or in combination ..... ***Picea* spp. / *Calamagrostis canadensis* p. a.**
3. *C. canadensis*, *C. stricta*, and *S. triangularis* scarce 4

4. *Cornus sericea* (formerly *C. stolonifera*, red-osier dogwood) or *Alnus incana* (mountain alder) common ..... ***Picea* spp. / *Cornus sericea* p. a.**
4. *C. sericea* scarce 5

5. Two of the following moist-site forbs present or one or more common; *Streptopus amplexifolius*, (clasping-leaved twisted stalk), *Galium triflorum* (sweetscented bedstraw), *Actaea rubra* (baneberry) . . .. ***Picea spp. / Galium triflorum* p. a.**
5. Not as above 6

N.B. Sites above this level in the key are usually wetlands and/or associated with riparian features

4. *Linnaea borealis* (twinflower) common ..... ***Picea* spp. / *Linnaea borealis* p. a.**
4. *L. borealis* scarce 5

5. *Physocarpus malvaceus* (mallow ninebark) well represented ..... ***Picea* spp. / *Physocarpus malvaceus* p. a.**
5. *P. malvaceus* poorly represented 6

6. *Maianthemum stellatum* (formerly *Smilacina stellata*, starry Solomon's seal) or *Thalictrum ccidentale* (western meadowrue) common ..... ***Picea spp. / Maianthemum stellatum* p.a.**
6. *M. stellatum* and *T. occidentale* scarce 7

7. *Senecio streptanthifolius* (Rocky Mountain butterweed) present; undergrowth generally depauperate . ..... ***Picea spp. / Senecio streptanthifolius* p.a.**
   a. *Pseudotsuga menziesii* (Douglas-fir) common ..... **Pseudotsuga menziesii phase**
   b. *P. menziesii* scarce, sites above its elevational limits ..... ***Picea* spp. phase**
7. *S. streptanthifolius* absent, undergrowth various ..... **Undefined p.a.'s. within *Picea* spp. Series**

Pinus albicaulis (whitebark pine) Series
Key to Plant Associations

1. *Vaccinium scoparium* (grouse whortleberry) well represented (not necessarily dominant undergrowth species in the presence of high coverage's of various herbs, usually *Arnica latifolia* (broadleaf arnica) or *A. cordifolia* (heart-leaf arnica) ..... ***Pinus albicaulis / Vaccinium scoparium* p. a.**
1. *V. scoparium* poorly represented 2

2. *Carex geyeri* (elk sedge) well represented ..... ***Pinus albicaulis / Carex geyeri* p.a.**
2. *C. geyeri* poorly represented 3

3. *Juniperus communis* (common juniper), *Astragalus miser* (weedy milkvetch), or *Shepherdia canadensis* (Canada buffaloberry) well represented or dominant, either singly or collectively..... ..... ***Pinus albicaulis / Juniperus communis* p.a.**
3. Not as above 4

4. *Festuca idahoensis* (Idaho fescue) common ..... ***Pinus albicaulis / Festuca idahoensis* p.a.**
4. *F. idahoensis* scarce ..... **Undefined p.a.'s./c.t.'s. within the *Pinus albicaulis* Series**

Pinus contorta (lodgepole pine) Series
Key to Plant Associations

1. *Calamagrostis canadensis* (bluejoint reedgrass) or *C. stricta* (narrow-spike reedgrass), singly or their combined cover, well represented .... **Pinus contorta / Calamagrostis canadensis c. t. (see a. below)**
   a. *Vaccinium cespitosum* (dwarf huckleberry) present having at least 1% canopy cover .... ***Vaccinium cespitosum* phase**
   a. *V. cespitosum* scarce, having less than 1% ..... ***Calamagrostis canadensis* phase**
1. *C. canadensis* and *C. stricta*, poorly represented, either individually or their combined cover 2

2. *Vaccinium cespitosum* (dwarf huckleberry) common ..... ***Pinus contorta / Vaccinium cespitosum* c. t.**
2. *V. cespitosum* scarce 3

3. *Linnaea borealis* (twinflower) common ..... ***Pinus contorta / Linnaea borealis* p.a.**
3. *L. borealis* scarce 4

4. *Xerophyllum tenax* (beargrass) well represented ..... ***Pinus contorta / Xerophyllum tenax* c. t.**
4. *X. tenax* poorly represented 5

5. *Vacuum scoparium* (grouse whortleberry) well represented .... ***Pinus contorta / Vaccinium scoparium* c. t.**
5. *V. scoparium* poorly represented 6

6 *Thalictrum occidentale* (western meadowrue) or *T. fendleri* (Fendler's meadow rue) well represented... ..... ***Pinus contorta / Thalictrum occidentale* c. t.**
6. *T. occidentale* and T. fendleri poorly represented 7

7. *Calamagrostis rubescens* (pine grass) well represented..... ..... ***Pinus contorta / Calamagrostis rubescens* c. t.**
7. *C. rubescens* poorly represented 8

8. *Carex geyeri* (elk sedge) well represented ..... ***Pinus contorta / Carex geyeri* p.a.**
8. *C. geyeri* poorly represented 9

9. *Purshia tridentata* (antelope bitterbrush) common ..... ***Pinus contorta / Purshia tridentata* p. a.**

9. *P. tridentata* scarce ..... 10.

10. *Carex rossii* (Ross sedge) well represented or the undergrowth dominant.....
..... ***Pinus contorta / Carex rossii* p. a.**
10. *C. rossii* poorly represented or not the undergrowth dominant 11

11. *Arnica cordifolia* (heartleaf arnica) or *Astragalus miser* (weedy milkvetch) well represented, either singly or their combined cover ..... ***Pinus contorta / Arnica cordifolia* c. t.**
11. *A. cordifolia* and *A. miser* poorly represented, alone or their combined cover .....
..... **Undefined *Pinus contorta*-dominated type**

Pinus flexilis (limber pine) Series
Key to Plant Associations

1. *Cercocarpus ledifolius* (curl-leaf mountain mahogany) well represented .....
..... ***Pinus flexilis / Cercocarpus ledifolius* p.a.**
1. *C. ledifolius* poorly represented 2

2. *Juniperus communis* (common juniper) or *J. horizontalis* (creeping juniper) well represented.....
..... ***Pinus flexilis /Juniperus communis* p.a.**
2. *J. communis* and *J. horizontalis* poorly represented 3

3. *Festuca campestris* (formerly *Festuca scabrella,* rough fescue) common .....
..... ***Pinus flexilis / Festuca scabrella* p. a.**
3. *F. campestris* scarce 4

4. *Festuca idahoensis* (Idaho fescue) well represented ..... ***Pinus flexilis / Festuca idahoensis* p.a.**
4. *F. idahoensis* poorly represented 5

5. *Pseudoroegneria spicata* (formerly *Agropyron spicatum*, bluebunch wheatgrass) well represented .....
..... ***Pinus flexilis / Agropyron spicatum* p.a.**
5. *P. spicata* poorly represented ..... **Undefined p.a.'s. within *Pinus flexilis* Series**

Pseudotsuga menziesii (Douglas-fir) Series
Key to plant associations

1. Habitats on steep slopes (generally > 40%) composed of unstable substrates, from gravel to coarse rock, and lacking soil development; undergrowth canopy cover sparse and spatially quite variable ..... ***Pseudotsuga menziesii* / Scree p. a.**
1. Not as above; sites with some soil development due to stability of substrate; undergrowth cover more uniform reflecting lack of microsites 2

2. *Cornus sericea* (red-osier dogwood), Salix spp. (willows, excepting *S. scouleriana*, Scouler willow), *Actaea rubra* (baneberry), *Poa pratensis* (Kentucky bluegrass) or *Equisetum arvense* (field horsetail) common, individually or their combined cover ..... ***Pseudotsuga menziesii / Cornus sericea* p.a.**
2. Above listed species considered individually or their combined cover, scarce 3

3. Sites with at least one of the following wetland attributes present: hydrophytic vegetation, wetland hydrology, hydric soils ..... **Unclassified Wetland or Riparian Sites**
3. Sites lacking any one of the above-listed wetland attributes 4

4 *Vaccinium cespitosum* (dwarf huckleberry) common ..... ***Pseudotsuga menziesii / Vaccinium cespitosum* p.a.**
4. *V. cespitosum* scarce 5

5. *Linnaea borealis* (twinflower) common ..... ***Pseudotsuga menziesii / Linnaea borealis* p.a.**
5. *L. borealis* scarce 6

6. *Physocarpus malvaceus* (mallow ninebark) well represented ..... ***Pseudotsuga menziesii / Physocarpus malvaceus* p.a.**
6. *P. malvaceus* poorly represented 7

7. *Vaccinium membranaceum* (big huckleberry, formerly *V. globulare*) well represented ..... ***Pseudotsuga menziesii / Vaccinium membranaceum* p.a.**
7. *V. membranaceum* poorly represented 8

8. *Symphoricarpos albus* (common snowberry) well represented ..... ***Pseudotsuga menziesii / Symphoricarpos albus* p.a.**
8. *S. albus* poorly represented 9

9. *Calamagrostis rubescens* (pine grass) well represented ..... ***Pseudotsuga menziesii / Calamagrostis rubescens* p.a.**
9. C. rubescens poorly represented 10

10. *Carex geyeri* (elk sedge) well represented ..... ***Pseudotsuga menziesii / Carex geyeri* p.a.**
10. *C. geyeri* poorly represented 11

11. *Spiraea betulifolia* (shiny-leaf spiraea) well represented ..... ***Pseudotsuga menziesii / Spiraea betulifolia* p.a.**
11. *S. betulifolia* poorly represented 12

12. *Arctostaphylos uva-ursi* (kinnikinnick) well represented ..... ***Pseudotsuga menziesii / Arctostaphylos uva-ursi* p.a.**
12. *A. uva-ursi* poorly represented 13

13. *Juniperus communis* (common juniper) or *Juniperus horizontalis* (creeping juniper) the undergrowth dominant ..... ***Pseudotsuga menziesii / Juniperus communis* p.a.**

13. *J. communis* and *J. horizontalis* not the undergrowth dominants 14

14. *Symphoricarpos oreophilus* (mountain snowberry) well represented .....
.....***Pseudotsuga menziesii / Symphoricarpos oreophilus* p.a.**
14. *S. oreophilus* poorly represented 15

15. *Arnica cordifolia* (heartleaf arnica) or *Antennaria racemosa* (raceme pussy-toes) the dominant undergrowth species ..... ***Pseudotsuga menziesii / Arnica cordifolia* p.a.**
15. Neither *A. cordifolia* nor *A. racemosa* the dominant undergrowth species 16

16. *Cercocarpus ledifolius* (curl-leaf mountain mahogany) or *Juniperus scopulorum* (Rocky Mountain juniper) or their combined cover well represented 17
16. *C. ledifolius* and *J. scopulorum* poorly represented 18

17. *Cercocarpus ledifolius* (curl-leaf mountain mahogany) having greater canopy cover than *Juniperus scopulorum* (Rocky Mountain juniper) .....***Pseudotsuga menziesii / Cercocarpus ledifolius* p.a.**
17. *C. ledifolius* having less canopy cover than *J. scopulorum* .....
.....***Pseudotsuga menziesii / Juniperus scopulorum* p.a.**

18. *Festuca campestris* (formerly *Festuca scabrella*, rough fescue) common .....
.....***Pseudotsuga menziesii / Festuca scabrella* p.a.**
18. *F. campestris* scarce 19

19. *Festuca idahoensis* (Idaho fescue) common ..... ***Pseudotsuga menziesii / Festuca idahoensis* p.a.**
19. *F. idahoensis* scarce 20

20. *Pseudoroegneria spicata* (formerly Agro*pyron spicatum,* bluebunch wheatgrass*)* well represented .....
.....***Pseudotsuga menziesii / Pseudoroegneria spicata* p.a.**
20. *P. spicata* poorly represented ..... **Undefined p.a. of the *Pseudotsuga menziesii* Series**

KEY TO DECIDUOUS FORESTS AND WOODLANDS INCLUDING UPLAND AND WETLAND TYPES

[based largely on Hansen et al. (1995) & Mueggler (1988)]

1. *Populus angustifolia* (narrowleaf cottonwood) and *P. balsamifera* ssp. *trichocarpa* (formerly *P. trichocarpa*, black cottonwood) alone or their combined canopy cover, at least 25% or the dominant lifeform 2
1. *P. angustifolia* and *P. balsamifera* ssp. *trichocarpa* with < 25% canopy cover and not the dominant species,..... *P. tremuloides* (trembling aspen) dominant and having at least 25% cover, singly or in combination with *P. angustifolia* or *P. balsamifera* 11

2. *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) with greater canopy cover than *P. angustifolia* (narrowleaf cottonwood) 3
2. *P. balsamifera* ssp. *trichocarpa* having less canopy cover than *P. angustifolia* 7

3. Site recently deposited alluvial bar or overflow reach with seedling and sapling size classes (dbh <5.0 in.) dominating .....***Populus balsamifera* ssp. *trichocarpa* / Recent Alluvial Bar p.a.**
3. *P. trichocarpa* represented by pole or mature size classes..... 4

4. Shrub species having at least 15% canopy cover or *Cornus sericea* (red-osier dogwood, formerly *C. stolonifera*) common 5
4. Shrub species having less than 15% canopy cover and *Cornus sericea* scarce 6

5. *Cornus sericea* (red-osier dogwood) common .... ***P. balsamifera* ssp*. trichocarpa* / *Cornus sericea* p. a.**
5. *C. sericea* scarce; undergrowth may be dominated by any combination of *Symphoricarpos albus* (western snowberry), *S. occidentalis* (common snowberry), *Rosa woodsii* (woods rose), or *Rosa acicularis* (prickly rose) .....***P. balsamifera* ssp. *trichocarpa* / *Symphoricarpos occidentalis* p. a.**

6. *Poa pratensis* (Kentucky bluegrass), *Poa palustris* (fowl bluegrass), or *Agrostis alba* (redtop) abundant, or dominating the undergrowth.....***P. balsamifera* ssp. *trichocarpa* / *Poa pratensis* p. a.**
6. Not as above..... **Undefined p. a. within *P. balsamifera* ssp. *trichocarpa* Series**

7. *Populus angustifolia* (narrowleaf cottonwood) seedling or sapling size classes (dbh < 5.0 in.) dominate recently deposited alluvial bars..... ***Populus angustifolia* / Recent Alluvial Bar p.a.**
7. *P. angustifolia* pole or mature size classes dominate the site, regardless of substrate 8

8. Shrub species having a single or combined canopy cover of 25% or *Cornus sericea* (red-osier dogwood) at least common..... 9
8. Shrub species having less than 15% canopy cover 10

9. *Cornus sericea* (red-osier dogwood) common ..... ***Populus angustifolia* / *Cornus stolonifera* p. a.**
9. *C. sericea* scarce; undergrowth may be dominated by any combination of *Symphoricarpos albus* (western snowberry), *S. occidentalis* (common snowberry), *Rosa woodsii* (woods rose), or *Rosa acicularis* (prickly rose) .....***Populus angustifolia* / *Symphoricarpos occidentalis* p. a.**

10. *Poa pratensis (Kentucky bluegrass)*, *Poa palustris (fowl bluegrass)*, or *Agrostis alba* (redtop), singly or combined cover, abundant, or dominant ....***Populus angustifolia* / *Poa pratensis* p. a.**
10. Not as above..... **Undefined p.a. within *Populus angustifolia* Series**

11. *Calamagrostis canadensis* (bluejoint reedgrass) or *C. stricta* (narrow-spike reedgrass), singly or in combination, well represented..... ***Populus tremuloides* / *Calamagrostis canadensis* p. a.**
11. *C. canadensis* or *C. stricta*, either singly or their combined canopy cover, poorly represented..... 12

12. *Salix* (willow) spp., *Cornus sericea* (red-osier dogwood), *Alnus incana* (mountain alder) or *Prunus virginiana* (common chokecherry), individually or combined canopy cover, well represented..... ..... ***Populus tremuloides / Cornus sericea* p.a.**
12. *Salix* spp., *C. sericea*, *A. incana*, and *P. virginiana*, individually or combined cover, poorly represented..... 13

13. Any two of the following species common (not confined to microsites) or any single one well represented; *Angelica arguta* (sharptooth angelica), *Osmorhiza occidentalis* (western sweet-cicely), *Heracleum lanatum* (cow parsnip), *Actaea rubra* (baneberry), or *Galium triflorum* (sweetscented bedstraw) ..... ***Populus tremuloides / Osmorhiza occidentalis* p. a.**
13. Not as above; considered individually all of the above species poorly represented and as pairs not more than scarce 14

14. One or more members of the tall forb group prominent, their single or combined canopy cover at least 10%; *Agastache urticifolia* (stinging nettle), *Aster engelmannii* (Engelmann's aster), *Delphinium occidentale* (western larkspur), *Hackelia floribunda* (showy stickseed), *Heracleum lanatum* (cow parsnip), *Mertensia ciliata* (mountain bluebell), *Osmorhiza occidentalis* (western sweet-cicely), *Senecio serra* (tall butterweed), *Valeriana occidentalis* (western valerian)..... ..... ***Populus tremuloides* / tall forb p.a.**
14. No single one of the above species or any combination thereof constituting 10% canopy cover..... 15

15. Considered singly or in any combination, any of the following species having at least 10 % canopy cover; *Thalictrum fendleri* (Fendler's meadowrue) *T. occidentale* (western meadowrue), *Osmorhiza chilensis* (western sweet-cicely), *O. depauperata* (blunt-fruit sweet-cicely), *Geranium viscosissimum* (sticky geranium),..... ***Populus tremuloides / Thalictrum fendleri* p.a.**
15. None of the above-listed species, singly or in any combination, totaling 10% cover 16

16. *Calamagrostis rubescens* (pine grass) or *Carex geyeri* dominant, their individual or combined cover, at least 10 % ..... ***Populus tremuloides / Calamagrostis rubescens* p.a.**
16. Neither *C. rubescens* nor *C. geyeri* nor their combined cover exceeding 10%..... 17

17. *Bromus carinatus* (mountain brome), *B. anomalus* (nodding brome), *Elymus glaucus* (blue wildrye), *Elymus trachycaulus* (bearded wheatgrass), *Stipa occidentalis* (western needlegrass), alone or in any combination, comprising at least 10% canopy cover..... ..... ***Populus tremuloides / Bromus carinatus* p.a.**
17. Not as above; singly or in combination, the above species comprise less than 10% cover 18

18. *Poa pratensis* (Kentucky bluegrass) dominates the undergrowth..... ..... ***Populus tremuloides / Poa pratensis* p.a.**
18. *P. pratensis* not the undergrowth dominant..... **Undefined p. a. within *Populus tremuloides* Series**

KEY TO SHRUBLAND PLANT ASSOCIATIONS INCLUDING UPLAND AND WETLAND TYPES

[based largely on Hansen et al. 1995, Mueggler and Stewart 1980]

1. Sites with at least one of the following wetland attributes: hydrophytic vegetation, hydric soils, wetland hydrology.....see "**KEY TO WETLAND / RIPARIAN SHRUBLAND COMMUNITIES**" following lead 49
1. Sites lacking any of the wetland attributes listed above 2

2. *Pentaphylloides floribunda* (shrubby cinquefoil, formerly *Potentilla fruticosa*) well represented (often partially obscured by lush herbaceous vegetation; other shrubby taxa may be well represented as well)..... 3
2. *P. floribunda* poorly represented..... 8

3. *Carex utriculata* (beaked sedge), *C. atherodes* (awned sedge), *C. vesicaria* (inflated sedge), *C. aquatilis* (water sedge), singly or combined cover at least 10%..... ***Pentaphylloides floribunda / Carex utriculata* p. a.**
3. *C. utriculata*, *C. atherodes*, *C. vesicaria*, and *C. aquatilis* poorly represented, singly or combined..... 4

4. *Deschampsia cespitosa* (tufted hairgrass) common, or only present as scattered individuals under intensive grazing regimes ..... ***Pentaphylloides floribunda / Deschampsia cespitosa p. a.***
4. *D. cespitosa* scarce..... 5

5. *Festuca campestris* (rough fescue, formerly *F. scabrella*) common, or only present as scattered individuals with intensive grazing..... ***Pentaphylloides floribunda / Festuca* campestris p. a.**
5. *F. campestris* scarce..... 6

6. *Festuca idahoensis* (Idaho fescue) well represented (only common with intensive grazing)..... ***Pentaphylloides floribunda / Festuca idahoensis* p. a.**
6. *F. idahoensis* poorly represented (or scarce under intensive grazing regime) 7

7. *Potentilla ovina* (sheep cinquefoil) common, the dominant of a depauperate undergrowth; substrates may be water-scoured and eroded..... ***Pentaphylloides floribunda / Potentilla ovina* p. a.**
6. *P. ovina* scarce and not the undergrowth dominant ..... **Undefined *Pentaphylloides floribunda*-dominated vegetation**

8. *Artemisia cana* (silver sagebrush) having at least 10% canopy cover (other *Artemisia* taxa may be present)..... 9
8. *A. cana* having less than 10% cover..... 14

9. *Leymus cinereus* (formerly *Elymus cinereus*, giant or basin wildrye) well represented (or common under intensive spring grazing regime) ..... ***Artemisia cana / Leymus cinereus* p. a.**
9. *L. cinereus* poorly represented 10

10. *Poa secunda* (Sandberg's bluegrass, only that portion of the taxon formerly known as *Poa nevadensis* [Nevada bluegrass] or *P. juncifolia* [alkali bluegrass]), or *Carex praegracilis* (clustered field sedge) common, singly or combined cover ..... ***Artemisia cana / Poa secunda* p.a.**
10. *P. nevadensis*, *P. juncifolia*, and *C. praegracilis* scarce, individually or any combination..... 11

11. *Pascopyrum smithii* (formerly *Agropyron smithii*, western wheatgrass) or *Elymus lanceolatus* (formerly *A. dasystachyum*, thick-spike wheatgrass) well represented..... ***Artemisia cana / Pascopyrum smithii* p. a.**
11. *P. smithii* and *E. lanceolatus* poorly represented 12

12. Either *Festuca idahoensis* (Idaho fescue) or *Elymus trachycaulus* (bearded wheatgrass) well represented (only common under grazing).....see a & b below
    a. *F. idahoensis* well represented.....***Artemisia cana* / *Festuca idahoensis* p.a.**
    b. *F. idahoensis* poorly represented and *E. trachycaulus* well represented.....
    .....***Artemisia cana* / *Elymus trachycaulus* p. a.**
12. *F. idahoensis* and *E. trachycaulus* poorly represented..... 13

13. Either *Stipa comata* (needle-and-thread) or Poa pratensis (Kentucky bluegrass) well represented .....
    .....See a & b below
    a. *Stipa comata* well represented and *P. pratensis* poorly represented.....
    .....***Artemisia cana* / *Stipa comata* p.a.**
    b. *S. comata* poorly represented and *P. pratensis* well represented.....
    ..... ***Artemisia cana* / *Poa pratensis* p.a.**
13. *S. comata* and *P. pratensis* both poorly represented .....
    ..... **Undefined p.a. within *Artemisia cana* alliance**

14. *Artemisia tridentata* ssp. *tridentata* (Basin big sagebrush) either singly, or its combined cover with *A. tridentata* ssp. *vaseyana* (Vasey or mountain big sagebrush), well represented (other *Artemisia* taxa may be present) **and** *Sarcobatus vermiculatus* (black greasewood) scarce (should *S. vermiculatus* be common then lead #72) 15
14. *A. tridentata* v. *tridentata* or its combined cover with *A. tridentata* ssp. *vaseyana* poorly represented and *S. vermiculatus* scarce..... 18

15. Rhizomatous wheatgrasses, *Elymus lanceolatus* (thick-spike wheatgrass, formerly *Agropyron dasystachyum*) or *Pascopyrum smithii* (western wheatgrass, formerly *A. smithii*), common, individually or their combined cover.....***Artemisia tridentata v. tridentata* / *Pascopyrum smithii* p.a.**
15. *E. lanceolatus* and *Pascopyrum smithii* or other wheatgrasses scarce 16

16. *Festuca idahoensis* (Idaho fescue) well represented (or only common if intensive grazing a factor).....
    .....***Artemisia tridentata* v. *tridentata* / *Festuca idahoensis* p.a.**
16. *F. idahoensis* poorly represented 17

17. *Stipa comata* (needle-and-thread) or *S. spartea* (porcupine-grass) well represented .....
    .....***Artemisia tridentata v. tridentata* / *Stipa comata* p.a.**
17. *S. comata* and *S. spartea* poorly represented .....
    .....**Undefined p.a. within *Artemisia tridentata* v. *tridentata* Alliance**

18. *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) well represented 19
18. *A. tridentata* ssp. *vaseyana* poorly represented 27

19. *Leymus cinereus* (formerly *Elymus cinereus*, basin or giant wildrye) well represented (only common under intensive grazing regime) .....***Artemisia tridentata* ssp. *vaseyana* / *Leymus cinereus* p.a.**
19. *L. cinereus* poorly represented 20

20. *Festuca campestris* (formerly *Festuca scabrella*, rough fescue) common (only as scattered plants with intensive grazing) .....***Artemisia tridentata ssp. vaseyana* / *Festuca scabrella* p.a.**
20. *F. campestris* scarce..... 21

21. *Symphoricarpos oreophilus* (mountain snowberry) well represented..... 22
21. *S. oreophilus* poorly represented..... 24

22. *Bromus carinatus* (mountain brome), *B. anomalus* (nodding brome) or *B. inermis* var. *pumpellianus* (pumpelly brome) well represented, individually or combined coverage.....
    ..... ***Artemisia tridentata ssp. vaseyana – Symphoricarpos oreophilus* / *Bromus carinatus* p. a.**
22. *B. carinatus*, *B. anomalus* and *B. inermis* var. *pumpellianus* poorly represented, individually or their combined cover..... 23

23. *Festuca idahoensis* (Idaho fescue) well represented (only common under intensive grazing)..... .....***Artemisia tridentata ssp. vaseyana – Symphoricarpos oreophilus / Festuca idahoensis* p. a.**
23. *F. idahoensis* poorly represented 24

24. *Pascopyrum smithii* (western wheatgrass) or *Elymus lanceolatus* (thick-spike wheatgrass) well represented, individually or their combined coverage; *Festuca idahoensis* (Idaho fescue) poorly represented.....***Artemisia tridentata* ssp. *vaseyana* / *Pascopyrum smithii* p. a.**
24. *P. smithii* and *E. lanceolatus* poorly represented, individually or combined..... 25

25. *Festuca idahoensis* (Idaho fescue) well represented (only common under intensive grazing regime)..... ..... ***Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis* p.a. (see a-e below for proposed modifications of this associations, elevating phases to the p. a. level and defining new p. as.**
25. *F. idahoensis* poorly represented 26
a. *Pascopyrum smithii* (western wheatgrass) or *Elymus lanceolatus* (thick-spike wheatgrass) well represented..... ***A. tridentata* ssp. *vaseyana* / *F. idahoensis – Pascopyrum smithii* p. a.**
b. Not as above; *Stipa occidentalis* (western needlegrass) or *Stipa richardsonii* (Richardson's needlegrass) common ..... ***A. tridentata* ssp. *vaseyana* / *F. idahoensis – Stipa occidentalis* p. a.**
c. Not as above; *Elymus trachycaulus* (bearded wheatgrass), *Bromus carinatus* (mountain brome) or *B. anomalus* (nodding brome) common, individually or in any combination; or *Geranium viscosissimum* (sticky geranium), *Potentilla glandulosa* (sticky cinquefoil), or *Potentilla gracilis* (slender cinquefoil) present .... ***A. tridentata* ssp. *vaseyana* / *F. idahoensis – Geranium viscosissimum* p. a.**
d. Not as above, *Pseudoroegneria spicata* (bluebunch wheatgrass) well represented (reduce to common under intensive grazing regimes)..... .....***A. tridentata* ssp. *vaseyana* / *F. idahoensis – Pseudoroegneria spicata* p. a.**
e. Not as above; *P. spicata* poorly represented.....**undefined *A. tridentata* ssp. *vaseyana* vegetation *type***
26. *Pseudoroegneria spicata* (formerly *Agropyron spicatum*, bluebunch wheatgrass) well represented (reduce to common under intensive grazing regimes) .... ***Artemisia tridentata* ssp. *vaseyana* / *Pseudoroegneria spicata* p.a.**
26. *P. spicata* scarce..... **Undefined/unrecorded *Artemisia tridentata* ssp. *vaseyana* vegetation type**

27. *Artemisia nova* (black sagebrush) well represented (other *Artemisia* taxa may be present, even well represented)..... 28
27. *A. nova* poorly represented..... 30

28. *Festuca idahoensis* (Idaho fescue) well represented ..... ***Artemisia nova* / *Festuca idahoensis* p. a.**
28. *F. idahoensis* poorly represented 29

29. *Pseudoroegneria spicata* (bluebunch wheatgrass) or *Oryzopsis hymenoides* (Indian ricegrass) common, individually or their combined cover.....***Artemisia nova* / *Pseudoroegneria spicata* p.a.**
29. *A. spicatum* and *O. hymenoides* scarce .....**Undefined p. a. within *Artemisia nova* Alliance**

30. *Cercocarpus ledifolius* (curl-leaf mountain mahogany) well represented..... 31
30. *C. ledifolius* poorly represented (and by population structure not likely to increase) 33

31. *Festuca idahoensis* (Idaho fescue) well represented (only common if intensively grazed) .... ***Cercocarpus ledifolius* / *Festuca idahoensis* p.a.**
31. *F. idahoensis* poorly represented (or scarce with grazing)..... 32

32. *Pseudoroegneria spicata* (bluebunch wheatgrass) or *Oryzopsis hymenoides* (Indian ricegrass), individual or combined cover, the dominant graminoids..... .....***Cercocarpus ledifolius* / *Pseudoroegneria spicata* p.a.**
32. *P. spicata* and *O. hymenoides*, singly or combined cover, not the dominant graminoids ....**Undefined p. a. within *Cercocarpus ledifolius* Alliance**

33. *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) well represented 34
33. *A. tridentata* ssp. *wyomingensis* poorly represented 36

34. *Elymus lanceolatus* (thick-spike wheatgrass) or *Pascopyrum smithii* (western wheatgrass), individually or their combined cover, common ..... ***Artemisia tridentata* ssp. *wyomingensis* / *Elymus lanceolatus* p.a.**
34. *E. lanceolatus* and *P. smithii* scarce 35

35. *Pseudoroegneria spicata* (bluebunch wheatgrass) well represented (only common with intensive grazing) ..... ***Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* p.a.**
35. *P. spicata* (poorly represented) ..... **Undefined p.a. within *Artemisia tridentata* ssp. *wyomingensis* Alliance**

36. *Artemisia tripartita* (three-tip sagebrush) the dominant shrub spp. (*Artemisia* spp). 37
36. *A. tripartita* not the dominant shrub spp. 40

37. *Festuca idahoensis* (Idaho fescue) well represented (only common under intensive grazing) ..... ***Artemisia tripartita* / *Festuca idahoensis* p. a.**
37. *F. idahoensis* poorly represented 38

38. *Elymus lanceolatus* (thick-spike wheatgrass, formerly *Agropyron dasystachyum*) or *Pascopyrum smithii* (western wheatgrass, formerly *Agropyron smithii*), individually or in combination, common and the dominant graminoids ..... ***Artemisia tripartita* / *Elymus lanceolatus* p. a.**
38. *E. lanceolatus* and *P. smithii*, individually or their combined cover, poorly represented and neither being the dominant graminoids 39

39. *Pseudoroegneria spicata* (bluebunch wheatgrass, formerly *Agropyron spicatum*) well represented (only common under intensive grazing) and, excepting *Poa secunda* (Sandberg's bluegrass), constitutes the dominant graminoid ..... ***Artemisia tripartita* / *Pseudoroegneria spicata* p. a.**
39. *P. spicata* poorly represented, not the dominant graminoid ..... **Undefined p. a. within *Artemisia tripartita* Alliance**

40. *Rhus trilobata* (skunk-bush sumac, formerly *R. aromatica*) well represented, as scattered patches, or the dominant shrub 41
40. *R. trilobata* poorly represented, not the dominant shrub 43

41. *Festuca idahoensis* (Idaho fescue) well represented or dominant graminoid ..... ***Rhus trilobata* / *Festuca idahoensis* p.a.**
41. *F. idahoensis* poorly represented, not dominant graminoid 42

42. *Pseudoroegneria spicata* (bluebunch wheatgrass) common or dominant graminoid ..... ***Rhus trilobata* / *Pseudoroegneria spicata* p.a.**
42. *P. spicata* scarce or not the dominant graminoid ..... **Undefined p. a. within *Rhus aromatica* Alliance**

43. *Chrysothamnus viscidiflorus* (green rabbitbrush) well represented or the dominant shrub 44
43. *C. viscidiflorus* poorly represented or not the dominant shrub 45

44. *Stipa comata* (needle-and-thread) common or the dominant herbaceous species ..... ***Chrysothamnus viscidiflorus* / *Stipa comata* p. a.**
44. *S. comata* scarce, not the dominant herbaceous species ..... **Undefined *Chrysothamnus viscidiflorus*-dominated vegetation type**

45. *Sarcobatus vermiculatus* (black greasewood) well represented (valley locations with saline or alkaline soils) 46
45. *S. vermiculatus* poorly represented 49

46. *Distichlis spicata* (formerly *D. stricta*, inland saltgrass) well represented (usually alkali flat conditions prevail, for example salt efflorescence) ..... ***Sarcobatus vermiculatus / Distichlis spicata* p. a.**
46. *D. spicata* poorly represented, habitat conditions various 47

47. *Leymus cinereus* (formerly Elymus cinereus, basin or giant wildrye) common ..... ***Sarcobatus vermiculatus / Leymus cinereus* p.a.**
47. *L. cinereus* scarce, not the dominant graminoid 48

48. *Pascopyrum smithii* (western wheatgrass) or *Elymus lanceolatus* (thick-spike wheatgrass), individually or their combined cover, the dominant component of herbaceous vegetation ..... ***Sarcobatus vermiculatus / Pascopyrum smithii* p. a.**
48. *P. smithii* not the dominant herb Undefined/unrecorded p.a./c.t. of the *Sarcobatus vermiculatus* alliance

49. Undefined/unreported shrubland type(s) **or** see "**KEY TO DWARF-SHRUBLAND PLANT ASSOCIATIONS, INCLUDING UPLAND AND WETLAND TYPES" or** go to next lead "**KEY TO "WETLAND / RIPARIAN SHRUBLAND COMMUNITIES**"

KEY TO WETLAND / RIPARIAN SHRUBLAND COMMUNITIES

(see Alpine Key for high subalpine or alpine habitats where dwarf or prostrate shrubs [for example *Salix* spp.] are well represented)

1. *Salix* spp. (willow species) with at least 10% canopy cover 2
1. *Salix* spp. having less than 10% canopy cover 28

2. *Salix geyeriana* (Geyer willow), *S. boothii* (Booth willow), *S. drummondiana* (Drummond willow) or *S. lutea* (yellow willow) with at least 10% canopy cover, individually or combined 3
2. Above listed willow species, individually or combined, less than 10% canopy cover 16

3. *Salix lutea* (yellow willow) with greater canopy cover than *S. drummondiana* (Drummond willow) or the combined cover of *S. geyeriana* (Geyer willow) and *S. boothii* (Booth willow) 4
3. *S. lutea* having less canopy cover than *S. drummondiana* or combined cover of *S. geyeri* and *S. boothii* 6

4. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), *C. aquatilis* (water sedge) or *C. lenticularis* (lentil-fruit sedge), individually or in any combination, well represented (5% or greater canopy cover) ..... ***Salix lutea / Carex utriculata* p. a.**
4. The above listed *Carex* spp., either individually or in any combination, having less than 5% cover 5

5. *Calamagrostis canadensis* (bluejoint reedgrass), *C. stricta* (narrow-spiked reedgrass) or *Deschampsia cespitosa* (tufted hairgrass), individually or in combination, having at least 5% canopy cover ..... ***Salix lutea / Calamagrostis canadensis* p.a.**
5. *C. canadensis*, *C. stricta* and *D. cespitosa* individually or their combined cover less than 10% ..... ***Salix lutea* Plant Association** (a default community)

6. *Salix drummondiana* (Drummond willow) with a greater canopy cover than the individual or combined cover of *S. boothii* and *S. geyeriana* 7
6. *S. drummondiana* with less cover than the combined or individual cover of *S. boothii* and *S. geyeriana* 9

7. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), *C. aquatilis* (water sedge) or *C. lenticularis* (lentil-fruit sedge), individually or in any combination, well represented (5% canopy cover) ..... ***Salix drummondiana / Carex utriculata* p. a.**
7. The above listed *Carex* spp., either individually or in any combination, having less than 5% cover 8

8. *Calamagrostis canadensis* (bluejoint reedgrass), *C. stricta* (narrow-spiked reedgrass) or *Deschampsia cespitosa* (tufted hairgrass), individually or in combination, having at least 5% canopy cover ..... ***Salix drummondiana / Calamagrostis canadensis* p.a.**

8. Not as above; the above listed species, either singly or their combined canopy cover less than 5% .... ***Salix drummondiana* Plant Association** (a default community)

9. *Salix boothii* (Booth willow) having at least as much canopy cover as *S. geyeriana* (Geyer willow) 10
9. *S. boothii* having less canopy cover than *S. geyeriana* 12

10. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), *C. aquatilis* (water sedge) or *C. lenticularis* (lentil-fruit sedge), individually or in any combination, well represented (5% canopy cover)..... ***Salix boothii / Carex utriculata* p. a.**
10. None of the above listed *Carex* spp., either individually or in any combination, exceeding 5% cover.. 11

11. *Calamagrostis canadensis* (bluejoint reedgrass), *C. stricta* (narrow-spiked reedgrass) or *Deschampsia cespitosa* (tufted hairgrass), individually or in combination, having at least 5% canopy cover ..... ***Salix boothii / Calamagrostis canadensis* p.a.**
11. Not as above; the above listed species, either singly or their combined canopy cover less than 5% .... **Undefined *Salix boothii*-dominated p.a.**

12. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), *C. aquatilis* (water sedge) or *C. lenticularis* (lentil-fruit sedge), individually or in any combination, well represented (5% or greater canopy cover)..... ***Salix geyeriana / Carex utriculata* p. a.**
12. All of the above-listed *Carex* spp. with individual or combined cover less than 5%..... 13.

13. *Calamagrostis canadensis* (bluejoint reedgrass) or *C. stricta* (narrow-spiked reedgrass) well represented (5% or greater canopy cover), either individually or in combination .... ***Salix geyeriana / Calamagrostis canadensis* p.a.**
13. Not as above; the above listed species, either singly or in combination, poorly represented (canopy cover less than 5%) 14

14. *Deschampsia cespitosa* (tufted hairgrass) well represented (>5% canopy cover); if site grazed intensively *D. cespitosa* need only be common (greater than 1%) .... ***Salix geyeriana / Deschampsia cespitosa* p. a.**
14. *D. cespitosa* poorly represented (< 5% canopy cover)..... 15

15. Considered singly or in any combination, the following primarily disturbance associated species, dominate the herbaceous layer; *Poa pratensis* (Kentucky bluegrass), *P. palustris* (fowl bluegrass), *Phleum pratense* (timothy), *Agrostis stolonifera* (redtop), or J*uncus balticus* (Baltic rush) .... ***Salix geyeriana* / Mesic graminoids p. a.**
15. None of the above-listed species, singly or in any combination dominate the herbaceous layer..... ..... **Undefined *Salix geyeriana*-dominated p. a.**

16. Canopy cover of *Salix planifolia* (planeleaf willow) or *S. commutata* (undergreen willow), or their combined cover, is at least 10%..... 17
16. *S. planifolia* or *S. commutata*, their individual or combined cover, is less than10%. ..... .19

17. *Carex aquatilis* (water sedge) or *C. utriculata* (beaked sedge) well represented, individually or in combination..... ***Salix planifolia / Carex aquatilis* p.a.**
17. *C. aquatilis* and *C. utriculata* poorly represented..... 18

18. *Carex nebrascensis* (Nebraska sedge) or *C. simulata* (short-beaked sedge) well represented, either individually or in combination..... ***Salix planifolia / Carex nebrascensis* p.a.**
18. *C. nebrascensis* and *C. simulata* poorly represented, individually or in combination .... **Undefined p. a. within *Salix planifolia* or *S. commutata* alliances**

19. *Salix candida* (hoary willow) having at least 10% canopy cover 20
19. *S. candida* having less than 10% canopy cover 22

20. *Carex utriculata* (beaked sedge) or *C. aquatilis* (water sedge), or any combination of the two, well represented ..... ***Salix candida / Carex utriculata* p.a.**
20. *C. rostrata* and *C. aquatilis* poorly represented, individually or in combination 21

21. *Carex lasiocarpa* (slender sedge), *C. lanuginosa* (woolly sedge), *or C. buxbaumii* (Buxbaum's sedge) well represented, individually or in any combination ..... ***Salix candida / Carex lasiocarpa* p. a.**
21. Not as above; above listed sedges poorly represented, individually or in any combination .... **Undefined p. as. within *Salix candida* alliance**

22. *Salix wolfii* (Wolf's willow) having at least 10% canopy cover 23
22. *S. wolfii* with less than 10% canopy cover 25

23. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), *C. aquatilis* (water sedge) or *C. lenticularis* (lentil-fruit sedge), considered singly or in any combination, well represented ..... ***Salix wolfii / Carex utriculata* p.a.**
23. Any of the above-listed species, considered singly or in any combination, poorly represented 24

24. Deschampsia cespitosa (tufted hairgrass) or *Juncus balticus* (Baltic rush) or their combined cover well represented; accept *D. cespitosa* as common (1% or greater canopy cover) where grazing is intensive ..... ***Salix wolfii / Deschampsia cespitosa* p.a.**
24. *D. cespitosa* or *J. balticus* or their combined cover poorly represented .... **Undefined p. a. within *Salix wolfii* alliance**

25. Individual non-*Salix* (non-willow) species having a greater canopy cover than any individual *Salix* species 28
25. Individual *Salix* species with greater canopy than any individual non-*Salix* species 26

26. *Salix bebbiana* (Bebb willow) with greater canopy cover than any other *Salix* species .... ***Salix bebbiana* p.a.**
26 *S. bebbiana* having less canopy cover than any other *Salix* species 27

27. *Salix exigua* (sandbar willow) having greater canopy cover than any other *Salix* species .... ***Salix exigua* p. a.**
27. *S. exigua* having less canopy cover than any other individual *Salix* species .... **Undefined *Salix* spp.-dominated riparian-wetland site type**

28. *Betula nana (*formerly *B. glandulosa*, bog birch) having at least 10% canopy cover 29
28. *B. nana* having less than 10% canopy cover 30

29. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), *C. aquatilis* (water sedge) or *C. lenticularis* (lentil-fruit sedge), individually or in any combination, well represented (5% canopy cover) ..... ***Betula nana / Carex utriculata* p.a.**
29. All of the above-listed *Carex* spp. with individual or combined canopy covers less than 5% ..... **Undefined p. a. within *B. nana* alliance**

30. *Kalmia microphylla* (small-leaved laurel) having at least 10% canopy cover 31
30. *K. microphylla* having less than 10% canopy cover 32

31. *Carex scopulorum* (Holm's Rocky Mountain Sedge) or *C. nigricans* (black alpine sedge) or their combined cover well represented ..... ***Kalmia microphylla/Carex scopulorum* p.a.**
31. *C. scopulorum* or *C. nigricans* or their combined cover poorly represented .... **Undefined *K. microphylla*-dominated p. a.**

32. *Betula occidentalis* (water or river birch) having at least 10% canopy cover and with the greatest cover of the tallest vegetation layer ..... ***Betula occidentalis* p. a.**
32. *B. occidentalis* having less than10% canopy cover 33

33. *Alnus incana* (mountain alder) having at least 10% canopy cover and with greatest canopy cover in tallest layer ..... ***Alnus incana* p. a.**
33. *A. incana* having less than 10% canopy cover or not having the greatest canopy cover of the tallest layer 34

34. *Pentaphylloides floribunda* (shrubby cinquefoil, formerly *Potentilla fruticosa*) having at least 10% canopy cover 35
34. *P. floribunda* having less than 10% canopy cover 37

35. *Carex utriculata* (beaked sedge), *C. atherodes* (awned sedge), *C. vesicaria* (inflated sedge), *C. aquatilis* (water sedge), individually or in any combination, having at least 10% canopy cover ..... ***Pentaphylloides floribunda / Carex utriculata* p. a.**
35. *C. utriculata*, *C. atherodes*, *C. vesicaria*, and *C. aquatilis* poorly represented, singly or combined..... 36

36. *Deschampsia cespitosa* (tufted hairgrass) or *Juncus balticus* (Baltic rush) or their combined cover well represented; under intensive grazing *D. cespitosa* may be only common..... ***Pentaphylloides floribunda / Deschampsia cespitosa p. a.***
36. *D. cespitosa* and *J. balticus* poorly represented..... **Undefined p. a. within *Pentaphylloides floribunda* alliance**

37. *Artemisia cana* (silver sagebrush) well represented 38
37. *A. cana* poorly represented..... 42

38. *Leymus cinereus* (formerly *Elymus cinereus*, giant or basin wildrye) well represented (or merely common under intensive spring grazing regime)..... ***Artemisia cana / Leymus cinereus* p. a.**
38. *L. cinereus* poorly represented 39

39. *Poa secunda* (Sandberg's bluegrass, considering only that portion of the taxon formerly known as *Poa nevadensis* [Nevada bluegrass] or *P. juncifolia* [alkali bluegrass]), or *Carex praegracilis* (clustered field sedge) common, singly or their combined cover ... ***Artemisia cana / Poa secunda* p.a.**
39. *P. secunda* and *C. praegracilis* scarce, individually or any combination..... 40

40. *Pascopyrum smithii* (formerly *Agropyron smithii*, western wheatgrass) or *Elymus lanceolatus* (formerly *A. dasystachyum*, thick-spike wheatgrass) well represented..... ***Artemisia cana / Pascopyrum smithii* p. a.**
40. *P. smithii* and *E. lanceolatus* poorly represented 41

41. Either *Festuca idahoensis* (Idaho fescue) or *Elymus trachycaulus* (bearded wheatgrass) well represented (reduce to only common under intensive grazing) .....see a & b below
a. *F. idahoensis* well represented..... ***Artemisia cana / Festuca idahoensis* p.a.**
b. *F. idahoensis* poorly represented and *E. trachycaulus* well represented..... ***Artemisia cana / Elymus trachycaulus* p. a.**
41. *F. idahoensis* and *E. trachycaulus* poorly represented..... **Undefined p. a. within *Artemisia cana* alliance**

42. *Sarcobatus vermiculatus* (black greasewood) well represented or if vegetation depauperate then the shrub layer dominant; *S. vermiculatus* often not shrub layer dominant (expect *Artemisia* or *Chrysothamnus* spp.)..... 43
42. *S. vermiculatus* poorly represented or, if depauperate conditions obtain, then not the shrub layer dominant 46

43. *Distichlis spicata* (inland saltgrass, formerly *Distichlis stricta*) well represented (alkali flats conditions prevail) ..... ***Sarcobatus vermiculatus / Distichlis stricta* p.a.**
43. *D. stricta* poorly represented..... 44

44. *Leymus cinereus* (formerly *Elymus cinereus*, basin wildrye) well represented (reduced to only common under intensive grazing)..... ***Sarcobatus vermiculatus / Elymus cinereus* p.a.**
44. *L. cinereus* poorly represented 45

45. *Pascopyrum smithii* (syn. *Agropyron smithii*, western wheatgrass) or *Elymus lanceolatus* (syn. *A. dasystachyum,* thickspike wheatgrass) the dominant component of herbaceous layer..... .....***Sarcobatus vermiculatus / Pascopyrum smithii* p.a.**
45. *P. smithii* and *E. lanceolatus* not the dominant undergrowth component .... **Undescribed *Sarcobatus vermiculatus* p.a.**

46. *Betula occidentalis* (water birch) having at least 15% canopy cover **and** constituting the greatest canopy cover in the tallest layer ..... ***Betula occidentalis* p. a.**
46. *B. occidentalis* having less than 15% canopy cover **or** not having the greatest canopy cover within the tallest stratum 47

47. *Alnus incana* (mountain alder) having at least 15% canopy cover **and** having the greatest cover of the tallest layer present..... ***Alnus incana* p. a.**
47. *A. incana* having less than 15% canopy cover **or** without the greatest canopy cover in the tallest stratum 48

48. *Shepherdia argentea* (thorny buffaloberry) having at least 15% canopy cover **and** comprising the greatest canopy cover of the tallest stratum..... ***Shepherdia argentea* p. a.**
48. *S. argentea* having less than 15% cover **or** not exhibiting the greatest canopy cover among species of the uppermost stratum..... 49

49. *Rosa woodsii* (woods rose) or *R. acicularis* (prickly rose) or any combination of the two having at least 15% canopy cover **and** they comprise greatest cover in the tallest vegetation layer..... .....***Rosa woodsii* p. a.**
49. *R. woodsii* and *R. acicularis*, or any combination of the two having less than 15% cover **or** not comprising the greatest canopy cover in the uppermost vegetation layer 50

50. *Symphoricarpos occidentalis* (western snowberry) or *S. albus* (common snowberry), their individual or combined cover greater than 15% **and** having the greatest canopy cover in the tallest layer..... .....***Symphoricarpos occidentalis* p.a.**
50. *S. occidentalis* and S. albus or their combined cover less than15% **or** not comprising the greatest canopy cover in the tallest vegetation layer..... 51

51. Site having at least one of the following wetland criteria present: hydrophytic vegetation, hydric soils, wetland hydrology..... **Undefined riparian-wetland p.a.**
51. Site not exhibiting any of the above-listed wetland criteria..... **Upland Site**

KEY TO DWARF-SHRUBLAND PLANT ASSOCIATIONS INCLUDING UPLAND AND WETLAND TYPES

[Dwarf-shrubs (as individuals or clumps with a potential height less than 0.5 m) generally forming 25% or greater canopy cover (taxa include *Artemisia arbuscula* (low sagebrush), *A. arbuscula ssp. longiloba* (early low sagebrush), *A. nova* (black sagebrush), *A. pedatifida* (birdfoot sagebrush), *A. tridentata ssp. wyomingensis* (Wyoming big sagebrush), *A. tripartita* (three-tip sagebrush), *Atriplex gardneri* (Gardner's saltbush), *Cassiope mertensiana* (Mertens' mountain heather), *Dryas octopetala* (white dryas), *Kalmia microphylla* (small-leaved laurel), *Phyllodoce empetriformis* (red mountain-heath), *P. glanduliflora* (yellow mountain-heath), *Pentaphylloides floribunda* (shrubby cinquefoil), *Salix arctica* (alpine willow), *S. candida* (hoary willow), *S. barratiana* (Barratt willow), *S. brachycarpa* (short-fruited willow), *S. glauca* (glaucous willow), *S. planifolia* var. *monica* (dwarf planeleaf willow), *S. reticulata* (snow willow)); though an uncommon condition, dwarf-shrub cover may be less than 25% but exceeding the combined cover of the other lifeforms present (shrubs, herbs, nonvasculars) which is less than 25%]

1. *Salix* spp. (willow species) with at least 10% canopy cover 2
1. *Salix* spp. having less than 10% canopy cover 14

2. *Salix planifolia var. monica* (dwarf planeleaf willow) the dominant *Salix* spp. 3
2. *S. planifolia* var. *monica* not the dominant *Salix* spp. 4

3. *Carex scopulorum* (Holm's Rocky Mountain sedge) well represented and dominating the herbaceous layer (though *Deschampsia cespitosa* (tufted hairgrass) attains this status as well) ..... ***Salix planifolia var. monica / Carex scopulorum* p. a.**
3. *C. scopulorum* poorly represented and not the herbaceous layer dominant ..... **Undefined *Salix planifolia* var. *monica*-dominated vegetation type**

4. *Salix candida* (hoary willow) the dominant *Salix* spp. 5
4. *S. candida* not the dominant *Salix* spp. 7

5. *Carex utriculata* (beaked sedge), *C. atherodes* (awned sedge), *C. vesicaria* (inflated sedge), *C. aquatilis* (water sedge) well represented (cover ≥ 5%) ..... ***Salix candida / Carex utriculata* p. a.**
5. None of the above-listed species well represented, individually or in combination 7

6. *Carex lasiocarpa* (slender sedge), *C. buxbaumii* (Buxbaum's sedge), or *C. lanuginosa* (wooly sedge) well represented (cover ≥ 5%), singly or combined ..... ***Salix candida / Carex lasiocarpa* p. a.**
6. *C. lasiocarpa*, *C. buxbaumii*, *C. lanuginosa* poorly represented, singly or combined cover ..... **Undefined *Salix candida*-dominated vegetation type**

7. *Salix brachycarpa* (short-fruited willow) the dominant *Salix* spp. 8
7. *S. brachycarpa* not the dominant species of *Salix* 9

8. *Carex utriculata* (beaked sedge) or *C. aquatilis* (water sedge) well represented, singly or combined cover ..... ***Salix brachycarpa / Carex utriculata - Carex aquatilis* p. a.**
8. *S. brachycarpa* not the dominant *Salix* spp. ..... **Undefined *Salix brachycarpa*-dominated vegetation type**

9. *Salix reticulata* (snow willow) the dominant *Salix* spp; *Dryas octopetala* (white dryas) not abundant .. 10
9. *S. reticulata* not the dominant Salix spp; D. octopetala **may be** abundant 11

10. *Caltha leptosepala* (elkslip marsh-marigold) present (often abundant), but not necessarily dominating a diverse forb layer ..... ***Salix reticulata / Caltha leptosepala* p. a.**
10. *C. leptosepala* not present ..... **Undefined *Salix reticulata*-dominated vegetation type**

11. *Salix arctica* (Arctic willow) the dominant *Salix* spp. 12
11. *S. arctica* not the dominant *Salix* spp. 13

12. *Polygonum bistortoides* (American bistort) or *Polygonum viviparum* (alpine bistort), singly or combined cover, well represented, though somewhat ephemeral and diminutive often contributing the most forb cover ..... ***Salix arctica / Polygonum bistortoides* p. a.**
12. *P. bistortoides* and *P. viviparum* poorly represented ..... **Undefined *S. arctica*-dominated vegetation type**

13. *Salix glauca* (glaucous willow) the dominant *Salix* spp., undergrowth variable..... ***Salix glauca* p. a.**
13. *S. glauca* not dominating the shrub layer ..... **Undefined *Salix*-dominated vegetation type**

14. *Kalmia microphylla* (small-leaved laurel) having at least 10% canopy cover 15
14. *K. microphylla* having less than 10% canopy cover 16

15. *Carex scopulorum* (Holm's Rocky Mountain sedge) or *Carex nigricans* (black alpine sedge) well represented, singly or in combination..... ***Kalmia microphylla / Carex scopulorum* p. a.**
15. *C. scopulorum* and *C. nigricans* poorly represented, singly or in combination..... **Undefined *Kalmia microphylla* vegetation type**

16. *Phyllodoce empetriformis* (red mountain-heath) or *P. glanduliflora* (yellow mountain-heath) dominating the shrub layer, singly or in concert, their canopy cover generally abundant..... 17
16. *P. empetriformis* and *P. glanduliflora* not the shrub-layer dominants, not abundant..... 18

17. *Antennaria lanata* (woolly pussy-toes) common.. ***Phyllodoce empetriformis / Antennaria lanata* p. a.**
17. *A. lanata* scarce ..... **Undefined *Phyllodoce empetriformis*-dominated vegetation type**

18. *Cassiope mertensiana* (Mertens' mountain heather) dominating the shrub layer..... 19
18. *C. mertensiana* not the shrub-layer dominant 20

19. *Carex paysonis* (Payson sedge) common..... ***Cassiope mertensiana / Carex paysonis* p. a**.
19. *C. paysonis* scarce..... **Undefined *Cassiope mertensiana* vegetation type**

20. *Dryas octopetala* (white dryas) as the shrub-layer dominant, generally abundant 21
20. *D. octopetala* not the shrub-layer dominant..... 23

21. Relatively mesic sites of protected slopes giving the impression of nearly total vegetation coverage (turf sites); *Polygonum viviparum* (alpine bistort), *P. bistortoides* (American bistort), *Zigadenus elegans* (glaucous death-camas) and *Oxytropis viscida* (sticky crazyweed) common, either singly or in any combination..... ***Dryas octopetala / Polygonum viviparum p. a.***
21. Not as above, *P. viviparum*, *P. bistortoides*, *Z. elegans*, and *O. viscida* scarce; vegetation coverage various but not sparse..... 22

22. Sparsely vegetated sites of exposed positions (ridgetops, shoulders, saddles, etc.) with *Dryas octopetala* occurring in distinct clumps of highly variable coverage, usually surrounded by bare ground or gravel (rock pavement); commonly occurring forb-layer components include *Phlox pulvinata* (cushion phlox), *Oxytropis campestris* (slender crazyweed), *Minuartia obtusiloba* (Arctic sandwort), *Douglasia montana* (Rocky Mountain Douglasia); *Carex rupestris* (curly sedge) and *C. elynoides* (Kobresia-like sedge) dominate the sparse graminoid layer ..... ***Dryas octopetala / Carex rupestris* p. a.**
22. Not as above..... **Undefined *Dryas octopetala*-dominated vegetation type**

23. Any of the following species well represented or constituting the dwarf-shrub layer dominant, *Atriplex gardneri* (Gardner's saltsage, formerly *A. nuttallii), Artemisia arbuscula* (low sagebrush), *A. arbuscula* ssp. *longiloba* (early low sagebrush), *A. nova* (black sagebrush), *A. pedatifida* (birdfoot sagebrush), *A. tridentata* ssp*. wyomingensis* (Wyoming big sagebrush), *A. tripartita* (three-tip sagebrush)..... 31
23. Not as above; none of the named species well represented or constituting dwarf-shrub layer dominant 24

24. *Pentaphylloides floribunda* (shrubby cinquefoil, formerly *Potentilla fruticosa*) well represented (often partially obscured by lush herbaceous vegetation; other shrubby taxa may be well represented as well) 25
24. *P. floribunda* poorly represented ..... **Undefined dwarf-shrub vegetation type**

25. *Carex utriculata* (beaked sedge), *C. atherodes* (awned sedge), *C. vesicaria* (inflated sedge), *C. aquatilis* (water sedge), singly or combined cover at least 10% ..... ***Pentaphylloides floribunda / Carex utriculata* p. a.**
25. *C. utriculata*, *C. atherodes*, *C. vesicaria*, and *C. aquatilis* poorly represented, singly or combined 26

26. *Deschampsia cespitosa* (tufted hairgrass) common, or only present as scattered individuals under intensive grazing regimes ..... ***Pentaphylloides floribunda / Deschampsia cespitosa* p. a.**
26. *D. cespitosa* scarce 27

27. *Juncus balticus* (Baltic rush) well represented and dominating the herbaceous layer ..... ***Pentaphylloides floribunda / Juncus balticus* p. a.**
27. *J. balticus* poorly represented and not the herbaceous layer dominant 28

28. *Festuca campestris* (rough fescue, formerly *F. scabrella*) common, or only present as scattered individuals with intensive grazing ..... ***Pentaphylloides floribunda / Festuca* campestris p. a.**
28. *F. campestris* scarce 29

29. *Festuca idahoensis* (Idaho fescue) well represented (only common with intensive grazing) ..... ***Pentaphylloides floribunda / Festuca idahoensis* p. a.**
29. *F. idahoensis* poorly represented (or scarce under intensive grazing regime) 30

30. *Potentilla ovina* (sheep cinquefoil) common, the undergrowth dominant of a depauperate undergrowth; substrates may be water-scoured and eroded ..... ***Pentaphylloides floribunda / Potentilla ovina* p. a.**
30. *P. ovina* scarce and not the undergrowth dominant ..... **Undefined *Pentaphylloides floribunda*-dominated vegetation**

31. *Atriplex gardneri* (Gardner's saltsage, formerly *A. nuttallii*) well represented or the dwarf-shrub layer dominant 32
31. *A. gardneri* poorly represented and not the dwarf-shrub layer dominant 33

32. *Oryzopsis hymenoides* (Indian ricegrass) common or the herbaceous layer dominant ..... ***Atriplex gardneri / Oryzopsis hymenoides* p. a.**
32. *O. hymenoides* scarce and not the herbaceous layer dominant ..... **Undefined *Atriplex gardneri* vegetation type**

33. *Artemisia pedatifida* (birdsfoot sagebrush) well represented or the dwarf-shrub layer dominant 34
33. *A. pedatifida* poorly represented and not the dwarf-shrub layer dominant 35

34. *Festuca idahoensis* (Idaho fescue) common ..... ***Artemisia pedatifida / Festuca idahoensis* p. a.**
34. *F. idahoensis* scarce ..... **Undefined *Artemisia pedatifida* vegetation type**

35. *Artemisia arbuscula* (low sagebrush) or *A. arbuscula* ssp. *longiloba* (early low sagebrush) well represented or the dwarf-shrub layer dominants 36
35. *A. arbuscula* and *A. arbuscula* ssp. *longiloba* poorly represented or not the dwarf-shrub layer dominants 41

36. *A. arbuscula* ssp. *longiloba* (early low sagebrush) well represented and dominates the dwarf-shrub layer 37
36. *A. arbuscula* ssp. *longiloba* poorly represented and not the dwarf-shrub layer dominant 39

37. *Festuca idahoensis* (Idaho fescue) well represented (only common, if grazing intensity is high)..... ..... ***Artemisia arbuscula* ssp. *longiloba* / *Festuca idahoensis* p. a.**
37. *F. idahoensis* poorly represented (or scarce in the presence of intensive grazing 38

38. *Elymus lanceolatus* (thick-spike wheatgrass, formerly *Agropyron dasystachyum*) or *Pascopyrum smithii* (western wheatgrass, formerly *Agropyron smithii*), individually or in combination, well represented and the dominant graminoids .... ***Artemisia arbuscula* ssp. *longiloba* / *Elymus lanceolatus* p. a.**
38. *E. lanceolatus* and *P. smithii*, individually or their combined cover, poorly represented and not the dominant graminoids..... **undefined *Artemisia arbuscula* ssp. *longiloba* vegetation type**

39. *Festuca idahoensis* (Idaho fescue) well represented (may be only common with intensive grazing)..... .....***Artemisia arbuscula* / *Festuca idahoensis* p. a.**
39. *F. idahoensis* poorly represented 40

40. *Pseudoroegneria spicata* (bluebunch wheatgrass, formerly *Agropyron spicatum*) well represented .... ***Artemisia arbuscula* / *Pseudoroegneria spicata* p. a.**
40. *P. spicata* poorly represented ..... **Undefined *Artemisia arbuscula* vegetation type**

41. *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) well represented and the dwarf-shrub layer dominant 42
41. *A. tridentata* ssp*. wyomingensis* poorly represented or not the dwarf-shrub layer dominant..... 44

42. *Elymus lanceolatus* (thick-spike wheatgrass, formerly *Agropyron dasystachyum*) or *Pascopyrum smithii* (western wheatgrass, formerly *Agropyron smithii*), individually or in combination, common and the dominant graminoids ..... ***Artemisia tridentata* ssp. *wyomingensis* / *Pascopyrum smithii* p. a.**
42. *E. lanceolatus* and *P. smithii*, individually or their combined cover, poorly represented and not the dominant graminoids..... 43

43. *Pseudoroegneria spicata* (bluebunch wheatgrass, formerly *Agropyron spicatum*) well represented (only common under intensive grazing) and, excepting *Poa secunda* (Sandberg's bluegrass) the dominant graminoid .....***Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* p. a.**
43. *P. spicata* poorly represented, not the dominant graminoid .... **Undefined *Artemisia tridentata* ssp*. wyomingensis* vegetation type**

44. *Artemisia tripartita* (three-tip sagebrush) the dominant dwarf-shrub 45
44. *A. tripartit*a not the dominant dwarf-shrub 48

45. *Festuca idahoensis* (Idaho fescue) well represented (only common under intensive grazing)..... .....***Artemisia tripartita* / *Festuca idahoensis* p. a.**
45. *F. idahoensis* poorly represented 46

46. *Elymus lanceolatus* (thick-spike wheatgrass, formerly *Agropyron dasystachyum*) or *Pascopyrum smithii* (western wheatgrass, formerly *Agropyron smithii*), individually or in combination, common and the dominant graminoids .....***Artemisia tripartita* / *Elymus lanceolatus* p. a.**
46. *E. lanceolatus* and *P. smithii*, individually or their combined cover, poorly represented and not the dominant graminoids..... 47

47. *Pseudoroegneria spicata* (bluebunch wheatgrass, formerly *Agropyron spicatum*) well represented (only common under intensive grazing) and, excepting *Poa secunda* (Sandberg's bluegrass), constitutes the dominant graminoid.....***Artemisia tripartita* / *Pseudoroegneria spicata* p. a.**
47. *P. spicata* poorly represented, not the dominant graminoid .... **Undefined *Artemisia tripartita-dominated* vegetation type**

48. *Artemisia nova* (black sagebrush) well represented and the dominant dwarf-shrub..... 49

48. *A. nova* poorly represented and not the dominant dwarf-shrub 50

49. *Pseudoroegneria spicata* (bluebunch wheatgrass, formerly Agropyron spicatum) or *Oryzopsis hymenoides* (Indian ricegrass) singly or in combination, common or the dominant graminoids, excepting *Poa secunda* (Sandberg's bluegrass)..... ***Artemisia nova / Pseudoroegneria spicata* p. a.**
49. *P. spicata* and *O. hymenoides*, singly or in combination, scarce and not the dominant graminoids ....**Undefined *Artemisia nova*-dominated vegetation type**

50. Re-enter dwarf-shrub key at beginning lead and re-evaluate the effects of grazing on diagnostic species; see next lead if stand remains unclassifiable on second pass.
50. Undefined dwarf-shrub types should be accumulated here!

KEY TO GRASSLAND PLANT ASSOCIATIONS INCLUDING UPLAND AND WETLAND TYPES

In addition to vegetation types dominated by members of the Poaceae (grasses) we **include here** communities dominated by members of the families Juncaceae (rush family, including *Juncus* spp.[rush], *Luzula* spp. [woodrush]), Cyperaceae (sedge family, including *Carex* spp. [sedge]. *Cyperus* spp. [galingale], *Dulichium arundinaceum* [dulichium], *Eleocharis* spp. [spike rush], *Eriophorum* spp. [cotton grass], *Kobresia* spp. [kobresia], *Scirpus* spp. [bulrush], Typhaceae (cattail family, *Typha* spp. [cattails], Juncaginaceae (arrow grass family, including *Lilaea scilloides* (flowering quillwort) and *Triglochin* spp. [arrow grass]). **Not included** as "graminoid" types are vegetation types named for members of the ferns and "fern allies" including Equisetaceae (horsetail family), Lycopodiaceae (club moss family), Marsileaceae (pepperwort family), Ophioglossaceae (grape fern family), Polypodiaceae (fern family), Selaginellaceae (spike moss family); these herbaceous, non-graminoid groups are found under forbs

1. Sites ranging from temporarily flooded to permanently saturated, includes all wetlands (and some near-wetlands) wherein a graminoid is the first designated diagnostic species; sites dominated by or supporting as a diagnostic taxon any of the following species

   Agrostis stolonifera (redtop)
   Bromus inermis (smooth brome)
   Calamagrostis canadensis (bluejoint reedgrass), *C. stricta* (narrow-spiked reedgrass)
   Carex aperta (Columbia sedge), *C. aquatilis* (water sedge), *C. atherodes* (awned sedge), *C. buxbaumii* (Buxbaum's sedge), *C. lanuginosus* (woolly sedge), *C. lasiocarpa* (slender sedge), *C. lenticularis* (lentil-fruit sedge), *C. limosa* (mud sedge), *C. nebrascensis* (Nebraska sedge), C. praegracilis (clustered field sedge), *C. scopulorum* (Holm's Rocky Mountain sedge), *C. simulata* (short-beaked sedge), *C. utriculata* (beaked sedge), *C. vesicaria* (inflated sedge)
   Deschampsia cespitosa (tufted hairgrass)
   Distichlis spicata (inland saltgrass)
   Eleocharis acicularis (needle spike-rush), *E. palustris* (common spikesedge), *E. quinqueflora* (formerly *E. pauciflora*, few-flowered spike-rush), *E. rostellata* (beaked spike-rush)
   Glyceria borealis (northern mannagrass)
   Hordeum jubatum (foxtail barley)
   Juncus balticus (Baltic rush)
   Leymus cinereus (formerly *Elymus cinereus*, basin wildrye)
   Pascopyrum smithii (western wheatgrass)
   Phalaris arundinacea (reed canarygrass)
   Poa pratensis (Kentucky bluegrass), *P. palustris* (fowl bluegrass)
   Scirpus acutus (hardstem bulrush), *S. tabernaemontani* (formerly *S. validus*, softstem bulrush)
   Sporobolus airoides (alkali sacaton)
   Typha angustifolia (narrow-leaved cattail), *Typha latifolia* (common cattail)
   2

1. Sites drier than described above or occurring at the highest elevations of the subalpine zone (above the distribution of *Pseudotsuga menziesii* [Douglas-fir] as a climax species **and** at the upper distribution limits of *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) **and**, with the exception of *Deschampsia cespitosa* (tufted hairgrass) in the sub-alpine/alpine, not supporting any of the above-listed species as dominants or diagnostic spp. .....
   see following section with subheading **GRAMINOID-DOMINATED COMMUNITIES: UPLANDS, HIGH-SUBALPINE, AND ALPINE**

Note: Leads 2 through 10 key to wetland plant associations with *Carex* spp. (sedges) as diagnostic species

2. *Carex* spp. (sedge species) listed in #1, individually or their combined canopy cover at least 25% or these taxa dominant 3
2. *Carex* spp. having less than 25% single or combined cover and not dominant 11

3. *Carex utriculata* (beaked sedge), *C. vesicaria* (inflated sedge), *C. atherodes* (awned sedge), individually or their combined cover, at least 25%..... ***Carex utriculata* p. a.** (see a, b, c)
   a. *Carex aquatilis* (water sedge), *C. lenticularis* (lentil-fruit sedge) and grass species, individually or in combination having less than 5% cover..... Carex utriculata phase
   b. *Carex aquatilis* and *C. lenticularis*, singly or combined, at least well represented .....
   .....Carex aquatilis phase

c. *C. aquatilis* and *C. lenticularis*, singly or combined, poorly represented; grass species or *Juncus balticus* (Baltic rush) well represented, either as single species or their combined cover..... Deschampsia cespitosa phase

3. *C. utriculata*, *C. vesicaria*, and *C. atherodes*, individually or their combined cover, less than 25%..... 4

4. *Carex aquatilis* (water sedge), *C. aperta* (Columbia sedge) and *C. lenticularis* (lentil-fruited sedge), as individual species or combined, having at least 25% canopy cover..***Carex aquatilis* p. a.**(see a & b)
   a. *Juncus balticus* (Baltic rush) and grass species, as lone species or in combination, having less than 5% canopy cover ..... *Carex aquatilis* phase
   b. *J. balticus* or grass species having at least 5% canopy cover ..... *Deschampsia cespitosa* phase
4. *C. aquatilis*, *C. aperta*, and *C. lenticularis*, individually or combined, having less than 25% cover 5

5. *Carex limosa* (mud sedge) having at least 25% canopy cover ..... ***Carex limosa* p. a.**
4. *C. limosa* having less than 25% canopy cover 6

6. *Carex lasiocarpa* (slender sedge), *C. lanuginosa* (woolly sedge), and *C. buxbaumii* (Buxbaum's sedge), individually or in any combination, having at least 25% canopy cover ... ***Carex lasiocarpa* p. a.**
6. *C. lasiocarpa*, *C. lanuginosa*, and *C. buxbaumii*, individually or in combination, having less than 25% canopy cover..... 7.

7. *Carex simulata* (short-beaked sedge) having at least 25% canopy cover ..... ***Carex simulata* p. a.**
7. *C. simulata* having less than 25% canopy..... 8

8. *Carex scopulorum* (Holm's Rocky Mountain sedge) having 25% or greater canopy cover ..... ***Carex scopulorum* p. a.**
8. *C. scopulorum* having less than 25% canopy cover..... 9

9. *Carex nebrascensis* (Nebraska sedge) with a greater canopy cover than any other individual sedge species..... ***Carex nebrascensis* p. a.**
9. *C. nebrascensis* having less canopy cover than other sedge species present..... 10

10. Site with at least one of the following wetland attributes present; hydrophytic vegetation, hydric soils, wetland hydrology..... **Unclassified wetland or riparian site**
10. Site lacking any of the above listed wetland attributes..... **Upland site (see second item of lead #1)**

Note: Leads 11 through 35 key to wetland (or near-wetland) plant associations wherein Carex spp. are not the diagnostic species

11. *Typha latifolia* (common cattail) or *T. angustifolia* (narrow-leaved cattail), individually or their combined canopy cover, at least 25% **or** constituting the dominant vegetation ..... ***Typha latifolia* p. a.**
11. *T. latifolia* and *T. angustifolia* having less than 25% canopy cover and not constituting the dominant vegetation 12

12. *Scirpus acutus* (hardstem bulrush) or *S. tabernaemontani* (formerly *S. validus*, softstem bulrush), individually or in combination, constitute the dominant vegetation..... ***Scirpus acutus* p. a.**
12. *S. acutus* and *S. tabernaemontani*, individually or in combination, not the dominant species..... 13

13. *Phalaris arundinacea* (reed canarygrass) having 25 % canopy cover or is the dominant species ..... ***Phalaris arundinacea* p. a.**
13. *P. arundinacea* having less than 25% canopy cover and not the dominant species ..... 14.

14. *Equisetum fluviatile* (water horsetail) having at least 25% canopy or is the dominant species..... ***Equisetum fluviatile* p. a.**
14. *E. fluviatile* having less than 25% canopy cover and not the dominant species 15

15. *Eleocharis* palustris (common spikesedge) or *E. acicularis* (needle spike-rush), individually or in combination, having 25% canopy cover or constitute the dominant species ..***Eleocharis palustris* p. a.**

15. *E. palustris* and *E. acicularis*, individually or in concert, with less than 25% canopy cover and not dominant 16

16. *Eleocharis quinqueflora* (formerly *Eleocharis pauciflora*, few-flowered spike-rush) and *E. rostellata* (beaked spike-rush), individually or in combination, having 25% canopy cover or constituting the dominant species ..... ***Eleocharis quinqueflora* p.a.**
16. *E. pauciflora* and *E. rostellata* having less than 25% canopy cover and not the dominant species 17

17. *Glyceria borealis* (northern mannagrass) with at least 25% canopy cover or the dominant graminoid ..... ***Glyceria borealis* p. a.**
17. *G. borealis* having less than 25% canopy cover and not the dominant graminoid..... 18

18. *Calamagrostis canadensis* (bluejoint reedgrass) or *C. stricta* (narrow-spiked reedgrass), individually or in concert, having at least 25% canopy cover or constituting the dominant graminoids..... ***Calamagrostis canadensis* p. a.**
18. *C. canadensis* and *C. stricta* having less than 25% cover, individually or combined, and not the dominant graminoids..... 19

19. *Deschampsia cespitosa* (tufted hairgrass) having at least 15% canopy cover and constituting the dominant graminoid ..... ***Deschampsia cespitosa* p. a.**
19. *D. cespitosa* having less than 15% cover and is not the dominant graminoid ..... 20.

20. *Juncus balticus* (Baltic rush) the dominant graminoid 21
20. *J. balticus* not the dominant graminoid 23

21. *Carex praegracilis* (clustered field sedge) or *Muhlenbergia richardsonis* (mat muhly), individually or combined canopy cover, well represented ..... ***Juncus balticus – Carex praegracilis* p. a.**
21. *C. praegracilis* and *M. richardsonis*, their individual or combined coverage, poorly represented 22

22. *Juncus balticus* (Baltic rush) virtually a monospecific dominant, other species characteristically having less than 5% cover; generally occurring on continuously flooded or saturated soils, often drawdown zones of limnic environments..... ***Juncus balticus* p. a.**
22. *J. balticus* not a monospecific dominant; other graminoids and forbs occupying the site, though they may not be as dominant as *J. balticus*..... **Undefined Juncus balticus vegetation type**

23. *Distichlis spicata* (inland saltgrass, formerly *D. stricta*) having at least 15% canopy cover or dominating the graminoid layer..... ***Distichlis spicata* p. a.**
23. *D. spicata* having less than 15% cover and not the graminoid layer dominant..... 24.

24. *Leymus cinereus* (giant wildrye, formerly *Elymus cinereus*) well represented (characteristically on temporarily or seasonally flooded sites..... 25
24. *L. cinereus* poorly represented 26

25. *Puccinellia nuttalliana* (Nuttall's alkaligrass) or *P. distans* (weeping alkaligrass) or *Poa secunda* (Sandberg's bluegrass, formerly *Poa juncifolia*, alkali bluegrass), their individual or combined coverage well represented or dominant..... ***Leymus cinereus – Puccinellia nuttalliana* p. a.**
25. Not as above, *P. nuttalliana*, *P. distans* and *P. secunda* poorly represented and not dominant..... **Undefined *Leymus cinereus* vegetation type**

26. *Puccinellia nuttalliana* (Nuttall's alkaligrass) well represented or dominant; alkaline seeps or flats ..... ***Puccinellia nuttalliana* p. a.**
26. *P. nuttalliana* poorly represented and not dominant 27

27. *Sporobolus airoides* (alkali sacaton) well represented or the dominant graminoid; typically on seasonally flooded alkaline seeps or alluvial flats ..... ***Sporobolus airoides* p. a.**

27. *S. airoides* poorly represented and not the dominant graminoid 28

28. *Pascopyrum smithii* (western wheatgrass, formerly *Agropyron smithii*) well represented or dominant graminoid; characteristic of basins or swales or alluvial flats (usually with heavy-textured soils)..... ***Pascopyrum smithii* / alluvial flat p. a.**
28. *P. smithii* poorly represented and not the dominant graminoid 29

29. *Poa secunda* (Sandberg's bluegrass, formerly *Poa juncifolia* or *P. secunda* ssp*. juncifolia*, alkali bluegrass) well represented and dominant of graminoid layer; community characteristic of seasonally or temporarily flooded alluvial flats ..... ***Poa secunda* p. a.**
29. *P. secunda* poorly represented and not dominant graminoid 30

Note: At lead 30 begins a section of wetland (or near wetland) vegetation types characterized by introduced graminoids.

