National Park Service
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Natural Resource Stewardship and Science

Vegetation Inventory Project

Great Basin National Park

Natural Resource Report NPS/MOJN/NRR—2012/568

ON THE COVER
Wheeler Peak as viewed from Wheeler Peak Scenic Drive in GRBA
Photograph by: Dan Cogan

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Executive Summary

Great Basin National Park (GRBA) covers approximately 31,258 hectares (77,180 acres) in east central Nevada along the Utah border. The park was established to preserve a representative segment of the Great Basin region and to promote an understanding of the natural and cultural heritage of this physiographic region. GRBA gets its name from its location in the Great Basin desert region of the United States but more closely resembles the "ranges and basins" geologic province, due to the South Snake Range located in the center of the park. The South Snake Range creates a rugged landscape containing many natural and unique vegetation types including sparse alpine cushion plants and ancient bristlecone pine forests. To better understand and document GRBA's vegetation and to establish a baseline for comparison against future conditions the National Park Service (NPS) and the NPS Mojave Desert Network Inventory and Monitoring Program (MOJN I&M) started a GRBA vegetation inventory effort in 2007.

A five-year, four phase program was initiated to complete the task of classifying and mapping the vegetation at GRBA. Phase one was conducted by a combination of botanists and ecologists from NPS, MOJN I&M, GRBA, and NatureServe who collected 340 classification plots, observation points, and rapid assessment points across much of the park. In phase two, all of the field data was analyzed by NatureServe to classify 105 associations and 31 GRBA-specific vegetation types using the revised U.S. National Vegetation Classification (rUSNVC). Phase three, directed by Cogan Technology, Inc (CTI) produced a digital vegetation map that was validated using 70 independent data points. In the final phase, contracted scientists from Logan Simpson, Inc collected 872 stratified random accuracy assessment (AA) points to check and finalize the map.

GRBA's spatial database and map layer was produced from high-resolution 2007 Digital Map, Inc. imagery provided to CTI by the NPS. By comparing the signatures on the imagery to field and ground data, 64 map units (48 vegetated, four barren geology and snow, and 12 land-use / land-cover) were developed and the vegetation map units were directly cross-walked or matched to their corresponding rUSNVC plant associations. The interpreted and remotely sensed data were converted to Geographic Information System (GIS) spatial geodatabases and maps were printed, field tested, reviewed, and revised. The final map layer was accessed for thematic accuracy by creating contingency tables and the final overall accuracy of the map layer was determined to be 84% with a Kappa value of 82%.

Products developed for GRBA are described and presented in this report, as well as stored on the accompanying DVD. These include:

- A *Final Vegetation Inventory Report* that includes keys to the vegetation and imagery signatures, AA information, and all of the project methods and results;
- A *Spatial GIS Database* containing spatial data for the vegetation, plots, and AA points;
- *Digital Photos* from the field sampling efforts;
- *Metadata* for all spatial data (Federal Geographic Data Committee -compliant);
- *Vegetation Descriptions and Photo Signature Key* to the associations and map classes.

Please access the NPS Integrated Resource Management Application website for posting of this information: https://irma.nps.gov/App/Reference/Profile.

Acknowledgments

The production of this vegetation inventory was inspired by the enthusiasm and energy of many people over several years. The authors gratefully acknowledge the dedication of all involved in the completion of this project and production of this report.

We would like to specifically thank Tod Williams (Chief of Science and Resource Management) and Ben Roberts (Chief of Natural Resources) at Great Basin National Park for their input and commitment to this project. We'd also like to acknowledge Gretchen Baker, Bryan Hamilton, and the rest of the resource management staff at Great Basin National Park for their support and assistance with data acquisition, field work, and technical review of the final report.

We are grateful to the staff at the Mojave Desert Network Inventory and Monitoring Program and Lake Mead National Recreation Area who helped with contracting and project support.

Special recognition goes to Karl Brown and Tammy Cook with the National Park Service - Vegetation Inventory Program in Fort Collins, Colorado for prioritizing this project and providing funding. Without their financial support this project would not have been possible.

Introduction

National Vegetation Inventory Program

The National Vegetation Inventory Program (NVIP) was started as a cooperative effort between the National Park Service (NPS) and the United States Geological Survey (USGS) to classify, describe, and map existing vegetation communities in more than 270 national parks across the United States. The primary objective of the NVIP is to produce high-quality plant community classifications, standardized maps and associated data sets of the vegetation currently occurring within the parks. This information fills data gaps and complements a wide variety of resource assessments, park management, and conservation needs. Among its many uses, the NVIP products have helped park managers better identify and conserve plant biodiversity; manage non-native and rare species, monitor insect and disease effects; and provide a baseline to examine wildlife habitat relationships and the effects of wildland fires.

In 1999, the Director of the NPS approved the Natural Resource Challenge to encourage national parks to focus on the preservation of the nation's natural heritage through science, natural resource inventories, and expanded resource monitoring. The Natural Resource Challenge provided funding for 12 baseline inventories to be completed in each of 270 parks with significant natural resources. The vegetation mapping inventory is considered one of these 12 baseline inventories.

NVIP follows well-established procedures that are compatible with other agencies and organizations. The inventory uses the revised National Vegetation Classification Standard, Version 2 (rUSNVC) (FGDC 2008), a system that is integrated with the major scientific efforts in the taxonomic classification of vegetation, and is a Federal Geographic Data Committee (FGDC) standard (FGDC 1997 & FGDC 2008). In addition, stringent quality control procedures ensure the reliability of the vegetation data and encourage the use of resulting maps, reports, and databases at multiple scales.

A complete vegetation mapping project for a park follows a standard 12-step procedure (NPS 2009) and includes the following products:

- Detailed vegetation report
- Digital vegetation map
- Vegetation plot data
- Accuracy assessment data and analysis
- Dichotomous vegetation key
- Photo-interpretation key

Maps and other spatial data products for parks in the Continental United States are normally produced in Universal Transverse Mercator (UTM) projection, North America 1983 (NAD 83) datum, use meters for map and distance units, and have a nominal 1:24,000-scale with a minimum mapping unit (MMU) of 0.5 hectare (1.2 acres). The vegetation maps must meet the National Map Accuracy Standards for positional accuracy (TNC and ESRI 1994a & Lea and Curtis 2010), and the recently revised minimum map class accuracy goal across all vegetation and land cover classes of 60% percent (NPS 2009).

National Vegetation Classification Standard

In 1994, NPS formed the NVIP to cooperatively inventory and map the vegetation in the United States National Parks. Shortly thereafter, the USGS joined into a partnership, which continues to operate today. The goals of this program are to provide baseline ecological data for park resource managers, obtain data that can be examined in a regional and national context, and provide opportunities for future inventory, monitoring, and research activities. In the same year, the NVIP also adopted the U.S. National Vegetation Classification (USNVC) (Grossman et al. 1998) as a basis for the *a priori* definition of vegetation units to be inventoried. The USNVC has since been revised by NatureServe and in 2008 the FGDC formally endorsed the rUSNVC (FGDC 2008).

Use of a standardized vegetation classification system, such as the rUSNVC helps ensure data compatibility throughout the NPS and other agencies (FGDC 2008). A standard system is critical for a systematic inventory and classification of the nation's biological resources for more efficient stewardship and to help prioritize conservation efforts. The rUSNVC is being used for vegetation classification and mapping projects throughout Mojave Desert Network Inventory and Monitoring Program (MOJN I&M) and most of the other NPS Networks. The USNVC has been existence for over two decades and has evolved from the original classification systems first developed jointly by The Nature Conservancy (TNC), NatureServe, and various state Natural Heritage Programs (TNC and ESRI 1994a, Grossman et al. 1998).

The rUSNVC is a hierarchical system that allows for vegetation classification at multiple scales (FGDC 2008). There are eight levels with specific criteria set for each level (Table 1). The upper three levels are based on climate and physiognomic characteristics that reflect geographically widespread (global) topographic and edaphic factors. The middle three levels focus largely on broad sets of diagnostic plant species and habitat factors along regional-to-continental topographic, edaphic, and disturbance gradients. These middle levels have been drafted and are undergoing peer review (Faber-Langendoen et al. 2010). The lower two levels, as in the original NVC, are the alliance and association and are distinguished by differences in local floristic composition (Grossman et al. 1998).

The broader alliances are physiognomically distinct groups (i.e. forests, woodlands, shrublands, herbaceous vegetation etc.) of plant associations sharing one or more differential or diagnostic species (Mueller-Dombois and Ellenberg 1974). These are commonly the dominant(s) found in the uppermost strata of vegetation. The plant association is the base unit of the classification, and following Jennings et al. (2009) is defined as "a vegetation classification unit defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy."

Content for the rUSNVC is currently maintained by NatureServe and is being peer reviewed through collaboration with federal agencies and the Ecological Society of American (ESA) (Faber-Langendoen et al. 2009). The content is available to the public and is regularly updated through NatureServe Explorer (2010) (http://www.natureserve.org/explorer) and http://www.usnvc.org.

Table 1. Summary of USNVC Revised Hierarchy Levels and Criteria for Natural Vegetation.

Hierarchy Level	Criteria
Upper:	**Physiognomy plays a predominant role**.
L1 – Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.
L2 - Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions.
L3 – Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.
Mid:	**Floristics and physiognomy play predominant roles**
L4 – Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
L5 – Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
L6 – Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology and disturbance regimes.
Lower:	**Floristics plays a predominant role**
L7 – Alliance	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes.
L8 – Association	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

As of June 2012, content (list of types and descriptions) for the upper levels and middle levels of the hierarchy (Formation to Group level) has largely been developed and is undergoing a review process. The lower levels remain in flux with over 6,000 nationwide associations assigned to a Group level that have been screened for levels of confidence before being adopted into the new rUSNVC. The alliance level is undergoing a significant revision and review process to complete the initial content of the rUSNVC. Provisional rUSNVC alliance level units are being developed however, as part of ongoing NVIP projects for several park units in the MOJN I&M, Pacific Island Network, and Grand Canyon National Park. Until a comprehensive alliance revision and review is completed, the alliance level will be unevenly developed with possible changes.

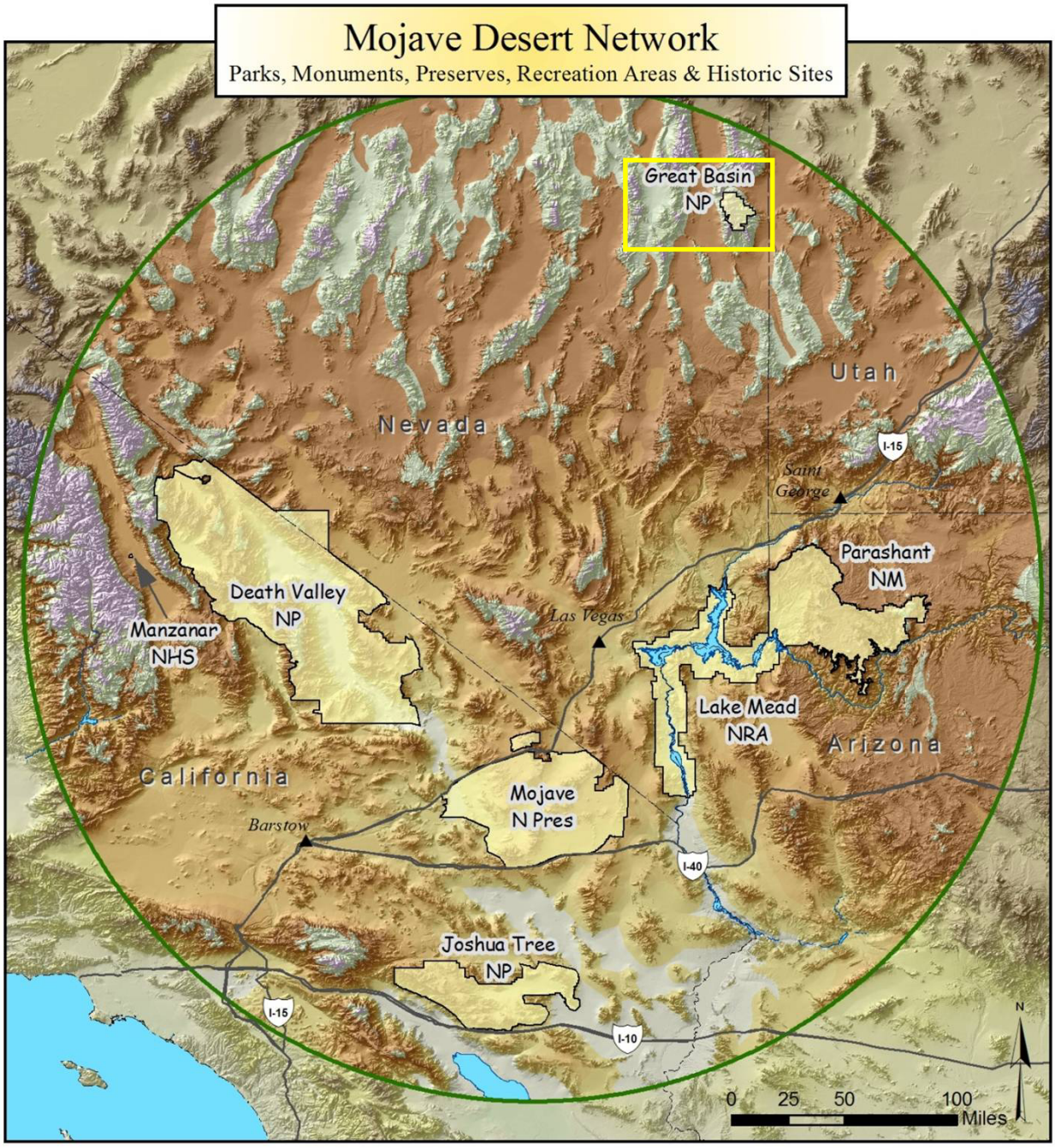
Both rUSNVC associations and alliances are commonly used for map units or classes in NVIP projects to ensure compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These vegetation maps and associated ecological information support a wide variety of resource assessment, park management, and planning needs. In addition they can be used to provide a structure for framing and answering critical scientific questions about plant communities and their relationship to environmental conditions and ecological processes across the landscape.

Mojave Desert Network Inventory and Monitoring Program

MOJN I&M is composed of seven NPS park units located in Arizona, California, and Nevada (Figure 1). MOJN I&M park units include: GRBA, Death Valley National Park, Joshua Tree National Park (JOTR), Lake Mead National Recreation Area (LAKE), Manzanar National Historical Site (MANZ), Mojave National Preserve, and Parashant National Monument. The majority of network parks are within the Great Basin-Mojave Desert region located between the Sierra Nevada Mountains, the Transverse ranges, the Southern Rocky Mountains, and the Columbia and Colorado plateaus. The biota contained in these parks are diverse and contain elements of neighboring ecosystems, including the Sonoran Desert, the Southern California Mountains, the Great Basin, and the Colorado Plateau. Biological diversity across the network is concentrated primarily in riparian habitats (e.g. springs, oases, and stream corridors), montane islands, and specialized habitats (e.g. sand dunes). The network parks contain a variety of regionally, nationally, and globally significant resources.

The MOJN I&M was organized to inventory and monitor status and trends for selected natural resources (network organization facilitates collaboration, information sharing, and economies of scale in natural resource monitoring). The inventory and monitoring information is used by NPS and park unit resource managers to guide management decisions, to inform scientific research, and to provide public education. One goal of the NPS service-wide inventory and monitoring program is to collect and serve data to better understand the dynamic nature and condition of park-managed ecosystems and to provide reference points for comparisons with other management types and possibly with altered environments. The development of a vegetation classification to the vegetation alliance/plant association level and associated GIS map and database for each park is viewed as a high priority in reaching this goal. To help achieve this requirement, the MOJN I&M approached the NVIP for advice and support in 2007 and the GRBA project presented in this report and others at JOTR, MANZ, and LAKE have resulted.

For more information about MOJN I&M please visit their website at: http://science.nature.nps.gov/im/units/mojn and to view examples of other completed NVIP projects in MOJN I&M please access the NPS Integrated Resource Management Application website: https://irma.nps.gov/App/Reference/Profile.



Source: NPS -MOJN I&M

Figure 1. The Mojave Desert Inventory and Monitoring Network Map.

Great Basin National Park

Traveling west from central Utah across the arid flat plains of the Great Basin Desert, the long backbone of the South Snake Range of mountains stretches across the horizon. The tree-lined slopes, barren high ridges and clouded, snowcapped peaks have continually thrilled and enticed numerous travelers -from early 1800's explorers and surveyors to present day tourists and sightseers. Encompassing most of the South Snake Range is GRBA, famous for its tall peaks, ice and snowfields, pristine lakes, ancient bristlecone pine trees, caves, and arches and unique rock formations.

GRBA gets its name from its location in the vast, arid and cold Great Basin Desert region that covers 200,000 square miles from eastern California to Central Utah. The Great Basin region of the United States is comprised of at least 90 individual basins and valleys that route water inland to be evaporated or filtered into the underground aquifers (Grayson 2011). Although GRBA occurs in this region, the park is nothing like its flat surroundings due in part to past geologic faults and glaciations. The uplifting and erosional events have created a rugged landscape that starts in the flat valley at the park administrative area near the town of Baker, Nevada, continues on a more than one mile (1.6 kilometers) gradual incline into the park, and is capped by a winding 10-mile access road to the trailhead at Wheeler Peak, the second highest point in the state of Nevada (NPS 2012).

GRBA was established by the United States to preserve a representative segment of the Great Basin region of the Western United States and to promote an understanding of the natural and cultural heritage of this physiographic region. Today's park began in 1922 with the creation of Lehman Caves National Monument. The original monument covered a square mile area centered around the entrance to the caves on the east-central side of the present-day park boundary. In 1986 the park was created when President Reagan signed the Great Basin National Park Act that transferred 31,225 hectares (77,100 acres) of the former Humboldt National Forest into the NPS creating GRBA. In the early 1990's a new 80-acre administrative area and visitor center along State Route 487 near Baker, Nevada was added putting the current total area of GBRA at approximately 77,180 acres (Figure 2).

Natural Setting

Geographically, GRBA is located in east-central Nevada along the Utah border and is the northern-most unit of the MOJN I&M. GRBA lies entirely within the Great Basin Desert and contains a majority of the South Snake Range. The Snake Range gives GRBA its characteristic rugged landscape, highlighted by snow-covered peaks, steep mountain slopes, rolling foothills, low desert basins and valley floors. Like other isolated ranges in the Basin and Range Province, GRBA is surrounded by basins with the Snake Valley to the east, the Hamlin Valley to the south and the Spring Valley to the west. Between GRBA's mountains and the surrounding valleys are broad, gently sloping alluvial fans.

Source: NPS

Figure 2. Great Basin National Park Map.

GRBA is part of a temperate desert with hot summers and cold, snowy winters. Due to the 8,000 ft (2,400 m) difference in elevation between Wheeler Peak and the valley floor, weather conditions in the park can vary greatly. For example the valley floor can be hot and sunny while clouds are bringing snow to the upper elevations. In general, GRBA high temperatures average 86°F (30°C) in July and 41°F (5°C) in January (as measured at Lehman Caves) with 20 - 30° F (10 - 15°C) drops in temperature at night. GRBA also has low relative humidity and precipitation levels that vary from dry to mesic as elevation increases. Largely because of its distance from urban centers, GRBA often has some of the best visibility in the nation (NPS 2012).

The southern and eastern portions of GRBA are made up of sedimentary rocks (limestone, shale, sandstone) and metamorphic and igneous (granite) rocks are exposed on the north and west sides of the park (NPS 2011). Substrates are variable ranging from un-weathered bedrock and shallow, very thin, coarse textured poorly developed soils to deeper, gravelly or sandy loams and clay loams derived from colluvium or alluvium (USDA-NRCS 2009).

Hydrology in the park is complex with both surface water and significant ground water. There are ten perennial streams flowing from the high mountains and then disappearing into the alluvium in surrounding valleys. Much of the southern portion of the park has karst (limestone) geology where surface water percolates into the rock and flows into aquifers leaving the surface dry (NPS 2011). GRBA is nationally known for its glacial and rock formations and karst geology including the Wheeler Peak glacier, the Lexington Arch, and least 45 natural caves that harbor a variety of biological and physical resources. GRBA's most decorated cave is Lehman Caves, which at 1.5 miles (2.4 kilometers) is the longest cave in Nevada (NPS 2012).

GRBA's elevation gradient and diversity of habitats support a wide variety of plant and animal species from desert adapted lizards and cacti to marmots and cushion plants in the alpine. GRBA also contains eight endemic plant, eight endemic animal species, and high elevation bristlecone pine stands that are over 5000 years old. The isolation of the park combined with pressures from human-related activities has left some of GRBA's flora and fauna vulnerable to localized extinction. To date 50 animal species have been listed by the park as sensitive and 10 plants have been identified by the park as rare and/or sensitive species (GRBA 2006). In addition to native species and habitat preservation other important issues to GRBA's resource management include control of invasive species, fire suppression and water management issues.

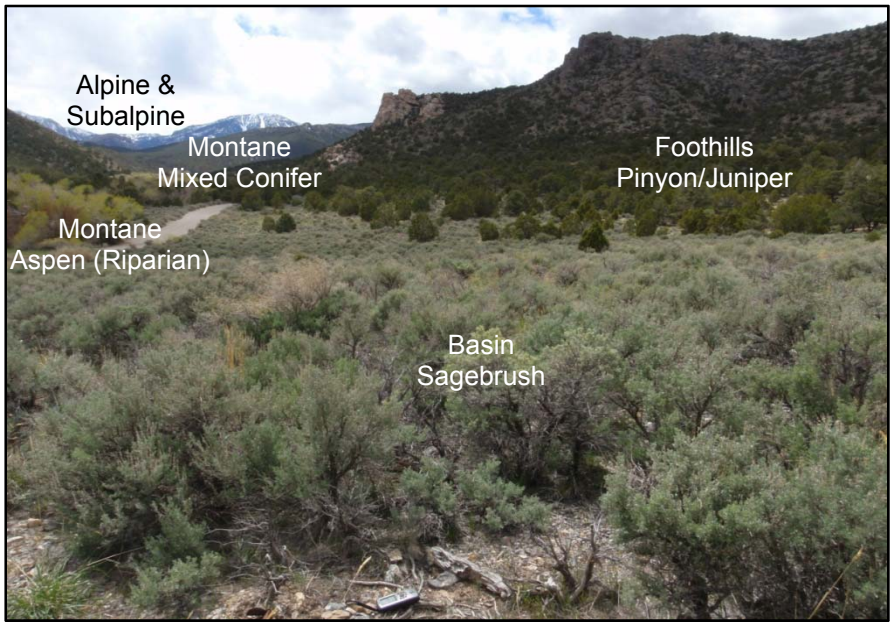
Vegetation

GRBA is a diverse and rugged environment with a steep elevational gradient. Along the gradient various plant communities have become established and have remained largely intact and unchanged throughout the years. The pristine nature of the vegetation and the future threats they face from climate change, fire, and other anthropogenic events has led to various vegetation studies at GRBA. Included in these investigations are a 1998 vegetation inventory of GRBA and surrounding environs by researchers from Oregon State University (OSU) (Eddleman and Jaindl 1994) and a 2003 fire and fire fuel study (Charlet 2003). Both studies were important in developing the GRBA Fire Management Plan (NPS 2007) and documenting the potential plant communities at GRBA.

Mountains lend themselves to be stratified by elevation (Merrian 1895 & Billings 1951) and the resulting life zones can be a valuable tool for understanding the vegetation diversity in complex environments. GRBA is no exception as the vegetation has been grouped by dominant overstory species by elevation into many different plant community classifications. The potential plant communities developed for GRBA's Fire Management Plan (NPS 2007) include the following types (from high to low elevation grouped by biogeographical area or life zone):

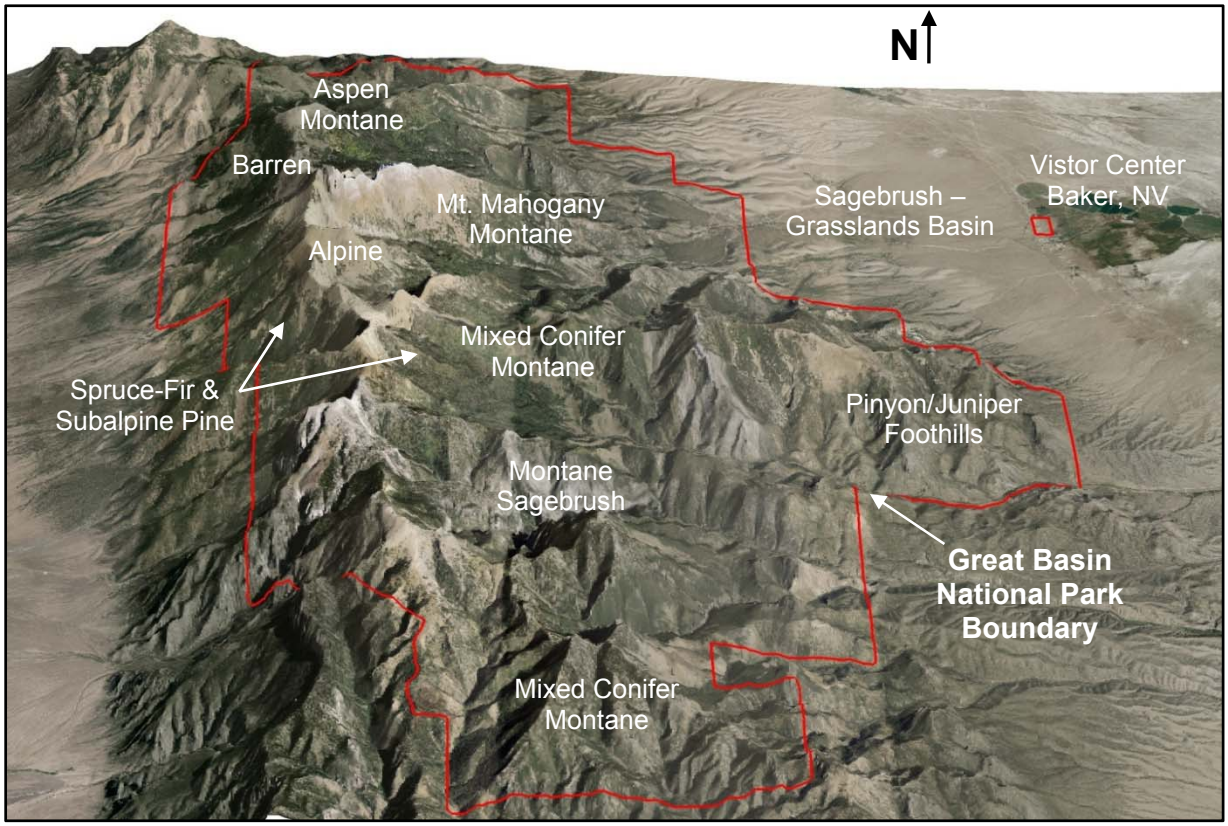
1. Alpine Vegetation – Alpine;
2. Spruce-Fir (dominated by Engelmann spruce, and white fir) – Subalpine;
3. Subalpine Pine (dominated by limber pine and bristlecone pine) – Subalpine;
4. Aspen – Subalpine & Montane;
5. Mixed Conifer (dominated by white-fir, Douglas-fir and limber pine) – Montane;
6. Ponderosa Pine – Montane;
7. Mountain Sagebrush – Montane;
8. Mountain Mahogany Woodlands – Montane & Foothills;
9. Pinyon-Juniper Woodlands – Foothills;
10. Sagebrush/Grasslands – Basin.

Using the potential plant community types, a review of GRBA's existing vegetation data and imagery reveals a general vegetative pattern based on elevation. The vegetation gradient starts at the base of GRBA's highest barren and snow-covered mountain peaks with a sparsely vegetated alpine zone that descends into dense conifer-tree lined subalpine and montane slopes followed by pinyon/juniper foothills that give way to shrublands and grasslands on undulating deposits and flat basins (Figures 3 & 4).

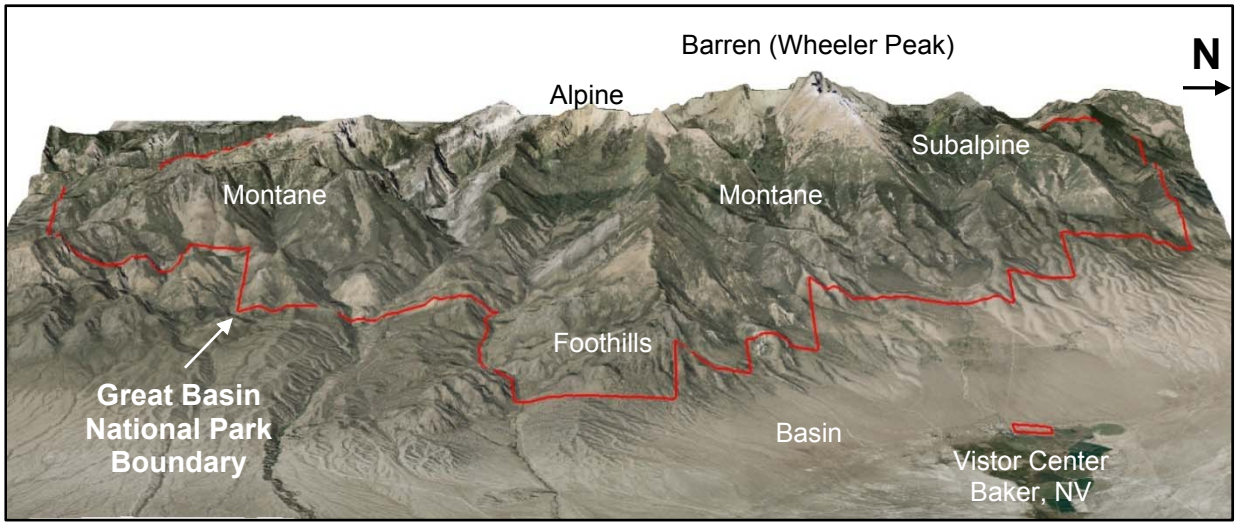


Source: CTI

Figure 3. GRBA Plant Communities and Life Zones example as seen from Snake Creek.



GRBA Overview looking North



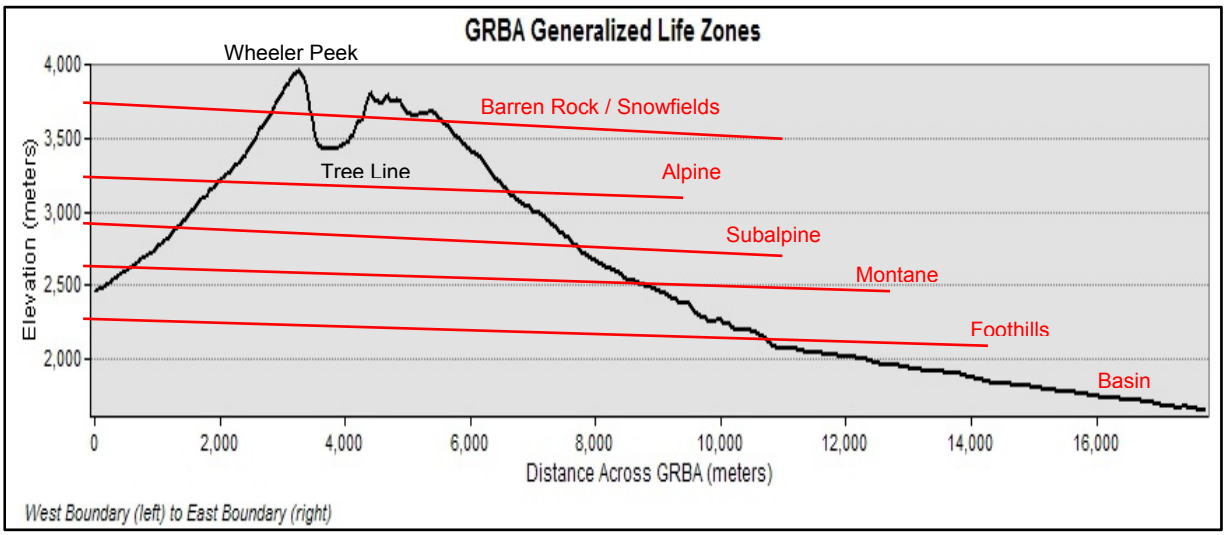
GRBA Overview looking West

Source: CTI, USGS 30-meter DEM, & 2006 NAIP Orthophography

Figure 4. Overview Images of GRBA showing Common Vegetation Patterns.

Further investigation using GPS-located field data shows other vegetation patterns such as general elevational ranges and aspect differences between plant communities located on east vs. west slopes (Figure 5). For instance, since the Snake Range runs north to south through GRBA, elevation gradients occur at slightly different elevations on the east versus west slopes. As a result, life zones on the western slopes of GRBA usually extend 100 to 200 meters further upslope as compared to their counterparts on the eastern side of the park. East-west aspect variation likely occurs due to differences in moisture regimes and solar insulation, with the west slopes getting more sunlight and are thus slightly drier and warmer than those on the eastern side of the park. This trend is verified for only the alpine, subalpine and montane zones as the western boundary of GRBA does not contain any foothill or basin representatives.

To better understand GRBA's vegetation distribution and diversity each of the life zones can be examined individually using their dominant existing plant species (Figure 6). Starting at about 12,000 feet (3,700 meters), GRBA's alpine zone is a cold wind-swept, rocky surface where



Source: CTI, USGS 30-meter DEM

	West -Slope		East-Slope	
Life Zone	Highest Elevation	Lowest Elevation	Highest Elevation	Lowest Elevation
Barren Rock / Snowfields	4,575	3,700	4,575	3,500
Alpine	3,700	3,200	3,500	3,000
Subalpine	3,200	2,900	3,000	2,700
Montane	2,900	2,700	2,700	2,500
Foothills	N/A	N/A	2,500	2,100
Basin	N/A	N/A	<2,100	

Source: CTI and GRBA Plot Data

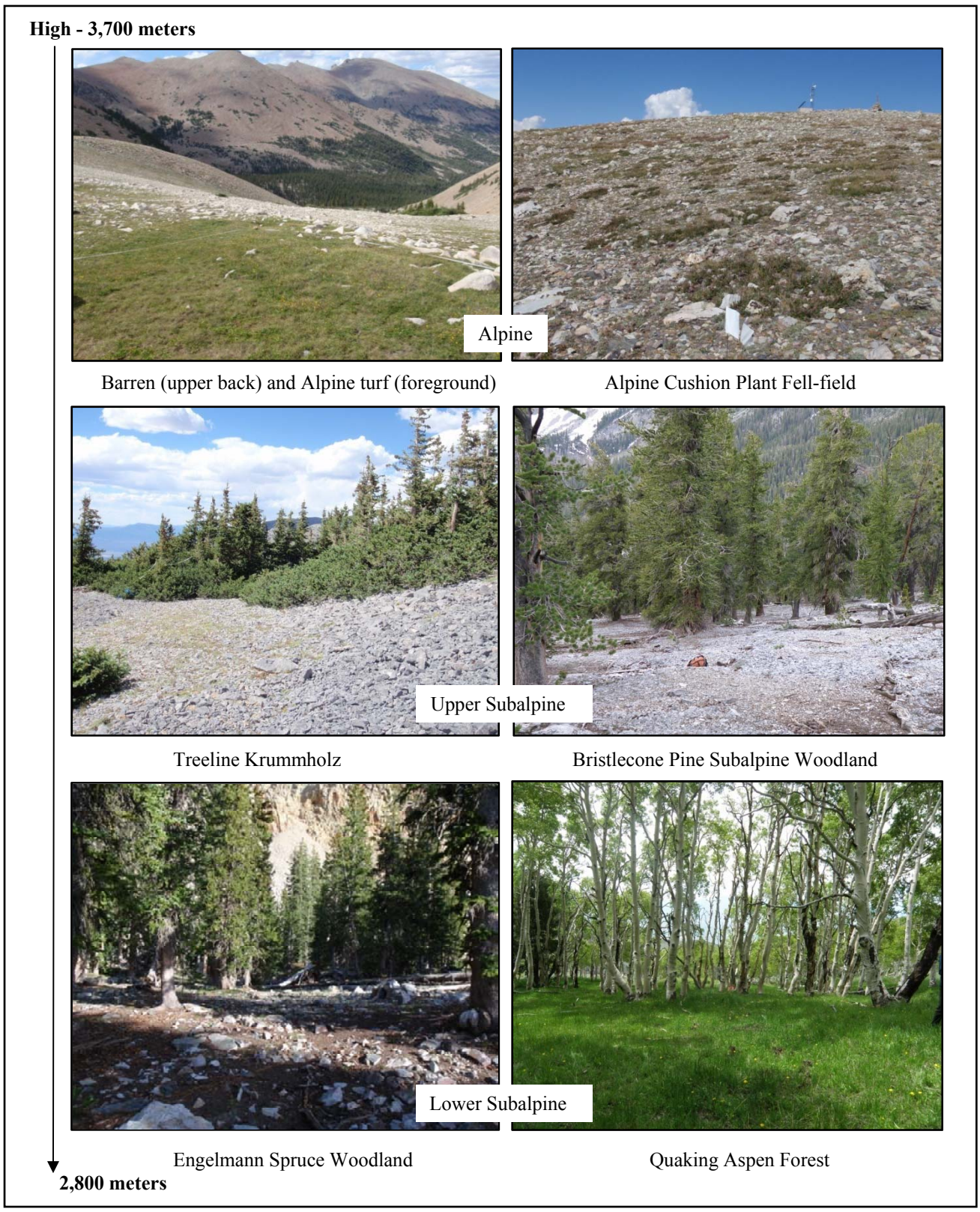
Figure 5. Representative GRBA Cross-section showing Life Zones and Elevation Extents.

only the hardiest sedges (*Carex* spp.), avens (*Geum rossii*), and cushion plants (*Aquilegia scopulorum, Arenaria congesta, Cymopterus nivalis, Polemonium viscosum,* etc.) survive. Tree-line occurs at approximately 9,800 feet (3,000 meters) and is characterized by stunted Krummholz and wind-flagged Engelmann spruce (*Picea engelmannii*), bristlecone pine (*Pinus longaeva*) and limber pine (*Pinus flexilis*) trees. Taller versions of these conifer species continue into the upper subalpine zone where they occur alongside mature stands of quaking aspen (*Populus tremuloides*) trees. Among the various conifer species at GRBA, limber pine occurs probably over the widest elevational gradient and is more associated with dry, rocky sites.

White fir (*Abies concolor*), limber pine and to a lesser degree ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) trees gradually replace the Engelmann spruce trees as large mixed conifer stands come to dominate the lower subalpine and montane zones. The mixed conifer montane areas at GRBA are widespread and contain green-leaf manzanita (*Arctostaphylos patula*) shrublands in canopy openings and dense slopes of curl-leaf mountain mahogany (*Cercocarpus ledifolius*) woodlands. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is also common throughout the montane and foothill zones where it forms thick shrublands with various associated species such as tall serviceberry (*Amelanchier alnifolia*) shrubs, sparse bluebunch wheatgrass (*Pseudoroegneria spicata*) herbaceous vegetation and sparse understories with little or no vegetation.

As the steepness of the mountain slopes lessen, foothills are prevalent supporting vast singleleaf pinyon pine - Utah juniper (*Pinus monophylla - Juniperus osteosperma*) woodlands. In the upper margins of the foothills region curl-leaf mountain mahogany and mountain big sagebrush are common associates. These two shrubs are replaced in lower areas with basin big sagebrush (*Artemisia tridentata ssp. tridentata*) and antelope bitterbrush (*Purshia tridentata*). Littleleaf mountain mahogany (*Cercocarpus intricatus*) is also frequent in this region of the park, especially on limestone outcrops. It is also common for the pinyon-juniper woodlands to have little or no vegetation in the understory. Sparse understories are common in dense pinyon-juniper stands with a continuous tree canopy as well as in sparse pinyon-juniper stands with an open tree canopy that occur on shale and rocky soil deposits. In other areas, the rocky and shale substrates at GRBA can also support sparse shrubs consisting of low sagebrush (*Artemisia arbuscula ssp. arbuscula*), black sagebrush (*Artemisia nova*) and other stunted or short (dwarf) shrubs.

Except for the 80-acre administrative site, GRBA contains very little flat basin area. Instead, the extreme eastern boundary consists of eroded fan-like basin deposits with rolling hilltop swells and bisecting ditches. On the upper surfaces, short black sagebrush (*Artemisia nova*) and littleleaf mountain mahogany shrubs occur. Taller basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and to a lesser extent black greasewood (*Sarcobatus vermiculatus*) and squaw apple (*Peraphyllum ramosissimum*) shrubs often grow in the bottom of these deposits especially along intermediate streams and on small floodplains. Early successional shrubs and grasses like rubber rabbitbrush (*Ericameria nauseosa*), green rabbitbrush (*Chrysothamnus viscidiflorus*) and broom snakeweed (*Gutierrezia sarothrae*) can be found along recently disturbed roadsides, former fields and ranch sites throughout this region of GRBA. Outside of the park on the valley floor, sparse, cool semi-desert scrub vegetation is common with shadscale saltbush (*Atriplex confertifolia*), winterfat (*Krascheninnikovia lanata*) and other short shrub species mixed with pockets of annual non-native grasses like cheatgrass (*Bromus tectorum*).

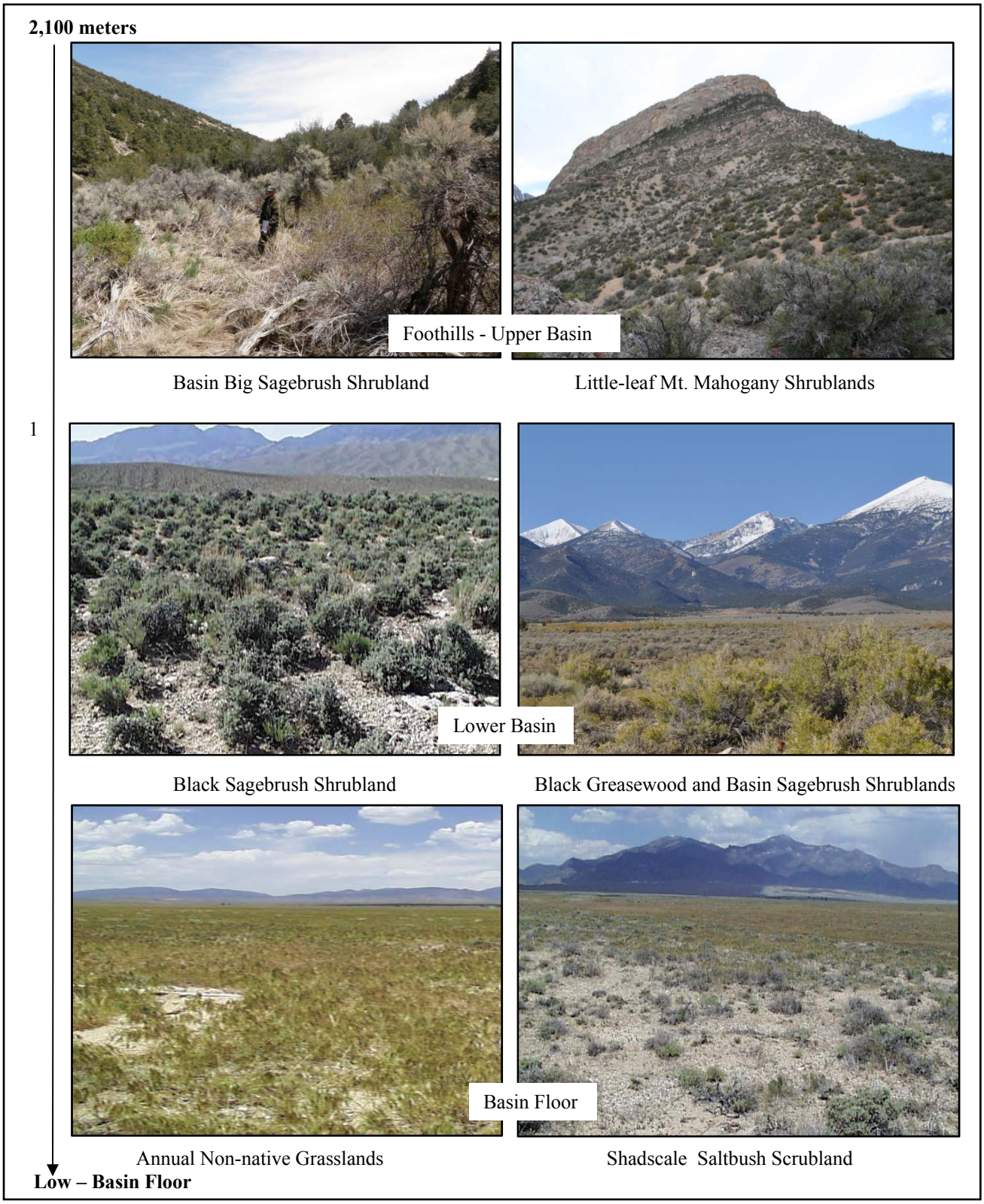


Source: NatureServe, CTI, NPS and Logan Simpson Photos

Figure 6. Common GRBA Vegetation Types by Life Zone.

Source: NatureServe, CTI, NPS and Logan Simpson Photos

Figure 6. Common GRBA Vegetation Types by Life Zone (continued).



Source: NatureServe, CTI, NPS and Logan Simpson Photos

Figure 6. Common GRBA Vegetation Types by Life Zone (continued).

Within the park administrative area (near Baker, NV) the terrain is predominately level with some minor drainages and small sandy mounds (Figure 7). The administrative area is detached from the rest of the Park but contains similar species including basin big sagebrush and black greasewood. Recent construction of the visitor center coupled with its close proximity to developed areas has also created some disturbed vegetation types. In these areas early successional species such as rubber rabbitbrush and perennial and annual grasses have become established.

Source: Jeanne Taylor

Figure 7. GRBA Visitor Center and Administrative Center near Baker, Nevada.

Crossing all of the life zones are riparian corridors and pockets of deciduous shrubs along the base of rock formations and in and around avalanche chutes (Figure 8). Runoff from rock surfaces and talus fields likely encourages the growth of lush shrub pockets consisting of a mix of locally abundant Rocky Mountain maple (*Acer glabrum*), water birch (*Betula occidentalis*), chokecherry (*Prunus virginiana*), currents *(Ribes* spp.), willow (*Salix* spp.) and serviceberry. The same species can also be found in the understory of linear riparian strips bordering GRBA's larger streams. Riparian tree canopy species vary somewhat at GRBA with elevation as corridors in the higher elevations usually contain lush quaking aspen stands co-occurring with Engelmann spruce and then changing to quaking aspen with white fir, ponderosa pine, and Douglas fir as elevation decreases. Riparian zones in the lower foothills and basin areas along the eastern edge of GRBA contain narrowleaf cottonwood (*Populu*s *angustifolia*) trees.

Herbaceous upland and wetland species are also common in all of the life zones as understory associates in forests, woodlands, and shrublands but rarely occur as true communities at GRBA. Where they do occur, wetlands are usually small and tend to be found along lake/pond margins and around montane seeps and spring-fed meadows (Figure 8). Wet meadows typically contain facultative wetland species such as Holm's Rocky Mountain Sedge (*Carex scopulorum*), Nebraska sedge (*Carex nebrascensis*), alpine shooting star, (*Dodecatheon alpinum*), and Baltic rush (*Juncus balticus*). Mesic meadows are characterized by slender wheatgrass (*Elymus trachycaulis*), basin wildrye (*Leymus cinereus*), and shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). Similarly, native upland grasslands and forblands are also usually small and are dominated by assemblages of balsamroot (*Balsamorhiza sagittata*), bluebunch wheatgrass (*Pseudoroegneria spicata*), or bluegrasses (*Poa* spp.).