30. *Poa palustris* (fowl bluegrass) having a greater canopy cover than other individual herbaceous species ..... ***Poa palustris* c. t.**
30. *P. palustris* canopy cover less than that of other herbaceous species..... 31

31. *Agrostis stolonifera* (redtop) having a greater canopy cover than that of other individual herbaceous species ..... ***Agrostis stolonifera* c. t.**
31. *A. stolonifera* canopy cover less than that of other herbaceous species 32

32. *Hordeum jubatum* (foxtail barley) having a greater canopy cover than that of other individual species ... . ***Hordeum jubatum* c. t.**
32. *H. jubatum* canopy cover less than that of other herbaceous species 33

33. *Bromus inermis* (smooth brome) having a greater canopy cover than that of other individual species ..... ***Bromus inermis* c. t.**
33. *B. inermis* canopy cover less than that of other herbaceous species 34

34. *Poa pratensis* (Kentucky bluegrass)) having a greater canopy cover than other individual herbaceous species ..... ***Poa pratensis* c. t.**
34. *P. pratensis* canopy cover less than that of other herbaceous species 35

35. Sites possessing at a minimum one of the following wetland criteria: hydrophytic vegetation, wetland hydrology, hydric soils..... **Unclassified or unreported wetland or riparian site** (see also "Riparian Dominance Types of Montana" [Hansen et al. 1988] to identify and describe the site)
35. Sites lacking all of the above-cited wetland criteria ..... **Upland site**

GRAMINOID-DOMINATED COMMUNITIES; UPLANDS, INCLUDING VARIOUS HIGH-SUBALPINE AND ALPINE ENVIRONMENTS

1. Sites ranging from moist uplands to seasonally saturated flats and seeps (including jurisdictional wetlands); dominated by any one of the following species, *Juncus balticus* (Baltic rush), *Deschampsia cespitosa* (tufted hairgrass), *Carex praegracilis* (clustered field sedge), *Muhlenbergia richardsonis* (mat muhly), *Hordeum jubatum* (foxtail barley), *Leymus cinereus* (giant or basin wildrye), *Pascopyrum smithii* (western wheatgrass), *Puccinellia nuttalliana* (Nuttall's alkaligrass)*, P. distans* (weeping alkaligrass)..... 2
1. Sites drier than described above or occurring at highest elevations of subalpine zone (above distribution of *Pseudotsuga menziesii* (Douglas-fir) as climax species, upper distribution of *Artemisia*

tridentata ssp. *vaseyana* [mountain big sagebrush]) upward into alpine and, with the exception of *D. cespitosa* in the sub-alpine/alpine, not supporting any of the above listed species as dominants 15

2. *Deschampsia cespitosa* (tufted hairgrass) well represented (only common if grazing intensive) 3
2. *D. cespitosa* poorly represented 5

3. *Potentilla diversifolia* (diverse-leaved cinquefoil) common or *Phleum alpinum* (alpine timothy) and *Trisetum spicatum* (spike trisetum) present; *Pseudoroegneria spicata* (bluebunch wheatgrass) not present; high subalpine to alpine meadows ..... ***Deschampsia cespitosa / Potentilla* diversifolia p.a.**
3. *P. diversifolia* scarce, *P. alpinum* and *T. spicatum* absent; habitats various 4

4. *Carex* spp. (sedge species, e.g) well represented or the dominant graminoids along with *D. cespitosa* ..... ***Deschampsia cespitosa – Carex* spp.**
4. Not as above, *Carex* spp. not the dominant graminoids ..... see a & b below
   a. *Festuca idahoensis* (Idaho fescue) well represented (or only common under intensive grazing) ..... ***Festuca idahoensis – Deschampsia cespitosa* p. a.**
   b. *F. idahoensis* poorly represented (the following type represents largely lower elevation sites too wet to support *F. idahoensis*, yet not formal wetlands) ..... ***Deschampsia cespitosa* p. a. (as described by Hansen et al. [1995])**

5. *Juncus balticus* (Baltic rush) is well represented 6
5. *J. balticus* poorly represented 8

6. *Carex praegracilis* (clustered field sedge) or *Muhlenbergia richardsonis* (mat muhly), individually or combined, well represented ..... ***Juncus balticus-Carex praegracilis* p.a.**
6. *C. praegracilis* and *M. richardsonis*, individually or combined cover, well represented 7

7. *Juncus balticus* (Baltic rush) virtually a monospecific dominant, among the few species present (<5); characteristically of drawdown zones of lemnic environments (includes just the most depauperate stands incorporated in Hansen et al. [1995]) ..... ***Juncus balticus* p.a.**
7 *J. balticus* not a monospecific dominant; other graminoids and forbs occupying the site, though their canopy cover may be less than that of *J. balticus* (includes most of the *J. balticus* community type as conceived of by Hansen et al. [1995]) ..... **Juncus balticus p. a.**

8. *Distichlis spicata* (inland saltgrass, formerly *D. stricta*) having at least 15% canopy cover or dominating the graminoid layer ..... ***Distichlis spicata* p. a.**
8. *D. spicata* having less than 15% canopy cover and not the dominant graminoid 9

9. *Leymus cinereus* (giant wildrye, formerly *Elymus cinereus*) well represented (characteristically on temporarily or seasonally flooded sites 10
9. *L. cinereus* poorly represented 11

10. *Puccinellia nuttalliana* (Nuttall's alkaligrass) or *P. distans* (weeping alkaligrass) or *Poa secunda* (Sandberg's bluegrass, formerly *Poa juncifolia*, alkali bluegrass), their individual or combined coverage well represented or dominant ..... ***Leymus cinereus – Puccinellia nuttalliana* p. a.**
10. Not as above, *P. nuttalliana*, *P. distans* and *P. secunda* poorly represented and not dominant ..... **Undefined *Leymus cinereus* vegetation type**
11. *Puccinellia nuttalliana* (Nuttall's alkaligrass) well represented or dominant; alkaline seeps or flats ..... ***Puccinellia nuttalliana* p. a.**
11. *P. nuttalliana* poorly represented and not dominant 12

12. *Sporobolus airoides* (alkali sacaton) well represented or the dominant graminoid; typically on seasonally flooded alkaline seeps or alluvial flats ..... ***Sporobolus airoides* p. a.**
12. *S. airoides* poorly represented and not the dominant graminoid 13

13. *Pascopyrum smithii* (western wheatgrass, formerly *Agropyron smithii*) well represented or dominant graminoid; characteristic of basins or swales or alluvial flats (usually with heavy-textured soils)..... .....***Pascopyrum smithii* / alluvial flat p. a.**
13. *P. smithii* poorly represented and not the dominant graminoid 14

14. *Poa secunda* (Sandberg's bluegrass, formerly *Poa juncifolia* or *P. secunda* ssp*. juncifolia*, alkali bluegrass) well represented and dominant of graminoid layer; community characteristic of seasonally or temporarily flooded alluvial flats .....***Poa secunda* p. a.**
14. *P. secunda* poorly represented and not dominant graminoid..... *...* **See lead #30 in the initial portion of "KEY TO GRASSLAND TYPES, UPLAND AND WETLAND" that treats wetlands**

15. Communities of high subalpine to alpine sites, generally above 8,500 ft., or if occurring lower then associated with windswept shoulders and ridges.....40
15. Not as above, communities of elevations generally considered to lie below the upper subalpine, roughly less than 8,500 ft. at this latitude and in this climatic regime..... 16

16. *Bromus carinatus* (mountain brome) or *B. anomalus* (nodding brome) well represented, individually or collectively (other graminoids may be dominant) .....***Bromus carinatus – Bromus anomalus* p. a.**
16. *B. carinatus* or *B. anomalus* poorly represented, individually or collectively..... 17

17. *Stipa richardsonii* (Richardson's needlegrass) abundant (only well represented if grazing intensive) . 18
17. *S. richardsonii* not abundant (and poorly represented in the presence of grazing)..... 19

18. *Festuca idahoensis* (Idaho fescue) well represented (or common if grazing intensive): **Note,** the following p.a. largely replaces *F. idahoensis – S. richardsonii* p. a. .....***Stipa richardsonii – Festuca idahoensis* p. a.**
18. *F. idahoensis* poorly represented ..... **Undefined *Stipa richardsonii* vegetation type**

19. *Festuca campestris (*formerly *F. scabrella*, rough fescue) well represented (only common under intensive grazing)..... 20
19. *F. campestris* poorly represented (or scarce under grazing)..... 22

20. *Festuca idahoensis* (Idaho fescue) well represented, *Pseudoroegneria spicata* (formerly *Agropyron spicata*, bluebunch wheatgrass), if present, with less cover than *F. idahoensis*..... ..... ***Festuca campestris - Festuca idahoensis* p.a.**
20. *F. idahoensis* (Idaho fescue) poorly represented, *P. spicata* (bluebunch wheatgrass) common or at least equal in cover to *F. idahoensis* 21

21. *Pseudoroegneria spicata* (formerly *Agropyron spicatum,* bluebunch wheatgrass) common (reduced to scattered individuals with intensive grazing) ..***Festuca campestris - Pseudoroegneria spicata* p.a.**
21. *P. spicatum* scarce..... **Undefined/unreported p.a./c.t. within *Festuca campestris* alliance**

22. *Festuca idahoensis* (Idaho fescue) well represented (or only common under intensive grazing)..... 23
22. *F. idahoensis* poorly represented (or scarce under intensive grazing); *D. cespitosa* absent..... 27

23. *Potentilla diversifolia* (diverse-leaved cinquefoil), *Carex scirpoidea* (Canadian single-spike sedge), *C. filifolia* (thread-leaved sedge) or *Phleum alpinum* (alpine timothy), their single or combined cover, common; sites at higher reaches of subalpine extending to alpine, extending lower on cold, exposed sites (includes two Mueggler & Stewart (1980) types, *F. idahoensis - Carex scirpoidea* p.a. (hypothesized) and *F. idahoensis-Carex filifolia* p.a. (verified)) .....***Festuca idahoensis* / *Potentilla diversifolia* p a.**

23. *P. diversifolia*, *C. scirpoidea*, *C. filifolia*, *P. alpinum* scarce, either individual or combined cover; sites not of alpine to high subalpine, or not exposed or colder than prevailing climate..... 24

24. *Geranium viscosissimum* (sticky geranium), *Potentilla gracilis* (slender cinquefoil) present and/or *Bromus carinatus* (mountain brome)*, B. anomalus* (nodding brome) or Elymus trachycaulus (formerly *Agropyron caninum*, bearded wheatgrass) common, individually or combined .....

..... ***Festuca idahoensis – Elymus trachycaulus* p.a.**
24. Not as above 25

25. *Pascopyrum smithii* (western wheatgrass) or *Elymus lanceolatus* (formerly *Agropyron dasystachyum*, thick-spike wheatgrass), their individual or combined cover, common .....
..... ***Festuca idahoensis / Pascopyrum smithii* p.a.**
25. *P. smithii* and *A. dasystachyum*, their individual or combined cover, scarce 26

26. *Pseudoroegneria spicata* (formerly *Agropyron spicatum*, bluebunch wheatgrass) common (accept merely present under intensive grazing regime) ***Festuca idahoensis - Pseudoroegneria spicata* p.a.**
26. *P. spicata* scarce..... **Undefined/unreported *Festuca idahoensis* vegetation type**

27. *Pascopyrum smithii* (western wheatgrass) or *Elymus lanceolatus* (formerly *Agropyron dasystachyum*, thick-spike wheatgrass), their individual or combined cover, common 28
27. *P. smithii* and *E. lanceolatus* scarce except in stands where *P. spicata* well represented 30

28. *Pascopyrum smithii* (western wheatgrass) a nearly monospecific dominant of gentle flats and bottomlands with fine-textured (heavy) soils .....***Pascopyrum smithii* / alluvial flats p.a.**
28. *P. smithii* not virtually the only species of importance, sites including more than fine-textured bottomlands 29

29. *Elymus lanceolatus* (thick-spike wheatgrass) common and usually dominant component of early seral stages on sandy substrates .....***Elymus lanceolatus / Phacelia hastata* p.a.**
29. *Elymus lanceolatus* scarce and/or not dominant .....
.....**Undefined *P. smithii and/or E. lanceolatus* vegetation types**

30. *Pseudoroegneria spicata* (bluebunch wheatgrass) well represented (only common under intensive grazing, or where badland conditions or a high cover of exposed substrate, usually gravel, exists).... 31
30. *A. spicatum* poorly represented (or scarce with grazing) 36

31. Rhizomatous wheatgrasses, principally *Elymus lanceolatus* (thick-spike wheatgrass) and *Pascopyrum smithii* (western wheatgrass) common, *Carex stenophylla* usually present.....
..... ***Pseudoroegneria spicata - Pascopyrum smithii* p.a.**
31. Rhizomatous wheatgrasses scarce; *C. stenophylla* usually absent..... 32

32. *Bouteloua gracilis* (blue grama) well represented ***Pseudoroegneria spicata - Bouteloua gracilis* p.a.**
32. *B. gracilis* poorly represented 33

33. *Oryzopsis hymenoides* (Indian ricegrass) present; sites either badlands with naturally (mostly) eroded conditions or excessively drained sandy soils.....
.....***Pseudoroegneria spicata - Oryzopsis hymenoides* p.a.**
33. *O. hymenoides* absent, sites not as above..... 34

34. Ridge shoulders or convexities exposed to prevailing winds (usually with soil deflation and much, 60%+, exposed substrate); at or below the upper subalpine zone; cushion plants (e.g *Eritrichium nanum*, *Douglasia montana*, *Townsendia* spp.) or compact forbs (e.g. *Oxytropis campestris*, *Stenotus acaulis* [formerly *Haplopappus acaulis*]) dominate the undergrowth; graminoid component far reduced relative to forbs .....
.....***Pseudoroegneria spicata* / Cushion Plants p.a.**
34. Not as above 35

35. *Poa secunda* (Sandberg's bluegrass) present, usually graminoid 2nd in importance to *Pseudoroegneria spicata* (bluebunch wheatgrass); *Stipa comata* (needle-and-thread) or *S. spartea* (porcupine-grass) may be conspicuous components on lower alluvial slopes and benches and valley bottoms ..... ***Pseudoroegneria spicata - Poa secunda* p.a.**
35. *P. secunda* absent, not as above ..... **Undefined/unreported *Pseudoroegneria spicata* vegetation type**

36. *Stipa comata* (needle-and-thread) or *S. spartea* (porcupine grass) and/or *Bouteloua gracilis* (blue grama) the dominant graminoids 37
36. *S. comata*, *S. spartea* and *B. gracilis* not the dominant graminoids 39

37. *Psoralidium tenuiflorum* (formerly *Psoralea tenuiflora*, slender-flowered scurf-pea) present, usually the dominant forb in depauperate vegetation; substrate sandy ..... ***Stipa comata / Psoralidium tenuiflorum* p. a.**
37. *P. tenuiflorum* absent 38

38. *Bouteloua gracilis* (blue grama) common ..... ***Stipa comata - Bouteloua gracilis* p.a.**
38. *B. gracilis* scarce ..... **Undefined / unreported Stipa comata vegetation type**

39. *Distichlis spicata* (formerly *D. stricta*, inland saltgrass) common, usually the dominant graminoid in salt-or alkali-affected sites ..... ***Distichlis spicata* p.a.**
39. *D. spicata* poorly represented, may not be the dominant graminoid ..... **Undefined / unreported herbaceous p.a./c.t. for southwestern MT**

Note: from lead 40 to 66 the vegetation types treated are of subalpine to alpine environments, both wetlands and uplands

40. Stands dominated by graminoids (grasses, sedges, rushes etc.). 41
40. Stands **not** graminoid-dominated, but rather by forbs ..... see "**KEY TO PERENNIAL FORB VEGETATION INCLUDING UPLAND AND WETLAND TYPES**"

41. Wetland sites with a floristic composition and/or soils/hydrology meeting wetland criteria 42
41. Sites not wetlands, not meeting wetland criteria 44

42. Wetland sites dominated by *Carex scopulorum* (Holm's Rocky Mountain sedge) *C. aquatilis* (water sedge), C. *lenticularis* (lentil-fruit sedge) *or C. aperta* (Columbia sedge), singly or in combination 43
42. Site not dominated by any combination of the above-listed species ..... **Undefined Graminoid-dominated Wetland**

43. Site dominated by *Carex scopulorum* (Holm's Rocky Mountain sedge) 44
43. Site not dominated by *C. scopulorum* 45

44. *Caltha leptosepala* (elkslip marsh-marigold) or *Senecio cymbalarioides* (few-leaved groundsel), singly or combined, well represented and diagnostic forbs ***Carex scopulorum / Caltha leptosepala* p. a.**
44. *C. leptosepala* and *S. cymbalarioides* poorly represented ..... **Undefined *Carex scopulorum* vegetation type**

45. Sites dominated by or having greater canopy cover of *Carex simulata* (short-beaked sedge) than any other single graminoid ..... ***Carex simulata* p. a.**
45. Sites dominated by graminoids other than *C. simulata* 46

46. *Carex aquatilis* (water sedge), C. *lenticularis* (lentil-fruit sedge) *or C. aperta* (Columbia sedge), singly or in combination, dominant or well represented ..... ***Carex aquatilis* p. a.** (see a & b below)
    a. Grass species or *Juncus balticus* (Baltic rush), alone or in combination, poorly represented ..... ***Carex aquatilis* Phase**
    b. Grass species and *J. balticus*, alone or in combination, poorly represented ..... ***Deschampsia cespitosa* Phase**
46. *C. aquatilis*, *C. lenticularis*, and *C. aperta*, singly or in combination, poorly represented and not dominant 47

47. Snowbed communities (sites with greater accumulations of snow than other landscape positions and/or later meltoff of snow) 48

47. Not snowbed sites, not characterized by above average snow deposition or late meltoff 51

48. Sites where snow is very long-persisting (longer than any other vegetated position) and *Carex nigricans* (black alpine sedge) is dominant and usually abundant ..... ***Carex nigricans* p. a.**
48. *C. nigricans* scarce, not the canopy dominant 49

49. Snowbed sites often with depauperate herb cover, with *Juncus drummondii* (Drummond's rush), *Antennaria lanata* (woolly pussy-toes) and/or *Sibbaldia procumbens* (creeping sibbaldia) present and dominant ..... ***Juncus drummondiana / Antennaria lanata* p. a.**
49. Snowbed sites but not as above, lacking *J. drummondii*, *A. lanata* and *S. procumbens* as dominants 50
50. *Juncus parryi* (Parry's rush) the dominant graminoid with *Erigeron ursinus* (Bear River fleabane) common and consistently the dominant forb, though cover seldom exceeds 5%..... ..... ***Juncus parryi / Erigeron ursinus* p. a.**
50. *J. parryi* not the dominant graminoid and *E. ursinus* not dominant forb .... **Undefined Snowbed Sites**

51. Stands dominated by one, or combinations, of the following six graminoids *Deschampsia cespitosa* (tufted hairgrass), *Festuca idahoensis* (Idaho fescue), *Festuca kingii* (spike-fescue, formerly *Hesperochloa kingii* or *Leucopoa kingii*) *Bromus inermis* var*. pumpellianus* (formerly *B. pumpellianus*, pumpelly brome), *Juncus balticus* (Baltic rush) or *Carex obtusata* (blunt sedge*)* 52
51. Stands not dominated by any one, or combination, of the above listed graminoid species 59

52. *Deschampsia cespitosa* (tufted hairgrass) well represented, the dominant graminoid of moist to wet meadows 53
52. *D. cespitosa* poorly represented and not the dominant graminoid 55

53. *Caltha leptosepala* (elkslip marsh-marigold) and/or *Senecio cymbalarioides* (few-flowered groundsel), singly or in combination, well represented or dominating the forb layer of wet meadows .... ***Deschampsia cespitosa / Caltha leptosepala* p. a.**
53. *C. leptosepala* and *S. cymbalarioides,* alone or combined cover not dominant and poorly represented 54

54. *Potentilla diversifolia* (diverse-leaved cinquefoil) common .... ***Deschampsia cespitosa / Potentilla diversifolia* p. a.**
54. *P. diversifolia* scarce ..... **Undefined *Deschampsia cespitosa* vegetation type**

55. *Festuca idahoensis* (Idaho fescue), *Carex obtusata* (blunt sedge), or *Bromus inermis* var*. pumpellianus* (pumpelly brome, formerly *B. pumpellianus*) or any combination of the three well represented or comprising the dominant graminoids 56
55. Neither *F. idahoensis*, *C. obtusata* nor *B. inermis* var*. pumpellianus* or any combination of the three dominating the graminoid component..... 57

56. *Potentilla diversifolia* (diverse-leaved cinquefoil) common .... ***Festuca idahoensis / Potentilla diversifolia* p. a.**
56. *P. diversifolia* scarce ..... **Undefined *Festuca idahoensis* vegetation type**

57. *Festuca kingii* (spike fescue, formerly *Hesperochloa kingii or Leucopoa kingii*) the graminoid with greatest coverage in rather depauperate communities 58
57. *F. kingii* not the indicated dominant .... **Undefined Graminoid-dominated vegetation type**

58. *Oxytropis campestris* (slender crazyweed) present and characteristic forb .... ***Festuca kingii / Oxytropis campestris* p. a.**
58. *O. campestris* not present ..... **Undefined *Festuca kingii* vegetation type**

59. Turf communities (commonly characterized by an abundance of dwarf, fibrous-rooted graminoids, usually *Carex* spp. [sedge species], but forbs may dominate some stands); dominant graminoids with individual or combined cover exceeding 15% including *Carex elynoides* (Kobresia-like sedge), *C. rupestris* (curly sedge), *C. scirpoidea* (Canadian single-spike sedge), *C. phaeocephala* (dunhead sedge), *C. albonigra* (black-and-white-scaled sedge), *C. atrata* (blackened sedge), *Festuca ovina* (sheep fescue), and *Calamagrostis purpurascens* (purple reedgrass) 60
59. Not graminoid-dominated or having reduced total (<50%) canopy coverage from turf communities as described above..... 66

60. Moist turf sites with one or any combination of the following *Carex* spp. (sedge species) dominant; *C. scirpoidea* (Canadian single-spike sedge), *C. phaeocephala* (dunhead sedge), *C. albonigra* (black-and-white-scales sedge), *C. atrata* (blackened sedge) 61
60. Dry turf sites (grading to cushion plant environments with much more open structure) with one or any combination of the following species dominant; *Carex rupestris* (curly sedge), *C. elynoides* (Kobresia-like sedge), *C. obtusata* (blunt sedge), *Festuca ovina* (sheep fescue), *Calamagrostis purpurascens* (purple reedgrass)..... 63

61. *Geum rossii* (Ross's avens) common (usually well represented and the dominant forb); substrates non-calcareous ..... ***Carex scirpoidea / Geum rossii* p. a.**
61. *Geum rossii* scarce, other forbs dominant..... 62

62. *Potentilla diversifolia* (diverse-leaved cinquefoil) and/or *Phlox pulvinata* (cushion phlox) dominant and/or common..... ***Carex scirpoidea / Potentilla diversifolia* p. a.**
62. Not as above, *P. diversifolia* and *P. pulvinata* scarce and not dominant..... ..... **Undefined moist alpine turf vegetation types**

63. Turf nearly continuous, *Carex rupestris* (curly sedge), *C. obtusata* (blunt sedge) and *Calamagrostis purpurascens* (purple reedgrass) not dominant or codominant graminoids; forbs a minor component.... ..... ***Carex elynoides* p. a.**
63. Turf patchy, *C. rupestris, C. obtusata* or *Calamagrostis purpurascens* (purple reedgrass) dominant graminoids with openings forb dominated and much exposed gravel/rock substrate existing..... 64

64. *Calamagrostis purpurascens* (purple reedgrass) well represented or dominant graminoid..... ..... ***Calamagrostis purpurascens – Carex rupestris* p. a.**
64. *C. purpurascens* poorly represented and not the dominant graminoid 65

65. *Carex rupestris* (curly sedge) or *C. obtusata* (blunt sedge) the dominant graminoid, well represented; *Potentilla ovina* (sheep cinquefoil) or *Phlox pulvinata* (cushion phlox) common, individually or combined, usually the dominant forbs ..... ***Carex rupestris / Potentilla ovina* p. a.**
65. *P. ovina* and *P. pulvinata*, singly or combined, scarce and not the dominant forbs..... ..... **Undefined / unrecorded *Carex rupestris* vegetation types**

66. Forb dominated turf communities ranging from dense generally continuous plant cover to somewhat open plant cover characterized by well-distributed clumps of erect forbs, though cushion plants may be dominant ..... see **"KEY TO PERENNIAL FORB VEGETATION TYPES, UPLAND AND WETLAND"**
66. More like cushion plant than turf communities, with erect forbs sparse and cushion plants dominant and/or there exists much exposed substrate..... ..... see "**KEY TO PERENNIAL FORB VEGETATION TYPES, UPLAND AND WETLAND"**

KEY TO PERENNIAL FORB VEGETATION INCLUDING UPLAND AND WETLAND TYPES

We **include** here as "forb-dominated" types vegetation types named for members of the ferns and "fern allies" including Equisetaceae (horsetail family), Lycopodiaceae (club moss family), Marsileaceae (pepperwort family), Ophioglossaceae (grape fern family), Polypodiaceae (fern family), Selaginellaceae (spike moss family) in addition to myriad other families, e.g. Asteraceae, Polymoniaceae, etc., the component species of which are traditionally thought of as forbs. **Not included** are members of the Poaceae (grasses) or members of the families Juncaceae (rush family, including *Juncus* spp.[rush], *Luzula* spp. [woodrush]), Cyperaceae (sedge family, including *Carex* spp. [sedge]. *Cyperus* spp. [galingale], *Dulichium arundinaceum* [dulichium], *Eleocharis* spp. [spike rush], *Eriophorum* spp. [cotton grass], *Kobresia* spp. [kobresia], *Scirpus* spp. [bulrush], Typhaceae (cattail family, *Typha* spp. [cattails], Juncaginaceae (arrow grass family, including *Lilaea scilloides* (flowering quillwort) and *Triglochin* spp. [arrow grass]);

1. Sites ranging from moist uplands to temporarily flooded to permanently flooded or saturated; dominated by having one of the following diagnostic species present, *Angelica arguta* (sharptooth angelica) or *Angelica dawsonii* (Dawson's angelica), *Equisetum fluviatile* (water horsetail), *Parnassia fimbriata* (fringed grass-of-parnassas), *Senecio triangularis* (arrowleaf groundsel), *Salicornia rubra* (red glasswort) 2
1. Not as above; sites drier than described above or occurring at highest elevations of the subalpine zone (above distribution of *Pseudotsuga menziesii* [Douglas-fir] as climax species, at upper distribution of *Artemisia tridentata* ssp. *vaseyana* [mountain big sagebrush]) upward into the alpine zone 5

2. *Equisetum fluviatile* (water horsetail) abundant (having at least 25% canopy cover ..... ***Equisetum fluviatile* p. a.**
2. *E. fluviatile* not abundant, canopy less than 25% 3

3. *Senecio triangularis* (arrowleaf butterweed or groundsel) well represented or any two of the following species common *S. triangularis*, *Parnassia fimbriata* (fringed grass-of-Parnassas), *Angelica arguta* (sharptooth angelica), *A. dawsonii* (Dawson's angelica) ..... ***Senecio triangularis* p. a.**
3. Not as above; *S. triangularis* poorly represented and all combinations of two of the above-listed species are scarce, less than 5% canopy cover. 4

4. *Salicornia rubra* (red glasswort) having a greater canopy cover than any other individual herbaceous species ..... ***Salicornia rubra* p. a.**
4. *S. rubra* having a lesser canopy cover than any other individual herbaceous species ..... **Undefined or undescribed perennial forb-dominated vegetation type**

5. *Geum rossii* (Ross's avens) as erect forb, dominant or co-dominant 6
5. *G. rossii* present, not dominant, cespitose and reduced in size 9

6. Erect forb *Trifolium parryi* (Parry's clover) dominant or co-dominant in forb layer ..... ***Geum rossii-Trifolium parryi* p. a.**[1]
6. *T. parryi* absent or not dominant/co-dominant 7

7. Cushion plant *Trifolium nanum* (dwarf clover) dominant/co-dominant in forb layer ..... ***Geum rossii - Trifolium nanum* p. a.**[1]
7. *T. nanum* not dominant/co-dominant 8

8. Cushion plant *Trifolium dasyphyllum* (whip-root clover) dominant/co-dominant ..... ***Trifolium dasyphyllum - Geum rossii* p. a.**[1]
8. *T. dasyphyllum* not dominant/co-dominant ..... **Undescribed / undefined turf community types**

9. Fellfield (high degree of exposed rock) or cushion plant environments (exposed, wind-blasted positions, usually ridge crests, slope shoulders and saddles); cushion plants range from a dominant aspect of community to slightly subordinate to erect forbs 10

9. Sites not fellfields nor cushion plant communities, rather they include steep, either dry or wet slopes with a high degree of exposed substrate (>70%) 14

10. Cushion plant communities wherein *Geum rossii* (Ross's avens)and/or *Minuartia obtusiloba* (formerly *Arenaria obtusiloba,* arctic sandwort) are common or dominants of the forb layer (which is often depauperate with scattered plants)..... ***Geum rossii - Arenaria obtusiloba* p. a.**
10. Neither *G. rossii* nor *M. obtusiloba* common, nor forb layer dominants 11

11. Moderately dense, single tier plant cover of prostrate and cespitose forbs, graminoid component depauperate, with *Phlox pulvinata* (cushion phlox) and *Trifolium dasyphyllum* (whip-root clover) providing more c.c. than other forbs ..... ***Phlox pulvinata - Trifolium dasyphyllum* p. a.[1]**
11. Not as above, neither *P. pulvinata* nor *T. dasyphyllum* the most important cushion plants 12

12. Scattered mixture of erect and cushion plants and graminoids with *Antennaria microphylla* (rosy pussy-toes) and/or *Artemisia scopulorum* (Rocky Mountain sagewort), alone or in combination, having the greatest forb cover ..... ***Antennaria microphylla - Artemisia scopulorum* p. a.[1]**
12. Cushion plant communities with neither *A. microphylla* nor *A. scopulorum* nor combinations of the two dominating the forb layer..... 13

13. Cushion plants dominant aspect of communities with varying combinations of the three species *Phlox multiflora* (many-flowered phlox), *Trifolium nanum* (dwarf clover) and *Eritrichium nanum* (pale alpine forget-me-not) providing the majority of canopy cover ..... ***Phlox multiflora-Triflorum nanum* p. a.[1]**
13. None of the above three species, alone or in combination, providing the dominant aspect of vegetation cover..... **Undefined Cushion Plant Vegetation Types**

14. Sites with predominantly northerly exposures, moderate to steep slopes with a high degree (at least 75%) of exposed substrate of which more than 80% is soil or gravel; soils moist to saturated throughout growing season: vegetative canopy cover is much reduced, not exceeding 40% but with no characteristic species assemblage ..... **Alpine Fellfield / Moist**
14. Sites not as above 15

15. Sites with uniformly steep (>40%), often unstable slopes of southeast through west-facing exposures; of the large amount of exposed substrate (>55%) about 50% is gravel; *Elymus scribneri* (formerly *Agropyron scribneri*, spreading wheatgrass) is usually the one species with higher coverage and constancy in this "type" than other p.a.'s ..... **Alpine Fellfield / Dry**
15. Sites not as described above..... **Undefined community types of Subalpine and Alpine Environments**

[1] Thelenius and Smith (1985)

Vegetation Classication: Descriptions of Types

Needle-leaved Evergreen Forests

Abies lasiocarpa / Arnica cordifolia Forest (ABILAS / ARNCOR) subalpine fir / heartleaf arnica

Natural Heritage Conservation Rank- G5 / S5

Environment- This is a major community type in the drier mountain ranges of Montana east of the Continental Divide, especially on calcareous substrates, ranging into northwestern Wyoming. It is a common, distributed on sites drier than those supporting *Abies lasiocarpa / Thalictrum occidentale* and occurring at generally higher elevations, usually transitional to the moister/colder *Abies lasiocarpa / Vaccinium scoparium* forest. Though more prevalent on northerly exposures, it is found on all aspects and degrees of slope. The observed elevation range was 7,300 to 8,900 ft., but the actual range is no doubt broader.

Vegetation- Limited data and reconnaissance observations indicate *Pinus contorta* and *Pseudotsuga menziesii* and all admixtures dominate seral stages and persist to near climax conditions. *Abies lasiocarpa* and *Picea engelmannii* are generally slow to reestablish following disturbance. Waist high 50-year-old *Abies* specimens are not unusual. *Pinus albicaulis* is scattered to abundant in the highest elevation examples of this type.

Undergrowth is generally somewhat depauperate depending on degree of canopy closure, but even young stands may have less than 5% cover. *Arnica cordifolia* is the diagnostic forb (by default); others commonly occurring are *Pyrola secunda, Aster conspicuus,* and *Osmorhiza chilensis* or *O. depauperata*. In early seral stands *Shepherdia canadensis, Juniperus communis* or *Symphoricarpos oreophilus* are often well represented but decline to scattered individuals as the tree canopy closes.

Other Studies- This is a common type east of the Continental Divide in Montana and its areal extent increases with the increase in calcareous substrates. In central Idaho (Steele et al. 1981) it is a common type on quartzite and mixed volcanics which is also the case in northwestern Wyoming (Steele et al. 1983). *Abies lasiocarpa / Arnica cordifolia* is purported to occur as far south as Colorado.

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Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Abies lasiocarpa / Calamagrostis canadensis Forest (ABILAS / CALCAN) subalpine fir / bluejoint reedgrass

Natural Heritage Conservation Rank- G5 / S5

Environment- *Abies lasiocarpa / Calamagrostis canadensis* forest association is broadly distributed near and east of the Continental Divide and is usually confined to small restricted areas that poorly drained or sub-irrigated sites that have surface water during late spring and early summer. These sites often border on streams and wet to moist, *Juncus*- or *Carex*-dominated species meadows. Where impermeable layers direct water to the surface this type can occur on mountain slopes. In general the stand size of *Abies lasiocarpa / Calamagrostis canadensis* are smaller than can be delineated on 1:24,000 scale maps, except as inclusions or a component of a complex.

Vegetation- The cool, wet conditions restrict the tree flora to predominantly three species. *Picea* (spruce) is usually the dominant species

in mature to old-growth stands and persists as a minor climax or co-climax species with *Abies lasiocarpa*. *Pinus contorta* (lodgepole pine) often is the major seral species in younger stands. *Pinus albicaulis* (whitebark pine) is a minor component associated with drier hummocks in higher elevation stands.

Calamagrostis canadensis (bluejoint reedgrass) or *C. stricta*, indicator species for the type is the dominant graminoid, generally occurring with greater than 5% canopy cover and averaging around 20%. *Senecio triangularis* (alternative indicator species), *Veratrum viride, Trollius laxus, Streptopus amplexifolius*, and *Dodecatheon jeffreyi* constitute the high-constancy forb component that is associated with these wet sites. *Thalictrum occidentale* and *Arnica latifolia*, generally associated with merely moist sites, also have high constancy and may be well represented. In the Red Rocks Lake NWR expression of this type, shrubs are a minor component except where *Ribes lacustre* and *Vaccinium scoparium* which may attain abundance on hummocks and raised areas surrounding tree bases.

Only the *Calamagrostis canadensis* and *Galium triflorum* phases have been identified in the Centennial Range and Valley in general. The *G. triflorum* phase represents an eqtally moist but slightly warmer microclimate as denoted by the presence of *G. triflorum* and *Actaea rubra*.

Element Code- CEGL000300
Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Abies lasiocarpa / Calamagrostis rubescens Forest (ABILAS / CALRUB) subalpine fir / pine grass

Natural Heritage Conservation Rank- G4G5 / S3

Environment- *Abies lasiocarpa / Calamagrostis rubescens* forest is common on the south-facing flank of the Centennial Range but on the north-facing Montana portion it is a less prevalent type from 6,600 to at least 8,800 ft. on warm exposures. It usually grades to *Abies lasiocarpa / Arnica cordifolia* or *Abies lasiocarpa / Thalictrum occidentale* on cooler exposures and exists in complex mosaics with *Abies lasiocarpa / Carex geyeri* that occasion the question as to what factors may differentiate these types.

Vegetation- Description of this type comes from mid-seral stands that have a mixed canopy dominance split between *Pseudotsuga menziesii* and *Pinus contorta*. *Abies lasiocarpa* and *Picea engelmannii* are slow to reestablish on these dry sites. *Pinus albicaulis* occurs scattered at the highest elevations of this type.

The undergrowth is typically dominated in younger open stands by a near sward of *Calamagrostis rubescens*, usually accompanied by *Carex geyeri*, and the forbs, *Thalictrum occidentalis, Fragaria virginiana, Aster conspicuus* and *Arnica cordifolia* are characteristically present, though poorly represented, (excepting *A. cordifolia)*. In older stands or those in the "closed canopy" stage *C. rubescens* may be reduced to scattered patches or even poorly represented. In open seral conditions *Shepherdia canadensis* and *Juniperus communis* may be well represented.

Soils- Very limited data preclude saying much about this type other than to observe that it occurred on rhyolite substrates in the Centennial Range north flank but also is known from sedimentary substrates on the south flank.

Other Studies- *Abies lasiocarpa / Calamagrostis rubescens* is a common type from central Montana (Pfister et al. 1977), where it occurs on calcareous substrates, to northern Utah (Mauk & Henderson 1984) and central Colorado (Karmokova et al. 1988). It occurs as far west as the eastern flank of the Cascades in Washington and Oregon (Williams and Smith 1990, Williams and Lillybridge 1985) and is prevalent in Oregon's Blue Mountains (Johnson & Simon 1987).

Element Code- CEGL000301
Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Abies lasiocarpa / Carex geyeri Forest (ABILAS / CARGEY) subalpine fir / elk sedge

Natural Heritage Conservation Rank- G5 / S3

Environment- The *Abies lasiocarpa / Carex geyeri* Forest is a minor type throughout the Centennial Range but gains greater prominence in the Greater Yellowstone, encompassing some of the driest sites within the *Abies lasiocarpa* series. Sampled sites ranged from 7,600 to 8,600 ft., but the lower portion of this range could be extended considerably based on reconnaissance observations. Slopes of all degrees of inclination are included and aspects range from primarily east- through south- to west facing. This type often grades to *Pseudotsuga menziesii / Carex geyeri* or *Calamagrostis rubescens* on yet drier (lower elevation) sites and to *Abies lasiocarpa / Thalictrum occidentale* or *Abies lasiocarpa / Arnica cordifolia* forest on moister exposures.

Vegetation- Sampled stands were both late mature and early seral and thus encompassed much variability in structure and composition. The lower elevation examples of this type are dominated throughout their existence by *Pseudotsuga menziesii* with *Abies lasiocarpa* and *Picea engelmannii* only slowly establishing. Long-lived *Pinus contorta* may also form nearly pure stands on this type, but the usual condition is to occur mixed with *Pseudotsuga*. Stands from higher elevations often have *A. lasiocarpa* establishing immediately following disturbance but *P. menziesii* is still a major component. P*inus albicaulis* (or *P. flexilis*) can also be a major long-lived seral component.

Because we recognize forb-rich conditions as conveying a higher moisture status and belonging to preferentially recognized plant associations, the undergrowth conditions in *Abies lasiocarpa / Carex geyeri* Forest are mostly typified by the dominance of *Carex geyeri* with only scattered forbs. In open stands *C. geyeri* may approach a sword-like coverage. Forbs commonly present in minor amounts include *Thalictrum occidentale, Astragalus miser, Fragaria virginiana, Aster foliaceus* and *Arnica cordifolia*. In early- to mid-seral conditions *Shepherdia canadensis* and *Juniperus communis* are usually well represented.

Soils- Very limited information for this type indicates it occurs preferentially on non-calcareous substrates, which agrees with type descriptions from other areas. We found it exclusively on rhyolite or various forms of extrusive igneous in the Centennial Range and others (Steele et al. 1983, Steele et al. 1981, and Alexander et al. 1986) also report it from volcanic substrates that weather to other than fine-textured substrates. Only in central MT has it been reported from calcareous substrates (Pfister et al. 1977).

Other Studies- *Abies lasiocarpa / Carex geyeri* Forest is recorded as a minor type in central Montana ranges (Pfister et al. 1977), as a major type within the granitics of central Idaho's Batholith and occurs as a minor type as far south as northwestern Colorado (Hoffman and Alexander 1980) and Utah. Across its range it appears associated with volcanics of various kinds, both extrusive and intrusive.

Element Code- CEGL000304
Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Abies lasiocarpa / Ribes montigenum Forest (ABILAS / RIBMON) subalpine fir / mountain gooseberry

Natural Heritage Conservation Rank- G5 / S4

Environment- *Abies lasiocarpa / Ribes montigenum* Forest is found within the upper subalpine zone, generally beyond the limits of *Pseudotsuga*, and well within an environment

wherein *Pinus albicaulis* is an important seral component. We noted this type as low as 7,500 ft on steep, north-facing slopes and extending to upper forest line (circa 8,600 ft.) on the Centennial Range's Big Table Mountain; Pfister et al (1977) noted this type extending to 9,000 ft in the higher portion of the Centennials. At upper elevations of its distribution *Abies lasiocarpa / Ribes montigenum* Forest occurred on all aspects but seemed to be associated with slopes having late snow release. This type generally grades to *Abies lasiocarpa / Arnica cordifolia* and *Abies lasiocarpa / Carex geyeri* at lower elevations and to *Abies lasiocarpa* / *Vaccinium scoparium* on more moist sites. At highest elevations groves of *Abies lasiocarpa / Ribes montigenum* (on north slopes or depressions) form a mosaic with *Artemisia tridentata* var. *vaseyana* -dominated shrublands or *Festuca idahoensis*-dominated grasslands.

Vegetation- Only older, late-mature to decadent stands were sampled and from their structure we infer that the early seral tree species are *Pinus albicaulis* and *Abies lasiocarpa* and to a much lesser degree *Picea engelmannii* and even *Pseudotsuga menziesii* (though ideally these sites are above the cold limits of *Pseudotsuga*). With stand break-up (heavy mortality in *P. albicaulis* and *A. lasiocarpa* at 150 to 200 years, or older) a second flush of *A. lasiocarp*a and *P. engelmannii* is established. As remarked by Pfister et al. (1977) these sites are apparently unfavorable for *Pinus contorta*.

Stands with closed canopies are quite depauperate, however with canopy openings *Ribes montigenum* is common to well represented, usually in openings that appear to receive greater snow deposition than the majority of the stand. Forbs with a consistent presence include *Pyrola secunda*, *Aquilegia flavescens*, and *Arnica cordifolia*. The higher elevations of BLM Centennial holdings are used as sheep range which may account for the greater than expected cover of *Poa pratensis* and lesser amounts of forbs.

Soils- All sampled stands occurred on Tertiary volcanics which weather into nutrient-poor, acidic medium-textured soils. The ground surface had less than 10% exposed rock or soil and more than 80% litter.

Other Studies- This type was originally described from Utah by Pfister (1972) and documented for south-central and southwestern Montana by Pfister et al. (1977) and adjacent Challis and Open Northern Rockies Sections by Steele et al. (1981). It is sporadically distributed across western Wyoming and here evidences some departure from the type, e.g. the importance of seral *P. contorta*, as opposed to the lack of this species described above for southwestern MT. The eastern extremity of distribution is Colorado (Langenheim 1962) and to the south, southern Utah (Youngblood and Mauk 1985).

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Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Abies lasiocarpa / Thalictrum occidentale Forest (ABILAS / THAOCC) subalpine fir / western meadowrue

Natural Heritage Conservation Rank- G4 / S3

Environment- *Abies lasiocarpa / Thalictrum occidentale* a common plant association in northwestern Wyoming and extends at least as far as the north-facing flank of the Centennial Range in Montana; it has not been documented from areas farther north. It occurs on cool, moist slopes of all degrees of inclination and primarily on north- to east-facing aspects. The sampled elevation range was 7,400 to 8,200 ft., but in reconnaissance was noted to occur as low as 7,100 and as high as 8,400 ft. *Abies lasiocarpa / Thalictrum occidentale* grades to *Abies lasiocarpa / Arnica cordifolia* or *Calamagrostis rubescens* on warmer, drier exposures.

Vegetation- The sampled stands in the Centennial Range were primarily of late-seral to old-growth conditions with long-lived (300+

years) *Pseudotsuga menziesii*, or occasionally *Pinus contorta*, dominating the upper canopy and *A. lasiocarpa* and *Picea engelmannii* at least common, usually abundant as understory pole and sapling-sized components. At the highest elevations of this type *Pinus albicaulis* can be an important seral component; the importance of *P. contorta* also appears to increase with increasing elevation. Based on age of breast-height cores it appears extensive stand-replacing fires occurred 182+ and 248+ years ago. Fire-scarred individuals were not found within stands, only on ridgelines where stem density is less and fuel loading is light.

Undergrowth cover is strongly dependent upon tree canopy cover; open stands have a nearly continuous forb cover and closed, generally younger stands have scattered forbs totaling less than 5% cover. *Thalictrum occidentale*, *Osmorhiza chilensis* (?) or *Arnica cordifolia* are dominant, but the two foregoing spp. must be at least well-represented (common in closed canopy stands) to be diagnostic for the type. Other forbs with relatively high constancy are *Aquilegia flavescens, Aster engelmannii* and *Erythronium grandiflorum*. *Calamagrostis rubescens, Poa pratensis* and *Carex geyeri* are the only graminoids with even moderate constancy and virtually never attain the sward-like cover they typically do in other associations. Total shrub cover seldom exceeds 5% but *Lonicera utahensis, Symphoricarpos oreophilus* and *Shepherdia canadensis* are present with at least 50% constancy.

Soils- Tertiary extrusive volcanics, predominantly rhyolite, dominate much of the north flank of the Centennial Range and all of the sample plots were located on this substrate which has weathered to deep, well-drained substrates. This type has also been noted on sedimentary substrates, primarily sandstone. We suspect calcareous substrates are effectively drier and support *primarily Abies lasiocarpa / Arnica cordifolia* or *Abies lasiocarpa / Juniperus communis.*

Other Studies- This type was first described for northwestern Wyoming and eastern Idaho by Steele et al. (1983) and a portion of Pfister et al. (1977) plots may also better fit the description of this type than that of *Abies lasiocarpa /Arnica cordifolia,* where they were grouped. Cole (1982) has described a very similar type for the Blue Mountains of northwestern Oregon.

Comments- Cattle grazing in this type has led, where canopy cover is reduced, to the introduction of locally dense patches of *Poa pratensis* and trampling of native vegetation; where surfaces remain moist into mid-to late-summer, soil compaction and hummocking are evident.

Element Code- CEGL000338

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Picea (engelmannii x glauca, engelmannii) / Equisetum arvense Forest
(PICEA / EQUARV) spruce / common horsetail

Natural Heritage Conservation Rank- G4 / S4

Environment- *Picea/ Equisetum arvense* is a major wetland type within the *Picea* series, being present throughout the Intermountain West, though little appropriately wet habitat is present in southwestern Montana. Patch size usually does not exceed a few tenths of an acre. *Picea/ Equisetum arvense* generally occurs on flat sites such as sub-irrigated terraces, seeps, fen margins and toeslopes that receive sufficient subsurface flow to be continuously saturated, or nearly so. Standing water may be present well into summer.

Vegetation- Stands are characteristically dominated by mature, not infrequently old growth size *Picea* with a low density of often severely suppressed specimens in the understory. Scattered *Abies lasiocarpa* and *Pinus contorta* are often present on raised microsites (windthrow hummocks) and may be generally distributed on drier sites within the type, but these species never create a dominant aspect.

The wettest or youngest examples of this type have *Salix* spp. (often *S. bebbiana*) present but more typically *Cornus sericea, Ribes lacustre* and *Symphoricarpos albus* are the only shrubs present. *Equisetum arvense* is diagnostic for this type, frequently with minor coverage, especially on sites with a thick carpet of bryophytes. A tally of other obligate or facultative hydrophytes, e.g. *Streptopus amplexifolius, Parnassia fimbriata, Senecio triangularis*, *Geum macrophyllum* and *Calamagrostis canadensis* (or C. *neglecta*) should confirm the hydrophytic nature of these sites.

Soils- The only site sampled for soils was developed on fine-textured alluvium and given the landscape position of other sites noted in reconnaissance various textures of alluvium would be expected. Generally a thick mat of mor humus is expected (up to 18 cm thick): for the sampled site humus was only 8 cm thick, but the upper soil horizons are also rich with organic material.

Other Studies- This association, or the very similar *P. engelmannii* / *Equisetum arvense*, has been documented from the east slope of the Cascades in Washington (Williams & Lillybridge 1983, Williams and Lillybridge 1990) and Oregon (Kovalchik 1987), east to Montana (Pfister et al. 1977, Hansen et al. 1995) and south through Wyoming (Steele et al. 1983), to Idaho (Steele et al. 1981), Utah (Padgett et al. 1989) and Colorado (Cooper and Cottrell 1990).

Comments- This association is particularly susceptible to livestock/wildlife trampling throughout the growing season; resulting damages include exposed substrate and consequent erosion, loss of vegetation and introduction of weeds.

Element Code- CEGL000408

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Picea engelmannii / Calamagrostis canadensis Forest (PICENG / CALCAN) Spruce/Bluejoint reedgrass

Natural Heritage Conservation Rank- G4 / S3

Environment- The *Picea engelmannii* / *Calamagrostis canadensis* community occurs at low to high elevations in the mountains throughout Montana. It is generally restricted to flat to gently sloping sites with poor drainage, such as fen and lake margins, toeslopes, and low stream and river terraces. Soil texture varies from silt to sandy loam with some redox concentrations present. This community is usually temporarily flooded in the spring, and stands have a high water table year round. Stands are characterized by a large amount of micro-topography stemming from windthrown spruce. Adjacent wetter communities include *Salix drummondiana* or *Betula glandulosa* shrublands, or *Carex* sp. dominated flats. Adjacent drier communities are usually upland conifer forests dominated by *Abies lasiocarpa* or *Pseudotsuga menziesii* (Hansen et al. 1995).

Range- This community is present in Montana, Idaho, Utah, and Wyoming.

Vegetation- The overstory is dominated by spruce, and *Abies lasiocarpa* may also be present. There is low coverage of shrubs, although the diversity of shrub species present is fairly high. *Calamagrostis canadensis* and/ or *Calamagrostis stricta* dominate the ground layer. Other associated species include *Carex utriculata*, *Solidago canadensis*, and *Equisetum arvense* (Hansen et al. 1995).

Similar Communities- Youngblood et al. (1985) described a similar community for western Wyoming and Jankovsky-Jones (1997) for southeastern Idaho. Some Utah stands in Padgett et al. (1989) which are classified as *Conifer*/*Calamagrostis canadensis* have a *Picea engelmannii* – dominated overstory.

Succession- Hansen et al. (1995) suggests that

the *Picea*/*Calamagrostis canadensis* community is a late seral phase of the *Abies lasiocarpa*/*Calamagrostis canadensis* habitat type described by Pfister et al. (1977). Gaps in the forest that are created by disturbances such as windthrow are dominated by shrubs such as *Alnus incana* and *Salix drummondiana*.

Management- Timber productivity in this type is moderate to high. Because of high water tables, windthrow following harvest can be a problem, as can soil damage resulting from harvesting and site preparation; timing of activities is important to avoid damage.

Palatability of *Calamagrostis canadensis* is moderate to high, and foliage is most palatable when young. However, wet conditions during this time period make soil susceptible to damage from livestock. If levels of utilization of *Calamagrostis canadensis* stay high for long periods, production of *Calamagrostis canadensis* can decline (Hansen et al. 1995).

Other Studies- In Montana and Idaho, *Picea glauca* and *Picea engelmannii* hybrids are common, thus, lumping both species together is practical for classification purposes (Hall and Hansen 1997; Hansen et al. 1995). The type here represents stands dominated by *P. engelmannii* or *Picea* hybrids as described by Pfister et al. (1977), Steele et al. (1981) and Mauk and Henderson (1984).

Element Code- CEGL000356

Edition / Author- 99-10-18 / J. Greenlee, MTNHP

Picea (engelmannii x glauca, engelmannii) / Galium triflorum Forest. (PICEA/GALTRI) Engelmann spruce / sweetscented bedstraw

Natural Heritage Conservation Rank- G4 / S4

Environment- *Picea / Galium triflorum* is usually associated with benches and terraces bordering riparian reaches, seep areas and moist toeslopes, from the lowest forested elevations to the mid subalpine zone. In southwestern MT the observed range was from 7,400 to 8,400 ft., considerably extending the range cited (2,800-7,050 ft.) by the Montana Riparian/Wetland Association (Hansen et al. 1995). In the vicinity of the drier Tendoy Range, *Picea / Galium triflorum* has a wide elevational range, but in the Centennial Range it occurs only at lower treeline. Upslope and at higher elevations with comparable environments, it gives way to *Abies lasiocarpa / Actaea rubra*. In other words, at least in southwestern Montana, this type is present only beyond the geographical or ecological limits of *Abies lasiocarpa*. In our study area *Picea / Galium triflorum* has very limited acreage as it was noted in reconnaissance to occur only as a narrow stringer in toeslope positions or on very narrow streamside terraces. These sites are considered to receive greater than average moisture due to subsurface flow, but most sites probably would not be considered jurisdictional wetlands.

Vegetation - We have followed the naming convention of Pfister et al. (1977) and perpetuated by Hansen et al. (1995) by referring to *Picea* at the genus level recognizing that most of the Montana populations are hybrid swarms of *P. glauca* x *P. engelmannii*. Cursory observations of cone size, scale morphology and length of the free scale indicated that *P. engelmannii* characters were predominant. In the portions of this p.a. with higher moisture status *Picea* generally dominates a closed mature canopy and other age classes are poorly represented. *Pseudotsuga menziesii* and *Pinus contorta* are important seral species on the drier portion of this habitat.

Undergrowth coverage is highly variable but generally the diagnostic species *Galium triflorum*, *Actaea rubra* and *Streptopus amplexifolius* are only present, seldom even common and only approach well represented. Other moist-site species with moderate constancy are *Heracleum lanatum, Smilacina stellata, Mertensia ciliata, and Geum macrophyllum* and on disturbed sites (by cattle) *Urtica dioica*. *Thalictrum occidentale, Osmorhiza chilensis* and *Taraxacum officinale*

(on disturbed sites) often are well represented. *Ribes lacustre*, *Symphoricarpos albus* and *Rubus parviflorus* are the only shrubs consistently present, though only *S. albus* is ever well represented. Some sites support a nearly continuous layer of bryophytes, but others have only a solid layer of litter.

Soils- Alluvial and colluvial deposits are the predominant substrates, they are derived from the country rock and generally silty in texture.

Other Studies- *Picea engelmannii / Galium triflorum* was first described by Pfister et al. (1977) as occurring from central MT southward, reaching its greatest abundance in the Gallatin Nat. Forest vicinity. It is also common in northwestern Wyoming (Steele et al. 1983) and central Idaho (Steele et al. 1981) recognized here by the same suite of indicator species, though apparently pure *P. engelmannii* populations dominate these extra-MT sites.

Comments- This type is especially susceptible to livestock trampling damage early in the growing season when soils are saturated; damages include vegetation destruction and severe hummocking and weed introduction.

Element Code- CEGL000409

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Picea (engelmannii x glauca, engelmannii) / Senecio streptanthifolius Forest (PICEA / SENSTR) spruce / Rocky Mountain butterweed

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Natural Heritage Conservation Rank- G4 / S4

Environment- This is the driest of *Picea* series types identified for Montana. Within the southwestern Montana study area, as is true regarding its overall distribution, it occurs only on calcareous substrates; thus it is areally extensive only in the Tendoy and Ruby ranges, where it was sampled and noted in reconnaissance. Both ranges are also in a rainshadow further exacerbating site severity. Its elevation range was from 7,600 to 8,800 ft with generally cool aspects and steeper slopes predominating. Sites often have considerable exposed soil, gravel and rock with litter not much exceeding 40%; alternatively, some sites have bryophyte coverage exceeding 40%. Adjacent sites with yet drier regimes are within the *Pseudotsuga menziesii* or *Pinus flexilis* series or occasionally an open *Festuca idahoensis*- or *Artemisia tridentata v. tridentata*-dominated complex; moister sites occupy restricted environments within this mountain range.

Vegetation- Seral tree dominants on this association are *Pseudotsuga menziesii* and *Pinus flexilis* and here they are slow growing. *Picea* is slow to establish on these droughty sites and is equally slow growing. Severity of site is also reflected in canopy structure, which usually does not exceed 80% and often is around 40-50%, especially where natural mortality has removed canopy dominants.

The undergrowth is generally low in coverage, not exceeding 30%, even when canopy structure is quite open. Composition can be quite diverse with many of the consistently present species drawn from the adjacent grasslands, such as *Potentilla diversifolia, Townsendia montana, Astragalus miser, Synthyris pinnatifida, Antennaria microphylla, Solidago multiradiata* and *Frasera speciosa*. None of the undergrowth species assert dominance in terms of cover, even the diagnostic *Senecio streptanthifolius*. Only *Arnica cordifolia* is well represented. On steep north-facing slopes bryophyte cover may be substantial, exceeding 20%.

Soils- As noted above all examples of this type occurred on calcareous substrates, usually limestone. Limestone weathers to a silty texture but these soils have much exposed gravel and rock, in combination usually exceeding 20%.

Other Studies- This type was first identified by Pfister et al. (1977) for Montana. It has not been recognized elsewhere, though the portion of *Picea engelmannii / Arnica cordifolia,*

which occurs on calcareous substrates in the Absaroka and Owl Creek Ranges of northwestern Wyoming and supports *S. streptanthifolius*, is virtually identical.

Element Code- CEGL000414

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pinus contorta / Carex rossii Forest (PINCON / CARROI) lodgepole pine / Ross sedge

Natural Heritage Conservation Rank- G5 / SP

Environment- Within the Dillon R.A. this community is apparently restricted to peculiar parent materials, possibly hydrothermally altered volcanics. *Pinus contorta / Carex rossii* was noted as very small stands (mostly < 1 acre) at scattered, low gradient valley locations surrounded by a mosaic of *Artemisia tridentata*- and *Festuca idahoensis*-dominated shrublands/grasslands. The soils are light-colored, highly reflective, virtually without structure but well drained and have very little incorporated organic matter. We suspect these substrates, as is typical for hydrothermally altered substrates, are more acidic than those of the surrounding rangelands; the actual composition for these parent materials have not been confirmed by persons with geological expertise.

Vegetation- Tree canopies are open (40-70% cover) and dominated by *Pinus contorta* and *Pinus flexilis.* These trees were the only species noted to be reproducing. Although these sites are well within range of other conifers, seed dispersal, most particularly *Pseudotsuga menziesii*, none have been able to colonize these sites. This may be due to the unusual nature of the substrate and the fact that this environment is outside the climatic window of species associated with subalpine conditions.

The undergrowth is very sparse (combined cover not exceeding 5%) with extremely low species diversity, generally fewer than five species per 1/10 acre. *Carex rossii* is the most abundant species and, with *Carex geyeri,* the only graminoids encountered. *Penstemon aridus* was the only forb consistently present.

Soils- Except for 5-20% litter, the surface is exposed soil with little incorporated organic matter resulting in a notably light-colored and reflective surface. There is virtually no profile development and soils are well drained. Expected low pH values and perhaps peculiar micronutrient and nutrient levels strongly condition the vegetation response.

Other studies- *Pinus contorta / Carex rossii* is described as an uncommon community type from the Yellowstone region southward to the Wind River Range (Steele et al. 1983); in the Yellowstone region it supports only scattered *Pinus flexilis* (or *P. albicaulis*) and is associated with extrusive volcanics (mostly rhyolite) that weather to a coarse-textured, excessively-drained substrate, much like those that it occupies within our study area.

This plant association may require a special recognition, e.g. *Pinus contorta / Carex rossii*-hydrothermal sites, as the substrate is so unusual as to constitute a unique environment.

Element Code- CEGL000144

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudotsuga menziesii / Arnica cordifolia Forest. (PSEMEN / ARNCOR*)* Douglas-fir / heartleaf arnica

Natural Heritage Conservation Rank- G4 / S4

Environment- *Pseudotsuga menziesii / Arnica cordifolia* occupies the coolest-driest exposures supporting the *Pseudotsuga* series in southwestern Montana, on moderate to steep slopes with north- through east-facing aspects. The sampled range was 6,200 to 8,050 ft. but the upper elevational limits are expected to be somewhat greater. *Pseudotsuga menziesii /*

Arnica cordifolia is often noted to extend continuously from slope bottoms, just above toeslopes, to near ridge shoulders or to grade to *Pseudotsuga menziesii / Symphoricarpos oreophilus* on upslope positions. This type is generally set in a landscape where drier exposures are *Artemisia tridentata* or *Festuca idahoensis*-dominated rangelands, though there may be a narrow bordering fringe of open *Pseudotsuga*- or *Pinus flexilis*-dominated forest with bunchgrass undergrowth.

Vegetation- Forest canopy cover is generally greater than 60-70%, dominated by *Pseudotsuga menziesii* with minor amounts, usually less than 10% canopy cover, of *Pinus flexilis* and *Juniperus scopulorum*. Scattered, stunted individuals (termed "accidentals") of *Abies lasiocarpa* or *Picea* indicate a transition to the moister-cooler environments characterized by these species in late successional stages.

Undergrowth is normally depauperate, especially in stands approaching late seral to old-growth status. The shrub component is very sparse with only *Ribes viscosissimum* and *Symphoricarpos oreophilus* consistently represented. *Artemisia tridentata* skeletons are present in younger stands indicating these sites may pass through a seral stage dominated by this species and other rangeland components. *Poa nervosa* appears to be the most constant of graminoids but is not well represented. Forb diversity is moderately diverse with the diagnostic *Arnica cordifolia* generally well represented to abundant and *Antennaria racemosa*, *Geranium viscosissimum*, *Astragalus miser*, *Potentilla gracilis* having high constancy. Bryophyte and lichen combined cover generally exceeds 30% and runs as high as 90% plus.

Soils- All sampled stands occurred on calcareous (limestone) substrates, but this type was noted on volcanics in the course of reconnaissance. These materials weather to loams to silt loams and have little (<10%) exposed rock, gravel or soil.

Comments- Sampled stands had all been entered either for clearcutting or salvage; pressure on these stands to provide timber and fuel for the mining industry was very intense in the latter decades of 1800's and opening decades of 1900's.

Other Studies- *Pseudotsuga menziesii / Arnica cordifolia* has been identified on a variety of parent materials for central and southwestern Montana (Pfister et al. 1977) where it is considered too dry to support *Calamagrostis rubescens* or *Carex geyeri* (and their comparably named *Pseudotsuga menziesii* series plant associations). This type extends to northwestern Wyoming (Steele et al. 1983) and east central Idaho (Steele et al. 1981) where two phases are recognized.

Element Code- CEGL000427

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudotsuga menziesii / Calamagrostis rubescens Forest (PSEMEN / CALRUB) Douglas-fir / pine grass

Natural Heritage Conservation Rank- G5 / S5

Environment- *Pseudotsuga menziesii / Calamagrostis rubescens* is an uncommon type on BLM holdings, documented only from the Madison Co. vicinity on relatively warm, moist slopes at 5,900 ft upward to ridge crests. This type was not found in the Tendoy Range and noted only as fragments in the Centennial Range and vicinity, but reasons for its absence were not apparent.

Vegetation- The tree canopy is usually closed and dominated by *Pseudotsuga menziesii*; *Pinus flexilis* and *Juniperus scopulorum* may be well represented, but usually they occur just as scattered individuals. These sites are accessible and generally support only second-growth stands.

Depending on canopy density and other factors the undergrowth can range from a luxuriant

sward of Calamagrostis *rubescens* and *Carex geyeri* with associated forbs to depauperate conditions where *C. rubescens* occurs in thin patches and forbs are scarce. Forbs with high frequency and that are occasionally well represented include *Arnica cordifolia, Antennaria racemosa, Aster conspicuus,* and *Galium boreale*.

Soils- This type has been documented from both granitic and calcareous substrates with sandy and silty loams. There is little exposed soil or gravel/rock; litter and bryophytes contribute most ground cover.

Other Studies- *Pseudotsuga menziesii / Calamagrostis rubescens* is such a common and broadly distributed plant association in Montana that four phases have been recognized reflecting different geographical influences and ecological conditions. Likewise for Idaho (Steele et al. 1981), Wyoming (Steele et al. 1983), Washington (Daubenmire and Daubenmire 1968) on into southern Utah (Mauk and Henderson 1984) geographical and ecological distinctions have been recognized at the phase level of the association.

Element Code- CEGL000429

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudotsuga menziesii / Juniperus communis Forest (PSEMEN / JUNCOM) Douglas-fir / common juniper

Natural Heritage Conservation Rank- G4 / S4

Environment- This is a very minor type of small stand size on the Red Rocks Lake National Wildlife Refuge (RRLNWR). In both the Beaverhead Mountains Section and in central Montana, where is has been previously inventoried, it is one of the warmest and driest plant associations in the *Pseudotsuga* series. On the RRLNWR, this type occurred at the lower forest margin, on southerly or westerly exposures on both calcareous and volcanic substrates. RRLNWLR expressions of *the Pseudotsuga menziesii / Juniperus communis* type quite clearly differ from the type at large by lacking seral *Pinus ponderosa*. It is unknown how *Pseudotsuga menziesii / Juniperus communis* of the RRLNWLR differs from other comparably dry *Pseudotsuga* series types, such as *Pseudotsuga menziesii / Symphoricarpos albus or Pseudotsuga menziesii/ Arnica cordifolia*. All these types are considered too dry to *support Carex geyeri or Calamagrostis rubescens (or Pinus contorta*, except when acid-weathering substrates are involved)

The tree canopy is relatively open, grading to that of woodland (< 60% tree canopy cover). Short-statured *Pseudotsuga menziesii* dominates all developmental stages and *Pinus flexilis* is a minor associate, especially on calcareous substrates; the Refuge, Centennial Valley and much of southwestern MT are too cold to support *Pinus ponderosa* as a component species.

Vegetation- *Arctostaphylos uva-ursi* and *Juniperus communis* dominate the undergrowth, where *Spiraea betulifolia* is often well represented. Both the graminoid and forb layers are depauperate with the only even moderately constant species being *Festuca idahoensis, Carex rossii, Galium boreale, Smilacina racemosa* and *Astragalus miser*.

Element Code- CEGL000439

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudotsuga menziesii / Physocarpus malvaceus Forest (PSEMEN / PHYMAL) Douglas-fir / ninebark

Natural Heritage Conservation Rank- G5 / S5

Environment- *Pseudotsuga menziesii / Physocarpus malvaceus* is a common forest type of the Garnet Resource Area but is a minor type within the Dillon R.A. It is found

primarily on steep, northwest, through north, to east-facing slopes. Slopes often have a bryophyte / lichen encrusted rocky limestone substrate that verges on unstable. This type is occasionally found to extend continuously from toe-slopes or drainage bottoms up to slope shoulders. Most of this type is found below 6,000 ft., the documented occurrences being below 4,600 ft. It was noted to grade to *Pseudotsuga menziesii* /Scree of steeper, rockier positions and *Pseudotsuga menziesii* / *Symphoricarpos oreophilus* (or *S. albus*) or *Pseudotsuga menziesii* /*Calamagrostis rubescens* on warmer exposures.

Vegetation- *Pseudotsuga menziesii* dominates the mostly closed canopy from seral through old-growth stages with *Pinus ponderosa* and *Juniperus scopulorum* consistently represented, their cover generally not exceeding 20%. *P. ponderosa* persists into the old-growth stage reproducing where canopy gaps are sufficiently large.

The undergrowth is dominated by shrubs, with *Physocarpus malvaceus* and *Acer glabrum* usually being abundant and *Symphoricarpos albus, Spiraea betulifolia, Clematis occidentalis* and *Berberis repens* consistently common to well represented. *Calamagrostis rubescens* is the only graminoid with high constancy, but in southwestern MT lacks the high coverage that distinguishes a phase of this association. *Smilacina stellata* and *Aster conspicuus* have high constancy and are often abundant; *Heuchera parviflora* and *Disporum trachycarpum* are consistently present but poorly represented.

Soils- All examples of *Pseudotsuga menziesii / Physocarpus malvaceus* in southwestern Montana were noted for calcareous substrates (this is not true throughout its much broader geographic range). In degree of development, rock and gravel content and depth soils are highly variable; some steep north-facing sites verge on being scree sites but an intact, nearly continuous bryophyte layer indicates little movement (such habitat conditions also obtain in eastern Washington and northern Idaho).

Other Studies- *Pseudotsuga menziesii / Physocarpus malvaceus* is one of the plant associations recognized in the Daubenmire's (1968) pioneering work of forest classification in eastern Washington and northern Idaho. Now this plant association (or regional permutations thereof) is recognized from as far west as interior British Columbia (Braumandl and Curran 1992) and the Okanogan of Washington State (Williams and Lillybridge 1983) to as far south as northern Utah (Mauk and Henderson 1984).

Comments- Being broadly distributed, there is much floristic diversity within this type. It also manifests the phenomena of factor compensation in a remarkable fashion; in the moist climatic regime of northern Idaho its found only on warmer exposures, south-facing slopes and in the much drier regimes of central and southwestern Montana on steep northerly exposures.

Element Code- CEGL000447

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudotsuga menziesii / Spiraea betulifolia Forest
(PSEMEN / SPIBET) Douglas-fir / white spiraea

Natural Heritage Conservation Rank- G5 / S4

Environment- *Pseudotsuga menziesii / Spiraea betulifolia* is cited as a minor type in Montana (Pfister et al. 1977) and northwestern Wyoming (Steele et al. 1983) but on the northern flank of the Centennial Range it is an important type. It is found along with *Pseudotsuga menziesii* / *Calamagrostis rubescens*, at lower timberline and generally on other than north-facing slopes. If one uses the approach of Steele (et al. 1983) who recognizes the indicator importance of *S. betulifolia* (well-represented) to be greater than that of *Calamagrostis rubescens*, then many of the warmer, calcareous exposures at lower elevations (<7,000 ft.) would be identified as

either the *Calamagrostis rubescens* or *Spiraea betulifolia* phases of *Pseudotsuga menziesii / Spiraea betulifolia*. (We have followed the Montana approach that treats stands with *C. rubescens* or *Carex geyeri* dominance as members of the *Calamagrostis rubescens* type.) Often *Pseudotsuga menziesii / Spiraea betulifolia* borders on valley locations or parks of *Festuca idahoensis*- or *Artemisia tridentata* ssp. *vaseyana*-dominated grasslands/ shrublands. North-facing slopes adjoining the valley are sometimes sufficiently moist to support the *Picea engelmannii* or *Abies lasiocarpa* series.

Vegetation- The tree stratum is usually dominated by *P. menziesii* with a minor component of *Pinus flexilis*, especially on calcareous substrates; or *Populus tremuloides* at the lower fringes of the type; or *P. menziesii* mixed with *Pinus contorta* on volcanic substrates. *Spiraea betulifolia* is a major component as a low shrub layer that sometimes includes high coverage of *Pachistima myrsinites* and *Berberis repens* and the presence of *Amelanchier alnifolia* (heavily browsed) and *Symphoricarpos oreophilus*. *Arnica cordifolia, Aster conspicuus, Aster engelmannii, Antennaria racemosa, Fragaria virginiana* and *Osmorhiza chilensis* comprise the forbs that are most predictably represented. In the modal expression of this type the graminoid component is minimal with only *C. rubescens, C. geyeri*, and *Poa nervosa* consistently present.

Element Code- CEGL000457

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudotsuga menziesii / Symphoricarpos oreophilus Forest (PSEMEN / SYMORE) Douglas-fir / mountain snowberry

Natural Heritage Conservation Rank- - G5 / S3

Environment- *Pseudotsuga menziesii / Symphoricarpos oreophilus* occupies cooler exposures, moderate to steep slopes with northwest- through southeast-facing aspects. The sampled range was 6,200 to 8,050 ft. but the upper elevation limits are expected to be somewhat greater; it often was noted to extend continuously from midslope to near ridge shoulders. This type is generally set in a landscape where drier exposures are *Artemisia tridentata* or *Festuca idahoensis*-dominated rangelands though there may be a narrow bordering fringe of open *Pseudotsuga*- or *Pinus flexilis*-dominated forest with bunchgrass undergrowth.

Vegetation- *Pseudotsuga menziesii* dominates a closed tree stratum wherein *Pinus flexilis* and *Juniperus scopulorum* are consistently present, usually not exceeding 20% cover. All the stands we sampled had been entered at some time in the past for clearcutting or salvage logging. Abundant skeletons of *Artemisia tridentata* in younger stands indicate a seral stage probably dominated by this and other rangeland species.

Undergrowth tends to be depauperate in number of species and coverage with no set pattern of dominance; we noted shrubs or graminoids or forbs could be dominant. *Symphoricarpos* is 100 % constant but seldom even well represented; other highly constant shrubs include *Ribes cereum* and *Juniperus communis*. *Festuca occidentalis* and *Poa pratensis* and *P. nervosa* are consistently present, sometimes well represented. *Arnica cordifolia, Solidago multiradiata, Astragalus miser* and *Phlox multiflora* have a high constancy and are occasionally well represented. Bryophyte and lichen cover varies widely from 30% plus to virtually none, the variability ostensibly based on time since the last disturbance.

Soils- *Pseudotsuga menziesii / Symphoricarpos oreophilus* was found only on calcareous substrates. Almost invariably these substrates weather to silt loams or loams. Surfaces have less than 5% exposed gravel, rock and soil (combined); they are covered with litter or bryophytes/lichens.

Other Studies- *Pseudotsuga menziesii / Symphoricarpos oreophilus* is very broadly distributed, ranging from east of the Cascades to northeastern Washington (Williams and Lillybridge 1983, 1985) and south to Blue Mountains of Oregon (Johnson and Simon 1987). It experiences a large distribution gap in northern Idaho and western Montana but then in the expansive calcareous substrates of southwestern Montana it resurges in importance. This type is known from central Idaho (Steele et al. 1981), western Wyoming (Steele et al. 1983) and Colorado (Johnson 1987) to southern Utah (Youngblood and Mauk 1985) and northern New Mexico (Muldavin 1994). It is found on other than calcareous substrates in regions outside southwestern Montana.

Element Code- CEGL000462

Edition / Author- 99-11-16 / S.V. Cooper.

Needle-leaved Evergreen Woodlands

Abies lasiocarpa / Juniperus communis Woodland
(ABILAS / JUNCOM) subalpine fir / common juniper

Natural Heritage Conservation Rank- G4G5 / S3

Environment- This is a very common plant association, identified from the drier mountain ranges of eastern Oregon and Washington, eastward into Montana and Wyoming and south as far as New Mexico and Arizona. Within the context of the relatively mesic, generally north-facing flank of the Centennial Range, *Abies lasiocarpa / Juniperus communis* represents habitats experiencing greater moisture stress than other common *A. lasiocarpa* types having either western meadowrue *(Thalictrum occidentale),* pinegrass (*Calamagrostis rubescens*) or shiny-leaf spiraea *(Spiraea betulifolia)* as the diagnostic species. On Sheep Mountain RNA, *Abies lasiocarpa / Juniperus communis* was encountered on warmer exposures (those with a westerly component), and above 7,800 ft., though it is capable of occurring at much lower elevations. It generally grades to *Abies lasiocarpa / Ribes montigenum* (mountain gooseberry), or to *Abies lasiocarpa / Thalictrum occidentale* and *Abies lasiocarpa* / *Arnica cordifolia* of moister environments.

Being a woodland, tree canopy cover is generally below 60% and tree form approaches "stunted" with heights barely exceeding 40 feet at more than 350 years of age. *Picea engelmannii* (Engelmann spruce) and *Abies lasiocarpa* are present mostly in the sapling/ seedling layer, though scattered mature and old-growth *Picea engelmannii* are typically present as well. This association is at the dry extreme of *Abies lasiocarpa* distribution and this species probably will never achieve canopy dominance. The canopy dominant in most of these stands is *Pseudotsuga menziesii* (Douglas-fir), though *Pinus flexilis* (limber pine) is a major component in patches.

Vegetation- *Juniperus communis* (common juniper*)* dominates the undergrowth, its cover generally exceeding 10%. The graminoid element is especially depauperate with only traces of *Poa reflexa* (nodding bluegrass) and *Carex rossii (*Ross sedge). *Aster conspicuus* (showy aster) is the only forb consistently occurring well represented; *A. conspicuus*, *Potentilla gracilis* (slender cinquefoil), and *Sedum lanceolatum (*lanceleaved stonecrop) were noted as the prevalent forbs consistently present throughout these drier woodland environments.