Cross-zone Vegetation

Aspen Riparian Woodland

Deciduous Riparian Shrubland

Rock and Talus Deciduous Shrubland

Narrowleaf Cottonwood Riparian Woodland

Herbaceous Wetland Vegetation

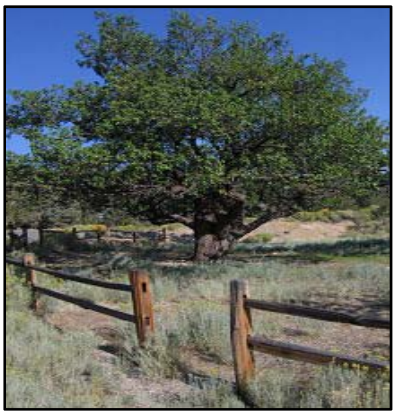
Herbaceous Non-native Perennial Vegetation

Source: Source: NatureServe, CTI, NPS and Logan Simpson Photos

Figure 8. Common GRBA Cross-zone Vegetation Types.

Like many areas in the West, past ranching, mining, and settlement efforts have removed or altered some of the native plant communities and opened the land allowing the establishment of non-native species. Although GRBA has escaped much of this disturbance, the lowest elevations at GRBA show examples of these activities as evidenced by the presence of planted orchard trees and non-native grasses used for lawns and pastures such as Kentucky bluegrass (*Poa pratensis*), crested wheatgrass (*Agropyron cristatum*), and smooth brome (*Bromus inermis*) (Figure 9). In addition to these introduced grasses, GRBA also monitors approximately 43 species of other troublesome invaders including the aggressive musk thistle (*Carduus nutans*), spotted knapweed (*Centaurea stoebe*), bull thistle (*Cirsium vulgare*), and field bindweed (*Convolvulus arvensis*).

Dense, dry vegetation tied with frequent human and natural thunderstorm activity can present many opportunities for wildfire ignition (Figure 9). GRBA has experienced approximately 91 different wildfires from 1959 to 2003 (NPS 2007). In addition to these unplanned fires, GRBA staff has also engaged in prescribed burning to help minimize large fire fuel loads and to help maintain healthy vegetation. Burning of the vegetation can vary in severity, ranging from small pockets of dead trees to large areas of blackened earth as witnessed at the Big Wash, Phillips Ranch, Horse Heaven, and Granite fires. The age and severity of the burn directly impacts the vegetation response and can leave a site with little vegetation or in an early state of succession with weedy species, native forbs/grasses, or seedling/sapling trees repopulating the burned area.



Lehman Orchard

Lawn near Rhodes Mining Cabin at Lehman Caves

Wildfire at GRBA

Source: NPS Photos

Figure 9. Examples of GRBA Planted Non-native and Disturbance Influenced Vegetation.

Vegetation Inventory Project

The specific decision to classify and map the vegetation at GRBA was made in response to guidelines set forth by the NVIP and implemented by the Mojave Desert Network. The MOJN I&M initiated a plant community inventory for GRBA in 2008 as part of a larger effort to complete vegetation inventories for each of the seven parks in the Network. Planning for the inventory projects began with an initial multi-year study plan developed for the MOJN I&M by Cogan Technology, Inc. (CTI) in 2008. The MOJN I&M study plan provided recommendations for completing the plant community classification, digital database, and map products for each of the MOJN I&M parks. The work plan received approval from the Washington Area Service Office (WASO) Inventory Coordinator in 2008.

Prior to the official start of this effort, NVIP contracted with NatureServe to train field crews (hired to complete a fire fuel loading study) on how to collect plant species composition and environmental data using NVIP standards (Keane et al. 2011). Data from 266 initial field plots was collected in 2003 (Charlet 2003). Once these were collected and analyzed, a preliminary vegetation community classification was created and used to help facilitate the rest of the project. It was apparent from the preliminary classification that many vegetation types had not been sampled in 2003 so NatureServe was contracted to collect additional data in undersampled vegetation types (e.g. ponderosa pine woodland, squaw apple shrublands, grasslands, wetlands, riparian and alpine vegetation in particular) in 2008. Using the original list of GRBA plant communities plus the network-wide work plan, MOJN I&M contracted with Cogan Technology, Inc. (CTI) in late 2009 to complete the mapping, assist with the accuracy assessment (AA), and help deliver the final products.

A GRBA planning meeting was held at MOJN I&M on February 4, 2009 to discuss the status of the plant community inventory. Results of this meeting indicated that more vegetation inventory work was needed and that GRBA staff would collect much of the additional field data during the 2009 field season. A second planning meeting was held at the GRBA Visitor Center in Baker, Nevada on May 11, 2010 to discuss the overall project. During this meeting CTI, NatureServe, and MOJN I&M staff gave detailed presentations on vegetation mapping, the status of the plant community inventory, and the project's overall progress, respectively. GRBA personnel provided input on the preliminary classification prepared by NatureServe, outlined their resource management objectives, and discussed what elements they wanted in the final products. As a result of this meeting, NatureServe would continue with the classification efforts, mapping was planned for 2010-2011, and the AA data collection was scheduled to occur in 2011. Together MOJN I&M, CTI, NatureServe and GRBA each provided project representatives to form an ad hoc GRBA-NVIP team.

Team objectives included producing final data products that meet the national program's mandates as outlined in their 12 Step Guidance for NPS Vegetation Inventories (NPS 2009). Important directives from the NVIP that were addressed by the team include the following:

Vegetation Information

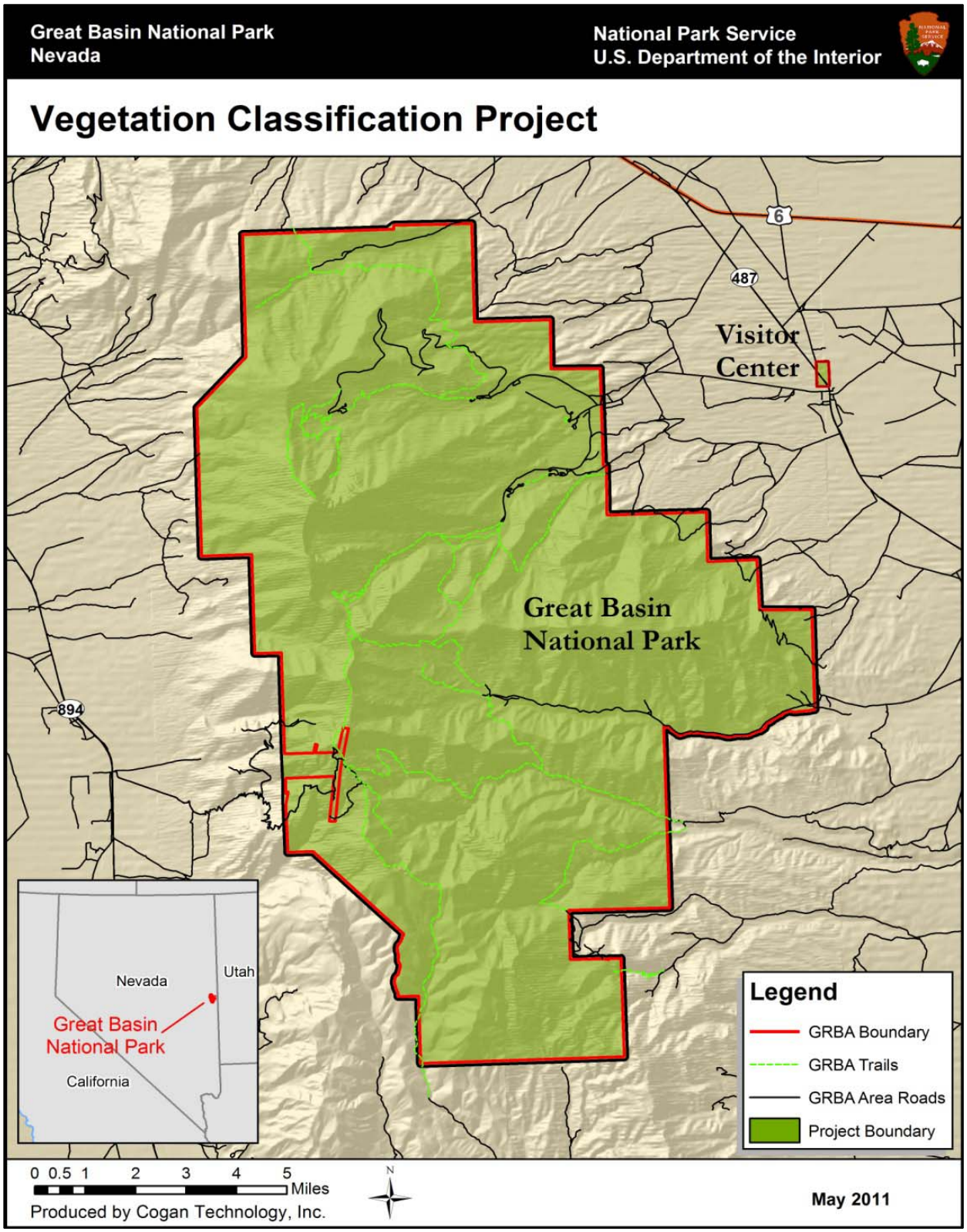
- Vegetation classification will be based on the rUSNVC;
- A dichotomous field key of vegetation associations will be created;
- Formal description for each vegetation association will be included;
- Representative ground photos will be attached for all vegetation associations;
- All of the field data will be presented in database format.

Spatial Data

- The map classification will be based on the rUSNVC and will include GRBA-specific requirements;
- Descriptions and a key will be created for each of the map units;
- A spatial database will be created for all of the vegetation data;
- Digital and hardcopy maps of the vegetation will be created;
- Metadata will be included for all spatial databases;
- An accuracy assessment of the vegetation spatial data will be performed.

Scope of Work

Vegetation inventory work for GRBA occurred within both the 31,201-hectare (77,100-acre) main park boundary and the new 32-hectare (80-acre) administrative area. Additional public lands surrounding GRBA were also inventoried as part of the fire fuels study and were used to complete descriptions of associations occurring within the park boundary. The vegetation mapping boundary was based on the GRBA park boundary but was minimally expanded (primarily along the western boundary) into some areas of the surrounding National Forest and Bureau of Land Management property to achieve an uniform project boundary. A total of 32,424 hectares (80,121-acres) was included in the final vegetation mapping boundary for GRBA (Figure 10).



Source: CTI

Figure 10. Map of the GRBA Vegetation Project Boundary and Park Boundary.

Methods

The vegetation inventory project at GRBA was considered to be in the “medium park” category based on the overall size of the project area and the “large park” category based on limited accessibility of the project area (TNC and ESRI 1994b). The field sampling methods for vegetation mapping suggest a gradsect approach to meet the sampling goal of identifying and characterizing all of the vegetation types across the NPS site (TNC and ESRI 1994b). However, because of a significant amount of legacy vegetation data from the 2003 fuels and vegetation project (Charlet 2003), the field sampling design and methodology was altered to target and inventory those plant communities not sampled or under-sampled during the 2003 project.

To determine areas for further sampling, NatureServe completed an ecological system gap analysis and sampling design review to serve as a gradsect guide (Shultz and Hall 2011). The purpose of this "gap" analysis was to identify additional sampling needed to classify, describe and map all vegetation types at GRBA and to develop a sampling design to target likely locations of under-sampled vegetation types. This was done initially using only the 2003 data for the 2008 field season, and was updated with 2008 data to inform the 2009 sampling.

Other than the sampling stage, the rest of the remaining vegetation inventory tasks for GRBA were considered to be standard as outlined in the 12 Step Guidance for NPS Vegetation Inventories (NPS 2009). The five major project categories are summarized below and the following report sections give detailed descriptions for each:

1. Plan, gather data, and coordinate tasks;
2. Survey GRBA to understand and sample the vegetation;
3. Classify the vegetation using the field data to rUSNVC standard associations and alliances and crosswalk these to recognizable map units;
4. Acquire current digital imagery and interpret the vegetation from the imagery using the rUSNVC and a map unit crosswalk;
5. Assess the accuracy of the final map product.

All protocols for this project as outlined in the following sections can be found in the original program documents produced by The Nature Conservancy and Environmental Research Systems Institute (1994a, 1994b, and 1994c) and later revisions (Lea 2011 and Lea and Curtis 2010) and can be found at this website: http://biology.usgs.gov/npsveg.

Planning, Data Gathering and Coordination

On October 4, 2007 the initial planning conference call for this project was conducted with representatives from NatureServe, NVIP, MOJN I&M and GRBA staff. The goal of this call was to (1) discuss the overall project and initial requirements, (2) discuss availability of existing data, especially from the 2003 work, and what was needed to complete vegetation sampling at GRBA, (3) learn about the management issues and concerns, (4) discuss procedural issues and data management, (5) develop a project scope of work and project timeline for plot sampling work and schedule the targeted vegetation sampling in August 2008, and (6) discuss future project needs and funding.

Additional planning and update meetings and conference calls were held throughout the course of the NVIP project at GRBA and included in chronological order:

(1) a conference call on March 13, 2008 to discuss funding and NatureServe's proposal to do the vegetation sampling work;
(2) a conference call on November 4, 2008 with NVIP representatives to discuss progress on the GRBA project and other on-going vegetation mapping projects within MOJN I&M;
(3) a planning meeting held on February 4, 2009 at the MOJN I&M offices in Boulder City, NV to present results from the 2008 field season and discuss the next steps in the project;
(4) a planning meeting and GRBA staff training May 11-15, 2009 in rapid assessment vegetation field data collection methods.
(5) a conference call on October 6, 2009 to discuss the vegetation mapping stage;
(6) a conference call on February 9, 2010 to review the existing spatial data available for the mapping stage;
(7) a vegetation mapping planning meeting on May 11, 2010 at the GRBA visitor center in Baker, NV prior to the start of the mapping phase,
(8) a series of conference calls in 2011 to resolve mapping related issues and prepare for the AA;
(9) an AA kick-off meeting and field crew training prior to the start of the accuracy assessment data collection at the GRBA Visitor Center on August 16-18, 2011;
(10) a conference call on February 6, 2012 do discuss the AA results, identify any new map classes and any revisions to the map needed, and identify input needed from park staff ;
(11) a conference call on February 21, 2012 to review the AA results with GRBA staff and get input on necessary modifications; and
(12) a project close-out meeting scheduled for July, 2012.

As a result of the proceeding calls and meetings and numerous other undocumented phone calls and e-mails the project work responsibilities were assigned, tasked and/or contracted with various entities to create an experienced vegetation inventory team for GRBA. The participants in the vegetation inventory project and their responsibilities include the following:

MOJN I&M Staff

- Provide oversight and project funding;
- Provide project management;
- Contract NatureServe to complete the vegetation classification and experienced companies to complete the mapping and map accuracy assessment;
- Assist with fieldwork, provide logistical support, assist with field crew training, and help with the map validation;
- Coordinate field work with GRBA, NatureServe, and contractors;
- Supervise and conduct map validation efforts;
- Work with NatureServe to develop the vegetation classification;
- Review draft and final products

GRBA Staff

- Provide the GRBA plant list, provide local expertise and other resources;
- Supply digital boundary files and ancillary data files;
- Collect additional vegetation data in 2009;
- Assist with all fieldwork and provide logistical support;
- Work with NatureServe to develop the vegetation classification;
- Coordinate and assist with the field work;
- Review drafts of the vegetation map, classification and report;
- Accept the final products and finalize the project.

NatureServe (Western Regional Office)

- Collect and manage plot, rapid assessment and observation point data from 2003, 2008-2010;
- Train GRBA staff in NVIP vegetation field data collection methods;
- Work with MOJN I&M to develop a vegetation classification for the study area based on the rUSNVC using quantitative analysis and ecological interpretation of the field data;
- Write 50-60 local descriptions of the vegetation types found at GRBA;
- Write a field key to the vegetation types found at GRBA;
- Write a vegetation classification report including methods, results and discussion to be incorporated into final project report;
- Write methods describing the field portion of this project;
- Write methods describing vegetation classification portion of this project;
- Provide guidance regarding the crosswalk of vegetation types to map units;
- Train AA field crews on NVIP accuracy assessment methods;
- Review AA data results and provide consultation to the mapping contractor, CTI;
- Review and provide sections of final project report;
- Present the final products to MOJN I&M and GBRA staff.

Cogan Technology, Inc. (Contractor)

- Help with overall project facilitation and coordination
- Interpret and delineate the final vegetation and land use types;
- Transfer and automate interpreted data to a digital spatial database;
- Ground-truth vegetation and land use/land cover signatures on the imagery;
- Develop map units linked to the rUSNVC;
- Assist with the AA by picking the stratified random target points, creating field maps, and provide AA point coordinates in a digital format for upload into GPS units;
- Produce spatial layers of field plot and AA site locations;
- Review AA point field determinations, generate contingency tables, and suggest post-AA modifications to the vegetation layer.
- Finalize the vegetation layer and create the final geo-database;
- Provide a visual guide to the map units and a final report describing the project;
- Create a DVD with reports, FGDC-compliant metadata, guides, vegetation classification, plot data, spatial data, vegetation database (map), graphics, and ground photos;
- Present the final products to MOJN I&M and GRBA staff.

Logan Simpson (Contractor)

- Collect vegetation data and determine vegetation association and map class using field keys at AA target point locations at GRBA in 2011;
- Enter AA data into the PLOTS database and provide final AA vegetation database and associated AA point photos.
- Write a summary AA report.

Field Surveys

The field methods used for developing the classification at GRBA followed the methodology outlined by the NVIP methods (TNC and ESRI 1994b and Lea 2011). Vegetation sampling was conducted during three field seasons, starting with a fire fuels study that collected vegetation data using NVIP methods in the summer of 2003, continued with a two week field trip by NatureServe in 2008, and completed by NPS staff in the summer of 2009. Plot size and shape requirements were consistent with NVIP guidelines (TNC and ESRI 1994b) and were determined by the physiognomy of the community being sampled (Table 2). Measuring tapes were used to establish the circular, square or rectangle sampling area and the plot size and shape was adjusted as needed to sample linear bands of vegetation in drainage bottoms or other confined sites. In 2003, all plots were square, oriented from a base stake that marked the southeast corner and extended north and west 20 m (400 m^2). (Please reference Charlet 2003 for more details on the field methods and results of the 2003 sampling effort). In 2009, most of the data was collected using a rapid assessment (RA) point methodology (a plotless method) to save time, so specific plot dimensions were not used.

Table 2. Plot Sizes Used for Classification Sampling at GRBA.

Dominant physiognomy	Plot size	Plot area
Forest: trees have their crowns overlapping, usually forming 60-100% cover, and **Woodland**: open stands of trees with crowns usually not touching. Canopy tree cover 25-60%, OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover.	Circular 11.28 m radius Square 20m x 20 m	400 m^2
Shrubland: shrubs greater than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, dwarf-shrub, herb, and nonvascular cover, and **Dwarf-shrubland** (e.g., heath): Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeds tree, shrub, herb, and nonvascular cover.	Circular 11.28 m radius Square 20m x 20 m	400 m^2
Herbaceous (e.g., grassland, meadow, marsh): Grasses or forbs dominant, usually forming more than 25% cover OR exceeds tree, shrub, dwarf-shrub, and nonvascular cover.	Circular 11.28 m radius Square 20m x 20 m	400 m^2 or 100 m^2
Nonvascular (e.g., fen, bog, cliff, scree slopes: nonvascular cover dominant, usually forming more than 25% cover.	Circular 11.28 m radius Square 20m x 20 m	400 m^2 or 100 m^2
Sparse vegetation (e.g., rock outcrops, talus slopes, and fell-fields): less than 10% total vegetation cover.	Circular 11.28 m radius Square 20m x 20 m	400 m^2 or 100 m^2

Following the establishment of each plot at GRBA, environmental data were recorded on the plot field forms (Appendix A). Environmental data included: elevation, slope, aspect, landform, topographic position, soil texture and drainage, hydrologic (flooding) regime, and evidence of disturbance or wildlife use. The unvegetated surface was estimated and recorded as percent cover of: bedrock, litter and duff, wood, bare soil, large rocks (>10 cm), small rocks (0.2 to10 cm), sand (0.1 to 2 mm), lichens, and mosses. Next the vegetation was visually divided into strata, with the height and canopy cover of the dominant vegetation estimated for each stratum. Within each stratum, all taxa within the plot area were identified and the foliar cover of each taxon was estimated using cover classes (Table 3).

Table 3. Cover Classes and Vegetation Strata used at GRBA.

Cover scales	Vegetation strata
T 0–1%	T1 Emergent Canopy:
P >1–5%	T2 Main Canopy
1 >5–15%	T3 Subcanopy
2 >15–25%	S1 Tall Shrubs
3 >25–35%	S2 Short Shrubs
4 >35–45%	S3 Dwarf-shrubs
5 >45–55%	H1 Herbaceous (Graminoids)
6 >55–65%	H2 Herbaceous (Forbs)
7 >65–75%	H3 Herbaceous (Ferns)
8 >75–85%	H4 Herbaceous (Tree seedlings)
9 >85–95%	A1 Floating-leaved aquatics
10 >95%	A2 Submerged-leaved aquatics

Additional species within the vegetation unit that occurred outside of sampled plots were sometimes listed to assist with creation of local descriptions. Species that were not identifiable in the field were collected for later identification and specimens were typically destroyed after being identified. Species were recorded by scientific name familiar to researchers and a provisional vegetation type was assigned to the plot. Appendix B contains all species found within sample plots and common names used throughout the document.

Field crews documented the vegetation plots as follows: (1) a species list was developed and recorded; (2) UTM NAD83 X-Y coordinates, field note headers (Identifiers/Locators), environmental descriptions, and elevation were recorded both on the plot forms and stored as waypoints in the GPS receiver; and (3) representative ground-based digital photographs were acquired for each plot. In the 2003 field season, two photographs were taken for each plot and in 2008-2009 four photos were taken facing each of the cardinal directions (N, E, S, and W).

In addition to the vegetation classification plots, field crews collected vegetation and environmental data at several observation point and rapid assessment (RA) point locations. Data recorded at observation and RA points reflected the vegetation of an area of variable spatial extent around the point rather than a measured plot and were less detailed (see Appendix A for RA field form). Overall conditions at each observation/RA point were documented by one or more digital photographs. All of the observation/RA data were intended primarily to help describe the variability and extent of GRBA's plant associations, aid in the writing of the local plant community descriptions, and provide additional location data for the mapping stage.

Specifically, observation and RA point data were collected for vegetation communities at GRBA for the following reasons:

- A large amount of data needed to be collected in an economical and time-saving manner;
- The vegetation was homogenous, representative, and several classification plots had already been sampled in this type;
- The vegetation was highly disturbed, ecotonal, or otherwise anomalous and therefore unlikely to be classified under the rUSNVC;
- CTI requested documentation of a specific photo-signature or area;
- Special features needed to be documented as requested by GRBA staff;
- A vegetation type consistently occurred in stands smaller than the 0.5 hectare (1.24 acre) minimum mapping unit (MMU) size;
- The sample point could not be safely accessed to complete the full plot.

During the 2009 field season a total of 136 RA and observation points were collected by the GRBA staff (Figure 11), with support from MOJN I&M and NatureServe ecologists during the field crew training week and a 1-week August field trip. Five of the RA points were also acquired from vegetation data collected during an alpine ecosystem monitoring project by the Global Observation Research Initiative in Alpine Environments during August 2009.

At the May 11, 2010 project update and mapping scoping meeting, GRBA staff reviewed the draft classification and identified several plant communities that were known to occur in the park, but not sampled. As a result, five additional RA and Observation Points were collected during the May 2010 site visit to document these previously unsampled plant communities. In addition, the GRBA administrative site situated to the east of the main park boundary near the town of Baker, NV was added to the project area. During the October 2010 site visit to validate the draft vegetation map, four RA points were collected to characterize plant communities in the administration site. The combined multi-year sampling efforts produced 340 plots, rapid assessment points and observation points from within the GRBA project area (Figure 12).

Based on the NVIP revised standards (NPS 2009) a validation of the thematic accuracy of the GRBA vegetation map layer was conducted by MOJN I&M staff with assistance provided by GRBA, CTI, and NatureServe on October 25-29, 2010. Map validation is an external product evaluation step that is independent of the mapping process (as opposed to internal quality assurance measures, such as verification). For GRBA, 70 validation points were located in relatively easy to access areas (Figure 12). Field crews recorded plant species data using methods similar to both observation and AA point data collection. The data recorded at each point were then tabulated and used to modify the classification, the preliminary map layer and the final list of map classes.

Finally, in 2011 three AA points were used as observation points to document occurrences of three vegetation communities in the park that previously had only been sampled outside its boundaries, yielding 343 sample sites inside GRBA. The overall total sample sites both inside and outside the GRBA project area was 521 and Table 4 summarizes all of the field sampling by location, sample type and year of collection.

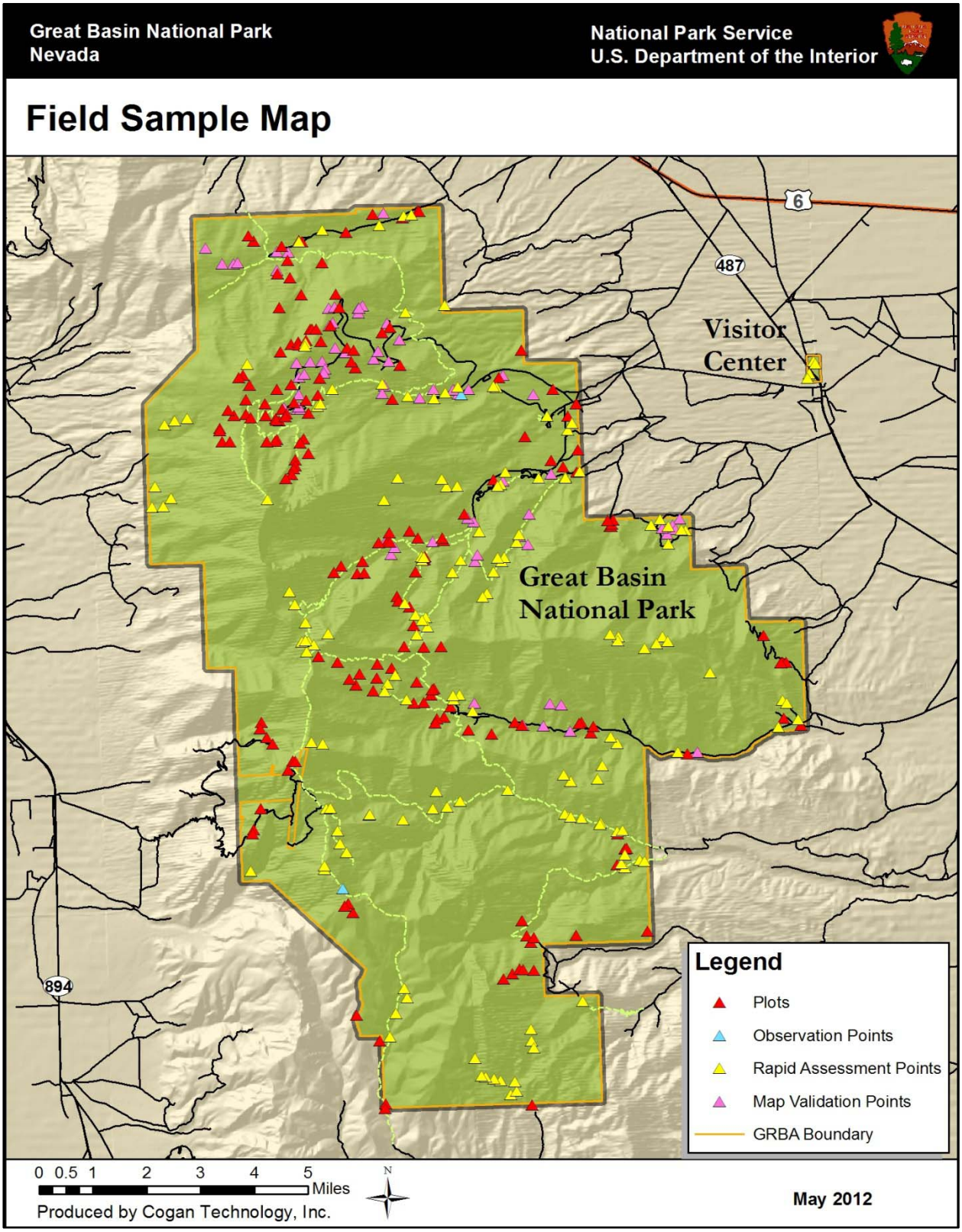
Table 4. Summary of Sample Units used in the GRBA Vegetation Classification.

Field Season	Total	Plots	Obs. Points	RA Points	MV Points
Inside park boundary					
2003	158	158			
2008	37	35	2		
2009	136		2	134	
2010	9		1	8	70
2011	3		*3		
Number of field samples used in classification	343	193	8	142	70
Outside park boundary					
2003	108	108			
All Field Samples	521				

* AA points were used to document 3 unsampled types for vegetation classification

Source: NPS-GRBA

Figure 11. Example of the Plot Data Collection at GRBA.



Source: CTI

Figure 12. Map of the Vegetation Plots, Observation Points, and RA Points Collected at GRBA.

Vegetation Classification

In 2008, the GRBA vegetation classification began with NatureServe reviewing all of GRBA's legacy data and using the 2003 field data (Charlet 2003) to develop a preliminary list of GRBA vegetation associations. All of the vegetation community data was then entered into Microsoft Excel spreadsheets by field crew members and then into the PLOTS 2.0 database by a NatureServe data manager. The PLOTS database is a custom Microsoft Access program that mirrors the standard field form with fields and tables that match all of the data recorded on the field forms. Following data entry, error checking was performed to minimize errors associated with duplicate entries or erroneously selected plant or association names or types. Next, the database was analyzed using NatureServe standards and all of the plant taxonomy was standardized. Unknown species, especially those with high cover were identified and mostly resolved, as were other taxonomic issues including grouping subspecies and varieties judged to be ecologically similar.

The field data collected in 2008-2011 was similarly entered into the PLOTS database and all of the digital data were subjected to a second quality review to eliminate data entry errors. During the second check, the database was examined, sorted, and queried to find missing data, misspellings, duplicate entries, typographical errors, and to insure that all of the plant species matched the standard USDA Plants Database list of plant names. Initial analysis of the vegetation data from 2003 and 2008 at GRBA was qualitative, based on expert reviews that matched the plot data to existing types in the rUSNVC. This analysis was used create a preliminary list of associations to inform future sampling. Following the 2009 field data collection all data was analyzed quantitatively.

Quantitative analysis began by exporting the species abundance data from the GRBA PLOTS database in order to classify all of the plots to the association level within the context of the rUSNVC. Only data from the full vegetation plots and rapid assessments were used by NatureServe in the quantitative analysis because they had complete or nearly complete floristic composition records. Observation point data and data collected in 2010 and 2011 (after the analysis) were qualitatively assigned to associations by NatureServe ecologists. During preliminary analysis, NatureServe found some inconsistencies in how the field crews assigned taxa to the various strata levels. To correct these issues, NatureServe first standardized and simplified the strata for analysis so that all shrub and herbaceous vegetation (included tree seedlings) were in the proper stratum. Then NatureServe merged individual taxa into one of four standardized strata levels (i.e. tree, shrub, herb, nonvascular) (Table 5).

Table 5. Conversion of Strata from Original Data to the Final Stratum used in Analyses.

Original Stratum	Description	Final Stratum	Code
T1	Emergent	Tree	T
T2	Canopy	Tree	T
T3	Subcanopy	Tree	T
S1	Tall Shrub	Shrub	S
S2	Short Shrub	Shrub	S
S3	Dwarf Shrub	Shrub	S
H	Herbaceous	Herbaceous	H
H1	Graminoids	Herbaceous	H
H2	Forbs	Herbaceous	H
H3	Ferns and Allies	Herbaceous	H
H4	Tree Seedlings	Herbaceous	H
N	Nonvascular	Nonvascular	N

Quantitative analysis continued by importing the revised PLOTS data into PC-ORD (McCune and Mefford 1999) and then conducting multivariate analysis and Nonmetric Multidimensional Scaling (NMS) ordination of the data using Sorensen (Bray-Curtis) distance measures (McCune and Grace 2002). NatureServe ecologists used an analytical, iterative classification process beginning with all GRBA plots and systematically removing outliers and groups of plots that were clearly different at each stage. Data were interpreted through 3- dimensional (3D) and 2-dimensional (2D) graphical representations. The data behind the outliers and groups were manually analyzed to classify plots to plant association level. Additional quantitative (ordination) or qualitative analysis was done on larger groups, such as pinyon-juniper woodlands. In this manner the entire GBRA vegetation plot data was classified into either existing or new rUSNVC associations/alliance or new park special types were created. The revised list of associations was finalized by expert review of individual plots and no physical parameters were used in the ordination.

The final products of the classification task included field keys and local plant association descriptions. The dichotomous field keys to the NEPE plant associations and map units were developed to assist users in identifying plant associations and map units in the field, particularly during the accuracy assessment task (Appendices C and D). The local descriptions were based on the field data and provide GRBA characteristics for some of the more common plant association using the NatureServe template (Appendix E).

More information on all of the vegetation classification methods used by NatureServe (including examples of the 2D and 3D graphics) can be found in the GRBA vegetation classification report (Schulz and Hall 2011) contained on the accompanying project DVD.

Digital Imagery and Vegetation Mapping

During the planning and coordination phase, GRBA staff provided two sources of existing digital imagery for evaluation and potential use as the base-map for the vegetation mapping. Existing GRBA base map imagery included a 4-band, 1-meter resolution, 2007 Digital Globe product and a 4-band, 6-inch resolution product acquired in June and July 2007 by Digital Mapping, Inc. (DMI) for the Southern Nevada Water Authority (Figure 13). Both products were reviewed by CTI and the 2007 Digital Globe imagery was found to be adequate for supplying ancillary information and for conducting the preliminary image processing and segmentation. The 2007 DMI product was found to be superior due to the finer resolution and all of the resulting mapping for GRBA was based on the DMI imagery.

Once digital copies of both images were acquired by CTI, interpretation and mapping of the vegetation began using a four step process involving: (1) preliminary image classification and segmentation, (2) photo-interpretation and digitizing, (3) ground-truthing of the mapped data, and (4) map refinement and finalization. First, the 2007 Digital Globe imagery was mosaiced and manipulated using image processing and segmentation techniques (e.g. unsupervised image classification, normalized difference vegetation index, etc.) to highlight any subtle vegetation signature differences such as the presence of quaking aspen (Figure 14). All of the preliminary results were evaluated for usefulness and the best examples were converted to lines and polygons, combined with other GRBA GIS layers (such as the roads and trails line network), and were used as the basis for the new GRBA vegetation mapping effort.

Building off the results of the preliminary image investigation efforts, all relevant lines and polygons were exported as ArcInfo shapefiles and converted to ArcInfo coverages. The resulting coverages were run through a series of smoothing routines provided in the ArcGIS software. Following smoothing, the line-work was manually cleaned to remove extraneous lines, small polygons, and polygons that obviously split a homogenous stand of vegetation. The cleaning stage was considered complete when all resulting polygons matched homogenous stands of vegetation apparent on the Digital Globe 2007 imagery.

At this point the mapping shifted to the DMI 2007 imagery and all of the vegetation lines and polygons were visually inspected and manually moved, edited and updated in ArcInfo as needed. Any obvious problems in the mapping (such as shifting and sliver polygons) were edited and resolved. Review of the preliminary vegetation polygon layer by GRBA staff revealed that the roads, facilities and riparian vegetation were too coarsely mapped. To resolve this, all riparian vegetation, developed areas, roads, and streams were manually updated by digitizing them directly off the 2007 DMI imagery. Once the preliminary lines were completed temporary map unit names and place-holder codes were used to attribute each vegetation polygon.

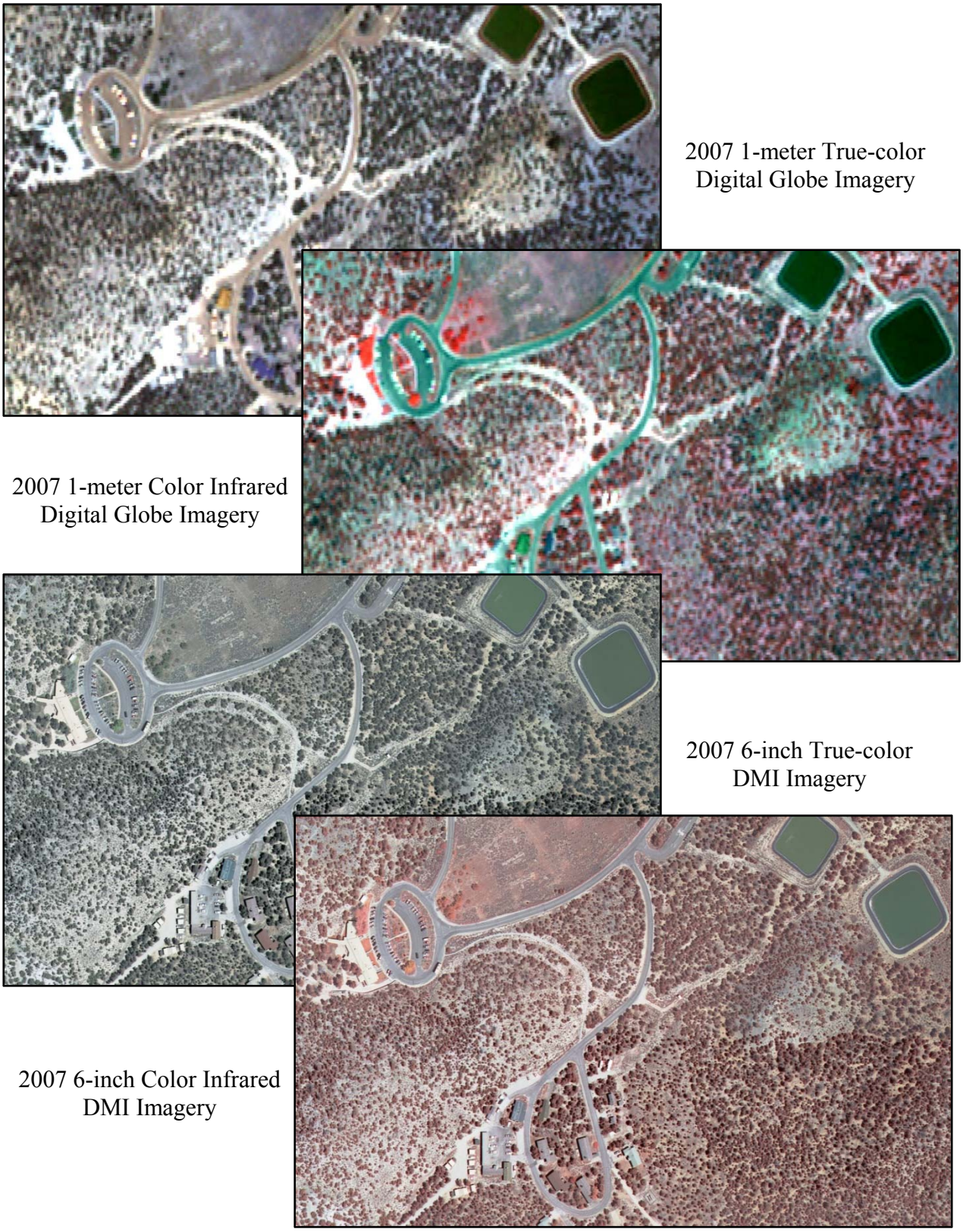
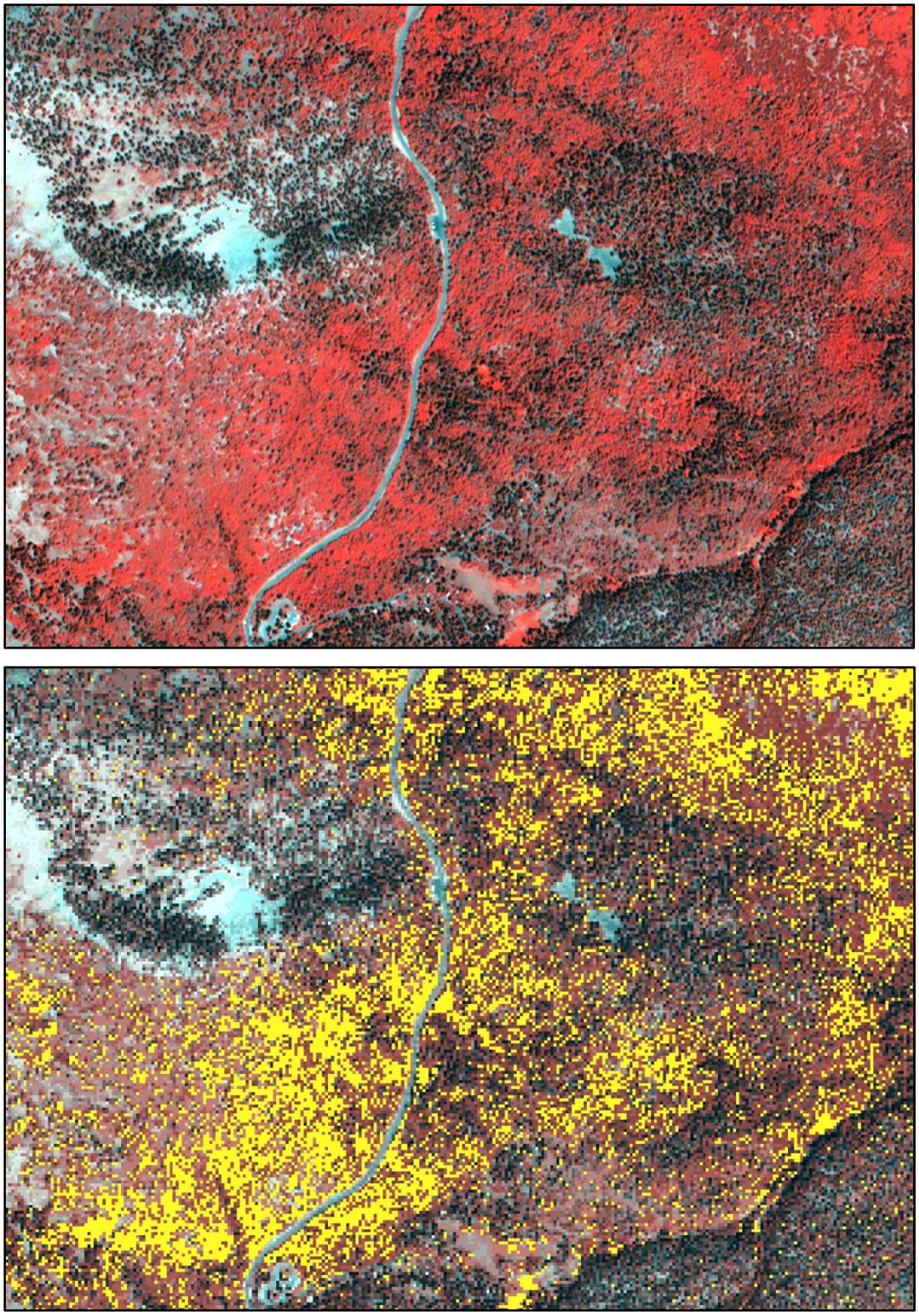


Figure 13. Examples of the 2007 Digital Globe and 2007 DMI imagery for GRBA.



Source: CTI

Figure 14. Example of the Digital Globe 2007 Imagery (top) and Results of an Unsupervised Classification Effort Highlighting the Presence of Quaking Aspen (yellow) (bottom).

Ground-truthing or verifying the preliminary vegetation polygons for GRBA occurred during two field trips in May and October of 2010. For both trips the preliminary GRBA vegetation layer was printed as a series of 1:6,000-scale hardcopy maps using the 2007 DMI basemap imagery and the vegetation linework as an overlay. Once at GRBA, CTI staff visited representative polygons and verified the map lines and labels against the actual vegetation on the ground. Additional or missing vegetation polygons were noted and more general observations were also taken to help write the map unit descriptions and to ultimately create the final list of map units for GRBA.

Upon return from the field, CTI staff refined the GRBA vegetation map layer by adding new polygons, moving/editing lines, and changing or adding polygon map unit labels as necessary. The mapping was considered complete in 2011 with the addition of NatureServe's final classification and final list of plant associations/alliances. In most cases, the preliminary map unit names and labels were simply changed to reflect the current rUSNVC association, alliance or higher level name. Due to the limitations of the imagery and the complex mixing of the vegetation at GRBA some of the map units contained multiple associations from different alliances. This issue was addressed by grouping similar associations/alliances into mapping complexes. For example, both *Cercocarpus ledifolius* shrubland and woodland alliances were combined into *Cercocarpus ledifolius* Shrubland & Woodland Complex Map Class. All of the resulting map units were then correlated or "cross-walked" by noting when plant associations were used as a map unit or when they were grouped. To round-out the mapping scheme, additional map units were created for land use types based on a mapping system developed by Anderson et al. (1976). This included land-use and land-cover types not in the rUSNVC, such as roads, facilities, and ponds. A separate class of map modifiers or "Park Specials" was defined especially for GRBA to cover bare geologic features and snow/glaciers.

In addition to the final map unit names and codes other polygon specific information or polygon modifiers were added to the vegetation layer (Table 6). Polygon modifiers included physical quantifiers such as average height of the vegetation, average density of the dominant vegetation strata, and the general pattern/shape of the vegetation in each polygon. Topographic and landscape modifiers (i.e. landform, biophysical location, geology, etc.) were also added for each vegetation polygon by extracting data from existing spatial datasets through GIS analysis routines (i.e. zonal statisitics and spatial joining). Finally the vegetation layer was converted to a Geodatabase file and all of the common rUSNVC data contained in the final NatureServe classification was joined using relationship-classes.

Table 6. Polygon Attribute Items and Descriptions used in the GRBA GIS Vegetation Layer.

ATTRIBUTE	DESCRIPTION
AREA*	Surface area of the polygon in meters squared
PERIMETER*	Perimeter of the polygon in meters
GRBAVEG*	Unique code for each polygon
GRBAVEG_ID*	Unique identification code for each polygon
MAP_CODE	Final Map Unit Codes – Project specific
MAP_DESC	Map Unit Scientific Description Name – Project Specific
MAP_CDESC	Map Unit Common Description Name – Project Specific
ALT_DESC	Map Unit Scientific Alternative Description Name – Project Specific (for vegetated Avalanche Chutes)
ALT_CDESC	Map Unit Scientific Alternative Description Name – Project Specific (for vegetated Avalanche Chutes)
DENS_MOD	Modifier - Percent Cover of the Upper Stratum Layer in the Polygon Percent cover classes: Sparse **10 - 25%,** Open **25 - 60%,** Discontinuous - Closed **> 60%**
PTRN_MOD	Modifier - Vegetation Pattern within the Polygon Vegetation pattern classes: Evenly Dispersed **= Homogeneous** Grouped Stands of Vegetation = **Bunched / Clumped** String of Vegetation **= Linear**
HT_MOD	Modifier - Height Range of the Dominant Vegetation Layer Height classes: **< 1, 1-5, 5-15, 15-30 & >30 meters**
BIOPHYS	General Biophysical Location **Alpine, Basin, Montane, or Subalpine**
GEOLOGY	Dominant Geological Formation for each Polygon
BPS_NAME	Biophysical Settings based on the NRCS Soil Surveys (TNC 2006)** **Alpine, Barren/Rock, Basin Wildrye-Montane Big Sagebrush, Developed/Roads, Limber-Bristlecone Pine Woodland, Limber-Bristlecone Pine Woodland-mesic, Mixed Conifer, Montane Riparian-Ponderosa Pine, Montane Sagebrush Steppe, Montane-Subalpine Riparian, Mountain Mahogany, NoData, Pinyon-Juniper, Ponderosa Pine, Seral Aspen, Seral Aspen-subapline, Subalpine Mesic Spruce-Fir, Water, Wet Meadow**
LANDFORM	Landform that the Polygon Occurs in: **Alpine Turf, Rock and Talus, Avalanche Chute, Basin, Foothills, Mountain, Riparian**
COMMENTS	Additional Comments about the Vegetation in Individual Polygons
ACRES	Surface area of the polygon in acres
HECTARES	Surface area of the polygon in hectares

***ArcInfo© default items**
**Some of the original BPS_Names were combined to account for small pixel size and rarity.

Accuracy Assessment

Once the vegetation layer was completed and finalized, the accuracy assessment (AA) was conducted on the vegeation map using the final list of map classes. Typically, in mapping exercises both thematic or attribute map accuracy as well as the positional or polygon line accuracy are considered. In the case of the NVIP however, the positional accuracy is usually omitted since rarely does vegetation split on discrete edges that can be positively located in the field. The subjectivity involved in this effort plus the high resolution and accuracy of DMI imagery allows for the assumption that all products derived from them are well within National Map Accuracy Standards for 1:12,000-scale maps (±30 feet).

The thematic accuracy of the vegetation map was assessed using the methodology provided by the NVIP (TNC and ESRI 1994c and Lea and Curtis 2010). The revised protocols included a four step AA process consisting of a (1) sample design, (2) sample site selection, (3) data collection, and (4) data analysis. The design of the AA process followed the three possible scenarios provided in the field manual with stratified random targets placed in each map class based on their respective frequency and abundance (Table 7).

Table 7. Standard Sample Size Allocations for AA Points Based on Map Unit Area.

MAP CLASS TOTAL AREA*	NUMBER OF OBSERVATIONS PER MAP CLASS
> 50 hectares	30**
8.33 to 50 hectares	0.6 per hectare**
< 8.33 hectares	5**

* - as measured before buffering for cost surface (access buffer) or for map class boundary buffer.
** - or as many spatially independent (non-overlapping) observation sites as map class area, MMU size and other considerations will allow.

The AA sample size allocation parameters were loaded into a custom GIS program along with the vegetation layer. This program picked the random target locations and also buffered them 10 meters (33 ft) away from any polygon boundary and 50 meters (165 ft) away from any other point. Being able to choose minimum distance to polygon boundaries helped to minimize confusion and accounted for the horizontal error typically encountered in common GPS receivers (±5 m). To complete the sampling targets, additional points were added to long linear riparian polygons and rare types that were missed. The resulting target locations were restricted to those within the boundaries of GRBA. Although the final locations of the AA sites were located near existing roads and trails no cost-surface or access buffering was conducted before the sampling occurred. By default hard to access points were either disregarded or replaced with easier to reach targets by the field crews for safety and economical reasons.

Once the target locations were selected, Logan Simpson ecologists were provided field maps with the AA point locations, overview maps, the key to the associations (Appendix C), the key to map units (Appendix D), and digital GPS files containing the location of the target AA sites. No descriptions of the associations or map classes were provided and identification of the site was based soley on the performance of the keys. During the 2011 summer field season, the ecologists either traveled directly to the AA target sites or remotely observed them with binoculars and spotting scopes. At most AA points, the observation area was a circle with a radius of 40 meters (131 feet) which is equal to the MMU of 0.5 hectare. Smaller observation areas of 0.25 hectare or 0.1 hectare were used for vegetation types that typically occur in stands of less than 0.5 hectare and whose average polygon size was less than 0.5 hectare in size. A rectangular sampling area was used when the vegetation type being sampled was linear in shape. When a rectangular sampling area was used, the target AA point marked the SW corner of the rectangle. When a circular sampling area was used the target AA point marked the center of the circle.

At each AA point, field crews recorded park site name, surveyor name(s), survey date, X and Y coordinates, species name, stratum in which the species occurred, percent cover by species, total tree cover, total shrub cover, total herb cover and total non-vascular cover. Only dominant or diagnostic species in each stratum were recorded to facilitate working through each of the field keys. Once dominant species and cover information was recorded, the primary map class and vegetation association was then determined using the field keys. Conformance to Key (good, fair, poor) was noted and any problem areas in the key were recorded (see AA field form in Appendix A). When there was fair or poor 'Conformance to Key', the point was re-keyed choosing an alternate route in the key and an alternate map class and/or association was recorded. To better assist the analysis, ground-based photographs were taken at each AA point to photo-document the current state of the vegetation. These photographs were generally taken looking out from the center of the observation point, noting on the field form the direction the image was taken. More detailed information on AA sampling methods can be found in the GRBA AA Report available on the project DVD

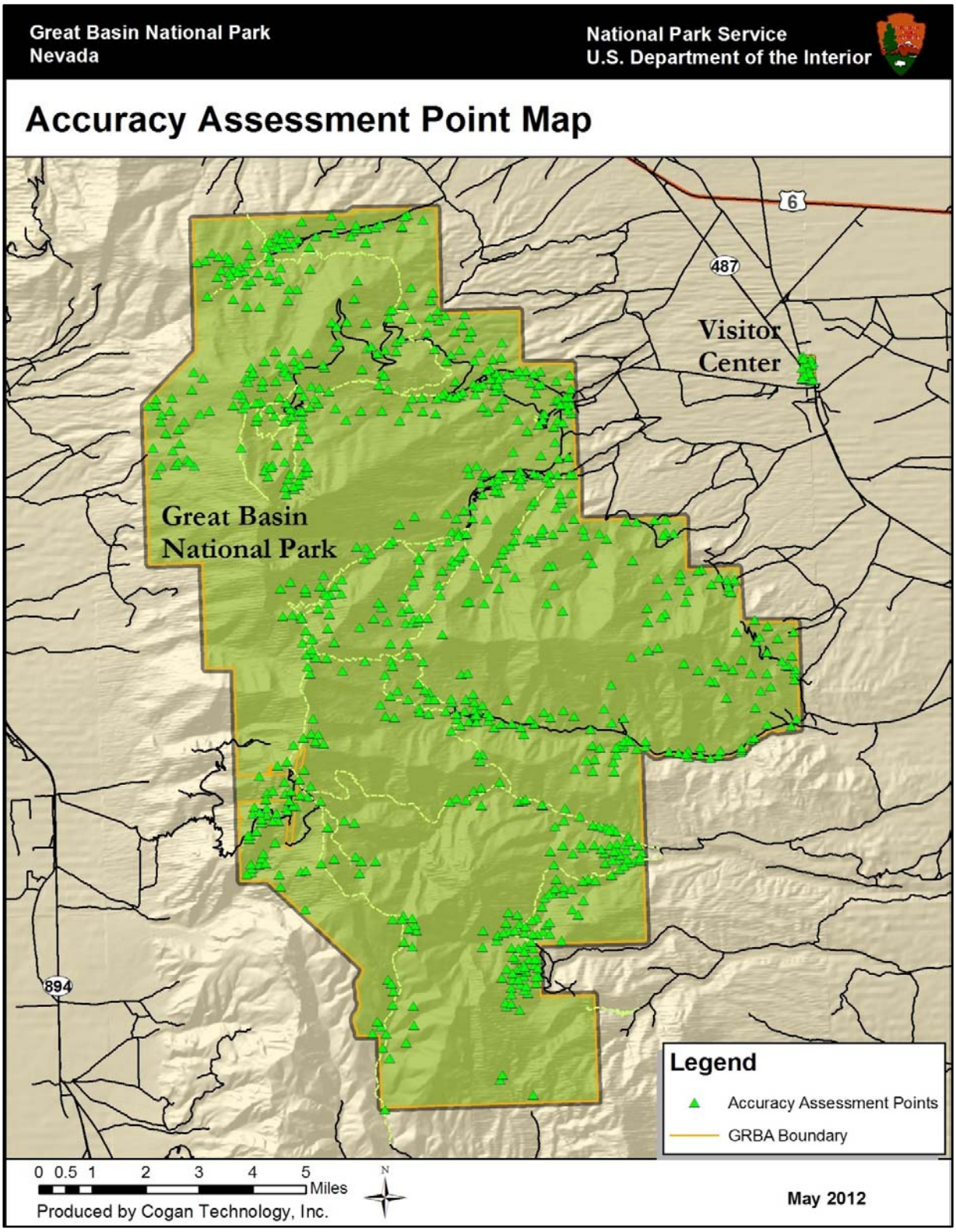
Between August and September, 2011, Logan Simpson field biologists sampled a total of 872 AA points (Figure 15) and 142 of these were remotely observed. The data recorded on the field forms were subsequently entered into the GRBA PLOTS database and reviewed for data entry errors. Incomplete data on the field sheets were corrected if possible. After the final review, Logan Simpson project managers provided copies of the completed field forms, field sketch maps, geospatial data, the PLOTS database, ground photos, and a summary report. More detailed information about the AA data collection can be found in Logan Simpson's final report to the NPS (Logan Simpson 2012) contained on the accompanying project DVD.

The results of the Logan Simpson data collection were imported from the PLOTS database into a GIS layer by CTI. The field determination of the vegetation associations and corresponding map unit names where then visually compared to the predicted map unit polygon labels during two stages of review. In the first stage the original AA point data was used to generate a sample contingency table to highlight any errors with the data collection. Points that differed from the predicted polygon label were further examined by reviewing the field forms in question and their associated ground photographs. Through a vigorous examination by CTI, NatureServe and MOJN I&M staff many of the general errors in the data were corrected. Common errors found in the AA data included incorrect UTM coordinates (standing outside of the target polygon or recording the remote location from where the vegetation was viewed), incomplete and incorrect field calls (corrected based on actual species cover values), discrepancies in the field key (wrong couplet was used), or incomplete polygons (i.e. unclosed polygons). Changes were made and recorded in the comments field of the AA point layer.

The second review step involved deciding between the corrected primary or secondary field call for the plant association. To accomplish this, CTI had to assign a final map unit for every point by choosing between the different calls. This was done by first adding a "Final_Code" attribute to the AA point layer and then comparing the assigned field names of the point with its corresponding location on the digital imagery. In most cases, the primary vegetation map unit name assigned by the field crew was used. However, some points were assigned their secondary field call based on one of the following reasons: (1) it appeared that the second call was the

better choice due to the overhead perspective (e.g. a stand judged to be sparse woodland on the imagery versus herbaceous vegetation in the field), (2) the data were actually recorded in a stand that was too small (i.e. inclusion below MMU size), or (3) the second call more appropriately matched the ecological context (e.g. riparian vegetation along a stream versus dry, upland vegetation).

Once the data were reviewed, the final AA analysis was conducted. This was accomplished by using CTI custom GIS programs and AA templates supplied by the NVIP. Through this automated process, the final map units in the AA layer were compared to the map unit designations for their corresponding polygons. All of the statistics and calculations used to analyze these data are described at length in the program manuals (TNC and ESRI 1994c and Lea and Curtis 2010). Final percent accuracy for each of the map classes was recorded using contingency tables (error matrices).



Source: CTI

Figure 15. Map of the Accuracy Assessment Points Collected at GRBA

Results

Vegetation Classification

The final GRBA classification of the 343 plots, RA points, and observation points from within the park by NatureServe resulted in 136 plant communities (associations or park specials) (Table 10). The vegetation analysis produced a classified list of 105 rUSNVC associations and 31 Park Special vegetation types. Park Specials represent local plant communities that differ significantly from existing rUSNVC association concepts, but lack enough data to describe a new association. Park Special types are not officially included in the rUSNVC hierarchy, but many times can be linked to an Alliance or Group level for classification and mapping purposes. With additional data and analysis, some of these Park Special plant communities may become new associations or may be subsumed into existing rUSNVC associations. Others sites might be unique vegetation and remain a Park Special. These plant communities can be distinguished by [Park Special] in the name or in the element code. Element codes for rUSNVC associations begin with CEGL versus CEPS for park specials.

Lower confidence associations within the rUSNVC are indicated by [Provisional] in the name. Parentheses in the name indicate the species may or may not be present in a given stand. A dash ("-") between species names indicates the species occur in the same vegetation layer (i.e. stratum) and a slash ("/") indicates species that occur in different vegetation layers. All plant communities are listed in Table 8 with element code and number of plots sampled in GRBA along with the total number of plots sampled (GRBA & adjacent BLM land) for comparison purposes.

When GRBA plant communities are summarized by physiognomic class, there are a total of 60 forest and woodland types, 37 shrublands types, 4 shrub herbaceous (shrub steppe) types, 30 herbaceous vegetation types, and five sparsely vegetated types. There were 107 upland plant communities, 14 riparian woodland and forests, 8 riparian shrublands and 7 herbaceous wetlands. Three samples were unclassified. One because it was ecotonal, and two were observation points that only had species lists and lacked cover data.

The vast majority of vegetation types classified for GRBA were dominated by native species with only 8 of 136 plant communities considered semi-natural or disturbed vegetation types as they were either completely dominated by introduced plant species or had a stratum (often the herbaceous stratum) dominated by introduced plants. These types were mostly the result of historic livestock grazing disturbance such as (1) the rabbitbrush shrubland below the planted orchards near the Lehman Caves Visitor Center, (2) seeding of crested wheatgrass in disturbed pastures in the valley bottoms along lower Snake Creek or in the NPS Administrative Area near Baker, NV, or (3) the introduced species dominated understory (usually Kentucky bluegrass or cheatgrass) of aspen and other forest types. Cheatgrass was particularly widespread across the lower elevations at GRBA occurring in the understory of various shrubland, woodland, and forest types and forming its own herbaceous community on disturbed and dryer sites.

Table 8. Summary of rUSNVC Associations and Park Specials for the GRBA Vegetation Classification.

Association	Element code	GRBA Field Samples	Total Field Samples
Abies concolor - (Populus tremuloides) / Salix boothii / Carex scopulorum Forest	CEGL005418	3	3
Abies concolor - Populus tremuloides / Carex scopulorum Forest	CEGL005419	1	1
Abies concolor - Populus tremuloides Avalanche Chute Shrubland	CEGL005420	1	1
Abies concolor - Pseudotsuga menziesii / Carex rossii Forest	CEGL000431	1	1
Abies concolor / Arctostaphylos patula Forest	CEGL000242	7	7
Abies concolor / Cercocarpus ledifolius Woodland	CEGL000885	4	4
**Abies concolor / Symphoricarpos oreophilus* Forest	CEGL000263	7	10
Abies concolor Rock Outcrop Sparse Vegetation [Park Special]	CEPS009594	1	1
Acer glabrum Drainage Bottom Shrubland	CEGL001062	1	1
Achnatherum lettermanii Herbaceous Vegetation	CEGL005354	1	1
Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata) Semi-natural Herbaceous Vegetation	CEGL005266	1	1
**Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland	CEGL002820	3	3
Aquilegia scopulorum - Eriogonum holmgrenii Fell-field Herbaceous Vegetation	CEGL005421	3	3
Arctostaphylos patula / Ceanothus martinii Shrubland	CEGL005422	2	2
Arctostaphylos patula Shrubland	CEGL002696	1	1
**Artemisia arbuscula* ssp. *arbuscula / Pseudoroegneria spicata* Shrub Herbaceous Vegetation	CEGL001412	2	3
Artemisia nova / Achnatherum hymenoides Shrubland	CEGL001422	1	7
Artemisia nova / Poa fendleriana Shrubland	CEGL002698	1	1
Artemisia nova / Pseudoroegneria spicata Shrubland	CEGL001424	1	1
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland	CEGL002699	2	7
Artemisia tridentata / Elymus elymoides Shrubland	CEGL001001	1	1
Artemisia tridentata ssp. *tridentata - Peraphyllum ramosissimum - Chamaebatiaria millefolium* Shrubland [Park Special]	CEPS009595	1	1
**Artemisia tridentata* ssp. *tridentata / Agropyron cristatum* Semi-natural Shrubland [Park Special]	CEPS009566	2	4
**Artemisia tridentata* ssp. *tridentata / Leymus cinereus* Shrubland	CEGL001016	3	3
Artemisia tridentata ssp. *tridentata / Pleuraphis jamesii* Shrubland	CEGL001015	1	1
Artemisia tridentata ssp. *vaseyana - Symphoricarpos oreophilus / Elymus trachycaulus* ssp. *trachycaulus* Shrubland	CEGL001034	5	7
Artemisia tridentata ssp. *vaseyana - Symphoricarpos oreophilus / Pseudoroegneria spicata* Shrubland	CEGL001038	7	7
Artemisia tridentata ssp. *vaseyana / Poa (glauca, secunda)* Shrubland	CEGL005423	4	4
Artemisia tridentata ssp. *vaseyana / Poa fendleriana* Shrubland	CEGL002812	4	5
Astragalus kentrophyta - Eriogonum holmgrenii Fell-field Herbaceous Vegetation [Park Special]	CEPS009597	1	1
Balsamorhiza sagittata Herbaceous Vegetation [Park Special]	CEPS009598	1	1
Betula occidentalis / Cornus sericea Shrubland	CEGL001161	1	1
Betula occidentalis / Mesic Graminoids Shrubland	CEGL002654	1	1
Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	CEGL005264	1	1
Bromus tectorum Semi-natural Herbaceous Vegetation	CEGL003019	1	1

Association	Element code	GRBA Field Samples	Total Field Samples
Carex elynoides - Geum rossii Herbaceous Vegetation	CEGL001853	2	2
Carex elynoides - Phlox pulvinata - Poa secunda Herbaceous Vegetation	CEGL005424	3	3
Carex nebrascensis Herbaceous Vegetation	CEGL001813	2	2
**Carex scopulorum* Herbaceous Vegetation	CEGL001822	3	3
Carex subnigricans - Geum rossii - Sibbaldia procumbens Snowbed [Provisional]	CEGL005425	1	1
**Cercocarpus intricatus - Glossopetalon spinescens* Shrubland	CEGL005426	4	5
Cercocarpus ledifolius / Arctostaphylos patula Woodland [Provisional]	CEGL005355	5	5
Cercocarpus ledifolius / Artemisia tridentata ssp. *vaseyana* Woodland	CEGL001022	2	2
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland	CEGL000967	1	1
Cercocarpus ledifolius / Symphoricarpos oreophilus Woodland	CEGL000970	9	9
Cercocarpus ledifolius Rock Outcrop Sparse Vegetation [Park Special]	CEPS009599	1	1
Chrysothamnus viscidiflorus Shrub Herbaceous Vegetation [Provisional]	CEGL002530	1	1
Cymopterus nivalis - Erigeron leiomerus - Poa secunda Herbaceous Vegetation [Park Special]	CEPS009600	1	1
Dasiphora fruticosa ssp. *floribunda / Elymus trachycaulus* Shrub Herbaceous Vegetation [Park Special]	CEPS009601	1	1
**Dodecatheon alpinum* Herbaceous Vegetation [Park Special]	CEPS009590	5	5
Elymus trachycaulis Herbaceous Vegetation	CEGL005427	3	3
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland	CEGL002937	1	1
Geum rossii - Calamagrostis purpurascens Herbaceous Vegetation [Park Special]	CEPS009602	1	1
Geum rossii - Phlox pulvinata Fell-field Herbaceous Vegetation	CEGL005428	2	2
Geum rossii Herbaceous Vegetation	CEGL001964	1	1
Hulsea algida - Selaginella watsonii Herbaceous Vegetation [Provisional]	CEGL005429	1	1
Juncus balticus Herbaceous Vegetation	CEGL001838	1	1
Juncus nevadensis - Poa secunda Herbaceous Vegetation [Park Special]	CEPS009603	1	1
Leymus cinereus Herbaceous Vegetation	CEGL001479	2	2
Lomatium graveolens var. alpinum Herbaceous Vegetation [Park Special]	CEPS009604	1	1
Peraphyllum ramosissimum - Artemisia tridentata Shrubland	CEGL005430	2	2
Petrophyton caespitosum Sparse Vegetation [Park Special]	CEPS009605	1	1
Phlox pulvinata Herbaceous Vegetation [Provisional]	CEGL002740	1	1
Picea engelmannii - (Pinus flexilis) / (Astragalus platytropis) Krummholz	CEGL005432	4	4
Picea engelmannii - (Pinus flexilis) / Carex rossii Woodland	CEGL005433	16	16
Picea engelmannii - Populus tremuloides / Arctostaphylos patula Forest [Park Special]	CEPS009644	1	1
Picea engelmannii - Populus tremuloides / Mesic Forb Forest [Park Special]	CEPS009587	3	3
Picea engelmannii - Populus tremuloides Avalanche Chute Shrubland	CEGL005431	2	2
Picea engelmannii / Carex scopulorum Woodland	CEGL005446	4	4
Picea engelmannii / Juniperus communis Forest	CEGL005925	9	9
Picea engelmannii / Moss Forest	CEGL000371	2	2
**Picea engelmannii / Ribes montigenum* Forest	CEGL000374	8	8
Pinus flexilis - (Populus tremuloides) / Arctostaphylos patula Forest	CEGL005434	9	9
Pinus flexilis / Artemisia tridentata ssp. *vaseyana* Woodland [Park Special]	CEPS009588	1	2
Pinus flexilis / Symphoricarpos oreophilus Woodland	CEGL005321	1	1
Pinus flexilis Bedrock Sparse Vegetation [Park Special]	CEPS009606	1	1
Pinus flexilis / Selaginella watsonii Krummholz	CEGL005435	2	2
**Pinus longaeva / (Ericameria discoidea, Ribes montigenum)* Woodland	CEGL005447	11	15

Association	Element code	GRBA Field Samples	Total Field Samples
Pinus longaeva / Arctostaphylos patula Woodland [Park Special]	CEPS009591	2	2
Pinus longaeva / Symphoricarpos oreophilus Woodland [Park Special]	CEPS009593	1	1
Pinus monophylla - Juniperus osteosperma / Artemisia arbuscula Woodland	CEGL000830	1	3
**Pinus monophylla - Juniperus osteosperma / Artemisia nova* Woodland	CEGL000831	2	14
**Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* ssp. *vaseyana* - Mixed Shrub Woodland	CEGL005436	5	10
Pinus monophylla - Juniperus osteosperma / Artemisia tridentata ssp. *vaseyana / Pseudoroegneria spicata* Woodland	CEGL000833	2	2
**Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Woodland	CEGL000832	7	15
**Pinus monophylla - Juniperus osteosperma / Betula occidentalis - Rosa woodsii* Woodland [Park Special]	CEPS009607	2	2
**Pinus monophylla – (Juniperus osteosperma) / Cercocarpus intricatus* Woodland	CEGL005437	3	6
**Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland	CEGL000828	5	10
Pinus monophylla - Juniperus osteosperma / Glossopetalon spinescens - Artemisia tridentata - Purshia stansburiana Woodland [Provisional]	CEGL005438	2	2
Pinus monophylla - Juniperus osteosperma / Peraphyllum ramosissimum Woodland	CEGL005439	1	3
Pinus monophylla - Juniperus osteosperma / Poa (fendleriana, secunda) Woodland	CEGL005440	2	2
Pinus monophylla - Juniperus osteosperma / Prunus virginiana Woodland	CEGL000836	1	1
Pinus monophylla - Juniperus osteosperma / Purshia tridentata Woodland [Park Special]	CEPS009608	3	3
**Pinus monophylla - Juniperus osteosperma /* Sparse Understory Woodland	CEGL000829	5	8
Pinus ponderosa - (Pinus longaeva) / Cercocarpus intricatus Woodland [Provisional]	CEGL005441	2	2
**Pinus ponderosa - Abies concolor / Symphoricarpos oreophilus* Woodland [Provisional]	CEGL005442	4	4
Pinus ponderosa - Abies concolor Riparian Forest [Park Special]	CEPS009609	2	2
Pinus ponderosa / Arctostaphylos patula Woodland	CEGL000842	1	1
Poa fendleriana - Astragalus kentrophyta Herbaceous Vegetation [Park Special]	CEPS009610	1	1
Poa secunda - Arenaria congesta Herbaceous Vegetation [Park Special]	CEPS009611	1	1
Poa secunda - Cirsium eatonii Post-burn Herbaceous Vegetation [Park Special]	CEPS009612	1	1
Polemonium viscosum - Castilleja nana Alpine Rock Sparse Vegetation [Provisional]	CEGL005443	4	4
Polygonum bistortoides Herbaceous Vegetation [Park Special]	CEPS009613	2	2
Populus angustifolia / Artemisia tridentata ssp. *tridentata - Prunus virginiana* Woodland [Park Special]	CEPS009614	1	1
Populus angustifolia / Cornus sericea Woodland	CEGL002664	1	1
Populus angustifolia / Prunus virginiana Woodland	CEGL000651	2	2
Populus angustifolia / Rosa woodsii Forest	CEGL000653	2	2
**Populus tremuloides - Abies concolor / Arctostaphylos patula* Forest	CEGL000522	8	8
Populus tremuloides - Abies concolor / Mesic Graminoid Forest [Park Special]	CEPS009586	1	1
Populus tremuloides - Abies concolor / Poa pratensis Semi-natural Forest	CEGL002947	1	1
Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest	CEGL000523	6	6
**Populus tremuloides - Pinus flexilis* Forest	CEGL000540	6	6

Association	Element code	GRBA Field Samples	Total Field Samples
Populus tremuloides / Artemisia tridentata Forest	CEGL000572	1	1
Populus tremuloides / Betula occidentalis Forest	CEGL002650	4	4
Populus tremuloides / Bromus carinatus Forest	CEGL000573	2	2
Populus tremuloides / Invasive Perennial Grasses Forest	CEGL003748	1	1
Populus tremuloides / Juniperus communis Forest	CEGL000587	1	1
Populus tremuloides / Prunus virginiana - Symphoricarpos oreophilus Forest [Park Special]	CEPS009645	1	1
Populus tremuloides / Ribes spp. Woodland [Park Special]	CEPS009589	1	1
Populus tremuloides / Rosa woodsii Forest	CEGL003149	1	1
Populus tremuloides / Symphoricarpos oreophilus Forest	CEGL000610	3	3
Prunus virginiana - Mixed Shrub Talus Shrubland [Provisional]	CEGL005444	2	2
Prunus virginiana - Penstemon rostriflorus Post-burn Shrubland [Park Special]	CEPS009596	1	1
Pseudoroegneria spicata - Hesperostipa comata Herbaceous Vegetation	CEGL001679	1	1
Pseudoroegneria spicata Herbaceous Vegetation	CEGL001660	2	2
Pseudotsuga menziesii / Arctostaphylos patula Woodland	CEGL000423	1	1
Purshia tridentata - Artemisia tridentata ssp. *tridentata* Shrubland	CEGL001054	1	1
Purshia tridentata / Hesperostipa comata Shrub Herbaceous Vegetation	CEGL001498	1	1
**Ribes (cereum, montigenum) - Ericameria discoidea* Shrubland [Provisional]	CEGL005445	4	4
Rosa woodsii Shrubland	CEGL001126	1	1
Salix bebbiana / Mesic Graminoids Shrubland	CEGL001174	2	2
Salix boothii / Mesic Forbs Shrubland	CEGL001180	1	1
Salix boothii / Mesic Graminoids Shrubland	CEGL001181	3	3
Salix exigua / Mesic Graminoids Shrubland	CEGL001203	1	1
**Sarcobatus vermiculatus - Artemisia tridentata* Shrubland	CEGL001359	2	3
Symphoricarpos oreophilus Shrubland	CEGL002951	1	1
Unclassified Plots		3	3
Totals (136 Total Vegetation Types for GRBA)		**343**	**410**

Table 8 notes:

*Plant associations have a local description written in Appendix D.
-The total number of plots includes field samples outside of project area.
-Field data from outside the project area was used to augment the local descriptions.
-Other common vegetation types are described at the alliance or group level of the rUSNVC.
-NatureServe uses Kartesz (1999) as standard for plant taxonomy.

NatureServe and Natural Heritage Programs have a system of imperilment ranks for species and plant communities. Ideally each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of known distinct localities or populations. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences. Although 45 of the rUSNVC associations at GRBA are not ranked (GNR) and 41considered secure (G4-G5), 19 associations were found to be of concern (i.e. G1= 3, G2 = 5, G2G= 4 and G3 = 7) (Table 9).

Table 9. List of G1-G3 Global Ranks for Associations at GRBA

Global Rank*	Element Code	Association
G1	CEGL000833	*Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* ssp. *vaseyana / Pseudoroegneria spicata* Woodland
G1	CEGL001054	*Purshia tridentata - Artemisia tridentata ssp. tridentata* Shrubland
G1Q	CEGL000836	*Pinus monophylla - Juniperus osteosperma / Prunus virginiana* Woodland
G2	CEGL001016	*Artemisia tridentata* ssp. *tridentata / Leymus cinereus* Shrubland
G2	CEGL000970	*Cercocarpus ledifolius / Symphoricarpos oreophilus* Woodland
G2	CEGL001660	*Pseudoroegneria spicata* Herbaceous Vegetation
G2	CEGL001498	*Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation
G2?	CEGL000431	*Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest
G2G3	CEGL000653	*Populus angustifolia / Rosa woodsii* Forest
G2G3	CEGL000540	*Populus tremuloides - Pinus flexilis* Forest
G2G3Q	CEGL001479	*Leymus cinereus* Herbaceous Vegetation
G2Q	CEGL000651	*Populus angustifolia / Prunus virginiana* Woodland
G3	CEGL001161	*Betula occidentalis / Cornus sericea* Shrubland
G3	CEGL002654	*Betula occidentalis /* Mesic Graminoids Shrubland
G3	CEGL001022	*Cercocarpus ledifolius / Artemisia tridentata* ssp. *vaseyana* Woodland
G3	CEGL005925	*Picea engelmannii / Juniperus communis* Forest
G3	CEGL002650	*Populus tremuloides / Betula occidentalis* Forest
G3	CEGL001174	*Salix bebbiana /* Mesic Graminoids Shrubland
G3	CEGL001180	*Salix boothii /* Mesic Forbs Shrubland

*GRBA Global Rank definitions include:

G1 = Critically imperiled globally = Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s)

G2 = Imperiled globally = Generally 6-20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s)

G3 = Rare or uncommon = Generally 21-100 occurrences; either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factor(s)

G#G# = Numeric range rank (range no greater than 2) = Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate; for example, a G1G3 rank indicates the rank could be G1, G2, or G3

Qualifiers:

? = Inexact numeric rank = A question mark added to a rank expresses an uncertainty about the rank in the range of 1 in either way on the 1-5 scale; for example, a G2? rank indicates that the rank is thought to be G2, but could be G1 or G3 (Note: G1? and G5? are both valid ranks)

Q = Questionable taxonomy = A "Q" added to a rank denotes questionable taxonomy; it modifies the degree of imperilment and is only used in cases where the type would have a less imperiled rank if it were not recognized as a valid type (i.e., if it were combined with a more common type); a GUQ rank often indicates that the type is unrankable because of daunting taxonomic question.

Digital Imagery and Mapping

For GRBA, 64 map units (48 vegetated, four barren geology and snow, and 12 land-use/land-cover) were developed. The final list of map classes/units was directly cross-walked or matched to corresponding plant associations and land use classes. GRBA map classes represent a compromise between the detail of the rUSNVC, the needs of the resource management staff (e.g. detailed mapping of riparian and wetland types), and the limitations of the imagery. As a result, the mapping legend does not match the rUSNVC at the finest level of association and the rUSNVC associations for GRBA were combined mostly into a one map unit to multiple associations/alliances relationship.When the rUSNVC link was not feasible, descriptive local map units or park specials were created. In addition some of the more widespread and disturbance oriented associations occurred in multiple map units. This many-to-one relationship contains associations where the sagebrush sub-species was not indicated, where the association occurred in both riparian and upland settings, and when the association occurred in multiple disturbance settings such as avalanche chutes and recently burned areas.

The following types represent the possible map scenarios encountered in the GRBA project:

1. **One-to-one relationship** = When a plant association or vegetation alliance had a unique photo signature and could be readily delineated on the imagery, the map unit adopted the plant association/alliance name or similar synonym.
2. **One-to-many relationship** = When related plant associations shared the same signature and could not be distinguished on the imagery, several plant associations were combined into a single complex.
3. **Additional Park Special Map Classes** = Were created for unvegetated bare geologic features and snow.
4. **Land Use – Land Cover** = Non-vegetated areas and vegetation types not recognized by the rUSNVC received Anderson et al. (1976, updated 2002) map unit designations.
5. **Many-to-one relationship =** Some of the GRBA associations occurred in more than map unit and include the following:

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a. *Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland Map Units = S_ARTR and S_ARTRV
   Reason = A disturbed type with no big sagebrush sub-species indicated in the plot data.
b. *Symphoricarpos oreophilus* Shrubland
   Map Units = S_AVAL and S_FIRE
   Reason = Common short shrub species ubiquitous in many early successional habitats.
c. *Leymus cinereus* Herbaceous Vegetation
   Map Units = H_WET and H_MESC
   Reason = Common grass species found in both mesic upland and wetland habitats.
d. *Populus tremuloides* - *Abies concolor* / Mesic Graminoid Forest
   Map Units = F_ABPO and W_ACRIP
   Reason = General understory type common to both riparian and mesic upland habitats.
e. *Populus tremuloides* - *Abies concolor* / *Symphoricarpos oreophilus* Forest
   Map Units = F_ABPO and W_ACRIP
   Reason = Common understory shrub species in both riparian and mesic upland habitats.

f. *Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation
   Map Units = S_AVAL, S_FIRE, and H_RMGC
   Reason = Common short shrub species ubiquitous in many herbaceous habitats.
g. *Poa secunda* - *Cirsium eatonii* Post-burn Herbaceous Vegetation
   Map Units = H_AVAL, H_RMGC and S_FIRE
   Reason = Common grassland association found in both early succesional avalanche chutes and upland grassland communities recovering from recent wildfire events.

Table 10 contains the final list of map units and their cross-walk to associations/alliances or mp unit description information and Appendix E contains descriptions and representative photographs for all the vegetation map units used at GRBA.

Table 10. Map Classes and Relationships to GRBA Plant Associations or Map Class Descriptions.

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
	Forests and Woodlands	
F_ABPO	*Abies concolor - Populus tremuloides* Forest Complex	-*Populus tremuloides - Abies concolor / Arctostaphylos patula* Forest -*Populus tremuloides - Abies concolor / Poa pratensis* Semi-natural Forest -*Populus tremuloides - Abies concolor / Symphoricarpos oreophilus* Forest -*Populus tremuloides - Abies concolor /* Mesic Graminoid Forest [Park Special]
F_PIEN1	*Picea engelmannii* Forest Complex	-*Picea engelmannii* - (*Pinus flexilis*) / *Carex rossii* Woodland -*Picea engelmannii / Juniperus communis* Forest -*Picea engelmannii* / Moss Forest -*Picea engelmannii / Ribes montigenum* Forest
F_PIEN2	*Picea engelmannii* Riparian Forest & Woodland Alliance	-*Picea engelmannii - Populus tremuloides* / Mesic Forb Forest [Park Special] -*Picea engelmannii / Carex scopulorum* Woodland
F_PIEN3	*Picea engelmannii - Populus tremuloides* Forest	-*Picea engelmannii - Populus tremuloides / Arctostaphylos patula* Forest -(Other Unclassified Understory Species)
F_POAN	*Populus angustifolia* Riparian Forest & Woodland Alliance	-*Populus angustifolia / Artemisia tridentata* ssp. *tridentata - Prunus virginiana* Woodland [Park Special] -*Populus angustifolia / Cornus sericea* Woodland -*Populus angustifolia / Prunus virginiana* Woodland -*Populus angustifolia / Rosa woodsii* Forest
F_POTR1	Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance	-*Populus tremuloides / Artemisia tridentata* Forest -*Populus tremuloides / Bromus carinatus* Forest -*Populus tremuloides* / Invasive Perennial Grasses Forest -*Populus tremuloides / Juniperus communis* Forest -*Populus tremuloides / Ribes* spp. Woodland [Park Special] -*Populus tremuloides / Symphoricarpos oreophilus* Forest
F_POTR2	Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance	-*Populus tremuloides / Betula occidentalis* Forest -*Populus tremuloides / Prunus virginiana - Symphoricarpos oreophilus* Forest [Park Special] -*Populus tremuloides / Rosa woodsii* Forest

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
F_PTPF	*Populus tremuloides - Pinus flexilis* Forest	-*Populus tremuloides - Pinus flexilis* Forest
W_ACPM	*Abies concolor - Pseudotsuga menziesii* Forest & Woodland Complex	-*Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest -*Abies concolor / Arctostaphylos patula* Forest -*Abies concolor / Cercocarpus ledifolius* Woodland -*Abies concolor / Symphoricarpos oreophilus* Forest -*Pseudotsuga menziesii / Arctostaphylos patula* Woodland
W_ACRIP	*Abies concolor* Riparian Forest & Woodland Alliance	-*Abies concolor* - (*Populus tremuloides*) / *Salix boothii / Carex scopulorum* Forest -*Abies concolor - Populus tremuloides / Carex* scopulorum Forest -*Populus tremuloides - Abies concolor /* Mesic Graminoid Forest -*Populus tremuloides - Abies concolor / Symphoricarpos* oreophilus Forest
W_CELE	*Cercocarpus ledifolius* Shrubland & Woodland Complex	-*Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Provisional] -*Cercocarpus ledifolius / Artemisia tridentata* ssp. *vaseyana* Woodland -*Cercocarpus ledifolius / Pseudoroegneria spicata* Scrub -*Cercocarpus ledifolius / Symphoricarpos oreophilus* Woodland
W_PIFL	*Pinus flexilis* Woodland Alliance	-*Pinus flexilis* - (*Populus tremuloides*) / *Arctostaphylos patula* Forest -*Pinus flexilis / Artemisia tridentata* ssp. *vaseyana* Woodland [Park Special] -*Pinus flexilis / Symphoricarpos oreophilus* Woodland
W_PILO1	*Pinus longaeva* Subalpine Woodland	-*Pinus longaeva* / (*Ericameria discoidea, Ribes montigenum*) Woodland -(Other Unclassified Understory Species)
W_PILO2	*Pinus longaeva* Montane Woodland	-*Pinus longaeva / Arctostaphylos patula* Woodland [Park Special] -*Pinus longaeva / Symphoricarpos oreophilus* Woodland [Park Special]
W_PJCL	*Pinus monophylla - Juniperus osteosperma /Cercocarpus ledifolius* Woodland	-*Pinus monophylla - Juniperus osteosperma /Cercocarpus ledifolius* Woodland

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
W_PJMX	*Pinus monophylla - (Juniperus osteosperma) /* Mixed Shrub Woodland Complex	-*Pinus monophylla - Juniperus osteosperma* / *Glossopetalon spinescens -Artemisia tridentata – Purshia stansburiana* Woodland [Provisional] -*Pinus monophylla* - (*Juniperus osteosperma*) / *Cercocarpus intricatus* Woodland -*Pinus monophylla - Juniperus osteosperma* / *Peraphyllum ramosissimum* Woodland
W_PJRP	*Pinus monophylla - Juniperus osteosperma /* Mixed Riparian Shrub Woodland Complex	-*Pinus monophylla - Juniperus osteosperma* / *Betula occidentalis - Rosa woodsii* Woodland [Park Special] -*Pinus monophylla - Juniperus osteosperma* / *Prunus virginiana* Woodland
W_PJSG	*Pinus monophylla - (Juniperus osteosperma) / Artemisia* spp. Woodland Complex	-*Pinus monophylla - Juniperus osteosperma* / *Artemisia arbuscula* Woodland -*Pinus monophylla - Juniperus osteosperma* / *Artemisia nova* Woodland -*Pinus monophylla - Juniperus osteosperma* / *Artemisia tridentata* ssp. *vaseyana* - Mixed Shrub Woodland -*Pinus monophylla - Juniperus osteosperma* / *Artemisia tridentata* ssp. *vaseyana* / *Pseudoroegneria spicata* Woodland -*Pinus monophylla - Juniperus osteosperma* / *Artemisia tridentata* Woodland -*Pinus monophylla - Juniperus osteosperma* / *Purshia tridentata* Woodland
W_PJSP	*Pinus monophylla* - (*Juniperus osteosperma*) / Grass & Sparse Understory Woodland Complex	-*Pinus monophylla - Juniperus osteosperma* / *Poa* (*fendleriana, secunda*) Woodland -*Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland
W_PPPM1	*Pinus ponderosa* - (*Pseudotsuga menziesii)* Woodland Complex	-*Pinus ponderosa* - (*Pinus longaeva*) / *Cercocarpus intricatus* Woodland -*Pinus ponderosa - Abies concolor* / *Symphoricarpos oreophilus* Woodland -*Pinus ponderosa* / *Arctostaphylos patula* Woodland
W_PPPM2	*Pinus ponderosa* - (*Pseudotsuga menziesii)* Riparian Forest Alliance	-*Pinus ponderosa - Abies concolor* Riparian Forest -(Other Unclassified Understory Species)

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
	Shrublands	
S_AMARTV	*Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland	-*Amelanchier utahensis - Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*) Shrubland
S_ARAR	*Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance	-*Artemisia arbuscula* ssp. *arbuscula* / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation -(Other Unclassified Understory Species)
S_ARNO	*Artemisia nova* Shrubland Alliance	-*Artemisia nova* / *Achnatherum hymenoides* Shrubland -*Artemisia nova* / *Poa fendleriana* Shrubland -*Artemisia nova* / *Pseudoroegneria spicata* Shrubland
S_ARPA	*Arctostaphylos patula* Shrubland Alliance	-*Arctostaphylos patula* Shrubland -*Arctostaphylos patula* / *Ceanothus martinii* Shrubland
S_ARTR	*Artemisia tridentata* ssp. *tridentata* Shrubland Complex	-*Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland -*Artemisia tridentata* / *Elymus elymoides* Shrubland -*Artemisia tridentata* ssp. *tridentata* / *Agropyron cristatum* Semi-natural Shrubland -*Artemisia tridentata* ssp. *tridentata* / *Leymus cinereus* Shrubland -*Artemisia tridentata* ssp. *tridentata* / *Pleuraphis jamesii* Shrubland -*Artemisia tridentata* ssp. *tridentata – Peraphyllum ramosissimum – Chamaebatiaria millefolium* Shrubland
S_ARTRV	*Artemisia tridentata* ssp. *vaseyana* / Grass Understory Shrubland Complex	-*Artemisia tridentata* ssp. *vaseyana* / *Poa* (*glauca, secunda*) Shrubland -*Artemisia tridentata* ssp. *vaseyana* / *Poa fendleriana* Shrubland -*Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland
S_ARTSY	*Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus* Shrubland Alliance	-*Artemisia tridentata* ssp. *vaseyana – Symphoricarpos oreophilus* / *Elymus trachycaulus* ssp. *trachycaulus* Shrubland -*Artemisia tridentata* ssp. *vaseyana – Symphoricarpos oreophilus* / *Pseudoroegneria spicata* Shrubland

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
S_AVAL	Southern Rocky Mountain Avalanche Chute Shrubland Complex	-*Abies concolor* - *Populus tremuloides* Avalanche Chute Shrubland -*Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional] -*Picea engelmannii* - *Populus tremuloides* Avalanche Chute Shrubland -*Symphoricarpos oreophilus* Shrubland
S_CIPR	*Cercocarpus intricatus* - (*Peraphyllum ramosissimum*) Shrubland Complex	-*Cercocarpus intricatus* - *Glossopetalon spinescens* Shrubland -*Peraphyllum ramosissimum* - *Artemisia tridentata* Shrubland
S_ERNA	*Ericameria nauseosa* Shrubland Alliance	-*Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland -(Other Unclassified Understory Species)
S_FIRE	Post-fire Shrubland Complex	-*Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional] -*Poa secunda* - *Cirsium eatonii* Post-burn Herbaceous Vegetation [Park Special] - *Prunus virginiana* - *Penstemon rostriflorus* Post-burn Shrubland [Park Special] -*Symphoricarpos oreophilus* Shrubland
S_MOTA	Montane Talus & Rock Outcrop Shrubland Complex	-*Prunus virginiana* - Mixed Shrub Talus Shrubland [Provisional] -(Other Unclassified Shrublands)
S_PIEN	*Picea engelmannii* - (*Pinus flexilis)* Great Basin Krummholz Shrubland Alliance	-*Picea engelmannii* - (*Pinus flexilis*) / (*Astragalus platytropis*) Krummholz -*Pinus flexilis* / *Selaginella watsonii* Krummholz
S_PUTR	*Purshia tridentata* Shrubland Complex	-*Purshia tridentata* - *Artemisia tridentata* ssp. *tridentata* Shrubland -Purshia tridentata / *Hesperostipa comata* Shrub Herbaceous Vegetation
S_RIP	Montane Riparian Shrubland Complex	-*Acer glabrum* Drainage Bottom Shrubland -*Betula occidentalis* / *Cornus sericea* Shrubland -*Betula occidentalis* / Mesic Graminoids Shrubland -*Rosa woodsii* Shrubland -*Salix bebbiana* / Mesic Graminoids Shrubland -*Salix boothii* / Mesic Forbs Shrubland -*Salix boothii* / Mesic Graminoids Shrubland -*Salix exigua* / Mesic Graminoids Shrubland
S_RMJC	*Ribes montigenum* - (*Juniperus communis*) Shrubland Complex	-*Ribes* (*cereum, montigenum*) – *Ericameria discoidea* Shrubland -(Other Unclassified *Juniperus communis* Shrublands)

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
S_RT	Mixed Rock & Talus Shrubland Complex	-*Abies concolor* Rock Outcrop Sparse Vegetation [Park Special] -*Cercocarpus ledifolius* Rock Outcrop Sparse Vegetation [Park Special] -*Hulsea algida - Selaginella watsonii* Herbaceous Vegetation [Provisional] -*Petrophyton caespitosum* Sparse Vegetation [Park Special] -*Pinus flexilis* Bedrock Sparse Vegetation -*Polemonium viscosum - Castilleja nana* Alpine Rock Sparse Vegetation [Provisional]
S_SAVE	*Sarcobatus vermiculatus* Shrubland Alliance	-*Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland -(Other Unclassified *Sarcobatus vermiculatus* dominated shrublands))
	Dwarf Shrublands	
DS_GUSA	*Gutierrezia sarothrae* Dwarf-shrubland Alliance	-*Gutierrezia sarothrae* Dwarf-shrubland Alliance
	Herbaceous Vegetation	
H_AINV	Annual Invasive Complex	-*Bromus tectorum* Semi-natural Herbaceous Vegetation -(Other Unclassified Herbaceous Vegetation Species)
H_AVAL	Southern Rocky Mountain Avalanche Chute Herbaceous Vegetation Complex	-*Lomatium graveolens* var. *alpinum* Herbaceous Vegetation -*Poa secunda - Cirsium eatonii* Post-burn Herbaceous Vegetation [Park Special] -(Other Unclassified Herbaceous Vegetation)
H_MESC	Montane Mesic Meadow Complex	-*Dasiphora fruticosa ssp. floribunda* / *Elymus trachycaulus* Shrub Herbaceous Vegetation [Park Special] -*Elymus trachycaulis* Herbaceous Vegetation -*Leymus cinereus* Herbaceous Vegetation
H_PINV	Perennial Invasive Grassland Complex	-*Agropyron cristatum* - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation -*Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
H_RMGC	Rocky Mountain Montane - Subalpine Grassland Complex	-*Achnatherum lettermanii* Herbaceous Vegetation -*Balsamorhiza sagittata* Herbaceous Vegetation [Park Special] -*Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional] -*Poa fendleriana - Astragalus kentrophyta* Herbaceous Vegetation [Park Special] -*Poa secunda - Arenaria congesta* Herbaceous Vegetation [Park Special] -*Poa secunda - Cirsium eatonii* Post-burn Herbaceous Vegetation [Park Special] -*Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation -*Pseudoroegneria spicata* Herbaceous Vegetation
H_TURF	Alpine Turf Complex	-*Carex elynoides - Geum rossii* Herbaceous Vegetation -*Carex elynoides - Phlox pulvinata - Poa secunda* Herbaceous Vegetation -*Carex subnigricans - Geum rossii – Sibbaldia procumbens* Snowbed [Provisional] -*Geum rossii - Calamagrostis purpurascens* Herbaceous Vegetation [Park Special] -*Geum rossii* Herbaceous Vegetation
H_WET	Montane Wet Meadow Complex	-*Carex nebrascensis* Herbaceous Vegetation -*Carex scopulorum* Herbaceous Vegetation -*Dodecatheon alpinum* Herbaceous Vegetation [Park Special] -*Juncus balticus* Herbaceous Vegetation -*Juncus nevadensis - Poa secunda* Herbaceous Vegetation -*Leymus cinereus* Herbaceous Vegetation -*Polygonum bistortoides* Herbaceous Vegetation [Park Special]
Sparse Vegetation		
SV_FELL	Alpine Cushion Plant Fell-field Complex	- *Aquilegia scopulorum - Eriogonum holmgrenii* Fell-field Herbaceous Vegetation - *Astragalus kentrophyta - Eriogonum holmgrenii* Fell-field Herbaceous Vegetation [Park Special] - *Cymopterus nivalis - Erigeron leiomerus- Poa secunda* Herbaceous Vegetation [Park Special] - *Geum rossii - Phlox pulvinata* Fell-field Herbaceous Vegetation - *Phlox pulvinata* Herbaceous Vegetation [Provisional]

Map Code	Map Class Name	rUSNVC Association Assigned to Map Class (or Map Class Description)
Barren Geology and Snowfields		
G_AVAL	Unvegetated Avalanche Chute Talus & Rock	Sloping linear rock formations with boulders and debris
G_ROCK	Unvegetated Rock Cliffs & Outcrops	Bare consolidated rock formations
G_SNOW	Glaciers & Snowfields	Permanent snow and glaciers
G_TALS	Bare Talus, Scree & Fell-fields	Fields and slopes with unconsolidated boulders, rocks and gravel
Land-use and Land-cover		
L_AGRI	Agricultural Business	Ranch and farm facilities
L_CANL	Canal / Ditch	Man-made linear water conveyance systems
L_FACL	NPS Facilities	Visitor center, Housing, Maintenance Yard, etc.
L_FILD	Planted / Cultivated	Tilled and cropped agricultural fields
L_ORCH	Orchard / Vineyards / Groves	Planted woody vegetation used for fruit production, shade, wind-breaks, and landscaping
L_PITS	Quarries / Strip mines / Gravel Pits	Sites disturbed by humans to extract sand, gravel, rock or other minerals
L_POND	Lake / Pond	Natural and small human-made water impoundments
L_RESD	Residential	Housing and residential areas
L_ROAD	Transportation	Paved and earthen roads
L_ROCK	Bare Rock / Sand	Recently cleared land
L_STRM	Stream / River	Natural linear drainage features
L_TRAN	Transitional	Previously developed land, fallow fields, roadsides, slash piles, etc.