Element Code- CEGL000919

Edition / Author- 99-11-16 / S.V. Cooper.

Cercocarpus ledifolius / Festuca idahoensis Woodland
(CERLED / FESIDA) curl-leaf mountain mahogany / Idaho fescue

Natural Heritage Conservation Rank- G3 / S2

Environment- The only documented occurrence for southwestern Montana is on steep residual mountain slopes at elevations around 6000 feet. The total cover of soil, gravel, and rock usually exceeds 40% and the soil surface is stable with no evidence of accelerated erosion. Parent materials are granitic and soils are Ustorthents and are moderately deep and very cobbly. Textures vary from loamy sands to sandy loams. The soils are non-calcareous and their available water holding capacities are low due to the coarse soil textures and abundant coarse fragments. This association can be expected on other, especially calcareous, parent materials.

Adjacent Communities- The *Cercocarpus ledifolius / Festuca idahoensis* and *C. ledifolius / Pseudoroegneria spicata* types are ecologically similar and intergrade. Of the two types, *C. ledifolius / Pseudoroegneria spicata occurs* in slightly more xeric situations. The *Pseudotsuga menziesii / F. idahoensis* type may be found on adjacent more mesic sites that are less rocky and have deeper soils.

Vegetation- *Cercocarpus ledifolius* and *Pseudoroegneria spicata are* abundant. *Festuca idahoensis* cover generally exceeds 5%. Other species that are generally present with cover exceeding 1% include *Artemisia frigida, A. tridentata, Opuntia polyacantha*, and *Poa sandbergii*. *Bromus tectorum* may be abundant where surface disturbance has occurred through grazing.

Other Studies- This type has been previously described from northeastern Oregon (Johnson and Simon 1987) and central Idaho (Schlatterer 1972).

Element Code- CEGL000962

Edition / Author- 99-11-16 / S.V. Cooper.

Juniperus scopulorum / Artemisia tridentata Woodland (JUNSCO / ARTTRI) Rocky Mountain juniper / big sagebrush

Natural Heritage Conservation Rank- G2Q / S2?

Environment- The type occurs on plateaus and residual mountain slopes at elevations between 5500 and 6000 feet. The total covers of soil, gravel, and rock averages 70%. The soil surface is sometimes unstable because of a lack of adequate vegetation cover.

Soils are generally shallow or very shallow (i.e., lithic) and are derived from igneous or sedimentary parent materials and feature strong to violent effervescence. Textures vary from sandy loams to silt loams and are gravelly to very gravelly. Available water holding capacity varies from low to medium.

Vegetation- *Juniperus scopulorum* is the only tree species present. Species exceeding 5% cover in the undergrowth include *Artemisia tridentata, Opuntia polyacantha, Pseudoroegneria spicata, Aristida longiseta, Bouteloua gracilis, Oryzopsis hymenoides*, and *Stipa comata*.

Adjacent Communities- The *Artemisia tridentata / Pseudoroegneria spicata* community type often occurs on adjacent less rocky sites with deeper soils. More xeric (or at least rockier) sites with similar soils feature the *Juniperus scopulorum / Cercocarpus ledifolius* community type.

Other Studies- This type has not been previously described but has been reported as a possible type in Colorado and Wyoming (Bourgeron and Engelking 1994).

Element Code- CEGL000743

Edition / Author- 99-11-16 / S.V. Cooper

Juniperus scopulorum / Cercocarpus ledifolius Woodland (JUNSCO / CERLED) Rocky Mountain juniper / mountain mahogany

Natural Heritage Conservation Rank- G3? / S3?

Environment- This type occurs predominantly on steep dip slopes and residual mountain

slopes at elevations between 5500 and 6500 feet. The total cover of soil, gravel, and rock usually exceeds 50% and the soil surface is often unstable because of a lack of adequate vegetation cover

Vegetation- *Juniperus scopulorum* is the only tree species present. Abundant *Cercocarpus ledifolius* characterizes the undergrowth. Other species that are generally present with cover exceeding 1% include *Artemisia frigida, Opuntia polyacantha, Pseudoroegneria spicata,* and *Oryzopsis hymenoides*.

Soils- Parent materials are predominantly quartzite or limestone and soils are generally Orthents and are shallow (lithic) and gravelly to very stony. Textures vary from loamy sands to loams. Most of the soils exhibit strong and/ or violent effervescence. Available water holding capacity is mostly low due to the coarse soil textures, abundant coarse fragments, and shallow depth.

Adjacent Communities- The *Juniperus scopulorum / Cercocarpus ledifolius* and *C. ledifolius / Pseudoroegneria spicata types* are ecologically similar and intergrade. Of the two types, *J. scopulorum /C. ledifolius* occurs in slightly more mesic situations. The *J. scopulorum / Artemisia tridentata* and *A. tridentata / Pseudoroegneria spicata types* adjoin *J. scopulorum / Cercocarpus ledifolius* on drier sites. The *Pseudoroegneria spicata / Bouteloua gracilis* type is often found on adjacent less rocky and less steep sites.

Other Studies- This type has been described only for Montana (Chaffee 1981).

Element Code- CEGL000744

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Juniperus scopulorum / Pseudoroegneria spicata Woodland
(JUNSCO / AGRSPI) rocky mountain juniper / bluebunch wheatgrass

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Natural Heritage Conservation Rank- G4 / S4

Environment: In eastern Montana this community type is commonly found in low to moderate relief rolling uplands as well as in badland arroyos/draws, often occurring adjacent to *Juniperus scopulorum* / *Oryzopsis hymenoides* but on warmer exposures (not strictly north-facing) with the same moderate to steep slopes. In eastern MT three of the four sampled stands were on calcareous substrates, though this h.t. is not confined to these substrates in this region. It has also been recorded for the BVHDMS occurring on rocky, primarily volcanic substrates with thin soils; substrate conditions here appear to be the determining factors in its occurrence. It is primarily associated with lower treeline positions and slope and aspect are only weak determining factors. In eastern MT., *Juniperus scopulorum / Pseudoroegneria spicata* also has more exposed soil and rock (often exceeding 50%) than the associated *Juniperus scopulorum* / *Oryzopsis hymenoides*, . The same situation often obtains in western MT where bare soil and exposed rock usually constitute 60% plus of the substrate and litter is never more than 20% and adjacent shrubland types often have more developed, deeper soils.

Vegetation: As a result of the ubiquitous past cutting for fencing, stands of *Juniperus scopulorum / Pseudoroegneria spicata* in eastern MT are rather open, with coverage of 8 to 12 ft tall *Juniperus scopulorum* not exceeding 50%; in BVHDMS the tree canopy are also quite open (at most approaching 30% canopy cover). We speculate tree coverage does not much exceed these figures due to limitations of site factors. The higher coverage of shrubs (up to 20 % for *Artemisia tridentata* and *A. frigida* combined) that are reported in northeastern MT as opposed to southeastern Montana (Hansen and Hoffman 1988) is also attributable to seral conditions. In BVHDMS *A. tridentata ssp. vaseyana and ssp. wyomingensis, A. frigida, Chrysothamnus nauseosus,* and *C. viscidiflorus* have the highest constancy but comprise less than 5% cover in the aggregate. The undergrowth is dominated by graminoids, chief among which and diagnostic of the type is *Pseudoroegneria*

spicata, always well represented (40% ave. cover in eastern MT only 10% on the BVHDMS). *Carex filifolia* and *Koeleria cristata* have high constancy and *Bouteloua curtipendula* is consistently present in the easternmost occurrences of this type. Forb diversity is moderately high and higher in western than eastern MT with not much overlap in high constancy species between regions; regardless of location, forb coverage's are generally low, not exceeding 10% except in the most open stands.

Other Studies: In a study centered on southeastern Montana, Hansen and Hoffman (1988) have best documented this type and Brown (1971) has also described it for badland landforms in the Ashland District, Custer National Forest. This association has been described as relatively common in Wyoming and extends as far south as Colorado.

Element Code- CEGL000748

Edition / Author- 99-12-03 / S.V. Cooper, MTNHP

Pinus albicaulis - Abies lasiocarpa Woodland [Provisional] (PINALB – ABILAS) whitebark pine - subalpine fir

Natural Heritage Conservation Rank- G5? / S5

Environment- The type occurs on glaciated mountain ridges and upper slopes at elevations above 8900 feet. The total cover of soil, gravel, and rock exceeds 50%. The soil surface is often unstable because of a lack of adequate vegetation cover.

Vegetation- *Pinus albicaulis*, *Abies lasiocarpa*, *Picea engelmannii*, and occasionally *Pseudotsuga menziesii* occur in varying amounts in the often open, stunted, and wind-deformed tree layer. The undergrowth is highly variable in composition and few individual species ever exceed 5% cover.

Adjacent Communities- This type occurs at, or near, upper timberline. It is often bordered below by the *Abies lasiocarpa - Pinus albicaulis / Vaccinium scoparium* type and above by alpine scrub. Unvegetated talus slopes sometimes interfinger with this type.

Soils- Soils are typically gravelly to very gravelly, feature a cryic temperature regime, and may be strongly to violently effervescent. Textures are sandy loams to loams. Soil depth is shallow to moderately deep. Available water holding capacity varies from low to medium.

Other Studies- This type has been described only in Montana, where it is quite common (Pfister et al. 1977).

Comments- *Pinus albicaulis - Abies lasiocarpa*, is actually a syntaxonomic unit above the plant association level because considerable undergrowth variation is accommodated within it as originally described. Pfister et al (1977) did not choose to decompose this unit on the basis of various undergrowth assemblages because it encompasses environments with very low production and similar management implications.

Element Code- CEGL000128

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pinus albicaulis / Festuca idahoensis Woodland (PINALB / FESIDA) whitebark pine / Idaho fescue

Natural Heritage Conservation Rank- G4 / S4

Environment- The *Pinus albicaulis / Festuca idahoensis woodland* association is a minor type recorded from the highest forested elevations, generally above 8,600 ft., of the Centennial and Tendoy Ranges on wind-swept ridgelines and west and southwest-facing slopes; this association is expected in other dry southwestern Montana Ranges. Ostensibly drier sites are *Festuca idahoensis*- or *Artemisia*

tridentata var. *vaseyana*-dominated; on moister or less stressful exposures are found *Abies lasiocarpa* / *Ribes montigenum, Abies lasiocarpa* / *Arnica cordifolia* and *Picea* / *Senecio streptanthifolius*.

Vegetation- *Pinus albicaulis* dominates an open canopy generally not exceeding 60% coverage. Scattered *Pinus contorta* and stunted *Picea* or *Abies lasiocarpa* may be present; ring counts or these species taken in the most open portion of these stands indicated ages of 40 to 105 years for trees not exceeding 6 ft, thus indicating lack of potential to establish dominance from stand opening treatments. Undergrowth in undisturbed stands of this type is dominated by *Festuca idahoensis,* but in the Centennials and Tendoys sheep grazing has led to reduction of the forb component and the introduction of *Poa pratensis*, which has become well represented in some stands. *Trisetum spicatum* and *Poa nervosa* are consistently present though coverages are seldom even common. Forbs consistently present include *Antennaria microphylla, Solidago multiradiata* and *Astragalus miser*.

Soil- *Pinus albicaulis / Festuca idahoensis* was noted to occur on both calcareous and extrusive volcanics which weather to silt loam and loam textures. Exposed substrate is commonly less than 10% and litter is usually 80% plus and relatively deep (1 inch plus).

Other Studies- This is a minor to incidental type from southern Montana and northwestern Wyoming (Steele et al. 1983) and east central Idaho (Steele et al. 1981) and is not reported elsewhere.

Element Code- CEGL000755

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pinus flexilis / Cercocarpus ledifolius Woodland (PINFLE / CERLED) limber pine / curlleaf mountain mahogany

Natural Heritage Conservation Rank- G3G4 / S3

Environment- *Pinus flexilis / Cercocarpus ledifolius* has been sampled only in the Limestone Hills vicinity, in the proximity of the Elkhorn Range but has been noted in reconnaissance in the Tendoy and Greenhorn ranges. In both areas *Pinus flexilis / Cercocarpus ledifolius* is associated with moderate to steep slopes with west- to south-facing aspects and calcareous substrates. In the Tendoys it occurs as a narrow fringe, rather ecotonal, between the drier (or at least less rocky) *Artemisia tridentata* and *Festuca idahoensis*-dominated rangelands and pure *Cercocarpus ledifolius* stand and on moister sites open to closed forests of the and *Pseudotsuga menziesii* series.

Vegetation- Tree canopies are very open with scattered *Pinus flexilis* and *Pseudotsuga menziesii* and, in younger stands, well represented *Juniperus scopulorum*. The shrub stratum is dominated by well represented to abundant *Cercocarpus ledifolius; Artemisia frigida* and *Gutierrezia sarothrae* are consistently present but poorly represented. *Pseudoroegneria spicata* and *Oryzopsis hymenoides* (or *O. micrantha*) and , only in extreme southwestern Montana, *Festuca kingii* are the dominant graminoids; their cover varies widely but never was noted to exceed 10-15%. Forbs diversity may be appreciable but cover seldom exceeds trace amounts, with the exception of *Cymopterus bipinnatus* and *Petrophytum caespitosum*.

Soils- *Pinus flexilis / Cercocarpus ledifolius* has been documented only from calcareous substrates in Montana, sites with shallow soils and rock and gravel exposure usually exceeding 30%. Soils are silt loams but the gravel content severely diminishes their water holding capacity but may facilitate its deep percolation to leves tapped by deep rooted shrubs and trees.

Other Studies- This minor type was first recorded for Montana in a preliminary report (DeVelice 1992) regarding southwestern counties and it is very similar to *Pseudotsuga menziesii* / *Cercocarpus ledifolius* described

for the Pryor Mountains (DeVelice and Lesica 1993). This association extends as an incidental type to northwestern Wyoming (Steele et al. 1983) and eastern central Idaho (Steele et al. 1981) but further to the south in northern Utah it is more extensive (Mauk and Henderson 1984).

Element Code- CEGL000804

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Pinus flexilis / Festuca idahoensis Woodland (PINFLE / FESIDA) limber pine / Idaho fescue

Natural Heritage Conservation Rank- G5 / S5

Environment- *Pinus flexilis / Festuca idahoensis* is commonly found on west- to south-facing aspects of moderate to steep slopes often associated with upper slope, wind-exposed conditions. The observed elevation range was 7,500 to 8,800 ft., though in fact it is probably greater. Adjacent drier sites support *Festuca idahoensis* and *Artemisia tridentata* var. *vaseyana*-dominated rangeland communities; it grades to *Pseudotsuga menziesii* series sites of moister habitats at lower elevations and to *Picea* series sites at upper elevations.

Vegetation- Widely spaced *Pinus flexilis* dominate the upper statum in these open, savanna-like all-aged appearing stands (at least stands not readily accessible to tree harvesting) wherein total canopy cover usually does not exceed 60%. *Pseudotsuga menziesii* may be well represented or even co-dominant , but size-class distributions indicate *P. flexilis* will continue to be at least a co-dominant component. *Juniperus scopulorum* may be well represented as a long-persisting seral species. Scattered, old (>250 yrs.) fire-scarred individuals (both *P. menziesii* and *P. flexilis*) with multiple fire-scars may be present indicating a past history of ground-fires or fires creating a mosaic of age classes.

Undergrowth is dominated by bunchgrasses with *Festuca idahoensis* common indicating habitats more moist than those supporting just *Pseudoroegneria spicata* or *Hesperochloa kingii* as dominants. In extreme southwestern Montana *H. kingii* is a conspicuous, occasionally dominant, component. Forb diversity is often high with *Phlox hoodii, Machaeranthera canescens, Astragalus miser, Senecio canus* and *Linum perenne* being consistently represented. Shrubs commonly found scattered in canopy openings are *Juniperus communis, Artemisia tridentata* var. *vaseyana*, *Ribes cereum* and *Chrysothamnus nauseosus*.

Soils- All stands sampled and noted in reconnaissance were developed on calcareous substrates having much, usually 20% plus, exposed soil and gravel/rock; these substrates have weathered to silt loam textures.

Other Studies- *Pinus flexilis / Festuca idahoensis* is a major plant association of calcareous substrates along the Rocky Mountain Front and ranges of central Montana (Pfister et al. 1977) and continues as a notable component to south-central and southwest Montana and extends as a minor type to east-central Idaho (Steele et al. 1981) and northwestern Wyoming in the rainshadow of the Absaroka Range and the very dry Owl Creek Range (Steele et al. 1983).

Comments- Intensive cattle grazing in this type can virtually eliminate the bunchgrass component, or at least reduce the cover of *F. idahoensis* and *Pseudoroegneria spicata* to the point where site potential is not discernable; the fact that grass cover potentially is considerably less than that of open rangelands does not seem to lessen the degree of impact.

Element Code- CEGL000805

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Pinus flexilis / Juniperus communis Woodland (PINFLE / JUNCOM) limber pine / common juniper

Natural Heritage Conservation Rank- G5 / S4

Environment- Within the study area, this minor type was sampled at 5,800 ft. on calcareous substrates with moderate exposures. It was not encountered in reconnaissance further south than the Dewey, MT vicinity (it is common along the Rocky Mountain Front to the north). Drier sites are occupied by *Cercocarpus ledifolius*/*Pseudoroegneria spicata* and moister ones by the *Pseudotsuga menziesii* series.

Vegetation- The one plot is typical for the type at large as described by Pfister et al. (1977) with *Pinus flexilis* dominating the canopy and *Pseudotsuga menziesii* and *Juniperus scopulorum* as subordinate species, but with population structure indicating *Pseudotsuga* would not outcompete *P. flexilis* in the long term.

The undergrowth is dominated by the trailing shrub *Arctostaphylos uva-ursi* and *Juniperus communis*. Under appreciable grazing pressure the highly palatable bunchgrass *Pseudoroegneria spicata* was present as mostly consumed scattered clumps. The lack of *Festuca idahoensis* may be attributable to grazing pressure as it is common in the general vicinity. *Astragalus miser* is the dominant forb as it is in most occurrences of this association.

Soils- Sampled substrates were calcareous sandstones and weathered to silty sands with approximately 20% exposed gravel and rock. With high shrub cover the litter cover was comparably high.

Other Studies- *Pinus flexilis / Juniperus communis* is found as far west as the Blue Mountains of Oregon (Cole 1982) and Lost River and Lemhi Ranges of Idaho (Steele et al. 1981) where it is an incidental type and increases in importance to the east where it's extensive along the Rocky Mountain Front of Montana (Pfister et al. 1977) and Wyoming (Steele et al. 1983). In southeastern Wyoming (Alexander et al. 1986) and northwestern Colorado (Johnson 1987) it's extent is again reduced relative to its representation in Montana.

Element Code- CEGL000807

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Pinus flexilis / Pseudoroegneria spicata Woodland (PINFLE / PSESPI) limber pine / bluebunch wheatgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- *Pinus flexilis / Pseudoroegneria spicata* is found on the driest exposures capable of supporting trees, steep southeast- through southwest-facing slopes. The noted study area elevation range was from 5,500 to 7,600 ft. but this association could occur at higher elevations. This type is usually found in a mosaic of grassland/shrubland on deeper soils with adjacent forest types being *Pseudotsuga menziesii* / *Cercocarpus ledifolius*, *Pseudotsuga menziesii* / *Juniperus communis* and *Pinus flexilis / Juniperus communis* on rockier sites.

Vegetation- Widely spaced *Pinus flexilis* usually dominates the canopy, often in conjunction with *Juniperus scopulorum* and *Pseudotsuga menziesii*; in early seral stands *J. scopulorum* can have greater cover than other tree species, but in the aggregate the visual expression is that of a very open forest or savanna.

Undergrowth cover is intrinsically low and with cattle grazing may look especially depauperate. *Pseudoroegneria spicata* well represented is diagnostic for the type; usually it is the dominant herb but in the southwestern extreme *Festuca kingii* may be a co-dominant

or even dominant with cattle grazing preferentially removing *Pseudoroegneria spicata*. Contribution of herbs from contiguous grasslands, e.g. *Oryzopsis hymenoides, Koeleria cristata, Phlox hoodii, Senecio canus, Liatris punctata, Draba* spp., *Oxytropis* spp. and *Linum perenne*, often produce a species-rich undergrowth. Combined shrub cover seldom exceeds 5% with *Artemisia frigida, A. tridentata, Gutierrezia sarothrae, Ribes cereum* and *Symphoricarpos oreophilus* being the most commonly represented.

Soils- This type was noted only on calcareous substrates, both sandstone and limestone, with exposed surfaces of soil, gravel and rock often exceeding 60%.; from the descriptions of others there is reason to expect this type on other than calcareous parent materials.

Other Studies- This type is found all along the Rocky Mountain Front and scattered ranges of central (Pfister et al. 1977) as well as southwestern Montana (DeVelice 1992). This type is not identified for contiguous states to the south because the cline of increasing *Festuca kingii* toward the south causes these *Pinus flexilis* -dominated stands with *Pseudoroegneria spicata* to be termed *Pinus flexilis* / *Festuca kingii* (see Steele et al. 1981, 1983); *Pinus flexilis* / *Festuca kingii* extends to the Medicine Bow Range of southeastern Wyoming (Alexander et al. 1986).

Element Code- CEGL000813

Edition / Author- 99-11-16 / S.V.Cooper.

Pseudotsuga menziesii / Cercocarpus ledifolius Woodland (PSEMEN / CERLED) Douglas-fir / curlleaf mountain mahogany

Natural Heritage Conservation Rank- G4? / S?

Environment- *Pseudotsuga menziesii / Cercocarpus ledifolius* is restricted to dry, often steep (>40%) upper slopes and ridges with south- to west-facing aspects. Sites mostly have shallow soils and much (>30%) exposed substrate that often approaches scree in lack of stability. Sampled elevation range was 5,800 to 6,600 ft, though its noted range included higher elevations. *Pseudotsuga menziesii / Symphoricarpos oreophilus* occurs on relatively more mesic, or less rocky sites and *Cercocarpus ledifolius / Pseudoroegneria spicata* is also part of what is often a fairly fine-scaled mosaic of forest/tall shrub communities.

Vegetation- Canopy structure is usually quite open, savanna-like with total combined cover of *Pseudotsuga menziesii* and *Juniperus scopulorum*, the only tree species present, not exceeding 50% and often as little as 5%. *Pinus flexilis* was not recorded where substrates are crystalline (Silverbow Co.) but was noted in reconnaissance of calcareous substrates (Beaverhead Co.).

Shrub cover, the two principal ones of which are *Cercocarpus ledifolius* and *Artemisia tridentata*, is at least as variable as the tree cover but seldom exceeds 50%. *Artemisia frigida* and *Chrysothamnus nauseosus* have high constancy and scarce coverage. The herb component is poorly represented and only *Pseudoroegneria spicata*, *Poa sandbergii* and *Lappula redowskii* have greater than 50% constancy. Combined bryophyte and lichen cover ranged as high as 40%, but usually they are merely traces.

Soils- All sampled stands occurred on coarse-textured soils derived from granitic parent materials and had as much as 90% exposed gravel and rock; deep percolation of precipitation subsequently tappable by trees and shrubs is the factor assumed to favor these lifeforms on these sites.

Other Studies- DeVelice and Lesica (1993) have *described Pseudotsuga menziesii / Cercocarpus ledifolius* for the Pryor Mountains and vicinity. It extends from the study area into east-central Idaho (Steele et al.1981) and southeastern Idaho and southwestern Wyoming (Steele et al. 1983), where it is found on a variety of substrates, and

is documented as far south as southern Utah (Youngblood and Mauk 1985).
Element Code- CEGL000897

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Pseudotsuga menziesii / Festuca idahoensis Woodland (PSEMEN / FESIDA) Douglas-fir / Idaho fescue

Natural Heritage Conservation Rank- G4 / S4

Environment- *Pseudotsuga menziesii / Festuca idahoensis* is a dry site type but was found on all aspects depending on local precipitation patterns; in rainshadow positions it is found on north-facing aspects whereas in main mountain masses it is associated with steep, west- to south-facing slopes. The observed elevation range was 6,600 to 7,800 ft., but there is no reason it could not be found beyond both of these extremes. It grades to *Pseudotsuga menziesii* / *Pseudoroegneria spicata* or *Artemisia tridentata* var. *vaseyana*- or *Festuca idahoensis*-dominated rangelands on drier aspects or more densely forested *Pseudotsuga*-dominated community types of moister exposures.

Vegetation- *Pseudotsuga menziesii* dominates the canopy and all size classes including reproduction, whereas *Pinus flexilis* and *Juniperus scopulorum* are reduced to minor components (cover < 10%) of the canopy and reproduce only in larger canopy gaps. Stands with warmer exposures tend to be more open (< 60 % cover) than those of cooler northerly slopes (approaching 90% canopy cover).

Artemisia tridentata var. *vaseyana* and *Chrysothamnus viscidiflorus* are present as scattered individuals and many skeletons of *A. tridentata* may be present in younger stands indicating this type passes through an *A. tridentata*-dominated seral stage. Herbaceous components are those of the adjacent grasslands, but with reduced cover. *Festuca idahoensis* is the dominant graminoid except were grazing pressure is intensive, then *Poa sandbergii*, *Koeleria cristata* or *Festuca kingii* (only in the southwestern extreme) become dominant. *Astragalus miser* and *Antennaria microphylla* are common, occasionally abundant , forbs. Lichen and bryophyte cover varies widely, but apparently is related to stand age (or history) being higher in older, more dense ones..

Soils- Parent materials include both crystalline and calcareous substrates and generally there is less than 20% exposed substrate, most of which is soil. The relatively high content of woody debris is mostly from sagebrush skeletons or toppled-over old wolf trees.

Other Studies- The *Pseudotsuga menziesii / Festuca idahoensis* p.a. has a broad geographic distribution, from east of the Cascades in Washington (Williams and Lillybridge 1983) and British Columbia (McLean 1970) to northwestern Colorado (Bourgeron and Engelking 1994), but has its greatest areal extent along the Rocky Mountain Front and isolated ranges of central Montana (Pfister et al. 1977).

Element Code- CEGL000900

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Pseudotsuga menziesii / Scree Woodland (PSEMEN / SCREE) Douglas-fir / scree

Natural Heritage Conservation Rank- G5 / S4

Environment- *Pseudotsuga menziesii* / Scree is a widespread plant association in Montana previously recognized by the simple designation of “Scree” without dominant overstory identified. This association is distinguished by its unique substrate, unstable, generally steep slopes; potentially this type can be found on slopes of any aspect or angle of repose providing they are unstable, but as sampled and noted it occurs on those with any aspect, but greater than 50% slope. All sampled

conditions and the most extensive stands (on quartzite) were in Granite Co. but this type was noted for the Tendoy and Centennial Ranges as limited linear patches on substrates of various origin. The sampled elevation range was 4,400 to 5,400 ft. but it has been noted over a much wider range; potentially it is coextensive with the distribution of Pseudotsuga.

Vegetation- Due to existing severe site conditions trees are usually widely spaced and slow growth with a wolfy form; combined canopy cover ranged from 20 to 70%, dominated by *Pseudotsuga menziesii* but with *Juniperus scopulorum* and *Pinus ponderosa* well represented on lower elevation sites. The combination of unstable substrates, low undergrowth productivity and widely spaced trees has resulted in a high proportion of these stands developing into old-growth, with *Pseudotsuga* 2-3 ft. in diameter.
The undergrowth is depauperate, in both diversity and cover, in the graminoid and forb components with only *Pseudoroegneria spicata*, Heuchera parviflora and *Phacelia hastata* having high constancy. Shrubs take advantage of their deep rooting habit to become by far, the undergrowth component with the greatest coverage (and highest diversity); *Acer glabrum* consistently dominated this layer with *Ribes cereum*, *Amelanchier alnifolia*, and *Symphoricarpos oreophilus* (*S. albus* to the northwest of area) consistently present, occasionally well represented.

Soils- The unstable nature of these substrates is their distinguishing character; parent material includes calcareous and non-calcareous sedimentary as well as crystalline materials. The combined exposure of soil, gravel and rock usually exceeds 50% and runs as high as 90% with litter the only other important component. Usually even the litter and bryophyte components are underlain by coarse fragments. Soil development is minimal with no horizonation evident.

Other Studies- For Montana and Idaho this type was first described under the broader designation “Scree” (Pfister et al. 1977, Cooper et al. 1987) but this syntaxon included enormous variation as it included all tree series. Pseudotsuga menziesii/scree has been formally described only for southern Colorado and northern New Mexico (DeVelice et al. 1986, Fitzhugh et al. 1987) largely because other regional forest classifications (e.g. Steele et al. 1983, Youngblood and Mauk 1985) have been biased toward commercial forests, which Pseudotsuga menziesii / scree is clearly not. Using a key based on vegetation alone these sites would key to *Pseudotsuga menziesii / Acer glabrum* (Steele et al. 1983) which is a very different, highly productive association of central and northern Idaho.

Element Code- CEGL000911

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Montane or Boreal Cold-deciduous Forest

Populus balsamifera ssp. trichocarpa / Poa pratensis Forest
(POPBST / POAPRA) black cottonwood / Kentucky bluegrass

Natural Heritage Conservation Rank- G? / S?

Environment- *Populus balsamifera ssp. trichocarpa / Poa pratensis* is cited by Hansen et al. (1995) to be a major forested riparian type of western Montana; it is uncommon within the study area being found on alluvial terraces of major steams and rivers as well as bordering ponds and lakes. The type as defined by Hansen et al. is a default class within the *Populus balsamifera ssp. trichocarpa* series and thus very inclusive of both environmental and vegetation variation. This type incorporates sites subjected to periodic disturbances such as flooding and erosion/deposition. Intensive grazing further adds to site heterogeneity and can also result in solid swards of introduced, rhizomatous grasses (eventually to weed-choked terraces). Upslope these sites usually abruptly give way

to *Artemisia tridentata* var. *vaseyana* or t*ridentata* dominated shrub steppe.
Vegetation- This type has a simple two layer structure of mostly open *Populus balsamifera ssp.trichocarpa* over a sward of introduced rhizomatous grasses, *Poa pratensis* and *Phleum pratense* and the rhizomatous-appearing *Poa palustris*. Other commonly occurring grasses include *Bromus inermis, Carex praegracilis, C. utriculata* and *Phalaris arundinacea*. *Solidago gigantea, Smilacina stellata, Thermopsis montana* and *Taraxacum officinale* are consistently present and capable of occurring well represented.

Soils- There was a conspicuous lack of genetic horizonation in these alluvium-derived soils of loam to silty loam to coarse sand that had a notable gravel component at greater depths. There is notable spatial heterogeneity due to active and past fluvial processes.

Other Studies- The *Populus balsamifera ssp. trichocarpa / Poa pratensis* zootic disclimax has been described for only Montana; it has been documented by Hansen et al. (1995) to be a major riparian type of low- to mid-elevations throughout the foothills and mountains of Montana.

Element Code- CEGLMTNH31

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Populus tremuloides / Bromus carinatus Forest (POPTRE / BROCAR) trembling aspen / mountain brome

Natural Heritage Conservation Rank- G5 / S?

Environment- This is a broadly distributed aspen-dominated type documented from the mountain ranges of the Great Basin and western Utah; it has not previously been described from a location as far north as Red Rock Lakes NWR. On the Refuge *Populus tremuloides / Bromus carinatus* occurs on the lower slopes and toeslope positions of the Centennial escarpment; generally these sites have deep and relatively rock-free soils with an upper horizon having a strong blocky structure and very low chroma (dark, humus-rich soils).

Vegetation- *Populus tremuloides* is the dominant tree and forms a nearly continuous canopy as well as having seedling and sapling size classes present in some stands. Conifer "invasion" appears to be very slow on these sites; seedlings and very scattered saplings of *Picea engelmannii* and *Abies lasiocarpa* were noted, though the predominant seed-rain would have been from *Pseudotsuga menziesii*.

In addition to *P. tremuloides* dominating the tree canopy, this association is identified when the undergrowth component is dominated by one of the following tall grasses *Bromus carinatus, Elymus glaucus,* or *Elymus trachycaulus* (syn. *Agropyron caninum*) and the tall forb component is poorly represented. On the Refuge the first two listed grasses were almost always the dominants. Other frequently abundant graminoids, include *Poa pratensis, Carex hoodii, C. petasata, Stipa occidentalis,* and *Poa pratensis*. Forbs consistently present include, include *Achillea millefolium, Thalictrum occidentale* (or *T. fendleri*), *Osmorhiza chilensis, Geranium viscosissimum,* and *Potentilla gracilis.*

Element Code- CEGL000573

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Populus tremuloides / Calamagrostis canadensis Forest (POPTRE / CALCAN) trembling aspen / bluejoint reedgrass

Natural Heritage Conservation Rank- G3 / S2

Environment- The *Populus tremuloides / Calamagrostis canadensis* association is described as an incidental type within Montana (Hanson et al. 1995) and not listed at all for the Intermountain Region (Mueggler 1988) therefore the occurrences on the Red Rock

Lakes NWL Refuge can be considered somewhat unique, pending further inventory. Hanson et al. (1995) probably never sampled *Populus tremuloides* stands in the vicinity of the Refuge and the higher elevations of southwestern Montana because the stands on the Refuge occur at considerably higher elevations than cited for the *Populus tremuloides / Calamagrostis canadensis* type by Hansen et al. (1995). *Populus tremuloides / Calamagrostis canadensis* occurs on flats and depressions along the Centennnial Mtns. escarpment as small stands (< 1 acre) or as fringes on herb- or shrub-dominated wetlands and generally is associated with seasonally saturated soils.

Vegetation- The observed stand structure was rather open, verging on woodland (< 60% canopy cover) and having *P. tremuloides* as the sole dominant of the upper canopy; seedlings and saplings of *Picea engelmannii* and *Abies lasiocarpa* are widely scattered. These stands are putatively seral to *Picea engelmannii* / *Calamagrostis canadensis* or *Abies lasiocarpa* / *Calamagrostis canadensis* but completion of the sere would require hundreds of years disturbance-free.

The undergrowth dominant, *Calamagrostis canadensis*, usually occurs in a sward with high cover values (> 40%). Other graminoids include *Elymus glaucus*, *Bromus ciliatus*, and *Elymus trachycaulus* and where disturbance has occurred *Phleum pratense* and *Poa pratensis*. Forbs usually constitute a minor presence, individual species generally not exceeding 5% cover; commonly present in Refuge stands are *Smilacina stellata, Geranium richardsonii, Galium triflorum, Osmorhiza occidentalis* and *Geum macrophyllum*. Shrubs are a minor component with *Rosa woodsii*, *Symphoricarpos albus*, and *Salix bebbiana* being most typical.

Element Code- CEGL000574

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Populus tremuloides / Calamagrostis rubescens Forest (POPTRE / CALRUB) trembling aspen / pine grass

Natural Heritage Conservation Rank- G5? / S4

Environment- Mueggler (1988) noted *Populus tremuloides / Calamagrostis rubescens* to be an especially common type in the Centennial Mtns. of Idaho and Gros Ventre Range of western Wyoming; southwestern Montana reflects this pattern as well with this community type the prevalent *Populus tremuloides*-dominated vegetation type. *Populus tremuloides / Calamagrostis rubescens* occupies gentle to moderate slopes and benches irrespective of aspect or slope configuration. It is generally associated with landscape positions that could be inferred to be collecting positions (e.g. in the lee of a knoll or ridge) where in the past aeolian material would have been deposited or currently where snow deposition would be greater. Though extensive soil measurements were not taken this type does seem to occur with deeper and relatively rock free profiles (at least for upper horizons).

Vegetation- The successional status of this association is still debated (Mueggler 1988); it is usually dominated in all size strata by *P. tremuloides* (inferring existence of a climax plant association) with only the occasional presence of conifer regeneration to suggest that some stands may be slowly successional to conifer dominance. On the Refuge the conifer species most likely to replace *P. tremuloides* are, in order of probability, *Abies lasiocarpa*, *Pseudotsuga menziesii* and *Pinus contorta*. Very often P. tremuloides forms a nearly continuous upper canopy.

Shrubs such as *Symphoricarpos albus, S. oreophilus*, *Berberis repens*, *Rosa woodsii* and *Arctostaphylos uva-ursi* occur scattered, not as a discrete layer. The type is characterized by the dominance/codominance of *Calamagrostis rubescens* and/or *Carex geyeri*, which often

occur in such density as to create a sward-like aspect. Other graminoids consistently present, but with low cover, include *Elymus glaucus, Bromus carinatus, Elymus trachycaulus, Stipa occidentalis* and where disturbance has favored their intrusion *Poa pratensis* and *Phleum pratense*. Total forb cover is generally less than 10% and includes *Geranium viscosissimum, Lupinus agents, Thalictrum occidentale* (or *T. fendleri*), *Achillea millifolium, Fragaria vesca* (or *F. virginiana*). High coverages of *A. millefolium, Taraxacum officinale, Hackelia floribunda* and *Astragalus miser* are indicative of past or continuing grazing (usually intensive).

Element Code- CEGL000575

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Populus tremuloides / Poa pratensis Forest (POPTRE / POAPRA) trembling aspen / Kentucky bluegrass

Natural Heritage Conservation Rank- G? / S?

Environment- *Populus tremuloides / Poa pratensis* is a common grazing-induced community type found along the foothills to the Centennial Range, often associated with slumps and pockets of loess soils. This type generally occupies benches or gentle north- or east-facing slopes. The classification manual of Montana's riparian/wetland vegetation (Hansen et al. 1995) recognizes a portion of this type to occupy wetland sites (including requisite soil and hydrological properties). However, the *Populus tremuloides / Poa pratensis* sites we noted were candidate wetlands; at most they could be considered mesic sites in water receiving positions but lacking even facultative hydrophytes. Adjacent communities are the putatively less grazing-impacted *Populus tremuloides /Thalictrum fendleri* c.t. and *Pseudotsuga menziesii / Calamagrostis rubescens* or on drier transitions *Artemisia tridentata* ssp *vaseyana /Festuca idahoensis*.

Vegetation- The overstory is generally a closed canopy of *Populus tremuloides*; the understory may be dominated (but cover not exceeding 10-20%) by a younger age-class of *P. tremuloides* but more often a scattering (cover < 10%) of *Pseudotsuga menziesii, Abies lasiocarpa* or *Picea engelmannii* is found. These "climax" species are slow to establish and equally slow to exert dominance. Two 80-100 year old *P. tremuloides*-dominated stands had no more than 5% of the aforenamed climax tree species and they had all established within the last 30 years. Wild ungulate browsing on the *Abies* was evident but the other two species fared no better in their growth rates.

Like the conifers, the shrubs, *Symphoricarpos oreophilus, Berberis repens, Prunus virginiana* (heavily browsed) and *Rosa woodsii*, are an insignificant component of the vegetation complex. This type generally supports a lush sward of *Poa pratensis* in which *Bromus carinatus, B. ciliatus Elymus trachycaulus* and *Elymus glaucus* have been reduced to minor components from what are assumed to be their pre-disturbance levels. *Phleum pretense* well represented was assumed to denote an even further degraded condition. Forb composition may be diverse and even include indicators of relatively mesic conditions (*Thalictrum occidentale, T. fendleri, Osmorhiza chilensis, Geranium viscosissimum* and *Valeriana dioica*) but coverage's of mesic indicator, even combined, do not exceed 5% whereas weedy species (*Taraxacum officinale, Trifolium repens*) may be abundant.

Soils- The only excavated pit showed deep (>80 cm) silt loam with no rock or gravel and a mollic epipedon at least 20 cm thick. Other exploratory excavations of this c.t. found the upper 10-20 cm to be mollic with virtually no rock or gravel. In extremely impacted areas *P. pratensis* may be reduced to poorly represented and *T. officinale* is dominant.

Other Studies- Mueggler's monograph (1988) of aspen in the Intermountain region describes *Populus tremuloides / Poa pratensis* as a minor type, a grazing-induced deflection of the *Populus tremuloides* alliance with *Thalictrum*

fendleri, *Symphoricarpos oreophilus*, or *Calamagrostis rubescens* community types from Utah, Nevada, northward to the Bridger-Teton N.F. of Wyoming and Targhee of Idaho. In Colorado it is speculated to be a disturbance-induced version of *Populus tremuloides / Calamagrostis rubescens*. In Montana Hansen et al. (1995) recognize *Populus tremuloides / Poa pratensis* as a major type, part of the riparian complex, though not always a jurisdictional wetland. Hansen et al's concept of this type is probably broader than those of the Intermountain region as they cite a different suite of browsed-out shrubs e.g. *Cornus sericea*, *Prunus virginiana, Alnus incana* and *Salix species*.

Element Code- CEGLMTHP27

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Populus tremuloides / Tall Forbs Forest
(POPTRE / Tall Forbs) Trembling aspen / Tall Forb

Natural Heritage Conservation Rank- G5 / S3

Environment- Though *Populus tremuloides* / Tall Forb is the most commonly encountered *P. tremuloides*-dominated plant association in the Intermountain Region it is relatively uncommon on the RRLNWLR. Generally it occurs on concave to undulating landform configurations. Soils are relatively deep, rock-free and developed from a number of parent material types including limestone, sandstone, quartzite and andesite. Environmental parameters have not been definitively identified that would make this type differentiable from *Populus tremuloides / Thalictrum fendleri*, (or *Populus tremuloides / Calamagrostis rubescens*) and it does grade to these types in a landscape context. We speculate that this type occurs on slightly more mesic landscape positions relative to the other types. Stands on the RRLNWLR are small (< 1ac) and have received significant past disturbance by livestock. Refuge examples of this type appear to be near-climax aspen communities with little indication that conifers will ever achieve dominance.

Vegetation- The unifying distinctions for the type is the presence and usual prominence of one or more members of what Mueggler (1988) has termed the "tall forb group", lack of a distinct shrub layer, and inconsequential amounts of conifers in the tree stratum. The tall forb guild is comprised of *Valeriana occidentalis, Osmorhiza occidentalis, Hackelia floribunda, Senecio serra, Agastache urticifolia, Mertensia paniculata, Delphinium occidentale, Aster engelmannii* and *Heracleum lanatum (*syn. *H. sphondylium*). On Refuge stands *O. occidentale, A. engelmannii*, and *H. lanatum* are most likely to be layer dominants in undisturbed conditions, whereas *A. urticifolia* and *H. floribunda* more typically exploit disturbance conditions.

The tree stratum characteristically is composed of only *P. tremuloides*. *Abies lasiocarpa* and *Picea engelmannii* may be present as scattered seedlings and saplings; *Abies* is very heavily browsed by moose and has little chance of escaping sapling status.

Shrub are present, usually *Symphoricarpos oreophilus*, *Berberis repens* and *Ribes* spp., but their combined cover does not generally exceed 5%. Low forbs with high constancy in this type include *Geranium richardsonii, G. viscosissimum, Osmorhiza chilensis* (or *O. depauperata*), *Thalictrum occidentale* (or *T. fendleri*) and *Potentilla glandulosa*. The common graminoid component, which can have appreciable cover though obscured by the tall forbs, includes *Bromus carinatus, Elymus glaucus*, and *Elymus trachycaulus*.

Element Code- CEGL000618

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Populus tremuloides / Thalictrum fendleri Forest
(POPTRE / THAFEN) trembling aspen / Fendler's meadowrue

Natural Heritage Conservation Rank- G5 / S?

Environment- *Populus tremuloides / Thalictrum fendleri*, is a common community type found along the foothills to the Centennial Range, often associated with slumps and pockets of loessal soils. This type generally occupies benches or gentle north- or east-facing slopes. This type was not found above 7,400 ft elevation. Adjacent communities of drier (?) environments *are Populus tremuloides /Calamagrostis rubescens, Pseudotsuga menziesii* / *Calamagrostis rubescens* or Artemisia tridentata ssp vaseyana/*Festuca idahoensis*; it grades to Populus tremuloides / *Cornus sericea* or most often Populus tremuloides /*Osmorhiza occidentalis* of moister environments (recognized by 5% coverage of *Viola canadensis, Heracleum lanatum, Actaea rubra, O. occidentalis* or *Galium triflorum*).

Vegetation- The overstory is generally a closed canopy of *Populus tremuloides*; the understory may be dominated (but cover not exceeding 10-20%) by a younger age-class of *P. tremuloides* but more often a scattering (cover < 10) of *Pseudotsuga menziesii, Abies lasiocarpa* or *Picea engelmannii* is found. These "climax" species are slow to establish and equally slow to exert dominance. A *P. tremuloides*-dominated stand in excess of 100 years old had no more than 10% of the aforenamed climax tree species and they had all established within the last 40 years. Wild ungulate browsing on the *Abies lasiocarpa* was evident but the other two species fared no better in their growth rates.

Shrubs, including the highly constant *Symphoricarpos oreophilus, Rosa woodsii,* and *Berberis repens,* are poorly represented; *Shepherdia canadensis* can be well represented in small patches and may represent fragments of the *Populus tremuloides / Shepherdia canadensis* c.t. but does not appear to be associated with a particular environmental feature. The dominant aspect of this c.t. in good condition is that of a low-forb layer with highly variable coverage of introduced rhizomatous (*Poa pratensis, Phleum pratense*) and native grasses (*Bromus ciliatus, B. vulgaris, B. carinatus, Elymus glaucus* and *Agropyron caninum*) The coverage of introduced grasses may be abundant on grazing-impacted sites. In its modal form the diagnostic forbs *Thalictrum fendleri* (or *T. occidentale*), *Osmorhiza chilensis* (or *O. depauperata*), and *Geranium viscosissimum* have at least 10% cover, singly or in the aggregate. Other species noted to be consistently present and associated with even more mesic conditions than those listed above include *Ligusticum filicinum, Geranium richardsonii, Geum macrophyllum, Smilacina stellata,* and *Mertensia ciliata*. *Taraxacum officinale, Descurainia pinnata* and *Myosotis arvensis* are increaser forbs with grazing.

Soils- The only excavated pit showed deep (>100 cm) silt loam with no rock or gravel and a mollic epipedon at least 30 cm thick. Other exploratory excavations of this c.t. found the upper profile to be mollic and totally lacking rock or gravel. The litter layer is continuous and very thin, as is the humus layer as is typical for productive Populus tremuloides-dominated stands. In extremely overgrazed areas *P. pratensis* may be reduced to poorly represented and *T. officinale* and *Achillea millifolium* are dominant.

Other Studies- For the Intermountain region Mueggler (1988) has defined as areally extensive a *Populus tremuloides* /*Thalictrum fendleri* c.t. that ranges from northwestern Wyoming to eastern Idaho (as /*Geranium viscosissimum* c.t. Mueggler and Campbell 1982) and Utah (Mueggler and Campbell 1986) and southeastern Wyoming (Alexander et al. 1986). *Populus tremuloides /Thalictrum fendleri* is apparently very abundant in western Colorado (Johnson 1987).

Comments- Mueggler (1988) remarks that this c.t. appears to slowly succeed to the *Abies lasiocarpa / Osmorhiza chilensis* habitat type; population structure of stands in our study area seem to substantiate this observation.

Element Code- CEGL000619

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Shrublands

Artemisia cana / Pacopyrum smithii Shrubland (ARTCAN / PASSMI) silver sagebrush / western wheatgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- (The following description characterizes the type as found in northeastern MT; it is a minor type in southwestern MT, noted only in passing). The ARTCAN / *Pascopyrum smithii* association is found on level to gently sloping, narrow to extremely broad alluvial (floodplain) terraces and coalescing alluvial fans and upslope may occur in swales and gentle depressions. These sites are moister than contiguous upslope vegetation and in some cases may constitute wetland sites (none of our sampled stands were, this can only be determined by hydrological monitoring or examination of soil characteristics). Substrates are generally moderately fine to fine textured, being derived from sediments deposited in low energy environments (or in the case of basins and swales from slopewash), have a high water holding capacity and are well- to imperfectly drained. As speculated in other studies (Jorgenson 1979, Hansen et al 1991) perched or high water tables may influence the rooting zone for a portion of the year. A variety of community types are found to occur adjacent on upland sites, most commonly *Stipa comata - Bouteloua gracilis* and *Pascopyrum smithii - Stipa comata*, whereas moister positions are frequently dominated by the *Symphoricarpos occidentalis* and *Rosa woodsii* dominated associations or *Sarcobatus vermiculatus*-dominated types when the setting is in highly erosive to badlands topography.

Vegetation- *Artemisia cana* having at least 5% canopy cover is diagostic of this type, but its cover usually exceeds 30%. None of the sites supported the robust 4-5 ft tall specimens cited by Hansen and Hoffman (1988) or Mueggler and Stewart (1980) for favorable site conditions. *Artemisia frigida* was consistently present in low amounts (greater than 10% where cattle grazing intensive) and other shrub species were only sporadic. Graminoids dominate the herbaceous layer with *Pacopyrum smithii* usually dominant, but in our samples *Stipa viridula*, *S. comata* and *Bouteloua gracilis* were all dominant or co-dominant in at least one stand (they also had greater than 75% constancy). This variability is speculated to reflect differing grazing pressure as stands were not chosen for pristine condition (stand with *B. gracilis* dominant had *A. smithii* and *S. viridula* confined to canopies of *A. cana*). The forb component is insignificant; none had even 50% constancy.

Other Studies- This, or closely related, types have been documented in other areas of MT; southeastern (Hansen and Hoffman 1988), southwestern (Mueggler and Stewart 1980) and central (Jorgensen 1979). The most comprehensive sampling (43 stands) of this type is that performed by the Montana Riparian Association (Hansen et al. 1995) for the entire state. This type has been described only for Montana, North and South Dakota (Hansen et al. 1984).

Element Code- CEGL001072

Edition / Author- 99-12-03 / S.V.Cooper, MTNHP

Artemisia tridentata ssp. tridentata / Festuca idahoensis Shrubland (ARTTST / FESIDA) basin big sagebrush / Idaho fescue

Natural Heritage Conservation Rank- G4? / SP

Environment- This type is found on moist lower slopes or short slopes at 6,600-7,200 ft in the Tendoy Mountains and repeats in the Centennial Sandhills as the late seral stage of stabilized dune sands. Adjacent less mesic sites are dominated by *Artemisia tridentata vaseyana* and *Festuca idahoensis*. Moister sites with finer textured soils support *Artemisia*

tridentata ssp.tridentata with an understory dominated by *Pascopyrum smithii* and/or *Leymus cinereus*.

Vegetation- *Artemisia tridentata ssp. tridentata* is the dominant shrub with 10-20% canopy cover. *Chrysothamnus* spp. and *Tetradymia canescens* are present in many stands. Grass canopy cover is 50-70%. *Festuca idahoensis* dominates, and *Pseudoroegneria spicata* is also common. Forb cover is generally ca. 10% with moderate diversity. *Astragalus adsurgens, Penstemon aridus* and *Senecio canus* are often present. Mosses and lichens may be common.

Soils- Soils are deep and silty or loamy in texture; the Centennial Sandhills composed of aeolian sand to loamy sands constitute a rather unique substrate. From 10 to 20% of the surface is bare, and surface gravel is usually present, with the exception of the Centennial Sandhills representatives of the type.

Other Studies- Mueggler and Stewart (1980) do not mention that *Artemisia tridentata ssp. tridentata* may occur with *Festuca idahoensis* in Montana. Similar vegetation is reported for Idaho, Oregon and Washington (Bourgeron and Engelking 1994).

Element Code- CEGL001014

Edition / Author- 99-11-16 / S.V.Cooper, MTNHP

Artemisia tridentata ssp. tridentata / Pascopyrum smithii Shrubland (ARTTST / PASSMI) basin big sagebrush / western wheatgrass

Natural Heritage Conservation Rank- G3? / S3

Environment- This type is common on gently slope to nearly level stream terraces at 5,900-7,200 ft in the Tendoy Mountains; very limited areas of *Artemisia tridentata ssp. tridentata / Pascopyrum smithii* were noted in reconnaissance of the Centennial Valley and other locations within the northern portion of Dillon Resource Area. Sites are often associated with dry stream channels and thus have a low gradient. The landscape location and vegetation might be considered riparian but the type is not a jurisdictional wetland using soils and hydrological criteria. Parent material is alluvium derived from limestone and quartzite. Adjacent upslope sites support sagebrush steppe dominated by *Artemisia tridentata ssp. tridentata* or *vaseyana* and *Festuca idahoensis*; in the Yellowstone Ecosystem this type was noted to grade to *Artemisia cana* / *Pascopyrum smithii* of moister regimes. Cool slopes are dominated by *Pseudotsuga menziesii* or *Pinus flexilis* forests, and very rocky slopes support *Cercocarpus ledifolius* woodlands.

Vegetation- *Artemisia tridentata* ssp. *tridentata* is the dominant shrub with canopy cover ranging from 10 to 50%. *Chrysothamnus nauseosus* and *C. viscidiflorus* occur, poorly represented, in many stands. The subshrub, *Artemisia frigida,* may be common in some stands. Grass cover is high to nearly continuous in most stands. *Pascopyrum smithii* and/or *Elymus lanceolatus (*in our concept of the type) are the dominant and diagnostic grass species. *Poa pratensis* and *Leymus cinereus* may be abundant. *Pseudoroegneria spicata and* small bluegrass's such as *Poa secunda, P. juncifolia,* or *P. cusickii* are often present. Forb cover is usually 10% or less, and diversity is low to moderate. *Achillea millefolium, Antennaria microphylla, Erigeron compositus, Senecio canus* and *Taraxacum officinale* are species with high constancy. Mosses and lichens are often present and may be common.

Soils- Soils are very deep with a silty to loamy texture. Some may be slightly saline. The amount of bare soil surface varies between 10% and 70%, but there is no surface gravel.

Other Studies- Mueggler and Stewart (1980) describe associations dominated by *Sarcobatus vermiculatus* and either *Pascopyrum smithii* or *Leymus cinereus* for western Montana. These types have a similar herbaceous layer to *Artemisia tridentata ssp. tridentata / Pascopyrum smithii* but the dominant shrub is

S. vermiculatus. An *Artemisia tridentata* ssp. *tridentata* / *Pascopyrum smithii* c.t. is reported for Colorado and Nevada, and an *Artemisia tridentata ssp. tridentata* /*Leymus cinereus* type is reported for Colorado, Idaho and Oregon (Bourgeron and Engelking 1994).

Comments- Most sites that are mesic enough to support *Artemisia tridentata* ssp. *tridentata* will probably also support a robust grass such as *Leymus cinereus*. Heavy spring and early summer grazing of these bottomland sites would favor the shorter, rhizomatous *Pascopyrum smithii* over the more robust, bunch-forming *E. cinereus*. We hypothesize that heavy grazing in the early part of the century removed most *E. cinereus* from these sites. With light grazing it is conceivable that *E. cinereus* could eventually regain dominance. This type might best be considered a disclimax of the *Artemisia tridentata ssp. tridentata* / *Leymus cinereus* plant association but only exclosures established before the cattle industry was initiated could pose an answer.

Element Code- CEGL001017

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tridentata / Stipa comata Shrubland (ARTTRI / STICOM) basin big sagebrush / needle-and-thread

Natural Heritage Conservation Rank- G4Q / S4

Environment- *Artemisia tridentata (ssp. tridentata)* / *Stipa comata* is endemic to stabilized sand dunes in the Centennial Valley at 6,600-6,700 ft. Adjacent blowouts support *Stipa comata / Psoralea tenuiflora* as a seral community type.

Vegetation- *Artemisia tridentata ssp. tridentata* is the dominant shrub with 10-30% canopy cover. *Chrysothamnus* spp. are present in many stands. Grass canopy cover is ca. 40-70% with *Stipa comata, Festuca idahoensis*, or *Elymus lanceolatus* sharing dominance, depending on the stage of succession. Forbs have 10-30% cover and moderate to high diversity. *Opuntia fragilis, Lupinus argenteus, Comandra umbellata* and *Artemisia dracunculus* may be common. Mosses and lichens are absent.

Soils- Soils are deep and sandy. Gravel and rock are absent. 40-60% of the soil surface is bare.

Other Studies- Vegetation dominated by *Artemisia tridentata* ssp. *tridentata* and *Stipa comata* is reported for Idaho, Washington and Oregon (Bourgeron and Engelking 1994). This type occurs at low elevations in Washington and common forbs are very different than those of the Montana type (Daubenmire 1970).

Comments- This type might be considered a seral stage of Artemisia tridentata ssp. tridentata /Festuca idahoensis or an edaphic phase of this type. However, it appears to be stable over long time periods and has different soil, forb and bryophyte components than typical Artemisia tridentata ssp. tridentata / Festuca idahoensis.

The relationship between this type and the closely related *Stipa comata* phase *of Artemisia tripartita / Festuca idahoensis* is unclear. Both are found in apparently similar habitats. Fire and/or grazing may play a role in maintaining these different associations in the Centennial Sandhills landscape.

Element Code- CEGL001010

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland (ARTTSV / LEYCIN) mountain big sagebrush / basin wildrye

Natural Heritage Conservation Rank- G4? / S?

Environment- Gentle to moderate slopes and terraces with warm aspects, deep soils and

mesic moisture regimes may support examples of *Artemisia tridentata ssp vaseyana / Leymus cinereus*. Stands occur at 6,900-7,200 ft or higher in the Red Rock River drainage. Slightly drier sites support *Artemisia tridentata ssp vaseyana / Festuca idahoensis*, while cooler sites support *Pseudotsuga menziesii* or *Pinus flexilis* forests. Adjacent rocky slopes support *Cercocarpus ledifolius* woodlands.

Vegetation- *Artemisia tridentata vaseyana* is the dominant shrub with 20-30% canopy cover. *Artemisia tripartita, Tetradymia canescens* and *Chrysothamnus* spp. are often present but not common. Grass cover is 70-90%. Dominant grasses are *Leymus cinereus* and *Festuca idahoensis*. *Agropyron caninum, A. dasystachyum* and *Bromus carinatus* may be common in some stands. *Poa pratensis* occurs in stands that have been heavily grazed. Forbs have 10-20% cover, but diversity is only low to moderate. *Achillea millefolium, Cirsium spp., Erysimum inconspicuum* and *Potentilla gracilis* are present in many stands. Mosses may be common in some stands.

Soils- Soils are deep with a loamy or silty in texture and are often derived from alluvium. Some sites may be slightly saline. Bare ground and surface gravel are uncommon.

Other Studies- This type has been described for Idaho (Bourgeron and Engelking 1994).

Comments- This type might also be considered a mesic phase of Artemisia tridentata ssp vaseyana/Festuca idahoensis. At this time the successional relationships of *Festuca idahoensis* and *Leymus cinereus* are not clear. Heavy spring or early summer grazing probably results in a decrease of *E. cinereus*, while light summer grazing may favor this species. Although this type is now confined to very mesic sites, it may not have been so restricted prior to introduction of livestock.

Element Code- CEGL001027

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland (ARTTSV / PSESPI) mountain big sagebrush / bluebunch wheatgrass

Natural Heritage Conservation Rank- G5 / S?

Environment- This type is common on steep slopes or occasionally ridges or terraces at 5,000-6,000 ft on the east slopes of the Pioneer Mountains and the Block Mountain area; it was noted in reconnaissance in the Tendoy Range on south-facing slopes. Common associated parent materials are basalt, quartzite or mixed sedimentary. Adjacent shallower, rocky soils are dominated by *Cercocarpus ledifolius*. Artemisia tridentata ssp. tridentata and Pascopyrum smithii dominate adjacent terraces.

Vegetation- *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub with 10-40% canopy cover. Scattered *Chrysothamnus nauseosus* plants are usually present. The subshrubs, *Artemisia frigida* and *Gutierrezia sarothrae* are common in most stands. Grass canopy cover is generally 40-70%. *Pseudoroegneria spicata is* the dominant species; *Stipa comata, Bouteloua gracilis* and *Poa secunda* are other common species. Forb canopy cover is 10-30%, and diversity is low to moderate. *Opuntia polyacantha, Phlox muscoides* and *Erigeron compositus* are common species. Mosses and lichens are often common.

Soils- Soils have a loamy or sandy clay texture. The surface may be as much as 20% bare soil, but rock and gravel account for up to 70% cover.

Other Studies- Mueggler and Stewart (1980) describe this type for western Montana. Similar communities have been reported for most of the Northern Rocky Mountains and intermountain states (Bourgeron and Engelking 1994). Mueggler and Stewart (1980) discuss how the types described from different areas

differ.

Comments- Most of the country south of Horse Prairie Creek may be too high to support extensive stands of this type.

Element Code- CEGL001030

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus Shrubland (ARTTSW / ELYLAN) Wyoming big sagebrush / thick-spike wheatgrass

Natural Heritage Conservation Rank- G4 / S?

Environment- This type occurs on gently sloping alluvial fans and terraces. Our single example was from 6,650 ft, but Artemisia tridentata ssp. wyomingensis/Elymus lanceolatus might be expected to occur at 5,000-7,500 ft. Artemisia arbuscula ssp. longiloba and Elymus lanceolatus or Leymus cinereus and Poa juncifolia dominate adjacent stands on heavier soils with poorer drainage. Adjacent slopes with deeper soils may support stands dominated by *Artemisia tridentata vaseyana* and *Festuca idahoensis* or *Pseudoroegneria spicata.*

Vegetation- *Artemisia tridentata ssp. wyomingensis* is the dominant shrub. *Chrysothamnus* spp. may also be present. The subshrub, *Artemisia frigida*, is usually common. Grass canopy cover is moderate to high and dominated by the midgrass species, *Elymus lanceolatus* and *Stipa viridula*. *Poa cusickii* and *P. secunda* may also be present. Forb cover is low, and diversity is low to moderate. *Phlox hoodii* and *Astragalus adsurgens* are common species. Mosses and lichens are uncommon.

Soils- Soils are fine-textured. Much of the soil surface is bare, and surface gravel is uncommon.

Other Studies- Jorgensen (1979) describes vegetation dominated by *Artemisia tridentata wyomingensis* and *Elymus lanceolatus* in central Montana. This type, or a very similar analogue, is reported for Wyoming and Colorado as *Artemisia tridentata* var. *wyomingensis* /Elymus lanceolatus var. *albicans* (Bourgeron and Engelking 1994).

Comments- Elymus *lanceolatus* and *Pascopyrum smithii* have overlapping habitat requirements throughout much of Montana (see Coupland 1961 and Jorgensen 1979). In much of Montana the two types, *Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii and Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus* may be indistinguishable except for the different dominant rhizomatous wheatgrasses.

Element Code- CEGL001044

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Betula glandulosa / Carex utriculata Herbaceous Vegetation (BETGLA / CARUTR) bog birch/beaked sedge

Natural Heritage Conservation Rank- G4? / S4

Environment- This community type occurs adjacent to beaver ponds, lakes, or marshes, and on seeps, swales and wet alluvial terraces adjacent to low gradient meandering streams (Hansen et al. 1995). This community occurs on fairly wet sites with peat accumulation, indicating a predominance of anaerobic processes. In contrast, some willow stands, like *Salix drummondiana* stands, commonly occur on soils that are better aerated, and hence are not usually found in peatlands. Soils are commonly flooded until mid summer, and are saturated year round on wetter sites. Redox concentrations are present in some mineral soils; redox depletions (gleyed soil) occur rarely. Organic matter accumulations may form floating, quaking mats as this type encroaches onto open water. Drier extremes have shallow organic horizons overlying

deeper mineral soil (Hansen et al. 1995).

Range- *Betula glandulosa / Carex utriculata* is a minor type at mid elevations in western Montana (Hansen et al. 1995), and throughout Idaho (Moseley et al. 1991, Bursik and Moseley 1995).

Adjacent Communities- *Salix drummondiana, S. geyeriana, Carex utriculata or C. lasiocarpa* may dominate adjacent wetter sites. Drier wetland communities support *Poa pratensis, Populus trichocarpa,* and *Potentilla fruticosa.* At higher elevations, adjacent wetland forests are often dominated by *Picea engelmannii* or *Abies lasiocarpa*. Adjacent uplands support habitat types from the *Abies lasiocarpa, Pseudotsuga menziesii,* and *Pinus ponderosa* series, depending on elevation and aspect (Hansen et al. 1995).

Vegetation- *Betula glandulosa* contributes an average of 35% to the overstory. Minor amounts of *Potentilla fruticosa* and *Salix* species are usually present. The canopy cover provided by the various shrubs is sparse to moderate, but the herbaceous layer cover is high. Associated shrubs include *Rhamnus alnifolia* and various willows. Understory species composition is dependent on water levels. The wettest sites support *Carex utriculata* and *C. aquatilis*. *Geum macrophyllum* and the graminoides *Poa pratensis* and *Agrostis stolonifera* are often present in drier micro-sites and/or disturbed sites (Hansen et al. 1995).

Similar Communities- The *Betula glandulosa / Carex utriculata* habitat type is equivalent to *Betula glandulosa / Carex rostrata* (Hansen et al. 1995), which had been previously described in an unpublished study by Pierce (1986). *Carex utriculata* was erroneously referred to *as Carex rostrata* in earlier taxonomic and ecological studies (Griffiths 1989). Pierce (1986) described a similar community with an understory dominated by Deschampsia cespitosa. Other communities with a *Betula glandulosa* overstory and *Carex lasiocarpa* understory occur in northern Idaho and northwest Montana (Jankovsky-Jones 1997, Chadde et al. 1998, and Greenlee 1999). *Betula glandulosa / Carex cusickii* plant associations also exist in northwest Montana (Greenlee 1999).

Succession - The *Betula glandulosa / Carex utriculata* community type represents a fairly stable type. Grazing my decrease the vigor of bog birch and increase the presence of species tolerant of grazing including *Agrostis stolonifera, Poa pratensis, Poa palustris,* and *Juncus balticus*.

Management - Saturated soils are highly susceptible to soil compaction and streambank sloughing when used by livestock and heavy machinery. Overuse may result in reduced vigor or eventual elimination of shrubs from the site. Burning of this type can temporarily increase productivity of *Carex* species. However, care should be taken when burning along streambanks because of the excellent erosion protection provided by *Betula glandulosa / Carex utriculata* habitat type (Hansen et al. 1995).

Wildlife Values- *Betula glandulosa* is a valuable browse species for elk (Kufeld 1973). Communities dominated by *Betula glandulosa* may function to stabilize channel banks (frequently creating overhanging banks) and provide shade creating quality fish habitat.

Element Code- CEGL001079

Edition / Author- 95-09-05/L. Williams

Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland (CERLED / AGRSP); curl-leaf mountain mahogany / bluebunch wheatgrass

Natural Heritage Conservation Rank- G4Q / S4

Environment- Mountain mahogany woodlands often dominate on steep, rocky-gravelly slopes, usually with warm, southeast-through west-facing aspects at 5,400-7,900 ft throughout the study area; these conditions are usually found on upper and shoulder positions of ridge and hill slopes. Adjacent cool slopes

may support *Pseudotsuga menziesii* or *Pinus flexilis* forests. Adjacent warm slopes with deeper soils/less rock are dominated by the grasses *Festuca idahoensis* and *Pseudoroegneria spicata with* or without *Artemisia tridentata vaseyana* or *A. tripartita*. Many stands grade into barren rock outcrops or talus slopes.

Vegetation- Stands are dominated by *Cercocarpus ledifolius* with canopy cover of 10-60% with a mean of 30%. *Artemisia tridentata vaseyana* and *Chrysothamnus viscidiflorus* are often common. *Juniperus scopulorum* occurs in about half of the stands with a mean cover of 6% but its presence cannot be convincingly linked to particular habitat conditions or stand history. The subshrub, *Artemisia frigida*, is present in most stands. Grass cover is sparse. *Pseudoroegneria spicata and Oryzopsis hymenoides* are the herbs with the highest constancy; the presence of either as common is diagnostic for the type. *Poa secunda* and *Stipa comata* are present in many stands. Forb cover is low but diversity is often moderate to high. No species occurred in even half of the sampled stands. *Achillea millefolium, Opuntia polyacantha* and *Taraxacum officinale* were the only species with constancy higher than 25%. Mosses are present in most stands, and lichens are occasionally found.

Soils- Textures are sandy to sandy loam. An average of greater than 65% of the soil surface is bare or covered with rock or gravel. As Mueggler and Stewart (1980) suspected this type is not confined to calcareous substrates but is often found on these substrates because they weather to the appropriate rocky-gravelly substrate; this type was also found on granitics, extrusive volcanics and quartzite.

Other Studies- Mueggler and Stewart (1980) describe this type for western Montana; however, their sampling was limited to calcareous parent materials. Similar vegetation has been described for Idaho (Schlatterer 1972, Lewis 1975, Scheldt and Tisdale 1970). Vegetation with the same dominants has been reported for Colorado, Utah, Nevada and Wyoming (Bourgeron and Engelking 1994).

Comments- Stands with *Juniperus scopulorum* have sometimes been segregated as a separate type (Bourgeron and Engelking 1994); however, we could find no consistent habitat or floristic differences between these two putative types in our study area, and indirect gradient analysis did not separate them. There is a tendency for *J. scopulorum* to be present only non-calcareous sites.

The presence of large quantities of pellets and strongly hedged *C. ledifolius* indicates that this vegetation type is very important for deer, particularly as winter range.

Element Code- CEGL000967

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Chrysothamnus viscidiflorus / Stipa comata Shrubland (CHRVIS / STICOM) green rabbitbrush / needle-and-thread

Natural Heritage Conservation Rank-

Environment- The *Chrysothamnus viscidiflorus / Stipa comata* c.t. has been found only on the Centennial Sandhills as a putative seral stage to the *Artemisia tridentata* ssp *vaseyana / Festuca idahoensis* or *Artemisia tridentata* ssp. *tridentata / Stipa comata* community types. *Chrysothamnus viscidiflorus / Stipa comata* apparently represents a relatively early stage in the colonization of sandy substrates that have blownout (lost their original vegetation cover leaving a raw substrate). It can occur in any position in this dune system but most often was noted in drier exposures of upslope positions because these are the locations most often subject to disturbance.

Vegetation- Total vegetative cover on these sites is generally low, not exceeding 30%, with *Chrysothamnus viscidiflorus* dominant and other shrubs, *Tetradymia canescens, Chrysothamnus nauseosus* and *Leptodactylon*

pungens, scattered. *Stipa comata or Elymus lanceolatus, Opuntia polyacantha, Psoralea tenuiflora,* and *Phacelia hastata* dominate the forb layer, but none are even well represented, the combined forb cover being less than 15%.

Soils. The substrate is fine-textured sand with more than 90% exposed and only a trace of litter. There is no evidence of soil development with the exception of a trace of organic matter darkening the surface.

Other Studies- There is no comparable community type listed for the western United States and only one type (in Utah) wherein *Chrysothamnus viscidiflorus* is the diagnostic species *(Chrysothamnus viscidiflorus* / *Leymus salinus* ssp. *salinus*; Bourgeron and Engelking 1994).

Element Code- CEGLMTNH12

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Cornus sericea Shrubland (CORSER) red-osier dogwood

Natural Heritage Conservation Rank- G4 / S3

Environment- This type is typically adjacent to stream and river channels, but it can occupy a diversity of landforms. It may appear as dense linear bands on alluvial benches in narrow canyons or broad thickets on islands and floodplains of major streams and rivers. It may also occur on well-watered sites below beaver dams. Most occurrences have evidence of annual or near-annual flooding (Manning and Padgett 1995; Hall and Hansen 1997). Soils of this community are classified as Inceptisols, Entisols, or Mollisols. Where sites are located outside of the active floodplain, a litter/duff layer 2 inches or more thick may accumulate. Surface horizons are comprised of a wide range of alluvial materials with textures ranging from silty clay to sandy loam. These layers may be relatively shallow or as deep as 5 feet. Underlying layers are typically coarse sands, gravels, and cobbles that facilitate the movement of aerated groundwater through the subsurface layers which may be important for the longevity of stands. Water availability ranges from high, where this type occupies floodplains immediately adjacent to active channels and mottled and gleyed soils may occur (Manning and Padgett 1995; Hall and Hansen 1997; Crowe and Clausnitzer 1997), to low on upper, remote floodplain sites.

Range- This is a widespread type known from Washington, Oregon, Idaho, Nevada, and Montana.

Adjacent Communities- Because of the wide geographic range for this type, communities of adjacent uplands can be coniferous forest, aspen, sagebrush-steppe, and pinyon-juniper types.

Vegetation- *Cornus sericea* forms a dense, closed canopy, often excluding understory shrub and herbaceous species. *Cornus sericea* is usually the only species with high cover values. Associated species vary with geographic location and elevation, but commonly associated shrubs include *Rosa woodsii, Ribes hudsonianum, Acer glabrum, Salix exigua, S. lutea,* and *Clematis ligusticifolia.* Because of its wide range, a great diversity of herbaceous species are associated with this community, usually in low cover (Manning and Padgett 1995; Hansen et al. 1995; Hall and Hansen 1997; Crowe and Clausnitzer 1997).

Similar Communities- *Cornus sericea* is a community dominant in several associations. This community, however, lacks the structural diversity of the other types, for example the *Alnus incana / Cornus sericea* and *Cornus sericea-Salix* sp. types from Nevada (Manning and Padgett 1995). The relationship of this community with the *Cornus sericea / Heracleum lanatum* and *C. sericea / Galium triflorum* types from Utah and eastern Idaho (Youngblood et al. 1985, Padgett et al. 1989) is unclear.

Succession- This is considered an early seral community, typically colonizing sites adjacent

to streams. The herbaceous cover is often sparse, probably due to the dense overstory canopy and regular flooding, scouring, and deposition. The latter factor is probably responsible for maintaining this as a persistent community type on the landscape. The presence of tall shrubs or trees in some stands may represent succession toward *Alnus incana, Populus trichocarpa, P. tremuloides, P. angustifolia, Picea engelmannii, Pseudotsuga menziesii*, or other communities.

Management- The herbaceous biomass varies widely and is largely dependent on the density of the dogwood canopy (Crowe and Clausnitzer 1997). Ratings for red-osier dogwood palatability for livestock range from low (Manning and Padgett 1995; Crowe and Clausnitzer 1997) to "ice cream" (Hansen et al. 1995; Hall and Hansen 1997), but the stands are often so dense that they limit grazing in many cases. This community functions in a variety of ways to promote stream health. Red-osier dogwood forms dense root networks that stabilize streambanks against lateral cutting and erosion, provides cover in the form of overhanging branches and banks, and shades channels, effectively moderating extreme summer temperature fluctuations (Hall and Hansen 1997). Dogwood sprouts vigorously after a fire and germination of it's seed-bank is stimulated by fire (Crowe and Clausnitzer 1997).

Wildlife Values- Red-osier dogwood provides food and cover for mule deer, moose, elk, cottontail rabbits, snowshoe hares, and many birds. The fruits are an important back bear food and are also eaten by songbirds, grouse, quail, partridge, cutthroat trout, ducks, crows, mice, and other mammals. Deer mice, meadow voles, and other small rodents eat the young stems and bark. Red-osier dogwood often grows in dense thickets because of its layering ability. These thickets provide good mule deer fawning and rearing areas and nesting habitat for many songbirds (Hansen et al. 1995, Crowe and Clausnitzer 1997).

Element Code- CEGL001165

Edition / Author- 98-01-02/ B. Moseley

Pentaphylloides floribunda / Deschampsia cespitosa Shrubland (POTFRU / DESCES) shrubby cinquefoil / tufted hairgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- These alkaline meadows occur on sub-irrigated flood plains, stream terraces and gentle lower slopes, often in association with springs or seeps; though facultative hydrophytes are often abundant these do not consistently possess hydrologic regimes or soil characteristics indicating jurisdictional wetlands. This c.t. was found at 5,000-7,500 ft throughout the study area, most often in areas of calcareous parent material. Most examples of this type have hummock-hollow microtopography. *Salix spp., Carex utriculata or Carex simulata fen or Juncus balticus and Deschampsia cespitosa* often dominate wetter sites. Drier sites may be dominated by *Leymus cinereus, Carex praegracilis* and *Puccinellia distans*. Artemisia tridentata, A. tripartita or A. longiloba and Festuca idahoensis dominates adjacent upland communities.

Vegetation- *Pentaphylloides floribunda* is the only common shrub with 10-30% cover. Dominant graminoids, usually well represented, are *Juncus balticus* and *Deschampsia cespitosa*. Other common species include *Carex praegracilis* and *Muhlenbergia richardsonis*. Forbs are diverse and may be abundant, up to 35% cover. Common species include *Aster occidentalis, Senecio debilis, Allium schoenoprasum* and *Valeriana edule*. *Taraxacum officinale, Poa pratensis* and *Iris missouriensis* may be common in stands that have been heavily impacted by livestock grazing. Mosses are common in some stands.

Soils- Soils have a silty texture and an alkaline reaction; some may be slightly saline as well. Soils are moist to wet for at least the first half of the growing season. There is very little bare

ground and no surface gravel.

Other Studies- Hansen et al. (1995) and Lesica (1990) describe a *Pentaphylloides floribunda / Deschampsia cespitosa* habitat type for western Montana. Similar vegetation has been described for Idaho, Utah and western Wyoming (Youngblood et al. 1985, Padgett et al. 1989, and Chadde et al. 1988).

Comments- Hansen et al. (1995) believes that the abundance of *Juncus balticus* is positively correlated with overgrazing. However, we believe that other factors, such as hydrologic regime, salinity and soil reaction may also affects the relative dominance of *J. balticus* and *Deschampsia cespitosa* (see comments under *Juncus balticus - Carex praegracilis*

The *Pentaphylloides floribunda / Deschampsia cespitosa* c.t. is similar in composition to the *Deschampsia cespitosa* c.t. and the *Juncus balticus - Carex praegracilis* c.t. The presence of *Pentaphylloides floribunda* is undoubtedly related to the degree of soil aeration, with *Pentaphylloides floribunda* increasing soils become drier. However, this relationship is also influenced by the degree of hummocking. Hummocks provide a better-aerated environment and allow *P. fruticosa* to occur in areas where it otherwise would not. It is not known how hummocks are formed, but frost action may play a role. Trampling by livestock enhances the hummocks and probably allows shrubs to become larger and more frequent. It is also possible that trampling by livestock and other large animals is the primary cause of the hummocks. *Deschampsia cespitosa* and *Juncus balticus - Carex praegracilis* types can probably be converted to *Pentaphylloides floribunda / Deschampsia cespitosa* by the formation of hummocks.