Vegetation Map

The GRBA vegetation map consists of 13,129 polygons totaling 32,401 hectares (80,090 acres) (Appendix G) with an average polygon size of about 2.5 hectares (6.1 acres) (Table 11). The relatively small polygon size was due in part to the detailed mapping of riparian and wetland vegetation and the importance of delineating rare vegetation types such as the subalpine bristlecone pine stands and small areas near the entrance to the park that contain non-native vegetation. The mapping was also finely detailed since the 2007 DMI imagery was of high resolution allowing for very small stands of vegetation to be accurately delineated. Figure 15 shows an example of the detailed GRBA vegetation mapping centered on the Lehman Caves Visitor Center.

Based on the final vegetation layer, lands managed by NPS at GRBA consisted of 31,183 hectares (77,084 acres) representing about 96% of the total project area and included the property surrounding the administrative area in Baker, Nevada. Of the NPS land, 93% (71,842 acres) were vegetated, 7% (5,027 acres) were barren or snow covered, and less than 1% (214 acres) was developed. The largest single map unit was the W_ACPM covering 13% (9,747 acres) of the park. Interesting trends in the vegetation mapping at GRBA include that 19% (14,354 acres) of the NPS managed lands consisted of one of the four pinyon-juniper map units and 11% (8,580 acres) were represented by the W_CELE type. Vegetation in the alpine (including Krummholz and shrublands) totaled 4% (3,021 acres) of the GRBA mapped area and riparian and wetland vegetation made-up 2% (1,271 acres) of the park. Non-native vegetation communities represented by the H_AINV and H_PINV map units only totaled 13 acres (< 1 %) and grasslands as a whole were only present on 1,054 acres or about 1% of GRBA.

For further analysis of the vegetation trends at GRBA, the full vegetation spatial database can be explored and manipulated using the additional linked databases and the additional polygon attributes such as density, height, pattern, landform, geology and biophysical setting in a GIS program. The extensive data created for GRBA in this project are difficult to convey in a table or on a two-dimensional map, but it should be understood that the different attributes can be combined in many ways and at different scales and resolutions to produce additional products better representing the full spectrum of the vegetative diversity. For example, areas of pinyon pine and Utah juniper trees that are potentially encroaching on big sagebrush shrublands due to fire suppression can be explored by selecting the five pinyon-juniper map units and then re-selecting for only those polygons that occur in the Montane Sagebrush Steppe or Basin Wildrye-Big Sagebrush biophysical settings (Figure 17).

Table 11. Summary Statistics for the GRBA Map Class Polygons.

Map Code	Map Unit Description	NPS Lands			Total Project Area		
		# of Polygons	Acres	Hectares	# of Polygons	Acres	Hectares
F_ABPO	*Abies concolor - Populus tremuloides* Forest Complex	395	4,197.9	1,700.1	396	4,282.5	1,734.3
F_PIEN1	*Picea engelmannii* Forest Complex	382	6,622.0	2,682.0	381	6,732.1	2,726.5
F_PIEN2	*Picea engelmannii* Riparian Forest & Woodland Alliance	24	107.4	43.6	24	107.4	43.6
F_PIEN3	*Picea engelmannii - Populus tremuloides* Forest	55	759.2	307.3	55	759.2	307.3
F_POAN	*Populus angustifolia* Riparian Forest & Woodland Alliance	90	35.9	13.7	84	46.1	17.7
F_POTR1	Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance	656	2,322.0	939.4	669	2,378.8	962.7
F_POTR2	Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance	235	523.2	210.8	238	549.5	221.8
F_PTPF	*Populus tremuloides - Pinus flexilis* - Forest	78	1714.8	694.4	78	1715.3	694.6
W_ACPM	*Abies concolor - Pseudotsuga menziesii* Forest & Woodland Complex	945	9,747.4	3,947.4	945	10,025.4	4,060.2
W_ACRIP	*Abies concolor* Riparian Forest & Woodland Alliance	35	82.8	33.5	35	87.0	35.2
W_CELE	*Cercocarpus ledifolius* Shrubland & Woodland Complex	1024	8,580.1	3,476.2	1024	9,025.6	3,657.0
W_PIFL	Great Basin *Pinus flexilis* Woodland Alliance	360	6,710.4	2716.7	360	6,932.5	2,806.8
W_PILO1	*Pinus longaeva* Subalpine Woodland	53	11,86.5	480.3	53	1,292.7	523.5
W_PILO2	*Pinus longaeva* Montane Woodland	42	429.8	174.2	42	478.0	193.6
W_PJCL	*Pinus monophylla - Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland	398	4,927.6	1,996.5	398	4,998.0	2024.8
W_PJMX	*Pinus monophylla* - (*Juniperus osteosperma*) / Mixed Shrub Woodland Complex	194	3,531.3	1,430.2	194	3,779.8	1,530.8
W_PJRP	*Pinus monophylla - Juniperus osteosperma* / Mixed Riparian Shrub Woodland Complex	114	83.6	33.3	114	94.8	38.0
W_PJSG	*Pinus monophylla* - (*Juniperus osteosperma*) / *Artemisia* spp. Woodland Complex	577	4,648.3	1882.3	577	5,004.9	2,026.8
W_PJSP	*Pinus monophylla* - (*Juniperus osteosperma)* / Grass & Sparse Understory Woodland Complex	377	4,778.5	1,935.5	377	5,061.3	2,049.6
W_PPPM1	*Pinus ponderosa* - (*Pseudotsuga menziesii*) Woodland Complex	68	379.8	153.4	68	385.3	155.7
W_PPPM2	*Pinus ponderosa* - (*Pseudotsuga menziesii*) Riparian Forest Alliance	38	59.5	24.2	38	60.3	24.5

Map Code	Map Unit Description	NPS Lands			Total Project Area		
		# of Polygons	Acres	Hectares	# of Polygons	Acres	Hectares
S_AMARTV	*Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland	17	152.0	61.4	17	152.0	61.4
S_ARAR	*Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance	92	296.7	120.3	92	322.8	131.0
S_ARNO	*Artemisia nova* Shrubland Alliance	92	167.3	67.5	94	213.3	86.0
S_ARPA	*Arctostaphylos patula* Shrubland Alliance	268	465.4	188.1	275	503.1	203.4
S_ARTR	*Artemisia tridentata* ssp. *tridentata* Shrubland Complex	168	170.4	68.3	173	204.1	82.0
S_ARTRV	*Artemisia tridentata* ssp. *vaseyana* / Grass Understory Shrubland Complex	764	3,071.2	1,240.8	774	3,172.0	1,281.7
S_ARTSY	*Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus* Shrubland Alliance	30	101.1	40.9	29	118.1	47.7
S_AVAL	Southern Rocky Mountain Avalanche Chute Shrubland Complex	295	743.7	301.1	309	763.7	309.1
S_CIPR	*Cercocarpus intricatus* - (*Peraphyllum ramosissimum*) Shrubland Complex	124	795.1	321.6	126	819.6	331.6
S_ERNA	*Ericameria nauseosa* Shrubland Alliance	71	19.8	7.3	71	19.8	7.3
S_FIRE	Post-fire Shrubland Complex	39	268.5	108.6	40	302.1	122.4
S_MOTA	Montane Talus & Rock Outcrop Shrubland Complex	277	144.9	56.9	285	150.3	59.0
S_PIEN	*Picea engelmannii* - (*Pinus flexilis)* Great Basin Krummholz Shrubland Alliance	267	1,403.1	568.2	265	1,432.8	580.2
S_PUTR	*Purshia tridentata* Shrubland Complex	25	93.7	38.3	25	104.1	42.4
S_RIP	Montane Riparian Shrubland Complex	341	166.4	64.1	346	175.9	68.1
S_RMJC	*Ribes montigenum* - (*Juniperus communis*) Shrubland Complex	22	127.7	51.7	22	127.7	51.7
S_RT	Mixed Rock & Talus Shrubland Complex	119	93.1	36.6	120	95.4	37.4
S_SAVE	*Sarcobatus vermiculatus* Shrubland Alliance	31	26.2	10.5	31	26.2	10.5
DS_GUSA	*Gutierrezia sarothrae* Dwarf-shrubland Alliance	9	1.2	0.4	9	1.2	0.4
H_AINV	Annual Invasive Complex	20	2.9	0.9	20	2.9	0.9
H_AVAL	Southern Rocky Mountain Avalanche Chute Herbaceous Vegetation Complex	7	9.2	3.6	7	9.2	3.6
H_MESC	Montane Mesic Meadow Complex	112	79.6	31.3	112	80.2	31.6
H_PINV	Perennial Invasive Grassland Complex	44	10.4	3.2	44	10.4	3.2
H_RMGC	Rocky Mountain Montane - Subalpine Grassland Complex	90	377.2	152.8	94	433.1	175.2

Map Code	Map Unit Description	NPS Lands			Total Project Area		
		# of Polygons	Acres	Hectares	# of Polygons	Acres	Hectares
H_TURF	Alpine Turf Complex	106	441.9	178.8	111	450.5	182.2
H_WET	Wet Meadow Complex	279	132.8	51.9	285	135.4	52.8
SV_FELL	Alpine Cushion Plant Fell-field Complex	132	1,052.4	425.8	129	1,072.4	434.1
G_AVAL	Unvegetated Avalanche Chute Talus & Rock	56	175.8	71.1	56	176.4	71.3
G_ROCK	Unvegetated Rock Cliffs & Outcrops	1007	1,412.0	568.4	1,030	1,511.5	608.5
G_SNOW	Glaciers & Snowfields	71	42.1	16.5	71	42.1	16.5
G_TALS	Bare Talus, Scree & Fell-fields	1,683	3,398.0	1,365.5	1705	3,436.9	1,381.1
L_AGRI	Agricultural Business	1	0.1	<0.1	1	0.1	<0.1
L_CANL	Canal / Ditch	4	5.1	2.1	4	5.2	2.2
L_FACL	NPS Facilities	33	7.8	3.0	33	7.8	3.0
L_FILD	Planted / Cultivated	1	0.1	<0.1	1	0.1	<0.1
L_ORCH	Orchard / Vineyards / Groves	1	0.4	0.2	1	0.4	0.2
L_PITS	Quarries / Strip mines / Gravel Pits	2	3.0	1.2	2	3.0	1.2
L_POND	Lake / Pond	10	17.5	7.2	10	17.5	7.2
L_RESD	Residential	6	0.2	0.0	9	1.1	0.4
L_ROAD	Transportation	25	138.5	56.0	24	150.8	60.9
L_ROCK	Bare Rock / Sand	5	0.5	0.1	5	0.5	0.1
L_STRM	Stream / River	30	29.2	11.6	31	30.4	11.9
L_TRAN	Transitional	52	11.8	4.1	52	11.8	4.1
	Total Vegetation	9,981	71,842	29,076	10,094	74,695	30,232
	Total Barren Geology	2,817	5,028	2,022	2,862	5,167	2,077
	Total Land Use / Land Cover	170	214	86	173	229	91
	Totals	**12,968**	**77,084**	**31,183**	**13,129**	**80,090**	**32,401**

Table 11 notes:

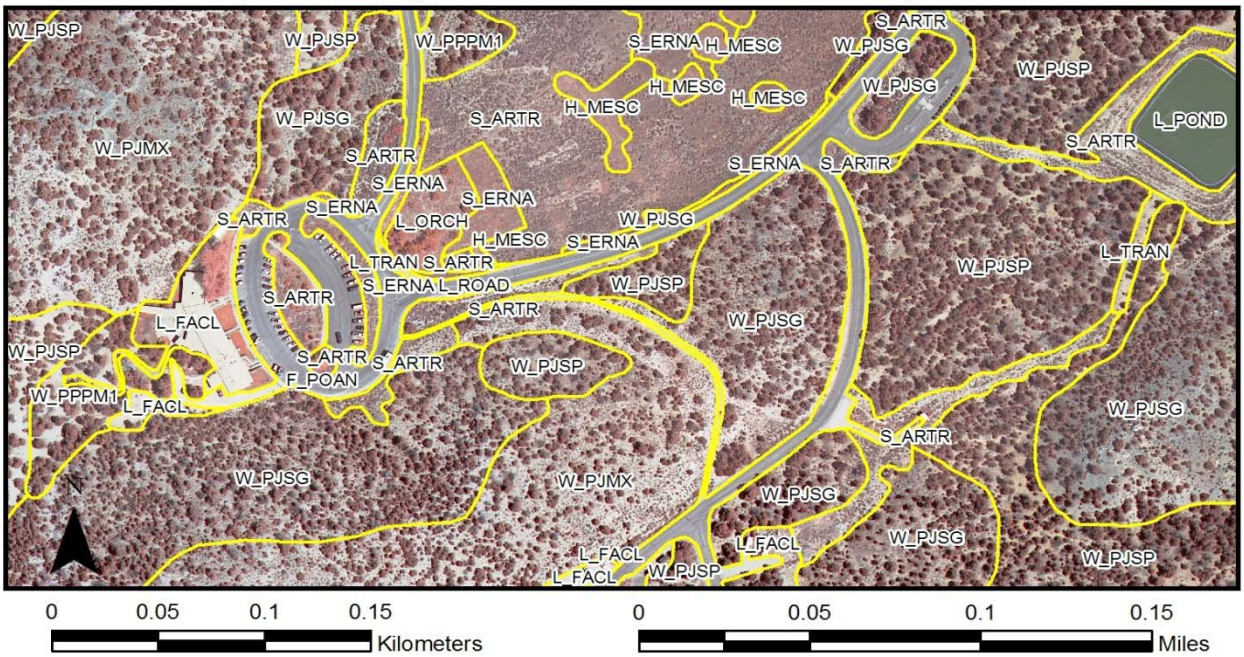
-Total Project Area includes some additional lands outside of the official GRBA boundary.

-Map classes with less Total Project Area polygons but larger areas then the NPS Land totals are a result of creating smaller sliver polygons from larger polygons during the clipping process.

Great Basin National Park
Nevada

National Park Service
U.S. Department of the Interior

Example of Vegetation and Land-use Map Classes

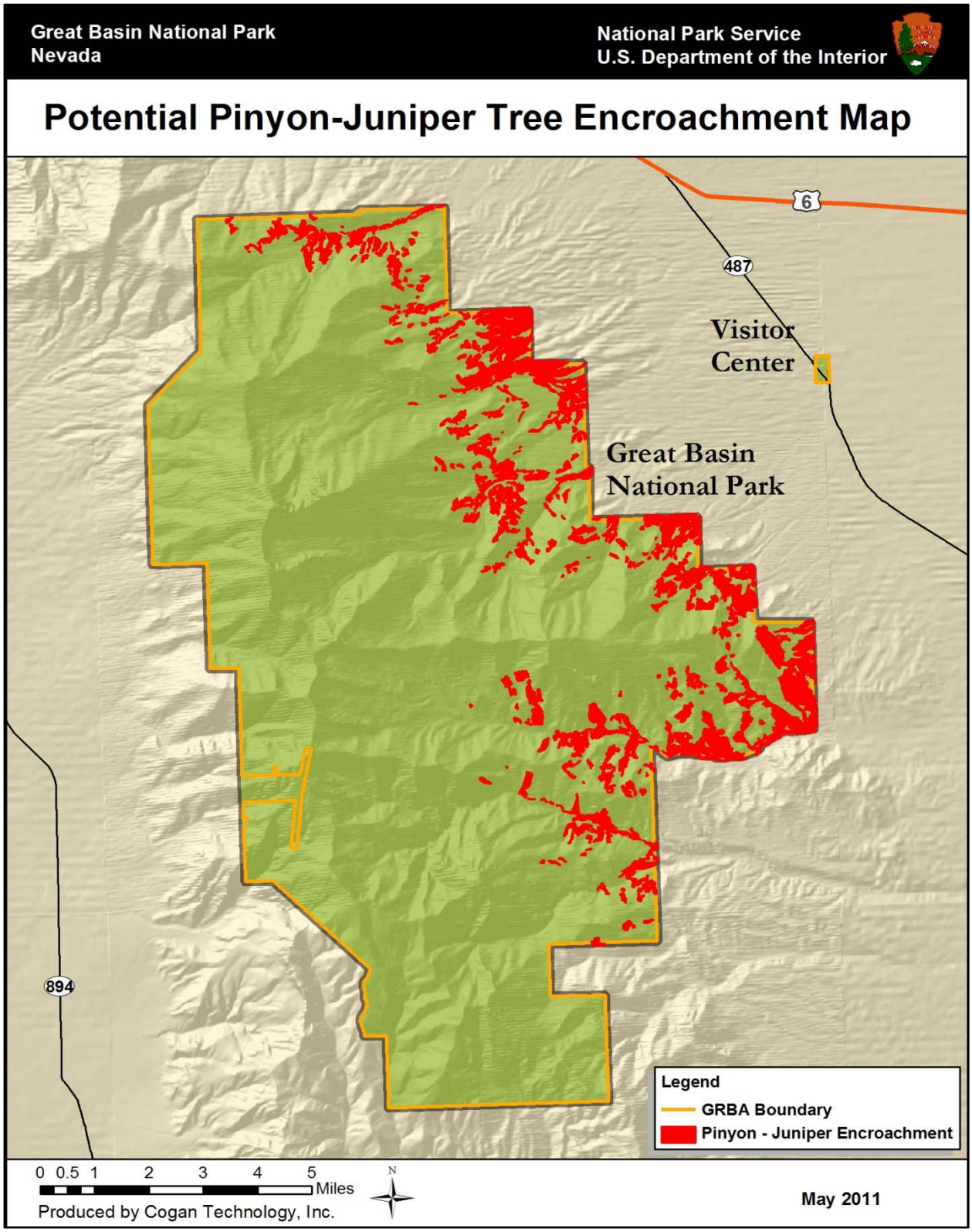


Map Code **Map Unit Description**

F_ABPO *Abies concolor - Populus tremuloides* Forest Complex
F_PIEN1 *Picea engelmannii* Forest Complex
F_PIEN2 *Picea engelmannii* Riparian Forest & Woodland Alliance
F_PIEN3 *Picea engelmannii* - Populus tremuloides Forest
F_POAN *Populus angustifolia* Riparian Forest & Woodland Alliance
F_POTR1 Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance
F_POTR2 Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance
F_PTPF *Populus tremuloides - Pinus flexilis* Forest
W_ACPM *Abies concolor - Pseudotsuga menziesii* Forest & Woodland Complex
W_ACRIP *Abies concolor* Riparian Forest & Woodland Alliance
W_CELE *Cercocarpus ledifolius* Shrubland & Woodland Complex
W_PIFL Great Basin *Pinus flexilis* Woodland Alliance
W_PILO1 *Pinus longaeva* Subalpine Woodland
W_PILO2 *Pinus longaeva* Montane Woodland
W_PJCL *Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland
W_PJMX *Pinus monophylla - (Juniperus osteosperma)* / Mixed Shrub Woodland Complex
W_PJRP *Pinus monophylla - Juniperus osteosperma* / Mixed Riparian Shrub Woodland Complex
W_PJSG *Pinus monophylla - (Juniperus osteosperma)* / Artemisia spp. Woodland Complex
W_PJSP *Pinus monophylla - (Juniperus osteosperma)* / Grass & Sparse Understory Woodland Complex
W_PPPM1 *Pinus ponderosa - (Pseudotsuga menziesii)* Woodland Complex
W_PPPM2 *Pinus ponderosa - (Pseudotsuga menziesii)* Riparian Forest Alliance
S_AMARTV *Amelanchier utahensis - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis)* Shrubland
S_ARAR *Artemisia arbuscula ssp. arbuscula* Shrub Herbaceous Alliance
S_ARNO *Artemisia nova* Shrubland Alliance
S_ARPA *Arctostaphylos patula* Shrubland Alliance
S_ARTR *Artemisia tridentata ssp. tridentata* Shrubland Complex
S_ARTRV *Artemisia tridentata ssp. vaseyana* / Grass Understory Shrubland Complex
S_ARTSY *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus* Shrubland Alliance
S_AVAL Southern Rocky Mountain Avalanche Chute Shrubland Complex
S_CIPR *Cercocarpus intricatus - (Peraphyllum ramosissimum)* Shrubland Complex
S_ERNA *Ericameria nauseosa* Shrubland Alliance
S_FIRE Post-fire Shrubland Complex
S_MOTA Montane Talus & Rock Outcrop Shrubland Complex
S_PIEN *Picea engelmannii - (Pinus flexilis)* Great Basin Krummholz Shrubland Alliance
S_PUTR *Purshia tridentata* Shrubland Complex
S_RIP Montane Riparian Shrubland Complex
S_RMJC *Ribes montigenum - (Juniperus communis)* Shrubland Alliance
S_RT Mixed Rock & Talus Shrubland Complex
S_SAVE *Sarcobatus vermiculatus* Shrubland Alliance
DS_GUSA *Gutierrezia sarothrae* Dwarf-shrubland Alliance
H_AINV Annual Invasive Complex
H_AVAL Southern Rocky Mountain Avalanche Chute Herbaceous Vegetation Complex
H_MESC Montane Mesic Meadow Complex
H_PINV Perennial Invasive Grassland Complex
H_RMGC Rocky Mountain Montane - Subalpine Grassland Complex
H_TURF Alpine Turf Complex
H_WET Wet Meadow Complex
SV_FELL Alpine Cushion Plant Fell-field Complex
G_AVAL Unvegetated Avalanche Chute Talus & Rock
G_ROCK Unvegetated Rock Cliffs & Outcrops
G_SNOW Glaciers & Snowfields
G_TALS Bare Talus, Scree & Fell-fields
L_AGRI Agricultural Business
L_CANL Canal / Ditch
L_FACL NPS Facilities
L_FILD Planted / Cultivated
L_ORCH Orchard / Vineyards / Groves
L_PITS Quarries / Strip mines / Gravel Pits
L_POND Lake / Pond
L_RESD Residential
L_ROAD Transportation
L_ROCK Bare Rock / Sand
L_STRM Stream / River
L_TRAN Transitional

Source: CTI and DMI Imagery (Color Infrared Band)

Figure 16. Example of the GRBA Vegetation Map Layer.



Source: CTI

Figure 17. Example of the GRBA Vegetation Layer with Potential PJ Woodland Encroachment Areas.

Accuracy Assessment

The 2011 AA effort yielded 872 points distributed throughout GRBA, including representative sites near the administrative area in Baker, NV. Logan Simpson staff collected the AA points in the summer of 2011 through a combination of site visits and observing the vegetation on remote sites with binoculars and spotting scopes. After the field work, the resulting AA data was entered in the PLOTS database and NatureServe used some of the point data to update the classification and to revise the local plant community descriptions. Review of the AA database revealed that 10 points occurred in the wrong target location, the wrong GPS coordinates were recorded, or the recorded location of the point placed it off the park or on a land-use map unit (e.g. road). These 10 points were removed from analysis yielding a final sample size of 862 points.

Analysis of the AA points involved a point-by-point review in two stages. In stage one, an AA GIS point file was created from the point coordinates recorded in the field. The AA point layer was then digitally overlaid on the vegetation map and a comparison of the final AA field call versus the vegetation polygon label was made by CTI staff using a visual buffer of about 50 meters. Stage one resulted in a preliminary error matrix that was reviewed by MOJN I&M, NatureServe, and CTI. Adjustments were made to the field calls or a secondary field was added at this time based on the actual cover values of the dominant vegetation, the topographic location of the point (i.e. riparian vs. upland), and if the primary call was not recorded (or a placeholder was used) by Logan Simpson staff. The final map unit determination for each of AA point was then recorded in the AA point layer in the "Final_Code" attribute field. In most cases, the primary and/or secondary map unit determination as recorded in the field was used or was slightly modified. All changes to the AA field calls were noted in an "AA_Comments" attribute field contained in the AA point layer.

Following the AA point review, the raw, overall accuracy of the GRBA vegetation layer was found to be 79%. Results were presented to MOJN I&M and GRBA staff and recommendations were made to improve the accuracy of the map. These included:

- Including Douglas-fir in the ponderosa pine map units = W_PPPM1 and W_PPPM2;
- Broadening the white fir map unit to include Douglas-fir trees = W_ACPM;
- Creating a new mountain big sagebrush class that included mountain snowberry (S_ARTSY) to replace a temporary placeholder map unit (S_ARTRMX);
- Added common juniper to the S_ RIMO map unit = S_RMJC;
- Added multiple associations to the S_FIRE map unit;
- Removed S_CHVI from the list of map units since it was never a clear dominant and placed the yellow rabbitbrush into multiple associations;
- Created a new S_CIPR map unit by merging the S_PERA and S_CEIN map classes since squaw apple and little-leaf mountain mahogany tend to occur together;
- Created a new pinyon pine – juniper woodland map unit by merging the pinyon-juniper sparse understory woodland and pinyon-juniper grass understory map units to improve accuracy = W_PJSP;
- Added an antelope bitterbrush shrubland map unit to account for solid stands of antelope bitterbrush in the eastern portions of the GRBA = S_PUTR;
- Approved the inclusion of the remaining map units that had lower than expected accuracy.

Stage two of the analysis involved incorporating the NPS recommendations and re-running the accuracy assessment using the new NVIP protocols (Lea and Curtis 2010). Following vegetation map update, errors were reported in both a sample contingency table (Table 12) and as results from a population contingency table analysis (Table 13). The sample contingency table includes the observation counts, with the predicted, sample data values (vegetation map classes) as rows and the observed reference data values (vegetation types as identified on the ground) as columns. The value in the cells is the number of accuracy assessment observations mapped in each class (row) that were found to be of a specific class (column) in the field. The values in the shaded cells along the diagonal represent counts for correctly classified observations, where the reference data (column) vegetation type matches the mapped vegetation type (row) value. The results of the population contingency table analysis is similar to the sample table; however the values are the proportion of the target area in the corresponding true and mapped vegetation classes, rather than the raw count of observations. Due to space considerations the actual population contingency table was not included in this report but can be viewed directly from the project DVD (see GRBA_AA_Matrix.xls).

By reading across these tables (i.e., rows) one can calculate the percent error of commission, or how many polygons for each map unit were incorrectly labeled when compared to the field data. By reading down the tables (i.e., columns) one can calculate the percent error of omission, or how many polygons for that type were left off the map. Numbers "on the diagonal" tell the user how well the map unit was interpreted and how confident they can be in using it. Numbers "off the diagonal" yield important information about the deficiencies of the map including which types were either: (1) over- mapped - commission errors on the right –more of this type was mapped than occurs at the site, or (2) under-mapped - omission errors on the bottom – some of this type was mapped as other map units.

Table 12. Sample Contingency Table for GRBA.

Map Code	F_ABPO	F_PIEN1	F_PIEN2	F_PIEN3	F_POAN	F_POTR1	F_POTR2	F_PTPF	W_ACPM	W_ACRIP	W_CELE	W_PIFL	W_PILO1	W_PILO2	W_PJCL	W_PJMX	W_PJRP	W_PJSG	W_PJSP	W_PPPM1	W_PPPM2	S_AMARTV	S_ARAR	S_ARNO	S_ARPA	S_ARTR	S_ARTRV	S_ARTSY	S_AVAL	S_CIPR	S_ERNA	S_FIRE	S_MOTA	S_PIEN	S_PUTR	S_RIP	S_RMJC	S_RT	S_SAVE	DS_GUSA	H_AINV	H_AVAL	H_MESC	H_PINV	H_RMGC	H_TURF	H_WET	SV_FELL	Total	User Accuracy
F_ABPO	18	0	0	3	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	75%
F_PIEN1	0	7	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	64%
F_PIEN2	0	0	17	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	85%
F_PIEN3	0	0	0	20	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	83%
F_POAN	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	11	91%
F_POTR1	3	0	0	0	0	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	65%
F_POTR2	0	0	1	1	0	0	25	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	31	81%
F_PTPF	1	0	0	1	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	75%
W_ACPM	0	0	0	0	0	0	0	0	14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	93%
W_ACRIP	1	0	2	0	0	0	0	0	0	12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	75%
W_CELE	0	0	0	0	0	0	0	0	0	0	17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	94%
W_PIFL	0	1	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	88%
W_PILO1	0	3	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	85%
W_PILO2	0	0	0	0	0	0	0	0	1	0	1	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	85%
W_PJCL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	95%
W_PJMX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	64%
W_PJRP	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	16	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	89%
W_PJSG	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	25	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	81%
W_PJSP	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	4	47	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	85%
W_PPPM1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	83%
W_PPPM2	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	69%
S_AMARTV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	95%
S_ARAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	90%
S_ARNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	21	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	88%
S_ARPA	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	13	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	65%
S_ARTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	23	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	74%
S_ARTRV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	88%
S_ARTSY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	9	78%
S_AVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	11	91%
S_CIPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	88%
S_ERNA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	6	67%
S_FIRE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	94%
S_MOTA	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	94%
S_PIEN	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	79%
S_PUTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%
S_RIP	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	20	0	0	0	0	0	0	1	0	0	0	0	0	25	80%
S_RMJC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	3	0	0	0	24	88%
S_RT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	10	91%
S_SAVE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	8	75%
DS_GUSA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	0	0	4	25%
H_AINV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	100%
H_AVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	67%
H_MESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	12	0	0	0	2	0	17	59%
H_PINV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	0%
H_RMGC	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	33	76%
H_TURF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	13	0	0	14	87%
H_WET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	2	0	20	0	25	80%
SV_FELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	9	73%
Total	25	13	21	25	11	20	29	11	18	23	20	8	20	12	24	17	18	33	57	20	11	18	23	23	13	32	31	7	11	38	5	28	17	12	4	24	22	10	6	1	6	4	14	4	27	16	22	8		
Producers Accuracy	72%	54%	81%	80%	91%	75%	86%	82%	78%	52%	85%	88%	85%	92%	88%	94%	89%	78%	82%	100%	82%	100%	83%	91%	100%	72%	68%	100%	91%	97%	80%	57%	88%	92%	50%	83%	95%	100%	100%	100%	14%	50%	83%	0%	93%	81%	91%	100%		

-Table 13 Note: Columns represent AA observation names (field calls) and rows represent predicted map unit names (polygon labels).

Table 13. Population Contingency Table Analysis Results for GRBA.

Map Code	Target Number	Sampled	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
F_ABPO	30	25	75%	58%	92%	87%	86%	88%
F_PIEN1	30	14	64%	35%	92%	77%	75%	80%
F_PIEN2	26	21	85%	69%	100%	13%	12%	47%
F_PIEN3	30	25	83%	69%	98%	48%	47%	48%
F_POAN	11	11	91%	72%	100%	88%	88%	88%
F_POTR1	30	20	68%	50%	87%	94%	93%	94%
F_POTR2	30	29	81%	67%	94%	48%	47%	48%
F_PTPF	30	11	75%	50%	100%	67%	66%	67%
W_ACPM	30	28	93%	79%	100%	98%	96%	99%
W_ACRIP	18	28	75%	54%	96%	13%	12%	13%
W_CELE	30	20	94%	83%	100%	91%	90%	92%
W_PIFL	30	8	88%	62%	100%	99%	98%	100%
W_PILO1	30	20	85%	69%	100%	60%	59%	60%
W_PILO2	30	12	85%	64%	100%	99%	99%	99%
W_PJCL	30	24	95%	86%	100%	86%	86%	87%
W_PJMX	30	17	70%	52%	88%	97%	96%	97%
W_PJRP	22	18	89%	74%	100%	86%	86%	86%
W_PJSG	30	33	81%	67%	94%	82%	81%	83%
W_PJSP	30	57	85%	77%	94%	78%	77%	78%
W_PPPM1	30	10	83%	69%	98%	100%	100%	100%
W_PPPM2	20	6	69%	44%	94%	66%	66%	66%
S_AMARTV	30	18	95%	84%	100%	100%	100%	100%
S_ARAR	30	23	90%	78%	100%	42%	42%	43%
S_ARNO	30	23	88%	74%	100%	89%	89%	89%
S_ARPA	30	13	65%	45%	85%	100%	100%	100%
S_ARTR	30	33	74%	60%	89%	39%	39%	39%
S_ARTRV	30	31	88%	74%	100%	97%	97%	98%
S_ARTSY	30	7	78%	49%	100%	100%	100%	100%
S_AVAL	30	11	91%	72%	100%	100%	99%	100%
S_CIPR	30	25	90%	81%	99%	84%	83%	85%
S_ERNA	5	5	67%	27%	100%	65%	64%	66%
S_FIRE	30	5	94%	82%	100%	40%	39%	41%
S_MOTA	30	17	94%	81%	100%	45%	44%	46%
S_PIEN	30	13	79%	57%	100%	65%	64%	66%
S_PUTR	5	4	100%	75%	100%	80%	79%	81%
S_RIP	30	24	80%	65%	95%	81%	80%	82%
S_RMJC	30	19	88%	74%	100%	48%	47%	49%
S_RT	30	11	100%	95%	100%	100%	100%	100%
S_SAVE	6	6	75%	44%	100%	100%	100%	100%
DS_GUSA	5	10	25%	0%	73%	100%	100%	100%
H_AINV	5	7	100%	50%	100%	15%	14%	16%
H_AVAL	5	4	67%	5%	100%	50%	5%	59%
H_MESC	19	11	71%	49%	92%	82%	81%	83%
H_PINV	5	4	0%	0%	17%	0	0	50%
H_RMGC	30	22	76%	62%	90%	97%	96%	98%
H_TURF	30	16	93%	78%	100%	96%	95%	97%
H_WET	30	23	80%	65%	95%	92%	91%	93%
SV_FELL	30	8	89%	66%	100%	100%	100%	100%

Based on the population table accuracy analysis for GRBA the overall accuracy and Kappa values of the vegetation layer are as follows:

OVERALL ACCURACY (P_c)	=	83.9%
LOWER LIMIT, 90% CONFIDENCE INTERVAL	=	80.1%
UPPER LIMIT, 90% CONFIDENCE INTERVAL	=	87.7%
KAPPA (**K**):	=	81.8%
LOWER LIMIT, 90% CONFIDENCE INTERVAL, **K**	=	79.6%
UPPER LIMIT, 90% CONFIDENCE INTERVAL, **K**	=	84.0%

Analyzing the existing AA data shows that most of the map units had high user's accuracy of at least 80%. The map units below 80% accuracy include those that had marginal accuracy of 60% – 79% and map units that had low accuracy of < 60%. All of the map units with marginal and low accuracy were accepted by GRBA and MOJN I&M staff as important for natural resource management and the reasons for the lower than expected accuracy varies by type. One source of error is likely caused by the small AA point sample sizes (for some of the map classes) that fall below the minimum number of AA target locations as directed by NVIP standards (Lea and Curtis 2010) (see Table 13). Sampling was limited in part to due to the rugged logistics of GRBA and the financial constraints of maintaining field crews for extended periods of time. More sampling in the under-sampled types would likely improve the individual map class accuracy and reduce the corresponding confidence intervals.

Other sources of error in the map units with marginal accuracy can likely be explained by the difficulty in resolving the difference in scale and perspective between viewing the vegetation on the imagery and assessing it on the ground. For example, sampling could have occurred in inclusions of shrublands or herbaceous vegetation in canopy openings that were actually a part of a larger woodland or forest type. Also the similar appearance of closely related mapping units likely caused some confusion in the mapping signatures leading to incorrect polygon labels (i.e. mountain big sagebrush versus basin big sagebrush and ponderosa pine vs. Douglas-fir trees). Two map units, H_PINV and DS_GUSA had low accuracy but were retained in the GRBA mapping layer for resource management purposes. Both map units primarily occurred on recently disturbed sites within the GRBA administrative area and were confused with the similar H_AINV map unit. All three map units contained some of the same species including broom snakeweed, cheatgrass and crested wheatgrass and appeared very similar on the basemap imagery. Also the dynamic nature of these sites and the timing of the AA field work may have resulted in higher cover of the diagnostic species than was captured during the time the imagery was acquired.

Discussion

The steep elevation gradient and rugged landscape at GRBA support a wide diversity of mostly natural plant communities adapted to a variety of environments from dry deserts to cold alpine fell-fields. The wide-ranging and remote habitats of the park including mountain peaks, valleys and desert basins made for many unique challenges to the vegetation inventory project. Challenges included many logistical considerations due to short growing seasons, working on exposed, steep slopes, negotiating routes through dense forest, and working largely on foot from limited roads, trails and other access points. In addition the natural mixing of the dominant vegetation coupled with wildfires, avalanches, and other disturbance events created many mixed species and multi-strata vegetation stands that were difficult to discern from aerial (or overhead) imagery. The inventory and mapping process described in this report although largely successful revealed opportunities for improvement and new approaches for future efforts that are discussed herein.

Approaches that worked well: Field data collection occurred over multiple years with continued review by knowledgeable GRBA staff. This approach allowed for gaps in the data collection to be quickly identified and for subsequent data collection efforts to be focused on the missing plant communities. Through multiple iterations over 4-years the final GRBA vegetation classification is likely more complete than similar projects that only use one or two field seasons for data collection. Timely and high resolution base imagery is also essential to produce detailed and accurate maps and the 2007 DMI imagery was of superior quality and resolution than comparable NAIP or other existing imagery sources. Further, having imagery with 4-bands and the ability to view the vegetation in color infrared format was essential to the detailed and accurate mapping of the riparian and wetlands vegetation at GRBA.

Areas for Improvement: Inherent to all vegetation mapping projects is the need to produce both a consistent vegetation classification and a comprehensive set of map units. Typically, the systems are very similar, but when using a national classification such as the rUSNVC there is usually not a strict 1:1 correspondence. Nonconformity is due to the remote sensing (i.e. collecting data at a distance) nature of the imagery (photo) interpretation and the ability to delineate map units based only on photo signatures. Subtle vegetation characteristics that can be seen on the ground are not necessarily the same as those apparent on the imagery. Canopy closure, shadows, soil reflections and the timing of the imagery acquisition can all impact the vegetation signatures. In the future it may be possible to supplement the classification by collecting additional field samples that may help remove the [Provisional] moniker and/or add new associations to the final list plant associations. New or confirmed associations coupled with more field-based ground-truthing work may allow for more detailed mapping especially for the complex mixed conifer types. In addition, there were a high number of plant communities (95) that were undersampled, based only on 1 or 2 plots. Additional targeted sampling could better capture a more complete range of variation for each of those communities,

Field Surveys

At GRBA a large amount of existing legacy data from the 2003 fire fuel loading project was used to develop the vegetation classification. Because of this, vegetation field sampling at GRBA did not follow the standard NVIP sample site selection methods, which normally would have been an expensive endeavor entailing two, 2-3 person field crews collecting 400-500 plots over two field seasons. Instead NatureServe ecologists reviewed the 266 plots from the 2003 legacy data, identified gaps, and provided target plant communities for future sampling in 2008 and 2009. Although largely useful, the 2003 data did have some limitations due to its broad scope with 40% of plots (108 of 266) sampled landing outside of GRBA. As a result, there was some over-sampling of common upland forest, woodland, and shrubland plant communities and under-sampling of less common, local types (especially wetland, grassland, riparian, sparse, and alpine vegetation). In addition, the 2003 project used randomly located sites that may not be representative of a vegetation type or fall in a transition zone (ecotone) that can confound classification analysis.

Difficulties in the 2003 fuels data were addressed by creating a multi-organizational team of expert collaborators from MOJN I&M, GRBA NatureServe, various contractors, and volunteers. The GRBA team of professional botanists, ecologists and scientists were able to process and build-off the 2003 fuels data and it is fortunate that foresight was given to ensure that the 2003 data would be compatible with the future NVIP data. Although only 60% of the plots from 2003 (158 of 266 plots) was used to classify the vegetation within GRBA, all the 2003 plot data was classified, and 67 of the 108 plots sampled outside the park were classified to associations that occurred within the park. With a total of 136 total plant communities classified, most of the vegetation types that exist within GRBA have been sampled using a non-standard yet efficient and cost-saving approach.

Vegetation Classification

Consistency in data collection methodology can be an issue when vegetation is sampled by numerous field members. At GRBA, even with having dozens of field personnel collecting data, data collection inconsistencies were minimized by field methodology training sessions at the beginning of the 2003 and 2009 field seasons and using trained staff in 2008. Most of the resulting inconsistencies were minor; however one issue that needed to be addressed was inconsistent identification of big sagebrush to subspecies. The rUSNVC classifies sagebrush to subspecies because these taxa occur in ecologically different environments. Misidentification or not noting the subspecies is not unusual since big sagebrush subspecies can hybridize and are often challenging to identify (especially at GRBA).

To overcome the limitations in the big sagebrush data a novel approach was used to help separate the montane-subalpine mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) shrubland and shrub steppe from the lower elevation basin big sagebrush shrublands (*A. t.* ssp. *tridentata*) when subspecies was not specified. Accurately splitting the big sagebrush plots by subspecies included stratifying the data based on a combination of landform type, total floristic composition, and an elevation break of approximately 2,300 meters (7,500 feet). This method was also used to separate similar pinyon - juniper woodlands with different (non-identified) subspecies of big sagebrush in the understory. Using ancillary data to help differentiate between the various big sagebrush subspecies appeared to work (as witnessed in the accuracy assessment results) and

helped avoid having to re-sample these types. [In should also be noted that a third subspecies, Wyoming big sagebrush *(Artemisia tridentata* ssp. *wyomingensis*) is not reported from within the park boundaries and likely does not occur at GRBA (Clifton 2008).]

The vegetation at GRBA was classified using the NVIP National Vegetation Standard, Version 2 (rUSNVC) (FGDC 2008). There exists some confusion over how physiognomy is used in classifying existing vegetation in the rUSNVC compared to how it was used in the previous USNVC, Version 1 (FGDC 1997). To clarify, the physiognomy of a plant community (i.e. forest, woodland, shrubland, shrub steppe, herbaceous or sparse vegetation) does not trump floristic composition or ecology when classifying vegetation in the rUSNVC. Further, the strict and detailed physiognomic hierarchy of the USNVC version 1 is not maintained in the rUSNVC. Rather, very broad physiognomic criteria are applied at higher levels, with floristics playing an increasingly stronger role at the mid and lower levels. As a result the association and alliance levels only have fine-scale physiognomic criteria when they are supported by floristics and ecology. Thus "forest to open woodland" is separated from "shrubland and grassland" at the highest levels, based on the 10% or more cover of trees and finer scale splits are only made at lower levels as needed. For example, wooded shrubland physiognomic class is no longer applicable in the rUSNVC unless ecologically justified by floristic composition.

The use of the new rUSNVC at GRBA likely helped reduce the number of potentially confusing plant associations resulting from mixed stands of vegetation. For example shrub dominated vegetation with scattered trees (up to 9% cover of trees) is now classified as a shrubland and if there is 10% or more cover of trees, then the stand is classified as a woodland or forest. This discourages the classification of transitional vegetation (either spatial transitions such as in ecotones, or temporal transitions when trees colonize/invade shrublands) to rUSNVC associations, reducing the proliferation of associations based solely on physiognomy and reducing the complexity of the classification in general. The 10% or more tree cover break for woodlands and forests is applied globally in the rUSNVC with few exceptions. One significant exception may occur in sparse woodlands (such as pinyon pine on rocky sites at GRBA) were the total vegetation cover only equals 10-15% and the trees dominate with slightly less than 10% cover.

It is not uncommon in large and complex parks such as GRBA to make changes to the classification following the AA data collection. This is mainly due to AA field crews being dispersed into new areas with un-documented vegetation types not previously sampled during the classification stage. GRBA was no exception as the AA field crews were able to produce a list (Table 14) of potentially new plant associations that included 27 rUSNVC associations that occurred at more than one AA target point, eight rUSNVC associations represented by a single AA point, and three proposed provisional associations that were only observed and not sampled.

Table 14. Potential Additional rUSNVC Associations that may occur at GRBA.

Types represented by more than a single AA point
CEGL002698 *Artemisia nova / Poa fendleriana* Shrubland
CEGL001003 *Artemisia tridentata - Ephedra viridis* Shrubland*
CEGL002966 *Artemisia tridentata* ssp. *tridentata / Hesperostipa comata* Shrubland
CEGL002200 *Artemisia tridentata* ssp. *tridentata / Sporobolus airoides* Shrubland
CEGL001037 *Artemisia tridentata* ssp. *vaseyana – Symphoricarpos oreophilus / Poa secunda* Shrubland
CEGL001020 *Artemisia tridentata* ssp. *vaseyana / Balsamorhiza sagittata* Shrubland
CEGL001027 *Artemisia tridentata* ssp. *vaseyana / Leymus cinereus* Shrubland
CEGL003019 *Bromus tectorum* Semi-natural Herbaceous Vegetation
CEGL001802 *Carex aquatilis* Herbaceous Vegetation
CEGL001768 *Carex douglasii* Herbaceous Vegetation*
CEGL001792 *Carex microptera* Herbaceous Vegetation*
CEGL000963 *Cercocarpus ledifolius / Holodiscus dumosus* Woodland*
CEGL000966 *Cercocarpus ledifolius / Prunus virginiana* Shrubland*
CEGL002085 *Erodium cicutarium* Semi-natural Annual Herbaceous Vegetation*
CEGL002801 *Holodiscus dumosus* Rock Outcrop Sparse Vegetation*
CEGL001838 *Juncus balticus* Herbaceous Vegetation
CEGL000734 *Juniperus osteosperma / Cercocarpus ledifolius* Woodland*
CEGL000366 *Picea engelmannii / Geum rossii* Forest
CEGL000807 *Pinus flexilis / Juniperus communis* Woodland
CEGL003073 *Pinus longaeva - Pinus flexilis* Woodland [Placeholder]*
CEGL001925 *Poa fendleriana* Herbaceous Vegetation*
CEGL003081 *Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Vegetation [Placeholder]*
CEGL000648 *Populus angustifolia / Betula occidentalis* Woodland*
CEGL000594 *Populus tremuloides / Mahonia repens* Forest*
CEGL000442 *Pseudotsuga menziesii / Mahonia repens* Forest*
CEGL001133 *Ribes montigenum* Shrubland
CEGL001134 *Rubus idaeus* Scree Shrubland*
CEGL001853 *Carex elynoides - Geum rossii Herbaceous Vegetation*
Types represented by a single AA point
CEGL001010 *Artemisia nova / Hesperostipa comata* Shrubland
CEGL002345 *Artemisia nova – Purshia tridentata / Poa fendleriana* Shrubland
CEGL002931 *Artemisia tridentata ssp. vaseyana / Hesperostipa comata* Shrubland
CEGL001037 *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Poa secunda* Shrubland
CEGL003853 *Juniperus communis var. depressa* Shrubland
CEGL000734 *Juniperus osteosperma / Cercocarpus ledifolius* Woodland
CEGL003154 *Pinus monophylla / Artemisia tridentata / Elymus elymoides* Woodland
CEGL000619 *Populus tremuloides / Thalictrum fendleri* Woodland
CEGL002888 Sparse (on rock and unconsolidated substrates) Nonvascular Vegetation
Proposed provisional associations for GRBA based on AA point data
Artemisia nova / *Bromus tectorum* Semi-natural Shrubland
Betula occidentalis - Rosa woodsii Shrubland
Pinus monophylla - Juniperus osteosperma / *Bromus tectorum* Semi-natural Woodland

Associations marked with * indicate types that were identified during the validation stage.

While some of these additional rUSNVC associations probably occur at GRBA, they should be considered potential and should not be added to the final GRBA classification until further data collection and analysis can be conducted for a variety of reasons. First, the proposed plant association may be based on very limited field data with only the dominant species documented and no associate species or habitat description provided. Second, it is extremely likely that through the random point allocation process the AA target occurred in an atypical stand of vegetation (e.g. ecotone) resulting from local variation and/or disturbance and is not indicative of a broader, association concept. With that said, even though the sampling efforts at GRBA were vigorous it is likely that some new plant associations and unsampled rUSNVC types may exist. Future sampling efforts may help identify and document these unknown types and may warrant their addition to the GRBA rUSNVC list of associations and alliances. More information on the vegetation classification effort at GRBA can be found in NatureServe's final report (Schulz and Hall 2011) and this information along with the list of types in Table 14 may help guide future field sampling work and supplement the GRBA classification.

Digital Imagery and Mapping

The vegetation map for GRBA was based primarily on the 2007 DMI Ortho Photography. Therefore, all of the resulting mapping products correspond to the summer of 2007 timing of the image acquisition (i.e. snapshot in time). As the data are used, it should be remembered that fires, avalanches, and other changes to the landscape since 2007 are not included in this product. In the future it might be beneficial to update the map with newer imagery and GPS coordinates (perimeters) for major events (e.g. wildfire perimeters, insect infestation events, etc).

It is also important to understand that the mapping portion of this project is primarily a remotely sensed exercise and the field work was conducted on site, therefore all resulting products are scale dependent. In general the mapping portions should be viewed as a broader overview and the field data as site-specific. An analyst can enlarge the imagery beyond the 1:12,000-scale using GIS software and see more detail; however it should be remembered that the actual interpretation/mapping was conducted at this scale. As such, any work performed with this product at a finer scale (enlarged image) could lead to some uncertainty. In contrast, the field work was conducted at individual locations at one specific time and extrapolation using these locations to represent out-lying areas or using them to determine species presence at different times/seasons is less reliable. Database users should recognize scale limitations and balance research and modeling projects accordingly.

Accuracy Assessment

An important and necessary aspect of this project is the accuracy assessment since it is an independent ground data collection exercise that determines the usefulness of the vegetation map. As such, users of this product should remember that the GIS mapping and the classification portions of this project were conducted separately from both the plot and AA field data collection. Employing divisions when completing tasks created some challenges related to communication among the teams, including: (1) adequately conveying changes to the vegetation classification based on finding potentially new vegetation types during the field portion of the AA, (2) thoroughly testing and adjusting the field key to remove confusing splits among similar types, (3) insuring that adequate sample sizes are collected for rare and infrequent types, and (4) avoiding having to collect more than the estimated 30 data points for common types.

Actual errors in the GRBA mapping likely stemmed from (1) limitations within the ortho photography (as previously described), (2) natural changes in the vegetation between when the classification plot data was collected in 2003, when the imagery was acquired in 2007, and the timing of the AA conducted in 2011, (3) dichotomous break errors in the field key, (4) difficulty in establishing an overhead perspective to exactly match the ground view, and (5) field access limitations due to hazardous conditions. Of particular note for the GRBA project is the lower than expected AA sample sizes for some of the map units and the use of binoculars and spotting scopes to remotely view the vegetation at some of the AA targets. Remote sampling of AA points was employed at GRBA when points were inaccessible or too treacherous to reach, and by its nature introduces a greater risk of the wrong target area being observed. Although the accuracy for GRBA assessed high, improvements can be made and users should fully explore and understand the sources of error as presented in the error matrix and in the final AA report for GRBA (Logan Simpson 2012).

Future Recommendations

This vegetation classification of GRBA represents the best efforts put forth by NPS and NatureServe staff and others over a relatively short time period for such a challenging environment with diverse vegetation. In order to create the best possible "long-term" vegetation classification for GRBA this project should not be viewed as final, but park staff should continue to explore the park and observe the vegetation to look for additional types. Present and future NPS staff should be encouraged to scrutinize the classification, to better understand the full range of variation of undersampled types and document unsampled and undersampled types by using the field key and doing additional rapid assessment points.

In summary the products produced as part of this project can assist and direct future vegetation and land-use monitoring and management, as follows:

1. The diversity of plant species and dynamic nature of GRBA with respect to pinyon-juniper encroachment, fire, water diversions, climate change, and other vegetation altering influences warrants periodic **field surveys** by experienced ecologists. Working with and sampling more of the plant communities would also be beneficial allowing for the possibility of discovering new associations, updating the descriptions of the current plant associations, and devising better landscape management strategies. All new information could be used to update both the GIS map layer (i.e. better delineation) and the classification (i.e. new associations).

2. Remote sensing does not replace on-the-ground knowledge provided by GPS-linked plots, observations, rapid assessment points, site photographs, and verification/ground-truthing work. Time, topographic features, and funding limitations curtailed the amount of **ground-truthing** performed at GRBA. As research opportunities arise, maps should be examined in the field by experienced crews. Also GPS receiver data and other GIS layers (such as soils and geology) should be used to improve and update the spatial data. Data could be collected on a standard field form, stored, and then used to update the GIS layer on an annual basis. The vegetation map layer should not be viewed as static but should be updated with more current and accurate information.

3. To better understand the limitations of the map, the **accuracy assessment** data presented in the error matrix and final AA report should be thoroughly reviewed by NPS staff. Map classes with low accuracy should be examined to determine if they could be improved with future studies using ground-truthing or other remote-sensing formats (i.e. fine-scale imagery, hyperspectral, etc). Also, landscape modeling may help to tease out the location of specific types based on specific habitat information. For some applications it may make sense to combine map classes into higher units, such as rUSNVC Groups to improve their accuracy**.**

4. For monitoring purposes, **change over time** could be addressed by similar remote sensing projects. New imagery acquired at regular intervals could be used to create up-to-date vegetation layers that could be overlain on this baseline vegetation and land-use layer. Any changes between the two layers could be extracted and analyzed. Also periodically and immediately following vegetation altering events new data should be collected and any changes noted in a new vegetation layer. That way, new vegetation map layers can be prepared on a regular basis to prevent the vegetation map from becoming out-dated over time.

5. In the future, resource management personnel could link the habitat for **species of concern** to specific associations and map units. These map units could be used to help locate potential sites of rare, endangered, or threatened species and communities in the field or identify areas for non-native plant removal or treatment. Known populations of threatened, endangered, or non-native species could be overlain on the vegetation map using point or small polygon layers to extract helpful plant community indicator data such as soils, slope, aspect, hydrology, etc.

Research Opportunities

The wide array of final products produced for this project lends themselves for future research opportunities. On the inventory and classification side, research could range from setting up a photo monitoring project to periodically retake plot photographs to document vegetation change over time, to mining the PLOTS database for locations of species of concern both for rare plants or invasive species For example several of the rare alpine plants at GRBA such as *Eriogonum holmgrenii* (globally critically imperiled, G1) were encountered in plots sampled during the course of this project.

Having an accurate and current vegetation map in a geodatabase also presents many new and exciting opportunities including expanding or linking the GIS layer to derive other information such as fire models, wildlife habitat monitoring locations, guides for rare plant surveys, wildlife habitat structural analyses, and inventorying areas that are likely vectors for invasive species. The map could also be enhanced by overlaying other existing GIS layers including geology, hydrology, elevation, and soils. In this manner complex interactions between these layers could be examined and yield important information about growth rates, regeneration after disturbance, biomass distribution, and stream morphology among others. Through innovative analyses the vegetation layer could be used as a baseline for other ecological and climate-related studies including examining how the vegetation is impacted by global warming events and how it interacts with soil chemistry, pollution, paleontological/archeological sites, insect infestations, weather patterns, etc.

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Appendix A: GRBA Field Data Forms

2003 Plot Forms

[For More Information on the GRBA Data Collection and Field Manuals Please Reference: Schulz, K. A. and M. E. Hall. 2011. Vegetation Classification Report: Great Basin National Park. Unpublished Report submitted to USDI, National Park Service, Mojave Desert Inventory and Monitoring Network. NatureServe, Western Regional Office, Boulder, Colorado. 29 pp. plus Appendices A-H.**]**

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

Plot Code: VMP.GRBA_____ Alliance Group Code: _____

Provisional Community Name: _____

State: NV Park Name: Great Basin NP Park Site Name: _____

Quad Name: _____ Quad Code: _____

Survey Date:_____ Surveyors:_____

UTM X: ___ ___ ___ ___ ___ ___ (m E) UTM Y: ___ ___ ___ ___ ___ ___ ___ (m N) UTM Zone: 11
Comments: _____ GPS Error (+/-)_____

Directions to Plot:

Plot length(m):_____ Azimuth: _____ Plot width(m):_____ If circle (dia.):_____ Flashcard/Roll #: _____ Frame #:_____
Permanent Plot Marker Code: VMP.GRBA _____ Flashcard/Roll #: _____ Frame #:_____

Plot representativeness (discuss decisions for placement and/or reasons for non-representativeness)
Representativeness of association (if known):

Representativeness of plot in stand:

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect_____
Topographic Position (see cheat sheet)

Landform (see cheat sheet)

Surficial Geology (see cheat sheet)

Cowardan System	Hydrology
_ Upland ____ Palustrine Riverine ____ Lacustrine	___Permanently Flooded ___Seasonally Flooded ___Temporarily Flooded ___Semi-permanently Flooded ___Saturated ___Intermittently Flooded ___Unknown

Environmental Comments (dynamic stage, fire history, insect damage, etc):	% Ground Cover: *(estimate to the nearest percentage. Sum = 100%)* ___ Bare soil ___ Moss ___ Small rocks (0.2-10 cm) ___ Bedrock ___ Water ___ Large rocks (> 10 cm) ___ Litter / duff ___ Cryptogam ___ Sand (0.1-2 mm) ___ Wood (> 1 cm) ___ Lichen ___ Other:_____
Soil Texture: ___ sand ___ loam ___ clay ___ loamy sand __ ___ silt loam ___ silt ___ clay loam ___ silty clay ___ sandy clay ___ peat ___ muck ___ sandy loam	Soil Drainage ___ Rapidly drained ___ Well drained ___ Moderately well drained ___ Somewhat poorly drained ___ Poorly drained ___ Very poorly drained

GRBA Vegetation Plot Form, Revised 5/2003

2003 Plot Forms (continued)

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Height Scale for Strata	Cover Scale for Strata
Trees and Shrubs __ __Evergreen __ __Cold-deciduous __ __Mixed evergreen-cold-deciduous Herbs ___Annual ___Perennial	___Broad-leaved ___Needle-leaved ___Microphyllous ___Graminoid ___Forb ___Pteridophyte	___Forest ___Woodland ___Shrubland ___Dwarf Shrubland ___Herbaceous ___Nonvascular ___Sparsely Vegetated	<0.5 m 0.5-1m 1-2 m 2-5 m 5-10 m 10-15 m 15-20 m 20-35 m 35 – 50 m 10 >50 m	T 0-1% P >1-5% >5-15% >15-25% >25-35% >35-45% >45-55% >55-65% >65-75% >75-85% >85-95% 10 > 95%

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

Animal Use Evidence (including scat, browse, graze, burrows, bedding sites, etc)

Natural and Anthropogenic Disturbance Comments (please see cheat sheet for impact codes, list intensity as High, Med, or Low)

Other Comments (locations of photos and permanent plot marker)

GRBA Vegetation Plot Form, Revised 5/2003

Plot Code_VMP GRBA_____

Species/percent cover: Starting with the uppermost stratum, list all species with % cover for each species in the stratum. For each **tree** species estimate seedling, sapling, and mature cover indicating stratum. Put an asterisk next to any species that are known diagnostics for a particular community in the classification.
Also list species outside the plot at the end of the table or designate with a 0 in Cover Class column.

Vegetation Strata: T1 Emergent; T2 Canopy; T3 Subcanopy, S1 Tal. Shrub (>2m), S2 Short Shrub (<2m), S3 Dwarf-shrub (<0.5m),
Ht Herbaceous total, H1 Graminoids, H2 Forbs, H3 Ferns, H4 Tree seedlings, N non-vascular, V vine, E Epiphyte

Stratum	Species Name	Cover Class	Stratum	Species Name	Cover Class	Stratum	Species Name	Cover Class

2008 /2009 Plot Forms

NPS VEGETATION MAPPING PROGRAM: GREAT BASIN NATIONAL PARK VEGETATION SURVEY FORM

IDENTIFIERS/LOCATORS

Plot Code: GRBA_____ ☐ Observation Point Survey Date: ____/____/2008 Surveyors: _____

Provisional Map Unit Name: _____

Provisional Association Name: _____

UTM Zone: 11 UTM X: __ __ __ __ __ __ (m E) UTM Y: __ __ __ __ __ __ __ (m N) Accuracy _____m

Location Comments:

Plot length(m):_____ Plot width(m):_____

Azimuth: _____° Radius(m):_____

Camera #: _____ CF Card #: _____Other#_____

Photo #: N_____ E_____ S_____ W_____ Rep_____

Plot representativeness (discuss decisions for placement and/or reasons for non-representativeness)

a. Representativeness of association (if known):

b. Representativeness of plot in stand:

ENVIRONMENTAL DESCRIPTION

Elevation _____m Slope _____° Aspect _____°

Topographic Position (see cheat sheet)_____ Landform (see cheat sheet)_____

Surficial Geology (see cheat sheet)_____

Cowardan System:	Soil Texture:	Soil Drainage:	% Ground Cover: *(Sum = 100%)*
___ Upland	___ sand	___ Rapidly drained	___ Litter / duff
___ Palustrine	___ loamy sand	___ Well drained	___ Wood (1<3 cm) ___(3<10cm) ___(>10cm)
___ Riverine	___ sandy loam	___ Moderately well drained	___ Bare soil
___ Lacustrine	___ silt loam	___ Somewhat poorly drained	___ Sand (0.1-2 mm)
	___ sandy clay loam	___ Poorly drained	___ Small rocks (0.2-10cm)
Hydrology:	___ clay loam	___ Very poorly drained	___ Large rocks (10-60cm) ___Boulder(>60cm)
___Permanently Flooded	___ silty clay loam		___ Bedrock
___Seasonally Flooded	___ silt		___ Water
___Semi-permanently Flooded	___ sandy clay		___ Moss
___Temporarily Flooded	___ clay		___ Lichen
___Intermittently Flooded	___ silty clay		___ Cryptogam /Biological Crust
___Saturated	___ peat		___ Basal area
___Unknown	___ muck		___ Other: _____
	___ loam		

Environmental Comments (dynamic stage, fire history, insect damage, animal use evidence, natural or anthropogenic disturbance, geology, etc.):

2008 /2009 Plot Forms (continued)

VEGETATION DESCRIPTION

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

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

Vegetation and Other Comments: average DBH cm of canopy trees. Even-aged, mult-aged canopy, early or late seral/old growth stand.

2008 /2009 Plot Forms (continued)

SPECIES LIST

PlotCode GRBA.

Stratum Codes			
T1 Emergent	S1 Tall Shrub	H1 Graminoids	N Non-vascular
T2 Canopy	S2 Short Shrub	H2 Forbs	V Vine/liana
T3 Sub-canopy	S3 Dwarf-shrub	H3 Ferns	E Epiphyte
		H4 Seedlings	

Cover Class Scale			
T	0-1%	4	>35-45%
P	>1-5%	5	>45-55%
1-	>5-10%	6	>55-65%
1+	>10-15%	7	>65-75%
2	>15-25%	8	>75-85%
3	>25-35%	9	>85-95%
		10	> 95%

Stratum	Species Name	CoverClass	Stratum	Species Name	CoverClass
				Species outside plot:	

2009 Rapid Assessment Forms

NPS VEGETATION MAPPING PROGRAM: GREAT BASIN NATIONAL PARK VEGETATION RAPID ASSESSMENT SURVEY FORM

IDENTIFIERS/LOCATORS

Rapid Point Code: GRBA_____ _ Observation Point Survey Date: ____/____/2009 Surveyors: _____

Provisional Map Unit Name: _____

Provisional Association Name: _____

UTM Zone: 11 UTM X: __ __ __ __ __ __ (m E) UTM Y: __ __ __ __ __ __ __ (m N) Accuracy _____m

Location Comments:

Plot length(m):_____ Plot width(m):_____

Azimuth: _____° Radius(m):_____

Camera #: _____ CF Card #: _____Other#_____

Photo #: N_____ E_____ S_____ W_____ Rep_____

Plot representativeness (discuss decisions for placement and/or reasons for non-representativeness)

a. Representativeness of association (if known):

b. Representativeness of plot in stand:

ENVIRONMENTAL DESCRIPTION

Elevation _____m Slope _____° Aspect_____°

Topographic Position (see cheat sheet)_____ Landform (see cheat sheet)_____

Surficial Geology (see cheat sheet)_____

Cowardan System:	Soil Texture:	Soil Drainage:	% Ground Cover: *(Sum = 100%)*
___ Upland	___ sand	___ Rapidly drained	___ Litter / duff
___ Palustrine	___ loamy sand	___ Well drained	___ Wood (1<3 cm) ___(3<10cm) ___(>10cm)
___ Riverine	___ sandy loam	___ Moderately well drained	___ Bare soil
___ Lacustrine	___ silt loam	___ Somewhat poorly drained	___ Sand (0.1-2 mm)
	___ sandy clay loam	___ Poorly drained	___ Small rocks (0.2-10cm)
Hydrology:	___ clay loam	___ Very poorly drained	___ Large rocks (10-60cm) ___Boulder(>60cm)
___Permanently Flooded	___ silty clay loam		___ Bedrock
___Seasonally Flooded	___ silt		___ Water
___Semi-permanently Flooded	___ sandy clay		___ Moss
___Temporarily Flooded	___ clay		___ Lichen
___Intermittently Flooded	___ silty clay		___ Cryptogam /Biological Crust
___Saturated	___ peat		___ Basal area
___Unknown	___ muck		___ Other: _____
	___ loam		

Environmental Comments (dynamic stage, fire history, insect damage, animal use evidence, natural or anthropogenic disturbance, geology, etc.):

Vegetation and Other Comments: average DBH cm of canopy trees. Even-aged, mult-aged canopy, early or late seral/old growth stand.

2009 Rapid Assessment Forms (continued)

VEGETATION DESCRIPTION Plot Code: GRBA._____ Survey Date: ____/____/2009

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

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

SPECIES INFORMATION

Stratum	Species Name	CoverClass	Stratum	Species Name	CoverClass

2011 Accuracy Assessment Form

MOJN Vegetation Classification and Mapping Program **Great Basin National Park, 2011**

ACCURACY ASSESSMENT FIELD FORM

(August 9, 2011)

Section 1. Accuracy Assessment (AA) Point\GPS\Photographic Information

Park Code: GRBA Park Site Name: Strawberry Creek/Cluster 1B AA Point #: GRBA_AA_225____

Surveyor(s) _____ Survey Date: _____

GPS Unit: _____ Model _____ 3D Differential: WAAS on! Waypoint #: _____

Datum: NAD 83 UTM: ZONE 11N UTME __ __ __ __ __ __ UTMN __ __ __ __ __ __ __ Error +/- _____m

Is GPS within stand? Yes / No. If No, site from GPS point to stand, the distance _____ (m) and bearing _____ (degrees)

Projected AA point location: UTME __ __ __ __ __ __ UTMN __ __ __ __ __ __ __ Error +/- _____m

GPS comments: _____

Slope: _____ degrees Aspect: _____ degrees (use 360 for N) Elev. (m) _____ Declination: 12.5° E

Camera# _____ Photo #/ Dir (*take photos in direction that best captures the stand*): _____ _____ _____ _____ ___ _____

Section 2. Observation Area Size/Shape/Location Comments

☐ Standard Observation Area: 0.5 ha Shape: circular (*a circle with a radius of 40m*)

☐ Alternate Observation Area: _____ ha Shape: _____ Length _____ Azimuth _____Width _____

☐ *If* the AA Point location is an intentional offset from the original point coordinates, circle the explanation:

a. The stand is too heterogeneous to key because there are one or more clearly distinct types within the observation area

b. Physical constraints in reaching waypoint

c. Other (explain) _____

AA point location comments\Environmental Comments: _____

_____

_____

Section 3. Vegetation Description: Species and Stratum % Cover (*Record the full scientific species name and cover values for the dominant and/or diagnostic species in each stratum and the total cover by stratum*)

Species Name	Stratum	Percent Cover

Stratum	Total tree cover	Total shrub cover	Total herb cover	Total Nonvascular Cover
% Cover				

Strata: T1 Emergent, T2 Canopy, T3 Sub-canopy, S1 Tall Shrub, S2 Short Shrub, S3 Dwarf Shrub, H1 Graminoids, H2 Forbs, H3 Ferns, H4 Seedlings, N= non-vascular, E=Epiphyte **Height classes:** 1=<0.5m, 2=0.5-1m, 3=1-2m, 4=2-5m, 5=5-10m, 6=10-15m, 7=15-20 m, 8=20-35m, 9=35-50m, 10= >50m

Cover classes (*for reference*): T = 0-1%, P = >1-5%, 1 = >5-15%, 2 = >15-25%, 3 = >25-35%, 4 = >35-45%, 5 = >45-55%, 6 = >55-65%, 7 = >65 – 75%, 8 = > 75-85%, 9 = > 85-95%, 10 = >95-%

Section 4. Field Key to Association

☐ Primary Association: _____

☐ Alternate Association: _____

Conformance to Key (☐Good ☐Fair ☐Poor): _____

Section 5. Field Key to Map Class

For office use only
Mapped as:

☐ Primary Map Class: _____

☐ Alternate Map Class: _____

☐ More than one association? (*i.e. map class is a complex or mosaic*) _____

Conformance to Key (☐Good ☐Fair ☐Poor): _____

Appendix B: Plant Species Found During Field Sampling at Great Basin National Park

There were 616 plant taxa were encountered while sampling field plots, rapid assessment points, observation points, and accuracy assessment points. Subspecies and varieties were listed when provided. Plant names identified only to Family or Genus were included only when there were no Genera recorded in that family or no species recorded in that Genus, respectively. Nomenclature follows that of USDA PLANTS and Kartesz 1999 for flowering plants, ferns and fern-allies. Common names listed were selected primarily from USDA PLANTS.

Family	Genus species	Common Name	NRCS Code
Aceraceae	Acer glabrum	Rocky Mountain maple	ACGL
Aceraceae	Acer glabrum var. diffusum	Rocky Mountain maple	ACGLD3
Anacardiaceae	Rhus trilobata	skunkbush sumac	RHTR
Anacardiaceae	Rhus trilobata var. trilobata	skunkbush sumac	RHTRT
Apiaceae	Angelica kingii	King's angelica	ANKI
Apiaceae	Berula erecta	cutleaf waterparsnip	BEER
Apiaceae	Cicuta maculata	spotted water hemlock	CIMA2
Apiaceae	Cymopterus nivalis	snowline springparsley	CYNI3
Apiaceae	Ligusticum porteri	Porter's licorice-root	LIPO
Apiaceae	Lomatium foeniculaceum	desert biscuitroot	LOFO
Apiaceae	Lomatium foeniculaceum ssp. fimbriatum	desert biscuitroot	LOFOF
Apiaceae	Lomatium graveolens	king desertparsley	LOGR6
Apiaceae	Lomatium graveolens var. alpinum	alpine biscuitroot	LOGRA
Apiaceae	Lomatium nevadense	Nevada biscuitroot	LONE
Apiaceae	Osmorhiza depauperata	bluntseed sweetroot	OSDE
Apiaceae	Osmorhiza occidentalis	western sweetroot	OSOC
Apiaceae	Perideridia bolanderi	Bolander's yampah	PEBO2
Apocynaceae	Apocynum androsaemifolium	spreading dogbane	APAN2
Apocynaceae	Apocynum cannabinum	Indianhemp	APCA
Asteraceae	Achillea millefolium	common yarrow	ACMI2
Asteraceae	Achillea millefolium var. alpicola	common yarrow	ACMIA
Asteraceae	Achillea millefolium var. occidentalis	western yarrow	ACMIO
Asteraceae	Agoseris aurantiaca	orange agoseris	AGAU2
Asteraceae	Agoseris glauca	pale agoseris	AGGL
Asteraceae	Agoseris glauca var. laciniata	false agoseris	AGGLL
Asteraceae	Ambrosia psilostachya	Cuman ragweed	AMPS
Asteraceae	Antennaria corymbosa	flat-top pussytoes	ANCO
Asteraceae	Antennaria media	Rocky Mountain pussytoes	ANME2
Asteraceae	Antennaria microphylla	littleleaf pussytoes	ANMI3
Asteraceae	Antennaria parvifolia	small-leaf pussytoes	ANPA4
Asteraceae	Antennaria rosea	rosy pussytoes	ANRO2
Asteraceae	Arnica chamissonis	Chamisso arnica	ARCH3
Asteraceae	Arnica cordifolia	heartleaf arnica	ARCO9
Asteraceae	Arnica longifolia	spearleaf arnica	ARLO6
Asteraceae	Arnica mollis	hairy arnica	ARMO4
Asteraceae	Artemisia arbuscula	little sagebrush	ARAR8
Asteraceae	Artemisia arbuscula ssp. arbuscula	little sagebrush	ARARA

Family	Genus species	Common Name	NRCS Code
Asteraceae	Artemisia dracunculus	tarragon	ARDR4
Asteraceae	Artemisia frigida	prairie sagewort	ARFR4
Asteraceae	Artemisia ludoviciana	white sagebrush	ARLU
Asteraceae	Artemisia ludoviciana ssp. candicans	white sagebrush	ARLUC8
Asteraceae	Artemisia michauxiana	Michaux's wormwood	ARMI4
Asteraceae	Artemisia nova	black sagebrush	ARNO4
Asteraceae	Artemisia tridentata	big sagebrush	ARTR2
Asteraceae	Artemisia tridentata ssp. tridentata	basin big sagebrush	ARTRT
Asteraceae	Artemisia tridentata ssp. vaseyana	mountain big sagebrush	ARTRV
Asteraceae	Aster alpinus	alpine aster	ASAL3
Asteraceae	Balsamorhiza hookeri	Hooker's balsamroot	BAHO
Asteraceae	Balsamorhiza sagittata	arrowleaf balsamroot	BASA3
Asteraceae	Brickellia californica	California brickellbush	BRCA3
Asteraceae	Brickellia microphylla	littleleaf brickellbush	BRMI
Asteraceae	Brickellia oblongifolia var. oblongifolia	Mojave brickellbush	BROBO
Asteraceae	Centaurea solstitialis	yellow star-thistle	CESO3
Asteraceae	Chaenactis douglasii	Douglas' dustymaiden	CHDO
Asteraceae	Chaenactis stevioides	Steve's dustymaiden	CHST
Asteraceae	Chaetopappa ericoides	rose heath	CHER2
Asteraceae	Chrysothamnus	rabbitbrush	CHRYS9
Asteraceae	Chrysothamnus albidus	whiteflower rabbitbrush	CHAL9
Asteraceae	Chrysothamnus viscidiflorus	yellow rabbitbrush	CHVI8
Asteraceae	Chrysothamnus viscidiflorus ssp. puberulus	yellow rabbitbrush	CHVIP4
Asteraceae	Chrysothamnus viscidiflorus ssp. viscidiflorus	yellow rabbitbrush	CHVIV2
Asteraceae	Cirsium arizonicum	Arizona thistle	CIAR3
Asteraceae	Cirsium eatonii	Eaton's thistle	CIEA
Asteraceae	Cirsium neomexicanum	New Mexico thistle	CINE
Asteraceae	Cirsium subniveum	Jackson Hole thistle	CISU
Asteraceae	Cirsium vulgare	bull thistle	CIVU
Asteraceae	Crepis acuminata	tapertip hawksbeard	CRAC2
Asteraceae	Crepis atribarba	slender hawksbeard	CRAT
Asteraceae	Crepis intermedia	limestone hawksbeard	CRIN4
Asteraceae	Crepis modocensis	Modoc hawksbeard	CRMO4
Asteraceae	Crepis occidentalis	largeflower hawksbeard	CROC
Asteraceae	Ericameria discoidea	whitestem goldenbush	ERDI14
Asteraceae	Ericameria nauseosa	rubber rabbitbrush	ERNA10
Asteraceae	Ericameria watsonii	Watson's goldenbush	ERWA8
Asteraceae	Erigeron argentatus	silver fleabane	ERAR3
Asteraceae	Erigeron compactus	fernleaf fleabane	ERCO3
Asteraceae	Erigeron compositus	cutleaf daisy	ERCO4
Asteraceae	Erigeron concinnus	Navajo fleabane	ERCO27
Asteraceae	Erigeron divergens	spreading fleabane	ERDI4
Asteraceae	Erigeron grandiflorus	largeflower fleabane	ERGR3
Asteraceae	Erigeron jonesii	Jones' fleabane	ERJO2
Asteraceae	Erigeron leiomerus	rockslide yellow fleabane	ERLE6
Asteraceae	Erigeron pumilus	shaggy fleabane	ERPU2
Asteraceae	Erigeron simplex	onestem fleabane	ERSI3
Asteraceae	Erigeron tener	slender fleabane	ERTE6

Family	Genus species	Common Name	NRCS Code
Asteraceae	Erigeron ursinus	Bear River fleabane	ERUR2
Asteraceae	Erigeron watsonii	Watson's fleabane	ERWA5
Asteraceae	Gutierrezia sarothrae	broom snakeweed	GUSA2
Asteraceae	Helianthella uniflora	oneflower helianthella	HEUN
Asteraceae	Heterotheca villosa	hairy false goldenaster	HEVI4
Asteraceae	Hulsea algida	Pacific hulsea	HUAL
Asteraceae	Hymenopappus filifolius	fineleaf hymenopappus	HYFI
Asteraceae	Iva axillaris	povertyweed	IVAX
Asteraceae	Lactuca serriola	prickly lettuce	LASE
Asteraceae	Machaeranthera canescens	hoary tansyaster	MACA2
Asteraceae	Machaeranthera canescens ssp. canescens	hoary tansyaster	MACAC
Asteraceae	Malacothrix glabrata	smooth desertdandelion	MAGL3
Asteraceae	Microseris nutans	nodding microceris	MINU
Asteraceae	Packera multilobata	lobeleaf groundsel	PAMU11
Asteraceae	Packera werneriifolia	hoary groundsel	PAWE4
Asteraceae	Petradoria pumila	rock goldenrod	PEPU7
Asteraceae	Picrothamnus desertorum	bud sagebrush	PIDE4
Asteraceae	Senecio crassulus	thickleaf ragwort	SECR
Asteraceae	Senecio integerrimus	lambstongue ragwort	SEIN2
Asteraceae	Solidago canadensis	Canada goldenrod	SOCA6
Asteraceae	Solidago canadensis var. salebrosa	rough Canada goldenrod	SOCAS
Asteraceae	Solidago multiradiata	Rocky Mountain goldenrod	SOMU
Asteraceae	Solidago simplex	Mt. Albert goldenrod	SOSI3
Asteraceae	Solidago velutina	threenerve goldenrod	SOVE6
Asteraceae	Stenotus acaulis	stemless mock goldenweed	STAC
Asteraceae	Stephanomeria exigua	small wirelettuce	STEX
Asteraceae	Stephanomeria pauciflora	brownplume wirelettuce	STPA4
Asteraceae	Stephanomeria spinosa	thorn skeletonweed	STSP6
Asteraceae	Symphyotrichum ascendens	western aster	SYAS3
Asteraceae	Symphyotrichum eatonii	Eaton's aster	SYEA2
Asteraceae	Symphyotrichum foliaceum	alpine leafybract aster	SYFO2
Asteraceae	Symphyotrichum foliaceum var. apricum	alpine leafybract aster	SYFOA
Asteraceae	Symphyotrichum spathulatum	western mountain aster	SYSP
Asteraceae	Taraxacum officinale	common dandelion	TAOF
Asteraceae	Taraxacum officinale ssp. ceratophorum	common dandelion	TAOFC
Asteraceae	Tetradymia canescens	spineless horsebrush	TECA2
Asteraceae	Tetradymia spinosa	shortspine horsebrush	TESP2
Asteraceae	Tetraneuris acaulis	stemless four-nerve daisy	TEAC
Asteraceae	Tragopogon dubius	yellow salsify	TRDU
Asteraceae	Tragopogon porrifolius	salsify	TRPO
Berberidaceae	Mahonia repens	creeping barberry	MARE11
Betulaceae	Betula occidentalis	water birch	BEOC2
Boraginaceae	Cryptantha cinerea	James' cryptantha	CRCI3
Boraginaceae	Cryptantha circumscissa	cushion cryptantha	CRCI2
Boraginaceae	Cryptantha compacta	compact cryptantha	CRCO17
Boraginaceae	Cryptantha confertiflora	basin yellow cryptantha	CRCO12
Boraginaceae	Cryptantha flavoculata	roughseed cryptantha	CRFL6
Boraginaceae	Cryptantha humilis	roundspike cryptantha	CRHU2
Boraginaceae	Cryptantha pterocarya	wingnut cryptantha	CRPT

Family	Genus species	Common Name	NRCS Code
Boraginaceae	Cryptantha recurvata	curvenut cryptantha	CRRE5
Boraginaceae	Cryptantha torreyana	Torrey's cryptantha	CRTO4
Boraginaceae	Cryptantha watsonii	Watson's cryptantha	CRWA2
Boraginaceae	Hackelia patens	spotted stickseed	HAPA
Boraginaceae	Lappula occidentalis	flatspine stickseed	LAOC3
Boraginaceae	Lappula occidentalis var. occidentalis	flatspine stickseed	LAOCO
Boraginaceae	Lithospermum	stoneseed	LITHO3
Boraginaceae	Lithospermum ruderale	western stoneseed	LIRU4
Boraginaceae	Mertensia	bluebells	MERTE
Boraginaceae	Mertensia ciliata	tall fringed bluebells	MECI3
Boraginaceae	Mertensia franciscana	Franciscan bluebells	MEFR2
Boraginaceae	Mertensia oblongifolia	oblongleaf bluebells	MEOB
Boraginaceae	Plagiobothrys	popcornflower	PLAGI
Brassicaceae	Arabis demissa	nodding rockcress	ARDE
Brassicaceae	Arabis drummondii	Drummond's rockcress	ARDR
Brassicaceae	Arabis hirsuta	hairy rockcress	ARHI
Brassicaceae	Arabis holboellii	Holboell's rockcress	ARHO2
Brassicaceae	Arabis holboellii var. retrofracta	second rockcress	ARHOR
Brassicaceae	Barbarea orthoceras	American yellowrocket	BAOR
Brassicaceae	Cardamine breweri	Brewer's bittercress	CABR6
Brassicaceae	Cardamine cordifolia	heartleaf bittercress	CACO6
Brassicaceae	Caulanthus crassicaulis	thickstem wild cabbage	CACR11
Brassicaceae	Descurainia	tansymustard	DESCU
Brassicaceae	Descurainia californica	Sierra tansymustard	DECA6
Brassicaceae	Descurainia incana	mountain tansymustard	DEIN5
Brassicaceae	Descurainia incana ssp. incisa	mountain tansymustard	DEINI2
Brassicaceae	Descurainia pinnata	western tansymustard	DEPI
Brassicaceae	Descurainia sophia	herb sophia	DESO2
Brassicaceae	Draba albertina	slender draba	DRAL4
Brassicaceae	Draba crassifolia	snowbed draba	DRCR2
Brassicaceae	Draba oligosperma	fewseed draba	DROL
Brassicaceae	Erysimum capitatum	sanddune wallflower	ERCA14
Brassicaceae	Lesquerella kingii	King bladderpod	LEKI
Brassicaceae	Lesquerella occidentalis	western bladderpod	LEOC
Brassicaceae	Physaria chambersii	Chambers' twinpod	PHCH2
Brassicaceae	Rorippa nasturtium-aquaticum	watercress	RONA2
Brassicaceae	Sisymbrium altissimum	tall tumblemustard	SIAL2
Brassicaceae	Streptanthus cordatus	heartleaf twistflower	STCO6
Brassicaceae	Thelypodium integrifolium	entireleaved thelypody	THIN
Cactaceae	Coryphantha	beehive cactus	CORYP
Cactaceae	Echinocereus engelmannii	Engelmann's hedgehog cactus	ECEN
Cactaceae	Echinocereus triglochidiatus	kingcup cactus	ECTR
Cactaceae	Escobaria vivipara	spinystar	ESVI2
Cactaceae	Opuntia erinacea	grizzlybear pricklypear	OPER
Cactaceae	Opuntia polyacantha	plains pricklypear	OPPO
Cactaceae	Opuntia pulchella	sagebrush cholla	OPPU
Cactaceae	Pediocactus simpsonii	Simpson hedgehog cactus	PESI
Caprifoliaceae	Sambucus nigra	European black elderberry	SANI4

Family	Genus species	Common Name	NRCS Code
Caprifoliaceae	Sambucus nigra ssp. caerulea	blue elderberry	SANIC5
Caprifoliaceae	Sambucus nigra ssp. cerulea	blue elderberry	SANIC5
Caprifoliaceae	Sambucus racemosa	red elderberry	SARA2
Caprifoliaceae	Symphoricarpos longiflorus	desert snowberry	SYLO
Caprifoliaceae	Symphoricarpos oreophilus	mountain snowberry	SYOR2
Caryophyllaceae	Arenaria congesta	ballhead sandwort	ARCO5
Caryophyllaceae	Arenaria congesta var. wheelerensis	Wheeler's sandwort	ARCOW
Caryophyllaceae	Arenaria kingii	King's sandwort	ARKI
Caryophyllaceae	Cerastium beeringianum	Bering chickweed	CEBE2
Caryophyllaceae	Cerastium fontanum	common mouse-ear chickweed	CEFO2
Caryophyllaceae	Cerastium fontanum ssp. vulgare	big chickweed	CEFOV2
Caryophyllaceae	Minuartia nuttallii	Nuttall's sandwort	MINU4
Caryophyllaceae	Minuartia obtusiloba	twinflower sandwort	MIOB2
Caryophyllaceae	Minuartia rubella	beautiful sandwort	MIRU3
Caryophyllaceae	Pseudostellaria	pseudostellaria	PSEUD20
Caryophyllaceae	Pseudostellaria jamesiana	tuber starwort	PSJA2
Caryophyllaceae	Sagina saginoides	arctic pearlwort	SASA
Caryophyllaceae	Silene acaulis	moss campion	SIAC
Caryophyllaceae	Silene douglasii	seabluff catchfly	SIDO
Caryophyllaceae	Silene drummondii	Drummond's campion	SIDR
Caryophyllaceae	Silene menziesii	Menzies' campion	SIME
Caryophyllaceae	Silene nachlingerae	Nevada catchfly	SINA2
Caryophyllaceae	Stellaria calycantha	northern starwort	STCA
Caryophyllaceae	Stellaria crispa	curled starwort	STCR2
Caryophyllaceae	Stellaria longifolia	longleaf starwort	STLO
Caryophyllaceae	Stellaria longipes	longstalk starwort	STLO2
Chenopodiaceae	Atriplex canescens	fourwing saltbush	ATCA2
Chenopodiaceae	Atriplex confertifolia	shadscale saltbush	ATCO
Chenopodiaceae	Atriplex rosea	tumbling saltweed	ATRO
Chenopodiaceae	Chenopodium album	lambsquarters	CHAL7
Chenopodiaceae	Chenopodium atrovirens	pinyon goosefoot	CHAT
Chenopodiaceae	Chenopodium fremontii	Fremont's goosefoot	CHFR3
Chenopodiaceae	Chenopodium leptophyllum	narrowleaf goosefoot	CHLE4
Chenopodiaceae	Chenopodium pratericola	desert goosefoot	CHPR5
Chenopodiaceae	Grayia spinosa	spiny hopsage	GRSP
Chenopodiaceae	Halogeton glomeratus	saltlover	HAGL
Chenopodiaceae	Kochia americana	green molly	KOAM
Chenopodiaceae	Krascheninnikovia lanata	winterfat	KRLA2
Chenopodiaceae	Salsola paulsenii	barbwire Russian thistle	SAPA8
Chenopodiaceae	Salsola tragus	prickly Russian thistle	SATR12
Chenopodiaceae	Sarcobatus vermiculatus	greasewood	SAVE4
Clusiaceae	Hypericum scouleri	Scouler's St. Johnswort	HYSC5
Cornaceae	Cornus sericea	redosier dogwood	COSE16
Crassulaceae	Sedum lanceolatum	spearleaf stonecrop	SELA
Crossosomataceae	Glossopetalon spinescens	spiny greasebush	GLSP
Crossosomataceae	Glossopetalon spinescens var. aridum	spiny greasebush	GLSPA
Crossosomataceae	Glossopetalon spinescens var. microphyllum	spiny greasebush	GLSPM2

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Cupressaceae	Juniperus communis	common juniper	JUCO6
Cupressaceae	Juniperus communis var. depressa	common juniper	JUCOD
Cupressaceae	Juniperus monosperma	oneseed juniper	JUMO
Cupressaceae	Juniperus osteosperma	Utah juniper	JUOS
Cupressaceae	Juniperus scopulorum	Rocky Mountain juniper	JUSC2
Cyperaceae	Carex albonigra	blackandwhite sedge	CAAL6
Cyperaceae	Carex aquatilis	water sedge	CAAQ
Cyperaceae	Carex bolanderi	Bolander's sedge	CABO2
Cyperaceae	Carex deweyana	Dewey sedge	CADE9
Cyperaceae	Carex disperma	softleaf sedge	CADI6
Cyperaceae	Carex douglasii	Douglas' sedge	CADO2
Cyperaceae	Carex elynoides	blackroot sedge	CAEL3
Cyperaceae	Carex filifolia	threadleaf sedge	CAFI
Cyperaceae	Carex geyeri	Geyer's sedge	CAGE2
Cyperaceae	Carex hassei	salt sedge	CAHA5
Cyperaceae	Carex interior	inland sedge	CAIN11
Cyperaceae	Carex microptera	smallwing sedge	CAMI7
Cyperaceae	Carex nebrascensis	Nebraska sedge	CANE2
Cyperaceae	Carex nova	black sedge	CANO3
Cyperaceae	Carex occidentalis	western sedge	CAOC2
Cyperaceae	Carex ovalis	eggbract sedge	CAOV8
Cyperaceae	Carex pellita	woolly sedge	CAPE42
Cyperaceae	Carex petasata	Liddon sedge	CAPE7
Cyperaceae	Carex phaeocephala	dunhead sedge	CAPH2
Cyperaceae	Carex praegracilis	clustered field sedge	CAPR5
Cyperaceae	Carex rossii	Ross' sedge	CARO5
Cyperaceae	Carex scopulorum	mountain sedge	CASC12
Cyperaceae	Carex scopulorum var. bracteosa	mountain sedge	CASCB
Cyperaceae	Carex straminiformis	Shasta sedge	CAST7
Cyperaceae	Carex subfusca	brown sedge	CASU6
Cyperaceae	Carex subnigricans	nearlyblack sedge	CASU7
Cyperaceae	Carex vallicola	valley sedge	CAVA3
Cyperaceae	Eleocharis	spikerush	ELEOC
Cyperaceae	Scirpus microcarpus	panicled bulrush	SCMI2
Dryopteridaceae	Cystopteris fragilis	brittle bladderfern	CYFR2
Dryopteridaceae	Woodsia oregana	Oregon cliff fern	WOOR
Dryopteridaceae	Woodsia scopulina	Rocky Mountain woodsia	WOSC
Elaeagnaceae	Shepherdia canadensis	russet buffaloberry	SHCA
Ephedraceae	Ephedra nevadensis	Nevada jointfir	EPNE
Ephedraceae	Ephedra viridis	mormon tea	EPVI
Equisetaceae	Equisetum arvense	field horsetail	EQAR
Equisetaceae	Equisetum hyemale	scouringrush horsetail	EQHY
Equisetaceae	Equisetum laevigatum	smooth horsetail	EQLA
Ericaceae	Arctostaphylos patula	greenleaf manzanita	ARPA6
Euphorbiaceae	Euphorbia	spurge	EUPHO
Fabaceae	Astragalus agrestis	purple milkvetch	ASAG2
Fabaceae	Astragalus argophyllus	silverleaf milkvetch	ASAR4
Fabaceae	Astragalus beckwithii	Beckwith's milkvetch	ASBE3
Fabaceae	Astragalus beckwithii var. purpureus	Beckwith's milkvetch	ASBEP

Family	Genus species	Common Name	NRCS Code
Fabaceae	Astragalus calycosus	Torrey's milkvetch	ASCA9
Fabaceae	Astragalus calycosus var. calycosus	Torrey's milkvetch	ASCAC5
Fabaceae	Astragalus kentrophyta	spiny milkvetch	ASKE
Fabaceae	Astragalus kentrophyta var. tegetarius	mat milkvetch	ASKET
Fabaceae	Astragalus lentiginosus	freckled milkvetch	ASLE8
Fabaceae	Astragalus newberryi	Newberry's milkvetch	ASNE6
Fabaceae	Astragalus piutensis	Sevier milkvetch	ASPI7
Fabaceae	Astragalus platytropis	broadkeel milkvetch	ASPL3
Fabaceae	Astragalus tenellus	looseflower milkvetch	ASTE5
Fabaceae	Astragalus utahensis	Utah milkvetch	ASUT
Fabaceae	Astragalus whitneyi	balloonpod milkvetch	ASWH
Fabaceae	Lathyrus brachycalyx	Bonneville pea	LABR
Fabaceae	Lupinus argenteus	silvery lupine	LUAR3
Fabaceae	Lupinus caudatus	tailcup lupine	LUCA
Fabaceae	Lupinus caudatus ssp. caudatus	tailcup lupine	LUCAC3
Fabaceae	Lupinus kingii	King's lupine	LUKI
Fabaceae	Oxytropis parryi	Parry's oxytrope	OXPA2
Fabaceae	Thermopsis montana var. montana	mountain goldenbanner	THMOM3
Fabaceae	Thermopsis rhombifolia	prairie thermopsis	THRH
Fabaceae	Trifolium gymnocarpon	hollyleaf clover	TRGY
Fabaceae	Trifolium longipes	longstalk clover	TRLO
Fabaceae	Trifolium longipes ssp. hansenii	Hansen's clover	TRLOH
Fabaceae	Trifolium repens	white clover	TRRE3
Fabaceae	Vicia americana	American vetch	VIAM
Gentianaceae	Frasera albomarginata	desert frasera	FRAL5
Gentianaceae	Frasera speciosa	elkweed	FRSP
Geraniaceae	Erodium cicutarium	redstem stork's bill	ERCI6
Grossulariaceae	Ribes aureum	golden currant	RIAU
Grossulariaceae	Ribes cereum	wax currant	RICE
Grossulariaceae	Ribes cereum var. pedicellare	whisky currant	RICEP
Grossulariaceae	Ribes inerme	whitestem gooseberry	RIIN2
Grossulariaceae	Ribes montigenum	gooseberry currant	RIMO2
Hydrophyllaceae	Hydrophyllum capitatum	ballhead waterleaf	HYCA4
Hydrophyllaceae	Phacelia crenulata	cleftleaf wildheliotrope	PHCR
Hydrophyllaceae	Phacelia hastata	silverleaf phacelia	PHHA
Hydrophyllaceae	Phacelia hastata var. hastata	silverleaf phacelia	PHHAH
Hydrophyllaceae	Phacelia sericea ssp. ciliosa	silky phacelia	PHSEC
Juncaceae	Juncus arcticus ssp. littoralis	mountain rush	JUARL
Juncaceae	Juncus balticus	Baltic rush	JUBA
Juncaceae	Juncus compressus	roundfruit rush	JUCO
Juncaceae	Juncus ensifolius	swordleaf rush	JUEN
Juncaceae	Juncus mertensianus	Mertens' rush	JUME3
Juncaceae	Juncus nevadensis	Sierra rush	JUNE
Juncaceae	Juncus nevadensis var. badius	Sierra rush	JUNEB
Juncaceae	Juncus parryi	Parry's rush	JUPA
Juncaceae	Luzula parviflora	smallflowered woodrush	LUPA4
Juncaceae	Luzula spicata	spiked woodrush	LUSP4
Lamiaceae	Mentha arvensis	wild mint	MEAR4
Lamiaceae	Monardella odoratissima	mountain monardella	MOOD