This vegetation is productive and often remains green throughout the growing season, making it attractive to livestock, especially late in the year. The moist to wet soils and generally small size of stands make this type very prone to degradation. Trampling by livestock, especially during the spring and early summer results in the formation or enhancement of hummocks. The presence of substantial hummocking may cause an increase of the shrub, *Pentaphylloides floribunda.*

Element Code- CEGL001107

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pentaphylloides floribunda / Potentilla ovina Shrubland (PENFLO / POTOVI) shrubby cinquefoil / sheep cinquefoil

Natural Heritage Conservation Rank- G? / S?

Environment- This uncommon type occurs in broad swales of gently sloping alluvial fans in areas of calcareous parent material. These sites may be sub-irrigated during part of the year; they have the appearance of being salt-affected and possibly experience soil loss through sheet erosion on an annual basis. *Pentaphylloides floribunda / Potentilla ovina* is found at 7,000-7,400 ft towards the headwaters of Big Sheep Creek in the Beaverhead and Tendoy mountains. Artemisia tridentata ssp. wyomingensis or A. longiloba and Festuca idahoensis dominates adjacent upland vegetation.

Vegetation- The only shrub is *Pentaphylloides floribunda* with canopy cover of ca. 30%. Ground layer vegetation is sparse. Graminoid canopy cover is usually less than 20%; species with high constancy and at least common coverage are *Muhlenbergia richardsonis, Pascopyrum smithii, Carex scirpoidea* and *Poa juncifolia*. Forbs frequently present include *Potentilla ovina, Gentiana affinis, Viola nephrophylla, Aster occidentalis* and *Hedysarum sulphurescens*. Mosses and lichens are absent, perhaps stripped by a flooding regime.

Soils- Soils have a silty texture and a near neutral to alkaline reaction. They appear to be shallow and stony with ca. one third of the surface covered with gravel or rock. Over 50%

of the soil surface is bare.

Other Studies- Similar vegetation has not been previously described.

Comments- Soil appears to have been removed from these sites by water, although this seems implausible given the nearly level slope. Perhaps wind erosion following severe overgrazing caused the shallow soils. This type bears some similarity to *Pentaphylloides floribunda / Deschampsia cespitosa*; however, it has very different soils and herbaceous species that indicate drier conditions.

Trampling by livestock during the spring when these sites are wet results in soil compaction and a decrease in productivity.

Element Code- CEGLMTHP17

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Salix boothii / Calamagrostis canadensis Shrubland (SALBOO / CALCAN) Booth's willow / Bluejoint reedgrass

Natural Heritage Conservation Rank- G3G4Q / SR

Environment- The *Salix boothii* / *Calamagrostis canadensis* association can be found in montane habitats in western Montana (from valley bottoms to mid-elevations in the mountains) and in the mountains of central and eastern Montana. It is frequently found on alluvial terraces where beaver activity has created a series of dams that raise the local water table, along streams, and near seeps or springs. Soils are usually deep silt or sand overlying more sand, gravel, or cobbles. This community usually floods during spring, with the water level within 1m of the surface the rest of the year. Nearby wetter communities could include *Carex utriculata, Salix geyeriana* / *Carex utriculata, Typha latifolia*, or open water, and nearby drier communities could include *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea, Calamagrostis canadensis*, *Deschampsia cespitosa*, or *Juncus balticus*. A variety of adjacent uplands could occur nearby ranging from conifer dominated communities to dry shrublands such as *Artemisia tridentata* associations (Hansen et al. 1988, Hansen et al. 1995).

Range- The *Salix boothii* / *Calamagrostis canadensis* association is found in Montana, Utah, Idaho, and western Wyoming.

Vegetation: The *Salix boothii* / *Calamagrostis canadensis* association typically has a dense overstory dominated by *Salix boothii*, and an understory dominated by *Calamagrostis canadensis*. In contrast to *Salix geyeriana* – dominated communities, these stands are more often closed and less easily accessible by large ungulates, while *Salix geyeriana* stands have a more open corridor aspect (Padgett et al. 1989). Other willows commonly found in this community are *Salix geyeriana* and *Salix drummondiana*; however, *Salix boothii* is clearly the dominant willow. Common associated understory species are *Carex utriculata, Geum macrophyllum, Mentha arvensis, Solidago canadensis*, and *Equisetum arvense* (Hansen et al. 1995).

Similar Communities- This community has also been documented in Utah (Padgett et al. 1989), Idaho and western Wyoming (Youngblood et al. 1985). Other studies (Hansen et al. 1995, Hall and Hansen 1997) include *Salix boothii*-dominated stands within a *Salix geyeriana* habitat type for management purposes, since *Salix boothii* and *Salix geyeriana* are often codominant within a stand. Other authors (e.g. Padgett et al. 1989) separate *Salix boothii*-dominated stands as a separate plant association due to structural differences between *Salix boothii* and *Salix geyeriana* stands, although based on the descriptions in Padgett et al. (1989), there is some degree of overlap between the two plant associations.

Succession- *Salix boothii* / *Calamagrostis canadensis* stands are fairly stable if the hydrologic regime remains unchanged. Kittel et al. (1998) suggest that flooding events in *Salix boothii*/*Carex utriculata* communities can

result in sediment deposition, which raises the floodplain surface higher above the water table. As the floodplain aggrades, the site could become less saturated, which could cause the graminoid understory to change towards *Calamagrostis canadensis*. Similarly, Kittel (1994) states that distance from the stream channel can change the degree of soil saturation, and thereby influence the understory composition. Removal of beaver from a *Salix boothii*/*Carex utriculata* stand could also cause compositional changes. Unmaintained beaver dams could break, and cause a lowering of the water table, which could cause a shift in the dominant understory graminoid towards *Calamagrostis canadensis* (Hansen et al. 1995).

Management- *Calamagrostis canadensis* is moderately to highly palatable and with high grazing pressure, the vigor, reproductive success, and competitive ability of this grass will decrease. Exotic pasture grasses such as *Poa pratensis* or *Agrostis stolonifera* may then increase. Livestock grazing in this association should be avoided when the soils are wet to avoid churning of the soil surface. *Salix boothii* / *Calamagrostis canadensis* stands exposed to heavy browsing pressure usually show reduced vigor of the willow species, such as highlining, clubbing, or dead clumps, with eventual decrease in willow coverage (Hansen et al. 1995).

Element Code- CEGL001175

Edition / Author- 99-10-18 / J. Greenlee, MTNHP

Salix candida / Carex utriculata Shrubland (SALCAN / CARUTR) Hoary willow - Beaked sedge

Natural Heritage Conservation Rank- G3 / S3

Environment- This community is found in montane to lower subalpine habitats in western, southwestern, and central Montana. It occurs on peat deposits that have developed around the margins of lakes and ponds, and around springs/seeps. These sites are seasonally flooded and have water tables at or near the surface throughout the growing season. Adjacent wetter communities include *Carex lasiocarpa* floating mats, rooted aquatic vegetation like *Nuphar* sp., or open water. Adjacent drier communities include those dominated by *Pentaphylloides floribunda*/ *Deschampsia cespitosa*. Uplands are usually dominated by coniferous forest (Hansen et al. 1995).

Vegetation- *Salix candida* grows as a low shrub and dominates the shrub layer, although canopy coverage tends to be low (10%-40%). There may be a few scattered shrubs with greater stature than *Salix candida*, like *Betula glandulosa*. A dense cover of Carex utriculata, and Carex aquatilis, Carex simulata dominates the understory, and *Triglochin maritimum* can also compose significant amounts of the understory coverage. Forb coverage is usually low (Hansen et al. 1995).

Similar Communities- Chadde et al. (1998) mention a *Salix candida* / *Carex lasiocarpa* peatland community for western Montana which is similar to *Salix candida* / *Carex utriculata*, except that the understory is dominated by *Carex lasiocarpa*; this type is also supported by unpublished plot data on file at MTNHP. Lesica (1986) also notes *Salix candida* as an important shrub component in dwarf carr vegetation at the Pine Butte Fen on the Rocky Mountain Front.

Succession- The successional dynamics of this community are poorly understood. It is most likely a fairly stable community, as the peat deposits upon which this community is found require a stable hydrologic regime.

Management- The organic soils of this type are easily damaged by livestock use, especially when wet. However, due to the wetness of this type, it most likely does not receive much livestock use in any case. The response of *Salix candida* to fire has not been documented.

Element Code- CEGL001188

Edition / Author- 99-10-18 / J.Greenlee, MTNHP

Salix exigua Temporarily Flooded Shrubland (SALEXI) sandbar willow

Natural Heritage Conservation Rank- G5 / S5

Environment- This type occurs on gravelly alluvial parent materials on flat flood plains and terraces in wide valley bottoms. Elevations are between 5000 and 5500 feet. Litter plus wood cover equals or exceeds 60% of the ground surface and soil cover is typically around 20%. The soil surface is unstable because of a lack of adequate vegetation cover and the active fluvial disturbance regime present on *S. exigua* sites.

Vegetation- *Salix exigua* dominates the overstory (often with a total canopy cover of 100%). The undergrowth is typically very depauperate due to the intense competition with *S. exigua* and seldom exceeds 5% total cover. Species that are often present in this sparse undergrowth include *Cirsium arvense*, *Mentha arvensis*, and *Phalaris arundinacea*.

Soils- Soils are often Aquic Udifluvents, are very deep with sandy textures, have a low available water holding capacity, and are non-calcareous. Coarse fragment contents vary from gravelly to very cobbly.

Adjacent Communities- Adjacent sites are often open water. Adjacent drier riparian communities often feature the *Populus balsamifera ssp. trichocarpa / Cornus sericea* type.

Other Studies- This type has been described as ubiquitous and abundant in Montana by Hansen et al. (1991); it is reported for the northwest, where it is comparatively rare, by Kovalchik (1987) and as far to the southeast as Colorado (Kittel and Lederer 1993).

Element Code- CEGL001197

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Salix drummondiana / Calamagrostis canadensis Shrubland (SALDRU / CALCAN) drummond's willow / bluejoint reedgrass

Natural Heritage Conservation Rank- G3 / SP

Environment- Elevation ranges from 2320 to 8200 feet throughout the range of the community. Type occurs on low gradient slopes adjacent to beaver ponds, lakes, marshes, rivers and streams, or on toeslopes below upland sites. Soils are coarse to fragmented loams or grass peat over deep, erosive, moderately fine textured alluvium (Kovalchik 1993, Tuhy and Jensen 1982). Hansen et al. (1995) notes soil textures range from silt to clay loam; mottling and gleyed soils are common. Type is relatively dry compared to other willow plant association (Kovalchik 1993). Water levels range from at the surface to 100 cm below the surface during the growing season.

Range- This community is a minor type in Colorado, Utah, Idaho, Washington, and Montana.

Adjacent Communities- Adjacent wetter sites may support *Salix drummondiana / Carex utriculata, Carex utriculata, C. aquatilis*, or *C. scirpoidea var. pseudoscirpoidea* types, or open water. Drier sites may support *Salix* dominated types with a *Poa pratensis* or *Juncus balticus* understory, or *Potentilla fruticosa, Alnus incana* or conifer dominated types (Hansen et al. 1995, Kovalchik 1993).

Vegetation- *Salix drummondiana* dominates the tall shrub layer (25-60% cover*). Salix geyeriana, Salix boothii and Salix monticola* are sometimes present in lesser amounts than the dominant shrub. *Lonicera involucrata, Ribes spp., Alnus incana, and Pentaphylloides floribunda* are usually present with up to 15% cover individually. Calamagrostis canadensis contributes at least 5% and up to 60% cover to

the understory. Other species with high constancy include *Carex microptera, C. utriculata, C. aquatilis, Deschampsia cespitosa, Aster foliaceus,* and *Fragaria virginiana*.

Similar Communities- Similar communities include Tuhy's (1981*) Salix drummondiana / Ribes lacustre /Thalictrum occidentale,* Mutz and Queiroz's (1983*) Salix drummondiana-Salix boothii / Calamagrostis canadensis,* Baker's (1989) *Salix drummondiana-Salix monticola/Calamagrostis canadensis-Carex rostrata*, and Kittel et al.'s (1998) *Salix drummondiana* / mesic forb types.

Grazing pressure will cause a decrease in Calamagrostis canadensis and Deschampsia cespitosa, with a corresponding increase in either introduced or less desirable species such as *Ribes setosum, Urtica dioica*, and *Equisetum arvense*. Abundance of *Calamagrostis canadensis* suggests that communities may be seral stages of Abies lasiocarpa/Calamagrostis canadensis habitat type. The development of a conifer overstory tends to reduce and eventually eliminate the shade intolerant Salix species without affecting the herbaceous layer (Tuhy and Jensen 1982, Hansen et al. 1995).

Management- The vigor of Salix spp. in these communities appears directly related to streambank stability and rate of sedimentation into stream systems (Tuhy et al. 1982). Sustained grazing decreases the vigor, reproductive success, and competitive ability of Calamagrostis canadensis and Deschampsia cespitosa. To maintain vigor and prevent damage to soils and vegetation, grazing should be deferred until soils dry. Proper levels of grazing should range from light to moderate. Overuse by livestock will result in reduced vigor of willow species present, illustrated by uneven stem age distribution, highlining, and clubbing or dead clumps. With continued overuse, willows may be eventually eliminated from the site (Hansen et al. 1995).

Wildlife Values- Abundant food, cover, and proximity to water provide habitat for numerous wildlife species and songbirds. Moose and beaver tend to heavily utilize most species of willow.

Element Code- CEGL002667

Edition / Author- 1996-06-13/L. Williams

Salix drummondiana / Carex utriculata Shrubland (SALDRU / CARUTR) drummond's willow / beaked sedge

Natural Heritage Conservation Rank- G3 / S5

Environment- The community is found in narrow to wide valleys on alluvial terraces adjacent to streams of low or moderate gradients (Mutz and Queiroz 1983; Hansen et al. 1995; Hall and Hansen 1997). These streams are often moderately entrenched, Rosgen C types (Kovalchik 1993). It is equally common adjacent to poorly drained or impounded areas such as beaver ponds, peatlands, lakes, marshes, seeps, springs, and road crossings (Kovalchik 1993; Moseley et al. 1994; Hansen et al. 1995). Though on mostly flat ground, channels and hummocks (Mutz and Queiroz 1983) characterize the microtopography. As with landform settings, soils vary from Entisols and Histosols to Mollisols. Soils adjacent to moderate gradient streams are often poorly developed, coarse textured, and sandy with high gravel and cobble content. These soils allow the water necessary to support Carex utriculata to easily pass through (Hansen et al. 1995). In wider valleys, clay and silt-loam or organic soils are more common. Gleying and mottling are often present, typical of a spring/summer surface water table followed by the water table dropping to 100 cm below the surface by late summer (Kovalchik 1993). Organic loam and sedge peat soils, with high available water content, are up to 1 m deep and classified as Cumulic Cryaquolls and Terric, Hemic, Sapric, and Fibric Histosols (Mutz and Queiroz 1983; Kovalchik 1993). A 5-cm surface litter/duff layer may be present. The soils of this community are held together by sod mats formed by *Carex* species and willow cover

which effectively stabilize stream banks (Hansen et al. 1995).

Range- The *Salix drummondiana / Carex utriculata* community type is known from Montana, Idaho, Washington, and probably western Wyoming.

Adjacent Communities- Communities adjacent to *Salix drummondiana / Carex utriculata* include other *Salix drummondiana* types with slightly drier moisture regimes. Examples are *Salix drummondiana / Calamagrostis canadensis*, *Salix drummondiana / Carex scopulorum var. prionophylla,* and *Salix drummondiana / Poa pratensis* (Mutz and Queiroz 1983, Hansen et al. 1988, Kovalchik 1993, Hansen et al. 1995). Other adjacent communities with similar moisture levels are *Salix geyeriana / Carex rostrata, Salix boothii / Carex rostrata, Salix farriae / Carex scopulorum var. prionophylla,* and *Salix wolfii* communities (Mutz and Queiroz 1983, Kovalchik 1993, Hall and Hansen 1997, Walford et al. 1997). Slightly drier adjacent communities include *Alnus incana / Calamagrostis canadensis, Alnus incana / Carex utriculata, Potentilla fruticosa / Deschampsia cespitosa, and Deschampsia cespitosa* communities. Wetter adjacent communities are herbaceous types *(Carex utriculata, Carex aquatilis,* or *Carex lasiocarpa* dominated) and *Salix farriae / Carex utriculata* (Kovalchik 1993, Hansen et al. 1995). Adjacent uplands are *Abies lasiocarpa, Pseudotsuga menziesii, Picea engelmannii,* or *Pinus ponderosa* habitat types (Hansen et al. 1988, Hansen et al. 1995).

Vegetation- The *Salix drummondiana / Carex utriculata* community type is variable, often having mixed *Salix* and *Carex* species present. Salix drummondiana is usually dominant with 30 to 55% cover and 70 to 100% constancy (Kovalchik 1993, Hansen et al. 1995, Jankovsky-Jones 1997). Other tall willow species, such as *Salix geyeriana, S. boothii, S. sitchensis, S. lasiandra, S. bebbiana,* and *S. pseudomonticola,* usually have less than 40% cover and less than 30% constancy. While these species form a tall shrub canopy (to 4 m), shorter species, such as *Salix farriae* or *Salix planifolia,* can be prominent in the understory (Mutz and Queiroz 1983, Kovalchik 1993, Hansen et al. 1995). Where Salix species have been reduced by beaver or overgrazing, *Betula glandulosa* (10 to 15% cover), *Spiraea douglasii,* or *Ribes* species may be important (Hansen et al. 1995). *Picea engelmannii, Abies lasiocarpa,* and *Alnus incana* are also occasionally present. The herbaceous layer is dominated by *Carex utriculata* (10 to 39% cover, about 80% constancy) and *Carex aquatilis* (less than 34% cover, less than 80% constancy) with *Carex vesicaria* also common. Other associated *Carex,* having low cover and constancy, include *Carex lanuginosa, C. lasiocarpa, C. lenticularis,* and *C. nebrascensis*. Other common graminoid species, with low constancy but occasionally moderate cover (less than 40%), are *Calamagrostis canadensis, Phalaris arundinacea, Scirpus microcarpus, Glyceria species,* and *Juncus* species (Mutz and Queiroz 1983; Kovalchik 1993; Hansen et al. 1995; Jankovsky-Jones 1996; Jankovsky-Jones 1997). Due to the dense Salix and Carex species cover, overall forb cover is low and mainly around shrub bases. Widespread species *are Epilobium ciliatum, Geum macrophyllum,* and *Equisetum arvense*. Less common species (but occasionally with higher cover) include *Saxifraga arguta, Galium species, Petasites sagittatus,* and *Aster modestus* (Mutz and Queiroz 1983, Kovalchik 1993, Hansen et al. 1995, Jankovsky-Jones 1996, Jankovsky-Jones 1997). Moss cover is often high.

Similar Communities- Earlier studies lumped this community within *broader Salix / Carex rostrata* [often misidentified, actually *Carex utriculata*], Salix drummondiana-Salix boothii/ Carex rostrata-Carex aquatilis, and Salix/Carex rostrata-Carex aquatilis communities (Tuhy and Jensen 1982, Mutz and Queiroz 1983, Walford et al. 1997). Likewise, in eastern Idaho, western Wyoming, and Utah, it may have been kept within the *Salix boothii / Carex rostrata* or *Salix geyeriana / Carex rostrata* community types (Youngblood et al. 1985, Padgett et al. 1989). These communities often

have high cover and constancy of *Salix drummondiana* (to the level of co-dominance) making lumping of types seems logical (Hansen et al. 1995, Hall and Hansen 1997). Salix drummondiana communities, with their mixed Salix species composition, may be transitional to other community types (Kovalchik 1993). In addition, *Salix sitchensis* is easily confused with *Salix drummondiana* (with which it may hybridize). *Salix sitchensis* sometimes co-dominates stands making community identification difficult (Jankovsky-Jones 1997).

The edaphic and hydrologic situations which allow *Carex utriculata* dominance also promote many different Salix species. However, dominance by any one Salix species can be the result of many factors such as elevation or grazing (Hall and Hansen 1997). Tall willow communities similar to *Salix drummondiana / Carex utriculata* (often with high cover and constancy of *Salix drummondiana*) include: Salix *drummondiana-Salix boothii / Carex rostrata-Carex aquatilis, Salix boothii / Carex rostrata, Salix geyeriana / Carex rostrata, Salix lutea / Carex rostrata,* and *Salix drummondiana / Carex aquatilis* (Mutz and Queiroz 1983, Youngblood et al. 1985, Padgett et al. 1989, Hansen et al. 1995, Hall and Hansen 1997, Walford et al. 1997, Kittel et al. 1998). Short willow species may dominate at higher elevations. *Salix drummondiana* is sometimes present in short willow communities such as: Salix candida/ Carex utriculata; Salix farriae/Carex utriculata; and Salix wolfii/Carex rostrata (Youngblood et al. 1985; Padgett et al. 1989; Kovalchik 1993; Hansen et al. 1995; Walford et al. 1997). Other Carex species may be more common *than Carex utriculata* in similar communities due to variations in seral status or other factors. These include *Salix boothii / Carex aquatilis, Salix geyeriana / Carex aquatilis, and Salix drummondiana / Carex scopulorum var. prionophylla* (Youngblood et al. 1985; Padgett et al. 1989; Kovalchik 1993; Hansen et al. 1995; Hall and Hansen 1997).

Succession- The successional origin of *Salix drummondiana / Carex utriculata* is not well known. Both *Salix drummondiana* and *Carex utriculata* can be colonizers of fresh, mineral alluvium (Hansen et al. 1995, Walford et al. 1997). Thus, when alluvium is exposed, such as post-flood silt deposits around willow roots or after a beaver dam breaks, these species may invade. Alternately, *Carex utriculata* might invade on silt deposited in open beaver ponds, then allowing later Salix invasion as the site dries (Mutz and Queiroz 1983). Another hypothesis, taken from the similar *Salix boothii / Carex utriculata* type, is that a Salix community existed before the beaver dam. The beaver dam was built, flooding the *Salix* but not eliminating it, subsequent siltation allowed *Carex utriculata* to invade, and *Salix* rejuvenated later (Youngblood et al. 1985, Padgett et al. 1989). Whatever the origin, stability of the *Salix drummondiana / Carex utriculata* community is indicated by a thick accumulation of organic matter (Kovalchik 1993). Disturbance by livestock or beaver will reduce *Salix drummondiana* cover and allow graminoids, especially introduced species, to increase (Mutz and Queiroz 1983). If willows are reduced too much, beaver will leave in search of food and fail to maintain dams washed out by storms. The water table will then lower as the stream downcuts and the community will change toward a drier *Salix drummondiana / Calamagrostis canadensis* or *Abies lasiocarpa* type (Hansen et al. 1988; Hansen et al. 1995).

Management- *Salix drummondiana / Carex utriculata* can be a productive community but will decrease if soils are damaged or hydrologic conditions change. For example, recreation trails, road building, agriculture (including draining with ditches), and livestock grazing easily damage organic soils through compaction and reduction of water holding capacity (Mutz and Queiroz 1983; Moseley et al. 1994; Hansen et al. 1995). These activities may also cause streambank sloughing as well as premature soil drying, the loss of vegetative protection, and eventual loss of the community. Beavers are also important in maintaining necessary hydrologic conditions. Thick shrub cover and excessive wetness often limit activities in this community. Livestock forage

value varies with season and historic use, but both *Salix drummondiana* and *Carex utriculata* are fair to good forage in the spring (Hansen et al. 1988, Hansen et al. 1995). Overgrazing of willows decreases their vigor and can eliminate them from the site allowing graminoid cover to increase. This may occur with a late summer and fall grazing regime, which reduces willow regrowth and allows sedges, with their underground root reserves, to later proliferate. Thus, long rest periods are needed to maintain the community (Hansen et al. 1995). Prescribed fire effectively rejuvenates dead clumps because *Salix drummondiana* sprouts vigorously after fire (quick, hot fires are preferred over slow, cool burns). Fires also increase *Carex rostrata* but only if ungrazed before and after the fire (Hansen et al. 1995). Both *Salix drummondiana* and *Carex rostrata* (and *Carex aquatilis* and *C. vesicaria*) are excellent for re-vegetation over the long-term and provide good erosion control (Hansen et al. 1995).

Wildlife Values- In the winter, *Salix drummondiana* shoots are heavily browsed by moose. Throughout the year *Salix drummondiana* is utilized by beaver and provides fair forage for elk and deer. Songbirds also utilize Salix species habitat for feeding and nesting. In addition to Salix root masses, the dense *Carex rostrata and Carex aquatilis* sod overhangs undercut banks creating prime fish habitat (Hansen et al. 1988; Hansen et al. 1995; Hall and Hansen 1997; Walford et al. 1997).

Element Code- CEGL002631

Edition / Author- 1998-11-25 / Chris Murphy

Salix glauca Shrubland (SALGLA) Glaucus willow

Natural Heritage Conservation Rank- G3? / S2

Environment- The single stand of *Salix glauca* occurred on a moderate to steep upper, north-facing slope, just in the lee of a divide ridge at 9,900 ft in the Snowcrest Range. We observed but did not sample other examples of this type in the Gravelly Range. This site was a definite snow catchment area. Adjacent associations were Carex elynoides turf and moist slopes.

Vegetation- *Salix glauca* had canopy cover of 60%; no other shrubs were present. Trace amounts of *Poa alpina* and *Elymus lanceolatus* were present, but total graminoid cover was only 1%. Forb cover was 60%. Common species included *Aster alpigenus, Hedysarum sulphurescens, Senecio crassulus and Synthyris pinnatifida*. Lichens and mosses covered 7% of the ground surface.

Soils- Parent material was calcareous sandstone. Exposed ground and gravel constituted 6% of the surface. Depths of litter and duff were 1.0 in and 0.5 in respectively. The high surface organic matter probably reflects low rates of decomposition due to low insolation and late snowmelt. Percent coarse fragments were very different for different microsites but averaged 30% for the stand. The texture of the fine fraction was sandy loam. Soil pH was 7.6. Organic matter content was 14%, mean total nitrogen was 0.31%, and C: N ratio was 28:1.

Productivity- Our estimates are based on only three plots in one stand and should be considered only rough approximations. *Salix glauca* produced 759 lbs/acre. Graminoid productivity was 12 lbs/acre, and forb productivity was 759 lbs/acre. Total productivity was 1,530 lbs/acre.

Other Studies- Achuff and Corns (1982) describe three community types dominated by *Salix glauca* from the Canadian Rockies. These associations contain other shrubs (i.e., *Salix, Betula, and Potentilla*) and better developed graminoid cover. *Salix glauca* associations were observed near treeline in the Front Range of Montana, south of Glacier National Park (Cooper and Lesica, pers. obs.). Associations dominated by *Salix glauca* occur on gentle lee slopes on the east end of the Beartooth Range (Lesica 1991). Common understory species in these communities were

Carex paysonis, Deschampsia cespitosa, Geum rossii and Lupinus argenteus. In the Beartooth Range of Montana and the Rocky Mountains of Colorado, *Salix planifolia* and *S. glauca* dominated associations found on cool moist slopes having late snow release (Johnson and Billings 1962, Komarkova and Webber 1978).

Element Code- CEGL001136

Edition / Author- 97 –10 / S.V. Cooper et al.

Salix geyeriana / Calamagrostis canadensis Shrubland (SALGEY / CALCAN) Geyer's willow / Bluejoint reedgrass

Natural Heritage Conservation Rank- G5 / S4

Environment- The *Salix geyeriana*/ *Calamagrostis canadensis* association can be found in montane habitats in western Montana (from valley bottoms to mid-elevations in the mountains) and in the mountains of central and eastern Montana. It is frequently found on alluvial terraces where beaver activity has created a series of dams that raise the local water table, along streams, and near seeps or springs. Soils are usually deep silt or sand overlying more sand, gravel, or cobbles. This community usually floods during spring, with the water level within 1m of the surface the rest of the year. Nearby wetter communities could include *Carex utriculata*, *Salix geyeriana*/ *Carex utriculata, Typha latifolia*, or open water, and nearby drier communities could include *Populus balsamifera ssp. trichocarpa* / *Cornus sericea*, *Calamagrostis canadensis*, *Deschampsia cespitosa*, or *Juncus balticus*. A variety of adjacent uplands could occur nearby, ranging from conifer dominated communities to dry shrublands such as *Artemisia tridentata* associations (Hansen et al. 1988, Hansen et al. 1995).

Range- This community or one very similar to it occurs in Montana, Utah, Nevada, and Idaho.

Vegetation- The *Salix geyeriana*/ *Calamagrostis canadensis* association typically has an overstory dominated by *Salix geyeriana*, which occurs as large clumps, and an understory dominated by *Calamagrostis canadensis*. These stands have an open corridor aspect, while *Salix boothii* communities are more often closed and less easily accessible by large ungulates (Padgett et al. 1989). Other willows commonly found in this community are *Salix boothii* and *Salix drummondiana*; however, *Salix geyeriana* is clearly the dominant willow. Common associated understory species are *Carex utriculata, Geum macrophyllum, Mentha arvensis, Solidago canadensis*, and *Equisetum arvense* (Hansen et al. 1995).

Similar Communities- This community has also been documented in Utah (Padgett et al. 1989) and Idaho (Hall and Hansen 1997, Youngblood et al. 1985). Several studies (Hansen et al. 1995, Hall and Hansen 1997) include in this association stands dominated by *Salix boothii*, a willow that is frequently a codominant with *Salix geyeriana*. Other authors (e.g. Padgett et al. 1989) separate *Salix boothii*-dominated stands as a separate plant association, based on structural differences between *Salix boothii* and *Salix geyeriana* stands. Kittel et al. (1998) describe a *Salix geyeriana-Salix monticola*/*Calamagrostis canadensis* community which has an understory that is similar to *Salix geyeriana*/ *Calamagrostis canadensis* but which has *Salix monticola* in the overstory as a codominant instead of *Salix boothii*. In Nevada, Manning and Padgett (1995) describe a *Salix geyeriana*/ Mesic graminoid association which is similar to *Salix geyeriana*/*Calamagrostis canadensis*, although the understory of the former is apparently more diverse.

Succession- *Salix geyeriana*/*Calamagrostis canadensis* stands are fairly stable if the hydrologic regime remains unchanged. Kittel et al. (1998) suggest that flooding events in *Salix geyeriana*/*Carex utriculata* communities can result in sediment deposition, which raises the floodplain surface higher above the water table. As the floodplain aggrades, the site could become less saturated, which could cause the graminoid understory to change towards

Calamagrostis canadensis. Similarly, Kittel (1994) states that distance from the stream channel can change the degree of soil saturation, and thereby influence the understory composition. Removal of beaver from a *Salix geyeriana*/*Carex utriculata* stand could also cause compositional changes. Unmaintained beaver dams could break, and cause a lowering of the water table, which could cause a shift in the dominant understory graminoid towards *Calamagrostis canadensis* (Hansen et al. 1995).

Management- *Calamagrostis canadensis* is moderately to highly palatable and with high grazing pressure, the vigor, reproductive success, and competitive ability of this grass will decrease. Exotic pasture grasses such as *Poa pratensis* or *Agrostis stolonifera* may then increase. Livestock grazing in this association should be avoided when the soils are wet to avoid churning of the soil surface. *Salix geyeriana*/ *Calamagrostis canadensis* stands exposed to heavy browsing pressure usually show reduced vigor of the willow species, such as highlining, clubbing, or dead clumps, with eventual decrease in willow coverage (Hansen et al. 1995).

Element Code- CEGL001205

Edition / Author- 99-10-15 / J.Greenlee, MTNHP

Salix geyeriana / Carex utriculata Shrubland (SALGEY / CARUTR) Geyer's willow / Beaked Sedge

Natural Heritage Conservation Rank- G5 / S5

Environment- The *Salix geyeriana* / *Carex utriculata* association can be found in montane habitats in western Montana (from valley bottoms to mid-elevations in the mountains) and in the mountains of central and eastern Montana. It is frequently found on alluvial terraces where beaver activity has created a series of dams that raise the local water table, along streams, and near seeps or springs. Soils are usually fine textured mineral soils that accumulate during periodic flooding events, and they may have a surface organic horizon. Soil reaction is neutral to moderately alkaline (pH 7.0 to 7.5), and this community is usually flooded during spring and early summer, with the water level near the surface the rest of the year. Nearby wetter communities could include *Carex utriculata*, *Typha latifolia*, or open water, and nearby drier communities could include *Salix geyeriana*/*Calamagrostis canadensis*, *Calamagrostis canadensis*, *Deschampsia cespitosa*, or *Juncus balticus*. A variety of adjacent uplands could occur nearby, ranging from conifer dominated communities to dry shrublands such as *Artemisia tridentata* associations (Hansen et al. 1988, Hansen et al. 1995).

Range- This community is found in Montana, Idaho, eastern Oregon, Utah, Nevada, Colorado, and Wyoming.

Vegetation- The *Salix geyeriana* / *Carex utriculata* association typically has an overstory dominated by *Salix geyeriana* which occurs as large clumps and an understory dominated by *Carex utriculata*. Other willows commonly found in this community are *Salix boothii* and *Salix drummondiana*. Common associated understory species are *Carex aquatilis*, *Geum macrophyllum*, and *Epilobium ciliatum*. This community can occur as a part of a diverse mosaic of wetland types depending on degree and frequency of flooding, scouring, channel changes, and beaver activity (Hansen et al. 1995).

Similar Communities- This community has been documented by a number of studies in other western states: eastern Oregon (Kovalchik 1987), Utah (Padgett et al. 1989), Nevada (Manning and Padgett 1995), Idaho (Hall and Hansen 1997), Colorado (Kittel et al. 1998), and Wyoming (Chadde et al. 1988). Several studies (Hansen et al. 1995, Hall and Hansen 1997) include in this association stands dominated by *Salix boothii*, a willow that is frequently a codominant with *Salix geyeriana*. Other authors (e.g. Padgett et al. 1989) separate *Salix boothii*-dominated stands as a separate

plant association, based on structural differences between *Salix boothii* and *Salix geyeriana* stands.

Succession- *Salix geyeriana* / *Carex utriculata* stands are fairly stable if the hydrologic regime remains unchanged. However, flooding events can result in sediment deposition, which raises the floodplain surface higher above the water table. As the floodplain aggrades, the site could become less saturated, which could cause the graminoid understory to change. Similarly, Kittel (1994) states that distance from the stream channel can change the degree of soil saturation, and thereby influence the understory composition. Removal of beaver from a *Salix geyeriana*/*Carex utriculata* stand could also cause compositional changes. Unmaintained beaver dams could break, and cause a lowering of the water table, which could cause a shift in the dominant understory graminoid (Hansen et al. 1995).

Management- *Salix geyeriana* / *Carex utriculata* stands exposed to heavy browsing pressure usually show reduced vigor of the willow species, such as highlining, clubbing, or dead clumps, with eventual decrease in willow coverage. Livestock disturbance in drier *Salix geyeriana* / *Carex utriculata* stands can result in increases in cover of exotic pasture grasses like *Poa pratensis* or *Agrostis stolonifera*

Element Code- CEGL001207

Edition / Author- 1999-10-15 / J. Greenlee, MTNHP

Salix planifolia / Carex nebrascensis Shrubland (SALPAL / CARNEB) planeleaf willow / Nebraska sedge

Natural Heritage Conservation Rank- G? / S?

Environment- *Salix planifolia / Carex nebrascensis* is a minor community type, generally occurring as small (<1 acre) patches in the Centennial Valley vicinity on flat or gently sloping meadows and on lower slopes with a variety of aspects. The high water tables found in *Salix planifolia / Carex nebrascensis* result from lateral subirrigation though in several instances this type was noted to be associated with fluvial conditions as narrow stringer of small, first order streams. This community is usually is the moistest on the local moisture gradient and grades to *Deschampsia cespitosa*-, Poa *pratensis*- or *Juncus balticus*- dominated c.t.'s. of drier positions or more usually abruptly gives way to the *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tripartita* / *Festuca idahoensis* c.t.

Vegetation- Shrub dominance on sampled occurrences varied between *Salix brachycarpa* and *Salix. planifolia* (ssp. unknown due to inopportune sampling time) and both species and *Pentaphylloides floribunda* were noted to be present in most stands, but coverages never exceeded 20% (see comments). The dominant aspect of these stands is a solid sward of mid-height graminoids, *Carex nebrascensis, Carex praegracilis, Carex. simulata, Calamagrostis stricta, Deschampsia cespitosa* and *Juncus balticus*; only the first thee named are abundant. Well represented *Pedicularis groenlandica* is the dominant forb and *Senecio sphaerocephalus, Aster occidentalis* and *Sisyrinchium angustifolium* are frequently present, often well represented. Basal area of graminoids and about 10% litter account for the 20% of the ground that is not a carpet of bryophytes.

Soils- The upper 10-20 cm of profiles have at least 50% fibrous to histic organic matter and the remainder is a silty or clayey mineral material; in one case the mineral material was a 3 cm. thick layer intercalated between two histic organic layers. Soils were saturated to the surface in late July.

Other Studies- This description should be considered preliminary as this exact community type has not been described elsewhere; in fact, a misidentification of Salix spp. on our part could place it with any number of *Salix*-dominated community types with *C. nebrascensis* as a dominant undergrowth component. Youngblood et al. (1985) describe a *Salix planifolia* c.t. of "low

elevations" in the Centennial Range and Yellowstone Plateau and note that *Carex utriculata* and *Juncus balticus* dominate the undergrowth therefore having a high resemblance to this type.

Comments- Judging by the intensive hedging of the *Salix* species (mature specimens not over 2 dm when potential is 1m plus) in these and adjacent *Salix*-dominated stands we surmise the wild ungulate pressure to be intensive on these sites. Some hummocking is present but not enough to create difficult walking. Cattle use has not yet markedly altered composition (potential for creating *Poa pratensis*- and *Juncus balticus*-dominated stands).

Element Code- CEGLMTHP20

Edition / Author- 97 –10 / S.V. Cooper et al.

Sarcobatus vermiculatus / Distichlis spicata Shrubland (SARVER / DISSPI) black greasewood / inland saltgrass

Natural Heritage Conservation Rank- G4 / S2

Environment- This uncommon type is found on wide stream terraces and lower alluvial fans often in areas of calcareous parent material such as the Centennial Valley. Higher terraces with less saline soil may support stands dominated by *Sarcobatus vermiculatus* or *Artemisia tridentata ssp. tridentata* and *Pascopyrum smithii* or *Leymus cinereus*. Nearby slopes are dominated by *Artemisia tridentata* or *A. tripartita* and *Pseudoroegneria spicata or Festuca idahoensis*.

Vegetation- *Sarcobatus vermiculatus* is the dominant shrub although canopy cover is often less than 10%. *Artemisia tridentata ssp. tridentata* and *Chrysothamnus nauseosus* are also often present. Halophytic grasses including *Distichlis stricta, Puccinellia distans,* and/or *Poa juncifolia* dominate the ground layer. Forbs are uncommon, and diversity is low. *Lepidium densiflorum, Haplopappus uniflorus* and *Antennaria microphylla* may be present. Mosses and lichens are absent.

Soils- Soils are silty and deep. The surface horizons are saline. Most of the soil surface is bare, and gravel is absent.

Other Studies- Mueggler and Stewart (1980, p. 76) state that they have reason to believe that this type occurs in western Montana, but they do not describe it. Similar vegetation has been described for eastern Washington (Daubenmire 1970), Colorado, Idaho and Oregon (Bourgeron and Engelking 1994).

Comments- *Sarcobatus vermiculatus* / *Distichlis stricta* and *Sarcobatus vermiculatus* / *Pascopyrum smithii* are similar types; this type might also be considered a saline phase of *the Sarcobatus vermiculatus / Pascopyrum smithii* c.t. (see Comments under *Sarcobatus vermiculatus* / *Pascopyrum smithii).*

Element Code- CEGL001363

Edition / Author- 99-11-16 / S.V. Cooper. MTNHP

Sarcobatus vermiculatus / Leymus cinereus Shrubland (SARVER / LEYCIN) black greasewood / basin wildrye

Natural Heritage Conservation Rank- G3 / S3

Environment- This association characteristically occurs in low precipitation areas as comparatively narrow bands along river and stream flood plains. *Sarcobatus vermiculatus* is typically found on heavy textured, poorly drained saline or alkaline substrates. According to Mueggler and Stewart (1980) environmental distinctions separating this type from *Sarcobatus vermiculatus / Pascopyrum smithii* have not been identified but *Sarcobatus vermiculatus* / *Leymus cinereus* does appear to be associated with better drained, less alkaline soils, such as occur on concave toe slopes (and not on flats). This association is documented to occur throughout the west, from Washington south to California

and east to Nevada and Wyoming.

Vegetation- Tussocks of the tall grass *Leymus cinereus* comprising at least 1% canopy cover distinguish this association from the related *Sarcobatus vermiculatus* / *Pascopyrum smithii* or *Sarcobatus vermiculatus* / *Distichlis stricta* associations. As in the *Sarcobatus vermiculatus* / *Pascopyrum smithii type, S. vermiculatus* is the shrub with the highest cover values, followed closely by *Artemisia tridentata* ssp. *tridentata* (or *A. tridentata* ssp. *wyomingensis*). The large shrub stature relative to that of the associated vegetation cause this type to be treated as a Shrubland (their combined cover usually not exceeding 15%). The low shrubs *Artemisia frigida* and *Chrysothamnus viscidiflorus* are noted to increase on disturbed sites and may have in excess of 10% cover. Technically speaking, combined shrub canopy cover values are never sufficient (>25%) for this to be classified as other than a shrub herbaceous type. *Pascopyrum smithii* and/or *Elymus lanceolatus* are the only abundant graminoids but others with high constancy include *Pseudoroegneria spicata, Koeleria macrantha, Carex filifolia* and *Poa juncifolia*. Forb diversity and cover is higher here than in related *S. vermiculatus*-dominated types; *Sphaeralcea coccinea, Aster falcatus, Aster. chilensis* and *Iva axillaris* are consistently present in trace amounts.

Comments- Mueggler and Stewart (1980) observe that overgrazing causes the decline of *Pascopyrum. smithii* and *Pseudoroegneria. pseudoroegneria* and that persistent heavy use can cause the decrease of *Koeleria cristata* and *Leymus. cinereus*. Krall et al. (1970) found early spring grazing, prior to the "boot" developmental stage, to be very detri-mental to *Leymus cinereus*. We suspect that some proportion of this type has been convert-ed to the *Sarcobatus vermiculatus* / *Pascopy-rum smithii* association through overgrazing in the early spring because *P. smithii*, though it is more palatable, is less susceptible than *Leymus. cinereus* to the pressures of inappropriately timed grazing.

Element Code- CEGL001366

Edition / Author- 99-12-03 / S.V. Cooper

Shepherdia argentea Shrubland (SHEARG) thorny buffaloberry

Natural Heritage Conservation Rank- G3G4/S3

Environment: *Shepherdia argentea* is a minor type documented only from the wetlands between Twin Bridges and Dillon Valley where it occurs in subirrigated valley positions in an extensive complex mosaic with other riparian and wetland communities. In this landscape *S. argentea* forms patchily distributed copses with other shrubs, the intervening ground being dominated by *Pascopyrum smithii, Sporobolus airoides* and other mesic graminoids. The southwestern MT occurrences contrast with those of Phillips and Valley Counties where it occurs as small stands (mostly < 1/5 acre) on the most mesic positions, often V-shaped ravines at drainage headwaters, in a rolling uplands or badlands landscape mosaic. This landscape position agrees with the observations of Hansen et al. [1991] who targeted riparian areas specifically and found the type along the Sun, Milk, Missouri and Yellowstone Rivers. Stands range from small to large patch and show much internal heterogeneity in both microtopography and vegetation, with clumpy distribution of *S. argentea* (and other shrubs). The smallest stands are not much more than individual clumps or narrow stringers of *S. argentea*.

Soils- Soils are developed from fine-textured alluvium whereas those of northeastern Montana are developed from glacial drift or shales. Several sites were noted to have gleyed and mottled soils; only one sampled stand in northeastern Montana at a drainage headland qualified as jurisdictional wetland with gleying and mottling within 6 in of surface. Being productive sites, the ground cover is primarily litter, though much bare soil is exposed where animal trails are concentrated.

Vegetation: *Shepherdia argentea*, a tall shrub

(4 to 7 ft tall in eastern MT sites and to 12 to 15 ft tall in Beaverhead Mountains Section) is usually abundant, forming a patchy distribution. *Symphoricarpos occidentalis*, *Rosa woodsii* (or *R. acicularis*) or *Juniperus horizontalis* may have greater cover, but occur in the low shrub layer. In eastern MT., *Ribes setosum* is consistently present as a mid to tall shrub. The forb layers form two sampled stands were very different, apparently reflecting differences in soil moisture. The wet-site herb layer was dominated by *Poa palustris* (eastern MT) or *Sporobolus airoides* and *Elymus trachycaulus* (western MT) whereas the drier stands were dominated by *Pascopyrum smithii* in both regions.

Other Studies: For Montana, *Shepherdia argentea* was first described in the southeast by Hansen and Hoffman (1988) and subsequently documented to range from southwestern, through central, to eastern sections by Hansen et al. (1995). Other northern Great Plains occurrences are described from North Dakota (Nelson 1961 and Boldt et al. 1978) and cited from South Dakota (Faber-Langendoen 1993).

Comments- At least in eastern Montana, due to landscape position and structure, these sites are heavily used by wild ungulates for cover; domestic stock also use these sites preferentially. Either/both of these groups are probably implicated in the introduction of *Euphorbia esula* (leafy spurge) to these moist habitats that are so favorable to its propagation.

Element Code- CEGL001128

Edition / Author- 99-12-03 / S.V. Cooper, MTNHP

Dwarf-Shrublands including Dwarf-Shrub Herbaceous

Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Dwarf-shrub Herbaceous Vegetation (ARTASL / ELYLAN) early low sagebrush / thick-spike wheatgrass

Natural Heritage Conservation Rank- G? / S?

Environment- *Artemisia arbuscula ssp. longiloba* / *Elymus lanceolatus* is found on gently sloping terraces and lower slopes of alluvial fans as well as broad, low ridges at 6,600-7,200 ft, usually in areas of calcareous parent material. Adjacent communities on moist stream terraces may be dominated by *Pentaphylloides floribunda, Juncus balticus, Carex praegracilis, Deschampsia cespitosa, Leymus cinereus* or *Poa juncifolia*. Deeper or better-drained soils are dominated by *Artemisia tridentata* ssp. *wyomingensis* or *A. tripartita* and *Elymus lanceolatus* or *Festuca idahoensis*.

Vegetation- *Artemisia arbuscula ssp. longiloba* is the dominant shrub with 10-40% canopy cover. Other common shrubs include *Chrysothamnus nauseosus* and *C. viscidiflorus*. *Artemisia frigida* is a common subshrub. Grass cover was 30-70%. *Elymus lanceolatus* is the dominant tall grass with 10-50% cover. Other common grasses include *Poa secunda, P. cusickii* and *P. juncifolia*. Forb cover is only ca. 10%, and diversity is low. Highly constant, usually poorly represented forb species include *Phlox hoodii, Antennaria microphylla, A. parvifolia* and *Erigeron compositus*. Mosses are absent, but lichens may be common.

Soils- Soils have a silty to clayey texture and are usually calcareous and perhaps saline as well. 30-70% of the soil surface is bare. There

is little or no surface gravel.

Other Studies- Vegetation dominated by *Artemisia arbuscula ssp. longiloba* and *Pascopyrum* is reported for Colorado (Bourgeron and Engelking 1994).

Comments- This type is used by antelope and may be important deer and elk winter range. See comments under *Artemisia nova / Pseudoroegneria spicata*. This association occurs only in southern Beaverhead County in Montana.

Element Code- CEGLMTHP01

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia arbuscula ssp. *longiloba / Festuca idahoensis* Dwarf-shrub Herbaceous Vegetation (ARTASL / FESIDA) early low sagebrush / Idaho fescue

Natural Heritage Conservation Rank- G3? / S2

Environment- Gentle slopes of broad low ridges, alluvial fans and terraces at 6,900-7,200 ft may support vegetation dominated by *Artemisia arbuscula ssp. longiloba* and *Festuca idahoensis*. This type usually occurs in areas of calcareous parent material. Sheet erosion is evident in many stands. Adjacent deeper and/ or better-drained soils support *Artemisia tridentata wyomingensis* or *vaseyana* and *Festuca idahoensis* or *Pseudoroegneria spicata*. *Elymus lanceolatus / Festuca idahoensis* gradually merges into the *Artemisia arbuscula ssp. longiloba* /*Elymus lanceolatus* c.t. on lower and gentler slopes with heavier soils.

Vegetation- The dominant shrub is *Artemisia arbuscula ssp. longiloba* with 10-20% canopy cover. *Chrysothamnus viscidiflorus* occurs in most stands. *Artemisia tridentata* and *A. tripartita* may occur when they occupy adjacent stands. Total grass canopy cover averages ca. 40%. *Festuca idahoensis* is the dominant grass with 20-40% cover. Other common grasses include *Elymus lanceolatus, Pseudoroegneria spicata Koeleria cristata* and *Poa secunda*. Forb cover is rarely greater than 10%. Common species include *Antennaria microphylla, Geum triflorum, Linum lewisii, Phlox hoodii* and *Taraxacum officinale*. Mosses are rare, but lichens are common in some stands.

Soils- Soils have a silty to clayey texture and are usually calcareous and perhaps saline as well. 20-70% of the soil surface may be bare or covered with gravel.

Other Studies- Similar vegetation has been reported for Nevada (Zamora and Tueller 1973) and Idaho (Tisdale et al. 1965) and likely occurs in Wyoming and Oregon as well (Bourgeron and Engelking 1994).

Comments- See comments under Artemisia nova / Pseudoroegneria spicata. In Montana, this association is known only from southern Beaverhead County.

Element Code- CEGL001522

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia nova / Pseudoroegneria spicata Dwarf-shrubland (ARTNOV / PSESPI) black sagebrush / bluebunch wheatgrass

Natural Heritage Conservation Rank- G4G5 / S3

Environment- This type is common on gentle to steep slopes, alluvial fans and terraces in areas of calcareous parent material; generally it is present on slopes with south- or west-facing aspects. It is found in the Tendoy Mountains north to Badger Pass at 5,500-7,200 ft. *Cercocarpus ledifolius* or *Pinus flexilis* dominates adjacent rockier soils. *Artemisia tridentata vaseyana* or *Artemesia tridentata tridentata* and *Festuca idahoensis, Pseudoroegneria spicata* or *Pascopyrum smithii* dominates deeper soils.

Vegetation- *Artemisia nova* is the dominant shrub with coverages up to 40%. *Chrysothamnus nauseosus* is usually common. Common subshrubs include *Artemisia frigida* and *Gutierrezia sarothrae*. *Pseudoroegneria spicata is* well represented and usually the dominant grass with canopy cover of 10-40%. *Stipa comata* and *Oryzopsis hymenoides* are highly constant but generally are not even well represented. Forb cover is sparse, but diversity is moderate. *Opuntia polyacantha, Phlox hoodii, Stephanomeria runcinata, Erigeron tweedyi* and *Penstemon aridus* are often present. Mosses are absent, and lichens are rare.

Soils- Soils have a silty or sandy texture and are usually stony, shallow and derived from calcareous parent material. Up to 80% of the ground may be bare or covered with gravel or rock.

Other Studies- Mueggler and Stewart (1980) first described this type for western Montana as *Artemisia arbuscula/Pseudoroegneria spicata*, lumping the *nova* and *arbuscula* subspecies of *A. arbuscula*. Various authors have subsequently recognized the distinct ecology, if not taxonomy, of these taxa. Similar vegetation has been reported for Oregon, Nevada, Idaho, Colorado and Wyoming (Bourgeron and Engelking 1994).

Comments- There has been a good deal of confusion surrounding the taxonomic nomenclature of the low sagebrush *Artemisia nova, Artemisia arbuscula* and *Artemisia. longiloba* in Montana. Hitchcock and Cronquist (1973) place all three taxa under *Artemisia. arbuscula*. Schulz (1984) recognizes *Artemisia. nova* as a distinct species, but places *Artemisia. longiloba* as a subspecies of *Artemisia. arbuscula*. Beetle (1982) recognizes all three as separate species. This variable nomenclature has caused confusion in the vegetation classification literature.

The closely related *Artemisia nova / Festuca idahoensis* c.t. also occurs in southwest Montana, but we failed to sample any stands.

Element Code- CEGL001424

Edition / Author- 99-11-16 / S.V. Cooper. P

Atriplex gardneri / Oryzopsis hymenoides Dwarf-shrubland (ATRGAR / ORYHYM) Gardner's saltbush / indian ricegrass

Natural Heritage Conservation Rank- G3 / S3

Environment- The type occurs on steep badland sites at elevations around 5000 feet. Bare soil cover totals at least 60% and most of the remaining ground cover is comprised of coarse fragments. The soil surface is unstable because of a lack of adequate vegetation cover and gully erosion is common.
Parent materials are sedimentary rocks and soils are very shallow and poorly developed. Soils range from not gravelly to very gravelly and are non-calcareous. Textures are generally very fine (e.g., silty clay loams) and available water holding capacity is low.

Vegetation- Total vegetation cover in this badlands type seldom exceeds 5%. Characteristic species include *Atriplex nuttallii, Chrysothamnus nauseosus,* and *Oryzopsis hymenoides*.

Adjacent Communities- Vegetation on adjacent more stable soils include the *Artemisia tridentata / Pseudoroegneria spicata type* on non-alkaline soils and the *Sarcobatus vermiculatus / Pascopyrum smithii* type on alkaline soils.

Other Studies- This type has not previously been reported in Montana but has been reported in Colorado and is listed as questionably present in Oregon and Wyoming (Bourgeron and Engelking 1994).

Element Code- CEGL001444

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Cassiope mertensiana / Carex paysonis Dwarf-shrubland (CASMER / CARPAY) Merten's moss-heather / Payson's sedge

Natural Heritage Conservation Rank- G2? / S2

Environment- *Cassiope mertensiana / Carex paysonis* is uncommon in the study area, occurring at the base of gentle, north- or east-facing slopes at 9,400-9,600 ft in the Anaconda and Tobacco Root ranges. This type probably also occurs in the Pioneer Range. These cool, protected sites have deep snow during the winter, and release comes somewhat late in the growing season. They often showed signs of frost-churning and solifluction, suggesting that they receive additional upslope moisture. *Cassiope mertensiana / Carex paysonis* exists in a mosaic with other snowbed associations such as *Carex nigricans* and J*uncus drummondii / Antennaria lanata* and often occurs adjacent to moist turf communities such as *Salix arctica* / *Polygonum bistortoides* and *Carex scirpoidea / Geum rossii. Cassiope mertensiana / Carex paysonis* probably experiences earlier snow release than the other mountain-heather community, *Phyllodoce empetriformis / Antennaria lanata*

Vegetation- Mean canopy cover of shrubs was 60%. *Cassiope mertensiana* and *Salix arctica* were the dominant shrubs; we refer to this community as Cassiope mertensiana because of its greater stature and generally greater abundance compared to *Salix. arctica*. *Phyllodoce glanduliflora* was present in one stand. Mean graminoid cover was 23%, with *Carex paysonis* the dominant one. *Poa alpina* and *Carex scirpoidea* were common; *Poa fendleriana* and *Deschampsia cespitosa* were well represented in one stand. Mean forb cover was 30%. *Geum rossii* and *Potentilla diversifolia* were common species, and *Erigeron simplex* and *Polygonum bistortoides* were frequent. *Antennaria lanata and Juncus drummondii* were notable for their absence or low cover. Mean cover of lichens and mosses was less than 1%.

Soils- Parent materials were quartzite, gneiss and granite. Bare ground and gravel covered 11% of the surface, while rock cover was 8%. Mean depth of litter was 0.2 in, and mean depth of duff was 0.1 in. Percent coarse fragments varied from 9% to 35% with a mean of 23%. Mean texture of the fine fraction was sandy clay. Soil pH ranged from 5.8 to 6.2 with a mean of 6.0. Mean organic matter content was 19%, mean total nitrogen was 0.52%, and C:N ratio was 19:1. Soils were moderately deep and moist to wet in late July.

Productivity- We measured productivity in only one stand, and Cassiope was difficult to clip accurately. Thus, our production estimates are only rough approximations. Shrub productivity was 237 lbs/acre, graminoid productivity was 267 lbs/acre, and forb productivity was 712 lbs/acre. Total productivity was 1216 lbs/acre.

Other Studies- Associations dominated by *Cassiope mertensiana* have been reported for the Canadian Rockies, the Cascade Range and northwest Montana. *Phyllodoce* spp. were often codominant. See discussion under *Phyllodoce empetriformis / Antennaria lanata* dwarf shrubland.

Element Code- CEGL001396

Edition / Author- 97 –10 / S.V. Cooper et al.

Dryas octopetala / Carex rupestris Dwarf-shrub Herbaceous Vegetation (DRYOCT / CARRUP) Mountain avens / curly sedge

Natural Heritage Conservation Rank- G4 / S3

Environment- This sparsely vegetated community type occurred on broad ridge tops, shoulders, saddles and upper slopes at 9,200-9,700 ft in the Pioneer and Anaconda ranges. Distinct patterning was apparent, with *Dryas*

octopetala forming mats surrounded by bare ground or rock pavement. Mats were either evenly spaced or aligned along the edge of stepped terraces or wind rows. Bamberg and Major (1968) report that *Dryas* mats in the Big Snowy Range of Montana demonstrated appreciable yearly downslope movement. However, wind rows at Siyeh Pass in Glacier Park were relatively stable. *Dryas octopetala / Carex rupestris* usually occurred in a matrix of dry or moist turf communities such *as Carex elynoides* or *Carex scirpoidea / Potentilla diversifolia*. This community type is closely related *to Dryas octopetala / Polygonum viviparum* and the two may intergrade. However, *Dryas octopetala / Polygonum viviparum* occurred on wetter sites, had higher total cover, and had more species, such as *Salix reticulata, Polygonum* spp., and *Poa alpina*, indicative of more mesic conditions.

Vegetation- Mean cover of dwarf shrubs was 38%. *Dryas octopetala* was the only common shrub species; *Cassiope mertensiana, Pentaphylloides floribunda and Salix arctica* each occurred in one stand. Mean graminoid cover was 13%. Common species included *Carex rupestris and C. elynoides*. *Calamagrostis purpurascens, Festuca ovina and Poa secunda* were locally distributed, individually seldom attaining more than 5% cover. Mean forb cover was only 15%, the second lowest value among all community types. *Oxytropis campestris* and *Phlox pulvinata* were common species found in most stands. *Anemone drummondii, Minuartia obtusiloba, Douglasia montana, Geum rossii, Oxytropis viscida, Potentilla diversifolia, Zigadenus elegans* and *Selaginella densa* were common in some stands. Cover of mosses and lichens was less than 1%.

Soils- Parent materials were limestone, granite and quartzite, with limestone predominating. Bare ground and gravel covered 40% of the surface. Mean depths of litter and duff were both 0.1 in. Percent coarse fragments ranged from 33% to 54% with a mean of 42%. Texture of the fine fraction varied from sandy clay to sandy clay-loam, and mean texture was sandy clay. Soil pH ranged from 6.2 to 7.8 with a mean of 7.3. Mean organic matter content was 12%, mean total nitrogen was 0.34%, and C:N ratio was 36:1. Soils evidenced past erosion events and are often unstable. Sandy clay-loam soils, which are derived from calcareous parent materials, often show evidence of frost churning.

Productivity- Our estimates are based on only three stands, and two of these occurred on barren soils derived from partially metamorphosed limestone. These soils likely have unusual physio-chemical properties that deter plant establishment and growth. Consequently, our production estimates for this type are probably low. Shrub productivity varied from 44 to 651 lbs/acre with a mean of 157 lbs/acre. Graminoid productivity ranged from 15 to 89 lbs/acre with a mean of 33 lbs/acre. Forb productivity varied from 8 to 148 lbs/acre with a mean of 43 lbs/acre. Total productivity averaged 233 lbs/acre.

Other Studies- Achuff and Corns (1982) describe an alpine type from the Canadian Rockies dominated by *Dryas octopetala* and *Kobresia myosuroides*, but this community has many mesic site indicators and is more similar to our *Dryas octopetala/Polygonum viviparum*. Douglas and Bliss (1977) describe *Dryas* fellfields from the North Cascades of Washington. Besides *Dryas ctopetala*, only a handful of other species, including *Festuca ovina* and *Minuaritia obtusiloba*, were common. Associations dominated by *Dryas octopetala, Carex rupestris, Carex. elynoides* and *Carex. scirpoidea* occur in the Big Snowy and Flint Creek ranges of Montana (Bamberg and Major 1968). *Dryas* communities in Glacier Park, Montana appear compositionally intermediate between those in the Flint Creek Range and those of the Canadian Rockies (Bamberg and Major 1962, Choate and Habeck 1967). Johnson and Billings (1962) state that *Dryas octopetala* colonizes wind-eroded sites and is very limited on the Beartooth Plateau of south-central Montana and adjacent Wyoming. Urbanczyk and Henderson (1994) described vegetation dominated by *Dryas octopetala* and *Carex. rupestris* on steep north slopes below snowbanks in Idaho's Lemhi Range.

Communities dominated by *Dryas octopetala* and *Carex rupestris* from the Rocky Mountains of Colorado are associated with high levels of calcium according to Komarkova and Webber (1979) and Willard (1978), but Eddleman and Ward (1984) found no such relationship. *Festuca ovina, Geum rossii, Silene acaulis* and *Trifolium nanum* are also common in the Colorado representation of this type.

Our two *Dryas*-dominated types *Dryas octopetala / Carex rupestris* and *Dryas octopetala / Polygonum viviparum* appear to be at the drier and wetter ends of a moisture gradient. The former type predominates in relatively dry mountain ranges of the Central and Northern Rockies and on the east side of the Cascades, while the latter type is more common in the Canadian Rockies and the wetter ranges of the Northern Rockies (see Other Studies under *Dryas octopetala / Polygonum viviparum*).

Element Code- CEGL001892

Edition / Author- 97 –10 / S.V.Cooper et al.

Dryas octopetala / Polygonum viviparum Dwarf-shrub Herbaceous Vegetation (DRYOCT / POLVIV) white dryas / viviparous bistort

Natural Heritage Conservation Rank- G3? / S2

Environment- This minor type was found in both the wettest, (Anaconda and Madison) and driest (Tendoy) ranges. Small occurrences of this type were noted but not sampled in other mountain ranges. This vegetation was generally found on northerly-facing gentle to steep slopes. Evidence of disturbance, including solifluction, slumps and earthflows, were also common. Only trace amounts of rock were exposed but gravel ranged from 5 to 30%.

Vegetation- Mats of *Dryas octopetala*, ranging in cover from 30 to 80%, and *Salix reticulata* (5-20% c.c) provided the dominant aspect of this c.t. Graminoid canopy cover was low, not exceeding 5%, and composed of the common turf species *Carex elynoides, C. rupestris*, and *Festuca ovina* as well as *Poa alpina*. Average forb cover was also relatively low, 14%, with dominance shared among the diagnostic species for the type, *Polygonum viviparum, P. bistortoides, Zigadenus elegans* and *Oxytropis viscida*. Other forbs with high constancy, low coverage and some degree of fidelity to this type were *Lloydia serotina, Senecio crassulus, Smelowskia calycina, Oxytropis campestris* and *Pedicularis cystopteridifolia*. Two plots had moss and lichen coverages in excess of 50% adding to the impression of a smooth blanket of vegetation.

Soils- Parent materials were limestone and quartzite. Average litter and duff depth were, respectively 0.4 and 0.5 in. Coarse fragment content ranged from 8 to 45% and averaged 30%. Mean textural class of the fine fraction was sandy clay. Soil reaction for calcareous sites ranged from 7.4 to 7.6; the lone quartzite sample was more than one pH unit lower at 6.2. Mean organic matter content was 25%, mean total nitrogen was 0.75%, and C:N ratio was 18:1. This type had the highest average organic matter and nitrogen content of any non-wetland community in our study.

Productivity- Of the two plots clipped, the one from the rocky site registered only 548 lbs/acre (46% shrub) whereas the one with only trace amounts of exposed rock and soil produced 1229 lbs/acre (97% shrub).

Other Studies- Vegetation similar to *Dryas octopetala / Polygonum viviparum* is common in the Canadian Rockies (Achuff and Corns 1982, Hrapko and LaRoi 1978). Canadian types have high diversity of lichens and mosses and are considered successionally mature. Concentrating on calcareous substrates of several Montana ranges, Bamberg and Major (1968) sampled many stands of what they termed zonal alpine vegetation, but did not explicitly group stands into community types. On the basis of their stand tables it appears *Dryas octopetala / Polygonum viviparum* is a major c.t. in Glacier National Park and Big Snowy Mountains. A similar turf type occurs

in the Flint Creek Range. In the Colorado Rockies, Willard (1979) described moist fellfield communities dominated by *D. octopetala* with significant *P. viviparum* cover and lichens and mosses, but lacking dwarf *Salix* spp.; she described dwarf willow communities as being confined to snowbed environments. McGraw (1985) found that *D. octopetala* consists of at least two distinct ecotypes in Alaska: one that occurs in cool, moist habitats and one that is found on dry, exposed sites. Similar ecotypic differentiation would explain the dominance of *D. octopetala* in the relatively cool, moist *Dryas octopetala / Polygonum viviparum* c.t. as well as the drier *Dryas octopetala / Carex rupestris* c.t.

Element Code- CEGL001894

Edition / Author- 97 –10 / S.V.Cooper et al.

Phyllodoce empetriformis / Antennaria lanata Dwarf-shrubland (PHYEMP / ANTLAN) Mountain-heather / woolly pussytoes

Natural Heritage Conservation Rank- G3 / S3

Environment- *Phyllodoce empetriformis / Antennaria lanata* was locally common on gentle to moderate, protected slopes between 9,200 and 10,100 ft in the Anaconda, Madison and Pioneer ranges, associated with crystalline parent materials in these wetter ranges of our study area. These sites are undoubtedly well covered by snow during the winter, and melt off probably occurs relatively late in the season, although not as late as in the *Carex nigricans* c.t. In addition to other snowbed associations such as *Carex nigricans* and *Juncus drummondii / Antennaria lanata, Phyllodoce* empetriformis /Antennaria lanata often grades to moist turf communities such as *Salix arctica* / *Polygonum bistortoides* and Carex scirpoidea / *Geum rossii.* A typical toposequence on a lee slope might *be Carex scirpoidea / Geum rossii* on the lower slope, *Phyllodoce empetriformis /Antennaria lanata* at the base of the slope, *with Carex nigricans* in the bottom.

Vegetation- Dwarf shrubs provide the dominant aspect with a mean cover of 55%. *Phyllodoce empetriformis* and *Vaccinium scoparium* were common in all four stands, while *P. glanduliflora* and *Cassiope mertensiana* were common in two of the stands. Mean graminoid cover was low, 20%. *Carex paysonis, Juncus drummondii and Poa fendleriana* were common graminoids occurring in all or most stands. Forb cover was 35%; *Antennaria lanata, Polygonum bistortoides* and *Sibbaldia procumbens* were consistently present, though only *A. lanata* occurred with greater than 5% cover. Mean cover of mosses and lichens was less than 1%.

Soils- Parent materials were granite and quartzite. Cover of bare ground and gravel was 15% with 8% cover of rock. Mean depths of litter and duff were both 0.1 in. Percent coarse fragments varied from 0% to 14% with a mean of 7%. Mean texture of the fine fraction was sandy clay-loam. Soil reaction ranged from 6.0 to 6.4 with a mean pH of 6.1. Mean organic matter content was 14%, mean total nitrogen was 0.30%, and C:N ratio was 23:1. Soils underlying %. *Phyllodoce empetriformis* were relatively deep and generally still moist in late July.

Productivity- We measured productivity in only two stands, and the heather species proved difficult to clip accurately. Thus, our production estimates are only rough approximations. Mean shrub productivity was 166 lbs/acre. Graminoid productivity had a mean of 133 lbs/acre, and forb productivity had a mean of 104 lbs/acre. Mean total productivity was 403 lbs/acre.

Other Studies- Mountain-heather communities similar to *Phyllodoce empetriformis / Antennaria lanata* have been reported for Banff and Jasper national parks in the Canadian Rockies by Achuff and Corns (1982) and Hrapko and LaRoi (1978). The Canadian types had similar composition, but *Phyllodoce glanduliflora* and *Cassiope mertensiana* were the dominant heather species. Mountain-heather communities from the North Cascades

of Washington are more similar to *our Phyllodoce empetriformis /Antennaria lanata* (Douglas 1972, Douglas and Bliss 1977). Whereas Douglas (1972) combines all *Phyllodoce*- and *Cassiope*-dominated associations into one community type, Douglas and Bliss (1977) designate separate community type dominated by *Phyllodoce empetriformis, Phyllodoce glanduliflora* and *Cassiope. mertensiana*. In the North Cascades, where snowpack is much higher than most areas of the northern Rockies, these communities are not confined to areas of late snow release. Apart from these studies, Choate and Habeck's (1967) mention of a similar type at Logan Pass in Glacier National Park in northwest Montana is the only other reference to heather-dominated communities. Thus, mountain-heather associations appear to be confined to the mountains north and west of our study area.

Element Code- CEGL001405

Edition / Author- 97 –10 / S.V.Cooper et al.

Salix reticulata / Caltha leptosepala Dwarf-shrubland (SALRET / CALLEP) snow willow / marsh marigold

Natural Heritage Conservation Rank- G3 / S2

Environment- Sampled in only the Tendoy and Gravelly ranges, *Salix reticulata / Caltha leptosepala* appears to be a minor type, environmentally and floristically related to *Salix arctica* / *Polygonum bistortoides.* The relative paucity of this c.t. can be explained, at least in part, by lack of appropriate habitat (i.e., gentle to steep north-facing slopes). Slopes with this aspect and possessing a soil mantle are not common in the predominantly north-south trending ranges of the study area. Slopes with northerly aspects did occur as spur ridges but often they were merely boulder fields. Both stands carpeted active solifluction slopes and were subirrigated from late-persisting snowfields lying above. Ostensibly these sites could be as wet as *Carex scopulorum* / Caltha leptosepala, differing by lacking stagnant water and possessing both unstable substrates and possibly long-persisting snowpacks.

Vegetation- The prevailing aspect of this c.t. was a lush green carpet of dwarf shrub species (average c.c. 70%), among which *Salix reticulata* (= *S. nivalis*) was dominant, but *Salix rotundifolia* (= *Salix dodgeana*) and *Salix arctica* also figure prominently. The graminoid component was sparse, not exceeding 20% c.c. with *Carex haydenii, Carex nova, Carex scirpoidea, Deschampsia cespitosa, Luzula spicata* and *Poa alpina* having at least 5% c.c. in one or more stands. Averaging 21% c.c., *Caltha leptosepala* was a diagnostic species (only forb with 100% constancy) and it, along with *Silene acaulis*, were the only forbs with more than 10% coverage.

Soils- Both stands were developed on limestone but were notably low in coarse fragment content (< 10%). Litter and duff depths were less than 0.5 in. Mean soil texture was clay. Despite the wet conditions, soil reaction was typical for calcareous substrates (7.5 average). Mean organic matter content was 15%, mean total nitrogen was 0.40%, and C:N ratio was 24:1.

Productivity- The wide range in productivity, 517-1,670 lbs/acre, despite the similarity of site parameters, is partly explained by the fact that the low-productivity site had experienced snow release just prior to sampling. The higher figure would be more typical for the c.t. The shrub fraction of total production was 56% and 78%.

Other Studies- Stands dominated by *Caltha leptosepala* and *Trollius laxus* with a significant contribution by *Salix arctica* and *Salix reticulata* are occasionally found in alpine seepage areas in the Canadian Rockies (Achuff and Corns 1982). Johnson and Billings (1962) describe for the Beartooth Range small areas of soil frost disturbance dominated by *Salix arctica* or *S. reticulata* and *Trifolium parryi*. They infer these sites to be in an early stage of recolonization and describe no more extensive communities with dwarf Salix

spp. dominant. Our sites are like those of the Beartooth Range but disturbance (solifluction and congeliturbation) has apparently occurred on a much larger scale. Willard (1979) describes alpine marshes in Colorado Rockies dominated by *Carex scopulorum* and *Caltha leptosepala* with *Salix arctica* a common species (see discussion under *Carex scopulorum / Caltha leptosepala*). In her Colorado study area *S. reticulata* is apparently rare.

Element Code- CEGL001435

Edition / Author- 97 –10 / S.V.Cooper et al.

Herbaceous Vegetation with a Sparse Needle-leaved or microphyllus Evergreen Shrub Layer

Artemisia cana / Elymus trachycaulus Shrub Herbaceous Vegetation (ARTCAN / ELYTRA) silver sage / bearded wheatgrass

Natural Heritage Conservation Rank- G? / S?

Environment- This is a very minor vegetation component found on terraces, wide valley bottoms and fans. On the Red Rocks Lake National Wildlife Refuge we noted a number of very small areas where *Elymus trachycaulus* (syn. *Agropyron caninum*) constituted the dominant graminoid under a light canopy (10-20% cover) of *Artemisia cana*. *Poa juncifolia* and *Poa cusickii* are commonly associated with this community. The forb component is depauperate and composed of increaser species such as *Achillea millifolium, Artemisia ludoviciana, Tragopogon dubius* and *Antennaria microphylla*.

Vegetation- This type has not been described elsewhere and may represent a seral stage of *Artemisia cana / Pascopyrum smithii* (identified by the dominance of *Pascopyrum smithii* or *Elymus lanceolatus*). That *Artemisia cana* / *Elymus trachycaulus* would constitute a grazing "disclimax" is somewhat improbable given that *Elymus trachycaulus* is only slightly less palatable than the highly palatable *Pascopyrum smithii*; one would not expect one species to be so highly differentially grazed that it would be virtually eliminated and yet a companion species would remain in a vigorous condition. The *Artemisia cana / Pascopyrum smithii* type is common in southwestern Montana, but is often highly impacted by grazing and "converted" to *Artemisia cana* / *Poa pratensis*.

Element Code- CEGLMTHP37

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia cana / Festuca idahoensis Shrub Herbaceous Vegetation (ARTCAN / FESIDA) Silver sage / Idaho fescue

Natural Heritage Conservation Rank- G3? / S3?

Environment- This plant association was first named by Mueggler and Stewart (1980) and described as occurring in southwestern Montana (Yellowstone Park vicinity) as small patches on deep, loamy, alluvial soils along mountain streams above 6,000 feet elevation. It occurs as a very minor landscape component on the RRLNWLR associated with virtually identical environmental parameters as described by Mueggler and Stewart (1980) for the type at large.

Vegetation- Vegetation composition is that of the more moist portions of *the Artemisia tridentata ssp. vaseyana / Festuca idahoensis* habitat type, with high cover (> 30-40%) for *Festuca idahoensis*, and variable cover of other mesic graminoids including *Bromus carinatus, Bromus anomalus, Stipa occidentalis*, and *Elymus trachycaulus* (syn. *Agropyron caninum*). The shrub component, which generally does not exceed 15-20 % canopy cover, is dominated by *Artemisia cana* with

scattered *A. tridentata* ssp. *tridentata* or *A. tridentata* ssp. *vaseyana*. The forb component is rich with *Geranium viscosissimum, Potentilla gracilis, Geum triflorum*, and *Agoseris glauca* contributing the greatest cover; the moistest sites support appreciable amounts of *Polygonum bistortoides* and *Carex petasata*. *Taraxacum officinale, Achillea millifolium* and *Trifolium* spp. have high cover where grazing has altered communities.

Element Code- CEGL001552

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia cana / Poa pratensis Shrub Herbaceous Vegetation (ARTCAN / POAPRA) silver sage / Kentucky bluegrass

Natural Heritage Conservation Rank- G? / S?

Environment- *Artemisia cana / Poa pratensis* is a grazing induced "disclimax" of any one of a number of plant associations including *Artemisia cana / Festuca idahoensis, Artemisia cana / Elymus trachycaulus* or most probably *Artemisia cana / Pascopyrum smithii*. Within greater southwestern *Montana Artemisia cana / Pascopyrum smithii* is the most abundant association dominated by *Artemisia cana* (though within this region the type is relatively scarce); presumably the Centennial Valley is not unique so that *most Artemisia cana / Poa pratensis* would be derived from overgrazing of *Artemisia cana / Pascopyrum smithii*. Usually occurring as stringers on the first (or second) terrace up from small mountain streams, these communities occupy mesic to wet sites, with deep alluvial soils.

Vegetation- In the more severe cases of "conversion" the scattered shrub canopy (combined cover <20%) of *Artemisia cana* and occasionally *A. tridentata* ssp. *vaseyana* or *A. tridentata* ssp. *tridentata* is imposed over a sward of *Poa pratensis* and *Trifolium* spp. In less impacted stands graminoid remnants of past vegetation, such as *Carex petasata, Pascopyrum smithii, Elymus lanceolatus, Bromus ciliatus*, or *Stipa occidentalis* will be present. Cover for *Achillea millifolium, Trifolium spp., Potentilla gracilis*, and *Agoseris glauca* appears to increase under these conditions; where disturbance has been severe *Taraxacum officinale* can form a virtually continuous carpet (often with *Trifolium* spp.).