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Liliaceae	Allium bisceptrum	twincrest onion	ALBI2
Liliaceae	Allium nevadense	Nevada onion	ALNE
Liliaceae	Calochortus nuttallii	sego lily	CANU3
Liliaceae	Fritillaria atropurpurea	spotted fritillary	FRAT
Liliaceae	Maianthemum stellatum	starry false lily of the valley	MAST4
Liliaceae	Zigadenus elegans	mountain deathcamas	ZIEL2
Liliaceae	Zigadenus paniculatus	foothill deathcamas	ZIPA2
Liliaceae	Zigadenus venenosus	meadow deathcamas	ZIVE
Linaceae	Linum lewisii	prairie flax	LILE3
Loasaceae	Mentzelia albicaulis	whitestem blazingstar	MEAL6
Malvaceae	Sidalcea candida	white checkerbloom	SICA3
Malvaceae	Sphaeralcea grossulariifolia	gooseberryleaf globemallow	SPGR2
Nyctaginaceae	Mirabilis alipes	winged four o'clock	MIAL5
Onagraceae	Chamerion angustifolium	fireweed	CHAN9
Onagraceae	Epilobium ciliatum	fringed willowherb	EPCI
Onagraceae	Epilobium ciliatum ssp. glandulosum	fringed willowherb	EPCIG
Onagraceae	Epilobium hornemannii	Hornemann's willowherb	EPHO
Onagraceae	Epilobium lactiflorum	milkflower willowherb	EPLA3
Onagraceae	Gayophytum diffusum	spreading groundsmoke	GADI2
Onagraceae	Gayophytum diffusum ssp. parviflorum	spreading groundsmoke	GADIP
Onagraceae	Oenothera caespitosa	tufted evening-primrose	OECA10
Onagraceae	Oenothera howardii	Howard's evening-primrose	OEHO2
Ophioglossaceae	Botrychium crenulatum	scalloped moonwort	BOCR
Orchidaceae	Corallorrhiza maculata	summer coralroot	COMA4
Orchidaceae	Listera convallarioides	broadlipped twayblade	LICO5
Orchidaceae	Platanthera dilatata	scentbottle	PLDI3
Orchidaceae	Platanthera leucophaea	prairie white fringed orchid	PLLE2
Orchidaceae	Platanthera leucostachys	Sierra bog orchid	PLLE5
Orchidaceae	Platanthera sparsiflora	sparse-flowered bog orchid	PLSP2
Orobanchaceae	Orobanche corymbosa	flat-top broomrape	ORCO5
Orobanchaceae	Orobanche fasciculata	clustered broomrape	ORFA
Papaveraceae	Argemone munita ssp. rotundata	flatbud pricklypoppy	ARMUR
Phyllachoraceae	Lichenochora	lichenochora	LICHEN
Pinaceae	Abies concolor	white fir	ABCO
Pinaceae	Abies concolor var. concolor	white fir	ABCOC
Pinaceae	Picea engelmannii	Engelmann spruce	PIEN
Pinaceae	Pinus edulis	twoneedle pinyon	PIED
Pinaceae	Pinus flexilis	limber pine	PIFL2
Pinaceae	Pinus longaeva	Great Basin bristlecone pine	PILO
Pinaceae	Pinus monophylla	singleleaf pinyon	PIMO
Pinaceae	Pinus ponderosa	ponderosa pine	PIPO
Pinaceae	Pinus ponderosa var. scopulorum	ponderosa pine	PIPOS
Pinaceae	Pseudotsuga menziesii	Douglas-fir	PSME
Pinaceae	Pseudotsuga menziesii var. glauca	Rocky Mountain Douglas-fir	PSMEG
Poaceae	Achnatherum hymenoides	Indian ricegrass	ACHY
Poaceae	Achnatherum lettermanii	Letterman's needlegrass	ACLE9
Poaceae	Achnatherum nelsonii	Columbia needlegrass	ACNE9
Poaceae	Achnatherum nelsonii ssp. dorei	Dore's needlegrass	ACNED
Poaceae	Achnatherum nevadense	Nevada needlegrass	ACNE10

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Poaceae	Achnatherum parishii var. depauperatum	little Parish's needlegrass	ACPAD
Poaceae	Achnatherum pinetorum	pine needlegrass	ACPI2
Poaceae	Achnatherum speciosum	desert needlegrass	ACSP12
Poaceae	Agropyron cristatum	crested wheatgrass	AGCR
Poaceae	Agropyron desertorum	desert wheatgrass	AGDE2
Poaceae	Agrostis exarata	spike bentgrass	AGEX
Poaceae	Agrostis scabra	rough bentgrass	AGSC5
Poaceae	Agrostis stolonifera	creeping bentgrass	AGST2
Poaceae	Aristida purpurea	purple threeawn	ARPU9
Poaceae	Bouteloua gracilis	blue grama	BOGR2
Poaceae	Bromus anomalus	nodding brome	BRAN
Poaceae	Bromus arvensis	field brome	BRAR5
Poaceae	Bromus carinatus	California brome	BRCA5
Poaceae	Bromus ciliatus	fringed brome	BRCI2
Poaceae	Bromus inermis	smooth brome	BRIN2
Poaceae	Bromus porteri	Porter brome	BRPO2
Poaceae	Bromus tectorum	cheatgrass	BRTE
Poaceae	Calamagrostis canadensis	bluejoint	CACA4
Poaceae	Calamagrostis purpurascens	purple reedgrass	CAPU
Poaceae	Calamagrostis rubescens	pinegrass	CARU
Poaceae	Calamagrostis stricta	slimstem reedgrass	CAST36
Poaceae	Dactylis glomerata	orchardgrass	DAGL
Poaceae	Danthonia intermedia	timber oatgrass	DAIN
Poaceae	Danthonia unispicata	onespike danthonia	DAUN
Poaceae	Deschampsia caespitosa	tufted hairgrass	DECA18
Poaceae	Distichlis spicata	inland saltgrass	DISP
Poaceae	Elymus elymoides	squirreltail	ELEL5
Poaceae	Elymus elymoides ssp. brevifolius	squirreltail	ELELB
Poaceae	Elymus glaucus	blue wildrye	ELGL
Poaceae	Elymus hystrix	eastern bottlebrush grass	ELHY
Poaceae	Elymus lanceolatus	thickspike wheatgrass	ELLA3
Poaceae	Elymus scribneri	spreading wheatgrass	ELSC4
Poaceae	Elymus trachycaulus	slender wheatgrass	ELTR7
Poaceae	Elymus trachycaulus ssp. trachycaulus	slender wheatgrass	ELTRT
Poaceae	Festuca brachyphylla	alpine fescue	FEBR
Poaceae	Festuca idahoensis	Idaho fescue	FEID
Poaceae	Festuca minutiflora	smallflower fescue	FEMI3
Poaceae	Festuca ovina	sheep fescue	FEOV
Poaceae	Festuca rubra	red fescue	FERU2
Poaceae	Glyceria striata	fowl mannagrass	GLST
Poaceae	Hesperostipa comata	needle and thread	HECO26
Poaceae	Hesperostipa comata ssp. comata	needle and thread	HECOC8
Poaceae	Hordeum brachyantherum	meadow barley	HOBR2
Poaceae	Hordeum jubatum	foxtail barley	HOJU
Poaceae	Koeleria macrantha	prairie Junegrass	KOMA
Poaceae	Leucopoa kingii	spike fescue	LEKI2
Poaceae	Leymus cinereus	basin wildrye	LECI4
Poaceae	Leymus multicaulis	manystem wildrye	LEMU11
Poaceae	Leymus triticoides	beardless wildrye	LETR5

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Poaceae	Melica bulbosa	oniongrass	MEBU
Poaceae	Muhlenbergia arsenei	Navajo muhly	MUAR4
Poaceae	Muhlenbergia richardsonis	mat muhly	MURI
Poaceae	Pascopyrum smithii	western wheatgrass	PASM
Poaceae	Phleum alpinum	alpine timothy	PHAL2
Poaceae	Phleum pratense	timothy	PHPR3
Poaceae	Piptatherum exiguum	little ricegrass	PIEX3
Poaceae	Piptatherum micranthum	littleseed ricegrass	PIMI7
Poaceae	Pleuraphis jamesii	James' galleta	PLJA
Poaceae	Poa bulbosa	bulbous bluegrass	POBU
Poaceae	Poa compressa	Canada bluegrass	POCO
Poaceae	Poa cusickii	Cusick's bluegrass	POCU3
Poaceae	Poa cusickii ssp. epilis	Cusick's bluegrass	POCUE2
Poaceae	Poa fendleriana	muttongrass	POFE
Poaceae	Poa glauca	glaucous bluegrass	POGL
Poaceae	Poa glauca ssp. rupicola	timberline bluegrass	POGLR2
Poaceae	Poa palustris	fowl bluegrass	POPA2
Poaceae	Poa pratensis	Kentucky bluegrass	POPR
Poaceae	Poa reflexa	nodding bluegrass	PORE
Poaceae	Poa secunda	Sandberg bluegrass	POSE
Poaceae	Poa wheeleri	Wheeler's bluegrass	POWH2
Poaceae	Pseudoroegneria spicata	bluebunch wheatgrass	PSSP6
Poaceae	Pseudoroegneria spicata ssp. spicata	bluebunch wheatgrass	PSSPS
Poaceae	Sporobolus airoides	alkali sacaton	SPAI
Poaceae	Thinopyrum intermedium	intermediate wheatgrass	THIN6
Poaceae	Torreyochloa pallida var. pauciflora	pale false mannagrass	TOPAP3
Poaceae	Trisetum spicatum	spike trisetum	TRSP2
Poaceae	Trisetum wolfii	Wolf's trisetum	TRWO3
Poaceae	Vulpia octoflora	sixweeks fescue	VUOC
Polemoniaceae	Collomia linearis	tiny trumpet	COLI2
Polemoniaceae	Gilia inconspicua	shy gilia	GIIN2
Polemoniaceae	Ipomopsis aggregata	scarlet gilia	IPAG
Polemoniaceae	Ipomopsis congesta	ballhead ipomopsis	IPCO5
Polemoniaceae	Ipomopsis congesta ssp. crebrifolia	ballhead ipomopsis	IPCOC
Polemoniaceae	Ipomopsis tenuituba	slendertube skyrocket	IPTE4
Polemoniaceae	Leptodactylon pungens	granite prickly phlox	LEPU
Polemoniaceae	Phlox austromontana	mountain phlox	PHAU3
Polemoniaceae	Phlox caespitosa	tufted phlox	PHCA7
Polemoniaceae	Phlox gracilis	slender phlox	PHGR16
Polemoniaceae	Phlox longifolia	longleaf phlox	PHLO2
Polemoniaceae	Phlox pulvinata	cushion phlox	PHPU5
Polemoniaceae	Phlox stansburyi	cold-desert phlox	PHST11
Polemoniaceae	Polemonium pulcherrimum	Jacob's-ladder	POPU3
Polemoniaceae	Polemonium pulcherrimum ssp. delicatum	Jacob's-ladder	POPUD3
Polemoniaceae	Polemonium viscosum	sticky polemonium	POVI
Polygalaceae	Polygala subspinosa	spiny milkwort	POSU2
Polygonaceae	Eriogonum caespitosum	matted buckwheat	ERCA8
Polygonaceae	Eriogonum heracleoides	parsnipflower buckwheat	ERHE2
Polygonaceae	Eriogonum holmgrenii	Snake Range buckwheat	ERHO5

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Polygonaceae	Eriogonum lonchophyllum	spearleaf buckwheat	ERLO4
Polygonaceae	Eriogonum microthecum	slender buckwheat	ERMI4
Polygonaceae	Eriogonum microthecum var. laxiflorum	slender buckwheat	ERMIL2
Polygonaceae	Eriogonum nudum	naked buckwheat	ERNU3
Polygonaceae	Eriogonum ovalifolium	cushion buckwheat	EROV
Polygonaceae	Eriogonum ovalifolium var. purpureum	cushion buckwheat	EROVP2
Polygonaceae	Eriogonum racemosum	redroot buckwheat	ERRA3
Polygonaceae	Eriogonum umbellatum	sulphur-flower buckwheat	ERUM
Polygonaceae	Eriogonum villiflorum	gray buckwheat	ERVI4
Polygonaceae	Eriogonum watsonii	Watson's buckwheat	ERWA3
Polygonaceae	Polygonum bistortoides	American bistort	POBI6
Polygonaceae	Polygonum douglasii	Douglas' knotweed	PODO4
Polygonaceae	Polygonum douglasii ssp. johnstonii	Johnston's knotweed	PODOJ2
Polygonaceae	Rumex crispus	curly dock	RUCR
Portulacaceae	Lewisia pygmaea	alpine lewisia	LEPY2
Portulacaceae	Montia chamissoi	water minerslettuce	MOCH
Portulacaceae	Portulaca	purslane	PORTU
Primulaceae	Androsace septentrionalis	pygmyflower rockjasmine	ANSE4
Primulaceae	Dodecatheon alpinum	alpine shootingstar	DOAL
Primulaceae	Primula nevadensis	Nevada primrose	PRNE
Primulaceae	Primula parryi	Parry's primrose	PRPA
Pyrolaceae	Orthilia secunda	sidebells wintergreen	ORSE
Pyrolaceae	Pyrola asarifolia	liverleaf wintergreen	PYAS
Pyrolaceae	Pyrola minor	snowline wintergreen	PYMI
Ranunculaceae	Aconitum columbianum	Columbian monkshood	ACCO4
Ranunculaceae	Actaea rubra	red baneberry	ACRU2
Ranunculaceae	Anemone multifida	Pacific anemone	ANMU
Ranunculaceae	Aquilegia caerulea	Colorado blue columbine	AQCA2
Ranunculaceae	Aquilegia formosa	western columbine	AQFO
Ranunculaceae	Aquilegia scopulorum	Utah columbine	AQSC
Ranunculaceae	Ceratocephala testiculata	curveseed butterwort	CETE5
Ranunculaceae	Clematis ligusticifolia	western white clematis	CLLI2
Ranunculaceae	Delphinium andersonii	Anderson's larkspur	DEAN
Ranunculaceae	Ranunculus adoneus	alpine buttercup	RAAD
Ranunculaceae	Ranunculus alismifolius	plantainleaf buttercup	RAAL
Ranunculaceae	Ranunculus alismifolius var. montanus	waterplantain buttercup	RAALM
Ranunculaceae	Ranunculus inamoenus	graceful buttercup	RAIN
Ranunculaceae	Thalictrum alpinum	alpine meadow-rue	THAL
Ranunculaceae	Thalictrum fendleri	Fendler's meadow-rue	THFE
Rhamnaceae	Ceanothus martinii	Martin's ceanothus	CEMA2
Rosaceae	Amelanchier alnifolia	Saskatoon serviceberry	AMAL2
Rosaceae	Amelanchier utahensis	Utah serviceberry	AMUT
Rosaceae	Argentina anserina	silverweed cinquefoil	ARAN7
Rosaceae	Cercocarpus intricatus	littleleaf mountain mahogany	CEIN7
Rosaceae	Cercocarpus ledifolius	curl-leaf mountain mahogany	CELE3
Rosaceae	Cercocarpus ledifolius var. intercedens	curl-leaf mountain mahogany	CELEI
Rosaceae	Cercocarpus ledifolius var. intermontanus	curl-leaf mountain mahogany	CELEI4
Rosaceae	Chamaebatiaria millefolium	desert sweet/fernbush	CHMI2
Rosaceae	Dasiphora floribunda	shrubby cinquefoil	DAFL3

Family	Genus species	Common Name	NRCS Code
Rosaceae	Dasiphora fruticosa ssp. floribunda	shrubby cinquefoil	DAFRF
Rosaceae	Geum macrophyllum	largeleaf avens	GEMA4
Rosaceae	Geum macrophyllum var. perincisum	largeleaf avens	GEMAP
Rosaceae	Geum rossii	Ross' avens	GERO2
Rosaceae	Geum rossii var. turbinatum	Ross' avens	GEROT
Rosaceae	Holodiscus dumosus	rockspirea	HODU
Rosaceae	Peraphyllum ramosissimum	squaw apple	PERA4
Rosaceae	Petrophyton caespitosum	mat rockspirea	PECA12
Rosaceae	Petrophytum caespitosum	mat rockspirea	PECA12
Rosaceae	Potentilla biennis	biennial cinquefoil	POBI7
Rosaceae	Potentilla concinna	elegant cinquefoil	POCO13
Rosaceae	Potentilla diversifolia	varileaf cinquefoil	PODI2
Rosaceae	Potentilla glandulosa ssp. nevadensis	Nevada cinquefoil	POGLN
Rosaceae	Potentilla gracilis	slender cinquefoil	POGR9
Rosaceae	Potentilla nivea	snow cinquefoil	PONI2
Rosaceae	Potentilla ovina	sheep cinquefoil	POOV2
Rosaceae	Potentilla ovina var. ovina	sheep cinquefoil	POOVO
Rosaceae	Potentilla pulcherrima	beautiful cinquefoil	POPU9
Rosaceae	Potentilla rubricaulis	Rocky Mountain cinquefoil	PORU3
Rosaceae	Prunus virginiana	chokecherry	PRVI
Rosaceae	Purshia glandulosa	desert bitterbrush	PUGL2
Rosaceae	Purshia stansburiana	Stansbury cliffrose	PUST
Rosaceae	Purshia tridentata	antelope bitterbrush	PUTR2
Rosaceae	Rosa woodsii	Woods' rose	ROWO
Rosaceae	Rosa woodsii var. ultramontana	Woods' rose	ROWOU
Rosaceae	Rubus idaeus	American red raspberry	RUID
Rosaceae	Rubus idaeus ssp. strigosus	grayleaf red raspberry	RUIDS2
Rosaceae	Sibbaldia procumbens	creeping sibbaldia	SIPR
Rosaceae	Sorbus scopulina	Greene's mountain ash	SOSC2
Rubiaceae	Galium aparine	stickywilly	GAAP2
Rubiaceae	Galium bifolium	twinleaf bedstraw	GABI
Rubiaceae	Galium hypotrichium	alpine bedstraw	GAHY
Rubiaceae	Galium multiflorum	shrubby bedstraw	GAMU2
Rubiaceae	Galium trifidum	threepetal bedstraw	GATR2
Rubiaceae	Galium triflorum	fragrant bedstraw	GATR3
Salicaceae	Populus angustifolia	narrowleaf cottonwood	POAN3
Salicaceae	Populus tremuloides	quaking aspen	POTR5
Salicaceae	Salix bebbiana	Bebb willow	SABE2
Salicaceae	Salix boothii	Booth's willow	SABO2
Salicaceae	Salix exigua	narrowleaf willow	SAEX
Santalaceae	Comandra umbellata	bastard toadflax	COUM
Santalaceae	Comandra umbellata ssp. pallida	pale bastard toadflax	COUMP
Saxifragaceae	Heuchera parvifolia	littleleaf alumroot	HEPA11
Saxifragaceae	Heuchera rubescens	pink alumroot	HERU
Saxifragaceae	Heuchera rubescens var. alpicola	pink alumroot	HERUA
Saxifragaceae	Lithophragma glabrum	bulbous woodland-star	LIGL2
Saxifragaceae	Lithophragma tenellum	slender woodland-star	LITE4
Saxifragaceae	Saxifraga odontoloma	brook saxifrage	SAOD2
Scrophulariaceae	Castilleja angustifolia	northwestern Indian	CAAN7

Family	Genus species	Common Name	NRCS Code
		paintbrush	
Scrophulariaceae	Castilleja applegatei ssp. martinii	wavyleaf Indian paintbrush	CAAPM
Scrophulariaceae	Castilleja linariifolia	Wyoming Indian paintbrush	CALI4
Scrophulariaceae	Castilleja nana	dwarf alpine Indian paintbrush	CANA3
Scrophulariaceae	Castilleja scabrida	rough Indian paintbrush	CASC19
Scrophulariaceae	Castilleja scabrida var. barnebyana	Barneby's Indian paintbrush	CASCB3
Scrophulariaceae	Collinsia linearis	narrowleaf blue eyed Mary	COLI
Scrophulariaceae	Collinsia parviflora	maiden blue eyed Mary	COPA3
Scrophulariaceae	Cordylanthus kingii	King's bird's-beak	COKI
Scrophulariaceae	Cordylanthus parviflorus	purple bird's-beak	COPA9
Scrophulariaceae	Mimulus guttatus	seep monkeyflower	MIGU
Scrophulariaceae	Mimulus lewisii	purple monkeyflower	MILE2
Scrophulariaceae	Mimulus primuloides	primrose monkeyflower	MIPR
Scrophulariaceae	Pedicularis centranthera	dwarf lousewort	PECE
Scrophulariaceae	Penstemon concinnus	Tunnel Springs beardtongue	PECO15
Scrophulariaceae	Penstemon confusus	Owens Valley beardtongue	PECO7
Scrophulariaceae	Penstemon eatonii	Eaton's penstemon	PEEA
Scrophulariaceae	Penstemon humilis	low beardtongue	PEHU
Scrophulariaceae	Penstemon humilis ssp. humilis	low beardtongue	PEHUH
Scrophulariaceae	Penstemon leiophyllus	smoothleaf beardtongue	PELE7
Scrophulariaceae	Penstemon leiophyllus var. francisci-pennellii	smoothleaf beardtongue	PELEF
Scrophulariaceae	Penstemon pachyphyllus	thickleaf beardtongue	PEPA6
Scrophulariaceae	Penstemon pachyphyllus var. congestus	thickleaf beardtongue	PEPAC2
Scrophulariaceae	Penstemon palmeri	Palmer's penstemon	PEPA8
Scrophulariaceae	Penstemon rostriflorus	Bridge penstemon	PERO10
Scrophulariaceae	Penstemon speciosus	royal penstemon	PESP
Scrophulariaceae	Penstemon watsonii	Watson's penstemon	PEWA
Scrophulariaceae	Verbascum thapsus	common mullein	VETH
Scrophulariaceae	Veronica americana	American speedwell	VEAM2
Scrophulariaceae	Veronica biloba	twolobe speedwell	VEBI2
Selaginellaceae	Selaginella watsonii	Watson's spikemoss	SEWA2
Solanaceae	Nicotiana attenuata	coyote tobacco	NIAT
Urticaceae	Urtica dioica	stinging nettle	URDI
Urticaceae	Urtica dioica ssp. holosericea	stinging nettle	URDIH
Verbenaceae	Verbena bracteata	bigbract verbena	VEBR
Violaceae	Viola nephrophylla	northern bog violet	VINE
Violaceae	Viola palustris	marsh violet	VIPA4
Violaceae	Viola praemorsa	canary violet	VIPR3
Violaceae	Viola purpurea	goosefoot violet	VIPU4
Violaceae	Viola purpurea ssp. venosa	goosefoot violet	VIPUV2
Violaceae	Viola utahensis	Utah violet	VIUT
Viscaceae	Arceuthobium abietinum	fir dwarf mistletoe	ARAB4
Viscaceae	Arceuthobium divaricatum	pinyon dwarf mistletoe	ARDI3
Viscaceae	Phoradendron juniperinum	juniper mistletoe	PHJU

Appendix C: Field Key to the Vegetation of Great Basin National Park, Nevada

For More Information on the GRBA Data Collection and Vegetation Classification Please Reference:
Schulz, K. A. and M. E. Hall. 2011. Vegetation Classification Report: Great Basin National Park. Unpublished Report submitted to USDI, National Park Service, Mojave Desert Inventory and Monitoring Network. NatureServe, Western Regional Office, Boulder, Colorado. 29 pp. plus Appendices A-H.**]**

The Great Basin National Park (GRBA) Vegetation Classification was completed as part of the National Park Service's National Vegetation Inventory Program. A diverse assemblage of plant associations and other vegetation types were classified using field data collected in 2003 by Charlet and field crews, and during 2008, 2009, and 2010 by NatureServe and National Park Service staff. Some types identified from plots sampled outside the park boundaries are in included in this key as it is possible that they also occur within the park boundaries, but have not yet been sampled within the park. This key is structured to facilitate identification of plant associations with one or more dominant or characteristic species, and in some cases, the key also relates associations to their primary habitats and range within the Park. Because of natural variation within plant associations, it is possible that a community can be keyed using more than one of the physiognomic keys. For sites within ecotones (areas where dominant species intermix between plant associations), it may be difficult to determine a definitive association name

How to use the key

The key is designed to assist users in identifying vegetation associations in the field. The key has two levels; the first level is defined by the physiognomy of the vegetation, i.e., Forest/ Woodland, Shrubland/Shrub Steppe (shrub herbaceous), Herbaceous (graminoid or forb dominated) and Sparse vegetation. The second level focuses on the dominant and diagnostic species' canopy cover and to a lesser extent, habitat or elevation zone. The association field key was constructed from data collected during the classification phase of the mapping project. Because the key is based on a sample of the vegetation, it may not account for all associations occurring within GRBA, nor explain the full range of variation of all associations as they appear on the ground. When new associations are encountered during accuracy assessment, propose a community name and if time, do a rapid assessment to collect more data for classification.

When using this key, you may have difficulty arriving at an association that precisely describes your community. There are several possible reasons for this problem and each has a solution:

1. You are observing vegetation that you think is an herbaceous or shrubland community, but it has some tree cover. In this case, try keying the vegetation through the woodland key as well as the herbaceous or shrubland key. In general with any layer, if it does not cover at least 8% (tree layer) or 5% (shrub or herbaceous layers), it is ignored. The exception is in very sparse communities (see #4 below). Commonly confused types will be included in multiple places in the key.

2. The diagnostic layer consists of woody plants that may appear in either a shrub or a tree form, depending on site conditions and age. These species include *Pinus monophylla,*

Juniperus osteosperma, and *Cercocarpus ledifolius*. In this key, these species are considered to be evergreen trees, regardless of their height or growth form, and the rest are considered shrubs, regardless of their height or growth form.

3. Big sagebrush *Artemisia tridentata* was inconsistently identified to subspecies for a variety of reasons at GRBA. In general big sagebrush is confusing with putative hybrids or possibly additional subspecies such as *A. t.* ssp. *spiciformis*. Therefore only montane and subalpine stands of big sagebrush were treated as *A. t.* ssp. *vaseyana*.

4. You can follow a key to a certain point, but you clearly have something not described in the key. This is to be expected occasionally – very likely you have an association that was not found during the sampling phase of the project. As an example in this instance, simply record "Unclassified pinyon-juniper (or whatever type of vegetation you have) association". Be sure to note the dominant species and cover in each layer (stratum) as you fill out the Vegetation Description portion of the accuracy assessment (AA) form, as well as writing careful, complete notes on the environmental setting. For AA, be sure to key to map class as well.

5. Sparsely vegetated communities are defined as having total vascular plant cover of 2-10% (sometimes a little more given the range of natural variation) and are often a mix of woody and herbaceous plants with nothing dominant or diagnostic. In some stands cover of non-vascular organisms such as lichen and moss may actually dominate these communities. Sparsely vegetated areas are typically heterogeneous and borderline "sparsely" vegetated stands should always be run through multiple keys because even though they may not fall cleanly into a woodland, shrubland or herbaceous categories, they may actually be non-sparse communities given that the natural variation of some of the non-sparse GRBA vegetation types approaches 10% total vascular plant cover and may range below. This is especially true for shrubland and dwarf-shrubland associations that occur in harsh habitats. Go by dominance rather than absolute cover measurements.

6. Focus on the perennial species in the community unless the community or layer consists almost entirely of annuals or ephemerals or is highly disturbed or degraded.

7. When in doubt, record detailed field notes on your accuracy assessment field forms. These notes and the Vegetation Description information will be entered into the PLOTS database and analyzed to determine the map accuracy by comparing the map class identified by the photo-interpreter to the map class and association identified in the field by the AA field crew.

Special instructions for AA Crews

1. There are a number of closely related plant associations at Great Basin National Park that may be confusing in the field, although the key makes them appear easily distinguishable:

   For example, mixed mountain shrublands have been separated out into a number of associations, but a mix of shrubs not identified in the association name is generally present. The thing to keep in mind is that there is a classic "profile" for these associations, but a considerable amount of variation may occur. For example:

   a. ***Amelanchier utahensis - Artemisia tridentata (vaseyana, wyomingensis)*** **Shrubland** nearly always has *Symphoricarpos oreophilus* present and occasionally co-dominant. *Amelanchier utahensis* ranges from strongly dominant to codominant with *Artemisia tridentata*.

   b. ***Cercocarpus ledifolius / Pseudoroegneria spicata*** **Shrubland** nearly always has *Artemisia tridentata* present and sometimes co-dominant, and in heavily grazed examples, *Pseudoroegneria* may be very sparse to absent. *Amelanchier utahensis* is often present, but only with very low cover (<5%).

   c. Other ***Artemisia tridentata*** ssp. ***vaseyana*** **Shrublands** often have *Symphoricarpos oreophilus* present and often co-dominant in the northwestern portion of the park. *Amelanchier utahensis* may also be present with low cover.

2. *Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland is a broadly defined association that includes both 1) mature pinyon – juniper stands that have a relatively dense tree canopy (35-90% cover) and a sparse understory as result of shading, and 2) sparse to open canopy stands (5-35% tree cover) occurring on rocky or shaley sites that limit understory growth to a few scattered plants.

3. Associations with "forest" in the name usually have 60+% canopy cover, but also includes stands with < 60% canopy cover. Likewise, examples of associations with "woodland" in the name may occasionally have more than 60% cover.

4. Mixed evergreen – deciduous (aspen) forests and woodlands generally have 25-75% relative tree canopy cover of both conifers and aspen. Aspen stands generally have <25% relative tree canopy cover of conifer trees and conifer stands have <25% relative tree canopy cover of aspen. Be sure to consider the full Minimum Mapping Unit (MMU) observation area in case the point lands near a small patch inclusion.

5. For mixed canopy stands such as a *Picea engelmannii* and *Pinus flexilis* codominated forest stand, key vegetation in both species group keys for best fit.

6. If vegetation does not key to association, record alliance name and collect additional understory information or do a Rapid Assessment Point.

7. When in doubt, record detailed field notes. These notes and the Vegetation Description information are very important and will be entered into a database to be evaluated in detail during the Accuracy Assessment meeting that will be held to determine the map accuracy by comparing the interpreted map unit to the association identified in the field.

8. Another helpful tool is for you to understand that the revised United States National Vegetation Classification (rUSNVC) does not weight all species as contributing equally to a classification. Species vary in their degree of habitat specialization. To a point, the more specialized and persistent a species (in the larger world, not just at GRBA), the more it is likely to be a "diagnostic" species that controls the assignment of a community to an association. Generalist species such as *Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae, Poa secunda, Opuntia* spp. are only considered diagnostic if they are overwhelmingly dominant. For example, if you are in a pinyon - juniper woodland with about equal cover of *Cercocarpus ledifolius* and *Artemisia tridentata,* it will be classified as *Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland, not *Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Woodland. Weak indicator species generally are not used to classify unless strongly dominant.

So-called "diagnostic" species are not all equal either. There is a hierarchy, and it varies depending on the habitat and life form. Some examples are:

Rocky Slope: *Cercocarpus ledifolius > Cercocarpus intricatus > Peraphyllum ramosissimum, Glossopetalon spinescens > Artemisia tridentata >Ephedra viridis*

Uplands: *Artemisia arbuscula, Artemisia nova > Artemisia tridentata* ssp. *vaseyana > A. t.* ssp. *tridentata > Amelanchier utahensis > Purshia tridentata > Symphoricarpos oreophilus*

Alluvial fans, alluvial flats and terraces: *Sarcobatus vermiculatus > Artemisia tridentata* ssp. *tridentata > Ericameria nauseosa*

Grasses: Strong indicators: *Leymus cinereus, Elymus trachycaulus, Pseudoroegneria spicata, Achnatherum lettermanii, Hesperostipa comata,* **Medium***: Pleuraphis jamesii, Achnatherum hymenoides, Poa fendleriana.* **Weak***: Poa secunda, Elymus elymoides, Aristida* spp.*, Sporobolus cryptandrus, Bromus inermis, Poa pratensis, B. tectorum*.

Subalpine trees: *Pinus longaeva > Picea engelmannii > Pinus flexilis > Populus tremuloides*

Montane trees: *Pinus ponderosa > Abies concolor > Pseudotsuga menziesii > Populus tremuloides*, although this will differ among seral stands versus persistent stands.

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KEY I: THE MAJOR PHYSIOGNOMIC GROUPS OF GREAT BASIN NATIONAL PARK

1a) Site vegetated with > 10% total vascular vegetation cover. **(2)**

1b) Site sparsely vegetated generally with < 10% total vascular vegetation cover. Non-vascular (lichen and mosses) may exceed 10% cover.
Go to: **Key V (p 34)**

2a) Vegetation woody or appearing woody; the tallest layer (usually with at least 5% cover) dominated by trees, shrubs, or dwarf-shrubs; total vegetation cover may range from sparse to dense. **(3)**

2b) Vegetation non-woody; the tallest layer (usually with at least 5% cover) dominated by grasses, grass-like herbs (graminoids), and broad-leaf herbs (forbs), which may be tall and coarse; total vegetation cover may range from sparse to dense; comprised primarily of graminoid species; wetland to upland habitats; characteristic genera include *Achnatherum*, *Agropyron, Aquilegia*, *Astragalus, Balsamorhiza, Bromus*, *Calamagrostis, Carex*, *Distichlis, Dodecatheon*, *Eleocharis*, *Eriogonum, Elymus, Geum, Hesperostipa*, *Leymus*, *Mimulus*, *Muhlenbergia*, *Phlox, Phragmites*, *Pleuraphis*, *Poa, Polemonium, Polygonum, Pseudoroegneria, Sporobolus*, and *Typha* .
Go to: **Key IV (p 30)**

3a) Tree-dominated forests (interlocking tree canopies) or woodlands (open tree layer, non-interlocking tree canopies), or tree species dominated shrublands (avalanche chute, krummholz). Characteristic genera include *Abies, Cercocarpus, Juniperus*, *Picea*, *Pinus*, *Populus*, and *Pseudotsuga.* Generally the tree canopy layer has 10% or more cover, but may be as low 5% cover when trees characterize the otherwise borderline sparse vegetation stand when trees form a layer or are the dominant species in the stand. *Cercocarpus ledifolius* occurs as both a tree and shrub at GRBA and is treated in Key II (Forest and Woodland)
Go to: **Key II (p 7)**

3b) Shrub-dominated vegetation, including shrub-like herbs; canopies may interlock, but are more commonly less dense. Characteristic genera include *Acer, Amelanchier*, *Arctostaphylos*, *Artemisia*, *Atriplex*, *Betula*, *Cercocarpus*, *Chrysothamnus*, *Dasiphora*, *Ephedra*, *Ericameria*, *Eriogonum*, *Gutierrezia*, *Krascheninnikovia*, *Peraphyllum, Picrothamnus*, *Purshia*, *Rhus*, *Ribes, Rosa*, *Salix*, *Sarcobatus,* and *Symphoricarpos.* Scattered taller trees may be absent to present in shrublands especially in transitional standst. *Cercocarpus ledifolius* occurs as both a tree and shrub at GRBA. It is treated in Key II Forest and Woodland (p 5).
Go to: **Key III (p 22)**

KEY II: THE FOREST AND WOODLAND ASSOCIATIONS OF GREAT BASIN NATIONAL PARK

1a) Deciduous forests or woodlands that occupy a variety of habitats from riparian areas to high elevation slopes. Conifer trees are often present, but with <25% relative cover of tree canopy). There may be small patches (below MMU) of conifer dominated tree canopy within the deciduous forest. **(2)**

1b) Evergreen and mixed evergreen – deciduous (aspen) forests and woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) occupying a variety of habitats, typically upland or high elevation sites, but includes riparian sites. Includes both needle-leaved and sclerophyllous evergreen tree species. **(3)**

2a) Forests or woodlands characterized by *Populus angustifolia* occurring within drainage bottoms or on mesic alluvial deposits. Other trees such as *Abies concolor, Juniperus scopulorum* or *Pinus monophylla* are often present and may codominate, however *Populus angustifolia* is diagnostic.
Go to **Narrowleaf Cottonwood Forests and Woodlands (pg 14)**

2b) Forests or woodlands characterized by *Populus tremuloides* typically occupying stream banks, mesic areas, or on higher elevation slopes. Non-deciduous trees such as *Abies concolor, Juniperus scopulorum* or *Pinus flexilis* may be present, but total less than a quarter of total tree canopy.
Go to **Aspen Forests and Woodlands (pg 8)**

3a) Forests or woodlands dominated by sclerophyllous evergreen tree/tall shrub *Cercocarpus ledifolius*. Other trees such as *Abies concolor, Juniperus scopulorum* or *Pinus monophylla* may be present to codominant especially in transitional stands, however *Cercocarpus ledifolius* is diagnostic.
Go to **Mountain Mahogany Woodlands (pg 13)**

3b) Forests or woodlands with *Cercocarpus ledifolius* absent or with low cover in tree canopy, but may form an understory layer. **(4)**

4a) Forests or woodlands dominated or codominated by *Pinus ponderosa* occurring along drainages on mesic alluvial deposits or upland sites. Other trees such as *Abies concolor, Juniperus scopulorum* or *Pinus monophylla* are often present and may codominate, however large, visually dominant (often emergent) *Pinus ponderosa* in tree canopy is diagnostic even if not the most abundant tree.
Go to **Ponderosa Pine Forests and Woodlands (pg 18)**

4b) Forests or woodlands not characterized by *Pinus ponderosa* trees. *Pinus ponderosa* is absent or with low (accidental) cover. **(5)**

5a) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma*. Tree canopy ranges from moderately dense (35-80% canopy cover) to open (10-35% canopy cover) and may include stands with as low as 5% tree cover if these tree species dominate the total vegetation.

Go to **Pinyon Pine and Juniper Woodlands (pg 15)**

5b) Forests or woodlands not dominated by *Pinus monophylla* and *Juniperus osteosperma* trees. *Pinus monophylla* and *Juniperus osteosperma* trees may be present to codominant, but stand is dominated by other, usually taller tree species such as *Abies concolor, Picea engelmannii*, *Pinus flexilis, Pinus longaeva* and/or *Pseudotsuga menziesii*. **(6)**

6a) Woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) dominated or codominated by *Pinus longaeva* and/or *Pinus flexilis*. Other trees such as *Abies concolor,* and *Pseudotsuga menziesii*, may be present especially in transition with montane forests and *Populus tremuloides* may codominate; however the presence of *Pinus longaeva* with 5% or more absolute cover and/or dominance of *Pinus flexilis* trees are diagnostic. If *Picea engelmannii* and *Pinus flexilis* are codominant in tree canopy than *Pinus flexilis* generally has greater cover.

Go to **Bristlecone and Limber Pine Forests and Woodlands (pg 10)**

6b) Forests or woodlands not characterized by *Pinus longaeva* and/or *Pinus flexilis* trees. *Pinus longaeva* trees are absent or with low cover in atypical sites (accidental). If *Picea engelmannii* and *Pinus flexilis* are codominant in tree canopy than *Picea engelmannii* has equal or greater cover. **(7)**

7a) Subalpine forests and woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) dominated or codominated by *Picea engelmannii*. Other trees include *Abies concolor, Pseudotsuga menziesii, Pinus flexilis* and *Populus tremuloides,* which may be present to codominant especially in transition with montane forests; however *Picea engelmannii* is diagnostic when over 20% or more tree absolute canopy cover.

Go to **Engelmann Spruce Forests and Woodlands (pg 12)**

7b) Montane forests and woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) dominated or codominated by *Abies concolor* and *Pseudotsuga menziesii* and mixed conifer-deciduous forests and woodland codominated by *Populus tremuloides*. Other trees such as may be present especially in transition with foothill (*Pinus monophylla*) and subalpine forests *Pinus flexilis, Picea engelmannii)*, however *Abies concolor* and/or *Pseudotsuga menziesii* is diagnostic when over 20% tree canopy.

Go to **White Fir and Douglas-fir Mixed Montane Forests and Woodlands (pg 19)**

Forest and Woodland Groups
(Alphabetized by Common Name of Dominant Species)

Aspen Forests and Woodlands

1a) *Populus tremuloides* forests or woodlands with shrub layer in understory that has 10% or more cover or exceeds herbaceous layer if less than 10% cover. Dominant shrubs include species of *Arctostaphylos, Artemisia, Juniperus, Prunus, Ribes, Rosa,* and *Symphoricarpos*. **(2)**

1b) *Populus tremuloides* forests or woodlands with shrubs absent or low cover (<5% cover) and higher cover of herbaceous species, especially from the *Poa, Bromus,* and *Equisetum* genera. **(9)**

2a) Shrub layer in understory is dominated by *Artemisia tridentata.*
***Populus tremuloides / Artemisia tridentata* Forest**

2b) Shrub layer is dominated by other shrub species. **(3)**

3a) Shrub layer in understory is dominated by *Betula occidentalis.* Other riparian species maybe present such as *Salix boothii* and *S. exigua* - ***Populus tremuloides / Betula occidentalis* Forest**

3b) Shrub layer is dominated by other shrub species. **(4)**

4a) Shrub layer in understory is dominated by *Rosa woodsii.* Riparian species such as *Betula occidentalis, Salix boothii* and *S. exigua* are often present.
***Populus tremuloides / Rosa woodsii* Forest**

4b) Shrub layer is dominated by other shrub species. **(5)**

5a) Shrub layer in understory is dominated by *Prunus virginiana.*
***Populus tremuloides / Prunus virginiana - Symphoricarpos oreophilus* Forest [Park Special]**

5b) Shrub layer is dominated by other shrub species. **(6)**

6a) Shrub layer in understory is dominated by *Ribes* species such as *R. cereum.*
***Populus tremuloides / Ribes* spp. Woodland [Park Special]**

6b) Shrub layer is dominated by other shrub species. **(7)**

7a) Shrub layer in understory is dominated by *Juniperus communis.*
***Populus tremuloides / Juniperus communis* Forest**

7b) Shrub layer is dominated by other shrub species. **(8)**

8a) Shrub layer in understory is dominated by *Symphoricarpos oreophilus*
***Populus tremuloides / Symphoricarpos oreophilus* Forest**

8b) Shrub layer is dominated by other shrub species.
Unclassified *Populus tremuloides* Woodland

9a) Herbaceous layer in understory is dominated by *Bromus carinatus (=B. marginatus), Elymus glaucus,* or *Elymus trachycaulus.* Other abundant graminoids include *Juncus balticus, Poa secunda,* or *Poa wheeleri.* Mesic forbs are present and occasionally abundant such as *Achillea millefolium, Lathyrus* spp. or *Vicia americana* are abundant
***Populus tremuloides / Bromus carinatus* Forest**

9b) Herbaceous layer is dominated by other herbaceous species. **(10)**

10a) Herbaceous layer in understory is strongly dominated by *Poa pratensis.*
***Populus tremuloides* / Invasive Perennial Grasses Forest**

10b) Herbaceous layer is dominated by other herbaceous species.
Unclassified *Populus tremuloides* Woodland

Bristlecone and Limber Pine Forests and Woodlands

1a) Stand is a forest or woodland dominated or codominated by *Pinus longaeva* and/or *Pinus flexilis* trees 5-35 m tall. **(2)**

1b) Stand is krummholz scrub dominated by wind-stunted *Pinus flexilis* < 5 m tall occurring near upper tree line.
***Pinus flexilis / Selaginella watsonii* Krummholz**

2a) Open to moderately dense woodlands dominated or codominated by *Pinus longaeva*. *Pinus flexilis* is often present to codominant. Canopy ranges from 5-45%. Other trees such as *Abies concolor, Picea engelmannii*, and *Pseudotsuga menziesii* may be present and *Populus tremuloides* may codominate, however the presence of *Pinus longaeva* trees is diagnostic **(3)**

2b) Woodlands or shrublands dominated or codominated by *Pinus flexilis*. *Pinus longaeva* is typically absent or very low cover (accidental). Other trees such as *Abies concolor* and *Pseudotsuga menziesii* may be present and *Populus tremuloides* and *Picea engelmannii* may codominate, however the dominance of *Pinus flexilis* trees and the absence of *Pinus longaeva* trees is diagnostic **(7)**

3a) Shrubs in understory includes *Ericameria discoidea* and/or *Ribes montigenum*, although *Juniperus communis* may dominate. Subalpine and alpine herbaceous species are typically present as this is a high elevation type.
***Pinus longaeva / (Ericameria discoidea, Ribes montigenum)* Woodland**

3b) Shrub layer is dominated by other shrub species. **(4)**

4a) Shrubs in understory are dominated or codominated by *Cercocarpus intricatus*, although *Glossopetalon spinescens, Peraphyllum ramosissimum* and *Arctostaphylos patula* are often present. This type is typically dominated or codominated by *Pinus ponderosa* trees. *Pinus monophylla* trees may also be present. This type is a low elevation community found only in the Big Wash area on limestone derived substrates.
***Pinus ponderosa - (Pinus longaeva) / Cercocarpus intricatus* Woodland [Provisional]**

4b) Shrub layer is dominated by other shrub species. **(5)**

5a) Shrubs in understory are dominated by *Arctostaphylos patula* although on rocky sites cover of shrubs may be low. This type is a mid-elevation community.
***Pinus longaeva / Arctostaphylos patula* Woodland**

5b) Shrub layer is dominated by other shrub species. **(6)**

6a) Shrubs in understory are dominated by *Symphoricarpos oreophilus*. If other shrubs are present then they have low cover. This type is a mid-elevation community.
***Pinus longaeva* / *Symphoricarpos oreophilus* Woodland [Park Special]**

6b) Understory is dominated by other shrub or herbaceous species.
Unclassified *Pinus longaeva* Woodland

7a) Tree canopy is codominated by *Populus tremuloides* and *Pinus flexilis. Picea engelmannii* may be present to codominate. **(8)**

7b) Tree canopy is dominated by evergreen trees. *Populus tremuloides* may be present but not codominant. **(9)**

8a) Tree canopy is dominated by *Pinus flexilis* with *Populus tremuloides* present to codominant. *Picea engelmannii* may be present to codominate, but its cover is less than the cover of *Pinus flexilis*. This shrubby understory is dominated by *Arctostaphylos patula*.
***Pinus flexilis - (Populus tremuloides) / Arctostaphylos patula* Forest**

8b) Tree canopy is codominated by *Populus tremuloides* and *Pinus flexilis. Picea engelmannii* may be present to codominate, but its cover is less than the cover of *Pinus flexilis*. This association is broadly defined and includes stands with understories dominated by shrubs and/or herbaceous species.
***Populus tremuloides - Pinus flexilis* Forest**

9a) Woodlands dominated or codominated by *Pinus flexilis* with herbaceous dominated understory **(10)**

9b) Woodlands dominated or codominated by *Pinus flexilis* with shrub dominated understory **(11)**

10a) Woodland is codominated by *Pinus flexilis* and *Picea engelmannii*. The understory is dominated by *Carex rossii* or other dry upland sedges. Other common graminoids include *Poa fendleriana* and *Poa secunda.* Sometimes herbaceous cover is low, but still dominates.
***Picea engelmannii - (Pinus flexilis) / Carex rossii* Woodland**

10b) Understory is dominated by other herbaceous species or is sparse.
Unclassified *Pinus flexilis* Woodland with herbaceous or sparse understory

11a) Shrubs in understory are dominated or codominated by *Arctostaphylos patula*.
***Pinus flexilis - (Populus tremuloides) / Arctostaphylos patula* Forest**

11b) Shrub layer is dominated by other shrub species. **(12)**

12a) Shrubs in understory are dominated or codominated by *Artemisia tridentata* ssp. *vaseyana*. Other shrubs may be present to codominant. This type is a mid-elevation community and has not been sampled within GRBA boundaries.
***Pinus flexilis / Artemisia tridentata* ssp. *vaseyana* Woodland [Park Special]**
12b) Shrub layer is dominated by other shrub species. **(13)**

13a) Shrubs in understory are dominated by *Symphoricarpos oreophilus*. If other shrubs are present then they have low cover. This type is a mid-elevation community.
***Pinus flexilis* / Symphoricarpos oreophilus Woodland [Park Special]**
13b) Understory is dominated by other shrub species.
Unclassified *Pinus flexilis* Woodland with a shrub layer

<u>Engelmann Spruce Forests and Woodlands</u>

1a) Stand is a forest or woodland dominated or codominated by *Picea engelmannii* trees 5-35 m tall. **(3)**
1b) Stand is shrubland dominated or codominated by *Picea engelmannii* trees < 5 m tall. **(2)**

2a) Stand is composed of short and broken *Picea engelmannii* and *Populus tremuloides* damaged by reoccurring avalanche.
***Picea engelmannii - Populus tremuloides* Avalanche Chute Shrubland**
2b) Stand is a krummholz shrubland dominated by wind-stunted *Picea engelmannii* occurring near upper tree line.
***Picea engelmannii - (Pinus flexilis) / (Astragalus platytropis)* Krummholz**

3a) Mesic to wet lowland subalpine forests and woodlands dominated or codominated by *Picea engelmannii* that occur near streams and below seeps. **(4)**
3b) Upland subalpine forests and woodlands dominated or codominated by *Picea engelmannii*. **(5)**

4a) Understory is characterized by an herbaceous layer dominated or codominated by *Carex scopulorum*. Other graminoids may be present to codominant. This type is a riparian or seep community.
***Picea engelmannii / Carex scopulorum* Woodland**
4b) Understory is characterized by an herbaceous layer dominated or codominated by mesic and wet forbs such as *Aconitum columbianum, Aquilegia formosa, Angelica kingii, Ligusticum porteri, Mertensia ciliata, Mimulus guttatus, Osmorhiza depauperata, O. occidentalis, Ranunculus* spp., and *Saxifraga odontoloma.* Mesic graminoids such as *Carex microptera, Elymus trachycaulus,* and *Juncus balticus* may be present to codominant. *Populus tremuloides* is typically present to codominant.
***Picea engelmannii - Populus tremuloides* / Mesic Forb Forest [Park Special]**

5a) Mixed conifer – aspen subalpine forests and woodlands. *Populus tremuloides* cover has 25-75% relative tree canopy cover. If conifer canopy is mixed than cover of *Picea engelmannii* is equal or greater then *Pinus flexilis* tree cover**.**

***Picea engelmannii - Populus tremuloides* Forest Alliance**

If *Arctostaphylos patula* often dominates understory then stand is:

***Picea engelmannii - Populus tremuloides / Arctostaphylos patula* Forest [Park Special]**

5b) Subalpine forests and woodlands dominated or codominated by *Picea engelmannii* with *Pinus flexilis* absent to codominant. If present, *Populus tremuloides* has <25% relative tree canopy cover. **(6)**

6a) Subalpine forests and woodlands dominated or codominated by *Picea engelmannii* with a shrub dominated understory. Other trees such as *Abies concolor, Pseudotsuga menziesii,* and *Pinus flexilis* may be present to codominant. An herbaceous layer may be present or absent. **(9)**

6b) Subalpine forests and woodlands dominated or codominated by *Picea engelmannii* with herbaceous or non-vascular/moss dominated understory. Other trees such as *Abies concolor, Pseudotsuga menziesii,* and *Pinus flexilis* may be present to codominant. Scattered shrubs may be present with less than <5% cover. **(7)**

7a) Woodland is dominated or codominated by *Picea engelmannii* with *Pinus flexilis* present to codominant. The understory is dominated by herbaceous species with *Carex rossii* or other dry upland sedge dominant or codominant. Other common graminoids include *Poa fendleriana* and *Poa secunda.*

***Picea engelmannii - (Pinus flexilis) / Carex rossii* Woodland**

7b) Herbaceous layer is dominated by other species. **(8)**

8a) Understory is dominated by mosses forming a non-vascular layer. Stands lack any significant vascular herbaceous cover.