Element Code- CEGLMTHP38

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrub Herbaceous Vegetation (ARTTSV / FESIDA) mountain big sagebrush / Idaho fescue

Natural Heritage Conservation Rank- G5 / S4

Environment- Artemisia tridentata ssp vaseyana/Festuca idahoensis is common on slopes and upper terraces at 6,000-8,500 ft throughout the study area. Parent materials included limestone, quartzite, volcanic, igneous and alluvium. Adjacent cooler slopes support *Pseudotsuga menziesii* or *Pinus flexilis* forests. Sites with shallow soil are often dominated by *Cercocarpus ledifolius*. Nearly level sites of terraces with finer textured soils may be dominated by *Artemisia tridentata ssp. tridentata*.

Vegetation- *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub with canopy cover of 10-70%. *Chrysothamnus viscidiflorus* is the only other frequent and common shrub. Grass cover is generally high. *Festuca idahoensis* is the dominant grass with mean canopy cover of 48%. Other common grasses are *Pseudo-roegneria spicata and Koeleria cristata*. Forbs are generally abundant, and diversity is moderate to high. Common species include *Achillea millefolium, Antennaria microphylla, Besseya wyomingensis, Eriogonum umbellatum, Geum triflorum* and *Taraxacum officinale*. Mosses are uncommon in most stands. Particularly mesic sites at higher

elevations have robust grasses such as *Bromus carinatus* and *Elymus lanceolatus* and higher coverage of mesic forbs such as *Geranium viscosissimum, Galium boreale, Geum triflorum* and *Potentilla gracilis*.

Soils- Soils have a loamy texture and are generally deep. Up to 30% of the ground may be bare. Gravel is uncommon or absent.

Other Studies- Mueggler and Stewart (1980) describe this type for western Montana. Similar vegetation has been reported for all states in the Northern Rocky Mountains and intermountain states (Bourgeron and Engelking 1994). Mueggler and Stewart (1980) discuss how these associations differ from those in Montana.

Comments- Mesic stands supporting an abundance of robust grasses and forbs is considered the *Geranium viscosissimum* phase of the type (Mueggler and Stewart 1980).

Elk and mule deer are common in these habitats. Pocket gophers are evident in some stands.

Element Code- CEGL001533

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Herbaceous Vegetation (ARTTSW / PSESPI) Wyoming big sagebrush / bluebunch wheatgrass

Natural Heritage Conservation Rank- G4 / S3

Environment- Gently sloping alluvial fans and terraces may support stands of *Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata*. The single sample stand was at 7,400 ft, but this type might be expected to occur at 5,000-7,500 ft. Adjacent stands with heavier soils and poor drainage are dominated by *Artemisia arbuscula ssp. longiloba* and *Elymus lanceolatus* or *Festuca idahoensis* or *Leymus cinereus* and *Poa juncifolia*. Adjacent slopes with deeper soils may support stands dominated by *Artemisia tridentata vaseyana* and *Festuca idahoensis.*

Vegetation- *Artemisia tridentata* ssp. *wyomingensis* is the dominant shrub with a cover of at least 10%; in the course of reconnaissance cover was noted to vary from 5-10% (in the establishment phase) to 30% plus in stands heavily impacted by grazing. *Chrysothamnus* spp. may also be present. Grass cover may be as high as 60%, and *Pseudoroegneria spicata is* the dominant species. *Poa secunda* and *Koeleria cristata* are other high constancy grasses; with light grazing they are poorly represented but increase somewhat in proportion to increasing grazing pressure. Common forbs include *Phlox hoodii* and *Antennaria microphylla*. Mosses and lichens are uncommon or absent.

Soils- Soils are silty in texture. Much of the surface is bare, and surface gravel is common.

Other Studies- Vegetation dominated by *Artemisia tridentata wyomingensis* and *Pseudoroegneria spicata is* described for western Montana by Mueggler and Stewart (1980) who do not differentiate between subspecies *wyomingensis* and *vaseyana*. Jorgensen (1979) describes this type for central Montana. This type has also been reported for Washington, Oregon, Nevada, Idaho, Wyoming and Colorado (Bourgeron and Engelking 1994).

Comments- Subspecies *vaseyana* appears to be more common than subspecies *wyomingensis* in the high country of southwest Montana. We expect subspecies *wyomingensis* to be common only in the more windswept or otherwise arid sites where subspecies *vaseyana* is excluded.

Element Code- CEGL001535

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tripartita / Elymus lanceolatus Shrub Herbaceous Vegetation (ARTTRP / ELYLAN) three-tip sagebrush / thickspike wheatgrass

Natural Heritage Conservation Rank- G? / S?

Environment- This type is found on nearly level slopes of stream terraces and alluvial fans at ca. 6,500-6,700 ft in the Centennial Valley. Vegetation of lower positions in the landscape tends to be wetlands dominated by *Juncus balticus* or *Deschampsia cespitosa*. *Artemisia tripartita / Festuca idahoensis* is the most common type on adjacent slopes or better-drained positions with coarser-textured soils.

Vegetation- *Artemisia tripartita* is the dominant shrub with canopy cover of 10-20%. *Chrysothamnus nauseosus* and *Chrysothamnus viscidiflorus* are common in most stands. Grass cover varies between 40 and 60%. *Elymus lanceolatus* is usually the dominant grass. Small cespitose bluegrass's, such as *Poa juncifolia, Poa secunda* and *Poa cusickii*, are often common. Forb cover is ca. 10%, and diversity is low. *Phlox hoodii, Antennaria microphylla* and *Antennaria parvifolia* are common species. Mosses and lichens are absent.

Soils- Soils are deep and silty in texture. Some sites may be slightly saline. 40-70% of the soil surface is bare, and gravel is uncommon.

Other Studies- This type has not been previously described.

Comments- Examples of this unusual vegetation have been heavily grazed by livestock in the past and probably obscures the actual potential vegetation of these sites. Vegetation dominated by *Artemisia tripartita* and *Leymus cinereus* is reported for Idaho (Bourgeron and Engelking 1994), and a type dominated by *Artemisia tripartita* and *Stipa comata* occurs in Washington (Daubenmire 1970). *Artemisia tripartita / Elymus lanceolatus* may be a seral stage of vegetation similar to one of these types. A possible scenario envisions these sites as seral to *Artemisia tridentata* ssp. *tridentata* (or *vaseyana*), quite possibly the *Artemisia. tridentata* ssp. *tridentata* / *Leymus cinereus* or *Artemisia tridentata* ssp. *tridentata* / *Pascopyrum smithii* c.t.s.

Element Code- CEGLMTHP08

Edition / Author- 99-11-16 / S.V. Cooper

Artemisia tripartita / Festuca idahoensis Shrub Herbaceous Vegetation (ARTTRP / FESIDA) Three-tip sagebrush / Idaho fescue

Natural Heritage Conservation Rank- G3 / S3?

Environment- This type is common on gentle to moderate slopes and ridges at 6,300-7,500 ft within the drainage of the Red Rock River. The *Stipa comata* phase is common on the stabilized sandhills at 6,600-6,700 ft at the northeast end of the Centennial Valley. Soils are derived from many different parent materials. Finer textured soils of adjacent terraces support *Artemisia tripartita / Elymus lanceolatus*, while steeper, higher or cooler slopes are dominated by *Artemisia tridentata vaseyana* and *Festuca idahoensis*. The *Stipa comata* phase of *Artemisia tripartita / Festuca idahoensis* occupies long-term stabilized dunes in the Centennial Valley; areas that have been stabilized for shorter time support *Stipa comata* / *Psoralea tenuiflora.*

Vegetation- *Artemisia tripartita* is the dominant shrub with canopy cover of 10-30%. *Artemisia tridentata* ssp. *vaseyana, Chrysothamnus viscidiflorus* and *Tetradymia canescens* are often present. Total grass cover is generally high, 60-80% in most stands. *Festuca idahoensis* is usually the dominant species, but *Elymus lanceolatus, Pseudoroegneria spicata and Koeleria cristata* are also common. *Stipa comata* is common and its dominance defines the *Stipa comata* phase. Forb canopy cover and diversity are moderate. Common forbs are *Achillea millefolium, Antennaria microphylla, Geum triflorum, Comandra umbellata, Lupinus*

sericeus, Phlox hoodii and *Taraxacum officinale*. Mosses and lichens may be present but are uncommon.

Soils- Soils have a silty or loamy texture. Usually less than 30% of the surface is bare, and gravel is uncommon. The *Stipa comata* phase occurs on sandy soils with no surface gravel.

Other Studies- Daubenmire (1970) first described *Artemisia tripartita* / *Festuca idahoensis* as a zonal climax plant association for eastern Washington, but many of the common subordinate species are different from those of our study area. Mueggler and Stewart (1980) were the first to document this type for southwestern Montana. Similar vegetation has been described for Idaho (Hironaka 1977) and vegetation dominated by these two species is also reported for Colorado (Bourgeron and Engelking 1994).

Comments- The *Stipa comata* phase occurs on sandy rather than silty or loamy soils and is characterized by having *Stipa comata* rather than *Elymus lanceolatus* or *Pseudoroegneria spicata* as important subordinate grasses. See Comments under *Artemisia tridentata* ssp. *tridentata /Stipa comata*.

Mueggler and Stewart (1980) imply that stands dominated by *Artemisia tripartita* may occur on sites that are drier than optimum for *A. tridentata vaseyana*. This hypothesis is supported by our observation that *A. tridentata vaseyana* stands are often on cooler or higher elevation slopes. Capable of root sprouting as a reproductive tactic, *Artemisia tripartita* also resprouts after fire, while *A. tridentata* is killed, so fire history may play a role in determining the distribution of these plants across the landscape. Nonetheless, it is difficult to clearly distinguish between the ecological niches of these two sagebrush species, at least in the landscapes where they co-occur.

Element Code- CEGL001536

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Artemisia tripartita / Pseudoroegneria spicata Shrub Herbaceous Vegetation (ARTTRP / PSESPI) three-tip sagebrush / bluebunch wheatgrass

Natural Heritage Conservation Rank- G2G3 / S?

Environment- *Artemisia tripartita / Pseudoroegneria spicata* is a community of very limited acreage in the Beaverhead Mountains Section, noted only south of the Clark Fork Reservoir. It almost always occurs as small or linear patches on west- to south-facing ridges and convex slope shoulders; sites where solar insolation and prevailing winds exceed the tolerance of *Festuca idahoensis*. These sites usually have an abrupt transition to *Artemisia tripartita / Festuca idahoensis* or *Artemisia tridentata* ssp. *vaseyana / Festuca idahoensis* of less moisture-stressed positions.

Vegetation- These droughty sites have insufficient cover (10-20%) of *Artemisia tripartita* to be considered shrub stands. Other shrubs that occur, generally with less than 5% cover, include *Chrysothamnus viscidiflorus*, *Artemisia frigida* and *Artemisia tridentata* var. *vaseyana*. *Pseudoroegneria spicata and Koeleria cristata* dominate the herbaceous layer, though their coverage is commonly less than 30%. Forbs often include *Phlox hoodii*, *Achillea millifolium*, *Antennaria parviflora*, *A. microphylla* and *Erigeron compositus*, none having more than 5% cover.

Soils- Generally there is more than 70% exposed substrate (including soil, gravel and rock) and litter is confined to the immediate vicinity of shrub and bunchgrass canopies. Parent materials include extrusive volcanics and alluvial outwash.

Other Studies- *Artemisia tripartita / Pseudoroegneria spicata* was first described by Daubenmire (1970) for portions of the Columbia Basin of Washington State where it

occurs in much the same manner it does within the Centennial Valley, as isolated patches typifying hot, dry exposures within what is *Artemisia tripartita / Festuca idahoensis* dominated landscape (considered a climatic climax only in the Columbia Basin). It apparently is most extensive southward in Idaho's Snake River Plain and also occurs as an uncommon type in Oregon (Bourgeron and Engelking 1994).

Comments- Within the Centennial Valley *Artemisia tripartita / Pseudoroegneria spicata* we speculate to be a successional community type, seral to *Artemisia tridentata* ssp. *vaseyana / Pseudoroegneria spicata*. We noted, but did not sample, several small stands with mixed *A. tridentata* ssp. *vaseyana* and *A. tripartita* and occurring in the same landscape positions as *Artemisia tripartita / Pseudoroegneria spicata*. The severity of these sites may slow the rate at which *A. tridentata* ssp. *vaseyana* recolonizes and ultimately replaces *Artemisia. tripartita* (in the absence of fire).

Element Code- CEGL001538

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pentaphylloides floribunda / Festuca campestris Shrub Herbaceous (PENFLO / FESCAM) shrubby cinquefoil / rough fescue

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Natural Heritage Conservation Rank- G4 / S4

Environment- Owning to the fact that the geographic range of *Festuca campestris*, as a community dominant, extends on the east side of the Continental Divide southward to approximately 46 ° north latitude this association is found only north of this latitude in the Anaconda-Pintlar Range and on the upper slopes of the Deerlodge Valley Subsection. It is most prevalent on gently sloping or rolling topography but can occur on steep slopes within mountain parklands above the 4,500 to 6,000 feet elevation range quoted by Mueggler and Stewart (1980). This is a moderately mesic foothill to mountain type that likely falls in the 20 to 30 inch precipitation zone.

Soils- Parent materials on which it is noted to occur include sandstone, limestone and glacial drift; soils are moderately deep, 10 to 18 inches rooting depth. Considerable surface rock may be exposed, although little bare soil is minimal. In the more productive *Danthonia intermedia* Phase, litter and vegetation combine to cover 98% of the surface.

Vegetation- Like the *Pentaphylloides floribunda / Festuca idahoensis* association, but even more so, the shrub component, dominated by *Pentaphylloides. floribunda* (5-30% canopy cover), can be rendered quite obscure by the luxuriant graminoids, principally the tall tussock grass *Festuca campestris*; at least as the type occurs in Montana it would be best considered a dwarf-shrub type because *Pentaplylloides floribunda* seldom is taller than 4-5 decimeters. *Artemisia frigida* and *Gutierrezia sarothrae* are sub-shrubs that along with *Juniperus horizontalis* (dwarf-shrub) attain a high constancy but seldom are well represented, even with overgrazing. *Festuca idahoensis* and *Koeleria macrantha* have high constancy in both phases but are distinctly secondary to *Festuca campestris*. Forb diversity is generally high, those of high constancy being *Galium boreale, Gaillardia aristata, Achillea millefolium, Solidago missouriensis* and *Campanula rotundifolia*.

The *Danthonia intermedia* phase differs significantly (floristics coupled with environmental parameters of mesic situation) and it should be considered a separate association (*Pentaphylloides floribunda / Festuca campestris – Danthonia. intermedia*); this phase is typified by *Danthonia intermedia* being well represented and the relative abundance of Elymus *trachycaulus*, *Carex obtusata, Potentilla gracilis, Lupinus sericeus, Agoseris glauca*, *Geranium viscosissimum* and *Erigeron specious*.

Though not named by Mueggler and Stewart (1980), the drier phase should receive an association designation as well and be known as *Pentaphylloides. floribunda / Festuca campestris – Pseudoroegneria spicata*. It is typified by a relatively high constancy and coverage of *Pseudoroegneria spicata* and *Carex scirpoidea* and the consistent presence of a number of other graminoids that do not occur, or if they do, at much reduced levels in the mesic phase including *Danthonia parryi, Muhlenbergia cuspidata, Muhlenbergia. richardsonis* and *Poa secunda*. It lacks the mesic forbs of the more productive *Pentaphylloides floribunda / Festuca campestris – Danthonia intermedia* but dwarf shrubs are virtually exclusive to this phase along with the forbs *Chrysopsis villosa, Senecio canus, Erigeron caespitosus* and *Oxytropis sericea*.

Comments- This association should be partitioned into two, *Pentaphylloides floribunda / Festuca campestris – Danthonia intermedia* and *Pentaphylloides floribunda / Festuca campestris – Pseudoroegneria spicata*, based on floristic and environmental differences. This association is very similar to those in the Festuca campestris alliance. It is well suited to grazing by cattle and horses by virtue of having its forage comprised principally of tussock grasses. *Pentaphylloides floribunda* increases appreciably with overgrazing and complicates management because it is difficult to control, sprouting readily following burning or spraying (2,4-D). Those forbs decreasing on sheep range include *Lupinus sericeus, Gaillardia aristata, Galium boreale, Senecio canus* and possibly *Potentilla gracilis*; conversely these same forbs are candidates to increase on cattle range.

Element Code- CEGL001503

Edition / Author- 98-12-03 / S.V. Cooper

Pentaphylloides floribunda / Festuca idahoensis Shrub Herbaceous (PENFLO / FESIDA) shrubby cinquefoil / Idaho fescue

Natural Heritage Conservation Rank- G3 / S3

Environment- *Pentaphylloides floribunda / Festuca idahoensis* is an uncommon association in Montana, found only east of the Continental Divide, however it ranges southward into central Idaho, northern Nevada and western Wyoming. In Montana it has been found at elevations between 6,600 and 8,600 feet on gentle mountain slopes with moderately deep soils derived from granitics. Normally the soil surface is extensively covered with vegetation and litter. This association is considered moderately mesic, usually falling within the 20 to 30 inch precipitation zone.

Vegetation- Given the relatively short stature of *Pentaphylloides floribunda* combined with its low canopy cover (seldom exceeding 15%) it is appropriate to classify this type as shrub herbaceous (most Montana stands in fact would qualify for dwarf-shrub status). Occasionally *Artemisia tridentata* ssp. *vaseyana and A. cana* are present in trace amounts. *Festuca idahoensis* and *Danthonia intermedia* are the dominant graminoids; at higher elevations in south central Montana *Carex obtusata* may also be well represented. The mesic and relatively cold nature of these sites is revealed in the low cover of *Pseudoroegneria spicata* and presence of several *Stipa* spp and *Elymus trachycaulus*. The most common forbs are *Besseya wyomingensis, Campanula rotundifolia, Achillea millifolium, Arenaria congesta,* and *Potentilla gracilis*; *Geum triflorum* is sometimes the dominant forb.

Other Studies- Schlatterer (1972) has described an equivalent vegetation type from the White Cloud, Boulder and Pioneer Mountains of central Idaho. Mueggler and Stewart (1980) cite the type from Yellowstone National Park.

Comments- Over 60% of the total vegetation of this type consists of palatable grasses and sedges, the most productive of which are *Festuca idahoensis* and *Danthonia intermedia*; the first of the forenamed species in addition to

Elymus trachycaulus and *Carex obtusata* are the primary decreasers with overgrazing. *Pentaphylloides floribunda*, filling a niche akin to that of *Artemisia tridentata* ssp. *vaseyana* in *Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis*, generally increase appreciably with grazing pressure, along with *Geum triflorum* and *Potentilla gracilis*.

Element Code- CEGL001502

Edition / Author- 98-12-03 / S.V. Cooper

Salix arctica / Polygonum bistortoides Dwarf Shrubland (SALARC / POLBIS) Arctic willow / American bistort

Natural Heritage Conservation Rank- G2G3 / S2S3

Environment- Though our definition of this c.t. is based on only two plots, the fact that this type is recognized elsewhere in the Rocky Mountains allows us to compare and interpret our data. Sites were documented in the East Pioneer and Anaconda-Pintlar Ranges on lower to mid-slopes of gentle terrain (and noted in reconnaissance in the Beaverhead Mountains). We interpret these sites as wetland/turf hybrids in terms of both environment and vegetation. Both sites were potentially in water-receiving positions; one community was intercalated between snowbeds upslope and drier turf c.t's. downslope, while the other was developed on an ephemeral spring with spongy ground throughout. Landscape positions of *Salix arctica / Polygonum bistortoides* were much like those supporting *Salix reticulata / Caltha leptosepala* but with a higher probability of wind scouring. Vegetation composition also indicated a drier environment than that of *Salix reticulata / Caltha leptosepala.*

Vegetation- These stands were dominated by *Salix arctica* (50% c.c.) with lesser amounts of *Dryas octopetala*. Moss coverage in excess of 50% adds to the visual impression of a blanket of vegetation. Graminoid cover averaged 15%, contributed mostly by *Poa alpina* and moist-site *Carex spp., C. albonigra, C. phaeocephala* or *C. nova*. Forb cover averaged 30%. The diagnostic forb, *Polygonum bistortoides* (10% c.c.), was among several with relatively high coverages, including *P. viviparum, Geum rossii, Potentilla diversifolia, Aster alpigenus* and *Claytonia lanceolata*.

Soils- Parent material included quartzite and granite-limestone mix from a contact zone. Average litter and duff depths were 0.1 in and 0.4 in respectively. Coarse fragment content ranged from 19 to 33%. Mean texture of the fine fraction was clay. Soil reactions were slightly acid, averaging 6.50. Mean organic matter content was 16%, mean total nitrogen was 0.43%, and C:N ratio was 25:1

Productivity- Total productivity ranged from 798 to 1,095 lbs/acre with shrub productivity constituting 32 to 81% of the total; graminoid and forb coverage were 148 and 295 lbs/acre, respectively.

Other Studies- *Salix arctica* dominates in some snowbed communities of the Canadian Rockies (Achuff and Corns 1982, Hrapko and LaRoi 1978). *Potentilla diversifolia* and *Polygonum viviparum* were common species in the above-cited communities; however, snowbed indicator species, such as *Antennaria lanata, Phyllodoce glanduliflora* and *Cassiope mertensiana* were also common. Johnson and Billings (1962) discuss small disturbance sites within moist *Deschampsia cespitosa* meadows with vegetation very similar to *Salix arctica / Polygonum bistortoides* (see Other Studies section *Salix reticulata / Caltha leptosepala* for expanded discussion). In the Colorado Rockies Willard (1979) described snowbed vegetation dominated by *S. arctica*; her community type had high coverages of *Geum rossii, Polygonum spp., Festuca ovina*, mosses and lichens and was more similar to that of our study area than those cited from the Canadian Rockies. Baker (1983) described late snowbank communities dominated by *S. arctica* and *S. reticulata* for the Sangre de Cristo Range of New Mexico.

Element Code- CEGL001431

Edition / Author- 97 –10 / S.V. Cooper et al.

Sarcobatus vermiculatus / Pascopyrum smithii Shrub Herbaceous Vegetation (SARVER / PASSMI) black greasewood / western wheatgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- This uncommon type is found on wide stream terraces, often in areas of calcareous parent material such as the Ruby and Tendoy Mountains. Higher terraces with less alkaline-saline soil may support stands dominated by *Artemisia tridentata ssp. tridentata* and *Pascopyrum smithii* or *Leymus cinereus*. Nearby slopes are dominated by *Artemisia tridentata* and *Pseudoroegneria spicata or Festuca idahoensis*.

Vegetation- *Sarcobatus vermiculatus* is the dominant shrub, averaging approximately 10% canopy cover; its cover may be less but its stature in comparison to the associated species still conveys a shrubland aspect. *Artemisia tridentata* ssp. *tridentata* and *Chrysothamnus viscidiflorus* can be conspicuous components, their cover approaching that of *S. vermiculatus*. The subshrubs, *Artemisia frigida* and *Atriplex gardneri*, may also be common. *Pascopyrum smithii* and/or *Elymus lanceolatus* are the dominant and diagnostic species, often forming a thin sword. Forbs are scarce. *Opuntia polyacantha* or *Taraxacum officinale* may be present. Soil lichens or algae may be present as well where livestock trampling has been minimal.

Soils- Soils are silty and deep. The surface horizons are usually alkaline-saline. Most of the ground surface is bare soil and gravel is rare or absent.

Other Studies- Mueggler and Stewart (1980) describe this type for western Montana, and Hansen et al. (1995) describe it mainly for eastern Montana. Jorgensen (1979) described a very similar *Sarcobatus vermiculatus / Elymus lanceolatus* type from central Montana. *Sarcobatus vermiculatus / Pascopyrum smithii* is also reported from Wyoming (Bourgeron and Engelking 1994). A very similar type dominated by *Sarcobatus vermiculatus* and *Pascopyrum smithii* with the addition of *Leymus cinereus* has also been described for western Montana (Mueggler and Stewart 1980).

Comments- Although Mueggler and Stewart (1980) state that *Poa juncifolia* decreases with grazing, we believe that under late season grazing it may increase, while rhizomatous wheatgrasses decrease. Mueggler and Stewart (1980) indicate an inability to distinguish environment differences between *Sarcobatus vermiculatus / Leymus cinereus* and *Sarcobatus vermiculatus / Pascopyrum smithii*; the differences could be more attributable to grazing history than habitat. Most examples of *Sarcobatus vermiculatus / Pascopyrum smithii* are close to water and on nearly level terrain. Consequently most stands have been severely impacted by livestock grazing. *Leymus cinereus* may have been present in many of these stands prior to the heavy livestock grazing in the early part of the century (see **Comments-** under *Leymus cinereus / Puccinellia nuttalliana)*.

Element Code- CEGL001508

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Herbaceous Vegetation Lacking a Significant Shrub / Tree Component

Bromus carinatus – Bromus anomalus Herbaceous Vegetation (BROCAR – BROANO) mountain brome – nodding brome

Natural Heritage Conservation Rank- G? / S?

Environment- This community is associated

with sites that are both protected and receive more moisture than other positions in the landscape, either through snow deposition or subsurface input. Sites are usually found on gently inclined (<30% slope) lee slopes with northwest- to northeast-facing aspects in toeslope positions with concave to straight slope shapes. That these are lee slopes is partially corroborated by the soils. They are deep silt loams, often without rock (of any size class) in the upper 20 cm, but not having more than 5% stone to a depth of 40 cm in any of the examined profiles; we speculate that these soils originate primarily from the deposition of aeolian material and in part from slopewash of fines. Stands are usually small, less than 2-3 acres and often only a fraction of an acre. Adjacent vegetation is almost invariably dominated by the more mesic plant associations within the *Artemisia tridentata* ssp. *vaseyana* and *Festuca idahoensis* alliances, usually those communities denoted by *Elymus trachycaulus, Stipa richardsonii, Geranium viscosissimum, Potentilla gracilis* and *P. glandulosa.*

Range- This association has only been found on the lower slopes of the Snowcrest and Blacktail Ranges and various hills and foothills between these ranges; it was particularly in evidence on the Blacktail State Wildlife Management Area and occurred to a lesser degree and in a more degraded condition on the Robb-Ledford State Wildlife Management Area. We speculate that it could occur to the southward in Idaho, Nevada and Utah if one envisions it as a seral community resulting from the burning (or otherwise destruction) of the shrub component of *Artemisia tridentata* ssp. *vaseyana* / *B. carinatus* and *Symphoricarpos oreophilus* / *B. carinatus* communities. Anecdotal information from the foothills of the Rocky Mountain Front suggests this type occurs as small meadow patches within a primarily forested landscape.

Vegetation- This community is distinguished by its dearth of shrubs; *Artemisia tridentata* ssp. *vaseyana Chrysothamnus nauseosus* and *Symphoricarpos oreophilus* have the highest constancy but coverages seldom exceed trace amounts. The modal to highest quality (least disturbed) expression of this type is that of dense grassland, the tussocks set so closely that from a distance one appears to be viewing a grain field or vegetation dominated by rhizomatous grasses. The non-rhizomatous (approaching bunchgrass form) grasses *Bromus carinatus* and *B. anomalus* usually dominate the community and true bunchgrasses such as *Stipa richardsonii, S. occidentalis, Elymus trachycaulus, Festuca idahoensis, Poa juncifolia* and *Danthonia intermedia* are important components as well, their cover occasionally exceeding that of the diagnostic species. These communities are notable both for their dense cover of graminoids, whose combined individual cover values approach or exceed 100%, and for the variety of graminoids, usually exceeding 10 species per plot. In stands of ostensibly degraded condition *Poa pratensis* and occasionally *Phleum pratense* are well represented to abundant and probably indicative of past grazing pressure, quite possibly by horse herds. The forb component is highly variable in coverage, ranging from nearly 100% in stands where the graminoid component is reduced, to 20-40% in stands with the highest coverage of graminoids. Any of the following forbs may be both well represented and exhibit high constancy and their presence is indicative of the mesic nature of this type; *Potentilla gracilis, Potentilla glandulosa, Geranium viscosissimum, Aster chilensis, Geum triflorum, Agoseris glauca* and *Galium boreale*.

Similar Communities- Though this community occurs as small patches in unique environments, it is rather surprising that it has gone undescribed until now and in fact it is notable that there are no herbaceous community types noted in the NVCS with native *Bromus* spp. as diagnostic species. As noted above, it is quite conceivable that the successional seres of several shrub-dominated rangeland types of Idaho, Nevada and Utah would pass through a compositional stage approximating the community type described here. The community type most similar in environment and composition is *Stipa richardsonii – Festuca idahoensis*. This

community occurs in the same region and landscape positions closely comparable to those of *B. carinatus – B. anomalus* and could be seen as a variant of it, as it possess many of the same species, but the dominance of the *Bromus* spp. has been replaced by that of *S. richardsonii*.

Element Code- CEGLMTHP09

Edition / Author- 99-11-22 / S. V. Cooper, MTNHP

Calamagrostis canadensis Herbaceous Vegetation (CALCAN) Bluejoint reedgrass

Natural Heritage Conservation Rank- G4Q / S4

Environment- The *Calamagrostis canadensis* association is found in montane to subalpine habitats in the mountains of Montana. It is typically found in a variety of settings: in depressional landforms as one of the outer bands (i.e. the drawdown zone) of vegetation, in wet meadows, adjacent to stream courses and on alluvial terraces, and in moist forest openings. Soils in basin settings are generally loamy mineral soils, while those along low gradient streams are usually coarse textured alluvium. *Calamagrostis canadensis* communities usually flood in the spring and dry down by mid-summer. Adjacent wetter communities could include *Carex aquatilis* or *Carex utriculata* communities, and adjacent drier vegetation is usually upland coniferous forest (Hansen et al. 1988, Hansen et al. 1995).

Vegetation: *Calamagrostis canadensis* is the dominant species in this community, with canopy coverage averaging 70% (Hansen et al. 1995). Traces of conifers and of shrubs can be found in this association, and *Deschampsia cespitosa* is a frequently associated graminoid. A wide variety of forbs are associated with this community, usually at low coverage.

Similar Communities- Similar communities have been described by Mattson (1984) for Yellowstone National Park, Padgett et al. (1989) for Utah and southeastern Idaho, Jankovsky-Jones (1997) for northern Idaho, and eastern Oregon (Kovalchik 1987). Similar communities dominated by *Calamagrostis stricta* have been observed in Montana, and Hansen et al. (1995) have placed these in the *Calamagrostis canadensis* association because of similarities in management concerns. Other studies have documented *Calamagrostis canadensis* as the dominant understory species growing with a variety of other overstory species, including *Picea* sp. (Hansen et al. 1995), *Abies lasiocarpa* (Pfister et al. 1977), *Salix drummondiana*, *Salix geyeriana*, and *Salix lutea* (Hansen et al. 1995).

Succession- Successional dynamics of this community are poorly understood. Padgett et al. (1989) describe expansion of *Calamagrostis canadensis* into the moist borders of *Pinus contorta* stands dying from bark beetles, and ascribe this to increases in the water table due to less transpiration by the conifers. Hansen et al. (1995) suggest that *Picea* sp. / *Calamagrostis canadensis* communities are late seral stages of the *Abies lasiocarpa* / *Calamagrostis canadensis* community, with shrubs dominating where disturbance removes the tree overstory. However, it is not clear whether the *Calamagrostis canadensis* community should be considered an early seral community that is ultimately invaded by conifers and/or shrubs. Changes in the composition of the *Calamagrostis canadensis* community can take place when there are changes in the hydrologic regime.

Management- Palatability of *Calamagrostis canadensis* varies from moderate to high, and heavy grazing can reduce the vigor of this grass and lead to an increase of other graminoids such as *Poa pratensis, Poa palustris, Agrostis stolonifera*, or *Juncus balticus*. Heavily grazed wetter sites can be converted to dominance by *Juncus balticus* or *Carex nebrascensis*. Hansen et al. (1995) also state that moderate late-season grazing of *Calamagrostis canadensis* has only limited impact on stands, especially when soils are dry.

Element Code- CEGL001559

Edition / Author- 99-10-12 / J. Greenlee, MTNHP

Calamagrostis purpurascens – Carex rupestris Herbaceous Vegetation (CALPUR – CARRUP) purple reedgrass – curly sedge

Natural Heritage Conservation Rank- G? / S?

Environment- The *Calamagrostis purpurascens – Carex rupestris* p. a. is primarily a high subalpine to alpine vegetation type, having been documented from 8,900 ft. to the highest elevations of the Blacktail, Greenhorn and Tendoy Ranges (above 9,400 feet); it occupies the most exposed sites, generally including shoulders of ridges, ridgelines, and upper west and south-facing slopes. These upper slopes are flat to moderately sloping and usually convex to straight in shape. This type can be expected to occur in similar positions in mountain ranges adjacent to the ones cited above and that exist in the rain shadow of the Beaverhead Range. All BVRHDMS sampled sites and noted occurrences were developed on limestone and possessed soils with silt loam textures and a high rock content. In the study area it may occur on a wider variety of substrates than indicated based on the observation that in Wyoming (Regan et al. 1997) it is known to occur on non-calcareous sedimentary substrates. The amount of exposed substrate varies greatly, depending on exposure, but generally between dead and live *Selaginella densa*, bryophytes, and litter more than 70% of the surface has an organic cover. This type usually is the most areally extensive community in a mosaic of *C. rupestris / Potentilla ovina*, *Carex elynoides* turf communities, *Festuca kingii / Oxytropis campestris* grasslands that ostensibly occupy equally, if not more, stressful sites and *Carex scirpoidea / Potentilla diversifolia*, *Festuca idahoensis / Potentilla diversifolia* or *Deschampsia / P. diversifolia* communities found on more mesic, less exposed, or lower elevation sites.

Vegetation- These sites are recognized by *Calamagrostis purpurascens* being well represented and *Carex rupestris* or *C. obtusata* also being dominant or co-dominant; total graminoid canopy cover is mostly 50 to 70%. However, graminoid diversity is low on these sites, the only other ones occurring regularly were *Koeleria macrantha* and *Poa rupicola*. No shrubs or subshrubs occurred in this type. Forb diversity is generally high with at least 15 and up to 28 per plot, but overall forb cover seldom exceeds 20%. Forbs with the highest cover and constancy are *Bupleurum americanum*, *Phlox pulvinata*, *Oxytropis campestris*, *Erigeron compositus* and *Potentilla ovina*. *Senecio canus*, *S. streptanthifolius* and *Arenaria obtusiloba* simply have high constancy within the type. The cover of live (or photosynthetically active) *Selaginella densa* generally was not more than 20% but dead foliage/stems created anywhere from a trace to 30% cover.

Similar Communities- From Wyoming's Snowy Range a community of the same name (same dominant species) and occupying the same environmental niche has been described. South into Colorado as well as in Idaho (Urbanczyk and Henderson 1994, Richardson and Henderson 1999) and Montana (Cooper et al. 1997) several communities are documented wherein *Carex rupestris* alone is the dominant or diagnostic graminoid and the environments bear a strong resemblance to the one described here. Moseley (1985) has identified, based on a very limited sample in the alpine of east-central Idaho, a *Calamagrostis purpurascens* type. Urbanczyk and Henderson (1994) document a *Calamagrostis purpurascens – Carex elynoides* community wherein *Carex rupestris* is a major component; they indicate that this community occupies positions less e than *Carex elynoides* turf sites. In southwestern Montana it has not been established what environmental parameters consistently distinguish *Carex rupestris / Oxytropis campestris* from *Carex purpurascens / Carex. rupestris*, though it is likely the degree of exposure.

Element Code- CEGLMTHP11

Edition / Author- 99-11-22 / S. V. Cooper, MTNHP

Carex aquatilis Herbaceous Vegetation (CARAQU) Water sedge

Natural Heritage Conservation Rank- G5 / S5

Environment- *Carex aquatilis* communities can be found at mid to high elevations throughout Montana. It is typically found in depressional landforms, old channels along streams, fens, and in silted in beaver ponds. This community occurs both on mineral and organic soils, though more commonly on the latter. Soil reactions are usually acidic, and water levels in *Carex aquatilis* communities usually remain high throughout the growing season, occasionally dropping below the rooting zone in dry years. Adjacent wetter communities include *Carex utriculata* and *Carex lasiocarpa* stands, while drier communities could include *Juncus balticus*, *Calamagrostis canadensis*, or meadows dominated by *Deschampsia cespitosa* (Hansen et al. 1988).

Vegetation- *Carex aquatilis* is clearly the dominant species in this plant association, although it can be found growing with significant coverage of other graminoids, particularly *Carex utriculata* or *Deschampsia cespitosa*. Low coverage of shrubs such as *Salix* sp. or *Pentaphylloides floribunda* may also be found growing in this association. Low coverage of a variety of forbs may be found in this community; these forbs may include *Mentha arvensis*, *Galium triflorum*, *Aster occidentalis*, and *Epilobium* spp (Hansen et al. 1995, Hansen et al. 1988).

Similar Communities- Similar plant communities have been documented by other studies in eastern Oregon (Kovalchik 1987), Idaho (Hall and Hansen 1997), Utah (Padgett et al. 1989), Nevada (Manning and Padgett 1995), Wyoming (Youngblood et al. 1985), and Colorado (Kittel et al. 1998). Two phases, the *Carex aquatilis* and *Deschampsia cespitosa* phase, have been described for Montana (Hansen et al. 1995). *Carex aquatilis* has also been described growing as the dominant understory vegetation with *Salix planifolia* and *Salix wolfii* (Hansen et al. 1995).

Succession- *Carex aquatilis* communities probably represent a fairly stable plant association, although the successional pathways for this community are poorly understood. It can colonize expanses of mineral soil, such as dried out beaver ponds (Hansen et al. 1995), but it can also occupy sites on organic soils, which typically experience more anaerobic conditions.

Management- *Carex aquatilis* is considered moderately palatable to livestock, and poor grazing management practices can impact this plant community by causing decreases in *Deschampsia cespitosa* and increases in *Juncus balticus* and through trampling damage to organic soils. However, due to the rhizomatous habit of this sedge, disturbed sites do stand a chance of improving rapidly once the disturbance level is reduced (Kovalchik 1987). This species' rhizomes can also strongly anchor and stabilize streambanks.

Element Code- CEGL001802

Edition / Author- 99-10-05 / J. Greenlee, MTNHP

*Carex buxbaumi*i Herbaceous Vegetation (CARBUX) buxbaum's sedge

Natural Heritage Conservation Rank- G3 / S3

Environment- This community type occurs in moderately broad valley bottoms, in depressional wetlands like glacial potholes, in peatlands, and on lake plains. Saturated soil conditions persist in the surface peat from mid spring to mid summer. Water levels may then drop to the soil surface or, on drier sites, to several decimeters below the surface.

Range- *Carex buxbaumii* is a minor community type in the Uinta Mountains of

Utah, western and south-central Montana, Yellowstone National Park, and 4 disjunct areas of Idaho.

Adjacent Communities- In Montana, adjacent wetter communities include *Scirpus acutus, Carex lasiocarpa,* and *Carex utriculata,* and adjacent drier sites include *Deschampsia cespitosa* and *Juncus balticus* communities (Pierce 1986).

Vegetation- *Carex buxbaumii* is always dominant in this community, with 25% or greater cover. *Carex aquatilis* and/or *Carex saxatilis* are sometimes present and occasionally are co-dominants. Other associates include *Deschampsia cespitosa, Caltha leptosepala, Eleocharis pauciflora* (syn. *E. quinqueflora*), *Senecio cymbalarioides, Pedicularis groenlandica, Ligusticum tenuifolium, Carex lanuginosa, Carex utriculata, Carex lasiocarpa, Carex muricata, Carex livida, Carex nebrascensis, Carex praegracilis,* and *Carex simulata* (Padgett et al 1989).

Similar Communities- Includes the *Carex buxbaumii - Carex saxatilis* (Tuhy 1981) c.t. and *Carex buxbaumii - Carex aquatilis* (Mattson 1984) h.t. and phases. Hansen et al. (1995) lump this community with *Carex lasiocarpa* and *Carex lanuginosa* for management purposes. Pierce (1986) and Padgett et al. (1989) also describe this community type.

Management- Herbage production varies from low to moderate. Saturated soils are a natural deterrent to livestock grazing. Alteration of hydrology and subsequent dewatering may result in communities dominated by *Carex buxbaumii* being accessible to cattle. Fencing of these relatively small communities is a practical management method for restoration when the hydrologic regime is intact

Element Code- CEGL001806

Edition / Author - 95-06-09/ L. Williams

Carex elynoides Herbaceous Vegetation (CARELY) blackroot sedge

Natural Heritage Conservation Rank- G4 / S4

Environment- *Carex elynoides* was the most frequently sampled alpine c.t. in the BVHDMS. It was found in all eight mountain ranges and is undoubtedly, one of, if not the most extensive alpine vegetation type in our study area. It was most extensive in the drier Tendoy, Beaverhead, and Snowcrest ranges. *Carex elynoides* spanned a considerable range in elevation, 9,360 to 10,360 ft. All sites, because of topographic position and orientation, were inferred to be highly wind-impacted and blown free of winter snow. More than half the stands occurred on ridge crests or shoulders with less than 20% slope. Most of the remainder was on moderate to steep southwest- to west-facing slopes. This type often graded to grassland c.t's. *or Carex scirpoidea / Potentilla diversifoli*a c.t. on more protected moist sites and cushion plant-dominated sites with yet greater wind impact. Mean exposed bare soil, gravel and rock (23%) was slightly greater than for grassland types; however, sites grading to cushion plant communities had as much as 70% substrate exposure.

Vegetation- The *Carex elynoides* type is characterized by a short (< 4 in), usually dense ground cover of fibrous-rooted graminoids (ave. c.c. 46%) and forbs. *Carex elynoides* was strongly dominant (100% constancy, 27% c.c.) followed in decreasing order by the turf-formers *Carex rupestris* and *Festuca ovina*. Other common graminoids were *Calamagrostis purpurascens*, *Poa glauca,* and *Festuca* (syn. *Hesperochloa*) *kingii*. Average forb cover was 31%, only slightly less than that of grassland types. The dominance of *Phlox pulvinata* and *Selaginella densa* and the presence and occasional dominance of cushion plants set this type apart from grasslands. Forbs with high (>50%) constancy included *Cymopterus*

bipinnatus, Besseya wyomingensis, Hymenoxys grandiflora, Oxytropis campestris, Potentilla diversifolia, and *P. ovina*.

Soils- Parent materials were predominantly limestone and calcareous sandstone, but quartzite and gneiss were also represented. Mean litter and duff depths were, respectively, 0.4 in and 0.3 in. Percent coarse fragments ranged from 8 to 75% with a mean of 33%, a figure intermediate between the grassland and cushion plant c.t's. Texture of the fine fraction ranged from fine clay to sandy clay-loam, and the mean textural class was sandy clay. Soil reactions were slightly more basic than those of grasslands with an average pH of 7.5 for calcareous materials and 6.4 for non-calcareous substrates. Mean organic matter content was 16%, mean total nitrogen was 0.57%, and C:N ratio was 15:1.

Productivity- A nearly ten-fold range in productivity was recorded for both graminoids (80-682 lbs/acre) and forbs (115-977 lbs/acre). Average productivity's for graminoids, forbs and community total were respectively, 398, 398, and 796 lbs/acre. A cline of decreasing productivity occurred from solid turf conditions to near cushion plant conditions.

Other Studies- *Carex elynoides* turf communities are reported from similar environments on a variety of parent materials in neighboring ranges in Idaho (Moseley 1985, Caicco 1983, Urbanczyk and Henderson 1994, Richardson and Henderson 1999), calcareous sites in Montana (Bamberg and Major 1968), the Beartooth Plateau of Wyoming/Montana (Johnson and Billings 1962), throughout Colorado (Eddleman and Ward 1984, Willard 1979, Komarkova and Webber 1978), the Uinta Range of Utah (Lewis 1970), the Great Basin of Nevada (Loope 1969) and as far south as New Mexico (Baker 1983) and. Johnson and Billings (1962) consider *C. elynoides* and *G. rossii* dominated turf to be the climax vegetation type of their study area. Similar vegetation is not reported for the cooler and moister ranges to the north and west of our study area.

Element Code- CEGL001852

Edition / Author- 97 –10 / S.V. Cooper et al.

Carex lanuginosa Herbaceous Vegetation (CARLAN) woolly sedge

Natural Heritage Conservation Rank- G3? / SP

Range- *Carex lanuginosa* dominated communities have also been documented for Idaho (Hall and Hansen 1997, Jankovsky-Jones 1997) and eastern Oregon (Kovalchik 1987).

Environment- *Carex lanuginosa* communities can be found at low to mid elevations in western and central Montana. These marsh communities are usually found in depressions, older riverine sloughs, wet meadow areas along creeks, and in wetlands formed by springs and seeps. Stands primarily occur on mildly brackish mineral soils that are seasonally flooded but which usually dry down by late summer. Adjacent wetter communities include shallow marsh communities dominated by *Carex utriculata* or *Scirpus maritimus*, while adjacent drier, less frequently flooded communities include *Juncus balticus*, *Distichlis stricta*, or stands of exotic pasture grasses like *Phleum pratense*. Upland communities are often dominated by *Artemisia cana* or *Artemisia tridentata*.

Vegetation- *Carex lanuginosa* typically dominates these communities, and due to its rhizomatous habit often forms dense stands with heavy cover. Common associated species include *Mentha arvensis*, *Hordeum jubatum*, and *Juncus balticus*.

Similar Communities- Hansen et al. (1995) included the *Carex lanuginosa* plant association in the *Carex lasiocarpa* habitat type for management considerations; however, the two communities differ in that *Carex lasiocarpa* tends to occur on slightly acidic, organic soils that are permanently wet, while *Carex lanuginosa* communities are often found in mildly brackish marshes that dry down seasonally (Lesica 1994). *Carex lanuginosa* dominated communities have also been

documented for Idaho (Hall and Hansen 1997, Jankovsky-Jones 1997) and eastern Oregon (Kovalchik 1987).

Succession- *Carex lanuginosa* communities probably represent a fairly stable plant association, given a relatively stable hydrologic regime. Moderate disturbance could cause increases in *Juncus balticus* or any pasture grasses present, like *Poa pratensis* or *Phleum pratense* (Hansen et al. 1995).

Management- *Carex lanuginosa* is highly palatable, and communities can be impacted by season-long grazing, particularly when grazing management practices cause increased downcutting of stream channels, which could alter the hydrology of *Carex lanuginosa* communities located in floodplain settings. However, due to the rhizomatous habit of this sedge, disturbed sites do stand a chance of improving rapidly once the disturbance is removed and if the disturbance level isn't too high (Kovalchik 1987).

Element Code- CEGL001809

Edition / Author- 99-10-05 / J. Greenlee, MTNHP

Carex lasiocarpa Herbaceous Vegetation (CARLAS) Slender Sedge

Natural Heritage Conservation Rank- G5 / S5

Environment- The *Carex lasiocarpa* plant association usually occupies former lake basins, long-abandoned beaver ponds, potholes, and lake and stream margins that favor the accumulation of peat. Occasionally this community occurs as floating or quaking mats on fluid peat subsoil. This association can often be found in intermediate to rich fens. The soils are usually organic, with accumulations of sedge peat. This type is typically an indicator of a stable hydrologic regime with yearlong saturated soil conditions in the root zone at minimum. This community can tolerate yearlong flooded conditions.

Range- The *Carex lasiocarpa* community type is distributed globally throughout the northern hemisphere; in the western United States it is a minor type in eastern Washington, the Uinta Mountains of Utah, southeastern Idaho, throughout much of Montana, and in central Yellowstone National Park.

Adjacent Communities- Adjacent wetter sites may be dominated by *either Carex utriculata, Carex aquatilis,* or *Carex nebrascensis* communities. Drier sites may be dominated *by Deschampsia cespitosa, Artemisia cana / Festuca idahoensis,* or *Juncus balticus* communities. Adjacent uplands can be dominated by *Artemisia tridentata,* or a variety of conifer communities (Hansen et al. 1995).

Vegetation- *Carex lasiocarpa* dominates the community with 30-80% cover. It often forms monocultures in sedge meadows in Montana. *Carex utriculata* and *Carex lanuginosa* are often the only other species with high constancy.

Similar Communities- Some classifications include stands dominated by *Carex lanuginosa* in the *Carex lasiocarpa* plant association (Pierce 1986, Hansen et al. 1995), due to similarities in structure and management concerns. *Carex lanuginosa* tends to occur on mineral soils, while *Carex lasiocarpa* is most often found on organic soils (Hansen et al. 1988, Lesica 1994*). Carex buxbaumii* stands are also included in the *Carex lasiocarpa* habitat type by some classifications due to similarities in management concerns (Kovalchik 1987, Hansen et al. 1995).

Succession- Moderate disturbance will increase *Carex aquatilis, Juncus balticus* and associated forbs. Severe disturbance (resulting in dewatering) may lower the water table and cause the site to be dominated by *Poa pratensis, Poa palustris, Potentilla anserina*, or *Agrostis stolonifera*.

Management- Drought years may make occurrences of this community accessible to both domestic and wild grazing animals which could cause rutted and hummocky soils on margins. These sites are generally so wet as to

preclude most types of recreational uses except fishing. Heavy disturbance such as from ORV use should be avoided because the organic soils are slow to recover from mechanical damage. High water tables make burning difficult, but fire can be used on sites adjacent to floodplains. Dominant sedges of this h.t. are resistant to damage by fire except where hot fires penetrate the peat soil. It has often been the policy of land managers to trap and kill beaver because they can be a nuisance. However, because beavers produce such desirable habitat and provide many beneficial stream functions, their removal from a riparian system needs to be closely evaluated (Hansen et al. 1995).

Element Code- CEGL001810

Edition / Author- 95-07-11/ L. Williams

Carex nebrascensis Herbaceous Vegetation (CARNEB) Nebraska sedge

Natural Heritage Conservation Rank- G4 / S4

Environment- Hansen et al. (1995) identify *Carex nebrascensis* as a minor type at low to mid elevations throughout Montana; within southwest Montana and particularly on the Red Rock Lakes National Wildlife Refuge it is also a minor type occurring in small to large patch's. *Carex nebrascensis* in general is found on subirrigated, gently inclined lower slopes, basins and swales and spans a broad range in hydrologic regimes from semi-permanently flooded to saturated (soils drying to over a meter in depth). On the Refuge it is found most frequently as small patches (not individually mapped) in the wetland complexes surrounding Upper and Lower Red Rock Lakes as well as a riparian stinger and around scattered swales that might be vernally flooded. *Carex nebrascensis* generally occupies habitats intermediate (in hydrologic regime) between the wetter associations typically dominated by *Carex utriculata* or *Carex aquatilis* and the marginally drier associations *Deschampsia cespitosa*, *Calamagrostis canadensis* or *Pentaphylloides floribunda* / *Deschampsia. cespitosa*.

Vegetation- Because Hansen et al. (1995) consider *Carex nebrascensis* to be purely a species responding to grazing disturbance they recognize a *Carex nebrascensis* community type only after all other possible diagnostic *Carex* spp. have been discounted. *Carex nebrascensis* should also have greater cover than any other *Carex* spp. We do not necessarily subscribe to the grazing disclimax hypothesis of Hansen et al. (1995) regarding this type. It seems to occupy a somewhat unique niche and perhaps is associated with alkaline substrates; Hansen et al. (1995) do not indicate what associations are grazing impacted so significantly as to drive them to *Carex nebrascensis* dominance (and thus the *Carex nebrascensis* c.t.*).*

The only shrubs noted in this type are errant specimens of *Pentaphylloides floribunda* or *Lonicera involucrata*. In most southwestern Montana examples of this type the cover of *Carex nebrascensis* exceeds 60-70%; other graminoids of moderate to high constancy include *Deschampsia cespitosa, Juncus balticus*, *Calamagrostis stricta* (or *Carex canadensis*), *Carex praegracilis, Poa palustris* and *Eleocharis palustris*; the first three named spp. can have significant cover (>5%). The forb component of these sites is depauperate; those most consistently present and with the greatest cover (seldom in excess of 5%) include *Geum macrophyllum, Epilobium ciliatum, Aster occidentalis, Mentha arvensis* and *Triglochin maritimum*. Grazing impacted sites tend to have higher cover for *M. arvensis* and *Taraxacum officinale*.

Element Code- CEGL001813

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Carex nigricans Herbaceous Vegetation (CARNIG) Black alpine sedge

Natural Heritage Conservation Rank- G4 / S3

Environment- The *Carex nigricans* community type was found between 9,500 and 10,000 ft in the Anaconda, Madison, East Pioneer and Tobacco Root ranges, the wettest ranges within the BVHDMS. This distinctive community occurs on nearly level sites at the base of slopes and in valley and swale bottoms where blowing snow is deposited and melt off does not occur until well into the growing season. *Carex nigricans* occupied sites with perennially moist or saturated soil and with the shortest snow-free season of any snowbed c.t. In 1991, many of our stands had just begun to green-up in late July. *Carex nigricans* usually occurs in a matrix of small patches of wetland or other snowbed communities. *Deschampsia cespitosa / Caltha leptosepala, Carex scopulorum / Caltha leptosepala, Juncus drummondii /Antennaria lanata and Phyllodoce empetriformis / Antennaria lanata* are the associations most frequently found as matrix components.

Vegetation- Mean graminoid cover was 83%. *Carex nigricans* was the absolute dominant with mean cover of 76%. Other frequently occurring, but less abundant graminoids were *Juncus drummondii, Phleum alpinum* and *Carex paysonis*. Forbs had a mean cover of 21%. The most common herbaceous species were *Caltha leptosepala, Antennaria lanata* and *Erigeron peregrinus*. No forb species occurred in all four stands, and only one, *A. lanata* occurred in three out of four. The dwarf shrubs *Phyllodoce empetriformis and P. glanduliflora* were present in small amounts in two stands, and *Salix arctica* was common in one stand. Mean cover of mosses and lichens was less than 1%.

Soils- Parent materials were limestone, granite and gneiss. Bare ground and gravel covered only 2% of the surface. Mean depths of litter and duff were 0.4 in and 0.2 in respectively. Percent coarse fragments were always less than 10% with a mean of 3%. Mean texture of the fine fraction was sandy clay. pH was 6.5 at the limestone site and varied between 5.8 and 6.2 when parent materials were crystalline. Mean pH for the type was 6.2. Mean organic matter content was 15%, mean total nitrogen was 0.36%, and C:N ratio was 20:1. Soils in late July, 1992 were always wet and cold.

Productivity- Due to retarded phenology in 1991, we measured productivity in only two stands. Graminoid productivity had a mean of 375 lbs/acre, and forb productivity had a mean of 275 lbs/acre. Mean productivity of dwarf shrubs was 22 lbs/acre. Mean total productivity was 650 lbs/acre. *Carex nigricans* was not fully mature when we clipped plots in these stands; thus, our estimates of graminoid and total productivity are low.

Other Studies- Communities dominated by *Carex nigricans* have been described for Banff and Jasper national parks in Alberta, Canada (Achuff and Corns 1982, Hrapko and LaRoi 1978). Composition is similar to our *Carex nigricans* association, although *Luzula wahlenbergii* (= *L. piperi*) was a common component of the Canadian types (and not recorded in the BVHDMS). *Carex nigricans* communities are more common and widely distributed in the Canadian Rockies, often occurring on slopes as well as level areas. Communities similar to the *Carex nigricans* association described herein are also common in the North Cascades of Washington (Douglas 1972, Douglas and Bliss 1977). *Luetkea pectinata* and bryophytes were common components in the North Cascades type. Rottman and Hartman (1985) report an association dominated by *C. nigricans* occurring in the center of sorted stone polygons in the San Juan Mountains of Colorado; *Sibbaldia procumbens, Artemisia scopulorum and Juncus drummondii* were the commonly associated forbs. *Carex nigricans* snowbed communities appear to be most common to the north and west of our study area.

Element Code- CEGL001816

Edition / Author- 97 –10 / S.V. Cooper et al.

Carex rupestris / Potentilla ovina
Herbaceous Vegetation
(CARRUP / POTOVI) curly sedge / sheep cinquefoil

Natural Heritage Conservation Rank- G3 / S3

Environment- *Carex rupestris / Potentilla ovina* is transitional between an alpine turf and a cushion plant type. It occurs on exposed, windswept upper slopes, saddles and ridgetops, apparently strongly associated with soils developed from calcareous parent materials found in the Beaverhead, Madison, Pioneer, Tendoy and Blacktail Ranges. Appropriate habitat occurs in other ranges of southwestern Montana, especially the Centennial Range. It was sampled at elevations ranging from 9,300 to 10,400 ft. In several of the ranges, *Carex rupestris / Potentilla ovina* generally graded into the *Carex elynoides* or *Carex scirpoidea / Potentilla diversifolia* turf communities of deeper soils on more protected slopes, whereas in the Blacktail and Tendoy Ranges it graded to *Festuca idahoensis*-dominated community types, particularly *Festuca idahoensis – Elymus trachycaulus*. It grades to fellfield or cushion plant communities that typify harsher, more windswept sites.

Vegetation- Mean graminoid cover was 11%. Important graminoids were *Carex rupestris, Calamagrostis purpurascens,* and *Poa secunda,* and at higher elevations *Festuca ovina,* and *Festuca kingii*. *Carex elynoides* was common in some stands. Mean forb cover was 29%. Consistently present and often well represented forbs include *Potentilla ovina, Minuartia obtusiloba, Oxytropis campestris* and *Phlox pulvinata.* Occurring consistently but with low cover is *Eritrichium nanum, Bupleurum americanum, Cymopterus bipinnatus, Erigeron compositus* and *Senecio canus. Trifolium haydenii, Selaginella densa and Silene acaulis* were well represented in some stands. The shrub, *Pentaphylloides floribunda,* was present in one stand. Lichen and moss canopy cover averaged less than 2%.

Soils- Parent material was quartzite in one stand and limestone in the remaining seven stands. Bare ground and gravel covered 67% of the surface. Mean depths of litter and duff were both 0.1 in. Percent coarse fragments ranged from 40% to 66% with a mean of 57%. Texture of the fine fraction varied from sandy clay to sandy clay-loam with a mean class of sandy clay-loam. Soil pH varied from 6.9 to 8.2 with a mean of 7.8; pH from the seven plots on limestone varied from 7.5 to 8.2 with a mean of 7.9. pH of the single plot on quartzite was 6.9. Mean organic matter content was 12%, mean total nitrogen was 0.34%, and C:N ratio was 32:1.

Productivity- Graminoid productivity varied from 35 to 253 lbs/acre with a mean of 112 lbs/acre. Forb productivity ranged from 89 to 759 lbs/acre with a mean of 277 lbs/acre. Mean total productivity was 389 lbs/acre. Cushion plant productivity is difficult to measure; thus, the forb estimates are only rough approximations. However, this community type was among the least productive in our study area.

Comments- Some stands at lower elevations are dominated by *Calamagrostis purpurascens* which caused us to recognize it as an alternative indicator with *C. rupestris*. *Pseudoroegneria spicata* is also present in the warmest and most exposed of these stands that may represent transitions to the *Pseudoroegneria spicata* / Cushion Plant association. Some stands may be impacted by sheep grazing or pocket gophers. *Carex rupestris / Potentilla ovina* sites may provide important winter range for bighorn sheep. Vegetation of these dry, exposed sites is easily damaged by motorized vehicles and recovers slowly.

Other Studies- *Carex rupestris* commonly dominates windswept fellfields in the Rocky Mountains. Lewis (1970) describes cushion plant communities in the Uinta Mountains of Utah dominated by *C. rupestris, Festuca ovina* and cushion plants such as *Silene acaulis* and *Trifolium nanum*. Willard (1979) describes a dry turf association dominated by *C. rupestris, Potentilla nivalis* and *Silene acaulis* for Rocky Mountain National Park in Colorado, and Komarkova and Webber (1978) report a fellfield community dominated by *C. rupestris* and *Kobresia myosuroides* from Niwot Ridge. Baker (1983) describes a *C. rupestris*-cushion

community for the Sangre de Cristo Range of New Mexico. Moseley (1985) describes limestone fellfields dominated by *C. rupestris and Potentilla ovina* from east-central Idaho, while Urbancyzk and Henderson (1994) report cushion plant communities dominated by *C. rupestris* in the Lemhi Range of Idaho, but *P. ovina* was uncommon (D. Henderson, pers. comm.).

In our study area *Carex rupestris / Potentilla ovina* is ostensibly confined to calcareous parent materials, and *Potentilla ovina*, one of the dominant forbs, is a calciphile on these high elevation sites. In the limestone mountains to the north, most *C. rupestris* associations support *Dryas* spp. as an important component (Bamberg and Major 1968, Achuff and Corns 1982). To the east and south of our study area, *C. rupestris* fellfield communities on crystalline parent material are often codominated by *Geum rossii* or *Dryas octopetala* (Bliss 1956, Johnson and Billings 1962, Willard 1979) and are more similar to our *Geum rossii* / *Minuartia obtusiloba* c.t.. The *Carex rupestris / Potentilla ovina* c.t. may be endemic to calcareous ranges of southwest Montana and adjacent east-central Idaho.

Element Code- CEGL001862

Edition / Author- 97 –10 / S.V. Cooper et al.

Carex scirpoidea / Geum rossii Herbaceous Vegetation (CARSCI / GEUROS) northern single-spike sedge / Ross' avens

Natural Heritage Conservation Rank- G3 / S3

Environment- We regard *Carex scirpoidea / Geum rossii* as a geographic/substrate variant of *Carex scirpoidea / Potentilla diversifolia*. It was a common plant association in the BVHDMS's relatively moist mountain ranges dominated by granitic or metamorphosed intrusive volcanics, the East Pioneer and Tobacco Root Ranges. It was also found in the Madison Range, exclusively on gneiss. It spanned nearly the full range of alpine elevations available in these ranges, from 9,300 to 10,320 ft. Sample sites were about evenly divided between low gradient slopes and steeper slopes. All aspects were represented. Most characteristic was some degree of enhanced effective moisture through increased snowpack or delayed snowmelt. Often *Carex scirpoidea / Geum rossii* turf occurred as patches scattered among boulders which act as snow fences creating eddy currents and increasing snowpack. *Carex scirpoidea / Geum rossii* graded to drier turf types, usually *Carex elynoides*, of more exposed positions and to DRY SLOPE or MOIST SLOPE c.t's. of steeper, unstable slopes.

Vegetation- Graminoid canopy cover averaged only 37%, of which 24% was *Carex scirpoidea. Carex phaeocephala, C. atrata* and *C. albonigra* were also dominant in at least one stand. Common turf graminoids *C. rupestris, C. elynoides* and *Festuca ovina* had moderate coverages or high constancy but are much less important than in the *Carex scirpoidea / Potentilla diversifolia* c.t. Other graminoids with high constancy were *Luzula spicata, Poa alpina, P. secunda* and *Trisetum spicatum*. The moister sites supported *Deschampsia cespitosa*, but its cover did not exceed 5%. Carex scirpoidea / *Geum rossii* forb coverage averaged 51%, very similar to that of *Carex scirpoidea / Potentilla diversifolia*. With the exception of *Geum rossii,* which was 100% constant and averaged 37% c.c. in this type, the two *C. scirpoidea*-dominated turf types had many forb species of high constancy or coverage in common e.g., *Minuartia obtusiloba, Potentilla diversifolia, Phlox pulvinata, Polygonum bistortoides, Erigeron simplex, Lloydia serotina* and *Lupinus argenteus*. Nonetheless, these two mesic turf types had fewer herbs in common (55) than were found in only one of the two types (63).

Soils- All soils were developed on intrusive igneous or metamorphosed substrates thereof. *Carex scirpoidea / Geum rossii* had roughly seven times more exposed soil, gravel and rock than did *Carex scirpoidea / Potentilla diversifolia.* Both litter and duff depths were shallow (0.2 in). Coarse fragment content

ranged from 6 to 39% and averaged 19%, twice that of the *Carex scirpoidea / Potentilla diversifolia* c.t. Texture of the fine fraction ranged from sandy clay to sandy loam, while the mean textural class was sandy clay-loam. pH values were low, averaging 5.9 and ranging from 5.5 to 6.3. Mean organic matter content was 14%, mean total nitrogen was 0.45%, and C:N ratio was 18:1. Soils were more coarse-textured, and organic matter and nitrogen contents were lower than those of other turf communities.

Productivity- The high degree of variability in productivity appears to reflect the variability in exposed substrate. Total productivity ranged from 236 to 2669 lbs/acre and averaged 964 lbs/acre, 272 and 692 lbs/acre for graminoids and forbs, respectively.

Other Studies- The *Carex scirpoidea* var. *scirpoidea* c.t. described by Douglas and Bliss (1977) for the eastern North Cascades has strong floristic similarity with our *Carex scirpoidea/Geum rossii* p. a., except their type lacks *Geum rossii*. However, their *Carex scirpoidea* c.t. represents drier portions of moisture/snowmelt gradients from a much wetter climatic regime. Conversely, Thilenius and Smith (1985) describe as the moistest of their Absaroka Range alpine sites a *Geum rossii-Trifolium parryi* c.t. whose environmental parameters resemble those of *Carex scirpoidea / Geum rossii* but whose vegetation differs by having *C. scirpoidea* replaced by *C. ebenea*. In analogous fashion, the Sange de Cristo Range of New Mexico supports a *Geum rossii* meadow type in which *C. heteroneura* (= *C. atrata*) and *Deschampsia cespitosa* are conspicuous components denoting the mesic nature and a similarity to our *Carex scirpoidea / Geum rossii* c.t. (Baker 1983). Lewis (1970) described vegetation dominated by *Carex scirpoidea, Geum rossii* and *Deschampsia cespitosa* from Utah's Uinta Mountains. Well-drained sites were dominated by *C. scirpoidea*, while *D. cespitosa* dominated areas of impeded drainage. One can only speculate on the ecological or phytogeographic significance of the fact that this association has not been reported immediately to the south in the high ranges of east-central Idaho.

Element Code- CEGL001866
Edition / Author- 97 –10 / S.V. Cooper et al.

Carex scirpoidea / Potentilla diversifolia Herbaceous Vegetation (CARSCI / POTDIV) northern single-spike sedge / diverse-leaved cinquefoil

Natural Heritage Conservation Rank- G3 / S2

Environment- *Carex scirpoidea / Potentilla diversifolia* is a moist turf type found in BVHDMS ranges with higher precipitation (Gravelly, Snowcrest, Anaconda-Pintlar and Madison). It occurred from 9,300 to 10,320 ft associated with gentle, not nearly so wind-impacted slopes as those of the *Carex elynoides* c.t did. Most of the sites had evidence of frost-sorting or solifluction lobes. We hypothesize these sites are turf because they occur in windswept positions (little winter snow accumulation), but they are also moist, being in runoff collecting positions or, if on slopes, then ones with low solar insolation (north-facing). *Carex scirpoidea / Potentilla diversifolia* grades to the *Carex elynoides* association on upper slopes and to wet meadows or snowbed communities of yet wetter sites. With the exception of wet meadow c.t's., *Carex scirpoidea / Potentilla diversifolia* had less exposed soil and rock (4%) than any other alpine site, graminoid-dominated plant association within the BVHDMS.

Vegetation- Dominance of *Carex scirpoidea, C. atrata, C. phaeocephala, C. obtusata* or a combination of these sedges is diagnostic for this c.t. Graminoid canopy cover averaged 66%, of which 35% was *C. scirpoidea. Carex elynoides, C. rupestris, Festuca ovina* and *Calamagrostis purpurascens* were strongly represented. *Elymus trachycaulus, Luzula spicata* and *Poa alpina* had high constancy and low coverage. Average forb coverage (47%) was high, reflecting the favorable moisture status of these sites. Forbs with high constancy (> 50%) included those typical of moist sites

such as *Lloydia serotina, Erigeron simplex, Polygonum bistortoides, P. viviparum* and *Zigadenus eleg*ans. Other high-constancy forbs included *Cerastium arvense, Hymenoxys grandiflora, Lupinus argenteus, Pedicularis parryi, Solidago multiradiata*, and most characteristically *Potentilla diversifolia*. Forbs consistently present, but more typical of dry turf or cushion plant communities, included *Minuartia obtusiloba, Oxytropis campestris* and *Phlox pulvinata*.

Soils- Samples were about evenly divided between calcareous (limestone and conglomerate) and noncalcareous (basalt, granite and quartzite) substrates. Average litter and duff depths were, respectively 0.6 in and 0.4 in. Coarse fragment content ranged from 0 to 31% and averaged 9%. Texture of the fine fraction ranged from fine clay to sandy clay, and mean texture was sandy clay. Soil reaction was strongly conditioned by substrate type, averaging 7.2 for calcareous and 5.8 for noncalcareous types; both values were distinctly lower than for the drier turf types. Mean organic matter content was 20%, mean total nitrogen was 0.73%, and C:N ratio was 13:1.

Productivity- The range in total productivity was relatively narrow, 1,127 to 1,426 lbs/acre (1283 lbs/acre average), with graminoids averaging 743 and forbs 540 lbs/acre. These high values relative to, say the *Carex elynoides* p. a. (ave. 796 lbs/acre), further substantiate the less stressful, higher moisture status of the *Carex scirpoidea / Potentilla diversifolia* c.t.

Other Studies- Douglas and Bliss (1977) describe a *Carex scirpoidea* var. *scirpoidea* community type from the eastern North Cascades of Washington that is vegetationally and physiognomically very similar to *Carex scirpoidea / Potentilla diversifolia*. However, in the moister Cascadian climate, their *Carex scirpoidea* community represents the dry, early snow-free end of an alpine continuum, occurring on well-drained slopes of all aspects. Stand tables from Bamberg and Major (1968) show plots for the Big Snowy Mountains of Montana that conform to our conception of this c.t.

Element Code- CEGL001867

Edition / Author- 97 –10 / S.V. Cooper et al.

Carex scopulorum / Caltha leptosepala Herbaceous Vegetation (CARSCO / CALLEP) Holm's Rocky Mountain sedge / elkslip marsh marigold

Natural Heritage Conservation Rank- G4 / S3

Environment- This association was extensive in the Gravelly and Madison Ranges, sampled in the Tobacco Roots, noted in the East Pioneer and to be expected in the other ranges based on the broad distribution of the dominant species. Saturated soil, often with standing water throughout the growing season, was the dominant feature. These sites span the range from wet meadow to fen and occur in shallow undrained depressions, low-gradient subirrigated positions and also adjacent to first order streams or rivulets. From the high values for basal area (8% average) and abundant moss (60% average) and litter (30% average), it follows that there was seldom more than a trace amount of exposed soil/gravel or rock.

Vegetation- Only trace amounts of *Salix* spp. were present. Without exception, the graminoid component, dominated by the diagnostic species *Carex scopulorum* or *C. lenticularis*, was extremely dense (88% mean canopy cover), though they did not exceed 8-12 inches. Other graminoids with high constancy or coverage were *C. haydenii, Deschampsia cespitosa, Juncus drummondii, J. mertensiana* and *Poa alpina*. The forb component, notably lacking in diversity, was dominated by several wet-site species, most commonly *Caltha leptosepala* (35% mean c.c.), *Pedicularis groenlandica, Polygonum bistortoides, Senecio cymbalarioides, Trollius laxus* and *Veronica wormskjoldii*.

Soils- All parent materials were characterized as alluvium, mostly volcanic-derived. Four of the five sites had fibrous peat at least 6 in deep.

Litter depths averaged 0.7 in; we did not discriminate duff from peat. No coarse fragments were found in any of the profiles. Soil texture ranged from clay to sandy clay-loam with a modal condition being clay loam. Soil reaction for the one calcareous site (pH = 5.9) was the lowest of any calcareous site sampled; however, the soils derived from volcanic alluvium showed no trend of lower pH values (6.0 average) than other wet/moist sites. The only slightly acid values indicate minerotrophic sites having more in common with fens than bogs (as this c.t. has been termed in the literature). Mean organic matter content was 25%, mean total nitrogen content was 0.70%, and C:N ratio was 17:1. Organic matter and nitrogen content were higher than in other wetland types and were equaled only by the *Dryas octopetala / Polygonum viviparum* turf.

Productivity- Average productivity for the c.t., 2,277 lbs/acre, was higher, particularly in the graminoid component, 1,720 lbs/acre, than that of any other study area c.t. However, the range, 1,426 to 4,123 lbs/acre, overlaps with a number of moist/wet site types. We speculate that these values are underestimates, as sampling invariably occurred prior to phenological optima. A protected site at 10,230 ft in the Madison range had total productivity of 4,123 lbs/acre, much higher than for comparable c.t.'s in the Central Rockies (May and Webber 1982, Scott and Billings 1964, Briggs and MacMahon 1983).

Other Studies- Virtually identical alpine marsh communities and environmental parameters are described for the Beartooth Plateau of Montana/Wyoming (Johnson and Billings 1962), Medicine Bow (Scott and Billings 1964) and Teton Ranges (Spence and Shaw 1981) of Wyoming and Colorado's Front Range (Willard 1979 and May and Webber 1982). *Caltha leptosepala* is the dominant forb in many alpine marshes of Utah's Uinta Mountains, but the dominant graminoids are *Carex aquatilis or C. saxatilis*, rather than *C. scopulorum* (Briggs and MacMahon 1983, Lewis 1970). Hansen et al. (1995) describe a similar type from subalpine and alpine areas of Montana, but subalpine stands have a different forb composition. Similar communities have not been described north and west of our study area.

Element Code- CEGL001823

Edition / Author- 97 –10 / S.V. Cooper et al.

Carex simulata Herbaceous Vegetation (CARSIM) short-beaked sedge

Natural Heritage Conservation Rank- G4 / S3

Environment- This minor, but distinctive, fen community type was found confined to saturated organic soils developed in association with springs/subirrigation on stream terraces at 6,600-7,000 ft. in the vicinity of the Tendoy and Centennial Ranges; the actual elevation range is probably considerably greater. This vegetation type occurs on some of the wettest sites sampled in southwestern Montana. Plants generally occur on hummocks or mats between areas of standing water. Slightly drier adjacent communities are dominated by *Pentaphylloides floribunda / Juncus balticus* or *Poa juncifolia*, *Puccinellia distans*, and *Carex praegracilis*, or *Salix* spp. and *Carex utriculata*. Upland vegetation is dominated by various combinations of *Artemisia tridentata* (ssp. vaseyana or tridentata), *A. cana* or *A. longiloba* usually with *Festuca idahoensis* and/or *Leymus cinereus*.

Vegetation- Stands generally are somewhat depauperate, having fewer than ten species. *Carex simulata* is dominant and abundant. *Carex nebrascensis*, *Eleocharis pauciflora* (syn. *E. quinqueflora*), and *Deschampsia cespitosa* may be well represented in some stands. Forbs are generally not abundant. *Triglochin palustre* and *Epilobium palustre*, and *Ranunculus cymbalaria* are the most common forb species. Mosses are common, usually with 20-30% cover, though they can form a nearly continuous sward, occurring even where standing water existed at the time of sampling.

Soils- Soils are Histosols. Reducing conditions, as evidenced by gleying, are 1 cm to greater than 20 cm below the surface. Water covers 30-80% of the surface.

Other Studies- Hansen et al. (1995) describe a *Carex simulata* habitat type from western Montana. Lesica (1990) described similar communities from higher elevations in southwest Montana, but significant coverages of *Carex aquatilis* and *Salix brachycarpa* were present in some stands. More species rich vegetation dominated by *Betula glandulosa, Pentaphylloides floribunda* and *Carex simulata* was described for north-central Montana (Lesica 1986). Fen vegetation dominated by *C. simulata* has also been described for Idaho, Wyoming and Utah (Padgett et al. 1989, Youngblood et al. 1985).

Comments- Light to moderate livestock grazing does occur in the *Carex simulata* c. t. Although the effects of the associated herbivory are probably minimal, trampling may alter the habitat by creating hummocks that permit the invasion of shrubs and alien species.

Element Code- CEGL001825

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Carex utriculata Herbaceous Vegetation (CARUTR) beaked sedge

Natural Heritage Conservation Rank- G5 / S5

Environment- This is perhaps the most common of mid to high elevation wetland types in Montana; within the Centennial Valley it is rather uncommon with the strong exception of the Red Rock Lakes National Wildlife Refuge where perhaps the state's largest expanse occurs (it also occupies more area than any other single vegetation type on the Refuge). It is recognized by any of three sedges, *Carex utriculata, Carex vesicaria*, or *Carex atherodes* having at least 25 % canopy cover. On the Refuge and throughout southwestern Montana *C. utriculata* is by far the dominant and diagnostic sedge *and C. vesicaria* is sporadically present with low cover values. *Carex utriculata* is found as a narrow, linear feature, bordering steams or pond margins with continuously saturated soils but its most extensive development (at least in the BVHDMS) is in the wetlands surrounding Upper and Lower Red Rocks Lakes. In places it forms a broad band, scores of meters wide in places, around the majority of these lake's perimeters. Even in late summer soils of these sites are saturated to the surface and often are even inundated by standing water. Substrates have a high organic content, though not all of the Refuge sites investigated had histic epipedons (probably mostly Inceptisols and Entisols prevail though Aquic Mollisols and Histosols also occur). Soils are formed from alluvium of various sources and are generally moderately fine-textured, though lenses of silty-clays were also encountered. On the Refuge this type most often borders directly on open water but in places there are distinct patches dominated by *Typha latifolia, Scirpus acutus* and *Hippuris vulgaris* intercalated between Carex utriculata and open water. Toward shallower/drier habitats *Carex utriculata* grades to *Juncus balticus*-domination, mostly as *Juncus balticus* plant association (near monoculture of *J. balticus*) or the *Juncus balticus – Carex praegracilis* plant association. This type forms floating mats as well, when under the influence of wave action, pieces of the anchored mat are dislodged.

Vegetation- *Carex utriculata* verges on being a monospecific dominant in the portions of this type occupying sites that are nearly continuously inundated; *Carex aquatilis* shares dominance on a very minor portion of the type. Total graminoid cover often approaches 100%. The fact these are aggressively rhizomatous graminoids may explain site preemption (local dominance of one of the two species) and the low species diversity exhibited by this type, though the environment itself is considerably restrictive. Other graminoids consistently present, often well represented include *Calamagrostis stricta* and *Juncus balticus*. Shrubs, *Salix* spp., *Lonicera involucrata* and *Pentaphylloides floribunda*, and forbs,

principally *Epilobium ciliatum, Ranunculus spp.* and *Potentilla palustris* are present in trace amounts.

Comments- This is an extremely common and broadly distributed wetland type, ranging as far south as New Mexico and Arizona (Bourgeron and Engelking 1994). In Montana probably more sampling has been done to document the regional permutations of this type than has been conducted for any other wetland type. Thus three phases are recognized of which *Carex aquatilis* is the one sampled and commonly represented in the BVHDMS; the *Deschampsia cespitosa* phase (representative of less inundated and more livestock-accessible environments) may have been enormously reduced to extirpated by heavy grazing of these riparian/wetland habitats, most especially those of the Centennial Valley and Refuge lands.

Element Code- CEGL001562

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Deschampsia cespitosa Herbaceous Vegetation (DESCES) Tufted hairgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- This common plant association occurs on moist stream terraces, extensive subirrigated benchlands, small valley seeps and just above the drawdown zone of lakes and ponds. Within the BVHDMS some of the best quality stands, albeit of limited extent, occur throughout the lowlands of the Red Rock Lakes National Wildlife Refuge. Soils are generally silty to silty clays in texture. Sites with the BVHDMS exhibited little bare ground and no surface gravel. Adjacent sites are most frequently dominated by *Juncus balticus, Pentaphylloides floribunda, Carex utriculata, C. simulata* or *Salix* spp. *Artemisia tridentata, A. tripartita,* and/or *Festuca idahoensis* dominate adjacent upland vegetation.

Vegetation- The dominant aspect of these sites is a continuous dense canopy of graminoids, the dominants of which, *Deschampsia cespitosa* and *Juncus balticus*, are usually abundantly represented; however the mere presence of *D. cespitosa* under intense grazing is enough to indicate these moist to wet sites are potentially dominated by this species. *Muhlenbergia richardsonis* and *Carex praegracilis* are other common graminoids. The cover and diversity of forbs is low to moderate. *Aster occidentalis, Potentilla anserina, P. gracilis* and *Crepis runcinata* are common species. Mosses are common; occasionally they will form a nearly continuous layer.

Comments- (see comments under *Juncus balticus - Carex praegracilis*). This vegetation is productive and often remains green throughout the growing season, making it attractive to livestock, especially late in the year. The moist to wet soils and generally small size of stands make this type very prone to degradation. Hansen et al. (1995) describe the *Deschampsia cespitosa* habitat type as a major landscape component for Montana. Similar types have been described for the Blackfoot River Valley (Lesica 1994) and the Blackfeet Indian Reservation (Lesica 1989). Wet meadows dominated by *D. cespitosa* have also been described for the alpine zone of southwestern Montana mountains (Cooper and Lesica 1992). Youngblood et al. (1985) described this vegetation type for Wyoming and Idaho; in fact this is one on the most widespread wetland types of the Intermountain West (Padgett et al. (1989) and also extends to near-coastal environments (Bourgeron and Engelking 1994).

Element Code- CEGL001599

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Deschampsia cespitosa - Caltha leptosepala Herbaceous Vegetation (DESCES - CALLEP) tufted hairgrass / elkslip marsh marigold

Natural Heritage Conservation Rank-

G4 / S3

Environment- This c.t. was well represented in the Gravelly Range and also sampled in the Beaverhead and Madison Ranges; it was noted, but not sampled, in four of the other five major mountain ranges of the BVHDMS. It occurred at elevations as high as 10,100 feet, but was much more common in lower elevation collecting positions (either snow or percolating water) at the alpine/subalpine ecotone (approx. 9,200 to 9,500 feet). Sampled sites occupied flat to concave benches and slopes that did not exceed 15% slope and were north- through northeast-facing (and probably subirrigated). Small patches of this c.t. were noted on steeper slopes below persistent snowbanks and in swales. At time of sampling all soil profiles were saturated to the surface. Solifluction lobes were prominent even on the gentlest slopes.

Vegetation- The high coverage of moss (72% mean) contributed dramatically to the lush appearance of this c.t. Only trace amounts of *Salix* spp. were found. Graminoid cover varied considerably, averaging 38%. *Deschampsia cespitosa* was clearly the dominant graminoid; other moist site graminoids occurring with at least 5% coverage *were Carex atrata, C. nigricans, C. haydenii, Juncus drummondii and J. balticus*. Though *D. cespitosa* clumps provided a recognition factor for this association, forb cover (68% average) far outstripped that of the graminoids. *Caltha leptosepala* dominated (48% c.c.) the forb layer. Other forbs with high coverage but not necessarily high constancy were *Aster foliaceus, Claytonia lanceolata, Erigeron peregrinus, Pedicularis groenlandica, Polygonum bistortoides, P. viviparum, Senecio cymbalarioides and Veronica wormskjoldii.*

Soils- Parent materials included alluvium, limestone, sandstone, basalt and gneiss. Litter and duff depth averaged 0.6 in and 0.4 in, respectively. Coarse fragment content was consistently low, averaging only 3%, with traces of gravel and rock found on the surface. Bare soil exposure was as high as 20%, especially where pocket gopher (*Thomomys talpoides)* workings were extensive. Soil texture varied from clay to sandy clay with a mean of sandy clay. Soil reaction for calcareous substrates averaged 7.5 while that for noncalcareous was only 5.8. Mean organic matter content was 20%, mean total nitrogen was 0.57%, and C:N ratio was 15:1.

Productivity- Total productivity ranged widely, from 621 to 3,197 lbs/acre with a mean of 1,820 lbs/acre. Graminoid productivity accounted for only 13% to 42% of the total. These productivity figures are likely underestimates as at least two sites were sampled prior to culmination of growth.

Other Studies- Mueggler and Stewart (1980) describe a *Deschampsia cespitosa / Carex* spp. c.t. for subalpine meadows of western Montana. It has high productivity but little contribution by forbs. Our Deschampsia cespitosa / Caltha leptosepala c.t. can be interpreted as a alpine extension of the *Deschampsia* series. Johnson and Billings (1962) have described a more broadly defined Deschampsia cespitosa vegetation type (with appreciable Carex scopulorum) for the Beartooth Range of Montana-Wyoming. They observe an increasing coverage of *Caltha leptosepala* indicates a transition to *C. scopulorum*-dominated bog conditions. *Deschampsia cespitosa*-dominated meadows extend southward to Colorado (Willard 1979, Bonham and Ward 1970, May and Webber 1982 and Eddleman and Ward 1984), Utah (Lewis 1970), and northern New Mexico (Baker 1983) but apparently lack the mesic to hydric forbs that characterize the Deschampsia cespitosa / Caltha leptosepala c.t. Their *D. cespitosa*-dominated types are apparently intermediate moisture status between *our Deschampsia cespitosa / Potentilla diversifolia* and *Deschampsia cespitosa / Caltha leptosepala* c.t's.

Element Code- CEGL001882

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Deschampsia cespitosa - Potentilla diversifolia Herbaceous Vegetation (DESCES - POTDIV) tufted hairgrass / divers-leaved cinquefoil

Natural Heritage Conservation Rank- G5 / S2

Environment- This community type occurred from treeline to over 10,000 ft in the Gravelly, Madison and Snowcrest ranges, but small examples can probably be found in all of the BVHDMS ranges. It was confined to cool slopes, valley bottoms and depressions where soils are deep and remain moist until at least mid-summer. This community type occupies the most mesic situations in the lower alpine zone. Snow cover during winter protects the plants, and although snow release comes moderately early in the season, the sites are often fed by meltwater from upslope snowfields. *Deschampsia cespitosa / Potentilla diversifolia* was abundant on the old erosion terraces of the Gravelly Range and was often associated with slopes showing evidence of solifluction. This community type generally occurred in a matrix of drier grassland and moist or dry turf vegetation. It also graded into wetland communities, especially *Deschampsia cespitosa / Caltha leptosepala.* In the Gravelly Range it sometimes occurred immediately above shrublands dominated by *Artemisia tridentata ssp. vaseyana* or subalpine forests dominated by *Picea engelmannii.*

Vegetation- Graminoid cover in *Deschampsia cespitosa / Potentilla diversifolia* is high, averaging 78% and exceeded only by that of the *Carex scopulorum / Caltha leptosepala* marsh community. *Deschampsia cespitosa* is the dominant graminoid, often forming large tussocks. *Carex atrata* and *Phleum alpinum* are also important. *Festuca idahoensis* was common in stands at lower elevations, and *Carex phaeocephala* and *Juncus balticus* were locally common. The latter may have increased under the influence of livestock grazing (Hansen et al. 1995). Mean forb cover was 37%. *Potentilla diversifolia, Polygonum bistortoides* and *Senecio crassulus* were the most abundant forbs. *Cerastium arvense, Ranunculus eschscholtzii* and *Saxifraga oregana* were also common. *Mertensia ciliata* was abundant in one stand. Mean cover of lichens and mosses was 3%.

Soils- Parent materials for these stands were sandstone, limestone, quartzite and gneiss. Mean depths of litter and duff was 0.4 in and 0.8 in respectively. Generally soils supporting this community type were deep with dark, mollic-appearing epipedons and high moisture content throughout much of the growing season. Bare ground and gravel covered 6% of the surface. This type had the lowest coarse fragment content of all non-wetland types, ranging from 0-19% with a mean of 8%. Texture of the fine fraction ranged from fine clay to loamy sand with a mean textural class of clay loam. Soil reaction varied from a low of 6.0 on soils derived from gneiss to 7.0 on soils derived from limestone and calcareous sandstone. Mean pH for the type was 6.5. Mean organic matter content was 18%, mean total nitrogen was 0.65%, and C:N ratio was 14:1

Productivity- Graminoid productivity varied between 850 and 2,350 lbs/acre with a mean of 938 lbs/acre. Forb productivity ranged from 180 to 875 lbs/acre with a mean of 729 lbs/acre. Mean total productivity was 1,667 lbs/acre and was highest on warmer aspects.

Other Studies- *Deschampsia cespitosa / Potentilla diversifolia* at lower elevations is very similar in environment and composition to Mueggler and Stewart's (1980) *Festuca idahoensis / Deschampsia cespitosa* habitat type. Though impossible to evaluate with stand tables, Mueggler and Stewart's *Festuca idahoensis / Deschampsia cespitosa* association probably also encompasses the moist turf community type, *Carex scirpoidea / Potentilla diversifolia*. These authors state that productivity of their type probably ranges between 1200 and 1500 lbs/acre, somewhat lower than we measured. Johnson and Billings (1962) described wet meadows dominated by *D. cespitosa* and *Carex scopulorum* in the

Beartooth Mountains of south-central Montana, and Lesica (1991) reported that drier communities dominated by *D. cespitosa* and *Geum rossii* also occur in this range. In North America, similar associations are best developed in the Rocky Mountains from southern Montana south to New Mexico where Baker (1983) reported communities similar in dominant vegetation and landscape position. Lewis (1970) described alpine meadow communities from the Uinta Mountains of Utah dominated by *D. cespitosa, Polygonum bistortoides,* and *Geum rossii*. These types differ by having *G. rossii* dominant instead of *P. diversifolia* and by the greater prominence of *Trifolium* spp. Bonham and Ward (1970) and Komarkova and Webber (1978) described similar *D. cespitosa*-dominated communities in Colorado with *G. rossii* and *Trifolium parryi* as diagnostic species. This community type in Rocky Mountain National Park, Colorado did not have an abundance of *T. parryi*, and Willard (1979) believes that this species has increased under the influence of livestock grazing in unprotected areas outside the park. Meadows dominated by *D. cespitosa* are reported for the Cascade Range of Washington (Hamann 1972 as cited in Willard 1979).

Element Code- CEGL001889

Edition / Author- 97 –10 / S.V. Cooper et al.

Distichlis spicata Herbaceous Vegetation (DISSPI) Inland saltgrass

Natural Heritage Conservation Rank- G5 / S4

Environment- Hansen et al. (1995) observe that this is a minor type in central and eastern Montana and only as an incidental type in southwestern Montana valleys; it occurs on the Red Rock Lakes National Wildlife Refuge as small patch communities incapable of being mapped, except as inclusions. Relatively high quality examples occur on the Refuge on saline or alkali basins and swales, seep areas and the drawdown zone of pond or lake margins.

Vegetation- Relatively pure patches of *Distichlis spicata* with herbs typical of wetter or less saline (alkaline) environments occurring in not more than trace amounts identify this type. Scattered patches of the tussock grass, *Puccinellia nuttalliana*, are quite typical, as are lone specimens of *Leymus cinereus*. *Distichlis spicata* usually occurs in a matrix with *Leymus cinereus – Puccinellia nuttalliana and Sarcobatus vermiculatus*-dominated communities representing slightly drier sites and usually abruptly transitioning to Juncus balticus- or *Scirpus* spp.-dominated communities occurring on wetter and/or less saline sites. Shrubs and forbs are very scattered if they occur at all. *S. vermiculatus* and *Chrysothamnus nauseosus* are the only shrubs noted in the type and *Triglochin maritimum* and *Grindelia squarrosa* are the only forbs consistently present on Refuge examples. Hansen et al. remark that Hordeum jubatum can increase markedly with grazing but only scattered *H. jubatum* was noted.

Element Code- CEGL001770

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Eleocharis palustris Herbaceous Vegetation (ELEPAL) Common Spikerush

Natural Heritage Conservation Rank- G5 / S5

Environment- The *Eleocharis palustris* community type is found at low to moderate elevations, generally in wide, low gradient valleys of all shapes. Sites are wet basins, floodplains, meadows, gravel bars, and lake and pond margins. It typically occupies sites that are prone to yearly flooding or persistent surface water. Where streams are present, they are Rosgen's C and E stream types. Elevations range from 2,200 to at least 8,700 feet, depending on latitude (Hansen et al. 1995; Manning and Padgett 1995; Crowe and Clausnitzer 1997; Hall and Hansen 1997). Soils of this community type are classified as Mollisols, Entisols, Histosols, and Inceptisols. Textures are variable, ranging from sites that

are very coarse-fragment rich to others that are deep and fine-textured. The surface is usually rich in organic matter and the litter accumulation may blend into rich, black organic muck soils. The fine-textured upper horizons often arise from alluvial deposition. Sand, gravel, and cobbles usually constitute the main body of deeper subsurface materials (Manning and Padgett 1995; Crowe and Clausnitzer 1997; Hall and Hansen 1997).

Range- *Eleocharis palustris* is a common type in California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming, and Saskatchewan. Essentially it has been documented from every western state except Arizona and New Mexico (Bourgeron and Engelking 1994; Anderson et al. 1998).

Adjacent Communities- Due to the wide geographic distribution of this type, adjacent upland communities are varied, including shrub-steppe, woodland, and coniferous forest types. Adjacent riparian communities may be dominated by an equally varied assortment of types including deciduous forest, tall shrub, low shrub, and herbaceous communities

Vegetation- *Eleocharis palustris* is an aggressive, rhizomatous species that nearly excludes all other species from establishing any significant cover. Common associates in high quality sites include *Alopecurus aequalis, Mentha arvensis, Rumex crispus, Eleocharis acicularis, Carex utriculata, Glyceria spp*., and *Phalaris arundinacea*. On some sites aquatic species, such as *Hippuris vulgaris, Utriculata vulgaris,* and *Potamogeton natans,* have high cover.

Similar Communities- In some cases, the *Eleocharis palustris* may be confused with E. rostellata, especially if the stolons of *E. rostellata* are not present or not obvious. Be sure of the plant's true identity. A misidentification will result in the wrong community type being identified and ecological confusion will result because the sites on which they occur are very different ecologically. It should be noted that Hansen et al. (1995) consider *Eleocharis acicularis* (needle spike-rush) to be an ecological analogue of *E. palustris* and use it as a diagnostic species for the *E. palustris* association.

Succession- Padgett at al. (1989) suggest that *Eleocharis palustris* can represent an early seral species on ponds and streambanks where water is at or above the ground surface. As siltation occurs over time, other communities, such as *Carex utriculata*, may replace it. However, due to the continual saturation and dense growth of *Eleocharis palustris,* once formed, stands appear difficult to displace and may persist as climax vegetation. If water levels rise, *Scirpus* spp. and *Typha latifolia* may be able to supplant *E. palustris*. Hansen et al. (1995) have observed that disturbance can drastically shift the vegetative composition of this type toward increaser or invader species such as *Hordeum jubatum*.

Management- Seasonally wet conditions and low palatability of *Eleocharis palustris* limit the grazing value of this type for livestock, even during drought years when upland forage dries early and dies back (Kovalchik 1987). Sites occupied by this type are typically inundated or at least saturated for much of the year so as to preclude most development. Trampling damage and soil churning occurs readily with livestock use and may result in a shift toward more disturbance tolerant species such as *Hordeum jubatum, Carex nebrascensis,* and *Juncus balticus* (Hall and Hansen 1997).

Wildlife Values- Broad zones of this type along streams, rivers, lakes, and reservoirs provide valuable feeding and nesting areas for waterfowl. *Eleocharis palustris* and associated plants are a valuable source of food and cover for waterfowl. Wild ungulates seldom browse this habitat type due to its low palatability (Hall and Hansen 1997).

Element Code- CEGL001833

Edition / Author- 98-12-08/ B. Moseley

Elymus lanceolatus - Phacelia hastata
Herbaceous Vegetation
(ELYLSL / PHAHAS) thickspike

wheatgrass / silverleaf phacelia

Natural Heritage Conservation Rank- G2 / S2

Environment- This association has been observed only in the Centennial Valley in a landscape referred to as the Centennial Sandhills. It occurs on sand dune blow outs at elevations around 6,700 feet elevation. These sites may range from foredune apons, to moderately inclined dune faces and lee slope deposition areas. Bare soil (fine-textured sand) cover ranges from 60 to 90% and coarse fragments are absent. The soil surface is usually unstable because of a lack of adequate vegetation cover. Parent materials are eolian sand deposits. Soils are very deep Ustic Torripsamments lacking coarse fragments and are not calcareous. Available water holding capacity is low due to the coarse texture of the substrate.

Vegetation- *Elymus lanceolatus* is well represented to abundant within this community type; it and *Stipa comata* constitute the primary colonizing graminoids on these sites with shifting substrates. Other species that are generally present with cover ranging from 1 to 20% include *Chrysothamnus nauseosus, Tetradymia canescens, Eriogonum ovalifolium* v. *celsum, Linum perenne, Phacelia hastata, Psoralea tenuifolia, Oryzopsis hymenoides*, and *S. comata*.

Adjacent Communities- The *Artemisia tripartita / Festuca idahoensis, A. tridentata* ssp. *tridentata / Festuca idahoensis and A. tridentata* ssp. *tridentata / Stipa comata* plant associations are usually found on adjacent more stable soils and sites.

Other Studies- There are no other studies that describe similar communities.

Element Code- CEGL001745

Edition / Author- 99-11-16 / S.V. Cooper

Equisetum fluviatile *Herbaceous Vegetation* (EQUFLU) Water horsetail

Natural Heritage Conservation Rank- G4 / S4

Environment- Th *Equisetum fluviatile* plant association can be found at low to mid elevations in the mountains of central and southwestern Montana, and in the mountains and valleys of western Montana. It occurs in glacial potholes and lakes, old oxbows, and backwaters of rivers and streams. Soils are variable and they frequently include Mollisols, Entisols, and Histosols. The mineral soils usually have some degree of organic matter buildup. This community is usually flooded year-round. Adjacent wetter site can be dominated by aquatic communities such as *Nuphar* sp., *Typha latifolia*, or open water. A variety of drier communities can occur adjacent to *Equisetum fluviatile* communities, and these can include stands of *Carex* sp., *Salix* sp., or *Phalaris arundinacea* (Hansen et al. 1988, Hansen et al. 1995).

Range- This community occurs in Montana, Idaho, and Alberta.

Vegetation- This community is usually dominated by a dense, monotypic stand of *Equisetum fluviatile*. Scattered forbs may occur in the community, and these include *Polygonum amphibium*, *Potamogeton gramineus*, and *Comarum palustre*. *Carex lasiocarpa* and *Carex utriculata* can also occur in these stands in low amounts (Hansen et al. 1988, Hansen et al. 1995).

Similar Communities- This community has been documented in northern Idaho (Jankovsky-Jones 1997) and Alberta (Dirschl et al. 1974).

Succession- The successional dynamics of this community are poorly understood. If the hydrologic regime remains unchanged, it is likely that this community will be fairly stable.

Management- This community is generally so wet that it receives very little livestock use.

Element Code- CEGL001960

Edition / Author- 99-10-18 / J. Greenlee, MTNHP

Festuca idahoensis – Deschampsia cespitosa Herbaceous Vegetation (FESIDA – DESCES) Idaho fescue – tufted hairgrass

Natural Heritage Conservation Rank- G3 / S3

Environment- *Festuca idahoensis – Deschampsia cespitosa* is a minor subalpine meadow type of southwestern Montana. On the Red Rock Lakes National Wildlife Refuge (RRLNWLR) it is associated with especially mesic, or subirrigated sites at lower elevations (< 7,000 feet) than previously cited for this type (8,000 feet, Mueggler and Stewart 1980). It generally occurs as small inclusions within more extensive *Festuca idahoensis*-dominated types. The loamy soils appeared to have a loess component. Very little soil surface is exposed because of the high productivity and consequent abundant litter generation. This type grades abruptly to and is often encompassed within *Festuca idahoensis – Elymus trachycaulus* or other yet drier *F. idahoensis*-dominated type (i.e. the *Festuca idahoensis – Deschampsia cespitosa* type as found on the RRLNWLR and greater southwestern Montana constitutes moist pockets with favorable soils).

Vegetation- This association is recognized by the dominance of *Festuca idahoensis* and the presence of *Deschampsia cespitosa* and the absence of *Pseudoroegneria spicata* (these sites are too moist for this bunchgrass of xeric environments); Mueggler and Stewart (1980) do not make it clear whether the presence of *Phleum alpinum or Trisetum* spp. are also diagnostic. *Festuca idahoensis* is generally the dominant graminoid with *D. cespitosa* and *Elymus trachycaulus* having appreciable, though much reduced cover relative to *F. idahoensis*; other graminoids include *Phleum alpinum, Luzula spicata, Danthonia intermedia, Carex scirpoidea* (or *C. obtusata*) and *Trisetum* spp. Canopy cover for forbs usually exceeds 40%; *Polygonum bistortoides, Potentilla gracilis, P. diversifolia, Erigeron speciosus* and *Lupinus argenteus* contribute the greatest cover and are consistently present.

Similar Communities- *Deschampsia cespitosa / Potentilla diversifolia* is a subalpine/alpine grassland type the sampled stands of which have appreciable amounts of *F. idahoensis* and would key to the *F. idahoensis – D. cespitosa* type in Mueggler and Stewart (1980). The *D. cespitosa / P. diversifolia* type was distinguished by Cooper and Lesica (1997) based on their impression that it constituted a type of higher elevations, colder environments. Given *D. cespitosa's* restricted environmental amplitude and proven affinity of for moist to wet sites it might improve the classification to name this type *D. cespitosa – F. idahoensis*, making certain that future keys to vegetation give priority to *D. cespitosa* over *F. idahoensis*.

Element Code- CEGL001900

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Festuca idahoensis – Elymus trachycaulus Herbaceous Vegetation (FESIDA – ELYTRA) Idaho fescue - bearded wheatgrass

Natural Heritage Conservation Rank- G4 / S3S4

Environment- This type is common on upper slopes, rolling uplands and gentle ridgetops at 7,400-9,200 ft in the Tendoy and Centennial Mountains. These mesic, productive grasslands often occur in snow catchment areas such as lee slopes just below ridge lines. Vegetation dominated by *Artemisia tridentata* ssp. *vaseyana* often occurs below in slightly drier sites. Steep slopes on cool slopes support *Pseudotsuga menziesii, Pinus flexilis*, or *P. albicaulis* forests. Adjacent exposed ridge tops often support the cushion plant communities,

Pseudoroegneria spicata – Cushion Plants, Calamagrostis purpurascens – Carex rupestris or *Carex rupestris - Potentilla ovina*.

Vegetation- *Festuca idahoensis - Elymus trachycaulus* is dominated by *Festuca idahoensis* and the robust grasses, *Elymus trachycaulus* and *Bromus carinatus*. *Carex petasata* and *Koeleria cristata* are other common graminoids. The introduced *Poa pratensis* may be common in sites that have experienced considerable grazing pressure. This association has high cover of tall and low forbs and high species diversity. Common forbs include *Geum triflorum, Geranium viscosissimum, Arenaria congesta, Erigeron compositus, Achillea millefolium, Artemisia ludoviciana, Galium boreale,* and *Lupinus* spp. *Taraxacum officinale* may be common in some lower stands with a history of grazing pressure. Moss and lichens are rare.

Soils- Soils are deep, often with a surface horizon of loess. Parent materials are limestone, mixed sedimentary or volcanic. Bare ground usually has less than 20% cover, and rock and gravel are minimal.

Other studies- Mueggler and Stewart (1980) describe this type for western Montana. They state that high abundance of forbs such as *Geum triflorum* and *Achillea millefolium* are the result of grazing pressure.

Comments- The mesic *Geranium viscosissimum* phase of this type described by Mueggler and Stewart (1980) occurs on loessal soils. Deer, elk and antelope frequently use this type. Disturbance due to pocket gophers (*Thomomys talpoides*) is abundant in this mesic phase. The *G. viscosissimum* phase we recommend to be elevated to association level creating *F. idahoensis – E. trachycaulus / G. viscosissimum*. The 1995 version of the southwestern classification (Cooper et al.) puzzled what to do with a few very mesic stands with low canopy cover of or lacking *F. idahoensis*, but rather are dominated by *Stipa occidentalis, Danthonia intermedia, Elymus trachycaulus, Bromus carinatus* and *B. anomalus* and *Carex* spp. To correct this gap in the classification several different grassland associations, most notably *Bromus carinatus – B. anomalus* and *Stipa occidentalis – F. idahoensis*, have been proposed based on sampling conducted subsequent to the 1995 publication.

Element Code- CEGL001614

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Festuca idahoensis - Potentilla diversifolia Herbaceous Vegetation (FESIDA / POTDIV) Idaho fescue / diverse-leaved cinquefoil

Natural Heritage Conservation Rank- G3 / S3

Environment- *Festuca idahoensis / Potentilla diversifolia* is common below 9,900 ft in the Beaverhead, Gravelly, Snowcrest and Tendoy ranges. This type was most common on warm slopes at the low limit of alpine vegetation (ca. 9,500 ft) where moderate to light snow cover melts early in the growing season. It abutted subalpine forest dominated by *Picea engelmannii, Pinus albicaulis* and *Pseudotsuga menziesii*, or graded into shrublands dominated by *Artemisia tridentata ssp. vaseyana* below treeline. *Festuca idahoensis / Potentilla diversifolia* merged with *Deschampsia cespitosa / Potentilla diversifolia* grassland on moister slopes and with *Carex elynoides* turf at higher elevations on warm, dry, wind-impacted slopes. Dominance of *Bromus pumpellianus* defines a phase that was locally abundant on cool slopes in the Snowcrest Range.

Vegetation- Mean graminoid cover of *Festuca idahoensis / Potentilla diversifolia* was 55%. *Festuca idahoensis* was the dominant graminoid with *Elymus trachycaulus* ranking second in abundance. *Carex obtusata, Poa secunda, C. scirpoidea* and *P. arctica* were locally common, the former two on warm aspects and the latter two on cooler slopes or level areas with deeper soils. Mean forb cover was 34%. Common forbs were *Potentilla diversifolia, Phlox pulvinata* and *Polemonium*

viscosum. Polygonum bistortoides, Myosotis sylvatica and *Cerastium arvense* were frequent, and *Geum triflorum* and *Trifolium haydenii* were locally common. Mean cover of lichens and mosses was only 2%.

Bromus pumpellianus phase- Two stands from cool slopes in the Snowcrest range were dominated by *Bromus pumpellianus* instead of *Festuca idahoensis. Carex obtusata* was abundant in one. These stands were otherwise compositionally similar to typical *Festuca idahoensis/Potentilla diversifolia*.

Soils- Parent material was generally sedimentary, with limestone and calcareous sandstone's predominating. Quartzite, calcareous conglomerate, and volcanic andesite were also represented. Mean litter depth was 0.6 in, and mean duff depth was 0.3 in. Bare ground and gravel covered 11% of the surface. Percent coarse fragments varied from 2-51% with a mean of 20%. Texture of the fine fraction ranged from fine clay to sandy clay-loam; the mean textural class was sandy clay. Reaction of the soil was near-neutral (pH=6.7-7.5) with a mean pH of 7.2. Mean organic matter content was 19%, mean total nitrogen was 0.66%, and C:N ratio was 14:1.

Productivity- Graminoid productivity varied between 180 and 1,130 lbs/acre with a mean of 726 lbs/acre. Forb productivity varied between 160 and 1,270 lbs/acre with a mean of 778 lbs/acre. Mean total productivity for *Festuca idahoensis / Potentilla diversifolia* was 1,504 lbs/acre. Productivity was highest on deep soils.

Other Studies- *Festuca idahoensis / Potentilla diversifolia* could be considered a high-elevation phase of Mueggler and Stewart's (1980) *Festuca idahoensis / Elymus trachycaulus* habitat type. Although the dominant graminoids in the two types are similar, the important forbs are different, with *P. diversifolia* considered the diagnostic forb separating the two types. *Potentilla gracilis, Geum triflorum* and *Achillea millefolium* are the most abundant forbs in the lower-elevation type. Alpine grasslands similar to *Festuca idahoensis / Potentilla diversifolia* were described for east-central Idaho (Moseley 1985, Caicco 1983) where they were characterized by having the highest snow-deposition of all alpine communities (Moseley 1985). Alpine meadows dominated by *Festuca thurberi*, an ecological analogue of *F. idahoensis*, have been described for New Mexico (Baker 1983).

Element Code- CEGL001623

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Festuca idahoensis - Pseudoroegneria spicata Herbaceous Vegetation (FESIDA – PSESPI) Idaho fescue - bluebunch wheatgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- Mueggler and Stewart (1980) describe this association as the most frequently encountered grassland type in southwestern Montana. We have few samples of the type because it thought to be abundantly documented. We sampled it on moderate to steep, predominantly southerly-facing slopes in the Tendoy Mountains at 6,000-7,500 feet (the cited elevation range is 4,500 to 7,500 feet). On lower elevation sites it tends to occur on more moderate exposures and northerly aspects. Adjacent sites with deeper soils (or in some cases rockier soils) are dominated by *Artemisia tridentata* ssp. *vaseyana*. Rockier sites on warm slopes are often dominated by *Cercocarpus ledifolius*, while *Pseudotsuga menziesii* and *Pinus flexilis* forests occur on cooler slopes.

Vegetation- Stands are dominated by the diagnostic grasses *Festuca idahoensis* and *Pseudoroegneria spicata*; on lightly grazed sites their combined cover can exceed 70%. *Koeleria cristata* is also common. The shrubs, *Chrysothamnus nauseosus* and *Artemisia tridentata ssp. tridentata*, may be present but are not common, their cover not exceeding 5%. Forbs are diverse and abundant. Common

species include *Phlox hoodii, P. muscoides, Achillea millefolium, Antennaria microphylla* and *Draba oligosperma*. Mosses and especially lichens may be common.

Soils- Soils are well-drained and silty in texture. Little of the surface is bare, but gravel is common.

Other Studies- This vegetation has been described for western Montana by Mueggler and Stewart (1980). The type has also been documented to extend from the Kamloops area of British Columbia southward through Washington, Idaho and Wyoming, (Bourgeron and Engelking 1994).

Element Code- CEGL001624

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Festuca *kingii* - *Oxytropis campestris* Herbaceous Vegetation (FESKIN / OXYCAM) Spike fescue/field crazyweed

Natural Heritage Conservation Rank- G3? / S2

Environment- *Festuca kingii / Oxytropis campestris* is a minor type documented as occurring from 9,500-9,800 feet on moderate to steep slopes, generally with warm aspects. Extensive stands of this type occurred only in the Beaverhead and Tendoy ranges, the westernmost and driest part of our study area. Although not particularly windswept, these areas receive little precipitation and snowmelt occurs early. *Festuca kingii / Oxytropis campestris* most often occurred in a mosaic *of Festuca idahoensis / Potentilla diversifolia* grassland and Carex elynoides turf communities. It occurred in stonier soils than other grassland types and at lower elevations than turf communities. Subalpine grasslands and shrublands dominated by *Artemisia tridentata ssp. vaseyana* generally occurred at lower elevations.

Vegetation- Mean graminoid cover was 37%. *Festuca kingii* was the dominant grass. *Pseudoroegneria spicata, Poa fendleriana* and *P. secunda* were present with less than 5% cover in all three stands. Mean forb cover was 23%. High constancy forbs included *Oxytropis campestris, Phlox hoodii, Erigeron compositus* and *Cymopterus bipinnatus.* The subshrub *Artemisia frigida* was a minor component of all three stands, and the shrubs, *A. tridentata* ssp. *vaseyana* and *Chrysothamnus viscidiflorus* were minor components in the lowest stand that bordered subalpine shrublands. Mean cover of lichens and mosses was less than 1%.

Soils- *Festuca kingii / Oxytropis campestris* occurred only on soils derived from calcareous parent material, either limestone or Beaverhead conglomerate. Mean depths of litter and duff were 0.3 in and 0.2 in respectively. Bare ground and gravel covered 21% of the surface, and rock cover averaged 9%. Percent coarse fragments ranged from 33-65% with a mean of 51%. Mean texture of the fine fraction was sandy clay-loam. Soil reaction varied from 7.3-7.5, with a mean pH of 7.4. Mean organic matter content was 11%, mean total nitrogen was 0.35%, and C:N ratio was 21:1. This community occurred on the shallowest, stoniest and sandiest soils of any grassland type, and organic matter and nitrogen levels are only half of that in the other two types.

Productivity- Graminoid productivity varied between 275 and 875 lbs/acre with a mean of 613 lbs/acre. Forb productivity ranged from 250 to 600 lbs/acre with a mean of 399 lbs/acre. Shrub productivity in the lowest elevation stand was 253 lbs/acre. Mean total productivity was 1096 lbs/acre, appreciably less than that of the other two grassland types.

Other Studies- Although *Festuca kingii* occurs throughout much of the western U.S., similar alpine grassland associations have only been described for the calcareous ranges of east-central Idaho (Caicco 1983, Moseley 1985, Urbanczyk and Henderson 1994) and northwest Utah (Preece 1950, Ream 1964). In Idaho, where this association is more common, two types are recognized (Moseley 1985) based on differences in substrate stability.

Element Code- CEGL001912

Edition / Author- 97 –10 / S.V. Cooper et al.

Geum rossii - Minuartia obtusiloba
Herbaceous Vegetation
(GEUROS – MINOBT) Ross' avens - arctic sandwort

Natural Heritage Conservation Rank- G3 / S3

Environment- Geum rossii / *Minuartia obtusiloba* is common on exposed, windswept upper slopes, saddles and ridgetops between 9,800 and 10,400 ft in the Pioneer and Tobacco Root ranges. This type occurred only on soils developed from crystalline parent material. This sparsely vegetated association usually graded into the *Carex scirpoidea / Geum rossii* turf community having deeper soils and protected exposures.

Vegetation- Mean graminoid cover was only 4%. *Festuca ovina* was the only graminoid commonly present in appreciable amounts (canopy cover not exceeding 10%). *Luzula spicata and Carex elynoides* had low coverage but were frequent, and *Carex rupestris* and *Trisetum spicatum* were locally common. Mean cover of forbs was 30%. *Geum rossii* had the greatest constancy and cover of any forb; *Minuartia obtusiloba* (formerly *Arenaria obtusiloba*), *Eritrichium nanum, Phlox pulvinata* and *Silene acaulis* were common cushion plants. *Selaginella densa* and *S. watsonii* were locally abundant. Trace amounts of the shrubs, *Ribes hendersonii* and *Dryas octopetala*, occurred in one stand. Cover of mosses and lichens was less than 1%.

Soils- Parent materials were granite and quartzite. Bare ground and gravel covered 47% of the surface. Mean depths of litter and duff were both less than 0.1 in. Percent coarse fragments varied from 355 to 70% with a mean of 49%. Textural classes of the fine fraction ranged from sandy clay-loam to sand with a mean class of sandy loam. Soil pH ranged from 6.2 to 6.6 with a mean of 6.4. Mean organic matter content was only 8%, mean total nitrogen was 0.24%, and C:N ratio was 20:1. Soils had a sandier texture and lower levels of organic matter and nitrogen than most other community types sampled.

Productivity- Graminoid productivity ranged from 0 to 118 lbs/acre with a mean of 41 lbs/acre. Forb productivity varied from 192 to 651 lbs/acre with a mean of 453 lbs/acre. Mean total productivity was 494 lbs/acre. Cushion plant productivity is difficult to measure; thus, the forb estimates are only rough approximations. The low total productivity reflects the small graminoid contribution.

Other Studies- Fellfields and cushion plant communities similar to *Geum rossii / Minuartia obtusiloba* are common in the Rocky Mountains of southern Montana south to Colorado. Bamberg and Major (1968) describe a fellfield community from the Flint Creek Range of Montana dominated by *G. rossii, Carex elynoides, Lupinus argenteus and Potentilla concinna*. Cushion plant communities in the Beartooth Range of Montana and Wyoming are dominated by *G. rossii, Carex rupestris, Minuartia obtusiloba, Silene acaulis and Trifolium nanum* (Johnson and Billings 1962, Lesica 1991). Bliss (1956) describes ridgetop vegetation in the Medicine Bow Mountains of Wyoming dominated by *Carex rupestris* and cushion plants such as *Paronychia pulvinata, Selaginella densa, Minuartia obtusiloba, Phlox caespitosa* and *Trifolium dasyphyllum*. *Geum rossii* was present but of secondary importance. Similar associations with varying amounts of *Geum rossii* have been described from Wyoming's Absaroka Range (Thilenius and Smith 1985) and the Uinta Range in Utah (Lewis 1970). In the Rocky Mountains of Colorado, exposed ridges and fellfields are dominated by cushion plants, such as *Trifolium dasyphyllum, Paronychia pulvinata, Silene acaulis and Minuartia obtusiloba* as well as *Carex rupestris* and *Kobresia myosuroides* (Komarkova and Webber 1978, Willard 1979). *Geum rossii* is dominant in turf communities but is of secondary importance in cushion plant associations in these areas.

Element Code- CEGL001965

Edition / Author- 97 –10 / S.V. Cooper et al.

Hordeum jubatum Herbaceous Vegetation (HORJUB) Foxtail barley

Natural Heritage Conservation Rank- G4 / S4

Environment- This is an uncommon type west of eastern and central Montana; it is of very limited extent in BVHDMS, confined to drawdown zones of ponds or ephemeral ponds with moderately saline or alkali water. Early on in the growing season these sites are flooded but in the course of the summer the water table falls considerably below the surface leaving white crusts of salt efflorescence. Sites are recognized by the dominance of *Hordeum jubatum* (we noted minor amounts of *H. brachyantherum* in these stands; it is a close ecological analogue of *H. jubatum* and could be used as an alternative indicator for these environments). Some of the stands noted on the Red Rock Lakes National Wildlife Refuge may represent grazing disclimax of sites potentially dominated by *Pascopyrum smithii, Distichlis spicata* or *Leymus cinereus*.

Vegetation- A moderate coverage to dense sward of *Hordeum jubatum*, to the near exclusion of other species, characterizes these sites. Shrubs are not found in this type. Other graminoids present include those cited above as well as *Poa pratensis* and *H. brachyantherum*. *Polygonum* spp., *Grindelia squarrosa* and *Rumex crispus* are the only forbs consistently noted.

Element Code- CEGL001798

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Juncus balticus Herbaceous Vegetation (JUNBAL) Baltic rush

Natural Heritage Conservation Rank- G5 / S5

Environment- The *Juncus balticus* association is a major wetland association occurring from low to high elevations (2,300 to 9,000 ft. +) throughout Montana; it is found throughout the BLM's Dillon R. A. and is especially abundant on the Red Rocks Lakes National Wildlife Refuge (RRLNWLR) where it characterizes some of the wetter sites, those continuously saturated and often having year-long standing water. The only wetter sites would be dominated by *Carex utriculata, Carex aquatilis, Carex simulata, Scirpus* spp. or *Typha latifolia*. What we have referred to as the *Juncus balticus* type is somewhat different from, though included within, the broadly described type of Hansen et al. (1995). The plant association we refer to as *Juncus balticus* is virtually a monoculture of *Juncus balticus* and occurs on sites that are largely beyond the foraging range of livestock (except in drier years) and hence could not be grazing-induced disclimax as Hansen et al. (1995) claim is the case for all *J. balticus* dominated sites. There is generally no appreciable amount of forage on these sites, save for *Calamagrostis canadensis* (*C. stricta*); sedge species present are coarse and unpalatable. We recognize a *Juncus balticus – Carex praegracilis* association that characterizes moist meadows to seasonally flooded wetlands and which could be a grazing disclimax, but this interpretation is open to question as well.

Vegetation- On the RRLNWLR the *Juncus balticus* type characterizes the sometimes broad vegetation zone occurring on slightly less wet sites (or with shallower standing water through growing season) than does the predominant wetland type, *Carex utriculata - Carex utriculata*. The *Juncus balticus* type often was noted to grade to the *Juncus balticus – Carex praegracilis* or *Deschampsia cespitosa* associations of somewhat drier terrain. The form of *J. balticus* in this zone is especially robust (to 2.5-3 ft. tall). Other than the presence of scattered graminoids noted above the only other herbs regularly present are *Menyanthes trifoliata, Triglochin maritimum, Polygonum amphibium,* and *Ranunculus* spp.

Element Code- CEGL001838
Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Juncus balticus - Carex praegracilis
Herbaceous Vegetation
(JUNBAL – CARPRA) baltic rush – clustered field sedge

Natural Heritage Conservation Rank- G? / S?

Environment- *Juncus balticus - Carex praegracilis* is a wetland association common in subirrigated sites on stream terraces, pond and lake margins, and in swales of alluvial fans. It has been documented from 6,500-7,200 ft in the major valleys of the Tendoy Mountains and in the Centennial Valley and almost certainly occurs broadly throughout the BVHDMS. Most examples of this type have developed hummock-hollow microtopography. Adjacent moister sites are often dominated by *Pentaphylloides floribunda* and *Deschampsia cespitosa* or *Salix* spp. and *Carex* spp. Occasionally *Juncus balticus/Carex praegracilis* will adjoin *Carex simulata*- and *Carex nebrascensis*- dominated fens and wet meadows. Adjacent drier sites, though usually considered wetlands as well, are dominated by *Poa juncifolia* and *Leymus cinereus*. *Festuca idahoensis* and *Artemisia tridentata, A. tripartita* or *A. longiloba* dominate adjacent uplands. This type appears to be most common in areas of predominantly calcareous parent material.

Vegetation- Graminoid cover is over 80% in most stands. Dominant species include *Juncus balticus, Carex praegracilis* and *Muhlenbergia richardsonis*. Other common graminoids are *Deschampsia cespitosa* and *Poa juncifolia*. Cover of forbs is variable, probably depending on grazing history and moisture regime. Forb diversity is low to moderate. Common species include *Antennaria microphylla, Aster occidentalis, Crepis runcinata, Haplopappus uniflorus* and *Potentilla gracilis*. Bryophyte coverage is highly variable, ranging from trace amounts to a nearly continuous blanket.

Soils- Soils have a silty to clayey texture and are moist throughout most of the growing season. They have a near-neutral or slightly alkaline reaction and may also be mildly saline in some cases. Bare soil is generally uncommon except for areas that are heavily trampled.

Other Studies- Hansen et al. (1995) describe the *Juncus balticus* "community type" for Montana and state that it is a grazing-induced disclimax of vegetation previously dominated by *Deschampsia cespitosa* or *Calamagrostis canadensis*. They report that *Juncus balticus* and *Hordeum jubatum* are the only common species, suggesting that their type is significantly different than *Juncus balticus / Carex praegracilis* of southwest Montana. For the Blackfeet Reservation of northwest Montana Lesica (1989) described a *Deschampsia cespitosa / Juncus balticus* association with composition similar to that of *J. balticus / C. praegracilis*. Similar vegetation has also been described for the Blackfoot River Valley of Montana (Lesica 1994) southward into Idaho and Wyoming (Youngblood et al. 1985) to as far south as southern Utah (Padgett et al. 1989).

Comments- If *Juncus balticus* plant associations are a grazing-induced disclimax of *Deschampsia cespitosa* associations (Hansen et al. 1995), *D. cespitosa* should be negatively correlated with abundance of *J. balticus*, forbs and exotics, and abundance of *J. balticus* should be positively correlated with abundance of forbs and exotics. This does not appear to be the case in our study area. A Pearson's correlation coefficient (r) matrix is given below:

	Junbal	Desces	Forbs	Exotics
Junbal	1.000			
Desces	0.019	1.000		
Forbs	-0.297	-0.272	1.000	
Exotics	-0.122	-0.020	0.110	1.000

There was almost no correlation between the cover of *D. cespitosa* and *J. balticus*. Both species decrease as the abundance of forbs and exotics increase, although the correlation is not strong. These results suggest that both species

decrease with grazing disturbance and that the abundance of forbs is a better indicator of disclimax than the abundance of *J. balticus*, at least in the BVHDMS. Our ordination results suggest that *Juncus balticus* is dominant in slightly drier sites than those dominated by *D. cespitosa*.

Variety *montanus* is the common form of *Juncus balticus* in Montana. However one of our stands was a nearly complete monoculture of *J. balticus* var. *vallicola*, a more robust form of the species. This stand on a pond drawdown zone had the appearance of a bulrush monoculture. This vegetation may warrant recognition as a separate type if it occurs in other locations.

Trampling by livestock, especially during the spring and early summer results in the formation or enhancement of hummocks. The presence of substantial hummocking may allow the invasion of the shrub, *Pentaphylloides floribunda*, into habitats that are otherwise too wet.

Element Code- CEGLMTHP14

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Juncus drummondii - Antennaria lanata Herbaceous Vegetation (JUNDRU / ANTLAN) Drummond's rush / woolly pussytoes

Natural Heritage Conservation Rank- G3? / S2

Environment- Small patches (tenths of an acre at most) of *Juncus drummondii / Antennaria lanata* are relatively common in swales and other snow-collection microtopography set within valleys and cirque basins between 9,600 and 10,000 ft in the Madison Range. This community is always associated with areas of late snowmelt; however, melt off probably occurs earlier than in communities dominated by *Carex nigricans*. *Juncus drummondii / Antennaria lanata* was often part of vegetation mosaic resulting from uneven snow deposition. Commonly associated communities are moist turf, wetlands and other snowbed associations such *as Carex scirpoidea / Geum rossii, Carex scopulorum / Caltha leptosepala, Carex nigricans* and *Phyllodoce empetriformis / Antennaria lanata* .

Vegetation- Mean graminoid cover was 30%. Dominant graminoids were *Juncus drummondii, Poa fendleriana and Carex paysonis*. *Carex pyrenaica* was locally common. Mean cover of forbs was 37% and common species included *Antennaria lanata, Sibbaldia procumbens* and *Erigeron peregrinus*. *Arnica latifolia* was common in one stand. The shrub, *Vaccinium scoparium*, was also common in this same stand. Mean cover of mosses and lichens was 2%.

Soils- Parent materials were gneiss and granite. Bare ground and gravel covered 50% of the surface. Mean depths of litter and duff were both 0.1 in. Percent coarse fragments ranged from 6% to 17% with a mean of 13%. Mean texture of the fine fraction was sandy clay. Although they occurred in topographically low positions, these relatively barren and unproductive communities were apparently underlain by shallow and perhaps excessively well-drained soils. Soil pH ranged from 6.0 to 6.1 with a mean of 6.1. Mean organic matter content was 12%, mean total nitrogen was 0.21%, and C:N ratio was 24:1.

Productivity- Graminoid productivity varied between 200 and 270 lbs/acre with a mean of 237 lbs/acre. Forb productivity ranged from 150-860 lbs/acre with a mean of 460 lbs/acre. Productivity of dwarf shrubs in one stand was 30 lbs/acre. Mean total productivity was 726 lbs/acre. Highest productivity occurred on the deepest soils.

Other Studies- *Antennaria lanata* is a common component of snowbed communities in the North Cascades and Canadian Rockies, but the codominant species usually cited are *Carex nigricans* or dwarf shrubs such *as Cassiope* or *Phyllodoce* spp. rather than *Juncus drummondii* (Achuff and Corns 1982, Hrapko and LaRoi 1978, Douglas and Bliss 1977).

Snowbed communities dominated by *Juncus drummondii* with *Carex pyrenaica* and *Sibbaldia procumbens* occur in the Rocky Mountains of Colorado (Komarkova and Webber 1978, Willard 1979); however, *Antennaria lanata* is not listed for the Colorado associations. Lesica (1991) reports communities very similar to *Juncus drummondii / Antennaria lanata* from the eastern edge of the Beartooth Mountains in south-central Montana. It appears that *Juncus drummondii* dominates snowbed communities in the central Rocky Mountains, while *Antennaria lanata* occupies a similar niche in the Canadian Rockies and the North Cascades. The two species codominate snowbed associations in the crystalline ranges of southern Montana.

Element Code- CEGL001904

Edition / Author- 97 –10 / S.V. Cooper et al.

Juncus parryi / Erigeron ursinus Herbaceous Vegetation (JUNPAR / ERIURS) Parry's rush / bear fleabane

Natural Heritage Conservation Rank- G2? / S2?

Environment- Examples of *Juncus parryi / Erigeron ursinus* were locally common near the base of gentle slopes with warm aspects. Both of our stands were between 9,500 and 9,800 ft in the Gravelly Range. Although snow is expected to accumulate on these sites, this type of all the snowbed communities is perhaps least affected by late melt off. *Festuca idahoensis / Potentilla diversifolia* grassland was the common adjacent plant community. *Juncus parryi / Erigeron ursinus* is similar in physiognomy and habitat to *Juncus drummondii / Antennaria lanata.*

Vegetation- Mean graminoid cover was 35%. Dominant graminoids were *Juncus parryi* and *Festuca idahoensis*, and *Poa glauca* was consistently present with low coverages. Mean cover of forbs was 25%. Common species included *Erigeron ursinus, E. peregrinus, E. simplex, Antennaria umbrinella* and *Lewisia pygmaea*. Mean cover of mosses and lichens was 2%.

Soils- Parent materials in the two stands were andesite and quartzite. Bare ground and gravel covered 47% of the surface, indicating that this was the most barren of our snowbed communities. Mean depths of litter and duff were 0.3 in and 0.1 in respectively. Mean percent coarse fragments was 25%. Mean texture of the fine fraction was clay. Mean soil pH was 5.6. Mean organic matter content was 20%, mean total nitrogen content was 0.64%, and C:N ratio was 15:1. This sparsely vegetated community type is similar to Juncus drummondii / Antennaria lanata, but the soils were even more stony and acidic.

Productivity- Mean graminoid productivity was 439 lbs/acre, and mean forb productivity was 253 lbs/acre. Mean total productivity was 692 lbs/acre. Productivity is probably affected more by the shallow, poorly developed soils than late snow release.

Other Studies- Holway and Ward (1963) report snow accumulation areas in the Colorado Rocky Mountains dominated by *Carex pyrenaica and Juncus parryi*. Willard (1979) states that *Juncus parryi* is ecologically similar to *J. drummondii* but generally occurs at lower elevations. In our study area, *Juncus parryi / Erigeron ursinus* was associated with terrain supporting alpine grasslands, *while Juncus drummondii / Antennaria lanata* was associated with turf communities. Thus, it seems likely that these two community types occupy similar topographic positions, but *Juncus drummondii / Antennaria lanata* occupies cooler, moister habitats.

Element Code- CEGL001906

Edition / Author- 97 –10 / S.V. Cooper et al.

Leymus cinereus - Puccinellia nuttalliana Herbaceous Vegetation (LEYCIN – PUCNUT) basin wildrye – Nuttall's alkaligrass

Natural Heritage Conservation Rank-

G? / S?

Environment- Stream terraces and lower portions of alluvial valley floors at 6,500-7,000 feet within the BVHDMS support narrow corridors or extensive stands of *Leymus cinereus - Puccinellia nuttalliana*. This type is usually associated with areas dominated by limestone parent material. Adjacent moister vegetation types may be dominated by *Juncus balticus, Pentaphylloides floribunda, Deschampsia cespitosa* or *Salix* spp. with *Carex* spp. Adjacent upland vegetation supports stands dominated by *Artemisia arbuscula ssp. longiloba, A. tripartita*, or *A. tridentata wyomingensis* and *Festuca idahoensis*.

Vegetation- These species-poor associations are dominated by *Poa juncifolia, Puccinellia nuttalliana* (or *P. distans*) and *Carex praegracilis*. *Leymus cinereus* may be dominant, sometimes forming near monocultures, in stands that have not suffered intensive grazing pressure. The abundance and species composition of the forb component is variable and depends upon the moisture regime, soil texture, salinity, and degree of disturbance. *Haplopappus uniflorus* and *Antennaria microphylla* are the most common forb species. The shrub *Chrysothamnus nauseosus* is usually present and may be common. Mosses and lichens are absent.

Soils- Soils are usually saline with a silty or clayey texture. Reaction is neutral to alkaline. The surface is 60-90% bare with little or no gravel. Soils may be affected by natural or man-caused subirrigation.

Other studies- Similar vegetation dominated by *Leymus cinereus, Pascopyrum smithii* and *Puccinellia distans* in northwest Montana was briefly discussed by Mueggler and Stewart (1980, p. 75) and Lesica (1988); a general *Leymus cinereus* c.t. is found from Washington, Oregon, through Idaho to Colorado but has curious gaps (not cited for Wyoming or Utah) that may reflect a lack of inventory rather than an intrinsic absence (Bourgeron and Engelking 1994).

Comments- *Leymus cinereus* is highly palatable to livestock only early in the growing season; if grazed at this season it loses a significant portion of biomass that would have contributed to its potentially tall stature, thus making it very sensitive to intensive grazing. We believe that broad alluvial valleys of southwest Montana may have been dominated by *E. cinereus* before the advent of the livestock industry over 100 years ago. With the decline of this robust grass, smaller species adapted to saline soils, such as *Poa juncifolia, Puccinellia distans* and *Carex praegracilis* assumed dominance.

Element Code- CEGLMTHP15

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pascopyrum smithii Herbaceous Vegetation [Provisional] (PASSMI) western wheatgrass

Natural Heritage Conservation Rank- G3G5 / S4

Environment- This is an uncommon type in southwestern MT, occurring on alluvial floodplains that experience regular overland flow flooding or heavy-textured soils. It is found on islands of the Big Hole River at ca. 5,000-5,200 ft. Slightly higher areas are dominated by *Artemisia tridentata ssp. tridentata* and *Pseudoroegneria spicata*. Adjacent sites can support *Populus balsamifera ssp. trichocarpa* forests. Hansen et al. (1995) consider at least a portion of this type to be wetland sites (jurisdictional wetlands).

Vegetation- Graminoid cover is high, but *Pascopyrum smithi*i is the only dominant grass. *Koeleria cristata, Poa pratensis* and *Carex stenophylla* are other common species. *Equisetum hyemale* is the only common forb. A number of weedy forbs, such as *Grindelia squarrosa, Cirsium arvense, Tragopogon* spp. and *Melilotus officinalis*, may be present. Mosses and lichens are absent.

Soils- Soils are silt loams. There is no gravel

on the surface.
Other Studies- Coupland (1950) reports a similar type from alluvial floodplains in Alberta. Hansen et al. (1995) cite this as an important type in central and eastern Montana and in varying degrees of importance it extends to Colorado and Utah (Bourgeron and Engelking 1994).

Comments- This vegetation is clearly seral to *Populus balsamifera ssp. trichocarpa* forest or *Artemisia tridentata tridentata / Pascopyrum smithii*. Flooding or ice scour apparently retards colonization by woody species. These sites are likely areas to be invaded by *Euphorbia esula* (leafy spurge).

Element Code- CEGL001577

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Phalaris arundinacea Western Herbaceous Vegetation (PHAARU) reed canarygrass

Natural Heritage Conservation Rank- G5 / S4

Vegetation- *Phalaris arundinacea* dominates (often with a total canopy cover of 100%). The undergrowth is typically very depauperate due to the intense competition with *P. arundinacea*. *Poa palustris* may be well represented and *Cirsium arvense* and *Mentha arvensis* are often common. The total cover of the few additional species seldom exceeds 1%. Adjacent wetter sites often feature open water while adjacent drier riparian communities include the *Populus balsamifera ssp. trichocarpa / Cornus sericea* type and a wide variety of other riparian types.

Environment- This type occurs on gravelly alluvial parent materials on flat flood plains in wide valley bottoms at elevations around 5000 feet. Litter and soil cover equals or exceeds 30% and 20% of the ground surface, respectively. The soil surface is generally stable with no evidence of accelerated erosion.

Soils- Soils are often Fluvaquents or Fluvents, are very deep with loamy sand to loam textures, medium available water holding capacity, and are non-calcareous. Coarse fragment contents vary from none to gravelly.

Other Studies- Within the western U. S. this type has been described only in Montana, where it is a common type from the western intermountain valleys to the eastern plains (Hansen et al. 1995). Some contend that Phalaris arundinacea is not a native species, hence this type should be recognized as a disturbance type.

Element Code- CEGL001474

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Poa juncifolia Herbaceous Vegetation (POAJUN) alkali bluegrass

Natural Heritage Conservation Rank- G4? / S?

Environment- If were to slavishly follow the nomenclature of Kartez (1994) then this type would be known as the *Poa secunda* community. However, *Poa juncifolia* appears to us to be a distinct ecological entity, associated with alkali soils (as its common name indicates) and having a much more robust growth form with tussocks up to 2 to 3 times taller (and broader at the base) than those of *P. secunda*. These stands exist as small to large patches, commonly found on the western and central portions of the Refuge on fine-textured alluvial flats that are seasonally saturated, but which dry deeply by late summer. Traces of salt efflorescence have been noted. These sites may constitute grazing disclimax of *Pascopyrum smithii-*, *Elymus lanceolatus-*, *Leymus cinereus-*, *Hordeum jubatum-* or even *Puccinellia nuttalliana-*dominated habitats; only appropriate exclosures could answer this question. The closest named type of the literature is described from southern Oregon alkali flats as *Poa secunda* (*P. juncifolia*?) – *Puccinellia lemmonii* – *Elymus elymoides* (syn. *Sitanion hystrix*).

Vegetation- The bunchgrass *Poa juncifolia* dominates a sparse herbaceous layer with canopy cover in the range of 15-30%. Other graminoids consistently present with low cover values include *Sitanion hystrix, Poa cusickii, Pascopyrum smithii* (or *Elymus lanceolatus*), *Hordeum jubatum*, and *Puccinellia nuttalliana*. The only shrubs consistently present are scattered *Chrysothamnus nauseosus* or *C. viscidiflorus*. Forb diversity is low, mostly species associated with disturbance, e.g. *Grindelia squarrosa, Descurainia pinnata*, and various *Erigeron* spp., especially *E. corymbosus*.

Element Code- CEGL001657

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Poa pratensis Herbaceous Vegetation [Provisional] (POAPRA) Kentucky bluegrass

Natural Heritage Conservation Rank- GW / SW

Environment- The *Poa pratensis* community type, recognized by a higher coverage of *Poa pratensis* than any other herb present, represents a widely distributed, grazing- or otherwise disturbance-induced disclimax of Refuge lands; it is probably the most extensive disclimax on both the Refuge and in the state in general. *Poa pratensis*, a rhizomatous exotic European meadow grass, has a very broad ecological amplitude and is found from true wetlands mixed with *Juncus balticus, Pascopyrum smithii* and *Deschampsia cespitosa* types, to upland sites such as *Festuca idahoensis – Pseudoroegneria spicata* or *F. idahoensis – Elymus trachycaulus*; it develops its highest cover on grazing-impacted wet meadows and mesic grasslands characterized by medium-textured Mollisols, such as *F. idahoensis – Stipa richardsonii* or *Bromus carinatus*- and *B. anomalus*-dominated habitats. It also is found on sandy, as well as, dense clay soils, if the moisture status is favorable. As Hansen et al. (1995) note this is one of the driest of herb-dominated riparian or wetland community types.

Vegetation- Composition of these sites can vary from nearly pure swards of *P. pratensis* to mixtures of weedy species or increaser species, including *Bromus inermis, Phleum pratense, Juncus balticus, Festuca arundinacea, Hordeum jubatum, Potentilla anserina, P. gracilis* and *Taraxacum officinale*. Once a site has been captured by *P. pratensis* it is unlikely to revert to native cover due to the highly competitive nature of this species; it develops an extensive rhizome system that permits it to spread quickly and is extremely resistant to high levels of herbivory. We speculate that on the Refuge, as elsewhere, the native community types most often converted to *P. pratensis* dominance include *Pascopyrum smithii* and *Deschampsia cespitosa*.

Element Code- CEGL003081

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudoroegneria spicata - Cushion plant Herbaceous Vegetation (PSESPI - CUSH) bluebunch wheatgrass - cushion plant

Natural Heritage Conservation Rank- G3 / S3

Environment- This uncommon type occurs on windswept, limestone ridge crests and upper slopes in the Tendoy and perhaps Centennial Mountains at 8,000-9,000 ft. Adjacent sites with deeper soils are often dominated by *Artemisia tridentata vaseyana* and *Festuca idahoensis*. Cool slopes below these ridges may support *Pseudotsuga menziesii* or *Pinus flexilis* forests.

Vegetation- The dominant graminoids are *Pseudoroegneria spicata, Festuca kingii* and *Carex filifolia*. Shrubs are completely absent. There is a rich assemblage of low forbs, including many cushion-forming species such as *Cymopterus bipinnatus, Lesquerella alpina, Phlox hoodii, Eritrichium nanum, Oxytropis campestris* and *Townsendia* spp. Forbs have significantly more basal cover than graminoids,

especially in the most exposed sites. Mosses and especially lichens are common.

Soils- Soils are calcareous and shallow. Most of the surface is covered with gravel or the plant cushions.

Other Studies- DeVelice and Lesica (1993) described an extensive *Pseudoroegneria spicata* / Cushion plant type from windswept calcareous ridges at low to mid-elevations on the south side of the Pryor Mountains in south-central Montana. Although the forbs in these two types have the same low, cushion-like physiognomy, there is little overlap in species composition. Lesica (1988) described a sparsely vegetated grassland dominated by *Pseudoroegneria spicata* and *Eriogonum ovalifolium* in northwest Montana; however, this type is developed on excessively drained gravel and exhibits a different suite of forbs, without the high diversity of *Pseudoroegneria spicata* / Cushion plant. Alpine cushion plant communities described by Cooper and Lesica (1992) also have a similar physiognomy and many forb species in common, but the common graminoids are *Carex rupestris, C. elynoides* and *Festuca ovina*.

Comments- This type may occur lower but only on the most extremely exposed and edaphically harsh sites. Extensive areas will occur only at higher elevations.

These sites may provide important winter range for bighorn sheep. Vegetation of these dry, exposed sites is easily damaged by motorized vehicles and recovers slowly.

Element Code- CEGL001666

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudoroegneria spicata - Oryzopsis hymenoides Herbaceous Vegetation (PSESPI / ORYHYM) bluebunch wheatgrass / Indian ricegrass

Natural Heritage Conservation Rank- G3 / S?

Environment- The type occurs on steep badland sites at elevations around 5500 feet. Bare soil cover totals 20 to 70% and most of the remaining ground cover is comprised of coarse fragments. The soil surface is unstable because of a lack of adequate vegetation cover and rill and sheet erosion is common. Parent materials are sedimentary rocks and soils are shallow and poorly developed. Soils range from not gravelly to very gravelly and are strongly to violently effervescent. Textures are sands to loams and available water holding capacity is low.

Vegetation- Total vegetation cover in this badlands type seldom exceeds 15%. Characteristic species include *Gutierrezia sarothrae, Pseudoroegneria spicata, Aristida longiseta,* and *Oryzopsis hymenoides*.

Adjacent Communities- Vegetation on adjacent more stable soils include the *Artemisia tridentata / Pseudoroegneria spicata* and *Pseudoroegneria spicata/Bouteloua gracilis* types.

Other Studies- This type has not previously been reported in Montana but has been reported in Wyoming (Bourgeron and Engelking 1994).

Element Code- CEGL001674

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudoroegneria spicata - Pascopyrum smithii Herbaceous Vegetation (PSESPI – PASSMI) bluebunch wheatgrass - western wheatgrass

Natural Heritage Conservation Rank- G4 / S4

Environment- This uncommon type occurs on gently sloping alluvial fans at ca. 6,000-7,000 ft. as well as moderate to steep eroding slopes at 6,600-7,500 ft in the Centennial Mountains. Vegetation dominated by *Artemisia tridentata* ssp. *vaseyana* and either *Pseudoroegneria*

spicata or *Festuca idahoensis* occurs on adjacent deeper or less erodible soils.

Vegetation- *Pseudoroegneria spicata* and *A. smithii/dasystachyum* are common. Examples lower down on alluvial fans have abundant *Calamagrostis montanensis* and *Stipa comata*; both of these species probably increase with grazing at the expense of the wheatgrass and are also associated with coarser-textured soils. *Gutierrezia sarothrae* and *Artemisia frigida* are common subshrubs that also increase with grazing. Forbs are uncommon. *Festuca kingii* is common and occasionally well represented in examples of this type occurring on steep slopes of the Centennial Mountains. Subshrubs and other grasses are uncommon, but forbs are abundant and diverse. Common species include *Ipomopsis congesta* and *Aster occidentalis*. Mosses and lichens are rare.

Soils- This type appears to be most common on soils derived from calcareous parent materials, limestone or calcareous sandstone. Bare soil is abundant and surface gravel is common. Soils of slopes in the Centennial Mountains in the Peet Creek area are unstable and prone to slumping.

Other Studies- Mueggler and Stewart (1980) and Jorgensen (1979) describes this type for east and occasionally west of the Continental Divide in Montana. Their type is very similar to stands from southwest Montana that occur on alluvial fans. Pseudoroegneria spicata-Pascopyrum smithii is also reported from Wyoming (Bourgeron and Engelking 1994).

Comments- Extensive areas of the Centennial Mountains between Sand Creek and Peet Creek are dominated by highly erodible soils derived from calcareous sandstone. The grasslands occurring on these soils have been included here, but they may constitute a distinct phase of *the Pseudoroegneria spicata / Pascopyrum smithii* c.t. or perhaps a distinct community type.

Heavy livestock grazing or motorized vehicle use of these sites is not desirable due to the erodible nature of the soil.

Element Code- CEGL001675

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation (PSESPI / POASEC) bluebunch wheatgrass-Sandberg bluegrass

Natural Heritage Conservation Rank- G4? / S4

Environment- *Pseudoroegneria spicata - Poa secunda* is common on moderate to steep slopes and alluvial fans, usually with a warm aspect. Elevations range from 5,800-7,500 ft. Adjacent deeper soils often support vegetation dominated by *Artemisia tridentata* and *Festuca idahoensis*. Cooler aspects or higher elevations support woodlands dominated by *Pinus flexilis* or *Pseudotsuga menziesii*. Very rocky outcrops are dominated by *Cercocarpus ledifolius*. Most stands occur south of Dillon. Along the east front of the northern Tendoy Mountains, this vegetation often forms mosaics that include shallow drainage's and bald limestone outcrops.

Vegetation- Dominance is shared by *Pseudoroegneria spicata Stipa comata* and *Oryzopsis hymenoides*. *Poa secunda* and *Koeleria cristata* are present in small amounts in most stands. The subshrubs *Artemisia frigida* and *Gutierrezia sarothrae* are usually present. Forbs cover is low but diverse. Common species include *Phlox hoodii, Haplopappus acaulis, Arenaria kingii, Penstemon aridus* and *Lesquerella alpina*. Mosses are rare, but lichens may be common in some stands.

Soils- Parent materials are limestone or mixed sedimentary. 20-50% of the soils is exposed and gravel is abundant on the surface. Soils are generally well drained and often sandy in texture.

Other Studies- Pseudoroegneria spicata- *Poa secunda* (=AGRSP-POASEC) is described for

western Montana by Mueggler and Stewart (1980). Daubenmire (1970) describes a similar type with lower forb diversity and without *Stipa comata* that was once extensive in eastern Washington. Pseudoroegneria spicata- *Poa secunda* apparently extends as far south as northern Colorado and Utah but is only a significant landscape component in Wyoming (Bourgeron and Engelking 1994).

Comments- All of our stands fit the description of the *Stipa comata* phase of the *Pseudoroegneria spicata - Poa secunda* c.t. (Mueggler and Stewart, 1980). *Stipa comata, Poa sandbergii* and the subshrubs *Gutierrezia sarothrae* and *Artemisia frigida* increase with increasing grazing pressure, but at higher intensities *S. comata* decreases.

Element Code- CEGL001677

Edition / Author- 99-11-16 / S.V. Cooper

Puccinellia nuttalliana Herbaceous Vegetation (PUCNUT) Nuttall's alkaligrass

Natural Heritage Conservation Rank- G3? / S?

Environment- *Puccinellia nuttalliana* is an uncommon on the Refuge and globally ranked high for rarity as well. It is sparsely vegetated with Nuttall's alkaligrass *(Puccinellia nuttallii*) approaching monospecific dominance, occurring in small patches as a broken stringer along intermittent drainage's and on alluvial flats (mostly on the western fringe of Refuge). In some cases on the Refuge Puccinellia nuttalliana constitutes the vegetation band closest to the incised channel on a floodplain position with silty loam alluvial soils. Salt efflorescence was not observed but this community is known to occur on salt-affected soils that have a slightly wetter, temporarily inundated, moisture regime. The Puccinellia nuttalliana type has not been formally described from MT in the classification efforts of Hansen et al. (1995), but probably has been subsumed by these researchers within the *Distichlis stricta* or *Pascopyrum smithii* community types. Within the TNC tracking system this community type has been reported only from Colorado as G1? but Heidel and Cooper (1997) have documented it from western plains of Montana near the Rocky Mountain Front, noted it in field reconnaissance, and cited it from the Canadian literature (synonym: *Puccinellia airoides*, Dodd and Coupland 1966). We have recognized the type by *P. nuttalliana* having at least 10 % cover and greater cover than any other forb indicative of yet drier moisture regimes. It is usually exists in a complex with *Leymus cinereus* – Puccinellia nuttalliana, Pascopyrum smithii / alluvial flats or *Distichlis spicata*- and *Sarcobatus vermiculatus*-dominated types. In the vicinity of the *Puccinellia nuttalliana* sampling sites a comparable landscape position was occupied by what has been described as western wheatgrass – inland saltgrass grassland (*Pascopyrum smithii – Distichlis spicata* Herbaceous Vegetation; WY, ND).

Vegetation- The Refuge examples of this type have low diversity and are compositionally very similar to other observed Montana occurrences. *Puccinellia nuttalliana* dominants at around 40 % canopy cover; inland saltgrass (D*istichlis spicata*), *Hordeum jubatum* (*H. brachyantherum*), *Leymus cinereus*, *Grindelia squarrosa* and *Iva axillaris* are the only other herbs exhibiting more than trace coverages or that are present with any consistency. *Chrysothamnus nauseosus* and *Sarcobatus vermiculatus* in trace amounts were the only shrubs noted within the type.

Element Code- CEGL001799

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Scirpus acutus Herbaceous Vegetation (SCIACU) hardstem bulrush

Natural Heritage Conservation Rank- G5 / S5

Environment- This is a major wetland plant community throughout Montana noted as

occurring from low to mid elevation (Hansen et al. 1995); the examples occur at the cited upper elevation limits of the type (6,600 feet). On the refuge this type is found as a discontinuous fringe on the margins of ponds and is especially conspicuous on the margins of Upper and Lower Red Rock Lakes in water up to about six feet deep. It frequently grows with *Typha latifolia* or adjacent to *T. latifolia*-dominated communities (where *T. latifolia* cover is greater than 25% the community is defined as a *T. latifolia* type). *Scirpus acutus* usually grades to the *Carex utriculata – Carex utriculata* type or *Juncus balticus* communities that characterize shallower water.

Vegetation- Though Hansen et al. (1995) include *Scirpus validus* (softstem bulrush) as an equivalent indicator species for this type we found only *Scirpus acutus* on the Refuge. Except for the situations where *Typha latifolia* occurs with significant cover, *Scirpus. acutus* generally forms dense near monocultures with *Potamogeton amphibium, Potamogeton spp., Potentilla palustris, Eleocharis palustris* and *Triglochin maritimum* being present in barely more than trace amounts.

Element Code- CEGL001840

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Scirpus tabernaemontani Herbaceous Vegetation (SCITAB) Softstem bulrush

Natural Heritage Conservation Rank- G4 / S3

Environment- The *Scirpus tabernaemontani* association is typically found at low to mid elevations across Montana, but more frequently in the eastern part of the state. It is found in marshes, pond and lake margins, oxbow lakes, and backwater areas of rivers and streams. Soils are commonly Mollisols (Aquolls), Entisols (Aquents), or sometimes Histosols, and soil reaction ranges from neutral to moderately alkaline (pH 7.0 to 8.0). This community can occur in standing water up to 1-2 meters deep, and it is usually classified as semi-permanently flooded since the water levels can drop below the soil surface by the end of the growing season. This community occupies the same position in the landscape as *Typha* sp., with open water or aquatic communities occupying wetter spots and *Salix* sp., *Carex* sp., or *Phalaris arundinacea* communities occupying nearby drier sites (Hansen et al. 1988, Hansen et al. 1995).

Range- Communities of *Scirpus tabernaemontani* are widespread across the Great Plains states, and also occur in Montana and Idaho.

Vegetation- This plant association usually forms dense monocultures that can occupy large areas. Stems are usually 1-2 meters tall. The flooded conditions in which this species often grows precludes the establishment of other graminoids and forbs; if present, species like *Potentilla palustris* and *Polygonum amphibium* are often widely scattered. Its seeds require bare, moist soils for germination, so this species can rapidly colonize newly exposed mudflats and drawdown areas (Hansen et al. 1988, Hansen et al. 1995).

Similar Communities- *Scirpus tabernaemontani* is synonymous with *Scirpus validus*. Hansen et al. (1995), Hall and Hansen (1997), and Kittel et al. (1998) have a *Scirpus acutus* habitat type in their classifications that includes all combinations of *Scirpus acutus* and *S. tabernaemontani* due to similarities in environmental conditions and management concerns. *Scirpus tabernaemontani* is often treated as a separate alliance in the Western Regional Vegetation Classification (Bourgeron and Engelking 1994). Other communities with this species growing as a dominant or codominant have been described: *Scirpus tabernaemontani - Typha latifolia* (e.g. Komarkova 1986), and *Scirpus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) (Hoagland 1997). The *Scirpus tabernaemontani* type described here encompasses enough compositional and structural variation to include these other types.

Succession- This species can colonize newly exposed mudflats and drawdown areas, and communities tend to be persistent if the hydrologic regime is stable.

Management- Softstem bulrush has low to moderate palatability to livestock, and because communities are usually flooded, access for livestock is usually difficult. When stands dry down, livestock may heavily utilize these communities if upland forage is sparse. Stands of softstem bulrush can buffer wave action on lakes and ponds (Hansen et al. 1995).

Element Code- CEGL002623

Edition / Author- 99-10-15 / J. Greenlee, MTNHP

Stipa comata - Bouteloua gracilis Herbaceous Vegetation (STICOM – BOUGRA) needle-and-thread / blue grama

Natural Heritage Conservation Rank- G5 / S5

Environment- *Stipa comata-Bouteloua gracilis* occurs from the floors and gently sloping coalesced alluvial fans of intermountain valleys upslope to where it intergrades with *Festuca idahoensis*- and *Artemisia tridentata* ssp. *vaseyana*-dominated rangelands. Lowest elevation occurrences are represented by valley bottoms (non-saline or alkaline sites) around 4,500 ft. and the type extends as high as 6,300 ft as small patches with coarse-textured soils within a mosaic of more mesic vegetation. It is apparently not aspect or slope restricted within this elevation range but habitats within this landscape are generally low gradient (<25% slope). Mueggler and Stewart (1980) term *Stipa comata-Bouteloua gracilis* the driest of western Montana grassland habitat types; it is certainly the most extensive dry grassland type but is no drier than the more areally restricted *Pseudoroegneria spicata - Oryzopsis hymenoides*, *Stipa comata / Psoralidium tenuiflorum* or *Pseudoroegneria spicata* / Cushion Plant community types.