***Picea engelmannii* / Moss Forest**

8b) Understory is dominated by other shrub or herbaceous species.

Unclassified *Picea engelmannii* Woodland with a sparse or herbaceous layer

9a) Shrubs in understory include *Ribes montigenum* and *Ericameria discoidea. Juniperus communis* may be present, but not dominant. Subalpine and alpine herbaceous species are typically present as this is a high elevation type.

***Picea engelmannii / Ribes montigenum* Forest**

9b) Shrub layer is dominated by other shrub species. **(10)**

10a) Shrubs in understory are dominated by *Juniperus communis*. If other shrubs are present then they have low cover.

***Picea engelmannii / Juniperus communis* Forest**

10b) Understory is dominated by other shrub species.

Unclassified *Picea engelmannii* Forest or Woodland with shrub understory

Mountain Mahogany Woodlands (and Shrublands)

1a) *Cercocarpus ledifolius* woodlands with short shrub layer in understory that has 10% or more cover or exceeds herbaceous layer if less than 10% cover. Dominant shrubs include species of *Arctostaphylos*, *Artemisia,* and *Symphoricarpos*. **(2)**

1b *Cercocarpus ledifolius* woodlands with shrubs absent or low cover (<5% cover) and higher herbaceous cover, especially of species of *Hesperostipa, Poa,* and *Pseudoroegneria*. **(5)**

2a) Shrub layer in understory is dominated by *Arctostaphylos patula.*
***Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Provisional]**

2b) Shrub layer is dominated by other shrub species. **(3)**

3a) Shrub layer in understory is dominated by *Artemisia tridentata* ssp. *vaseyana.*
***Cercocarpus ledifolius / Artemisia tridentata* ssp. *vaseyana* Woodland**

3b) Shrub layer is dominated by other shrub species. **(4)**

4a) Shrub layer in understory is dominated by *Symphoricarpos oreophilus.*
***Cercocarpus ledifolius / Symphoricarpos oreophilus* Woodland**

4b) Shrub layer is dominated by other shrub species.
Unclassified *Cercocarpus ledifolius* Woodland

5a) Herbaceous layer in understory is dominated or codominated by *Pseudoroegneria spicata. Hesperostipa comata* and *Poa fendleriana* are often present to codominant.
***Cercocarpus ledifolius / Pseudoroegneria spicata* Shrubland**

5b) Herbaceous layer is dominated by other herbaceous species.
Unclassified *Cercocarpus ledifolius* Woodland or Shrubland

Narrowleaf Cottonwood Forests and Woodlands

1a) Woodlands dominated or codominated by *Populus angustifolia* in tree canopy with *Artemisia tridentata* ssp. *tridentata* dominating the open to dense shrub layer or codominating with widespread shrubs *Prunus virginiana* and *Chrysothamnus viscidiflorus*. Other shrubs may be present with lower cover. Stands occur on dryer stream terraces in canyon bottoms.
***Populus angustifolia / Artemisia tridentata* ssp. *tridentata - Prunus virginiana* Woodland [Park Special]**

1b) Woodland is not characterized by *Artemisia tridentata* ssp. *tridentata* dominating or codominating the shrub layer. If *Artemisia tridentata* ssp. *tridentata* is present, then understory is strongly dominated by *Cornus sericea, Prunus virginiana,* or *Rosa woodsii.* **(2)**

2a) Woodlands dominated or codominated by *Populus angustifolia* in tree canopy with *Cornus sericea* (usually > 15% cover) dominating or codominating the open to dense shrub layer with widespread *Prunus virginiana* and *Rosa woodsii*. Stands occur on mesic stream banks and terraces in canyon bottoms.
***Populus angustifolia / Cornus sericea* Woodland**

2b) Woodland is not characterized by *Cornus sericea* dominating or codominating the tall shrub layer. If *Cornus sericea* is present, then <15% cover and understory is strongly dominated by *Prunus virginiana, Rosa woodsii* or another shrub. **(3)**

3a) Woodlands dominated or codominated by *Populus angustifolia* in tree canopy with *Rosa woodsii* strongly dominating the open to dense shrub layer usually with twice the cover than all other shrubs combined. Other trees such as *Abies concolor, Juniperus scopulorum* or *Pinus monophylla* are often present. Stands occur on dryer stream terraces, especially disturbed sites.
***Populus angustifolia / Rosa woodsii* Forest**

3b) Woodland is not characterized by *Rosa woodsii* strongly dominating the shrub layer. **(4)**

4a) Woodlands dominated or codominated by *Populus angustifolia* in tree canopy with *Prunus virginiana* dominating or codominating the open to dense shrub layer or codominating with widespread *Rosa woodsii* or with other shrubs such as *Betula occidentalis, Rhus trilobata*, or *Salix* spp. (usually each < 15% cover). Other trees such as *Abies concolor, Juniperus scopulorum,* or *Pinus monophylla* are often present. Stands occur on mesic stream banks and terraces in canyon bottoms.
***Populus angustifolia / Prunus virginiana* Woodland**

4b) Woodland is not characterized by *Artemisia tridentata* ssp. *tridentata, Cornus sericea, Prunus virginiana,* or *Rosa woodsii.*
Unclassified *Populus angustifolia* Woodland

<u>Pinyon Pine and Juniper Woodlands</u>

1a) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma* trees. These woodlands are generally open (5-35% cover), but include some moderate to dense tree canopy stands (>35% cover). *Pinus monophylla* may dominate or have relatively low cover (2-10%). *Juniperus osteosperma* is often codominant, but may be absent or dominant. **(2)**

1b) Woodlands are generally open (5-30% canopy cover) and are dominated by *Juniperus osteosperma. Pinus monophylla* trees are absent or present with low (<2%) cover. Sites tend to occur at lower elevation than pinyon – juniper woodlands and are too hot or dry for *Pinus monophylla* to grow well. These woodlands are distinct stands rather than small inclusions that lack pinyon trees locally within a larger pinyon – juniper stand. Desert scrub such as *Atriplex* spp. or *Sarcobatus vermiculatus* may be present.
Unclassified *Juniperus osteosperma* Woodland

2a) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma* trees that lack a developed understory. Neither herbaceous nor shrub species has more than 5% cover, and most stands have less than 2% total understory cover. Stands may have a sparse understory because they are mature stands with relatively dense tree canopy that shades out understory or typically open stands occurring on harsh substrates such as on shale with poor water-holding capacity or limestone bedrock and colluvium.

***Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland**

2b) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma* trees with a developed understory over 5% and composed of shrubs or herbaceous species. **(3)**

3a) Understory lacks a shrub layer (generally < 10%). If shrubs present with 5-10% cover then herbaceous cover exceeds shrub cover. **(4)**

3b) Understory has a shrub layer (generally > 10%) or if shrub cover is 5-10%, then shrub cover exceeds herbaceous cover. **(5)**

4a) Understory is characterized by an herbaceous layer dominated or codominated by *Poa fendleriana* and/or *Poa secunda*.

***Pinus monophylla - Juniperus osteosperma / Poa (fendleriana, secunda)* Woodland**

4b) Herbaceous layer is dominated by other species.

Unclassified *Pinus monophylla - Juniperus osteosperma* Woodland with an herbaceous layer

5a) Understory is characterized by tall mesic shrubs such as *Betula occidentalis, Prunus virginiana,* and *Rosa woodsii.* **(6)**

5b) Shrub layer is dominated by upland shrub species. **(7)**

6a) Understory is characterized by tall and short shrub layers dominated or codominated by *Betula occidentalis* and *Rosa woodsii*. This type is a riparian community. Other wet graminoids and forbs may be present to codominant.

***Pinus monophylla - Juniperus osteosperma / Betula occidentalis - Rosa woodsii* Woodland [Park Special]**

6b) Understory is characterized by a tall shrubs layer dominated or codominated by *Prunus virginiana. Betula occidentalis* is absent or has low cover. This type is a mesic community found at the base of a cliff, but may occur along moist drainages. Wet graminoids and forbs are not present.

***Pinus monophylla - Juniperus osteosperma / Prunus virginiana* Woodland**

7a) Understory is dominated by shrub species from the genus *Artemisia*. **(8)**

7b) Understory is dominated by shrub species from the genera *Cercocarpus, Glossopetalon, Peraphyllum,* or *Purshia*. *Artemisia* spp. may be present, but not dominant. **(12)**

8a) Understory is characterized by a dwarf-shrub layer dominated by *Artemisia arbuscula*. Sites are higher elevations, generally above 7000 feet.

***Pinus monophylla - Juniperus osteosperma / Artemisia arbuscula* Woodland**

8b) Understory is characterized by other woody species. **(9)**

9a) Understory is characterized by a dwarf-shrub layer dominated by *Artemisia nova*. Sites generally occur at lower elevations below 7200 feet near park boundary.
***Pinus monophylla - Juniperus osteosperma / Artemisia nova* Woodland**

9b) Understory is characterized by other woody species. **(10)**

10a) Understory is dominated or codominated by *Artemisia tridentata* ssp. *vaseyana*. **(11)**

10b) Understory is dominated or codominated by *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *wyomingensis.* Stands typically occur at in bottomland and basins especially at lower elevations.
***Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Woodland**

11a) Understory is characterized by a shrub layer codominated by *Artemisia tridentata* ssp. *vaseyana* and other shrubs. Other shrubs such as *Amelanchier utahensis, Ephedra viridis, Holodiscus dumosus, Prunus virginiana, Purshia glandulosa,* or *Symphoricarpos oreophilus* are present to codominant. If present, *Cercocarpus ledifolius* and *Glossopetalon spinescens* have low cover (not codominant). The herbaceous layer is variable and may be sparse depending on shrub density. This type is an upper foothill/lower montane community.
***Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* ssp. *vaseyana* - Mixed Shrub Woodland**

11b) Understory is characterized by a shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana* with a moderate to dense herbaceous layer dominated or codominated by *Pseudoroegneria spicata*. Other common graminoids include *Hesperostipa comata* and *Poa fendleriana*. This type is an upper foothill/lower montane community.
***Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* ssp. *vaseyana* / *Pseudoroegneria spicata* Woodland**

12a) Understory is characterized by a shrub layer dominated by *Cercocarpus ledifolius*.
***Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland**

12b) Understory is characterized by other woody species. **(13)**

13a) Understory is characterized by a shrub layer dominated or codominated by *Cercocarpus intricatus*. Other shrubs may be present with low cover such as *Artemisia nova, Artemisia tridentata, Ephedra viridis, Glossopetalon spinescens*, *Peraphyllum ramosissimum, Purshia stansburiana, Rhus trilobata* and *Symphoricarpos longiflorus.* Stands occur on rocky slopes.
***Pinus monophylla – (Juniperus osteosperma) / Cercocarpus intricatus* Woodland**

13b) Understory is characterized by other woody species. **(14)**

14a) Understory is characterized by an open shrub layer dominated by *Peraphyllum ramosissimum*. *Artemisia nova, Ephedra viridis* and *Rhus trilobata* may be present to codominant. Other shrubs may include *Arctostaphylos patula, Artemisia tridentata,* and *Symphoricarpos longiflorus*. *Cercocarpus intricatus* is absent or has low cover (<5%).
***Pinus monophylla - Juniperus osteosperma / Peraphyllum ramosissimum* Woodland**

14b) Understory is characterized by other woody species. **(15)**

15a) Understory is characterized by an open shrub layer characterized by *Glossopetalon spinescens***,** which codominates with *Purshia stansburiana* and *Artemisia tridentata.* Scattered *Ephedra viridis, Chrysothamnus viscidiflorus* and *Artemisia nova* may be present. Stands were sampled on steep limestone slope near Cave Creek.
***Pinus monophylla - Juniperus osteosperma / Glossopetalon spinescens - Artemisia tridentata - Purshia stansburiana* Woodland [Provisional]**

15b) Understory is characterized by other woody species. **(16)**

16a) Understory is characterized by a shrub layer dominated by *Purshia tridentata*. Other shrubs present may include *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana, Ephedra viridis,* and occasionally scattered *Cercocarpus ledifolius*.
***Pinus monophylla - Juniperus osteosperma / Purshia tridentata* Woodland [Park Special]**

16b) Understory is characterized by other woody species.
Unclassified *Pinus monophylla - Juniperus osteosperma* Woodland with a shrub layer

<u>Ponderosa Pine Forest and Woodlands</u>

1a) Mixed canopy forests occurring along drainages with *Pinus ponderosa* codominant or conspicuously present as large emergent trees over a subcanopy of *Abies concolor, Juniperus scopulorum, Pinus monophylla* and/or *Populus tremuloides.* Characteristic riparian and mesic site understory species are typically present such as *Betula occidentalis* and *Salix* spp. mixed with upland species. *Pinus ponderosa* is diagnostic.
***Pinus ponderosa - Abies concolor* Riparian Forest [Park Special]**

1b) Forests or woodlands dominated or codominated by *Pinus ponderosa* occurring on upland sites. Other trees such as *Abies concolor* or *Pinus monophylla* are often present and may codominate. **(3)**

2a) Open woodlands typically dominated or codominated by *Pinus ponderosa* with *Cercocarpus intricatus* typically dominant in the understory. Other characteristic understory shrubs are *Glossopetalon spinescens* and *Peraphyllum ramosissimum*. *Pinus longaeva* is often present to codominant in the tree canopy. It was only sampled in the Big Wash area.
***Pinus ponderosa - (Pinus longaeva) / Cercocarpus intricatus* Woodland [Provisional]**

2b) Understory is dominated by other species. **(3)**

3a) Open woodlands typically dominated or codominated by *Pinus ponderosa* with *Arctostaphylos patula* dominant in the understory. *Abies concolor* is often present to codominant in the tree canopy.
***Pinus ponderosa / Arctostaphylos patula* Woodland**

3b) Understory is dominated by other species. **(4)**

4a) Open woodlands codominated by *Pinus ponderosa* with *Abies concolor.* The relatively mesic understory is variable but typically has an open shrub layer dominated by *Symphoricarpos oreophilus* with *Juniperus communis*. Other trees such as*, Juniperus scopulorum, Pinus flexilis* or *Pseudotsuga menziesii* are often present and may codominate, however *Pinus ponderosa* is diagnostic.
***Pinus ponderosa - Abies concolor / Symphoricarpos oreophilus* Woodland [Provisional]**

4b) Understory layer is dominated by other species.
Unclassified *Pinus ponderosa* Woodland

White Fir and Douglas-fir Mixed Montane Forests and Woodlands

1a) Stand is a forest or woodland dominated or codominated by *Abies concolor* and/or *Pseudotsuga menziesii* trees 5-30 m tall. **(2)**

1b) Stand is composed of short and broken *Abies concolor* and/or *Pseudotsuga menziesii* and *Populus tremuloides* trees < 5 m tall damaged by reoccurring avalanche.
***Abies concolor - Populus tremuloides* Avalanche Chute Shrubland**

2a) Montane forests and woodlands codominated by *Abies concolor* and/or *Pseudotsuga menziesii*. *Populus tremuloides* trees codominate with conifers. Other conifer trees such as *Picea engelmannii, Pinus flexilis* may be present with low cover (not codominant). **(3)**

2b) Montane forests and woodlands dominated or codominated by *Abies concolor* and/or *Pseudotsuga menziesii*. *Populus tremuloides* trees are absent or have low cover (not codominant). Other conifer trees such as *Picea engelmannii or Pinus flexilis* may be present, but are not codominant. **(12)**

3a) Understory lacks a shrub layer (generally < 10%). If shrubs are present with 5-10% cover then herbaceous cover exceeds shrub cover. **(4)**

3b) Understory has a shrub layer (generally > 10%) or if shrub cover is 5-10%, then shrub cover exceeds herbaceous cover. **(8)**

4a) Understory is characterized by an herbaceous layer dominated or codominated by *Carex scopulorum*. This type is a riparian community. Other wet graminoids and forbs may be present to codominant.
***Abies concolor - Populus tremuloides / Carex scopulorum* Woodland**

4b) Herbaceous layer is dominated by other species. **(5)**

5a) Understory is characterized by an herbaceous layer dominated or codominated by mesic forbs such as *Aconitum columbianum, Aquilegia formosa, Ligusticum porteri, Mertensia ciliata, Osmorhiza depauperata, O. occidentalis, and Saxifraga odontoloma*. *Populus tremuloides* is typically present to codominant. This forest is found in mesic bottomlands, riparian areas and seeps.
***Populus tremuloides - Abies concolor* / Mesic Forb Forest [Park Special]**

5b) Herbaceous layer is dominated by other species. **(6)**

6a) Understory is characterized by an herbaceous layer dominated by *Poa pratensis*. *Populus tremuloides* is typically present to codominant present. This is mesic forest is found in mesic bottomland and disturbed riparian areas.
***Populus tremuloides - Abies concolor* / *Poa pratensis* Semi-natural Forest**

6b) Understory is dominated by other herbaceous species or is sparse. **(7)**

7a) *Abies concolor* is present usually with 1% or more cover in tree canopy.
Unclassified Abies concolor - Populus tremuloides Forest or Woodland with an herbaceous or a sparse understory.

7b) *Pseudotsuga menziesii* dominates tree canopy. *Abies concolor* is absent or low cover (<1 % cover)
Unclassified Pseudotsuga menziesii - Populus tremuloides Forest or Woodland with an herbaceous or a sparse understory.

8a) Understory is dominated or codominated by *Salix boothii* with lush herbaceous layer typically dominated by *Carex scopulorum.* Other shrubs may be present but not dominant. This is a riparian or wetland community.
***Abies concolor - (Populus tremuloides) / Salix boothii / Carex scopulorum* Forest**

8b) Understory is dominated by other shrub species. **(9)**

9a) Understory is dominated or codominated by *Arctostaphylos patula*. This is an upland community.
***Populus tremuloides - Abies concolor / Arctostaphylos patula* Forest**

9b) Understory is dominated by other shrub species. **(10)**

10a) Understory is dominated by *Symphoricarpos oreophilus*. This is an upland community and is common on more mesic sites.
***Populus tremuloides - Abies concolor / Symphoricarpos oreophilus* Forest**

10b) Understory is dominated by other shrub species. **(11)**

11a) *Abies concolor* is present usually with 1% or more cover in tree canopy
Unclassified Abies concolor - Populus tremuloides Forest or Woodland with a shrub layer

11b) *Pseudotsuga menziesii* dominates tree canopy. *Abies concolor* is absent or low cover (<1 % cover).
Unclassified *Pseudotsuga menziesii - Populus tremuloides* Forest or Woodland with a shrub layer.

12a) Understory lacks a shrub layer (generally < 10%). If shrubs present with 5-10% cover then herbaceous cover exceeds shrub cover. **(13)**

12b) Understory has a shrub layer (generally > 10%) or if shrub cover is 5-10%, then shrub cover exceeds herbaceous cover. **(15)**

13a) Understory is characterized by an herbaceous layer dominated by *Carex rossii*. This is an upland forest.
***Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest**

13b) Understory is dominated by other herbaceous species or is sparse. **(14)**

14a) *Abies concolor* is present usually with 1% or more cover in tree canopy.
Unclassified *Abies concolor – (Pseudotsuga menziesii)* Forest or Woodland with an herbaceous or a sparse understory.

14b) *Pseudotsuga menziesii* dominates tree canopy. *Abies concolor* is absent or low cover (<1 % cover).
Unclassified *Pseudotsuga menziesii* Forest or Woodland with an herbaceous or a sparse understory layer

15a) Shrubs in understory are dominated or codominated by *Cercocarpus ledifolius.* Other shrubs may be present but not dominant. This is typically an upland community.
***Abies concolor / Cercocarpus ledifolius* Woodland**

15b) Understory is dominated by other shrub species. **(16)**

16a) Shrubs in understory are dominated or codominated by *Arctostaphylos patula.* Other shrubs may be present but not dominant. This is typically an upland community. **(17)**

16b) Understory is dominated by other shrub species. **(18)**

17a) *Abies concolor* is present usually with 1% or more absolute cover in tree canopy.
Abies *concolor / Arctostaphylos patula* Forest

17b) *Pseudotsuga menziesii* dominates tree canopy. *Abies concolor* is absent or has low cover (<1 % absolute cover).
***Pseudotsuga menziesii / Arctostaphylos patula* Forest**

18a) Shrubs in understory are dominated by *Symphoricarpos oreophilus.* Other shrubs may be present with low cover.
***Abies concolor / Symphoricarpos oreophilus* Forest**

18b) Understory is dominated by other shrub species. **(19)**

19a) *Abies concolor* is present usually with 1% or more cover in tree canopy
Unclassified *Abies concolor – (Pseudotsuga menziesii)* Forest or Woodland with a shrub layer

19b) *Pseudotsuga menziesii* dominates tree canopy. *Abies concolor* is absent or low cover (<1 % cover
Unclassified *Pseudotsuga menziesii* Forest or Woodland with a shrub layer

KEY III: THE SHRUBLAND AND SHRUB STEPPE ASSOCIATION OF GREAT BASIN NATIONAL PARK

1a) Shrubland stand is composed of short and broken aspen and conifer trees < 5 m tall. **(2)**
1b) Shrubland stand is composed of a variety of broadleaf and microphyllus shrubs. **(5)**

2a) Stand is composed of short and broken trees < 5 m tall damaged by reoccurring avalanche. **(3)**
2b) Stand is a krummholz shrubland dominated by wind-stunted trees < 5 m tall occurring near upper tree line. **(4)**

3a) Stand is composed of short and broken *Abies concolor* and/or *Pseudotsuga menziesii* and *Populus tremuloides* trees < 5 m tall damaged by reoccurring avalanche.
Abies concolor - Populus tremuloides **Avalanche Chute Shrubland**
3b) Stand is composed of short and broken *Picea engelmannii* and *Populus tremuloides* damaged by reoccurring avalanche.
Picea engelmannii - Populus tremuloides **Avalanche Chute Shrubland**

4a) Stand is a krummholz shrubland dominated by wind-stunted *Pinus flexilis* < 5 m tall occurring near upper tree line.
Pinus flexilis / Selaginella watsonii **Krummholz Shrubland**
4b) Stand is a krummholz shrubland dominated by wind-stunted *Picea engelmannii* occurring near upper tree line.
Picea engelmannii - (Pinus flexilis) / (Astragalus platytropis) **Krummholz Shrubland**

5a) Tall and short shrublands occurring within drainage bottoms or on mesic alluvial deposits (benches and terraces) that are dominated or codominated by species of *Acer, Betula, Prunus, Rosa* or *Salix*.
Go to **Montane Riparian Shrublands (pg 26)**
5b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of Arctostaphylos, *Atriplex, Artemisia, Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Gutierrezia, Krascheninnikovia, Peraphyllum, Prunus, Purshia, Ribes, Sarcobatus,* or *Symphoricarpos.* **(6)**

6a) Desert scrub typically occurring on lower elevation sites especially in Administrative Area near Baker. Vegetation is dominated or codominated by species of *Atriplex, Gutierrezia, Krascheninnikovia,* or *Sarcobatus* (sometimes codominated by *Artemisia*)
Go to **Desert Scrub (pg 25)**
6b) Shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Arctostaphylos, Artemisia, Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos*. **(7)**

7a) Shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Artemisia.*
Go to **Sagebrush Shrublands (pg 28)**

7b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Arctostaphylos, Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra, Gutierrezia, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos*. *Artemisia* ssp. may be present, but generally do not codominate. **(8)**

8a) Short shrublands (generally < 2m tall) occurring dry uplands that are dominated or codominated by *Arctostaphylos patula.* **(9)**

8b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Gutierrezia, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos*. **(10)**

9a) Shrublands dominated by *Arctostaphylos patula.*
***Arctostaphylos patula* Shrubland**

9b) Shrublands codominated by *Arctostaphylos patula* and *Ceanothus martinii.*
***Arctostaphylos patula / Ceanothus martinii* Shrubland**

10a) Tall shrublands occurring in dry uplands that are dominated or codominated by *Cercocarpus ledifolius*.
***Cercocarpus ledifolius* Woodland and Shrubland Alliance**
Go to **Mountain Mahogany Woodlands (and Shrublands) (pg.13)**

10b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos.* **(11)**

11a) Short shrublands (generally < 2m tall) occurring in dry uplands that are dominated or codominated by *Cercocarpus intricatus* and/or *Glossopetalon spinescens. Ephedra viridis, Purshia tridentata, Peraphyllum ramosissimum,* and *Artemisia tridentata* may be present, but not codominant.
***Cercocarpus intricatus - Glossopetalon spinescens* Shrubland**

11b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Chrysothamnus, Dasiphora, Ericameria, Prunus, Peraphyllum ramosissimum, Purshia, Ribes,* or *Symphoricarpos.* **(12)**

12a) Shrub layer is dominated or codominated by *Peraphyllum ramosissimum*. **(13)**

12b) Shrub layer is not dominated or codominated by *Peraphyllum ramosissimum.* **(14)**

13a) Shrub layer is codominated by *Peraphyllum ramosissimum* with indicator species *Chamaebatiaria millefolium.* This park special type is sampled from one site near North Fork of Big Wash.

***Artemisia tridentata* ssp. *tridentata - Peraphyllum ramosissimum - Chamaebatiaria millefolium* Shrubland [Park Special]**

13b) Shrub layer is dominated or codominated by *Peraphyllum ramosissimum* usually with *Artemisia tridentata* present to codominant. Scattered *Pinus monophylla, Juniperus osteosperma, and Cercocarpus ledifolius* trees may be present. This type is known from Big Wash area.

***Peraphyllum ramosissimum - Artemisia tridentata* Shrubland.**

14a) Short shrublands or shrub steppe (generally < 2m tall) that is occurring in dry uplands that are dominated by *Purshia tridentata*. *Artemisia nova, A. tridentata* or other shrubs may be present to codominant. The herbaceous layer dominated by *Hesperostipa comata* with other dry grasses. Known stands occur at relatively low elevation near Kious Basin near the eastern boundary.

***Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation**

14b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Chrysothamnus, Dasiphora, Ericameria, Ribes, Prunus* or *Symphoricarpos.* **(15)**

15a) Short shrublands or shrub steppe (generally < 2m tall) occurring in dry uplands that are dominated by *Chrysothamnus viscidiflorus* sometimes with *Eriogonum microthecum* codominant. The herbaceous layer is dominated by *Pseudoroegneria spicata.*

***Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional]**

15b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Dasiphora, Ephedra*, *Ericameria*, *Prunus, Ribes,* or *Symphoricarpos.* **(16)**

16a) Short shrublands or shrub steppe (generally < 2m tall) occurring in dry valleys and uplands that are dominated by *Ericameria nauseosa* with an herbaceous layer dominated by *Bromus tectorum,* an introduced annual grass. Sites have been disturbed in past and may have scattered *Artemisia tridentata* is some stands.

***Ericameria nauseosa / Bromus tectorum* Semi-natural Shrubland**

16b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Dasiphora, Ephedra*, *Ericameria, Prunus, Ribes,* or *Symphoricarpos.* **(17)**

17a) Short shrublands (generally < 2m tall) occurring somewhat mesic high elevation uplands that are dominated by *Ribes cereum* or *R. montigenum* and *Ericameria discoidea. Juniperus communis* may be present to codominant. Sites occur in upper subalpine near tree line.

***Ribes (cereum, montigenum) - Ericameria discoidea* Shrubland [Provisional]**

17b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Dasiphora, Ephedra*, *Prunus,* or *Symphoricarpos.* **(18)**

18a) Patchy, relatively mesic short mixed shrublands (generally < 2m tall) occurring on steep talus slopes on south facing slope in Big Wash. Stands are dominated by *Prunus virginiana* with *Holodiscus dumosus, Ephedra viridis, Artemisia tridentata* or *Acer glabrum* present to codominant.
***Prunus virginiana* - Mixed Shrub Talus Shrubland [Provisional]**

18b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Dasiphora* or *Symphoricarpos.* **(19)**

19a) Relatively mesic short open shrublands from montane to subalpine meadows occurring on gentle slopes. Stands are dominated by *Dasiphora fruticosa* ssp. *floribunda* with *Elymus trachycaulus* dominating the moderately dense herbaceous layer. .
***Dasiphora fruticosa* ssp. *floribunda / Elymus trachycaulus* Shrub Herbaceous Vegetation [Park Special]**

19b) Tall and short shrublands occurring in mesic or dry uplands that are not dominated or codominated by species of *Dasiphora fruticosa* ssp. *floribunda.* **(20)**

20a) Relatively mesic short open shrublands from montane to subalpine meadows occurring on gentle slopes. Stands are dominated by *Symphoricarpos oreophilus* with *Elymus trachycaulus* dominating the moderately dense herbaceous layer.
***Symphoricarpos oreophilus* Shrubland**

20b) Undescribed shrubland occurring at GRBA

Shrubland Groups

(Alphabetized by Common Name of Dominant Species)

Desert Scrub

1a) Open low shrubland dominated by *Gutierrezia sarothrae.* This type has not been sampled within GRBA boundaries, but is a disturbance type that could be found there.
***Gutierrezia sarothrae* Dwarf-shrubland Alliance**

1b) Short or dwarf shrublands dominated or codominated by *Krascheninnikovia lanata, Atriplex confertifolia or Sarcobatus vermiculatus.* **(2)**

2a) Open dwarf-shrubland dominated by *Krascheninnikovia lanata.* This type has not been sampled within GRBA boundaries.
***Krascheninnikovia lanata* Dwarf-shrubland**

2b) Short shrublands dominated or codominated by *Atriplex confertifolia or Sarcobatus vermiculatus.* **(3)**

3a) Shrublands dominated or codominated by *Atriplex confertifolia.* **(4)**

3b) Shrublands dominated or codominated by *Sarcobatus vermiculatus.* **(6)**

4a) Shrublands dominated by *Atriplex confertifolia.* This type has not been sampled within GRBA boundaries.
***Atriplex confertifolia* Great Basin Shrubland**

4b) Shrublands codominated by *Atriplex confertifolia.* **(5)**

5a) Shrublands codominated by *Atriplex confertifolia, Picrothamnus desertorum* and *Krascheninnikovia lanata.* This type has not been sampled within GRBA boundaries.
***Atriplex confertifolia - Picrothamnus desertorum / Krascheninnikovia lanata* Shrubland**

5b) Shrublands codominated by *Atriplex confertifolia* and *Sarcobatus vermiculatus.* Not sampled within park boundaries.
***Atriplex confertifolia - Sarcobatus vermiculatus* Shrubland**

6a) Shrublands dominated by *Sarcobatus vermiculatus.* **(7)**
6b) Shrublands codominated by *Sarcobatus vermiculatus.* **(8)**

7a) Shrublands dominated by *Sarcobatus vermiculatus* with an herbaceous layer dominated by *Distichlis spicata.* This type has not been sampled within GRBA boundaries.
***Sarcobatus vermiculatus / Distichlis spicata* Shrubland**

7b) Shrublands dominated by *Sarcobatus vermiculatus* with evidence of disturbances such as *Chrysothamnus viscidiflorus* in shrub layer and annuals like *Kochia americana* in the herbaceous layer. This type has not been sampled within GRBA boundaries.
***Sarcobatus vermiculatus* Disturbed Shrubland**

8a) Open shrublands codominated by *Sarcobatus vermiculatus* and *Artemisia tridentata.* Found on sand deposits near the GRBA administrative area near Baker.
***Sarcobatus vermiculatus / Artemisia tridentata* Shrubland**

8b) Open shrublands codominated by *Atriplex confertifolia* and *Sarcobatus vermiculatus.* This type has not been sampled within GRBA boundaries.
***Atriplex confertifolia - Sarcobatus vermiculatus* Shrubland**

Montane Riparian Shrublands

1a) Tall shrublands dominated or codominated by *Betula occidentalis or Salix* spp. **(2)**
1b) Tall shrublands dominated or codominated by species of *Acer, Prunus, and Rosa.* **(7)**

2a) Shrublands dominated by *Betula occidentalis.* **(3)**
2b) Shrublands dominated by *Salix* spp. *Betula occidentalis* may be present to codominant **(4)**

3a) *Betula occidental* dominates the tall shrub and *Cornus sericea* dominates the short shrub layers.
***Betula occidentalis / Cornus sericea* Shrubland**

3b) *Betula occidental* dominates the tall shrub layer and mesic graminoids such as *Carex* sp., *Juncus* sp., *Leymus cinereus, Poa pratensis,* and *Scirpus microcarpus* dominate the herbaceous layer. Mesic forbs are present to codominant. Scattered upland trees may be present in narrow stands.
***Betula occidentalis* / Mesic Graminoids Shrubland**

4a) Shrublands dominated by *Salix boothii.* **(5)**
4b) Shrublands dominated by *Salix bebbiana* or *Salix exigua*. **(6)**

5a) *Salix boothii* dominates the tall shrub and mesic graminoids such as *Carex aquatilis, C. disperma, C. praegracilis, Elymus glaucus, Equisetum arvense, Glyceria striata,* and *Juncus balticus* dominate the herbaceous layer. Mesic introduced forage grasses such as *Agrostis stolonifera, Dactylis glomerata, Phleum pratense,* and *Poa pratensis* are often present to codominant.
***Salix boothii* / Mesic Graminoids Shrubland**
5b) *Salix boothii* dominates the tall shrub and mesic to wet forbs such as *Aconitum columbianum, Angelica kingii, Dodecatheon alpinum, Mertensia franciscana, Osmorhiza occidentalis, Potentilla gracilis* and *Vicia americana* dominates the herbaceous layer.
***Salix boothii* / Mesic Forbs Shrubland**

6a) *Salix bebbiana* dominates the tall shrub and mesic graminoids such as *Carex aquatilis, C. disperma, C. scopulorum, C. subfusca, Equisetum arvense* and *Glyceria striata* dominates the herbaceous layer. Mesic introduced forage grasses such as *Agrostis stolonifera, Dactylis glomerata, Phleum pretense,* and *Poa pratensis* are often present to codominant.
***Salix bebbiana* / Mesic Graminoids Shrubland**
6b) *Salix exigua* dominates the tall shrub and mesic graminoids dominate the herbaceous layer.
***Salix exigua* / Mesic Graminoids Shrubland**

7a) Shrublands dominated by *Acer glabrum or Rosa woodsii*. **(8)**
7b) Shrublands dominated or codominated by *Prunus virginiana.* **(9)**

8a) Tall shrublands dominated by *Acer glabrum.*
***Acer glabrum* Drainage Bottom Shrubland**
8b) Tall shrublands dominated by *Rosa woodsii.*
***Rosa woodsii* Shrubland**

9a) Tall shrublands dominated by *Prunus virginiana* with *Penstemon rostriflorus* characteristic of the post-burn conditions of the type. Site was mesic lowland
***Prunus virginiana - Penstemon rostriflorus* Post-burn Shrubland [Park Special]**
9b) Tall shrublands dominated by *Prunus virginiana* with *Symphoricarpos oreophilus* dominating the short shrub layer and *Elymus* the herbaceous layer. Not sampled within GRBA boundaries.
***Prunus virginiana - Symphoricarpos oreophilus / Elymus trachycaulus* Shrubland [Park Special)**

Sagebrush Shrublands

1a) Short or dwarf-shrublands dominated or codominated by *Artemisia arbuscula* ssp. *arbuscula* with *Pseudoroegneria spicata* dominant or codominant in the herbaceous layer. *Artemisia tridentata* is absent or has low cover. Includes stands with *Poa fendleriana* dominant as long as *Pseudoroegneria spicata* is present with >25% relative cover. If *Artemisia tridentata* is present, then *A. arbuscula* ssp. *arbuscula* has equal or greater cover.
Artemisia arbuscula ssp. ***arbuscula / Pseudoroegneria spicata*** **Shrub Herbaceous Vegetation**

1b) Short or dwarf-shrublands dominated or codominated by species of *Artemisia nova* or *Artemisia tridentata.* **(2)**

2a) Shrublands dominated by *Artemisia nova. Artemisia tridentata* is absent or has low cover. **(3)**

2b) Shrublands dominated by *Artemisia tridentata* either ssp. *tridentata* or ssp. *vaseyana* unless specified in couplet. *Artemisia tridentata* ssp. *wyomingensis* is not reported from GRBA **(5)**

3a) *Achnatherum hymenoides* dominates the herbaceous layer.
Artemisia nova / Achnatherum hymenoides **Shrubland**

3b) *Achnatherum hymenoides* does not dominate herbaceous layer. **(4)**

4a) *Pseudoroegneria spicata* dominates the herbaceous layer.
Artemisia nova / Pseudoroegneria spicata **Shrubland**

4b) *Poa fendleriana* dominates the herbaceous layer.
Artemisia nova / Poa fendleriana **Shrubland**

5a) Shrubland is dominated or codominated by *Artemisia tridentata* with herbaceous layer dominated by annual introduced grass, *Bromus tectorum.* These are generally disturbed stands often with *Ericameria nauseosa* present to codominant.
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum **Semi-natural Shrubland**

5b) Shrublands are not as above. **(6)**

6a) Shrubland has mixed canopy codominated by *Artemisia tridentata* and other shrub species. **(7)**

6b) Shrubland is strongly dominated by *Artemisia tridentata.* If present other shrub species have low cover and do not codominate. **(12)**

7a) Mixed shrub layer is codominated by *Symphoricarpos oreophilus*. **(8)**

7b) Mixed shrub layer is codominated by *Amelanchier utahensis, Chamaebatiaria millefolium, Peraphyllum ramosissimum* or *Purshia tridentata. Symphoricarpos oreophilus* may be present but not codominant. **(9)**

8a) Herbaceous layer is characterized by *Elymus trachycaulus* ssp. *trachycaulus* and other relatively mesic species.
***Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus / Elymus trachycaulus* ssp. *trachycaulus* Shrubland**

8b) Herbaceous layer is characterized by *Pseudoroegneria spicata* and other relatively xeric species.
***Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus / Pseudoroegneria spicata* Shrubland**

9a) Shrub layer is codominated by *Amelanchier utahensis* and in some stands forms an emergent tall shrub layer. *Peraphyllum ramosissimum* is absent or has low cover.
***Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland**

9b) Shrub layer is codominated by *Peraphyllum ramosissimum* or *Purshia tridentata*. **(10)**

10a) Shrub layer is codominated by *Purshia tridentata* and *Artemisia tridentata*.
***Purshia tridentata - Artemisia tridentata* ssp. *tridentata* Shrubland**

10b) Shrub layer is codominated by *Peraphyllum ramosissimum.* **(11)**

11a) Shrub layer is codominated by *Peraphyllum ramosissimum* with indicator species *Chamaebatiaria millefolium.* This park special type is sampled from one site near North Fork of Big Wash.
***Artemisia tridentata* ssp. *tridentata - Peraphyllum ramosissimum - Chamaebatiaria millefolium* Shrubland [Park Special]**

11b) Shrub layer is codominated by *Peraphyllum ramosissimum.* Scattered *Pinus monophylla, Juniperus osteosperma, and Cercocarpus ledifolius* trees may be present. This type is known from Big Wash area.
***Peraphyllum ramosissimum - Artemisia tridentata* Shrubland.**

12a) Sites are relatively mesic and are found in valley bottoms mesic sites on stream terraces and near seeps. **(13)**

12b) Sites relatively dry and often rocky upland slopes. **(16)**

13a) Herbaceous layer is mesic and is dominated or codominated by *Leymus cinereus*. Stands are found in mesic sites on stream terraces and seeps.
***Artemisia tridentata* ssp. *tridentata / Leymus cinereus* Shrubland**

13b) Herbaceous layer is not dominated or codominated by *Leymus cinereus*. **(14)**

14a) Herbaceous layer is relatively mesic and is dominated by *Agropyron cristatum,* an introduced forage grass. Stands are found in valley bottoms up lower Snake Creek Canyon.
***Artemisia tridentata* ssp. *tridentata / Agropyron cristatum* Semi-natural Shrubland**

14b) Herbaceous layer is not dominated by *Agropyron cristatum.* **(15)**

15a) Herbaceous layer is dominated or codominated by *Pleuraphis jamesii*. *Poa fendleriana* may be present to codominant.
***Artemisia tridentata* ssp. *tridentata / Pleuraphis jamesii* Shrubland**

15b) Herbaceous layer is dominated by *Elymus elymoides*. *Elymus lanceolatus* may be present to codominant. *Artemisia tridentata* ssp. *tridentata* or *A. t.* ssp. *vaseyana* typically dominate.
***Artemisia tridentata / Elymus elymoides* Shrubland**

16a) Herbaceous layer is dominated or codominated by *Poa glauca* and/or *Poa secunda.* Stands are usually found in subalpine sites above 9,000 feet elevation.
***Artemisia tridentata* ssp. *vaseyana / Poa (glauca, secunda)* Shrubland**

16b) Herbaceous layer is dominated or codominated by *Poa fendleriana*. *Poa secunda* or *Hesperostipa comata* may be present to codominant. Stands are usually found in montane sites below 9,000 feet elevation.
***Artemisia tridentata* ssp. *vaseyana / Poa fendleriana* Shrubland**

KEY IV: THE HERBACEOUS ASSOCIATIONS OF GREAT BASIN NATIONAL PARK

1a) Herbaceous vegetation dominated by introduced herbaceous species. **(2)**

1b) Herbaceous vegetation dominated by native herbaceous species. **(4)**

2a) Herbaceous vegetation dominated by annual introduced herbaceous species, *Bromus tectorum* or other introduced annual brome grasses.
***Bromus tectorum* Semi-natural Herbaceous Vegetation**

2b) Herbaceous vegetation dominated by perennial introduced herbaceous species.