Vegetation- All sites sampled and noted in reconnaissance supported abundant *Stipa comata*, the diagnostic species, but cover was highly variable (20-80%) depending on grazing history and intrinsic severity of site, ostensibly controlled by the amount of gravel and stone in substrate. Cover of *Bouteloua gracilis*, the other diagnostic species, is also highly variable but shows a clinal response of increasing cover west to east. It was only sporadically encountered in the westernmost valley between Tendoy and Beaverhead Ranges. Other graminoids frequently occurring, usually poorly represented, include *Koeleria cristata*, *Carex stenophylla* and *Poa sandbergii*. Though ubiquitous on these sites it is here that the increase in cover of *Artemisia frigida* and *Gutierrezia sarothrae* with the increasing intensity of grazing is so apparent. Ceratoides lanata is also consistently present, in scare amounts. Forb cover and diversity is usually low, those species with the highest cover are often exotic weeds or escaped agricultural introductions (e.g. *Melilotus officinalis*, *Salsola kali*, *Medicago sativa*, *Taraxacum officinale*). *Sphaeralcea coccinea*, a increaser with grazing, is highly constant but scarce; no other forbs had even 50% constancy.

Soils- Given the position of these sites within the landscape and composition (dominance of *Stipa comata*) it follows that the soils are medium-textured to sandy, usually loamy Mollisols or Aridisols with free calcium carbonate at and near the surface. The amount of bare substrate (soil, gravel, rock) ranged from 20 to 50%; most of the surface is covered with litter and cryptogamic crust (dominated by lichens), the relative proportions of which are highly variable.

Other Studies- Coupland (1961) in southern Saskatchewan described a *Stipa comata - Bouteloua gracilis* faciation on sandy sites within the mixed-grass prairie. This major plant association extends southward along the western fringe of the Great Plains in eastern Montana, Wyoming and Colorado (Bourgeron and Engelking 1994). The study area constitutes the western extreme of its

distribution. Daubenmire described a Stipa comata-*Poa sandbergii* habitat type in eastern Washington that is similar to Stipa comata-Bouteloua gracilis in landscape position, community type matrix and dominants (with the exception of *Bouteloua gracilis* absence in WA). He showed with detailed soil analyses that *Stipa comata*-dominated sites differed at 95% confidence level from *Agropyron*- and *Festuca*-dominated sites in having both coarser (drier) and less fertile (lower exchange capacity and lower nutrient content) soils.

Element Code- CEGL001699

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Stipa comata - Psoralidium tenuiflorum Herbaceous Vegetation
(STICOM - PSOTEN) needle-and-thread - slender-leaved scurf-pea

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Natural Heritage Conservation Rank- G? / S?

Environment- This seral type characterizes recently stabilized blowouts of sandhills at 6,600-6,900 ft on the northeast side of the Centennial Valley. Adjacent vegetation is dominated by various combinations of *Artemisia tripartita* or *A. tridentata ssp. tridentata* with *Festuca idahoensis* or *Stipa comata* or yet earlier, forb-dominated seral vegetation.

Vegetation- Grass canopy cover is generally less than 30%. Dominant species are *Stipa comata, Elymus lanceolatus* and *Oryzopsis hymenoides*. Scattered *Chrysothamnus nauseosus* shrubs may be present. Forb cover is 10-30% with moderate diversity. *Psoralidium tenuiflorum, Opuntia fragilis*, and *Phacelia hastata* may be abundant. Other common forbs include *Machaeranthera canescens, Allium textile* and *Comandra umbellata*. Mosses and lichens are not present.

Soils- Soils are very sandy with little horizon development. They were probably stabilized relatively recently. 60-95% of the surface is bare.

Other Studies- Lesica (1987) described a similar association from the sandhills near Medicine Lake in Sheridan County, Montana. The *Stipa comata / Bouteloua gracilis* habitat type of Mueggler and Stewart (1980) is found at lower elevations and has *Bouteloua gracilis* and many different forbs than *Stipa comata / Psoralidium tenuiflorum.*

Comments- This vegetation is endemic to sandhills and other areas of very sandy soils. It is clearly a seral community associated with undeveloped soils and periodic disturbance from grazing, fire and/or wind.

Element Code- CEGLMTHP23

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

Stipa richardsonii - Festuca idahoensis Herbaceous Vegetation
(STIRIC – FESIDA) Richardson's needlegrass – Idaho fescue

Natural Heritage Conservation Rank- G1? / S?

Environment- Sites supporting this type are poorly documented in Montana. At least in southwestern Montana it occurs primarily in sheltered environments, such as toeslopes and leeward slopes in the foothills or lower slopes of mountain ranges, from 6,600 to 7,600 ft (there is no reason to suspect that this community is restricted to this elevation range). These are locations one would expect to receive drifted snow or possibly be subirrigated or in some way have augmented moisture regimes. The fact that sites are in collecting positions is borne out by the soils, which are loams or silt loams in texture and have virtually no rock in the upper 20-30 cm of the profile. Given the soil characteristics and landscape position of the type we infer that soils are primarily aeolian in origin with some colluvial and slopewash fine materials added. Reflecting highly productive nature of these sites, the substrate surface is composed of

copious litter and basal area and just a trace of exposed soil. This community is very circumscribed in area, usually less than 2-3 acres, because it is apparently confined to small lenses of aeolian materials. Adjacent vegetation is almost invariably dominated by the more mesic plant associations within the *Artemisia tridentata* ssp. *vaseyana* and *Festuca idahoensis* alliances, usually those communities (or phases) denoted by *Elymus trachycaulus, Stipa richardsonii, Geranium viscosissimum, Potentilla gracilis* and *P. glandulosa.*

Range- This community is currently known from the foothills and lower slopes of the Snowcrest, Gravelly, and Blacktail Mountain Ranges and the hills and ridge complexes between these ranges. It has been documented to occur in Wyoming as well within the Southern Rocky Mountain Steppe – Open Woodland – Coniferous Forest – Alpine Meadow Province.

Vegetation- The shrub component is present as scattered individuals of *Artemisia tridentata* ssp. *vaseyana* and *Chrysothamnus nauseosus* whose cover usually does not exceed trace amounts. Stands with plot data had a very strongly dominant tall graminoid layer that was so dense as to covey the look of an agricultural field when viewed from a distance (other stands, more open with less herbaceous cover, were noted in passing). *Stipa richardsonii* is conspicuously dominant with cover usually in excess of 70%. Other graminoids of high constancy include *Festuca idahoensis, Elymus trachycaulus, Stipa occidentalis, Danthonia intermedia,* and *Pascopyrum smithii,* their individual cover seldom exceeds 10 %. The suite of mesic site forbs regularly present includes Gentiana affinis, *Potentilla gracilis, Geum triflorum, Cirsium scariosum* (or *C. undulatum*), Agoseris glauca, *Campanula rotundifolia* and *Galium boreale*; seldom does individual forb cover exceed 5% and combined forb cover is usually in the range of 5-15%.

Similar Communities- The most similar community in name and all other parameters is *Festuca idahoensis – Stipa richardsonii* defined by Mueggler and Stewart (1980) for southwestern Montana; their plots also demonstrate *S. richardsonii* to have high canopy cover, significantly greater than that of *F. idahoensis*. We recommend that their type be combined with the *S. richardsonii – F. idahoensis* association as this latter name more appropriately describes the community, which is *S. richardsonii*-dominated and similar in composition and abiotic features.

Element Code- CEGL001712

Edition / Author- 99-11-22 / S. V. Cooper, MTNHP

Typha latifolia Western Herbaceous Vegetation (TYPLAT) common cattail

Natural Heritage Conservation Rank- G5 / S5

Environment- The *Typha latifolia* community is a broadly distributed, extremely common emergent wetland type that occurs from low to mid elevations (Red Rock Lakes NWR examples occur 400 feet higher than type's cited range [Hansen et al. 1995]), characteristically on permanently to semi-permanently flooded sites. Sites on the Refuge often are associated with water depths in excess of four feet and have a deep organic matter accumulated over silts and other fines. However, exposed mineral soil is required for germination and establishment *Typha latifolia* so that these sites presumably dry out in extreme years so as to facilitate these processes. The *Typha latifolia* type often occurs in small, individually unmapped patches, as part of a wetland mosaic with *Scirpus acutus* (in equally deep water) or as narrow stringers along channels removed from the main water bodies (in the case of Red Rocks Lake National Wildlife Refuge) where *Carex utriculata – Carex utriculata* communities are found immediately adjacent on sites with shallower water depths. Hansen et al. (1995) indicate that *Typha latifolia* is not as tolerant of brackish water as is *Scirpus acutus* but this is not the factor separating these

sites on RRLNWLR, rather it is probably a matter of priority of establishment and subsequent competition for substrate.

Vegetation- *Typha latifolia* (or *T. angustifolia*), usually exceeding 75% canopy cover, dominate these sites with few other forbs or graminoids present due to the constantly wet conditions. Scattered individuals from adjacent slightly less wet communities often include *Carex utriculata, Scirpus validus, Beckmannia syzigachne, Polygonum amphibium* and *Epilobium ciliatum*.

Element Code- CEGL002010

Edition / Author- 99-11-16 / S.V. Cooper, MTNHP

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Appendix A. Flora of the Beaverhead Mountains Section

Trees

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ABILAS	ABILAS	Abies lasiocarpa	Subalpine Fir
JUNSCO	JUNSCO	Juniperus scopulorum	Rocky Mountain Juniper
LARLYA	LARLYA	Larix lyallii	Subalpine Larch
PICENG	PICENG	Picea engelmannii	Engelmann Spruce
PINALB	PINALB	Pinus albicaulis	Whitebark Pine
PINCON	PINCON	Pinus contorta	Lodgepole Pine
PINFLE	PINFLE	Pinus flexilis	Limber Pine
PINMON	PINMON	Pinus monticola	Western White Pine
PINPON	PINPON	Pinus ponderosa	Ponderosa Pine
POPANG	POPANG	Populus angustifolia	Narrowleaf Cottonwood
POPBST	POPBST	Populus balsamifera ssp. trichocarpa	Balsam Poplar
POPTRE	POPTRE	Populus tremuloides	Quaking Aspen
PSEMEN	PSEMEN	Pseudotsuga menziesii	Douglas-fir

Appendix A. Flora of the Beaverhead Mountains Section

Shrubs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ACEGLA	ACEGLA	Acer glabrum	Rocky Mountain Maple
ALNINC	ALNINC	Alnus incana	Mountain Alder
ALNVSS	ALNVSS	Alnus viridis ssp. sinuata	
AMEALN	AMEALN	Amelanchier alnifolia	Western Serviceberry
AMEUTA	AMEUTA	Amelanchier utahensis	Utah Serviceberry
ARCUVA	ARCUVA	Arctostaphylos uva-ursi	Kinnikinnick
ARTARB	ARTARB	Artemisia arbuscula	Low Sagebrush
ARTASL	ARTLOL	Artemisia arbuscula ssp. longiloba	Alkali Sagebrush
ARTCAN	ARTCAN	Artemisia cana	Silver Sagebrush
ARTFRI	ARTFRI	Artemisia frigida	Fringed Sagewort
ARTNOV	ARTNOV	Artemisia nova	Black Sagebrush
ARTTST	ARTTST	Artemisia tridentata ssp. tridentata	Basin Big Sagebrush
ARTTSV	ARTTSV	Artemisia tridentata ssp. vaseyana	Mountain Big Sagebrush
ARTTSW	ARTTSW	Artemisia tridentata ssp. wyomingensis	Wyoming Big Sagebrush
ARTTRP	ARTTRP	Artemisia tripartita	Three-tip Sagebrush
ATRGAR	ATRNUT	Atriplex gardneri	Gardner's Saltsage
ATRNUT	ATRNUT	Atriplex nuttallii	Saltsage
BETGLA	BETGLA	Betula glandulosa	Bog Birch
BETOCC	BETOCC	Betula occidentalis	Water Birch
CASMER	CASMER	Cassiope mertensiana	Mertens' Mountain Heather
CASTET	CASTET	Cassiope tetragona	Four-angled Mountain Heather
CEAVEL	CEAVEL	Ceanothus velutinus	Mountain Balm
CERLED	CERLED	Cercocarpus ledifolius	Curl-leaf Mountain-mahogany
CHIUMB	CHIUMB	Chimaphila umbellata	Common Prince's-pine
CHRNAU	CHRNAU	Chrysothamnus nauseosus	Rubber Rabbitbrush
CHRVIS	CHRVIS	Chrysothamnus viscidiflorus	Green Rabbitbrush
CLECOU	CLECOU	Clematis columbiana	Matted Clematis
CLELIG	CLELIG	Clematis ligusticifolia	Western Virgins-bower
CLEOCC	CLEOCC	Clematis occidentalis	Western Blue Virginsbower
CORSER	CORSTO	Cornus sericea	Red-osier Dogwood
CRADOU	CRADOU	Crataegus douglasii	Black Hawthorn
DRYOCT	DRYOCT	Dryas octopetala	White Dryas
ELACOM	ELACOM	Elaeagnus commutata	Silverberry
ERINAN	HAPNAN	Ericameria nana	Dwarf Goldenweed
ERIMIC	ERIMIC	Eriogonum microthecum	Slenderbush Buckwheat
GAUHUM	GAUHUM	Gaultheria humifusa	Alpine Wintergreen
GUTSAR	GUTSAR	Gutierrezia sarothrae	Broom Snakeweed
JUNCOM	JUNCOM	Juniperus communis	Common Juniper
KALMIC	KALMIC	Kalmia microphylla	Small-leaved Laurel
KRALAN	CERLAN	Krascheninnikovia lanata	Winterfat
LEDGLA	LEDGLA	Ledum glandulosum	Labrador-tea
LEPPUN	LEPPUN	Leptodactylon pungens	Prickly Phlox
LINBOR	LINBOR	Linnaea borealis	Twinflower
LONINV	LONINV	Lonicera involucrata	Twin-berry
LONUTA	LONUTA	Lonicera utahensis	Utah Honeysuckle
MAHREP	BERREP	Mahonia repens	Creeping Oregongrape
MENFER	MENFER	Menziesia ferruginea	Menziesia
PENFRU	PENFRU	Penstemon fruticosus	Bush Penstemon
PENFLO	POTFRU	Pentaphylloides floribunda	Shrubby Cinquefoil
PHILEW	PHILEW	Philadelphus lewisii	Mockorange; Syringa

Appendix A. Flora of the Beaverhead Mountains Section

Shrubs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
PHYEMP	PHYEMP	Phyllodoce empetriformis	Red Mountain-heath
PHYGLA	PHYGLA	Phyllodoce glanduliflora	Yellow Mountain-heath
PHYMAL	PHYMAL	Physocarpus malvaceus	Mallow Ninebark
PRUVIR	PRUVIR	Prunus virginiana	Common Chokecherry
PURTRI	PURTRI	Purshia tridentata	Antelope Bitter-brush
RHAALN	RHAALN	Rhamnus alnifolia	Alder Buckthorn
RHUTRI	RHUTRI	Rhus trilobata	Skunk-bush Sumac
RIBAME	RIBAME	Ribes americanum	Black Currant
RIBAUR	RIBAUR	Ribes aureum	Golden Currant
RIBCER	RIBCER	Ribes cereum	Squaw Currant
RIBHUD	RIBHUD	Ribes hudsonianum	Stinking Currant
RIBINE	RIBINE	Ribes inerme	Whitestem Gooseberry
RIBIRR	RIBOSI	Ribes irriguum	Idaho Gooseberry
RIBLAC	RIBLAC	Ribes lacustre	Swamp Currant
RIBMON	RIBMON	Ribes montigenum	Mountain Gooseberry
RIBVIS	RIBVIS	Ribes viscosissimum	Sticky Currant
ROSACI	ROSACI	Rosa acicularis	Prickly Rose
ROSARK	ROSARK	Rosa arkansana	Arkansas Rose
ROSWOO	ROSWOO	Rosa woodsii	Woods Rose
RUBIDA	RUBIDA	Rubus idaeus	Red Raspberry
RUBLAC	RUBLAC	Rubus laciniatus	Evergreen Blackberry
RUBPAR	RUBPAR	Rubus parviflorus	Thimbleberry
SALARC	SALARC	Salix arctica	Artic Willow
SALBAR	SALBAR	Salix barclayi	Barclay's Willow
SALBEB	SALBEB	Salix bebbiana	Bebb Willow
SALBOO	SALBOO	Salix boothii	Booth Willow
SALBRA	SALBRA	Salix brachycarpa	Short-fruited Willow
SALCAN	SALCAN	Salix candida	Hoary Willow
SALDIS	SALDIS	Salix discolor	Pussy Willow
SALDRU	SALDRU	Salix drummondiana	Drummond Willow
SALEXI	SALEXI	Salix exigua	Sandbar Willow
SALFAR	SALFAR	Salix farriae	Farr's Willow
SALGEY	SALGEY	Salix geyeriana	Geyer Willow
SALGLA	SALGLA	Salix glauca	Glaucous Willow
SALLEM	SALLEM	Salix lemmonii	Lemmon's Willow
SALLUT	SALLUT	Salix lutea	Watson Willow
SALPLA	SALPLA	Salix planifolia	Planeleaf Willow
SALRIG	SALRIG	Salix rigida	Diamond Willow
SALSCO	SALSCO	Salix scouleriana	Scouler Willow
SALWOL	SALWOL	Salix wolfii	Wolf's Willow
SAMCER	SAMCER	Sambucus cerulea	Blue Elderberry
SAMRAC	SAMRAC	Sambucus racemosa	Red Elderberry
SARVER	SARVER	Sarcobatus vermiculatus	Black Greasewood
SHEARG	SHEARG	Shepherdia argentea	Thorny Buffaloberry
SHECAN	SHECAN	Shepherdia canadensis	Canada Buffaloberry
SORSCO	SORSCO	Sorbus scopulina	Cascade Mountain-ash
SPIBET	SPIBET	Spiraea betulifolia	Shiny-leaf Spiraea
SYMALB	SYMALB	Symphoricarpos albus	Common Snowberry
SYMORE	SYMORE	Symphoricarpos oreophilus	Mountain Snowberry
TETCAN	TETCAN	Tetradymia canescens	Gray Horse-brush

Appendix A. Flora of the Beaverhead Mountains Section

Shrubs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
VACCES	VACCES	Vaccinium cespitosum	Dwarf Huckleberry
VACMEM	VACMEM	Vaccinium membranaceum	Big Huckleberry
VACMYR	VACMYR	Vaccinium myrtillus	Dwarf Bilberry
VACSCO	VACSCO	Vaccinium scoparium	Whortleberry

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ACHMIL	ACHMIL	Achillea millefolium	Common Yarrow
ACOCOL	ACOCOL	Aconitum columbianum	Columbian Monkshood
ACTRUB	ACTRUB	Actaea rubra	Baneberry
AGACUS	AGACUS	Agastache cusickii	Cusick's Giant-hyssop
AGAURT	AGAURT	Agastache urticifolia	Nettle-leaf Giant-hyssop
AGOAUR	AGOAUR	Agoseris aurantiaca	Orange Agoseris
AGOGLA	AGOGLA	Agoseris glauca	Pale Agoseris
AGOHET	AGOHET	Agoseris heterophylla	Annual Agoseris
AGOLAC	AGOLAC	Agoseris lackschewitzii	Pink Agoseris
ALLBRA	ALLBRA	Allium brandegei	Brandegee Onion
ALLBRE	ALLBRE	Allium brevistylum	Short-style Onion
ALLCER	ALLCER	Allium cernuum	Nodding Onion
ALLGEY	ALLGEY	Allium geyeri	Geyer's Onion
ALLSCH	ALLSCH	Allium schoenoprasum	Chives
ALLTEX	ALLTEX	Allium textile	Textile Onion
ALLVIR	ALLVIR	Allotropa virgata	Candystick
ALYALY	ALYALY	Alyssum alyssoides	Pale Alyssum
ALYDES	ALYDES	Alyssum desertorum	Desert Alyssum
ANAMAR	ANAMAR	Anaphalis margaritacea	Common Pearly-everlasting
ANDFIL	ANDFIL	Androsace filiformis	Slender-stemmed Fairy-candelabra
ANDOCC	ANDOCC	Androsace occidentalis	Western Fairy-candelabra
ANDSEP	ANDSEP	Androsace septentrionalis	Northern Fairy-candelabra
ANECYL	ANECYL	Anemone cylindrica	Candle Anemone
ANEDRU	ANEDRU	Anemone drummondii	Drummond's Anemone
ANEMUL	ANEMUL	Anemone multifida	Cliff Anemone
ANENUT	ANEPAT	Anemone nuttalliana	Pasqueflower
ANEPAR	ANEPAR	Anemone parviflora	Small-flowered Anemone
ANETET	ANEMVT	Anemone tetonensis	Teton Anemone
ANGARG	ANGARG	Angelica arguta	Sharptooth Angelica
ANGROS	ANGROS	Angelica roseana	Rose's Angelica
ANTALP	ANTALP	Antennaria alpina	Alpine Pussy-toes
ANTANA	ANTANA	Antennaria anaphaloides	Tall Pussy-toes
ANTARO	ANTARO	Antennaria aromatica	Aromatic Pussy-toes
ANTCOR	ANTCOR	Antennaria corymbosa	Meadow Pussy-toes
ANTDIM	ANTDIM	Antennaria dimorpha	Low Pussy-toes
ANTLAN	ANTLAN	Antennaria lanata	Woolly Pussy-toes
ANTLUZ	ANTLUZ	Antennaria luzuloides	Woodrush Pussy-toes
ANTMIC	ANTMIC	Antennaria microphylla	Rosy Pussy-toes
ANTNEG	ANTNEG	Antennaria neglecta	Field Pussy-toes
ANTPAR	ANTPAR	Antennaria parvifolia	Nuttall's Pussy-toes
ANTRAC	ANTRAC	Antennaria racemosa	Raceme Pussy-toes
ANTROS	ANTMIC	Antennaria rosea	Rosy Pussy-toes
ANTUMB	ANTUMB	Antennaria umbrinella	Umber Pussy-toes
APOAND	APOAND	Apocynum androsaemifolium	Spreading Dogbane
APOCAN	APOCAN	Apocynum cannabinum	Hemp Dogbane
AQUCOE	AQUCOE	Aquilegia coerulea	Colorado Columbine
AQUFLA	AQUFLA	Aquilegia flavescens	Yellow Columbine
AQUFOR	AQUFOR	Aquilegia formosa	Sitka Columbine
ARATHA	ARATHA	Arabidopsis thaliana	Mouse-ear Cress

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ARADRU	ARADRU	Arabis drummondii	Drummond's Rockcress
ARAFEC	ARAFEC	Arabis fecunda	Sapphire Rockcress
ARAGLA	ARAGLA	Arabis glabra	Towermustard
ARAHIR	ARAHIR	Arabis hirsuta	Hairy Rockcress
ARAHOL	ARAHOL	Arabis holboellii	Holboell's Rockcress
ARALEM	ARALEM	Arabis lemmonii	Lemmon's Rockcress
ARALYA	ARALYA	Arabis lyallii	Lyall's Rockcress
ARAMIC	ARAMIC	Arabis microphylla	Littleleaf Rockcress
ARANUT	ARANUT	Arabis nuttallii	Nuttall's Rockcress
ARASPA	ARASPA	Arabis sparsiflora	Sicklepod Rockcress
ARECAP	ARECAP	Arenaria capillaris	Thread-leaved Sandwort
ARECON	ARECON	Arenaria congesta	Ballhead Sandwort
AREKIN	AREKIN	Arenaria kingii	King's Sandwort
ARGANS	POTANS	Argentina anserina	Silverweed Cinquefoil
ARNALP	ARNALP	Arnica alpina	Alpine Arnica
ARNCHA	ARNCHA	Arnica chamissonis	Meadow Arnica
ARNCOR	ARNCOR	Arnica cordifolia	Heart-leaf Arnica
ARNDIV	ARNDIV	Arnica diversifolia	Sticky Arnica
ARNFUL	ARNFUL	Arnica fulgens	Orange Arnica
ARNLAT	ARNLAT	Arnica latifolia	Broadleaf Arnica
ARNLON	ARNLON	Arnica longifolia	Longleaf Arnica
ARNMOL	ARNMOL	Arnica mollis	Hairy Arnica
ARNPAR	ARNPAR	Arnica parryi	Nodding Arnica
ARNRYD	ARNRYD	Arnica rydbergii	Rydberg's Arnica
ARNSOR	ARNSOR	Arnica sororia	Twin Arnica
ARTCAM	ARTCAM	Artemisia campestris	Pacific Sagewort
ARTDRA	ARTDRA	Artemisia dracunculus	Tarragon
ARTLUD	ARTLUD	Artemisia ludoviciana	Prairie Sagewort
ARTMIC	ARTMIC	Artemisia michauxiana	Michaux Mugwort
ARTSCO	ARTSCO	Artemisia scopulorum	Rocky Mountain Sagewort
ASCSPE	ASCSPE	Asclepias speciosa	Showy Milkweed
ASTALG	ASTALG	Aster alpigenus	Alpine Aster
ASTASC	ASTCHI	Aster ascendens	Long-leaved Aster
ASTCAM	ASTCAM	Aster campestris	Meadow Aster
ASTCHI	ASTCHI	Aster chilensis	Long-leaved Aster
ASTCOM	ASTFAL	Aster commutatus	White-prairie Aster
ASTCON	ASTCON	Aster conspicuus	Showy Aster
ASTEAT	ASTEAT	Aster eatonii	Eaton's Aster
ASTENG	ASTENG	Aster engelmannii	Engelmann's Aster
ASTFAL	ASTFAL	Aster falcatus	White-prairie Aster
ASTFOL	ASTFOL	Aster foliaceus	Leafy Aster
ASTHES	ASTHES	Aster hesperius	Marsh Aster
ASTINT	ASTINT	Aster integrifolius	Thick-stemmed Aster
ASTLAE	ASTLAE	Aster laevis	Smooth Aster
ASTMOD	ASTMOD	Aster modestus	Few-flowered Aster
ASTOCC	ASTOCC	Aster occidentalis	Western Aster
ASTPER	ASTPER	Aster perelegans	Elegant Aster
ASTSCO	ASTSCO	Aster scopulorum	Crag Aster
ASTSIB	ASTSIB	Aster sibiricus	Artic Aster

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ASTSTE	ASTSTE	Aster stenomeres	Rocky Mountain Aster
ASTSUB	ASTSUB	Aster subspicatus	Douglas' Aster
ASTABO	ASTAUS	Astragalus aboriginum	Indian Milk-vetch
ASTADS	ASTADS	Astragalus adsurgens	Standing Milk-vetch
ASTAGR	ASTAGR	Astragalus agrestis	Field Milk-vetch
ASTALP	ASTALP	Astragalus alpinus	Alpine Milk-vetch
ASTAME	ASTAME	Astragalus americanus	American Milk-vetch
ASTARG	ASTARG	Astragalus argophyllus	Silver-leaved Milk-vetch
ASTATR	ASTATR	Astragalus atropubescens	Kelsey's Milk-vetch
ASTBOU	ASTBOU	Astragalus bourgovii	Bourgeau's Milk-vetch
ASTCAN	ASTCAN	Astragalus canadensis	Canada Milk-vetch
ASTCER	ASTCER	Astragalus ceramicus	Painted Milk-vetch
ASTCRA	ASTCRA	Astragalus crassicarpus	Ground Plum
ASTDRU	ASTDRU	Astragalus drummondii	Drummond's Milk-vetch
ASTFLE	ASTFLE	Astragalus flexuosus	Wiry Milk-vetch
ASTGIL	ASTGIL	Astragalus gilviflorus	Plains Orophaca
ASTKEN	ASTKEN	Astragalus kentrophyta	Thistle Milk-vetch
ASTLEN	ASTLEN	Astragalus lentiginosus	Freckled Milk-vetch
ASTLEP	ASTLEP	Astragalus leptaleus	Park Milk-vetch
ASTMIS	ASTMIS	Astragalus miser	Weedy Milk-vetch
ASTMIO	ASTMIO	Astragalus missouriensis	Missouri Milk-vetch
ASTPLA	ASTPLA	Astragalus platytropis	Broad-keeled Milk-vetch
ASTPUR	ASTPUR	Astragalus purshii	Pursh's Milk-vetch
ASTROB	ASTROB	Astragalus robbinsii	Robbins' Milk-vetch
ASTSCA	ASTSCA	Astragalus scaphoides	Bitterroot Milk-vetch
ATRARG	ATRARG	Atriplex argentea	Silverscale
ATRPAT	ATRPAT	Atriplex patula	Common Orache
BALHOO	BALHOO	Balsamorhiza hookeri	Hooker's Balsamroot
BALSAG	BALSAG	Balsamorhiza sagittata	Arrowleaf Balsamroot
BARORT	BARORT	Barbarea orthoceras	American Wintercress
BESRUB	BESRUB	Besseya rubra	Bed Besseya
BESWYO	BESWYO	Besseya wyomingensis	Wyoming Kittentail
BRIGRA	BRIGRA	Brickellia grandiflora	Large-flowered Brickellia
BUPAME	BUPAME	Bupleurum americanum	American Thorough-wax
CALHER	CALHER	Callitriche hermaphroditica	Autumnal Water-starwort
CALAPI	CALAPI	Calochortus apiculatus	Pointed Mariposa
CALNUT	CALNUT	Calochortus nuttallii	Sego-lilly
CALLEP	CALLEP	Caltha leptosepala	Elkslip Marshmarigold
CALBUL	CALBUL	Calypso bulbosa	Fairy-slipper
CAMQUA	CAMQUA	Camassia quamash	Common Camas
CAMMIC	CAMMIC	Camelina microcarpa	Littlepod Falseflax
CAMPAR	CAMPAR	Campanula parryi	Parry's Bellflower
CAMROT	CAMROT	Campanula rotundifolia	Harebell
CAMSCA	CAMSCA	Campanula scabrella	Rough Bellflower
CAMUNI	CAMUNI	Campanula uniflora	Arctic Bellflower
CAPBUR	CAPBUR	Capsella bursa-pastoris	Shepherd's-purse
CAROLI	CAROLI	Cardamine oligosperma	Few-seeded Bittercress
CARDRA	CARDRA	Cardaria draba	Hoary Pepperwort
CARNUT	CARNUT	Carduus nutans	Musk Thistle

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
CARCAR	CARCAR	Carum carvi	Caraway
CASANG	CASANG	Castilleja angustifolia	Northwest Paintbrush
CASCHR	CASCHR	Castilleja chromosa	Desert Paintbrush
CASCOV	CASCOV	Castilleja covilleana	Rocky Mountain Paintbrush
CASCRI	CASCRI	Castilleja crista-galli	Cocks-comb Paintbrush
CASCUS	CASCUS	Castilleja cusickii	Cusick's Paintbrush
CASFLA	CASFLA	Castilleja flava	Yellow Paintbrush
CASGRA	CASGRA	Castilleja gracillima	Slender Paintbrush
CASHIS	CASHIS	Castilleja hispida	Harsh Paintbrush
CASLIN	CASLIN	Castilleja linariifolia	Narrow-leaved Paintbrush
CASLON	CASLON	Castilleja longispica	White Paintbrush
CASLUT	CASLUT	Castilleja lutescens	Yellowish Paintbrush
CASMIN	CASMIN	Castilleja miniata	Scarlet Paintbrush
CASNIV	CASNIV	Castilleja nivea	Snow Paintbrush
CASPAL	CASPAL	Castilleja pallescens	Palish Indian-paintbrush
CASPUL	CASPUL	Castilleja pulchella	Showy Indian-paintbrush
CASSUL	CASSUL	Castilleja sulphurea	Sulphur Paintbrush
CENMAC	CENMAC	Centaurea maculosa	Spotted Knapweed
CERARV	CERARV	Cerastium arvense	Field Chickweed
CERBEE	CERBEE	Cerastium beeringianum	Alpine Chickweed
CERNUT	CERNUT	Cerastium nutans	Nodding Chickweed
CERVUL	CERVUL	Cerastium vulgatum	Common Chickweed
CHADOU	CHADOU	Chaenactis douglasii	Hoary Chaenactis
CHEALB	CHEALB	Chenopodium album	Lambsquarter
CHEFRE	CHEFRE	Chenopodium fremontii	Fremont's Goosefoot
CHEGLA	CHEGLA	Chenopodium glaucum	Oakleaf Goosefoot
CHERUB	CHERUB	Chenopodium rubrum	Red Goosefoot
CHITWE	CHITWE	Chionophila tweedyi	Chionophila
CICDOU	CICDOU	Cicuta douglasii	Douglas Water-hemlock
CIRARV	CIRARV	Cirsium arvense	Canada Thistle
CIRFLO	CIRFLO	Cirsium flodmanii	Flodman's Thistle
CIRFOL	CIRFOL	Cirsium foliosum	Leafy Thistle
CIRLON	CIRLON	Cirsium longistylum	Long-styled Thistle
CIRSCA	CIRSCA	Cirsium scariosum	Elk Thistle
CIRSUB	CIRSUB	Cirsium subniveum	Jackson's Hole Thistle
CIRUND	CIRUND	Cirsium undulatum	Wavy-leaved Thistle
CIRVUL	CIRVUL	Cirsium vulgare	Bull Thistle
CLALAN	CLALAN	Claytonia lanceolata	Western Springbeauty
CLECVC	CLEOVC	Clematis columbiana var. columbi	Columbia Clematis
CLEHIR	CLEHIR	Clematis hirsutissima	Vaseflower Clematis
COLPAR	COLPAR	Collinsia parviflora	Small-flowered Blue-eyed Mary
COLLIN	COLLIN	Collomia linearis	Narrow-leaf Collomia
COLTEN	COLTEN	Collomia tenella	Diffuse Collomia
COMUMB	COMUMB	Comandra umbellata	Bastard Toad-flax
CONMAC	CONMAC	Conium maculatum	Poison Hemlock
COPOCC	COPOCC	Coptis occidentalis	Western Goldthread
CORAUR	CORAUR	Corydalis aurea	Golden Corydalis
CREACU	CREACU	Crepis acuminata	Tapertip Hawksbeard
CREATR	CREATR	Crepis atribarba	Slender Hawksbeard

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
CREINT	CREINT	Crepis intermedia	Gray Hawksbeard
CREMOD	CREMOD	Crepis modocensis	Low Hawksbeard
CREOCC	CREOCC	Crepis occidentalis	Western Hawksbeard
CRERUN	CRERUN	Crepis runcinata	Meadow Hawksbeard
CRYAFF	CRYAFF	Cryptantha affinis	Slender Cryptantha
CRYAMB	CRYAMB	Cryptantha ambigua	Obscure Cryptantha
CRYCEL	CRYCEL	Cryptantha celosioides	Northern Cryptantha
CRYFEN	CRYFEN	Cryptantha fendleri	Fendler's Cryptantha
CRYHUM	CRYHUM	Cryptantha humilis	Small Cryptantha
CRYINT	CRYINT	Cryptantha interrupta	Bristly Cryptantha
CRYSPI	CRYINT	Cryptantha spiculifera	Bristly Cryptantha
CYMBIP	CYMBIP	Cymopterus bipinnatus	Hayden's Cymopterus
CYMGLA	CYMGLA	Cymopterus glaucus	Grayish Cymopterus
CYNOFF	CYNOFF	Cynoglossum officinale	Common Hound's-tongue
DELAND	DELAND	Delphinium andersonii	Anderson's Larkspur
DELBIC	DELBIC	Delphinium bicolor	Little Larkspur
DELDEP	DELDEP	Delphinium depauperatum	Slim Larkspur
DELGLU	DELGLA	Delphinium glaucescens	Pale Larkspur
DELGLA	DELGLA	Delphinium glaucum	Pale Larkspur
DELOCC	DELOCC	Delphinium occidentale	Western Larkspur
DESPIN	DESPIN	Descurainia pinnata	Pinnate Tansymustard
DESSOP	DESSOP	Descurainia sophia	Flixweed Tansymustard
DIADEL	DIADEL	Dianthus deltoides	Maiden Pink
DICUNI	DICUNI	Dicentra uniflora	Steer's Head
DISTRA	DISTRA	Disporum trachycarpum	Wartberry Fairy-bell
DODCON	DODCON	Dodecatheon conjugens	Slimpod Shooting Star
DODJEF	DODJEF	Dodecatheon jeffreyi	Tall Mountain Shooting Star
DODPUL	DODPUL	Dodecatheon pulchellum	Few-flowered Shooting Star
DOUMON	DOUMON	Douglasia montana	Rocky Mountain Douglasia
DRAAPI	DRAAPI	Draba apiculata	Pointed Draba
DRAAUR	DRAAUR	Draba aurea	Golden Draba
DRACAN	DRALAN	Draba cana	Lance Leaved Draba
DRACRA	DRACRA	Draba crassifolia	Thickleaved Draba
DRADEN	DRADEN	Draba densifolia	Nuttall's Draba
DRAINC	DRAINC	Draba incerta	Yellowstone Draba
DRALAN	DRALAN	Draba lanceolata	Lance Leaved Draba
DRALON	DRALON	Draba lonchocarpa	Lancefruit Draba
DRANEM	DRANEM	Draba nemorosa	Woods Draba
DRAOLI	DRAOLI	Draba oligosperma	Few-seeded Draba
DRASTE	DRASTE	Draba stenoloba	Slender Draba
ECHANG	ECHANG	Echinacea angustifolia	Pale Purple Coneflower
EPIALP	EPIALP	Epilobium alpinum	Alpine Willow-herb
EPIANG	EPIANG	Epilobium angustifolium	Fireweed
EPICIL	EPICIL	Epilobium ciliatum	Common Willow-herb
EPIGLA	EPIGLA	Epilobium glaberrimum	Smooth Willow-herb
EPIMIN	EPIMIN	Epilobium minutum	Small-flowered Willow-herb
EPIPAL	EPIPAL	Epilobium palustre	Swamp Willow-herb
ERIASP	ERIASP	Erigeron asperugineus	Rough Fleabane
ERICAE	ERICAE	Erigeron caespitosus	Tufted Fleabane

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ERICOM	ERICOM	Erigeron compositus	Cut-leaved Daisy
ERICOR	ERICOR	Erigeron corymbosus	Long-leaved Fleabane
ERIDIV	ERIDIV	Erigeron divergens	Spreading Fleabane
ERIGLA	ERIGLA	Erigeron glabellus	Smooth Daisy
ERIGRA	ERIGRA	Erigeron gracilis	Slender Fleabane
ERIHUM	ERIHUM	Erigeron humilis	Arctic-alpine Daisy
ERIOCH	ERIOCH	Erigeron ochroleucus	Buff Fleabane
ERIPER	ERIPER	Erigeron peregrinus	Subalpine Daisy
ERIPHI	ERIPHI	Erigeron philadelphicus	Philadelphia Fleabane
ERIPUM	ERIPUM	Erigeron pumilus	Shaggy Fleabane
ERIRAD	ERIRAD	Erigeron radicatus	Taprooted Fleabane
ERIRYD	ERIRYD	Erigeron rydbergii	Rydberg's Daisy
ERISIM	ERISIM	Erigeron simplex	Alpine Daisy
ERISPE	ERISPE	Erigeron speciosus	Showy Fleabane
ERISTR	ERISTR	Erigeron strigosus	Branching Daisy
ERISUB	ERISUB	Erigeron subtrinervis	Three-veined Fleabane
ERITWE	ERITWE	Erigeron tweedyi	Tweedy's Daisy
ERIURS	ERIURS	Erigeron ursinus	Bear River Fleabane
ERICAS	ERICAS	Eriogonum caespitosum	Mat Buckwheat
ERICER	ERICER	Eriogonum cernuum	Nodding Wild Buckwheat
ERIFLA	ERIFLA	Eriogonum flavum	Yellow Buckwheat
ERIHER	ERIHER	Eriogonum heracleoides	Wyeth Buckwheat
ERIMAN	ERIMAN	Eriogonum mancum	Imperfect Buckwheat
ERIOVA	ERIOVA	Eriogonum ovalifolium	Cushion Buckwheat
ERIOVE	ERIOVE	Eriogonum ovalifolium var. nevac	Yellow Cushion Buckwheat
ERIUMB	ERIUMB	Eriogonum umbellatum	Sulfur Buckwheat
ERILAN	ERILAN	Eriophyllum lanatum	Common Eriophyllum
ERINAN	ERINAN	Eritrichium nanum	Pale Alpine Forget-me-not
EROCIC	EROCIC	Erodium cicutarium	Stork's-bill
ERYASP	ERYASP	Erysimum asperum	Plains Wallflower
ERYCAP	ERYASP	Erysimum capitatum	Western Wallflower
ERYCHE	ERYCHE	Erysimum cheiranthoides	Wormseed Wallflower
ERYINC	ERYINC	Erysimum inconspicuum	Smallflowered Wallflower
ERYGRA	ERYGRA	Erythronium grandiflorum	Glacier-lily
ESCVIV	CORVIV	Escobaria vivipara	Spinystar
EUPESU	EUPESU	Euphorbia esula	Leafy Spurge
FRAVES	FRAVES	Fragaria vesca	Woods Strawberry
FRAVIR	FRAVIR	Fragaria virginiana	Virginia Strawberry
FRAALB	FRAALB	Frasera albicaulis	White-stemmed Frasera
FRASPE	FRASPE	Frasera speciosa	Giant Frasera
FRIATR	FRIATR	Fritillaria atropurpurea	Checker Lily
FRIPUD	FRIPUD	Fritillaria pudica	Yellow Bell
GAIARI	GAIARI	Gaillardia aristata	Blanket-flower
GALAPA	GALAPA	Galium aparine	Goose-grass
GALBIF	GALBIF	Galium bifolium	Thinleaf Bedstraw
GALBOR	GALBOR	Galium boreale	Northern Bedstraw
GALTRF	GALTRF	Galium trifidum	Small Bedstraw
GALTRI	GALTRI	Galium triflorum	Sweetscented Bedstraw
GAUCOC	GAUCOC	Gaura coccinea	Scarlet Gaura

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
GAYDEC	GAYDEC	Gayophytum decipiens	Deceptive Groundsmoke
GAYDIF	GAYDIF	Gayophytum diffusum	Spreading Groundsmoke
GAYRAC	GAYRAC	Gayophytum racemosum	Racemed Groundsmoke
GENAFF	GENAFF	Gentiana affinis	Pleated Gentian
GENALG	GENALG	Gentiana algida	Siberia Gentian
GENAQU	GENAQU	Gentiana aquatica	Wet Meadow Gentian
GENCAL	GENCAL	Gentiana calycosa	Explorer's Gentian
GENAMA	GENAMA	Gentianella amarella	Northern Gentian
GENPRO	GENPRO	Gentianella propinqua	Four-parted Gentian
GERRIC	GERRIC	Geranium richardsonii	White Geranium
GERVIS	GERVIS	Geranium viscosissimum	Sticky Geranium
GEUALE	GEUALE	Geum aleppicum	Yellow Avens
GEUMAC	GEUMAC	Geum macrophyllum	Large-leaved Avens
GEUROS	GEUROS	Geum rossii	Ross's Avens
GEUTRI	GEUTRI	Geum triflorum	Prairie Smoke
GLAMAR	GLAMAR	Glaux maritima	Sea-milkwort
GLEHED	GLEHED	Glecoma hederacea	Ground Ivy
GLYLEP	GLYLEP	Glycyrrhiza lepidota	American Licorice
GNAVIS	GNAVIS	Gnaphalium viscosum	Sticky Cudweed
GOOOBL	GOOOBL	Goodyera oblongifolia	Western Rattlesnake-plantain
GRISQU	GRISQU	Grindelia squarrosa	Curlycup Gumweed
HACDEF	HACDEF	Hackelia deflexa	Nodding Stickseed
HACFLO	HACFLO	Hackelia floribunda	Showy Stickseed
HACMIC	HACMIC	Hackelia micrantha	Blue Stickseed
HACPAT	HACPAT	Hackelia patens	Spreading Stickseed
HAPACA	HAPACA	Haplopappus acaulis	Cushion Goldenweed
HEDBOR	HEDBOR	Hedysarum boreale	Northern Hedysarum
HEDSUL	HEDSUL	Hedysarum sulphurescens	Yellow Hedysarum
HELQUI	HELQUI	Helianthella quinquenervis	Nodding Helianthella
HELUNI	HELUNI	Helianthella uniflora	One-flowered Helianthella
HELNUT	HELNUT	Helianthus nuttallii	Nuttall's Sunflower
HERSPH	HERLAN	Heracleum sphondylium	Eltrot
HETVIL	CHRVIL	Heterotheca villosa	Hairy Golden-aster
HETVIL	CHRVIL	Heterotheca villosa	Hairy Golden-aster
HEUCYL	HEUCYL	Heuchera cylindrica	Roundleaf Alumroot
HEUGRO	HEUGRO	Heuchera grossulariifolia	Gooseberry-leaved Alumroot
HEUPAR	HEUPAR	Heuchera parvifolia	Small-leaved Alumroot
HIEALB	HIEALB	Hieracium albiflorum	White-flowered Hawkweed
HIECYN	HIECYN	Hieracium cynoglossoides	Houndstongue Hawkweed
HIEGRA	HIEGRA	Hieracium gracile	Alpine Hawkweed
HIPVUL	HIPVUL	Hippuris vulgaris	Common Mare's-tail
HYDCAP	HYDCAP	Hydrophyllum capitatum	Ballhead Waterleaf
HYMFIL	HYMFIL	Hymenopappus filifolius	Columbia Cut-leaf
IPOCON	IPOCON	Ipomopsis congesta	Ballhead Gilia
IPOSPI	IPOSPI	Ipomopsis spicata	Spicate Gilia
IRIMIS	IRIMIS	Iris missouriensis	Rocky Mountain Iris
IVAAXI	IVAAXI	Iva axillaris	Poverty-weed
IVEGOR	IVEGOR	Ivesia gordonii	Gordon's Ivesia
LACSER	LACSER	Lactuca serriola	Prickly Lettuce

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
LAPECH	LAPECH	Lappula echinata	Bristly Stickseed
LAPRED	LAPRED	Lappula redowskii	Western Stickseed
LEPCAM	LEPCAM	Lepidium campestre	Field Pepperweed
LEPDEN	LEPDEN	Lepidium densiflorum	Prairie Pepperweed
LEPPER	LEPPER	Lepidium perfoliatum	Clasping Pepperweed
LEPRAM	LEPRAM	Lepidium ramosissimum	Branched Pepperweed
LEPVIR	LEPVIR	Lepidium virginicum	Tall Pepperweed
LEPPYR	LEPPYR	Leptarrhena pyrolifolia	False Saxifrage
LESALP	LESALP	Lesquerella alpina	Alpine Bladderpod
LESCAR	LESCAR	Lesquerella carinata	Keeled Bladderpod
LESLUD	LESLUD	Lesquerella ludoviciana	Silvery Bladderpod
LESPAY	LESPAY	Lesquerella paysonii	Payson Bladderpod
LEWPYG	LEWPYG	Lewisia pygmaea	Dwarf Lewisia
LEWRED	LEWRED	Lewisia rediviva	Bitterroot
LIAPUN	LIAPUN	Liatris punctata	Dotted Blazing-star
LIGCAN	LIGCAN	Ligusticum canbyi	Canby's Licorice-root
LIGFIL	LIGFIL	Ligusticum filicinum	Fearn-leaf Lovage
LIGTEN	LIGTEN	Ligusticum tenuifolium	Slender-leafed Licorice-root
LINSEP	LINSEP	Linanthus septentrionalis	Northern Linanthus
LINVUL	LINVUL	Linaria vulgaris	Butter-and-eggs
LINLEW	LINPER	Linum lewisii	Wild Blue Flax
LINPER	LINPER	Linum perenne	Blue Flax
LINUSI	LINUSI	Linum usitatissimum	Cultivated Flax
LISCOR	LISCOR	Listera cordata	Heart-leaf Twayblade
LITGLA	LITGLA	Lithophragma glabrum	Smooth Woodlandstar
LITPAR	LITPAR	Lithophragma parviflorum	Smallflower Woodlandstar
LITTEN	LITTEN	Lithophragma tenellum	Slender Woodlandstar
LITINC	LITINC	Lithospermum incisum	Yellow Gromwell
LITRUD	LITRUD	Lithospermum ruderale	Western Gromwell
LLOSER	LLOSER	Lloydia serotina	Alpine Lily
LOMAMB	LOMAMB	Lomatium ambiguum	Swale Desert-parsley
LOMATT	LOMATT	Lomatium attenuatum	Tapertip Desertparsley
LOMCOU	LOMCOU	Lomatium cous	Cous Biscuit-root
LOMCUS	LOMCUS	Lomatium cusickii	Cusick's Desert-parsley
LOMDIS	LOMDIS	Lomatium dissectum	Fern-leaved Desert-parsley
LOMFOE	LOMFOE	Lomatium foeniculaceum	Fennel-leaved Desert-parsley
LOMMAC	LOMMAC	Lomatium macrocarpum	Bigseed Desert-parsley
LOMTRI	LOMTRI	Lomatium triternatum	Nine-leaf Lomatium
LOMROT	LOMROT	Lomatogonium rotatum	Felwort
LUPARB	LUPLVL	Lupinus arbustus	Spurred Lupine
LUPARG	LUPARG	Lupinus argenteus	Silvery Lupine
LUPLEP	LUPLEP	Lupinus lepidus	Prairie Lupine
LUPLEU	LUPLEU	Lupinus leucophyllus	Velvet Lupine
LUPSER	LUPSER	Lupinus sericeus	Silky Lupine
LUPWYE	LUPWYE	Lupinus wyethii	Wyeth's Lupine
LYGJUN	LYGJUN	Lygodesmia juncea	Rush-like Skeletonweed
MACCAN	MACCAN	Machaeranthera canescens	Hoary Aster
MAIRAC	SMIRAC	Maianthemum racemosum	False Spikenard
MAISTE	SMISTE	Maianthemum stellatum	Starry Solomon-plume

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
MEDLUP	MEDLUP	Medicago lupulina	Black Medic
MEDSAT	MEDSAT	Medicago sativa	Alfalfa
MELLIN	MELLIN	Melampyrum lineare	Narrow-leaved Cow-wheat
MELALB	MELALB	Melilotus alba	White Sweet-clover
MELOFF	MELOFF	Melilotus officinalis	Yellow Sweet-clover
MENARV	MENARV	Mentha arvensis	Field Mint
MENALB	MENALB	Mentzelia albicaulis	White-stemmed Mentzelia
MENDEC	MENDEC	Mentzelia decapetala	Evening Star
MENDIS	MENDIS	Mentzelia dispersa	Bushy Mentzelia
MENLAE	MENLAE	Mentzelia laevicaulis	Blazing-star Mentzelia
MERALP	MERALP	Mertensia alpina	Alpine Bluebells
MERCIL	MERCIL	Mertensia ciliata	Mountain Bluebells
MERLAN	MERLAN	Mertensia lanceolata	Lanceleaf Bluebells
MERLON	MERLON	Mertensia longiflora	Small Bluebells
MEROBL	MEROBL	Mertensia oblongifolia	Oblongleaf Bluebells
MERPAN	MERPAN	Mertensia paniculata	Panicle Bluebells
MERVIR	MERPER	Mertensia viridis	Obscure Bluebells
MICNUT	MICNUT	Microseris nutans	Nodding Microseris
MIMDEN	MIMDEN	Mimulus dentatus	Tooth-leaved Monkey-flower
MIMGLA	MIMGLA	Mimulus glabratus	Glaberous Monkey-flower
MIMGUT	MIMGUT	Mimulus guttatus	Common Monkey-flower
MIMLEW	MIMLEW	Mimulus lewisii	Lewis' Monkey-flower
MIMPRI	MIMPRI	Mimulus primuloides	Primrose Monkey-flower
MITBRE	MITBRE	Mitella breweri	Brewer's Mitrewort
MITCAU	MITCAU	Mitella caulescens	Leafy Mitrewort
MITPEN	MITPEN	Mitella pentandra	Five-stamened Mitrewort
MITSTA	MITSTA	Mitella stauropetala	Side-flowered Mitrewort
MOELAT	MOELAT	Moehringia lateriflora	Bluntleaf Sandwort
MONFIS	MONFIS	Monarda fistulosa	Horsemint
MONCHA	MONCHA	Montia chamissoi	Water Montia
MUSDIV	MUSDIV	Musineon divaricatum	Leafy Musineon
MYOALP	MYOASI	Myosotis alpestris	Wood Forget-me-not
MYOSYL	MYOSYL	Myosotis sylvatica	Wood Forget-me-not
MYRSPI	MYRSPI	Myriophyllum spicatum	Spiked Water-milfoil
NEMBRE	NEMBRE	Nemophila breviflora	Great Basin Nemophila
OENCES	OENCAE	Oenothera cespitosa	Desert Evening-primrose
OENFLA	OENFLA	Oenothera flava	Long-tubed Evening-primrose
ONOMOL	ONOMOL	Onosmodium molle	False Gromwell
OPUFRA	OPUFRA	Opuntia fragilis	Brittle Prickly-pear
OPUPOL	OPUPOL	Opuntia polyacantha	Plains Prickly-pear
OROCOR	OROCOR	Orobanche corymbosa	Flat-topped Broomrape
OROFAS	OROFAS	Orobanche fasciculata	Clustered Broomrape
OROLUD	OROLUD	Orobanche ludoviciana	Suksdorf's Broomrape
OROUNI	OROUNI	Orobanche uniflora	Naked Broomrape
ORTSEC	PYRSEC	Orthilia secunda	One-sided Wintergreen
ORTSEC	PYRSEC	Orthilia secunda	One-sided Wintergreen
ORTLUT	ORTLUT	Orthocarpus luteus	Yellow Owl-clover
ORTTEN	ORTTEN	Orthocarpus tenuifolius	Thin-leaved Owl-clover
OSMBER	OSMCHI	Osmorhiza berteroi	Sweetcicely

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
OSMDEP	OSMDEP	Osmorhiza depauperata	Blunt-fruit Sweet-cicely
OSMOCC	OSMOCC	Osmorhiza occidentalis	Western Sweet-cicely
OXYDIG	OXYDIG	Oxyria digyna	Mountain Sorrel
OXYCAM	OXYCAM	Oxytropis campestris	Slender Crazyweed
OXYDEF	OXYDEF	Oxytropis deflexa	Pendent-pod Crazyweed
OXYLAG	OXYLAG	Oxytropis lagopus	Rabbit-foot Crazyweed
OXYRIP	OXYRIP	Oxytropis riparia	Riparian Crazyweed
OXYSER	OXYSER	Oxytropis sericea	Silky Crazyweed; White Locoweed
OXYVIS	OXYVIS	Oxytropis viscida	Sticky Crazyweed
PARPEN	PARPEN	Parietaria pensylvanica	Pennsylvania Pellitory
PARFIM	PARFIM	Parnassia fimbriata	Fringed Grass-of-parnassus
PARPAL	PARPAL	Parnassia palustris	Northern Grass-of-parnassus
PARPAR	PARPAR	Parnassia parviflora	Small-flowered Grass-of-parnassus
PARSES	PARSES	Paronychia sessiliflora	Stemless Whitlow-wort
PEDBRA	PEDBRA	Pedicularis bracteosa	Bracted Lousewort
PEDCON	PEDCON	Pedicularis contorta	Coiled-beak Lousewort
PEDCYS	PEDCYS	Pedicularis cystopteridifolia	Fern-leaved Lousewort
PEDGRO	PEDGRO	Pedicularis groenlandica	Elephant's Head
PEDPAR	PEDPAR	Pedicularis parryi	Parry's Lousewort
PEDPUL	PEDPUL	Pedicularis pulchella	Pretty-dwarf Lousewort
PEDRAC	PEDRAC	Pedicularis racemosa	Sickletop Lousewort
PEDSIM	PEDSIM	Pediocactus simpsonii	Simpson's Hedgehog Cactus
PENALE	PENALE	Penstemon albertinus	Alberta Penstemon
PENARI	PENARI	Penstemon aridus	Stiff-leaf Penstemon
PENATT	PENATT	Penstemon attenuatus	Sulphur Penstemon
PENCON	PENCON	Penstemon confertus	Yellow Penstemon
PENDIP	PENDIP	Penstemon diphyllus	Diphyllus Penstemon
PENELL	PENELL	Penstemon ellipticus	Elliptic-leaved Beardtongue
PENERI	PENERI	Penstemon eriantherus	Fuzzytongue Penstemon
PENMON	PENMON	Penstemon montanus	Mountain Beardtongue
PENPRO	PENPRO	Penstemon procerus	Small-flowered Penstemon
PENRAD	PENRAD	Penstemon radicosus	Mat-root Penstemon
PENRYD	PENRYD	Penstemon rydbergii	Rydberg's Penstemon
PENWHI	PENWHI	Penstemon whippleanus	Whipple's Penstemon
PENWIL	PENWIL	Penstemon wilcoxii	Wilcox's Penstemon
PERGAI	PERGAI	Perideridia gairdneri	Gairdner's Yampah
PHAFRA	PHAFRA	Phacelia franklinii	Franklin's Phacelia
PHAGLA	PHAGLA	Phacelia glandulosa	Glandular Phacelia
PHAHAS	PHAHAS	Phacelia hastata	Silverleaf Phacelia
PHAHET	PHAHET	Phacelia heterophylla	Varileaf Phacelia
PHAINC	PHAINC	Phacelia incana	Hoary Phacelia
PHALIN	PHALIN	Phacelia linearis	Threadleaf Phacelia
PHASER	PHASER	Phacelia sericea	Silky Phacelia
PHLALB	PHLALB	Phlox albomarginata	White-margined Phlox
PHLALY	PHLALY	Phlox alyssifolia	Alyssum-leaved Phlox
PHLBRY	PHLBRY	Phlox bryoides	Moss Phlox
PHLCAE	PHLCAE	Phlox caespitosa	Tufted Phlox
PHLHOO	PHLHOO	Phlox hoodii	Hood's Phlox
PHLKEL	PHLKEL	Phlox kelseyi	Kelsey's Phlox

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
PHLLON	PHLLON	Phlox longifolia	Long-leaf Phlox
PHLMUL	PHLMUL	Phlox multiflora	Many-flowered Phlox
PHLPUL	PHLCAE	Phlox pulvinata	Cushion Phlox
PHYDID	PHYDID	Physaria didymocarpa	Common Twinpod
PHYGEY	PHYGEY	Physaria geyeri	Geyer's Twinpod
PLAERI	PLAERI	Plantago eriopoda	Saline Plantain
PLAMAJ	PLAMAJ	Plantago major	Common Plantain
PLAPAT	PLAPAT	Plantago patagonica	Indian-wheat
PLATWE	PLATWE	Plantago tweedyi	Tweedy's Plantain
POLOCC	POLOCC	Polemonium occidentale	Western Polemonium
POLPUL	POLPUL	Polemonium pulcherrimum	Skunk-leaved Polemonium
POLVIS	POLVIS	Polemonium viscosum	Sticky Polemonium
POLAMP	POLAMP	Polygonum amphibium	Water Smartweed
POLAVI	POLAVI	Polygonum aviculare	Prostrate Knotweed
POLBIS	POLBIS	Polygonum bistortoides	American Bistort
POLDOU	POLDOU	Polygonum douglasii	Douglas' Knotweed
POLRAM	POLRAM	Polygonum ramosissimum	Bushy Knotweed
POLVIV	POLVIV	Polygonum viviparum	Alpine Bistort
POTFRI	POTFRI	Potamogeton friesii	Flat-stalked Pondweed
POTGRM	POTGRM	Potamogeton gramineus	Grass-leaved Pondweed
POTPEC	POTPEC	Potamogeton pectinatus	Fennel-leafed Pondweed
POTARG	POTARG	Potentilla arguta	Tall Cinquefoil
POTCON	POTCON	Potentilla concinna	Early Cinquefoil
POTDIV	POTDIV	Potentilla diversifolia	Diverse-leaved Cinquefoil
POTFLA	POTFLA	Potentilla flabellifolia	Fan-leaf Cinquefoil
POTGLA	POTGLA	Potentilla glandulosa	Sticky Cinquefoil
POTGRA	POTGRA	Potentilla gracilis	Slender Cinquefoil
POTHIP	POTHIP	Potentilla hippiana	Woolly Cinquefoil
POTNIV	POTNIV	Potentilla nivea	Snow Cinquefoil
POTOVI	POTOVI	Potentilla ovina	Sheep Cinquefoil
POTPEN	POTPEN	Potentilla pensylvanica	Prairie Cinquefoil
POTRIV	POTRIV	Potentilla rivalis	Brook Cinquefoil
PRIINC	PRIINC	Primula incana	Mealy Primrose
PRUVUL	PRUVUL	Prunella vulgaris	Self-heal
PSOTEU	PSOTEN	Psoralidium tenuiflorum	Slender-flowered Scurf-pea
PTEAND	PTEAND	Pterospora andromedea	Woodland Pinedrops
PYRASA	PYRASA	Pyrola asarifolia	Pink Wintergreen
PYRCHL	PYRCHL	Pyrola chlorantha	Green Wintergreen
PYRMIN	PYRMIN	Pyrola minor	Snowline Pyrola
PYRPIC	PYRPIC	Pyrola picta	White-vein Pyrola
RANACR	RANACR	Ranunculus acris	Tall Buttercup
RANALI	RANALI	Ranunculus alismifolius	Water-plantain Buttercup
RANAQU	RANAQU	Ranunculus aquatilis	White Water-buttercup
RANCYM	RANCYM	Ranunculus cymbalaria	Shore Buttercup
RANESC	RANESC	Ranunculus eschscholtzii	Subalpine Buttercup
RANFLA	RANFLA	Ranunculus flammula	Creeping Buttercup
RANGLA	RANGLA	Ranunculus glaberrimus	Sagebrush Buttercup
RANINA	RANINA	Ranunculus inamoenus	Unlovely Buttercup
RANJOV	RANJOV	Ranunculus jovis	Jove's Buttercup

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
RANNAT	RANNAT	Ranunculus natans	Floating Water-buttercup
RANPYG	RANPYG	Ranunculus pygmaeus	Dwarf Buttercup
RANSCE	RANSCE	Ranunculus sceleratus	Blister Buttercup
RANUNI	RANUNI	Ranunculus uncinatus	Little Buttercup
RORISL	RORPAL	Rorippa islandica	Marsh Yellowcress
RORNAS	NASOFF	Rorippa nasturtium-aquaticum	Water-cress
RUDHIR	RUDHIR	Rudbeckia hirta	Black-eyed Susan
RUDOCC	RUDOCC	Rudbeckia occidentalis	Black Head
RUMACE	RUMACE	Rumex acetosella	Sheep Sorrel
RUMCRI	RUMCRI	Rumex crispus	Curly Dock
RUMMAR	RUMMAR	Rumex maritimus	Golden Dock
RUMPAU	RUMPAU	Rumex paucifolius	Mountain Sorrel
RUMSAL	RUMSAL	Rumex salicifolius	Willow Dock
SALKAL	SALIBE	Salsola kali	Russian Thistle
SAUWEB	SAUWEB	Saussurea weberi	Weber's Sawwort
SAXARG	SAXARG	Saxifraga arguta	Brook Saxifrage
SAXBRO	SAXBRO	Saxifraga bronchialis	Spotted Saxifrage
SAXCES	SAXCES	Saxifraga cespitosa	Tufted Saxifrage
SAXFLA	SAXFLA	Saxifraga flagellaris	Stoloniferous Saxifrage
SAXLYA	SAXLYA	Saxifraga lyallii	Red-stemed Saxifrage
SAXOCC	SAXOCC	Saxifraga occidentalis	Western Saxifrage
SAXODO	SAXARG	Saxifraga odontoloma	Brook Saxifrage
SAXOPP	SAXOPP	Saxifraga oppositifolia	Purple Saxifrage
SAXORE	SAXORE	Saxifraga oregana	Oregon Saxifrage
SAXRHO	SAXRHO	Saxifraga rhomboidea	Diamondleaf Saxifrage
SAXTEM	SAXTEM	Saxifraga tempestiva	Storm Saxifrage
SCHLIN	SCHLIN	Schoenocrambe linifolia	Flaxleaf Plainsmustard
SCUGAL	SCUGAL	Scutellaria galericulata	Marsh Skullcap
SEDBOR	SEDLEI	Sedum borschii	Leiberg's Stonecrop
SEDLAN	SEDLAN	Sedum lanceolatum	Lance-leaved Stonecrop
SEDSTE	SEDSTE	Sedum stenopetalum	Wormleaf Stonecrop
SENCAN	SENCAN	Senecio canus	Woolly Groundsel
SENCRA	SENCRA	Senecio crassulus	Thick-leaved Groundsel
SENCYM	SENCYM	Senecio cymbalarioides	Few-leaved Groundsel
SENDEB	SENDEB	Senecio debilis	Weak Butterweed
SENDIM	SENDIM	Senecio dimorphophyllus	Payson's Groundsel
SENFRE	SENFRE	Senecio fremontii	Dwarf Mountain Butterweed
SENHYR	SENFVH	Senecio hydrophiloides	Sweet-marsh Butterweed
SENHYD	SENHYD	Senecio hydrophilus	Alkali-marsh Butterweed
SENINT	SENINT	Senecio integerrimus	Western Groundsel
SENPAU	SENPAU	Senecio pauciflorus	Rayless Alpine Butterweed
SENPSE	SENPSE	Senecio pseudaureus	Streambank Groundsel
SENSER	SENSER	Senecio serra	Tall Butterweed
SENSPH	SENSPH	Senecio sphaerocephalus	Mountain-marsh Butterweed
SENSTR	SENSTR	Senecio streptanthifolius	Rocky Mountain Butterweed
SENTRI	SENTRI	Senecio triangularis	Arrowleaf Groundsel
SIBPRO	SIBPRO	Sibbaldia procumbens	Creeping Sibbaldia
SILACA	SILACA	Silene acaulis	Moss Campion
SILDOU	SILDOU	Silene douglasii	Douglas' Silene

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
SILMEN	SILMEN	Silene menziesii	Menzies' Silene
SILORE	SILORE	Silene oregana	Oregon Silene
SILPAR	SILPAR	Silene parryi	Parry's Silene
SILREP	SILREP	Silene repens	Creeping Silene
SILSCO	SILSCO	Silene scouleri	Scouler's Silene
SISLOE	SISLOE	Sisymbrium loeselii	Loeselii Tumblemustard
SISOFF	SISOFF	Sisymbrium officinale	Hedge Mustard
SISANG	SISIDA	Sisyrinchium angustifolium	Blue-eyed Grass
SISMON	SISMON	Sisyrinchium montanum	Mountain Blue-eyed Grass
SIUSUA	SIUSUA	Sium suave	Hemlock Water-parsnip
SMECAL	SMECAL	Smelowskia calycina	Alpine Smelowskia
SOLCAN	SOLCAN	Solidago canadensis	Canada Goldenrod
SOLGIG	SOLGIG	Solidago gigantea	Late Goldenrod
SOLMIS	SOLMIS	Solidago missouriensis	Missouri Goldenrod
SOLMUL	SOLMUL	Solidago multiradiata	Northern Goldenrod
SOLNAN	SOLNAN	Solidago nana	Low Goldenrod
SOLNEM	SOLNEM	Solidago nemoralis	Gray Goldenrod
SOLRIG	SOLRIG	Solidago rigida	Stiff Goldenrod
SOLSPA	SOLSPA	Solidago spathulata	Dune Goldenrod
SONASP	SONASP	Sonchus asper	Prickly Sow-thistle
SONULI	SONASU	Sonchus uliginosus	Marsh Sow-thistle
SPEARV	SPEARV	Spergula arvensis	Cornspurry
SPHCOC	SPHCOC	Sphaeralcea coccinea	Red Globe-mallow
SPIROM	SPIROM	Spiranthes romanzoffiana	Hooded Ladies-tresses
STAVIR	STAVIR	Stanleya viridiflora	Perennial Stanleya
STEAME	STEAME	Stellaria americana	American Starwort
STECAL	STECAL	Stellaria calycantha	Northern Starwort
STELON	STELON	Stellaria longipes	Longstalk Starwort
STEUMB	STEUMB	Stellaria umbellata	Umbellate Starwort
STERUN	STERUN	Stephanomeria runcinata	Runcinate-leaved Skeltonweed
STESPI	LYGSPI	Stephanomeria spinosa	Spiny Skeletonweed
STRAMP	STRAMP	Streptopus amplexifolius	Clasping-leaved Twisted-stalk
SUADEP	SUADEP	Suaeda depressa	Pahute Weed
SWEPER	SWEPER	Swertia perennis	Swertia
SYMOFF	SYMOFF	Symphytum officinale	Common Comfrey
SYNPIN	SYNPIN	Synthyris pinnatifida	Featherleaf Kittentails
TARERI	TARERI	Taraxacum eriophorum	Rocky Mountain Dandelion
TARLAE	TARLAE	Taraxacum laevigatum	Red-seeded Dandelion
TARLYR	TARLYR	Taraxacum lyratum	Dwarf Alpine Dandelion
TAROFF	TAROFF	Taraxacum officinale	Common Dandelion
THAALP	THAALP	Thalictrum alpinum	Alpine Meadowrue
THAFEN	THAFEN	Thalictrum fendleri	Fendler's Meadowrue
THAOCC	THAOCC	Thalictrum occidentale	Western Meadowrue
THAVEN	THAVEN	Thalictrum venulosum	Veiny Meadowrue
THEINT	THEINT	Thelypodium integrifolium	Entire-leaved Thelypody
THEPAN	THEPAN	Thelypodium paniculatum	Northwestern Thelypody
THESAG	THESAG	Thelypodium sagittatum	Slender Thelypody
THEMON	THEMON	Thermopsis montana	Mountain Thermopsis
THLARV	THLARV	Thlaspi arvense	Field Pennycress

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
THLMON	THLFEN	Thlaspi montanum	Fendler's Pennycress
THLPAR	THLPAR	Thlaspi parviflorum	Small-flowered Pennycress
TOFGLU	TOFGLU	Tofieldia glutinosa	Sticky Tofieldia
TOWCON	TOWCON	Townsendia condensata	Cushion Townsendia
TOWHOO	TOWHOO	Townsendia hookeri	Hooker's Townsendia
TOWPAR	TOWPAR	Townsendia parryi	Parry's Townsendia
TRADUB	TRADUB	Tragopogon dubius	Goat's Beard
TRAMIS	TRAMIS	Tragopogon miscellus	Hybrid Salsify
TRAPRA	TRAPRA	Tragopogon pratensis	Jack-go-to-bed-at-noon
TRITER	TRITER	Tribulus terrestris	Puncture-vine
TRIHAY	TRIHAY	Trifolium haydenii	Hayden's Clover
TRILON	TRILON	Trifolium longipes	Long-stalked Clover
TRINAN	TRINAN	Trifolium nanum	Dwarf Clover
TRIPAR	TRIPAR	Trifolium parryi	Parry's Clover
TRIPRA	TRIPRA	Trifolium pratense	Red Clover
TRIREP	TRIREP	Trifolium repens	White Clover
TRIMAR	TRIMAR	Triglochin maritimum	Seaside Arrow-grass
TRIPAL	TRIPAL	Triglochin palustre	Marsh Arrow-grass
TRIOVA	TRIOVA	Trillium ovatum	White Trillium
TROLAX	TROLAX	Trollius laxus	American Globeflower
TYPLAT	TYPLAT	Typha latifolia	Common Cattail
URTDIO	URTDIO	Urtica dioica	Stinging Nettle
UTRVUL	UTRVUL	Utricularia vulgaris	Common Bladderwort
VALACU	VALACU	Valeriana acutiloba	Downy-fruit Valerian
VALDIO	VALDIO	Valeriana dioica	Northern Valerian
VALEDU	VALEDU	Valeriana edulis	Edible Valerian
VALOCC	VALOCC	Valeriana occidentalis	Western Valerian
VALSIT	VALSIT	Valeriana sitchensis	Sitka Valerian
VERVIR	VERVIR	Veratrum viride	Green False Hellebore
VERTHA	VERTHA	Verbascum thapsus	Common Mullein
VERAME	VERAME	Veronica americana	American Speedwell
VERBIL	VERBIL	Veronica biloba	Bilobed Speedwell
VERCUS	VERCUS	Veronica cusickii	Cusick's Speedwell
VERSCU	VERSCU	Veronica scutellata	Marsh Speedwell
VERSER	VERSER	Veronica serpyllifolia	Thyme-leaved Speedwell
VERVER	VERVER	Veronica verna	Spring Speedwell
VERWOR	VERWOR	Veronica wormskjoldii	Wormskjold Speedwell
VICAME	VICAME	Vicia americana	American Vetch
VIOADU	VIOADU	Viola adunca	Hook Violet
VIOCAN	VIOCAN	Viola canadensis	Canada Violet
VIOGLA	VIOGLA	Viola glabella	Pioneer Violet
VIOMAC	VIOMAC	Viola macloskeyi	Small White Violet
VIONEP	VIONEP	Viola nephrophylla	Northern Bog Violet
VIONUT	VIONUT	Viola nuttallii	Yellow Prairie Violet
VIOORB	VIOORB	Viola orbiculata	Round-leaved Violet
VIOPAL	VIOPAL	Viola palustris	Marsh Violet
VIOVAL	VIONVV	Viola vallicola	Valley Yellow Violet
WYEAMP	WYEAMP	Wyethia amplexicaulis	Northern Mule's-ears
WYEHEL	WYEHEL	Wyethia helianthoides	White-head Mule's-ears

Appendix A. Flora of the Beaverhead Mountains Section

Forbs

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
XANSTR	XANSTR	Xanthium strumarium	Common Cockleburr
XERTEN	XERTEN	Xerophyllum tenax	Beargrass
ZIGELE	ZIGELE	Zigadenus elegans	Glaucous Zigadenus
ZIGPAN	ZIGPAN	Zigadenus paniculatus	Panicled Death-camas
ZIGVEN	ZIGVEN	Zigadenus venenosus	Meadow Death-camas
ZIZAPT	ZIZAPT	Zizia aptera	Heart-leaved Alexanders
ZYGFAB	ZYGFAB	Zygophyllum fabago	Syrian Bean-caper

Appendix A. Flora of the Beaverhead Mountains Section

Graminoids

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
AGRINT	ELYINE	Agropyron intermedium	Intermediate Wheatgrass
AGRREP	ELYREE	Agropyron repens	Quackgrass
AGRALB	AGRSTO	Agrostis alba	Redtop
AGRDIE	AGRDIE	Agrostis diegoensis	Thin Bentgrass
AGREXA	AGREXA	Agrostis exarata	Spike Bentgrass
AGRHUM	AGRHUM	Agrostis humilis	Alpine Bentgrass
AGRIDA	AGRIDA	Agrostis idahoensis	Idaho Bentgrass
AGRSCA	AGRSCA	Agrostis scabra	Tickle-grass
AGRSTO	AGRSTO	Agrostis stolonifera	Redtop
AGRTHU	AGRTHU	Agrostis thurberiana	Thurber Bentgrass
AGRVAR	AGRVAR	Agrostis variabilis	Variant Bentgrass
ALOAEQ	ALOAEQ	Alopecurus aequalis	Short-awn Foxtail
ALOALP	ALOALP	Alopecurus alpinus	Alpine Foxtail
ALOGEN	ALOGEN	Alopecurus geniculatus	Water Foxtail
ALOPRA	ALOPRA	Alopecurus pratensis	Meadow Foxtail
ARILON	ARILON	Aristida longiseta	Red Threeawn
BOUGRA	BOUGRA	Bouteloua gracilis	Blue Grama
BROANO	BROANO	Bromus anomalus	Nodding Brome
BROCAR	BROCAR	Bromus carinatus	Mountain Brome
BROCIL	BROCIL	Bromus ciliatus	Fringed Brome
BROINE	BROINE	Bromus inermis	Smooth Brome
BROISP	BROISP	Bromus inermis ssp. pumpellianus	Pumpelly Brome
BROJAP	BROJAP	Bromus japonicus	Japanese Brome
BROMAR	BROCVL	Bromus marginatus	Mountain Brome
BROMOL	BROMOL	Bromus mollis	Soft Brome
BROTEC	BROTEC	Bromus tectorum	Cheatgrass
BROVUL	BROVUL	Bromus vulgaris	Columbia Brome
CALCAN	CALCAN	Calamagrostis canadensis	Bluejoint Reedgrass
CALMON	CALMON	Calamagrostis montanensis	Plains Reedgrass
CALPUR	CALPUR	Calamagrostis purpurascens	Purple Reedgrass
CALRUB	CALRUB	Calamagrostis rubescens	Pinegrass
CALSTR	CALSTR	Calamagrostis stricta	Narrow-spiked Reedgrass
CARALB	CARALB	Carex albonigra	Black-and-white-scaled Sedge
CARAQU	CARAQU	Carex aquatilis	Water Sedge
CARATH	CARATH	Carex atherodes	Awned Sedge
CARATO	CARATO	Carex athrostachya	Slender-beaked Sedge
CARATR	CARATR	Carex atrata	Blackened Sedge
CARAUR	CARAUR	Carex aurea	Golden Sedge
CARBRE	CARBRE	Carex brevior	Short-beaked Sedge
CARBUX	CARBUX	Carex buxbaumii	Buxbaum's Sedge
CARCAN	CARCAN	Carex canescens	Gray Sedge
CARCON	CARCON	Carex concinnoides	Northwestern Sedge
CARDIA	CARDIA	Carex diandra	Lesser-panicled Sedge
CARDIS	CARDIS	Carex disperma	Soft-leaved Sedge
CARDOU	CARDOU	Carex douglasii	Douglas's Sedge
CARELY	CARELY	Carex elynoides	Kobresia-like Sedge
CAREXS	CARVES	Carex exsiccata	Inflated Sedge
CARFIL	CARFIL	Carex filifolia	Thread-leaved Sedge
CARGEY	CARGEY	Carex geyeri	Elk Sedge
CARHAY	CARHAY	Carex haydeniana	Hayden's Sedge

Appendix A. Flora of the Beaverhead Mountains Section

Graminoids

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
CARHOO	CARHOO	Carex hoodii	Hood's Sedge
CARIDA	CARPSI	Carex idahoa	Idaho Sedge
CARILL	CARILL	Carex illota	Sheep Sedge
CARINT	CARINT	Carex interior	Inland Sedge
CARLAN	CARLAN	Carex lanuginosa	Woolly Sedge
CARLAS	CARLAS	Carex lasiocarpa	Slender Sedge
CARLEN	CARLEN	Carex lenticularis	Lentil-fruited Sedge
CARLIM	CARLIM	Carex limosa	Mud Sedge
CARLUZ	CARLUZ	Carex luzulina	Woodrush Sedge
CARMIC	CARMIC	Carex microptera	Small-winged Sedge
CARNAR	CARNAR	Carex nardina	Spikenard Sedge
CARNEB	CARNEB	Carex nebrascensis	Nebraska Sedge
CARNEU	CARNEU	Carex neurophora	Alpine Nerved Sedge
CARNIG	CARNIG	Carex nigricans	Black Alpine Sedge
CARNOV	CARNOV	Carex nova	New Sedge
CAROBT	CAROBT	Carex obtusata	Blunt Sedge
CARPAC	CARPAC	Carex pachystachya	Thick-headed Sedge
CARPAR	CARPAR	Carex parryana	Parry's Sedge
CARPAY	CARPAY	Carex paysonis	Payson Sedge
CARPED	CARPED	Carex pedunculata	Woodland Sedge
CARPEN	CARPEN	Carex pensylvanica	Long-stolon Sedge
CARPET	CARPET	Carex petasata	Liddon's Sedge
CARPHA	CARPHA	Carex phaeocephala	Dunhead Sedge
CARPRA	CARPRA	Carex praegracilis	Clustered Field Sedge
CARPRT	CARPRT	Carex praticola	Meadow Sedge
CARPRI	CARPRI	Carex prionophylla	Saw-leaved Sedge
CARPYR	CARPYR	Carex pyrenaica	Pyrenaean Sedge
CARRAY	CARRAY	Carex raynoldsii	Raynolds' Sedge
CARROI	CARROI	Carex rossii	Ross Sedge
CARRUP	CARRUP	Carex rupestris	Curly Sedge
CARSCI	CARSCI	Carex scirpoidea	Canadian Single-spike Sedge
CARSCO	CARSCO	Carex scopulorum	Holm's Rocky Mountain Sedge
CARSIM	CARSIM	Carex simulata	Short-beaked Sedge
CARSPE	CARSPE	Carex spectabilis	Showy Sedge
CARUTR	CARUTR	Carex utriculata	Beaked Sedge
CARVAL	CARVAL	Carex vallicola	Valley Sedge
CARVES	CARVES	Carex vesicaria	Inflated Sedge
CARXER	CARXER	Carex xerantica	Dryland Sedge
CATAQU	CATAQU	Catabrosa aquatica	Brookgrass
CINLAT	CINLAT	Cinna latifolia	Drooping Woodreed
DACGLO	DACGLO	Dactylis glomerata	Orchard-grass
DANCAL	DANCAL	Danthonia californica	California Oatgrass
DANINT	DANINT	Danthonia intermedia	Timber Oatgrass
DANSPI	DANSPI	Danthonia spicata	Poverty Oatgrass
DANUNI	DANUNI	Danthonia unispicata	Onespike Oatgrass
DESCES	DESCES	Deschampsia cespitosa	Tufted Hairgrass
DISSPI	DISSPI	Distichlis spicata	Inland Saltgrass
DISSTR	DISSPI	Distichlis stricta	Alkali Saltgrass
ELEACI	ELEACI	Eleocharis acicularis	Needle Spike-rush
ELEPAL	ELEPAL	Eleocharis palustris	Common Spikesedge

Appendix A. Flora of the Beaverhead Mountains Section

Graminoids

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
ELEPAU	ELEPAU	Eleocharis pauciflora	Few-flowered Spike-rush
ELYCAN	ELYCAN	Elymus canadensis	Canada Wildrye
ELYELY	SITHYS	Elymus elymoides	Bottlebrush Squirreltail
ELYGLA	ELYGLA	Elymus glaucus	Blue Wildrye
ELYLAN	ELYLAN	Elymus lanceolatus	Thick-spike Wheatgrass
ELYREP	ELYREE	Elymus repens	Quackgrass
ELYSCR	ELYSCR	Elymus scribneri	Spreading Wheatgrass
ELYTRA	ELYTRA	Elymus trachycaulus	Bearded Wheatgrass
ELYVIR	ELYVIR	Elymus virginicus	Virginia Wildrye
ERIANG	ERIPOL	Eriophorum angustifolium	Many-spiked Cotton-grass
ERICHA	ERICHA	Eriophorum chamissonis	Chamisso's Cotton-grass
ERIVIR	ERIVIR	Eriophorum viridicarinatum	Green-keeled Cotton-grass
FESCAM	FESSCA	Festuca campestris	Rough Fescue
FESIDA	FESIDA	Festuca idahoensis	Idaho Fescue
FESKIN	LEUKIN	Festuca kingii	Spike-fescue
FESOCC	FESOCC	Festuca occidentalis	Western Fescue
FESOVI	FESOVI	Festuca ovina	Sheep Fescue
FESPRA	FESPRA	Festuca pratensis	Meadow Fescue
FESRUB	FESRUB	Festuca rubra	Red Fescue
GLYBOR	GLYBOR	Glyceria borealis	Northern Mannagrass
GLYELA	GLYELA	Glyceria elata	Tall Mannagrass
GLYGRA	GLYGRA	Glyceria grandis	American Mannagrass
GLYSTR	GLYSTR	Glyceria striata	Fowl Mannagrass
HORBRA	HORBRA	Hordeum brachyantherum	Meadow Barley
HORJUB	HORJUB	Hordeum jubatum	Foxtail Barley
HORPUS	HORPUS	Hordeum pusillum	Little Barley
JUNALP	JUNALP	Juncus alpinus	Northern Rush
JUNBAL	JUNBAL	Juncus balticus	Baltic Rush
JUNCAS	JUNCAS	Juncus castaneus	Chestnut Rush
JUNCON	JUNCON	Juncus confusus	Colorado Rush
JUNDRU	JUNDRU	Juncus drummondii	Drummond's Rush
JUNEFF	JUNEFF	Juncus effusus	Soft Rush
JUNENS	JUNENS	Juncus ensifolius	Dagger-leaf Rush
JUNLON	JUNLON	Juncus longistylis	Long-styled Rush
JUNMER	JUNMER	Juncus mertensianus	Merten's Rush
JUNNEV	JUNNEV	Juncus nevadensis	Sierra Rush
JUNPAR	JUNPAR	Juncus parryi	Parry's Rush
JUNTEN	JUNTEN	Juncus tenuis	Slender Rush
JUNTOR	JUNTOR	Juncus torreyi	Torrey's Rush
JUNTRA	JUNTRA	Juncus tracyi	Tracy's Rush
KOEMAC	KOECRI	Koeleria macrantha	Prairie Junegrass
LEYCIN	LEYCIN	Leymus cinereus	Giant Wildrye
LUZCAM	LUZCAM	Luzula campestris	Field Woodrush
LUZGVH	LUZHIT	Luzula glabrata var. hitchcockii	Smooth Woodrush
LUZPAR	LUZPAR	Luzula parviflora	Small-flowered Woodrush
LUZSPI	LUZSPI	Luzula spicata	Spike Woodrush
MELBUL	MELBUL	Melica bulbosa	Oniongrass
MELSPE	MELSPE	Melica spectabilis	Showy Oniongrass
MELSUB	MELSUB	Melica subulata	Alaska Oniongrass
MUHASP	MUHASP	Muhlenbergia asperifolia	Alkali Muhly

Appendix A. Flora of the Beaverhead Mountains Section

Graminoids

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
MUHCUS	MUHCUS	Muhlenbergia cuspidata	Plains Muhly
MUHFIL	MUHFIL	Muhlenbergia filiformis	Slender Muhly
MUHRIC	MUHRIC	Muhlenbergia richardsonis	Mat Muhly
NASVIR	STIVIR	Nassella viridula	Green Needlegrass
ORYEXI	ORYEXI	Oryzopsis exigua	Little Ricegrass
ORYHYM	ORYHYM	Oryzopsis hymenoides	Indian Ricegrass
PASSMI	PASSMI	Pascopyrum smithii	Western Wheatgrass
PHAARU	PHAARU	Phalaris arundinacea	Reed Canarygrass
PHLALP	PHLALP	Phleum alpinum	Alpine Timothy
PHLPRA	PHLPRA	Phleum pratense	Common Timothy
POAALP	POAALP	Poa alpina	Alpine Bluegrass
POAAMP	POASEC	Poa ampla	Alkali Bluegrass
POAARC	POAARC	Poa arctica	Artic Bluegrass
POAARI	POAARI	Poa arida	Plains Bluegrass
POABUL	POABUL	Poa bulbosa	Bulbous Bluegrass
POACAN	POASEC	Poa canbyi	Canby's Bluegrass
POACOM	POACOM	Poa compressa	Canada Bluegrass
POACUS	POAFEN	Poa cusickii	Cusick's Bluegrass
POAFEN	POAFEN	Poa fendleriana	Muttongrass
POAGLA	POAGLA	Poa glaucifolia	Pale-leaf Bluegrass
POAGRA	POAARC	Poa grayana	Gray's Bluegrass
POAINT	POAGLU	Poa interior	Inland Bluegrass
POAJUN	POASEC	Poa juncifolia	Alkali Bluegrass
POALEP	POALEP	Poa leptocoma	Bog Bluegrass
POALET	POALET	Poa lettermanii	Letterman's Bluegrass
POANER	POANER	Poa nervosa	Wheeler's Bluegrass
POANEV	POASEC	Poa nevadensis	Nevada Bluegrass
POAPAL	POAPAL	Poa palustris	Fowl Bluegrass
POAPRA	POAPRA	Poa pratensis	Kentucky Bluegrass
POAREF	POAREF	Poa reflexa	Nodding Bluegrass
POASAN	POASEC	Poa sandbergii	Sandberg's Bluegrass
POASCA	POASEC	Poa scabrella	Pine Bluegrass
POASEC	POASEC	Poa secunda	Sandberg's Bluegrass
POASTE	POASTE	Poa stenantha	Trinius' Bluegrass
POATRI	POATRI	Poa trivialis	Roughstalk Bluegrass
PSESPI	PSESPI	Pseudoroegneria spicata	Bluebunch Wheatgrass
PUCDIS	PUCDIS	Puccinellia distans	Weeping Alkaligrass
PUCNUT	PUCNUT	Puccinellia nuttalliana	Nuttall's Alkaligrass
SCIACU	SCIACU	Scirpus acutus	Hardstem Bulrush
SCITAB	SCIVAL	Scirpus tabernaemontani	Softstem Bulrush
SPAGRA	SPAGRA	Spartina gracilis	Alkali Cordgrass
SPAPEC	SPAPEC	Spartina pectinata	Prairie Cordgrass
SPHOBT	SPHOBT	Sphenopholis obtusata	Prairie Wedgegrass
SPOAIR	SPOAIR	Sporobolus airoides	Alkali Sacaton
SPOCRY	SPOCRY	Sporobolus cryptandrus	Sand Dropseed
STICOM	STICOM	Stipa comata	Needle-and-thread
STIOCC	STIOCC	Stipa occidentalis	Western Needlegrass
STIRIC	STIRIC	Stipa richardsonii	Richardson's Needlegrass
TRISPI	TRISPI	Trisetum spicatum	Spike Trisetum
TRIWOL	TRIWOL	Trisetum wolfii	Wolf's Trisetum

Appendix A. Flora of the Beaverhead Mountains Section

Fern and Fern Allies

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
CHEFEE	CHEFEE	Cheilanthes feei	Fee's Lip-fern
CYSFRA	CYSFRA	Cystopteris fragilis	Brittle Bladder-fern
EQUARV	EQUARV	Equisetum arvense	Field Horsetail
EQUFLU	EQUFLU	Equisetum fluviatile	Water Horsetail
EQUHYE	EQUHYE	Equisetum hyemale	Common Scouring-rush
EQULAE	EQULAE	Equisetum laevigatum	Smooth Scouring-rush
SELDEN	SELDEN	Selaginella densa	Compact Selaginella
SELWAT	SELWAT	Selaginella watsonii	Watson's Selaginella
WOOORE	WOOORE	Woodsia oregana	Oregon Woodsia
WOOSCO	WOOSCO	Woodsia scopulina	Rocky Mountain Woodsia

Appendix A. Flora of the Beaverhead Mountains Section

Non-Vascular

USFS Reg. 1 Code	Synonymy	Species Name	Common Name
Non-vascular Algae			
PEDBRA	PEDBRA	Pediastrum braunii	
PEDSIM	PEDSIM	Pediastrum simplex	
Non-vascular Lichen			
COLTEN	COLTEN	Collema tenax	
MELALB	MELALB	Melanelia albertana	
MELSUB	MELSUB	Melanelia substygia	
VERVIR	VERVIR	Verrucaria viridula	
Non-vascular Moss			
CALSTR	CALSTR	Calliergon stramineum	Pale Spoon Moss
LEPPYR	LEPPYR	Leptobryum pyriforme	Pear Moss

Appendix B.
Natural Heritage Global Rank Definitions and Their Modifiers

Rank	Global Rank Definitions
GX	Presumed Extinct - Believed to be extinct throughout its range. Not located despite intensive searches of historic sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
GH	Possibly Extinct - Known from only historical occurrences. Still some hope of rediscovery.
G1	Critically Imperiled - Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or stream miles (<10).
G2	Imperiled - Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or stream miles (10 to 50).
G3	Vulnerable - Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.
G4	Apparently Secure - Uncommon but not rare, and usually widespread. Possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.
G5	Secure - Common, typically widespread and abundant. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
GU	Unrankable - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
G?	Unranked - Global rank not yet assessed
?	Inexact numeric rank

Appendix C. Plant Associations of the Beaverhead Mountains Section

Evergreen Forest

Association	State Rank	Global Rank
Abies lasiocarpa / Actaea rubra Forest	S2	G4?
Abies lasiocarpa / Alnus viridis ssp. sinuata Forest	S4	G4
Abies lasiocarpa / Arnica cordifolia Forest	S5	G5
Abies lasiocarpa / Arnica latifolia Forest	S3	G4
Abies lasiocarpa / Calamagrostis canadensis Forest	S5	G5
Abies lasiocarpa / Calamagrostis rubescens Forest	S3	G4G5
Abies lasiocarpa / Carex geyeri Forest	S3	G5
Abies lasiocarpa / Clematis columbiana var. columbiana Forest	S3?	G3?
Abies lasiocarpa / Galium triflorum Forest	S4	G4
Abies lasiocarpa / Ledum glandulosum Forest	S4	G4
Abies lasiocarpa / Linnaea borealis Forest	S5	G5
Abies lasiocarpa / Luzula glabrata var. hitchcockii Forest	S5	G5
Abies lasiocarpa / Menziesia ferruginea Forest	S5	G5
Abies lasiocarpa / Ribes (montigenum, lacustre, inerme) Forest	S4	G5
Abies lasiocarpa / Streptopus amplexifolius Forest	S3	G4?
Abies lasiocarpa / Symphoricarpos albus Forest	S3	G3
Abies lasiocarpa / Thalictrum occidentale Forest	S3	G4
Abies lasiocarpa / Vaccinium cespitosum Forest	S5	G5
Abies lasiocarpa / Vaccinium membranaceum Rocky Mountain Forest	S5	G5
Abies lasiocarpa / Vaccinium scoparium Forest	S5	G5
Abies lasiocarpa / Xerophyllum tenax Forest	S5	G5
Picea (engelmannii X glauca, engelmannii) / Carex disperma Forest	S2?	G2Q
Picea (engelmannii X glauca, engelmannii) / Galium triflorum Forest	S4	G4
Picea (engelmannii X glauca, engelmannii) / Juniperus communis Forest	S2	G2Q
Picea (engelmannii X glauca, engelmannii) / Linnaea borealis Forest	S4	G4
Picea (engelmannii X glauca, engelmannii) / Maianthemum stellatum Forest	S3	G3
Picea (engelmannii X glauca, engelmannii) / Physocarpus malvaceus Forest	S3	G3
Picea (engelmannii X glauca, engelmannii) / Senecio streptanthifolius Forest	S4	G4
Picea (engelmannii X glauca, engelmannii) / Vaccinium cespitosum Forest	S4	G4
Picea engelmannii / Calamagrostis canadensis Forest	S3	G4
Picea engelmannii / Equisetum arvense Forest	S2	G4
Picea engelmannii / Hypnum revolutum Forest	SP	G2
Picea engelmannii / Vaccinium scoparium Forest	SP	G3G5
Pinus albicaulis / Carex rossii Forest	SP	G3?
Pinus albicaulis / Vaccinium scoparium Forest	S3	G4
Pinus contorta / Arnica cordifolia Forest	S3?	G4?
Pinus contorta / Calamagrostis rubescens Forest	S5	G5
Pinus contorta / Carex geyeri Forest	SP	G4?
Pinus contorta / Carex rossii Forest	SP	G5
Pinus contorta / Linnaea borealis Forest	S5	G5
Pinus contorta / Spiraea betulifolia Forest	SP	G3G4
Pinus contorta / Vaccinium cespitosum Forest	S5	G5
Pinus contorta / Vaccinium scoparium Forest	S5	G5
Pinus contorta / Xerophyllum tenax Forest	S4	G5
Pseudotsuga menziesii / Arnica cordifolia Forest	S4	G4
Pseudotsuga menziesii / Calamagrostis rubescens Forest	S5	G5

Appendix C. Plant Associations of the Beaverhead Mountains Section

Evergreen Forest

Association	State Rank	Global Rank
Pseudotsuga menziesii / Carex geyeri Forest	S4	G4?
Pseudotsuga menziesii / Juniperus communis Forest	S4	G4
Pseudotsuga menziesii / Linnaea borealis Forest	S4	G4
Pseudotsuga menziesii / Mahonia repens Forest	S3	G5
Pseudotsuga menziesii / Physocarpus malvaceus Forest	S5	G5
Pseudotsuga menziesii / Spiraea betulifolia Forest	S4	G5
Pseudotsuga menziesii / Symphoricarpos albus Forest	S5	G5
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	S3	G5
Pseudotsuga menziesii / Vaccinium membranaceum Forest	S5	G5?

Appendix C. Plant Associations of the Beaverhead Mountains Section

Evergreen Woodland

Association	State Rank	Global Rank
Abies lasiocarpa - Pinus albicaulis / Vaccinium scoparium Woodland	S5	G5?
Abies lasiocarpa / Juniperus communis Woodland	S3	G4G5
Abies lasiocarpa Scree Woodland	S5	G5?
Cercocarpus ledifolius / Festuca idahoensis Woodland	S2	G3
Juniperus scopulorum / Artemisia nova Woodland	S2	G2?
Juniperus scopulorum / Artemisia tridentata Woodland	S2?	G3Q
Juniperus scopulorum / Cercocarpus ledifolius Woodland	S3?	G3?
Juniperus scopulorum / Cornus sericea Woodland	S4	G4
Juniperus scopulorum / Pseudoroegneria spicata Woodland	S4	G4
Picea engelmannii / Cornus sericea Woodland	S3	G3
Pinus albicaulis - Abies lasiocarpa Woodland [Provisional]	S5	G5?
Pinus albicaulis / Carex geyeri Woodland	S1	G2G3
Pinus albicaulis / Festuca idahoensis Woodland	S4	G4
Pinus albicaulis / Juniperus communis Woodland	SP	G4?
Pinus albicaulis Woodland [Provisional]	S5	G5?
Pinus contorta / Juniperus communis Woodland	S3	G5
Pinus contorta Scree Woodland	S5Q	G5?
Pinus flexilis / Cercocarpus ledifolius Woodland	S3	G3G4
Pinus flexilis / Festuca idahoensis Woodland	S5	G5
Pinus flexilis / Juniperus communis Woodland	S4	G5
Pinus flexilis / Pseudoroegneria spicata Woodland	S4	G4
Pinus flexilis / Scree Woodland	S3	G3Q
Pinus ponderosa / Pseudoroegneria spicata Woodland	S4	G4
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland	S?	G4?
Pseudotsuga menziesii / Cornus sericea Woodland	S3	G4
Pseudotsuga menziesii / Festuca campestris Woodland	S4	G4
Pseudotsuga menziesii / Festuca idahoensis Woodland	S4	G4
Pseudotsuga menziesii / Juniperus scopulorum Woodland	S3	G3
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland	S4	G4
Pseudotsuga menziesii Scree Woodland	S4	G5

Appendix C. Plant Associations of the Beaverhead Mountains Section

Deciduous Forest and Woodland

Association	State Rank	Global Rank
Larix lyallii - Abies lasiocarpa Forest [Provisional]	S4	G4
Populus angustifolia / Cornus sericea Woodland	S3	G4
Populus balsamifera ssp. trichocarpa / Poa pratensis Forest	S?	G?
Populus tremuloides / Amelanchier alnifolia Forest	S3	G4
Populus tremuloides / Bromus carinatus Forest	S?	G5
Populus tremuloides / Calamagrostis canadensis Forest	S2	G3
Populus tremuloides / Calamagrostis rubescens Forest	S4	G5?
Populus tremuloides / Cornus sericea Forest	S3	G4
Populus tremuloides / Poa pratensis Forest	S?	G?
Populus tremuloides / Symphoricarpos oreophilus Forest	S3	G5
Populus tremuloides / Tall Forbs Forest	S3	G5
Populus tremuloides / Thalictrum fendleri Forest	S?	G5

Appendix C. Plant Associations of the Beaverhead Mountains Section

Shrubland

Association	State Rank	Global Rank
Alnus incana Shrubland	S3	G?Q
Alnus viridis ssp. sinuata Shrubland [Provisional]	S2	G2Q
Artemisia cana / Festuca idahoensis Shrub Herbaceous Vegetation	S3?	G3?
Artemisia cana / Leymus cinereus Shrubland	S?	G1
Artemisia cana / Pascopyrum smithii Shrubland	S4	G4
Artemisia cana / Poa pratensis Shrub Herbaceous Vegetation	S?	S?
Artemisia cana / Stipa comata Shrub Herbaceous Vegetation	S3	G3
Artemisia tridentata / Festuca campestris Shrub Herbaceous Vegetation	S3	G3
Artemisia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation	S4?	G4Q
Artemisia tridentata / Stipa comata Shrubland	S4	G4Q
Artemisia tridentata ssp. tridentata / Festuca idahoensis Shrubland	SP	G4?
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland	S1	G2
Artemisia tridentata ssp. tridentata / Pascopyrum smithii Shrubland	S3	G3?
Artemisia tridentata ssp. tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	SP	G2G4
Artemisia tridentata ssp. vaseyana / Festuca campestris Shrub Herbaceous Vegetation	S?	G?
Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrub Herbaceous Vegetation	S4	G5
Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Festuca idahoensis Shrubland	S?	G4
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Elymus trachycaulus Shrubland	S?	G?
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Geranium viscossimum Shrubland	S?	G?
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Pascopyrum smithii Shrubland	S?	G?
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Pseudoroegneria spicata Shrubland	S?	G?
Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland	S?	G4?
Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland	S3?	G3?
Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland	S?	G5
Artemisia tridentata ssp. vayesana / Festuca idahoensis - Stipa occidentalis Shrubland	S?	G?
Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus ssp. albicans Shrubland	S?	G4
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland	SP	G4
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Herbaceous Vegetation	S3	G4
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland	S5?	G5?
Artemisia tripartita / Elymus lanceolatus Shrub Herbaceous Vegetation	S?	G?
Artemisia tripartita / Festuca idahoensis Shrub Herbaceous Vegetation	S3?	G3
Artemisia tripartita / Pseudoroegneria spicata Shrub Herbaceous Vegetation	S?	G2G3
Betula glandulosa / Carex utriculata Shrubland	S4	G4?
Betula occidentalis Shrubland	S3	G3Q
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland	S4	G4Q
Chrysothamnus viscidiflorus / Stipa comata Shrubland	S?	S?
Cornus sericea Shrubland [Provisional]	S3	G4
Pentaphylloides floribunda / Carex utriculatra Shrubland	S?	G?
Pentaphylloides floribunda / Deschampsia cespitosa Shrubland	S4	G4

Appendix C. Plant Associations of the Beaverhead Mountains Section

Shrubland

Association	State Rank	Global Rank
Pentaphylloides floribunda / Festuca campestris Shrub Herbaceous Vegetation	S3	G4
Pentaphylloides floribunda / Festuca idahoensis Shrub Herbaceous Vegetation	S2S3	G3
Pentaphylloides floribunda / Potentilla ovina Shrubland	S?	G?
Purshia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation	S3	G3G5
Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	SP	G3
Rhus trilobata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	S4	G4
Rosa woodsii Shrubland	S5	G5
Salix bebbiana Shrubland	S3?	G3?
Salix boothii / Calamagrostis canadensis Shrubland	SR	G3G4Q
Salix boothii / Carex utriculata Shrubland	S?	G4
Salix boothii / Mesic Graminoids Shrubland	S?	G3?
Salix brachycarpa / Carex aquatilis Shrubland	S?	G2G3
Salix candida / Carex lasiocarpa Shrubland	S?	G?
Salix candida / Carex utriculata Shrubland	S3	G3
Salix drummondiana / Calamagrostis canadensis Shrubland	SP	G3
Salix drummondiana / Carex utriculata Shrubland	S5	G3
Salix drummondiana Shrubland [Provisional]	S3	G3Q
Salix exigua Temporarily Flooded Shrubland	S5	G5
Salix geyeriana / Calamagrostis canadensis Shrubland	S4	G5
Salix geyeriana / Carex rostrata Shrubland	S5	G5
Salix geyeriana / Carex utriculata Shrubland	S4	G4
Salix geyeriana / Deschampsia cespitosa Shrubland	S3	G4
Salix glauca Shrubland	S2	G3?
Salix lutea / Calamagrostis canadensis Shrubland	S3?	G3?
Salix planifolia / Carex aquatilis Shrubland	S3	G5
Salix planifolia / Carex nebrascensis Shrubland	S?	G?
Salix planifolia / Carex scopulorum Shrubland	S?	G4
Salix wolfii / Carex aquatilis Shrubland	S3	G4
Salix wolfii / Deschampsia cespitosa Shrubland	S3	G3
Sarcobatus vermiculatus / Distichlis spicata Shrubland	S2	G4
Sarcobatus vermiculatus / Elymus lanceolatus Shrub Herbaceous Vegetation	S3	G3
Sarcobatus vermiculatus / Leymus cinereus Shrubland	S2S3	G3
Sarcobatus vermiculatus / Pascopyrum smithii Shrub Herbaceous Vegetation	S4	G4
Shepherdia argentea Shrubland [Provisional]	S3?	G3G4
Symphoricarpos occidentalis Shrubland [Provisional]	S4S5	G4G5

Appendix C. Plant Associations of the Beaverhead Mountains Section

Dwarf Shrubland

Association	State Rank	Global Rank
Artemisia arbuscula / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	S3	G5
Artemisia arbuscula / Pseudoroegneria spicata Dwarf-shrub Herbaceous Vegetation	S3	G5
Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Dwarf-shrub Herbaceous Vegetation	S?	G?
Artemisia arbuscula ssp. longiloba / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	S2	G3?
Artemisia nova / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	S1S2	G2?
Artemisia nova / Pseudoroegneria spicata Dwarf-shrubland	S3	G4G5
Artemisia pedatifida / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	S2	G2?
Atriplex gardneri / Oryzopsis hymenoides Dwarf-shrubland	S3	G3
Cassiope mertensiana / Carex paysonis Dwarf-shrubland	S2	G2?
Dryas octopetala - Carex rupestris Dwarf-shrub Herbaceous Vegetation	S3	G4
Dryas octopetala - Carex spp. Dwarf-shrub Herbaceous Vegetation	S3?	G3?
Dryas octopetala - Polygonum viviparum Dwarf-shrub Herbaceous Vegetation	S2	G3?
Kalmia microphylla / Carex scopulorum Dwarf-shrubland	S3	G3G4
Phyllodoce empetriformis / Antennaria lanata Dwarf-shrubland	S3	G3
Salix arctica / Polygonum bistortoides Dwarf-shrubland	S2S3	G2G3
Salix reticulata / Caltha leptosepala Dwarf-shrubland	S2	G3

Appendix C. Plant Associations of the Beaverhead Mountains Section

Herbaceous

Association	State Rank	Global Rank
Agrostis stolonifera Herbaceous Vegetation	S5	GM
Alpine Fellfield / Dry	S?	G?
Alpine Fellfield / Moist	S?	G?
Bromus carinatus - Bromus anomalus Herbaceous Vegetation	S?	G?
Calamagrostis canadensis Western Herbaceous Vegetation	S4	G4Q
Calamagrostis montanensis Herbaceous Vegetation	S?	G?
Calamagrostis purpurascens - Carex rupestris Herbaceous Vegetation	S?	G?
Carex aquatilis Herbaceous Vegetation	S4	G5
Carex atherodes Herbaceous Vegetation	S5	G?
Carex buxbaumii Herbaceous Vegetation	S3	G3
Carex elynoides - Geum rossii Herbaceous Vegetation	S4	G4
Carex elynoides Herbaceous Vegetation	S4	G4
Carex lanuginosa Herbaceous Vegetation	SP	G3?
Carex lasiocarpa Herbaceous Vegetation	S4	G4
Carex nebrascensis Herbaceous Vegetation	S4	G4
Carex nigricans Herbaceous Vegetation	S3	G4
Carex rupestris - Potentilla ovina Herbaceous Vegetation	S3	G3
Carex scirpoidea - Geum rossii Herbaceous Vegetation	S3	G3
Carex scirpoidea - Potentilla diversifolia Herbaceous Vegetation	S2	G3?
Carex scopulorum - Caltha leptosepala Herbaceous Vegetation	S3	G4
Carex scopulorum Herbaceous Vegetation	S4	G5
Carex simulata Herbaceous Vegetation	S3	G4
Carex spp. - Geum rossii Herbaceous Vegetation	S4Q	G4Q
Carex utriculata Herbaceous Vegetation	S5	G5
Deschampsia cespitosa - Caltha leptosepala Herbaceous Vegetation	S3	G4
Deschampsia cespitosa - Carex spp. Herbaceous Vegetation	S4Q	G4Q
Deschampsia cespitosa - Potentilla diversifolia Herbaceous Vegetation	S2	G5
Deschampsia cespitosa Herbaceous Vegetation	S4	G4
Distichlis spicata Herbaceous Vegetation	S4	G5
Eleocharis palustris Herbaceous Vegetation	S5	G5
Eleocharis quinqueflora Herbaceous Vegetation	SP	G4
Elymus elymoides Herbaceous Vegetation	S?	G?
Elymus lanceolatus - Phacelia hastata Herbaceous Vegetation	S2	G2
Equisetum fluviatile Herbaceous Vegetation	S4	G4
Festuca campestris - Festuca idahoensis - Stipa richardsonii Herbaceous Vegetation	S?	G?
Festuca campestris - Festuca idahoensis Herbaceous Vegetation	S3	G3
Festuca campestris - Pseudoroegneria spicata Herbaceous Vegetation	S4	G4
Festuca idahoensis - Carex filifolia Herbaceous Vegetation	S3	G3
Festuca idahoensis - Danthonia intermedia Herbaceous Vegetation	S?	G3?
Festuca idahoensis - Deschampsia cespitosa Herbaceous Vegetation	S3	G3
Festuca idahoensis - Elymus trachycaulus Herbaceous Vegetation	S3S4	G4
Festuca idahoensis - Festuca kingii Herbaceous Vegetation	SP	G2?
Festuca idahoensis - Pascopyrum smithii Herbaceous Vegetation	S4	G4
Festuca idahoensis - Potentilla diversifolia Herbaceous Vegetation	S3	G3
Festuca idahoensis - Pseudoroegneria spicata Herbaceous Vegetation	S4	G4
Festuca idahoensis - Stipa richardsonii Herbaceous Vegetation	S3	G3
Festuca idahoensis Herbaceous Vegetation	S?	G3Q
Festuca kingii - Oxytropis campestris Herbaceous Vegetation	S2	G3?
Festuca kingii Herbaceous Vegetation	SP	G3Q
Geum rossii - Minuartia obtusiloba Herbaceous Vegetation	S3	G3
Glyceria borealis Herbaceous Vegetation	S3	G4
Hordeum jubatum Herbaceous Vegetation	S4	G4
Juncus balticus - Carex praegracilis Herbaceous Vegetation	S?	G?

Appendix C. Plant Associations of the Beaverhead Mountains Section

Herbaceous

Association	State Rank	Global Rank
Juncus balticus Herbaceous Vegetation	S5	G5
Juncus drummondii - Antennaria lanata Herbaceous Vegetation	S2	G3?
Juncus parryi - Erigeron ursinus Herbaceous Vegetation	S2?	G2?
Leymus cinereus - Festuca idahoensis Herbaceous Vegetation	S2?	G2?
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation	S3?	G3Q
Leymus cinereus - Puccinellia nuttalliana Herbaceous Vegetation	S?	G?
Leymus cinereus Herbaceous Vegetation [Provisional]	S2	G2G3Q
Pascopyrum smithii Herbaceous Vegetation [Provisional]	S4	G3G5Q
Phalaris arundinacea Western Herbaceous Vegetation	S4	G5
Phragmites australis Temperate Herbaceous Vegetation	S2	G4
Poa palustris Herbaceous Vegetation	S4	GW
Poa pratensis Herbaceous Vegetation [Provisional]	SW	GW
Poa juncifolia Herbaceous Vegetation	S?	G4?
Pseudoroegneria spicata - Bouteloua gracilis Herbaceous Vegetation	S3	G4
Pseudoroegneria spicata - Cushion Plant Herbaceous Vegetation	S3	G3
Pseudoroegneria spicata - Koeleria macrantha Herbaceous Vegetation	S4?	G4?
Pseudoroegneria spicata - Oryzopsis hymenoides Herbaceous Vegetation	S?	G3
Pseudoroegneria spicata - Pascopyrum smithii Herbaceous Vegetation	S4	G4
Pseudoroegneria spicata - Poa secunda - Stipa comata Herbaceous Vegetation	S?	G?
Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	S4	G4?
Pseudoroegneria spicata - Stipa comata Herbaceous Vegetation	S3	G4
Puccinellia nuttalliana Herbaceous Vegetation	S?	G3?
Scirpus acutus Herbaceous Vegetation	S5	G5
Scirpus tabernaemontani Temperate Herbaceous Vegetation	S3	G4
Senecio triangularis Herbaceous Vegetation	S3?	G3?
Silene acaulis Herbaceous Vegetation	S5	G5?
Sporobolus airoides Herbaceous Vegetation	S2	G3Q
Stipa comata - Bouteloua gracilis - Pascopyrum smithii Herbaceous Vegetation	S?	G?
Stipa comata - Bouteloua gracilis Herbaceous Vegetation	S5	G5
Stipa comata - Psoralidium tenuiflorum Herbaceous Vegetation	S?	G?
Typha latifolia Western Herbaceous Vegetation	S5	G5

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Abies lasiocarpa - Pinus albicaulis / Vaccinium scoparium Woodland	Cole 1982, Pfister et al. 1977
Abies lasiocarpa / Actaea rubra Forest	Hansen et al. 1991, Johnston 1987, Mauk and Henderson 1984, Padgett et al. 1988, Steele et al. 1983, Youngblood and Mauk 1985
Abies lasiocarpa / Alnus viridis ssp. sinuata Forest	Pfister et al. 1977, Steele et al. 1981
Abies lasiocarpa / Arnica cordifolia Forest	Hoffman and Alexander 1976, Pfister et al. 1977, Reed 1969, Steele et al. 1981, Steele et al. 1983, Youngblood and Mueggler 1981
Abies lasiocarpa / Arnica latifolia Forest	Cooper and Pfister 1981, Johnston 1987, Steele et al. 1983
Abies lasiocarpa / Calamagrostis canadensis Forest	Cooper et al. 1987, Hess and Alexander 1986, Johnston 1987, Mauk and Henderson 1984, Pfister et al. 1977, Richard et al. 1996, Steele et al. 1981, Steele et al. 1983
Abies lasiocarpa / Calamagrostis rubescens Forest	Cooper et al. 1987, Johnson and Simon 1987, Komarkova et al. 1988, Mauk and Henderson 1984, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Williams and Lillybridge 1985,
Abies lasiocarpa / Carex geyeri Forest	Alexander et al. 1986, Hess and Alexander 1986, Johnson and Clausnitzer 1992, Johnston 1987, Komarkova 1982, Komarkova et al. 1988, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Terwilliger et al. 1979, Wasser and Hess 1982, Youngblood and
Abies lasiocarpa / Clematis columbiana var. columbiana Forest	Pfister et al. 1977
Abies lasiocarpa / Galium triflorum Forest	Pfister et al. 1977
Abies lasiocarpa / Juniperus communis Woodland	Henderson et al. 1989,Johnston 1987, Mauk and Henderson 1984, Pfister et al. 1977, Roberts 1980, Steele et al. 1981, Steele et al. 1983, Youngblood and Mauk 1985
Abies lasiocarpa / Ledum glandulosum Forest	Hansen et al. 1991, Hansen et al. 1995
Abies lasiocarpa / Linnaea borealis Forest	Henderson et al. 1985, Johnson and Simon 1987, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Williams and Lillybridge 1985, Williams and Smith 1990, Williams et al. 1990
Abies lasiocarpa / Luzula glabrata var. hitchcockii Forest	Cooper et al. 1987, Pfister et al. 1977, Steele et al. 1983, Williams and Smith 1990
Abies lasiocarpa / Menziesia ferruginea Forest	Cooper et al. 1987, Daubenmire and Daubenmire 1968, Johnson and Simon 1987, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983
Abies lasiocarpa / Ribes (montigenum, lacustre, inerme) Forest	Henderson et al. 1977, Johnston 1987, Mauk and Henderson 1984, Osborn et al. 1998, Peet 1975, Pfister 1972, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983
Abies lasiocarpa / Streptopus amplexifolius Forest	Cooper et al. 1987,Hansen et al. 1995, Johnson and Simon 1987, Mauk and Henderson 1984, Padgett et al. 1988, Steele et al. 1981, Steele et al. 1983, Youngblood and Mauk 1985
Abies lasiocarpa / Symphoricarpos albus Forest	Cooper and Pfister 1981, Steele et al. 1983
Abies lasiocarpa / Thalictrum occidentale Forest	Cole 1982, Cooper 1975, Johnston 1987, Steele et al. 1983
Abies lasiocarpa / Vaccinium cespitosum Forest	Kerr and Henderson 1979, Mauk and Henderson 1984, Pfister et al. 1977, Steele et al. 1981, Williams et al. 1990, Youngblood and Mauk 1985
Abies lasiocarpa / Vaccinium membranaceum Rocky Mountain Forest	Cooper 1975, Johnston 1987, Kerr and Henderson 1979, Mauk and Henderson 1984, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Terwilliger et al. 1979

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Abies lasiocarpa / Vaccinium scoparium Forest	Alexander et al. 1986, Daubenmire and Daubenmire 1968, DeVelice 1983, Dix and Richards 1976, Hall 1973, Hess and Alexander 1986, Hoffman and Alexander
Abies lasiocarpa / Xerophyllum tenax Forest	Cooper 1975, Cooper et al. 1987, Daubenmire and Daubenmire 1968, Horton 1971, Pfister et al. 1977, Steele et al. 1983, Williams and Lillybridge 1985, Williams et al. 1990
Abies lasiocarpa Krummholz Shrubland	Habeck and Choate 1963
Abies lasiocarpa Scree Woodland	Pfister et al. 1977
Agrostis stolonifera Herbaceous Vegetation	Hansen et al. 1995
Alnus incana Shrubland	Evans 1989, Hansen et al. 1990, Hansen et al. 1991
Alnus viridis ssp. sinuata Shrubland [Provisional]	Hansen et al. 1991
Alpine Fellfield / Dry	Cooper et al. 1997
Alpine Fellfield / Moist	Cooper et al. 1997
Artemisia arbuscula / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	Blackburn et al. 1968, Blackburn et al. 1969, Hall 1973, Hess and Wasser 1982, Lewis 1975, Mueggler and Stewart 1980, Tweit and Houston 1980, Zamora and Tueller 1973
Artemisia arbuscula / Pseudoroegneria spicata Dwarf-shrub Herbaceous Vegetation	Blackburn et al. 1971, Hall 1973, Jensen et al. 1988, Lewis 1975, Mueggler and Stewart 1980, Schuller and Evans 1986, Tiedemann and Klock 1977, Zamora and Tueller 1973
Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Dwarf-shrub Herbaceous Vegetation	Mueggler and Stewart 1980
Artemisia arbuscula ssp. longiloba / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	Caicco and Wellner 1983, Hironaka et al. 1983, Jensen et al. 1988, Mueggler and Stewart 1980, Schlatterer 1972, Tisdale et al. 1965, Zamora and Tueller 1973
Artemisia cana / Festuca idahoensis Shrub Herbaceous Vegetation	Mueggler and Stewart 1980
Artemisia cana / Leymus cinereus Shrubland	Oregon Natural Heritage Program n.d.
Artemisia cana / Pascopyrum smithii Shrubland	Hansen et al. 1991, Hansen et al. 1995
Artemisia cana / Poa pratensis Shrub Herbaceous Vegetation	
Artemisia cana / Stipa comata Shrub Herbaceous Vegetation	DeVelice et al. 1991
Artemisia nova / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	Mueggler and Stewart 1980
Artemisia nova / Pseudoroegneria spicata Dwarf-shrubland	Baker 1983, Baker and Kennedy 1985, Blackburn et al. 1968, Blackburn et al. 1971, Fisser 1970, Hughes 1977, Tweit and Houston 1980, Zamora and Tueller 1973
Artemisia pedatifida / Festuca idahoensis Dwarf-shrub Herbaceous Vegetation	Mueggler and Stewart 1980
Artemisia tridentata / Festuca campestris Shrub Herbaceous Vegetation	Mueggler and Stewart 1980
Artemisia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation	Blackburn et al. 1968, Daubenmire 1970, Hall 1973, Hironaka et al. 1983, Mclean 1970, Mueggler and Stewart 1980, Poulton 1955, Tisdale 1947

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Artemisia tridentata / Stipa comata Shrubland	Blackburn et al. 1968, Caicco and Wellner 1983, Daubenmire 1970, Hironaka et al. 1983, Lesica and DeVelice 1992, Mclean 1970, Poulton 1955, Tueller and Blackburn 1974
Artemisia tridentata ssp. tridentata / Festuca idahoensis Shrubland	Hironaka et al. 1983, Jensen et al. 1988
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland	Baker 1982, Baker 1983, Hess 1981, Kittel et al. 1994, Osborn et al. 1998
Artemisia tridentata ssp. tridentata / Pascopyrum smithii Shrubland	Francis 1983, Keammerer 1977, Strong 1980, Tiedemann et al. 1987
Artemisia tridentata ssp. tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Caicco and Wellner 1983, Daubenmire 1970, Hironaka et al. 1983, Jensen et al. 1988, Mooney 1985, Mueggler and Stewart 1980, Tweit and Houston 1980
Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Festuca idahoensis Shrubland	Caicco and Wellner 1983, Hironaka et al. 1983
Artemisia tridentata ssp. vaseyana / Festuca campestris Shrub Herbaceous Vegetation	
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Elymus trachycaulus Shrubland	Mueggler and Stewart 1980
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Geranium viscossimum Shrubland	Mueggler and Stewart 1980
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Pascopyrum smithii Shrubland	Mueggler and Stewart 1980
Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Pseudoroegneria spicata Shrubland	Mueggler and Stewart 1980
Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrub Herbaceous Vegetation	Bramble-Brodahl 1978, Despain 1973, Hess and Wasser 1982, Hironaka et al. 1983, Jensen et al. 1988, Johnston 1987, Lewis 1975, Mooney 1985, Mueggler and Stewart 1980
Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland	Hironaka et al. 1983, Jensen et al. 1988, Mooney 1985
Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland	Rzedowski 1981, Smith 1966, Terwilliger et al. 1978
Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland	Baker 1983, Baker and Kennedy 1985, Bramble-Brodahl 1978, Current 1984, Hironaka et al. 1983, Jensen et al. 1988, Lewis 1975, Mooney 1985, Smith 1966, Terwilliger et al. 1978
Artemisia tridentata ssp. vayesana / Festuca idahoensis - Stipa occidentalis Shrubland	Mueggler and Stewart 1980
Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus ssp. albicans Shrubland	Giese 1975, Gross 1955, Marr et al. 1979, Steger 1970, Terwilliger et al. 1979
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland	Caicco and Wellner 1983, Hironaka et al. 1983, Jensen et al. 1988
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Baker 1983, Baker and Kennedy 1985, Brown 1971, Fisser 1964, Fisser 1970, Hansen and Hoffman 1988, Hess 1981, Knight et al. 1987, Strong 1980

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland	Blackburn 1967, Blackburn et al. 1968, Blackburn et al. 1969, Blackburn et al. 1971, Brotherson and Brotherson 1981, Daubenmire 1970, Hall 1973, Heinze et al. 1962, Hironaka et al. 1983, Lewis 1975, Mclean 1970, Moretti 1979, Moretti and Brotherson 1982,
Artemisia tripartita / Elymus lanceolatus Shrub Herbaceous Vegetation	
Artemisia tripartita / Festuca idahoensis Shrub Herbaceous Vegetation	Caicco and Wellner 1983, Daubenmire 1970, Hess 1981, Hironaka et al. 1983, Johnston 1987, Mueggler and Stewart 1980
Artemisia tripartita / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Caicco and Wellner 1983, Daubenmire 1970, Hironaka et al. 1983, Mclean 1970
Atriplex gardneri / Oryzopsis hymenoides Dwarf-shrubland	Baker 1983, Baker and Kennedy 1985, DeVelice 1992
Betula glandulosa / Carex utriculata Shrubland	Hansen et al. 1991
Betula occidentalis Shrubland	Hansen et al. 1991, Kittel and Lederer 1993
Bromus carinatus - Bromus anomalus Herbaceous Vegetation	
Calamagrostis canadensis Western Herbaceous Vegetation	Cooper 1986, Cooper and Cottrell 1990, Hansen et al. 1988, Hansen et al. 1991, Kovalchik 1993, Mattson 1984, Mutz and Queiroz 1983, Padgett et al. 1989, Wilson 1969
Calamagrostis montanensis Herbaceous Vegetation	
Calamagrostis purpurascens - Carex rupestris Herbaceous Vegetation	
Carex aquatilis Herbaceous Vegetation	Baker 1984, Baker and Kennedy 1985,Briggs and MacMahon 1983, Hall 1971, Hansen et al. 1987, Hansen et al. 1995, Hess and Wasser 1982,
Carex atherodes Herbaceous Vegetation	
Carex buxbaumii Herbaceous Vegetation	Hansen et al. 1988, Mattson 1984, Moseley et al. 1991, Moseley et al. 1994, Padgett et al. 1989, Pierce 1986, Pierce and Johnson 1986
Carex elynoides - Geum rossii Herbaceous Vegetation	Bamberg 1961
Carex elynoides Herbaceous Vegetation	Baker 1980, Baker 1983, Cooper and Lesica 1992, Moir and Smith 1970
Carex lanuginosa Herbaceous Vegetation	Hansen et al. 1987, Kittel et al. 1995, Kovalchik 1987, Padgett et al. 1988, Padgett et al. 1989
Carex lasiocarpa Herbaceous Vegetation	Hansen et al. 1988, Hansen et al. 1991, Kovalchik 1987, Kovalchik 1993, Padgett et al. 1989
Carex nebrascensis Herbaceous Vegetation	Baker 1982, Cooper and Cottrell 1990, Hall 1973, Hansen et al. 1995, Kittel et al. 1996, Kovalchik 1987, Mutz and Queiroz 1983, Padgett et al. 1989, Youngblood et al. 1985
Carex nigricans Herbaceous Vegetation	Agee and Kertis 1987, Cooper and Lesica 1992, Douglas and Bliss 1977, Hamann 1972, Henderson 1973, Henderson and Peter 1982
Carex rupestris - Potentilla ovina Herbaceous Vegetation	Cooper and Lesica 1992
Carex scirpoidea - Geum rossii Herbaceous Vegetation	Cooper and Lesica 1992, Cooper et al. 1997
Carex scirpoidea - Potentilla diversifolia Herbaceous Vegetation	Cooper and Lesica 1992, Cooper et al. 1997
Carex scopulorum - Caltha leptosepala Herbaceous Vegetation	Clements 1904, Cooper and Lesica 1992, Hess 1981, Hess and Wasser 1982, Johnston 1987, Kettler and McMullen 1996, Kittel et al. 1994, Willard 1963
Carex scopulorum Herbaceous Vegetation	Hansen et al. 1991, Kovalchik 1993, Manning and Padgett 1991

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Carex simulata Herbaceous Vegetation	Hansen et al. 1987, Hansen et al. 1991, Kovalchik 1987, Padgett et al. 1988, Padgett et al. 1989, Sanderson and Kettler 1996, Tuhy and Jensen 982, Youngblood et al. 1985
Carex spp. - Geum rossii Herbaceous Vegetation	Bamberg 1961
Carex utriculata Herbaceous Vegetation	Andrews 1983, Baker 1983, Benedict 1983, Franklin and Dyrness 1973, Hansen et al. 1987, Hansen et al. 1991, Hess and Wasser 1982, Kerr and Henderson 1979, Kittel et al. 1995
Cassiope mertensiana / Carex paysonis Dwarf-shrubland	Cooper and Lesica 1992, Cooper et al. 1997
Cercocarpus ledifolius / Festuca idahoensis Woodland	Cooper et al. 1995, DeVelice 1992, Dealy 1975, Hall 1973, Nesser 1997
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland	Baker 1983, Baker and Kennedy 1985, Knight et al. 1987, Lewis 1975, Miller 1964, Mueggler and Stewart 1980, Tisdale 1986
Chrysothamnus viscidiflorus / Stipa comata Shrubland	
Cornus sericea Shrubland [Provisional]	Hansen et al. 1991, Kittel et al. 1994, Kovalchik 1993, Osborn et al. 1998
Deschampsia cespitosa - Caltha leptosepala Herbaceous Vegetation	Bonham 1966, Bonham and Ward 1970, Cooper et al. 1997, Hess 1981, Hess and Wasser 1982, Johnson 1970, Johnston 1987, Komarkova 1986, May 1973, Osburn 1958, Wilson 1969
Deschampsia cespitosa - Carex spp. Herbaceous Vegetation	Mueggler and Stewart 1980
Deschampsia cespitosa - Potentilla diversifolia Herbaceous Vegetation	Baker 1983, Bonham 1966, Bonham and Ward 1970, Cooper et al. 1997
Deschampsia cespitosa Herbaceous Vegetation	Bonham and Ward 1970, Briggs and MacMahon 1983, Crowe and Clausnitzer 1997, Daubenmire and Daubenmire 1968, Franklin and Dyrness 1973, Hall 1971, Hall 1973, Hamann 1972, Hansen et al. 1987, Hansen et al. 1995, Hess and Wasser 1982, Jo
Distichlis spicata Herbaceous Vegetation	Baker 1984, Beatley 1976, Brotherson 1987, Daubenmire 1970, Franklin and Dyrness 1973, Hansen et al. 1991, Hyder et al. 1966, Jones and Walford 1995, Kittel and Lederer 1993
Dryas octopetala - Carex rupestris Dwarf-shrub Herbaceous Vegetation	Cooper et al. 1997, Cox 1933, Eddleman 1967, Fritz 1981,Hess and Wasser 1982, Holway 1962, Holway and Ward 1963, Johnston 1987, Komarkova 1976, Willard 1963, Willard 1979
Dryas octopetala - Carex spp. Dwarf-shrub Herbaceous Vegetation	Bamberg and Major 1968
Dryas octopetala - Polygonum viviparum Dwarf-shrub Herbaceous Vegetation	Cooper and Lesica 1992, Cooper et al. 1997
Eleocharis palustris Herbaceous Vegetation	Baker 1983, Baker and Kennedy 1985, Brotherson and Barnes 1984, Hansen et al. 1987, Hansen et al. 1995, Kettler and McMullen 1996, Kittel et al. 1994, Kovalchik 1993, M
Eleocharis quinqueflora Herbaceous Vegetation	Briggs and MacMahon 1983, Cooper 1990, Hansen et al. 1988, Jensen and Tuhy 1981, Johnston 1987, Kittel et al. 1994, Kovalchik 1987, Mattson 1984, Padgett et al. 1989
Elymus elymoides Herbaceous Vegetation	
Elymus lanceolatus - Phacelia hastata Herbaceous Vegetation	DeVelice 1992
Equisetum fluviatile Herbaceous Vegetation	Bursik and Moseley 1995, Hansen et al. 1991, Hansen et al. 1995, Kovalchik 1993

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Festuca campestris - Festuca idahoensis - Stipa richardsonii Herbaceous Vegetation	
Festuca campestris - Festuca idahoensis Herbaceous Vegetation	Daubenmire 1970, Hodgkinson and Young 1973, Mclean 1970, Mueggler and Stewart 1980, Tisdale 1947, Tisdale and Bramble-Brodahl 1983, Tisdale and McLean 1957
Festuca campestris - Pseudoroegneria spicata Herbaceous Vegetation	Mueggler and Stewart 1980
Festuca idahoensis - Carex filifolia Herbaceous Vegetation	Mueggler and Stewart 1980
Festuca idahoensis - Danthonia intermedia Herbaceous Vegetation	Mattson and National n.d.
Festuca idahoensis - Deschampsia cespitosa Herbaceous Vegetation	Mueggler and Stewart 1980
Festuca idahoensis - Elymus trachycaulus Herbaceous Vegetation	Hess and Wasser 1982, Johnston 1987, Mueggler and Stewart 1980
Festuca idahoensis - Festuca kingii Herbaceous Vegetation	Idaho Conservation Data Center n.d., Montana Natural Heritage Program n.d.
Festuca idahoensis - Pascopyrum smithii Herbaceous Vegetation	Mueggler and Stewart 1980
Festuca idahoensis - Potentilla diversifolia Herbaceous Vegetation	Caicco 1983, Cooper and Lesica 1992, Cooper et al. 1997, Moseley 1985
Festuca idahoensis - Pseudoroegneria spicata Herbaceous Vegetation	Mueggler and Stewart 1980, Tisdale 1986
Festuca idahoensis - Stipa richardsonii Herbaceous Vegetation	Mueggler and Stewart 1980
Festuca idahoensis Herbaceous Vegetation	Johnson 1970
Festuca kingii - Oxytropis campestris Herbaceous Vegetation	Cooper and Lesica 1992
Festuca kingii Herbaceous Vegetation	Montana Natural Heritage Program n.d.
Geum rossii - Minuartia obtusiloba Herbaceous Vegetation	Cooper and Lesica 1992
Glyceria borealis Herbaceous Vegetation	Hansen et al. 1995
Hordeum jubatum Herbaceous Vegetation	Bunin 1985, Hansen et al. 1991, Redmann 1972, Reid 1974, Vestal 1914
Juncus balticus - Carex praegracilis Herbaceous Vegetation	
Juncus balticus Herbaceous Vegetation	Brotherson and Barnes 1984, Bunin 1985, Flowers 1962, Hansen et al. 1988, Hansen et al. 1991, Hess 1981, Kittel et al. 1994, Komarkova 1986, Manning 1988,
Juncus drummondii - Antennaria lanata Herbaceous Vegetation	Cooper and Lesica 1992
Juncus parryi - Erigeron ursinus Herbaceous Vegetation	Cooper and Lesica 1992
Juniperus scopulorum / Artemisia nova Woodland	DeVelice and Lesica 1993, Lesica and DeVelice 1992
Juniperus scopulorum / Artemisia tridentata Woodland	Cooper et al. 1995, DeVelice 1992, DeVelice et al. 1995, Hess 1981, Hess and Alexander 1986, Jennings 1978, Jennings 1979, Johnston 1987, Wasser and Hess 1982

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Juniperus scopulorum / Cercocarpus ledifolius Woodland	DeVelice 1992
Juniperus scopulorum / Cornus sericea Woodland	Hansen et al. 1991, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1998, Osborn et al. 1998
Juniperus scopulorum / Pseudoroegneria spicata Woodland	Brown 1971, Francis 1983, Hansen 1985, Hansen and Hoffman 1988, Johnston 1987, Strong 1980, Tiedemann et al. 1987
Kalmia microphylla / Carex scopulorum Dwarf-shrubland	Boggs et al. 1990, Hansen et al. 1988, Hansen et al. 1991
Larix lyallii - Abies lasiocarpa Forest [Provisional]	Pfister et al. 1977
Leymus cinereus - Festuca idahoensis Herbaceous Vegetation	Ross et al. 1973
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation	Mueggler and Stewart 1980
Leymus cinereus - Puccinellia nuttalliana Herbaceous Vegetation	
Leymus cinereus Herbaceous Vegetation [Provisional]	Aldous and Shantz 1924, DeVelice 1992, Johnson and Simon 1987, Knight et al. 1976, Mueggler and Stewart 1980, Thilenius et al. 1995, Walker and Brotherson 1982
Pascopyrum smithii Herbaceous Vegetation [Provisional]	Baker 1983, Baker and Kennedy 1985, Bunin 1985, Christensen and Welsh 1963, Hansen et al. 1991, Marr and Buckner 1974, Ramaley 1942, Shanks 1977, Thilenius et al. 1995
Pentaphylloides floribunda / Carex utriculatra Shrubland	
Pentaphylloides floribunda / Deschampsia cespitosa Shrubland	Hansen et al. 1991, Kettler and McMullen 1996, Mutz and Graham 1982, Padgett et al. 1988, Padgett et al. 1989, Sanderson and March 1996, Youngblood et al. 1985
Pentaphylloides floribunda / Festuca campestris Shrub Herbaceous Vegetation	Mueggler and Stewart 1980
Pentaphylloides floribunda / Festuca idahoensis Shrub Herbaceous Vegetation	Mattson and National n.d., Mueggler and Stewart 1980, Tweit and Houston 1980, Youngblood et al. 1985
Pentaphylloides floribunda / Potentilla ovina Shrubland	
Phalaris arundinacea Western Herbaceous Vegetation	Boggs et al. 1990, Hansen et al. 1991, Hansen et al. 1995
Phragmites australis Temperate Herbaceous Vegetation	Baker 1982, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1995
Phyllodoce empetriformis / Antennaria lanata Dwarf-shrubland	Cooper and Lesica 1992, Cooper et al. 1997
Picea (engelmannii X glauca, engelmannii) / Carex disperma Forest	Steele et al. 1981, Steele et al. 1983
Picea (engelmannii X glauca, engelmannii) / Cornus sericea Forest	Hansen et al. 1991, Hansen et al. 1995
Picea (engelmannii X glauca, engelmannii) / Galium triflorum Forest	Pfister et al. 1977
Picea (engelmannii X glauca, engelmannii) / Juniperus communis Forest	Roberts 1980
Picea (engelmannii X glauca, engelmannii) / Linnaea borealis Forest	Pfister et al. 1977

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Picea (engelmannii X glauca, engelmannii) / Maianthemum stellatum Forest	Fisher and Clayton 1983, Pfister et al. 1977
Picea (engelmannii X glauca, engelmannii) / Physocarpus malvaceus Forest	Pfister et al. 1977
Picea (engelmannii X glauca, engelmannii) / Senecio streptanthifolius Forest	Pfister et al. 1977
Picea (engelmannii X glauca, engelmannii) / Vaccinium cespitosum Forest	Pfister et al. 1977
Picea engelmannii / Calamagrostis canadensis Forest	Boggs et al. 1990, Youngblood et al. 1985, Zuck 1974
Picea engelmannii / Caltha leptosepala Forest	Johnston 1987, Mauk and Henderson 1984, Steele et al. 1983
Picea engelmannii / Equisetum arvense Forest	Crowe and Clausnitzer 1997, Johnston 1987, Kettler and McMullen 1996, Kovalchik 1987, Mauk and Henderson 1984, Osborn et al. 1998, Padgett et al. 1989, Pfister et al. 1977, Steele et al. 1981
Picea engelmannii / Hypnum revolutum Forest	Johnston 1987, Steele et al. 1981, Steele et al. 1983
Pinus albicaulis - Abies lasiocarpa Woodland [Provisional]	Cooper et al. 1987, Pfister et al. 1977, Steele et al. 1981
Pinus albicaulis / Carex geyeri Woodland	Arno and Weaver 1990, Bowerman et al. 1997, Cooper 1975, Hall 1973, Johnston 1987, Murray 1996, Nesser 1997, Rust 1998, Schlatterer 1972, Steele et al. 1983
Pinus albicaulis / Carex rossii Forest	Johnston 1987, Reed 1969, Steele et al. 1983
Pinus albicaulis / Festuca idahoensis Woodland	Johnston 1987, Montana Natural Heritage Program n.d., Steele et al. 1983
Pinus albicaulis / Juniperus communis Woodland	Johnston 1987, Reed 1969, Steele et al. 1983
Pinus albicaulis / Vaccinium scoparium Forest	Cooper 1975, Johnston 1987, Reed 1969, Steele et al. 1983,
Pinus albicaulis Woodland [Provisional]	Pfister et al. 1977
Pinus contorta / Arnica cordifolia Forest	Johnston 1987, Steele et al. 1983
Pinus contorta / Calamagrostis rubescens Forest	Horton 1971, Johnson and Clausnitzer 1992, Pfister et al. 1977, Steele et al. 1983, Tisdale and McLean 1957
Pinus contorta / Carex geyeri Forest	Alexander et al. 1986, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Johnston 1987, Moir 1969, Steele et al. 1981, Steele et al. 1983, Wasser and Hess 1982
Pinus contorta / Carex rossii Forest	Alexander et al. 1986, Mauk and Henderson 1984, Steele et al. 1983
Pinus contorta / Juniperus communis Woodland	Alexander 1981, Alexander et al. 1986,Hess and Alexander 1986, Johnston 1987, Mauk and Henderson 1984, Moir 1969, Roberts 1980, Steele et al. 1981, Steele et al. 1983
Pinus contorta / Linnaea borealis Forest	Johnson and Simon 1987, Pfister et al. 1977, Steele et al. 1983
Pinus contorta / Spiraea betulifolia Forest	Steele et al. 1983
Pinus contorta / Vaccinium cespitosum Forest	Cooper et al. 1987, Mauk and Henderson 1984, Pfister et al. 1977, Steele et al. 1981

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Pinus contorta / Vaccinium scoparium Forest	Alexander et al. 1986, Cooper et al. 1987, Hall 1973, Harrington 1978, Hess 1981, Hess and Alexander 1986, Hoffman and Alexander 1976, Johnston 1987, Komarkova et al. 1988, Marr et al. 1973, Mauk and Henderson 1984, Oswald 1966
Pinus contorta / Xerophyllum tenax Forest	Arno et al. 1985, Cooper et al. 1987, Volland 1976
Pinus contorta Scree Woodland	Montana Natural Heritage Program n.d.
Pinus flexilis / Cercocarpus ledifolius Woodland	DeVelice 1992, Mauk and Henderson 1984, Steele et al. 1981, Steele et al. 1983
Pinus flexilis / Festuca idahoensis Woodland	Johnston 1987, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983
Pinus flexilis / Juniperus communis Woodland	Alexander et al. 1986, Cole 1982, Hoffman and Alexander 1980, Johnston 1987, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Wasser and Hess 1982
Pinus flexilis / Pseudoroegneria spicata Woodland	Pfister et al. 1977
Pinus flexilis / Scree Woodland	Pfister et al. 1977
Pinus ponderosa / Pseudoroegneria spicata Woodland	Cooper et al. 1987, Daubenmire and Daubenmire 1968, Hall 1973, Hansen and Hoffman 1988, Hoffman and Alexander 1976, Johnson and Clausnitzer 1992, Johnson and Simon 1985
Poa juncifolia Herbaceous Vegetation	Blackburn et al. 1969, Manning 1988
Poa palustris Herbaceous Vegetation	Hansen et al. 1991, Hansen et al. 1995
Poa pratensis Herbaceous Vegetation [Provisional]	Sawyer and Keeler-Wolf 1995
Populus angustifolia / Cornus sericea Woodland	Hansen et al. 1995, Hess and Wasser 1982, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1995, Muldavin and Johnson 1993,Padgett et al. 1988, Padgett et al. 1989, Richard et a
Populus balsamifera ssp. trichocarpa / Poa pratensis Forest	Hansen et al. 1995
Populus tremuloides / Amelanchier alnifolia Forest	Montana Natural Heritage Program n.d.
Populus tremuloides / Bromus carinatus Forest	Mueggler 1988, Mueggler and Campbell 1986
Populus tremuloides / Calamagrostis canadensis Forest	Boggs et al. 1990, Hansen et al. 1991, Mutel 1973, Powell 1988
Populus tremuloides / Calamagrostis rubescens Forest	Alexander et al. 1986, Cooper and Pfister 1981, Mueggler 1988, Mueggler and Campbell 1982, Mueggler and Campbell 1986, Williams and Lillybridge 1983, Youngblood and Mueggler 1981
Populus tremuloides / Cornus sericea Forest	Evans 1989, Hansen et al. 1990, Hansen et al. 1991, Kittel et al. 1994, Richard et al. 1996
Populus tremuloides / Poa pratensis Forest	
Populus tremuloides / Symphoricarpos oreophilus Forest	Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnston 1987, Johnston and Hendzel 1985, Keammerer and Peterson 1981, Keammerer and Stoecker 1975, Keammerer and Stoecker 1980
Populus tremuloides / Tall Forbs Forest	Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnston and Hendzel 1985,Kittel et al. 1994, Lewis 1975, Marr et al. 1973, Mueggler 1988

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Populus tremuloides / Thalictrum fendleri Forest	Boyce 1977, Bunin 1975, Crouch 1983, Hess 1981, Hess and Alexander 1986, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnston 1987, Johnston and Hendzel 1985, Komarkova et al. 1988, Langenheim 1962, Mueggler 1988
Pseudoroegneria spicata - Bouteloua gracilis Herbaceous Vegetation	Bear Creek Uranium Mine Application n.d., Boutton et al. 1980, Francis 1983, Mueggler and Stewart 1980, Terwilliger and Tiedemann 1978, Thilenius et al. 1995, Tiedemann et al. 1987
Pseudoroegneria spicata - Cushion Plant Herbaceous Vegetation	Lesica and DeVelice 1992
Pseudoroegneria spicata - Koeleria macrantha Herbaceous Vegetation	Ross et al. 1973
Pseudoroegneria spicata - Oryzopsis hymenoides Herbaceous Vegetation	Baker 1983, Baker 1984, DeVelice 1992
Pseudoroegneria spicata - Pascopyrum smithii Herbaceous Vegetation	Hansen and Hoffman 1988, Mueggler and Stewart 1980
Pseudoroegneria spicata - Poa secunda - Stipa comata Herbaceous Vegetation	
Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	Daubenmire 1970, Fisser et al. 1965, Hall 1973, Johnson and Simon 1985, Johnson and Simon 1987,Mueggler and Stewart 1980, Poulton 1955, Price and Brotherson 1987
Pseudoroegneria spicata - Stipa comata Herbaceous Vegetation	Anderson 1956,Daubenmire 1970, Hyde 1964, Montana Natural Heritage Program n.d., Mueggler and Stewart 1980, Poulton 1955, Tweit and Houston 1980
Pseudotsuga menziesii / Arnica cordifolia Forest	Johnston 1987, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983
Pseudotsuga menziesii / Calamagrostis rubescens Forest	Cooper et al. 1987, Daubenmire 1952, Daubenmire and Daubenmire 1968, Hall 1973, Horton 1971, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1987
Pseudotsuga menziesii / Carex geyeri Forest	Clausnitzer and Zamora 1987, Cooper et al. 1987,Hess 1981, Hess and Alexander 1986, Johnston 1987,Pfister et al. 1977, Steele et al. 1981, Williams and Smith 1990
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland	DeVelice 1992, Johnson and Clausnitzer 1992, Mauk and Henderson 1984, Steele et al. 1981, Steele et al. 1983, Youngblood and Mauk 1985
Pseudotsuga menziesii / Cornus sericea Woodland	Hansen et al. 1990, Hansen et al. 1991, Hansen et al. 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1997, Osborn et al. 1998, Richard et al. 1996
Pseudotsuga menziesii / Festuca campestris Woodland	Pfister et al. 1977
Pseudotsuga menziesii / Festuca idahoensis Woodland	Johnston 1987, Pfister et al. 1977, Steele et al. 1983
Pseudotsuga menziesii / Juniperus communis Forest	Giese 1975, Johnston 1987, Murphy 1982, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Vories 1974
Pseudotsuga menziesii / Juniperus scopulorum Woodland	Roberts et al. 1979
Pseudotsuga menziesii / Linnaea borealis Forest	Pfister et al. 1977, Steele et al. 1981
Pseudotsuga menziesii / Mahonia repens Forest	Alexander et al. 1984, Hoffman and Alexander 1976, Larson and Moir 1987, Mauk and Henderson 1984, Roberts 1980, Roberts et al. 1992, Steele et al. 1981, Steele et al. 1983, Youngblood and Mauk 1985

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Pseudotsuga menziesii / Physocarpus malvaceus Forest	Clausnitzer and Zamora 1987, Cooper et al. 1987, Daubenmire 1952, Daubenmire and Daubenmire 1968, Hall 1973, Johnson and Simon 1987, Johnston 1987, Mauk and Henderson 1984, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland	Cole 1982, Pfister et al. 1977
Pseudotsuga menziesii / Spiraea betulifolia Forest	Cooper et al. 1987, Horton 1971, Johnson and Simon 1987, Johnston 1987, Oswald 1966, Pfister et al. 1977, Steele et al. 1983, Youngblood and Mueggler 1981
Pseudotsuga menziesii / Symphoricarpos albus Forest	Cooper et al. 1987, Daubenmire and Daubenmire 1968, Johnson and Simon 1987, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Williams and Lillybridge 1983
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	Hess and Wasser 1982, Johnson and Simon 1987, Johnston 1987, Mauk and Henderson 1984, Muldavin 1994, Pfister et al. 1977, Reed 1976, Steele et al. 1981, Steele et al. 1983
Pseudotsuga menziesii / Vaccinium membranaceum Forest	Cooper et al. 1987,Johnston 1987, Pfister et al. 1977, Steele et al. 1983
Pseudotsuga menziesii Scree Woodland	DeVelice et al. 1986, Fitzhugh et al. 1987, Pfister et al. 1977
Puccinellia nuttalliana Herbaceous Vegetation	Ungar 1972, Ungar 1974, Heidel and Cooper 1997
Purshia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation	Daubenmire 1970, Hall 1973, Johnson and Simon 1987, Lewis 1975, Mueggler and Stewart 1980, Tweit and Houston 1980
Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Daubenmire 1970, Hall 1973, Hironaka et al. 1983, Johnson and Simon 1987, Mueggler and Stewart 1980
Rhus trilobata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Bighorn Coal Mine n.d., Brown 1971, Hansen and Hoffman 1988, Mueggler and Stewart 1980, Tweit and Houston 1980
Rosa woodsii Shrubland	Hansen et al. 1990, Hansen et al. 1991
Salix arctica / Polygonum bistortoides Dwarf-shrubland	Cooper and Lesica 1992, Cooper et al. 1997
Salix bebbiana Shrubland	Baker 1982, Dick-Peddie 1993, Hansen et al. 1991, Osborn et al. 1998, Szaro 1989
Salix boothii / Calamagrostis canadensis Shrubland	Mutz and Graham 1982, Mutz and Queiroz 1983, Norton et al. 1981, Padgett et al. 1988, Tuhy and Jensen 1982, Youngblood et al. 1985
Salix boothii / Carex utriculata Shrubland	Kittel and Lederer 1993, Kittel et al. 1994, Kovalchik 1987, Mutz and Graham 1982, Mutz and Queiroz 1983, Padgett et al. 1988, Padgett et al. 1989, Tuhy and Jensen 1982
Salix boothii / Mesic Graminoids Shrubland	Padgett et al. 1988, Padgett et al. 1989, Reid 1990
Salix brachycarpa / Carex aquatilis Shrubland	Colorado Natural Heritage Program n.d., Osborn et al. 1998
Salix candida / Carex lasiocarpa Shrubland	
Salix candida / Carex utriculata Shrubland	Hansen et al. 1991, Steele et al. 1981
Salix drummondiana / Calamagrostis canadensis Shrubland	Baker 1986, Baker 1989, Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Komarkova 1986, Sanderson and Kettler 1996, Tuhy and Jensen 1982
Salix drummondiana / Carex utriculata Shrubland	Kovalchik 1993, Moseley et al. 1994
Salix drummondiana Shrubland [Provisional]	Baker 1989, Boggs et al. 1990, Hansen et al. 1989, Hansen et al. 1991, Kittel and Lederer 1993, Phillips 1977

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Salix exigua Temporarily Flooded Shrubland	Evenden 1990, Foti et al. 1994, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1997, Kittel and Lederer 1993, Kovalchik 1987, Phillips 1977
Salix geyeriana / Calamagrostis canadensis Shrubland	Cooper and Cottrell 1990, Hansen et al. 1991, Johnston 1987, Kettler and McMullen 1996, Kittel et al. 1994, Osborn et al. 1998, Padgett et al. 1989, Tuhy and Jensen 1982, Youngblood et al. 1985
Salix geyeriana / Carex utriculata Shrubland	Hansen et al. 1991, Kettler and McMullen 1996, Kittel and Lederer 1993, Mutz and Queiroz 1983, Padgett et al. 1989, Tuhy and Jensen 1982, Youngblood et al. 1985
Salix geyeriana / Deschampsia cespitosa Shrubland	Jensen and Tuhy 1981, Montana Natural Heritage Program n.d., Padgett et al. 1988, Padgett et al. 1989
Salix glauca Shrubland	Cooper and Lesica 1992
Salix lutea / Calamagrostis canadensis Shrubland	Hansen et al. 1991
Salix planifolia / Carex aquatilis Shrubland	Baker 1989, Cooper and Cottrell 1990, Hansen et al. 1988, Hansen et al. 1991, Hess 1981, Hess and Wasser 1982, Jensen and Tuhy 1981, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Komarkova 1986, Lewis
Salix planifolia / Carex nebrascensis Shrubland	
Salix planifolia / Carex scopulorum Shrubland	Hess 1981, Hess and Wasser 1982, Komarkova 1976, Komarkova 1986
Salix reticulata / Caltha leptosepala Dwarf-shrubland	Cooper and Lesica 1992, Cooper et al. 1997
Salix wolfii / Carex aquatilis Shrubland	Baker 1986, Baker 1989, Hansen et al. 1991, Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1996, Mattson 1984
Salix wolfii / Deschampsia cespitosa Shrubland	Hansen et al. 1991, Padgett et al. 1988, Padgett et al. 1989, Youngblood et al. 1985
Sarcobatus vermiculatus / Distichlis spicata Shrubland	Daubenmire 1970, Franklin and Dyrness 1973, Mueggler and Stewart 1980
Sarcobatus vermiculatus / Elymus lanceolatus Shrub Herbaceous Vegetation	Jorgensen 1979
Sarcobatus vermiculatus / Leymus cinereus Shrubland	Mueggler and Stewart 1980
Sarcobatus vermiculatus / Pascopyrum smithii Shrub Herbaceous Vegetation	Hansen and Hoffman 1988, Mueggler and Stewart 1980, Olson and Gerhart 1982
Scirpus acutus Herbaceous Vegetation	Hansen et al. 1991, Hansen et al. 1995
Scirpus tabernaemontani Temperate Herbaceous Vegetation	Hansen et al. 1988, Kovalchik 1993, Sanderson and Kettler 1996
Senecio triangularis Herbaceous Vegetation	Hansen et al. 1991, Hansen et al. 1995, Komarkova 1976
Shepherdia argentea Shrubland [Provisional]	Hansen et al. 1991, Kittel and Lederer 1993, Kittel et al. 1994, Osborn et al. 1998
Silene acaulis Herbaceous Vegetation	Bamberg 1961
Sporobolus airoides Herbaceous Vegetation	Aldous and Shantz 1924, Cooper 1984, Francis 1986, Johnston 1987, Kittel and Lederer 1993, Lesica and DeVelice 1992, Steward 1982, Ungar 1974
Stipa comata - Bouteloua gracilis - Pascopyrum smithii Herbaceous Vegetation	

Appendix D.
Plant Associations: Principal and Substantiating References

Plant Association Name	Principle Reference Source
Stipa comata - Bouteloua gracilis Herbaceous Vegetation	Hess 1981, Johnston 1987, Mueggler and Stewart 1980, Ramaley 1916, Soil Conservation Service 1978, Stoecker-Keammerer Consultants n.d.
Stipa comata - Psoralea tenuiflora Herbaceous Vegetation	
Symphoricarpos occidentalis Shrubland [Provisional]	Christy 1973, Clark 1977, Clark et al. 1980, Hansen et al. 1991, Kittel et al. 1994, Osborn et al. 1998
Typha latifolia Western Herbaceous Vegetation	Bunin 1985, Christy 1973, Hansen et al. 1991, Kittel et al. 1996, Kovalchik 1993, Lindauer and Christy 1972, Muldavin and Johnson 1993, Padgett et al. 1989,Youngblood et al. 1985

Index to Descriptions of Types