3a) Herbaceous vegetation dominated by perennial introduced herbaceous species, *Bromus inermis*.
***Bromus inermis - (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation**

3b) Herbaceous vegetation dominated by introduced perennial herbaceous species, *Agropyron cristatum*, sometimes with remnant native grasses.
***Agropyron cristatum* - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation**

4a) Herbaceous vegetation dominated by alpine species.
Go to **Alpine Herbaceous Vegetation (pg 31)**

4b) Herbaceous vegetation dominated by foothill, montane and subalpine herbaceous species. **(5)**

5a) Herbaceous vegetation occupies mesic sites, including wetlands, perennial drainages, seeps, and springs, mesic meadows and depressions. Dominant and codominant species of *Carex, Dodecatheon, Elymus, Juncus, Leymus* and *Polygonum.*
Go to **Mesic and Wet Herbaceous Vegetation (pg 33)**

5b) Herbaceous vegetation occupies relatively xeric upland sites, including valley bottoms, terraces, slopes and benches; community not controlled by mesic conditions.
Go to **Upland Dry Herbaceous Vegetation (pg 34)**

Herbaceous Groups
(Alphabetized by Common Name of Dominant Species)

Alpine Herbaceous Vegetation

1a) Herbaceous vegetation occupies mesic to wet snow bed site including, depressions and seeps below snow depositions sites in alpine (snow bed community). Dominant species are *Carex subnigricans* and *Geum rossii* with wetland indicator species *Sibbaldia procumbens*.
***Carex subnigricans - Geum rossii - Sibbaldia procumbens* Herbaceous Vegetation [Provisional]**

1b) Herbaceous vegetation occupies relatively xeric upland sites in alpine. The community not controlled by mesic conditions. **(2)**

2a) Herbaceous vegetation is dominated or codominated by *Carex elynoides, Calamagrostis purpurasce*ns and *Geum rossii* forming alpine turf. *Phlox pulvinata* and *Poa secunda* may be present to codominant. **(3)**

2b) Herbaceous vegetation is dominated by cushion plants forming alpine fell-field. Characteristic species are *Aquilegia scopulorum, Astragalus kentrophyta, Eriogonum holmgrenii, Cymopterus nivalis, Erigeron leiomerus,* and *Phlox pulvinata.* **(6)**

3a) Herbaceous vegetation is strongly dominated by *Geum rossii.*
***Geum rossii* Herbaceous Vegetation**

3b) Herbaceous vegetation is codominated by *Calamagrostis purpurascens*, *Carex elynoides, Phlox pulvinata,* and *Poa secunda.* If present, *Geum rossii* is not dominant, only codominant or with low cover. **(4)**

4a) Herbaceous vegetation is dominated or codominated by *Calamagrostis purpurascens* and *Geum rossii.* If present, *Phlox pulvinata,* and *Poa secunda* have low cover.
***Geum rossii - Calamagrostis purpurascens* Herbaceous Vegetation [Park Special]**

4b) Herbaceous vegetation is dominated or codominated by *Carex elynoides.* **(5)**

5a) Herbaceous vegetation is dominated or codominated by *Carex elynoides, Phlox pulvinata,* and *Poa secunda.* If present, *Geum rossii* has low cover.
***Carex elynoides - Phlox pulvinata - Poa secunda* Herbaceous Vegetation**

5b) Herbaceous vegetation is dominated or codominated by *Carex elynoides* and *Geum rossii. If present, Phlox pulvinata,* and *Poa secunda* have low cover.
***Carex elynoides - Geum rossii* Herbaceous Vegetation**

6a) Herbaceous vegetation is strongly dominated by *Phlox pulvinata.*
***Phlox pulvinata* Herbaceous Vegetation [Provisional]**

6b) Herbaceous vegetation is dominated or codominated by *Aquilegia scopulorum, Astragalus kentrophyta, Eriogonum holmgrenii Cymopterus nivalis, Erigeron leiomerus, Geum rossii,* or *Poa secunda.* If present, *Phlox pulvinata* is not dominant, only codominant or with low cover. **(7)**

7a) Herbaceous vegetation is codominated by *Phlox pulvinata* and *Geum rossii.*
***Geum rossii - Phlox pulvinata* Fell-field Herbaceous Vegetation**

7b) Herbaceous vegetation is dominated or codominated by *Aquilegia scopulorum, Astragalus kentrophyta, Eriogonum holmgrenii Cymopterus nivalis, Erigeron leiomerus,* or *Poa secunda.* If present, *Phlox pulvinata* and *Geum* only have low cover (not codominant). **(8)**

8a) Herbaceous vegetation is codominated by *Cymopterus nivalis, Erigeron leiomerus,* and *Poa secunda*. If present, *Aquilegia scopulorum, Astragalus kentrophyta,* and *Eriogonum holmgrenii* have low cover.
***Cymopterus nivalis - Erigeron leiomerus - Poa secunda* Herbaceous Vegetation [Park Special**

8b) Herbaceous vegetation is codominated by *Eriogonum holmgrenii.* **(9)**

9a) Herbaceous vegetation is codominated by *Aquilegia scopulorum* and *Eriogonum holmgrenii.* If present, *Astragalus kentrophyta* has low cover.
***Aquilegia scopulorum - Eriogonum holmgrenii* Fell-field Herbaceous Vegetation**

9b) Herbaceous vegetation is dominated or codominated by *Astragalus kentrophyta* and *Eriogonum holmgrenii.* If present*, Aquilegia scopulorum* has low cover.
***Astragalus kentrophyta- Eriogonum holmgrenii* Herbaceous Vegetation [Park Special]**

Mesic and Wet Herbaceous Vegetation

1a) Forb dominated herbaceous vegetation occupying wet to mesic sites, including wetlands, perennial drainages, seeps and springs, mesic meadows and depressions. Dominant and codominant species are *Dodecatheon alpinum* and *Polygonum bistortoides.* Wet graminoids are often present, but do not dominate. **(2)**

1b) Graminoid dominated herbaceous vegetation occupying wet to mesic sites, including wetlands, perennial drainages, seeps and springs, mesic meadows and depressions. Dominant and codominant species are *Carex nebrascensis, Carex scopulorum*, *Elymus trachycaulus, Juncus balticus, Juncus nevadensis,* and *Leymus cinereus*. **(3)**

2a) Herbaceous vegetation dominated by wet to mesic forbs. *Dodecatheon alpinum* is dominant, but other species such as *Geum macrophyllum, Mimulus guttatus,* or *Polygonum bistortoides* may be present. **(3)**
***Dodecatheon alpinum* Herbaceous Vegetation [Park Special]**

2b) Herbaceous vegetation dominated by wet to mesic forbs. *Polygonum bistortoides* is dominant, but other species such as *Achillea millefolium, Juncus balticus, Poa pratensis* or *Trifolium longipes* spp. *hansenii* may be present.
***Polygonum bistortoides* Herbaceous Vegetation [Park Special]**

3a) Herbaceous vegetation dominated or codominated by *Carex nebrascensis* or *Carex scopulorum.* **(4)**

3b) Herbaceous vegetation dominated or codominated by *Elymus trachycaulus, Juncus balticus, Juncus nevadensis,* or *Leymus cinereus.* **(5)**

4a) Herbaceous vegetation dominated or codominated by *Carex nebrascensis.* Sites are generally montane.
***Carex nebrascensis* Herbaceous Vegetation**

4b) Herbaceous vegetation dominated or codominated by *Carex scopulorum.* Sites are generally subalpine.
***Carex scopulorum* Herbaceous Vegetation**

5a) Herbaceous vegetation dominated or codominated by *Juncus* spp. **(6)**

5b) Herbaceous vegetation dominated or codominated by *Elymus trachycaulus* or *Leymus cinereus.* **(7)**

6a) Herbaceous vegetation dominated or codominated by *Juncus balticus.* Sites are often disturbed.
***Juncus balticus* Herbaceous Vegetation**

6b) Herbaceous vegetation dominated or codominated by *Juncus nevadensis - Poa secunda.* Sites are wet meadows.
***Juncus nevadensis - Poa secunda* Herbaceous Vegetation [Park Special]**

7a) Herbaceous vegetation dominated or codominated by *Leymus cinereus.* Sites are generally near seeps or above wet meadows.
***Leymus cinereus* Herbaceous Vegetation**

7b) Herbaceous vegetation dominated or codominated by *Elymus trachycaulus.* Sites are generally mesic meadows.
***Elymus trachycaulus* Herbaceous Vegetation**

Upland Dry Herbaceous Vegetation

1a) Montane to foothill herbaceous vegetation dominated or codominated by *Balsamorhiza sagittata, Hesperostipa comata,* and *Pseudoroegneria spicata.* **(2)**

1b) Subalpine herbaceous vegetation dominated or codominated by *Achnatherum lettermanii*, *Arenaria congesta, Astragalus kentrophyta, Cirsium eatonii, Lomatium graveolens* var. *alpinum, Poa fendleriana,* and *Poa secunda.* **(5)**

2a) Herbaceous vegetation is strongly dominated by *Balsamorhiza sagittata.*
***Balsamorhiza sagittata* Herbaceous Vegetation [Park Special]**

2b) Herbaceous vegetation is dominated or codominated by *Hesperostipa comata* and *Pseudoroegneria spicata*. **(3)**

3a) Herbaceous vegetation is strongly dominated by *Pseudoroegneria spicata*. **(3)**
***Pseudoroegneria spicata* Herbaceous Vegetation**

3b) Herbaceous vegetation is codominated by *Hesperostipa comata* and *Pseudoroegneria spicata*. **(3)**
***Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation**

4a) Herbaceous vegetation dominated or codominated by *Achnatherum lettermanii*. *Arenaria congesta* and *Monardella odoratissima* may be present to codominant.
***Achnatherum lettermanii* Herbaceous Vegetation**

4b) Herbaceous vegetation dominated or codominated by *Arenaria congesta, Astragalus kentrophyta, Cirsium eatonii, Lomatium graveolens* var. *alpinum, Poa fendleriana,* or *Poa secunda* **(4)**

5a) Herbaceous vegetation is strongly dominated by *Lomatium graveolens* var. *alpinum*. There was a single stand sampled in a high elevation avalanche chute. It may be more widespread in the alpine.
***Lomatium graveolens* var. *alpinum* Herbaceous Vegetation [Park Special]**

5b) Herbaceous vegetation dominated or codominated by *Arenaria congesta, Astragalus kentrophyta, Cirsium eatonii, Poa fendleriana,* or *Poa secunda* **(6)**

6a) Herbaceous vegetation is codominated by *Poa fendleriana* and *Astragalus kentrophyta*. There was a single stand sampled in a high elevation park below Lincoln Peak
***Poa fendleriana - Astragalus kentrophyta* Herbaceous Vegetation [Park Special]**

6b) Herbaceous vegetation dominated or codominated by *Arenaria congesta, Cirsium eatonii,* or *Poa secunda* **(7)**

7a) Herbaceous vegetation codominated by *Poa secunda* and *Arenaria congesta.* If present, *Cirsium eatonii* has low cover.
***Poa secunda - Arenaria congesta* Herbaceous Vegetation [Park Special]**

7b) Mixed herbaceous vegetation codominated by *Poa secunda* and *Cirsium eatonii*. Other abundant species are *Elymus scribneri, Erigeron simplex, Penstemon pachyphyllus, Phacelia hastata,* and *Symphyotrichum spathulatum.* If present, *Arenaria congesta* has low cover. This type was sampled once in a post-burn area.
***Poa secunda - Cirsium eatonii* Post-burn Herbaceous Vegetation [Park Special]**

KEY V: THE SPARSE ASSOCIATIONS OF GREAT BASIN NATIONAL PARK

1a) Montane to foothill sparsely vegetated rock outcrop sites with less than 10% total vegetation cover and characterized by *Abies concolor* or *Cercocarpus ledifolius.* **(2)**

1b) Subalpine sparsely vegetated rock outcrop sites with less than 10% total vegetation cover and characterized by *Castilleja nana, Hulsea algida, Petrophyton caespitosum, Pinus flexilis,* or *Polemonium viscosum.* **(3)**

2a) Sparse vegetation on rock outcrop characterized by *Abies concolor*.
***Abies concolor* Rock Outcrop Sparse Vegetation [Park Special]**

2b) Sparse vegetation on rock outcrop characterized by *Cercocarpus ledifolius*.
***Cercocarpus ledifolius* Rock Outcrop Sparse Vegetation [Park Special]**

3a) Sparse vegetation on bedrock characterized by *Pinus flexilis* trees.
***Pinus flexilis* Bedrock Sparse Vegetation [Park Special]**

3b) Sparse vegetation on rock characterized by shrubs and herbs. **(4)**

4a) Sparse vegetation on bedrock characterized by *Petrophyton caespitosum*
***Petrophyton caespitosum* Sparse Vegetation [Park Special]**

4b) Sparse vegetation on rock characterized by other shrubs and herbs. **(5)**

5a) Sparse vegetation on bedrock characterized by *Hulsea algida.* **(4)**
***Hulsea algida* Alpine Rock Sparse Vegetation [Provisional]**

5b) Sparse vegetation on bedrock characterized by *Castilleja nana* and *Polemonium viscosum.*
***Polemonium viscosum - Castilleja nana* Alpine Rock Sparse Vegetation [Provisional]**

Appendix D: Field Key to the Vegetation Map Classes of Great Basin National Park, Nevada

Note: Before using key please review information from the Introduction in Field Key to the Vegetation of Great Basin National Park, Nevada. Map Class complexes are defined as groups of related alliances.

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KEY I: THE MAJOR PHYSIOGNOMIC GROUPS OF GREAT BASIN NP

1a) Site vegetated with ≥ 10% total vascular vegetation cover. **(2)**

1b) Site barren to sparsely vegetated generally with < 10% total vascular vegetation cover. Non-vascular (lichen and mosses) may exceed 10% cover. Scattered plants are present such as a *Pinus, Cercocarpus, Petrophyton, Hulsea*, and *Polemonium*, but do not form a layer.
Go to: **Key V (p 13)**

2a) Vegetation woody or appearing woody; the tallest stratum dominated by trees, shrubs, or dwarf-shrubs and is typically > 10% cover. Total vegetation cover may range from near sparse to dense. Cover of tree or shrub strata may extend down to 5% when that stratum dominates or characterized an open stand, especially. **(3)**

2b) Vegetation herbaceous; the tallest stratum dominated by grasses, grass-like herbs (graminoids), and broad-leaf herbs (forbs) usually w. Scattered trees or shrubs may be present with low cover <10% cover, but do not form a stratum and herbaceous cover is greater than woody cover. Total vegetation cover may range from near sparse to dense; comprised primarily of graminoid species; wetland to upland habitats; characteristic genera include *Achnatherum*, *Agropyron, Aquilegia*, *Astragalus, Balsamorhiza, Bromus*, *Calamagrostis, Carex*, *Distichlis, Dodecatheon*, *Eleocharis*, *Eriogonum, Elymus, Geum, Hesperostipa*, *Leymus*, *Mimulus*, *Muhlenbergia*, *Phlox, Phragmites*, *Pleuraphis*, *Poa, Polemonium, Polygonum, Pseudoroegneria, Sporobolus*, and *Typha.*
Go to: **Key IV (p 12)**

3a) Tree-dominated forests (overlapping tree canopies), woodlands (open tree canopies), or tree species forming shrublands or dwarf woodlands (avalanche chute, krummholz).Characteristic genera include *Abies, Acer*, *Cercocarpus, Juniperus*, *Picea*, *Pinus*, *Populus*, *Pseudotsuga*, and *Salix.* The tree canopy layer has 10% or more cover generally, but may be as low 5% cover when trees characterize the otherwise borderline sparse vegetation stand (total vegetation cover <20%).

Go to: **Key II (p 2)**

3b) Shrub-dominated vegetation, including shrub-like herbs (*Eriogonum* spp.); canopies may interlock, but are more commonly less dense. Characteristic genera include *Acer, Amelanchier*, *Arctostaphylos*, *Artemisia*, *Atriplex*, *Betula*, *Cercocarpus*, *Chrysothamnus*, *Dasiphora*, *Ephedra*, *Ericameria*, *Eriogonum*, *Gutierrezia*, *Peraphyllum, Picrothamnus*, *Purshia*, *Rhus*, *Ribes, Rosa*, *Salix*, *Sarcobatus,* and *Symphoricarpos.* Scattered tall trees may be present in shrublands, especially in transitional stands, but do not form a tree canopy (<10% cover) or characterize otherwise borderline sparse vegetation stand.

Go to: **Key III (p 8)**

KEY II: THE FOREST AND WOODLAND MAP CLASSES OF GREAT BASIN NP

1a) Deciduous forests or woodlands that occupy a variety of habitats from riparian areas to high elevation slopes. Conifer trees may be present, but generally do not codominate or only do so as occasional small clumps within the larger deciduous tree dominated stand. **(2)**

1b) Evergreen and mixed evergreen – deciduous (aspen) forests and woodlands; or shrublands (dwarfed trees in avalanche chutes or krummholz) occupying a variety of habitats, typically upland or high elevation sites, but includes riparian sites. Includes both needle-leaved and sclerophyllous evergreen tree species. **(4)**

2a) Forests or woodlands characterized by *Populus angustifolia* occurring within drainage bottoms or on mesic alluvial deposits. Other trees such as *Abies concolor, Juniperus scopulorum, Populus tremuloides* or *Pinus monophylla* are often present and may codominate, however *Populus angustifolia* is diagnostic. Understory is variable and may be dominated by *Artemisia tridentata* ssp. *tridentata, Cornus sericea, Prunus virginiana,* or *Rosa woodsii.*

***Populus angustifolia* Riparian Forest & Woodland Alliance (F_POAN)**

2b) Forests or woodlands dominated by *Populus tremuloides* typically occupying stream banks, mesic areas, or occurring on higher elevation slopes. Non-deciduous trees such as *Abies concolor, Juniperus scopulorum* or *Pinus flexilis* may be present, but total <25% relative cover of total tree canopy. If *Populus angustifolia* is present then it has low cover and does not codominate with *Populus tremuloides.* **(3)**

3a) Stand is found along a stream channel or seep. The understory is dominated by riparian shrubs and/or herbaceous species. Characteristic species include *Betula occidentalis, Salix boothii, S. exigua, Carex nebrascensis, C. scopulorum* and *Mimulus guttatus,* or other wet to mesic herbaceous species such as *Aquilegia formosa, Cardamine breweri, Berula erecta, Equisetum laevigatum, Glyceria striata, Juncus balticus, Ligusticum porteri, Maianthemum stellatum, Mertensia franciscana,* and *Scirpus microcarpus.* Shrubs *Amelanchier utahensis, Rosa woodsii, Prunus virginiana,* and *Symphoricarpos oreophilus* may be present to dominant, but are not always riparian.

Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance (F_POTR2)

3b) Stand is in mesic to dry uplands. The understory is usually dominated by shrubs and/or herbaceous species, but occasionally understory is sparse with high cover of leaf litter. Characteristic shrub species may include *Artemisia tridentata, Juniperus communis, Prunus virginiana, Ribes* spp. *Symphoricarpos oreophilus.* The herbaceous layer lacks the wetland species and is dominated by mesic and dry species such as *Achillea millefolium, Bromus carinatus, Elymus glaucus, Elymus trachycaulus, Lathyrus* spp., *Juncus balticus, Poa pratensis* (introduced species), *Poa secunda, Poa wheeleri,* or *Vicia americana*. Occasionally there is low cover of shrubs and herbaceous species and

Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance (F_POTR1)

4a) Forests or woodlands dominated by sclerophyllous evergreen tree/tall shrub *Cercocarpus ledifolius*. Other trees such as *Abies concolor, Juniperus scopulorum* or *Pinus monophylla* may be present to codominant especially in transitional stands; however dominance by *Cercocarpus ledifolius* is diagnostic. Understory is variable depending on site and may have short shrub or herbaceous layers or be sparse.

***Cercocarpus ledifolius* Shrubland & Woodland Complex (W_CELE)**

4b) Forests or woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) with *Cercocarpus ledifolius* absent or with low cover in tree canopy, but may form an understory layer. **(5)**

5a) Forests or woodlands dominated or codominated by *Pinus ponderosa* occurring along drainages on mesic alluvial deposits or upland sites. Other trees such as *Abies concolor, Juniperus scopulorum, Pinus monophylla, Pseudotsuga menziesii*, or *Populus tremuloides* are often present and may codominate, however *Pinus ponderosa* is diagnostic. **(6)**

5b) Forests or woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) not characterized by *Pinus ponderosa* trees. *Pinus ponderosa* is absent or with low (accidental) cover (<5%). **(7)**

6a) Mixed canopy forests occurring along drainages with *Pinus ponderosa* codominant or conspicuously present as large emergent trees over a subcanopy of *Abies concolor, Juniperus scopulorum, Pinus monophylla, Pseudotsuga menziesii* and/or *Populus tremuloides.* Characteristic riparian and mesic site understory species are typically present such as *Betula occidentalis* and *Salix* spp. mixed with upland species. *Pinus ponderosa* is diagnostic.

***Pinus ponderosa* – (*Pseudotsuga menziesii*) Riparian Woodland Alliance (W_PPPM2)**

6b) Forests or woodlands dominated or codominated by *Pinus ponderosa* occurring on upland sites. Other trees such as *Abies concolor, Pseudotsuga menziesii,* or *Pinus monophylla* are often present and may codominate, however large, visually dominant (often emergent) *Pinus ponderosa* in tree canopy is diagnostic even if not the most abundant tree.

***Pinus ponderosa* – (*Pseudotsuga menziesii*) Woodland Complex (W_PPPM1)**

7a) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma*. Stands often have an open tree canopy (generally 10-30% cover) with a denser shrub understory, but include very open woodland stands (down to 5% tree cover)when these trees dominate the vegetation and total vegetation cover is low (<20% cover), as well as denser canopied stands with >30% tree cover. **(8)**

7b) Forests or woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) not dominated by *Pinus monophylla* and *Juniperus osteosperma* trees. *Pinus monophylla* or *Juniperus osteosperma* trees may be present with low cover (not codominant). **(13)**

8a) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma* trees that lack a developed understory. Neither herbaceous nor shrub species have 5% or more cover, and most stands have less than 2% total understory cover. Stands may have sparse understories because they have nearly closed canopy that shades out understory or occur on substrates that limit understory growth (shale substrates with poor water-holding capacity, very high cover of surface rock or sand, sometimes with high cover biological soil crusts).

***Pinus monophylla - (Juniperus osteosperma) /* Grass & Sparse Understory Woodland Complex (W_PJSP)**

8b) Woodlands dominated by *Pinus monophylla* and/or *Juniperus osteosperma* trees with a developed understory (5% or more cover of shrubs or herbaceous species). **(9)**

9a) Understory is characterized by an herbaceous layer typically dominated or codominated by grasses, especially *Poa fendleriana* and/or *Poa secunda*. If shrubs present with 5-10% cover then herbaceous cover exceeds shrub cover.

***Pinus monophylla - (Juniperus osteosperma) /* Grass & Sparse Understory Woodland Complex (W_PJSP)**

9b) Understory characterized by a shrub layer (generally >10% cover). If shrubs present with 5-10% cover then shrub cover exceeds herbaceous cover. **(10)**

10a) Stand occurs along a stream or below a seep. Understory is characterized by mesic shrubs such as *Betula occidentalis, Prunus virginiana,* and *Rosa woodsii.* Wet to mesic graminoids and forbs such as *Juncus balticus, Leymus cinereus,* and *Maianthemum stellatum* may be present to abundant in the herbaceous layer, but upland species are often also abundant when the riparian zone is narrow.

***Pinus monophylla - Juniperus osteosperma /* Mixed Riparian ShrubWoodland Complex (W_PJRP)**

10b) Shrub layer is dominated by upland shrub species. **(11)**

11a) Understory is characterized by the tree layer codominated by *Cercocarpus ledifolius* or a shrub layer dominated or codominated by *Cercocarpus ledifolius*. Other shrubs may be present such as *Amelanchier utahensis* and *Artemisia tridentata*. In a mixed shrub understory layer, *Cercocarpus ledifolius* has 10% or more cover, or is most abundant shrub species if shrub layer is 5-10% cover. At GRBA, *Cercocarpus ledifolius* can have both a tree and shrub form.

***Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (W_PJCL)**

11b) Shrub layer is characterized by other species. **(12)**

12a) Understory is dominated by shrub species from the genus *Artemisia*, including *A. arbuscula, A. nova, A. tridentata* ssp. *tridentata, A. tridentata* ssp. *vaseyana, Artemisia tridentata* ssp. *wyomingensis* and/or the big sagebrush associate *Purshia tridentata.*

***Pinus monophylla - (Juniperus osteosperma) / Artemisia* spp. Woodland Complex (W_PJSG)**

12b) Understory is dominated or codominated by shrub species *Cercocarpus intricatus, Chrysothamnus viscidiflorus, Ephedra viridis, Glossopetalon spinescens, Peraphyllum ramosissimum, Purshia stansburiana,* and *Rhus trilobata* may be present to codominant. Other shrubs may include *Arctostaphylos patula* and *Symphoricarpos longiflorus*. *Artemisia* spp. may be present to codominant.

***Pinus monophylla - (Juniperus osteosperma*) / Mixed Shrub Woodland Complex (W_PJMX)**

13a) Woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) dominated or codominated by *Pinus longaeva* and/or *P. flexilis*. Other trees such as *Abies concolor, Picea engelmannii*, and *Pseudotsuga menziesii* may be present to codominant. *Populus tremuloides* may also be present to co-dominant in mixed stands; however >50% relative cover of conifer canopy cover of *Pinus flexilis* trees and/or presence of *Pinus longaeva* is diagnostic. **(14)**

13b) Forests, woodlands or shrublands (dwarfed trees in avalanche chutes or krummholz) that are not characterized by *Pinus longaeva* and/or *Pinus flexilis* trees. *Pinus longaeva* is absent and/or *Pinus flexilis* is absent or has <50% relative canopy cover of conifer trees. **(18)**

14a) Stand is krummholz (shrubland) dominated or codominated by wind-stunted *Pinus flexilis* < 5 m tall occurring near upper tree line. *Picea engelmannii* is often present to codominant.
Picea engelmannii - (Pinus flexilis) **Great Basin Krummholz Alliance (S_PIEN)**

14b) Stand is a forest or woodland dominated or codominated by *Pinus longaeva* and/or *P. flexilis* trees 5-35 m tall. **(15)**

15a) Open to moderately dense woodlands dominated or codominated by *Pinus longaeva*. *Pinus flexilis* is often present to codominant. Tree canopy ranges from 5-45%. Other trees such as *Abies concolor, Picea engelmannii* and *Pseudotsuga menziesii* may be present, and *Populus tremuloides* may codominate, however the presence of *Pinus longaeva* trees is diagnostic. **(16)**

15b) Woodlands dominated by *Pinus flexilis* (>50% relative cover of conifer canopy). *Pinus longaeva* is absent or has very low cover (accidental <2%). Other trees such as *Abies concolor, Picea engelmannii* and *Pseudotsuga menziesii* may be present and *Populus tremuloides* may codominate, however the dominance of *Pinus flexilis* trees and absence of *P. longaeva* trees is diagnostic. Tree canopy is variable, but generally >10% cover. **(17)**

16a) If present, shrubs in understory include *Ericameria discoidea* and *Ribes montigenum*, although *Juniperus communis* may dominate. Subalpine and alpine herbaceous species are typically present as this is a high elevation type (generally >9700ft).
Pinus longaeva **Subalpine Woodland (W_PILO1)**

16b) If present, shrubs in understory include *Arctostaphylos patula, Artemisia tridentata, Ceanothus martinii,* or *Symphoricarpos oreophilus.* Montane herbaceous species are typically present as this type occurs at lower elevation than the *Pinus longaeva* subalpine woodlands (generally <9700ft).
Pinus longaeva **Montane Woodland (W_PILO2)**

17a) Tree canopy is codominated by *Populus tremuloides* and *Pinus flexilis. Picea engelmannii* may be present to codominate with less canopy cover than *Pinus flexilis*. This association is broadly defined and includes stands with understories dominated by shrubs and/or herbaceous species.
Populus tremuloides - Pinus flexilis **Forest (F_PTPF)**

17b) Tree canopy is dominated by *Pinus flexilis* trees. *Populus tremuloides* may be present but not codominant. Shrubs in understory are dominated or codominated by *Artemisia tridentata* ssp. *vaseyana* or *Symphoricarpos oreophilus.* Other shrubs may be present to codominant. Also the understory may be composed of only an herbaceous layer or be sparse.
Great Basin *Pinus flexilis* Woodland Alliance (W_PIFL)

18a) Subalpine forests, woodlands or shrublands (stunted and broken trees in avalanche chutes or krummholz) dominated or codominated by *Picea engelmannii*. Other trees species may be present with equal or less cover than *Picea engelmannii* including *Abies concolor, Pseudotsuga menziesii,* and *Pinus flexilis* especially in transition zones with montane forests. *Populus tremuloides* may be present to codominate (in mixed conifer-deciduous forests and woodlands); however *Picea engelmannii* is diagnostic when it is one of the most abundant conifer trees. **(19)**

18b) Montane forests and woodlands or shrublands (stunted and broken trees in avalanche chutes) dominated or codominated by *Abies concolor* and/or *Pseudotsuga menziesii.* Other trees may be present with lower cover especially in transition zones with foothill (*Pinus monophylla*) and subalpine forests *Pinus flexilis, Picea engelmannii)*, however *Abies concolor* and/or *Pseudotsuga menziesii* are diagnostic species and combined generally dominate the conifer tree canopy. **(23)**

19a) Stand is a shrubland or stunted/broken woodland dominated or codominated by *Picea engelmannii* < 5 m tall. **(20)**

19b) Stand is a forest or woodland dominated or codominated by *Picea engelmannii* trees 5-35 m tall. **(21)**

20a) Stand is composed of short and broken *Picea engelmannii* and *Populus tremuloides* damaged by reoccurring avalanche. *Abies concolor* may be present to codominant.
Southern Rocky Mountain Avalanche Chute Shrubland Complex (S_AVAL)

20b) Stand is a krummholz shrubland dominated by wind-stunted *Picea engelmannii* occurring near upper tree line.
***Picea engelmannii - (Pinus flexilis)* Great Basin Krummholz Shrubland Alliance (S_PIEN)**

21a) Stand occurs along a stream or below a seep or spring (wetland). *Populus tremuloides* is often present to codominant in the tree canopy. Understory is characterized by an herbaceous layer dominated or codominated by *Carex scopulorum* or presence of other wetland indicator species such as *Aconitum columbianum, Angelica kingii, Carex microptera, C. phaeocephala, Juncus balticus, Mertensia ciliata,* and *Mimulus guttatus*. *Salix boothii* and mesic shrubs may be present to abundant. Mesic graminoids and forbs may be present to codominant. If other conifers are present in tree canopy, then *Picea engelmannii* is the most abundant conifer.
***Picea engelmannii* Riparian Forest & Woodland Alliance (F_PIEN2)**

21b) Stand is not riparian or wetland, but occurs in uplands from mesic valley bottoms to drier slopes and ridges. **(22)**

22a) Upland forests and woodlands codominated by *Picea engelmannii* and *Populus tremuloides*. *Populus tremuloides* trees codominate with conifers with 25-75% relative canopy cover. *Picea engelmannii* is the most abundant conifer tree in mixed conifer stands. Other conifer trees such as *Abies concolor*, *Pseudotsuga menziesii* and/or *Pinus flexilis* may be present with lower or equal individual canopy cover to *Picea engelmannii*. Understory is variable.

***Picea engelmannii - Populus tremuloides* Forest (F_PIEN3)**

22b) Upland forests and woodlands dominated by *Picea engelmannii*. *Populus tremuloides* trees are absent or have low cover (<25% relative cover of tree canopy). *Picea engelmannii* is the most abundant tree in mixed conifer stands. Other conifer trees such as *Abies concolor*, *Pseudotsuga menziesii* and/or *Pinus flexilis* may be present with lower or equal individual canopy cover to *Picea engelmannii*. Understory is variable.

***Picea engelmannii* Forest Complex (F_PIEN1)**

23a) Stand is composed of short and broken *Abies concolor* and/or *Pseudotsuga menziesii* and *Populus tremuloides* trees < 5 m tall damaged by reoccurring avalanche.

Southern Rocky Mountain Avalanche Chute Shrubland Complex (S_AVAL)

23b) Stand is a forest or woodland dominated or codominated by *Abies concolor* and/or *Pseudotsuga menziesii* trees 5-30 m tall. **(24)**

24a) Stand occurs along a stream or below a seep or spring (wetland). *Populus tremuloides* is often present to codominant in the tree canopy. Understory is characterized by wetland indicator species such as shrubs *Betula occidentalis, Salix bebbiana* or *S. boothii* and/or an herbaceous layer dominated or codominated by *Carex scopulorum* or presence of other wetland indicator species such as*, Angelica kingii, Cardamine breweri, Glyceria striata, Mertensia franciscana,* or *Mimulus guttatus,* . Other mesic graminoids may be present to codominant. *Symphoricarpos oreophilus* may form a shrub layer.

***Abies concolor* Riparian Forest & Woodland Alliance (W_ACRIP)**

24b) Stand is not riparian or wetland, but occurs in uplands from mesic valley bottoms to drier slopes and ridges. **(25)**

25a) Upland montane forests and woodlands codominated by *Abies concolor* and/or *Pseudotsuga menziesii*. *Populus tremuloides* trees codominate with conifers with 25-75% relative canopy cover. Other conifer trees such as *Picea engelmannii* and *Pinus flexilis* may be present; however *Abies concolor* and/or *Pseudotsuga menziesii* are the most abundant conifer trees.

***Abies concolor - Populus tremuloides* Forest Complex (F_ABPO)**

25b) Upland montane forests and woodlands dominated or codominated by *Abies concolor* and/or *Pseudotsuga menziesii*. *Populus tremuloides* trees are absent or have low cover (<25% relative cover of tree canopy). Other conifer trees such as *Picea engelmannii* and *Pinus flexilis* may be present; however the combined canopy cover of *Abies concolor* and *Pseudotsuga menziesii* exceeds that of other individual conifer trees.

***Abies concolor* - Pseudotsuga menziesii Forest & Woodland Complex (W_ACPM)**

KEY III: THE SHRUBLAND AND SHRUB STEPPE MAP CLASSES OF GREAT BASIN NP

1a) Shrubland stand composed of short and broken aspen and conifer trees < 5 m tall **(2)**
1b) Shrubland stand composed of a variety of broadleaf and microphyllus shrubs **(3)**

2a) Stand occurs in an avalanche chute is composed of short and broken trees generally < 5 m tall damaged by reoccurring avalanche and shrubs such as *Symphoricarpos* spp., *Chrysothmnus viscidiflorus,* and *Juniperus communis*. Tree species include *Abies concolor, Pseudotsuga menziesii* and *Populus tremuloides* trees in Montane Zone and *Picea engelmannii* and *Populus tremuloides* in Subalpine Zone.
Southern Rocky Mountain Avalanche Chute Shrubland Complex (S_AVAL)
2b) Stand is a krummholz shrubland dominated by wind-stunted trees < 5 m tall occurring near upper tree line. Tree species include *Picea engelmannii and Pinus flexilis.*
***Picea engelmannii - (Pinus flexilis)* Great Basin Krummholz ShrublandAlliance (S_PIEN)**

3a) Stand occurs in an avalanche chute is composed of shrubs such as *Symphoricarpos* spp., *Chrysothmnus viscidiflorus,* and *Juniperus communis*. Avalanche damaged tree species may be present with low cover.
Southern Rocky Mountain Avalanche Chute Shrubland Complex (S_AVAL)
3b) Stand does not occur in an avalanche chute. **(4)**

4a) Shrubland occurs in a previously burned area and may be dominated by by a variety shrubs such as *Prunus virginiana, Chrysothamnus viscidiflorus, Ribes spp.,*or *Symphoricarpos oreophilus* that are typical of seral stages of post-fire forest regeneration. *Penstemon rostriflorus* and *Cirsium eatonii* are characteristic of the post-burn conditions and are often present. This type is not well described and may include other shrubs or may be herbaceous dominated by as long as there is good evidence of recent fire.
Post-fire Shrubland Complex (S_FIRE)
4b) Shrubland is not in a previously burned area or was not recent enough to have clear evidence of fire. **(5)**

5a) Tall and short shrublands occurring within drainage bottoms or on mesic alluvial deposits (benches and terraces) that are dominated or codominated by species of *Acer, Betula, Prunus, Rosa* or *Salix*.
Montane Riparian Shrubland Complex (S_RIP)
5b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Arctostaphylos*, *Atriplex, Artemisia, Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Gutierrezia, Juniperus, Peraphyllum, Prunus, Purshia, Ribes, Sarcobatus,* or *Symphoricarpos*. **(6)**

6a) Desert scrub occurring on lower elevation sites around Baker Visitor Center that are dominated or codominated by species of *Atriplex, Gutierrezia, Artemisia* or *Sarcobatus.* **(7)**

6b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Arctostaphylos*, *Artemisia, Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Juniperus, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos.* **(8)**

7a) Open low shrubland dominated or codominated by *Gutierrezia sarothrae* with other disturbance species such as *Tetradymia.* It typically occurs on highly disturbed sites and was not sampled within park boundaries.
***Gutierrezia sarothrae* Dwarf-shrubland Alliance (DS_GUSA)**

7b) Open shrublands dominated or codominated by *Sarcobatus vermiculatus* with *Artemisia tridentata* and/or *Atriplex confertifolia.* Stands often occur on sandy upland sites near Baker Visitor Center and saline bottomlands along washes.
***Sarcobatus vermiculatus* Shrubland Alliance (S_SAVE)**

8a) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Artemisia. Amelanchier utahensis, Chamaebatiarria millefolium,* or *Peraphyllum ramosissimum* may be presen to codominant. **(9)**

8b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Amelanchier, Arctostaphylos*, *Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Juniperus, Gutierrezia, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos. Artemisia* spp. may be present, but do not codominate. **(14)**

9a) Shrubland or shrub steppe with open to dense shrub layer dominated or codominated by dwarf-shrub, *Artemisia arbuscula* ssp. *arbuscula* with 50% or more relative shrub cover or is the most abundant shrub species. Cover of herbaceous layer often exceeds the cover of shrubs. Common grasses are *Poa fendleriana* and *Pseudoroegneria spicata.*
***Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance (S_ARAR)**

9b) Shrublands or shrub steppe dominated or codominated by *Artemisia nova* or *Artemisia tridentata.* **(10)**

10a) Shrubland or shrub steppe with open to dense shrub layer dominated or codominated by dwarf-shrub by *Artemisia nova* with 50% or more relative shrub cover or is the most abundant shrub species.
***Artemisia nova* Shrubland Alliance (S_ARNO)**

10b) Shrublands or shrub steppe dominated or codominated by *Artemisia tridentata.* **(11)**

11a) Shrub layer is codominated by *Amelanchier utahensis* and *Artemisia tridentata,* usually *A. t.* ssp. *vaseyana. Amelanchier utahensis* will typically have >25% relative cover in short shrub layer or form a tall shrub layer over an *Artemisia tridentata* dominated short shrub layer.
***Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland (S_AMARTV)**

11b) Shrub layer is not codominated by *Amelanchier utahensis.* **(12)**

12a) Shrub layer is dominated or codominated by *Artemisia tridentata* ssp. *vaseyana.* Sampled stands are generally above 2290 m (7500 feet). **(13)**

12b) Shrub layer is dominated or codominated by *Artemisia tridentata* ssp. *tridentata.* Sampled upland stands are generally below 2350 m (7700 feet), except for bottomland associations which extend up to 2685 m (8800 feet). Other shrubs that may be present to codominant include *Chamaebatiarria millefolium, Ericameria nauseousa,* and *Peraphyllum ramosissimum.* Common grasses include *Elymus elymoides, Leymus cinereus, Pleuraphis jamesii,* and introduced species *Agropyron cristatum* and *Bromu tectorum.*

***Artemisia tridentata* ssp. *tridentata* Shrubland Complex (S_ARTR)**

13a) Shrub layer is dominated by *Artemisia tridentata* ssp. *vaseyana* with herbaceous layer dominated by grasses such as *Poa fendleriana, P. glauca, Poa secunda* and introduced annual, *Bromus tectorum. Symphoricarpos oreophilus* is typically absent or has low cover.

***Artemisia tridentata* ssp. *vaseyana* / Grass Understory Shrubland Complex (S_ARTRV)**

13b) Shrub layer is codominated by *Artemisia tridentata* ssp. *vaseyana* and *Symphoricarpos oreophilus.* Grasses such as *Elymus trachycaulis* and *Pseudoroegneria spicata* may be present and sometimes form an herbaceous layer

***Artemisia tridentata* ssp. *vaseyana – Symphoricarpos oreophilus* Shrubland Alliance (S_ARTSY)**

14a) Short shrublands (generally < 2m tall), occurring dry uplands that are dominated or codominated by *Arctostaphylos patula,* often with *Ceanothus martinii.*

***Arctostaphylos patula* Shrubland Alliance (S_ARPA)**

14b) Tall and short shrublands occurring in mesic or dry uplands that are dominated or codominated by species of *Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Juniperus, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos.* **(15)**

15a) Shrub layer is dominated or codominated by *Peraphyllum ramosissimum* typically with *Artemisia tridentata* present to sometimes nearly codominant. Many other shrubs may be present with less cover than *Peraphyllum ramosissimum* including *Cercocarpus intricatus, Glossopetalon spinescens,* and *Ephedra viridis.* Scattered *Pinus monophylla, Juniperus osteosperma, and Cercocarpus ledifolius* trees may be present. This type is known from Big Wash area.

***Cercocarpus intricatus* – (*Peraphyllum ramosissimum*) Shrubland Complex (S_CIPR)**

15b) Shrub layer is not dominated or codominated by *Peraphyllum ramosissimum.* **(16)**

16a) Shrub layer is dominated or codominated by *Amelanchier utahensis* and *Artemisia tridentata,* usually *A. t.* ssp. *vaseyana. Amelanchier utahensis* will typically have >25% relative cover in short shrub layer or form a tall shrub layer over an *Artemisia tridentata* dominated short shrub layer.

***Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland (S_AMARTV)**

16b) Shrub layer is not codominated by *Amelanchier utahensis.* **(17)**

17a) Tall shrublands occurring in dry uplands that are dominated or codominated by *Cercocarpus ledifolius*.

***Cercocarpus ledifolius* Shrubland and Woodland Complex (W_CELE)**

17b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Ephedra*, *Juniperus, Peraphyllum, Prunus, Purshia, Ribes,* or *Symphoricarpos.* **(18)**

18a) Short shrublands (generally < 2m tall), occurring on dry uplands that are dominated or codominated by *Cercocarpus intricatus* and/or *Glossopetalon spinescens. Ephedra viridis, Purshia tridentata, Peraphyllum ramosissimum,* and *Artemisia tridentata* may be present, but not codominant.

***Cercocarpus intricatus* – (*Peraphyllum ramosissimum*) Shrubland Complex (S_CIPR)**

18b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Chrysothamnus, Dasiphora, Ephedra, Ericameria, Juniperus, Prunus, Purshia, Ribes,* or *Symphoricarpos.* **(19)**

19a) Short shrublands or shrub steppe (generally < 2m tall) occurring dry uplands that are dominated by *Purshia tridentata* with *Artemisia tridentata* usually present to sometimes nearly codominant.

***Purshia tridentata* Shrubland Complex (S_PUTR)**

19b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Chrysothamnus, Dasiphora, Ephedra, Juniperus, Ericameria, Prunus, Ribes,* or *Symphoricarpos.* **(20)**

20a) Short shrublands or shrub steppe (generally < 2m tall) occurring on dry uplands that are dominated by *Chrysothamnus viscidiflorus* sometimes with *Eriogonum microthecum* codominant. The herbaceous layer is dominated by *Pseudoroegneria spicata.*

***Chrysothamnus viscidiflorus* Shrub Herbaceous Alliance (S_CHVI)**

20b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Dasiphora, Ericameria, Ephedra, Juniperus, Prunus, Ribes,* or *Symphoricarpos.* **(21)**

21a) Short shrublands or shrub steppe (generally < 2m tall), occurring in dry valleys and uplands that are dominated by *Ericameria nauseosa.* If present, the herbaceous layer is typically dominated by *Bromus tectorum,* an introduced annual grass. Sites have been disturbed in past and may have scattered *Artemisia tridentata* in some stands.

***Ericameria nauseosa* Shrubland Alliance (S_ERNA)**

21b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Dasiphora, Ericameria, Ephedra, Juniperus, Prunus, Ribes,* or *Symphoricarpos.* **(22)**

22a) Short shrublands (generally < 2m tall) occurring in somewhat mesic, higher elevation uplands that are dominated or codominated by *Ribes cereum* and/or *R. montigenum* often with *Ericameria discoidea* present to codominant. This map class also includes stands dominated by *Juniperus communis* with or without *Ribes* spp. Sites frequently occur near upper tree line in lower alpine – upper subalpine zones.

***Ribes montigenum* – (*Juniperus communis*) Shrubland Complex (S_RMJC)**

22b) Tall and short shrublands occurring on mesic or dry uplands that are dominated or codominated by species of *Dasiphora, Ephedra, Prunus,* or *Symphoricarpos.* **(23)**

23a) Stand is a mesic meadow. Mesic species such as *Elymus trachycaulus,* sometimes with an open shrub canopy of *Dasiphora fruticosa* ssp. *floribunda* dominate with other mesic herbaceous species, forming a mixture of mesic forbs and graminoids including *Achillea millefolium, Juncus parryi,* and *Potentilla pulcherrima,* sometimes with wet meadow species present such as *Polygonum bistortoides* or *Ranunculus alismifolius.* The mesic introduced grass, *Poa pratensis* is abundant on some sites.

Montane Mesic Meadow Complex (H_MESC)

23b) Stand not dominated by *Dasiphora fruticosa* ssp. *floribunda.* **(24)**

24a) Stands are patchy and near sparse (10-15% cover), mixed vegetation occurring on a variety of rocky sites such as bedrock outcrops and steep talus slopes. Vegetation ranges from mat-forming plants such as *Petrophyton caespitosum* and *Selaginella watsonii;* mixed cold deciduous shrubs with scattered seedlings of *Pinus flexilis, Abies concolor,* or *Cercocarpus ledifolius;* and various rock loving herbaceous species *Castilleja nana, Hulsea algida, Polemonium viscosum* and cushion plants at higher elevations.

Mixed Rock & Talus Shrubland Complex (S_RT)

24a) Stands are relatively mesic, tall mixed shrublands (generally > 2m tall) occurring at the somewhat mesic sites at such as the base of rock outcrops and below seep areas on steep talus slopes. Stands are dominated by *Prunus virginiana* with *Acer glabrum, Artemisia tridentata, Holodiscus dumosus, Rosa woodsii,* and/or *Symphoricarpos oreophilus* present to codominant.

Montane Talus & Rock Outcrop Shrubland Complex (S_MOTA)

KEY IV: THE HERBACEOUS MAP CLASSES OF GREAT BASIN NP

1a) Herbaceous vegetation occurring in avalanche chutes.

Southern Rocky Mountain Avalanche Chute Herbaceous Vegetation Complex (H_AVAL)

1b) Herbaceous vegetation occurring outside avalanche chutes **(2)**

2a) Recently burn site dominated by herbaceous vegetation (Also key vegetation to non-post fire types below).

Post-fire Shrubland (S_FIRE)

2b) Recently burn sites not dominated by herbaceous vegetation. **(3)**

3a) Herbaceous vegetation dominated by introduced herbaceous species. **(4)**

3b) Herbaceous vegetation dominated by native herbaceous species. **(5)**

4a) Herbaceous vegetation dominated by annual introduced herbaceous species, *Bromus tectorum* or other introduced annual grass or forb species.
Annual Invasive Complex (H_AINV)

4b) Herbaceous vegetation dominated by perennial introduced herbaceous species such as *Agropyron cristatum, Bromus inermis,* and/or *Poa pratensis*.
Perennial Invasive Grassland Complex (H_PINV)

5a) Herbaceous vegetation occurring above upper tree line and dominated by alpine species. **(6)**

5b) Herbaceous vegetation dominated by foothill, montane and subalpine herbaceous species. **(7)**

6a) Herbaceous vegetation is dominated or codominated by *Carex elynoides, Carex subnigricans, Calamagrostis purpurascens, Trisetum spicatum,* and *Geum rossii* forming alpine turf. *Phlox pulvinata* and *Poa secunda* may be present to codominant. Total plant cover ranges from 10-90%.
Alpine Turf Complex (SV_TURF)

6b) Herbaceous vegetation is dominated by cushion plants forming, windswept alpine fell-field. Characteristic species are *Aquilegia scopulorum, Astragalus kentrophyta, Eriogonum holmgrenii, Cymopterus nivalis, Erigeron leiomerus, Geum rossii* and *Phlox pulvinata.* Total plant cover typically ranges form 5-35% and there is often more than 50% ground cover of gravel and rock.
Alpine Cushion Plant Fell-field Complex (SV_FELL)

7a) Herbaceous vegetation occupies relatively xeric upland sites, including valley bottoms, terraces, slopes and benches; community not controlled by mesic conditions. Herbaceous layer is dominated or co-dominated by *Achnatherum lettermanii*, *Arenaria congesta, Astragalus kentrophyta, Balsamorhiza sagittata, Cirsium eatonii, Elymus scribneri, Erigeron simplex, Hesperostipa comata, Lomatium graveolens* var. *alpinum, Monardella odoratissima, Penstemon pachyphyllus, Phacelia hastata, Poa fendleriana, Poa secunda, Pseudoroegneria spicata* and *Symphyotrichum spathulatum.*
However, if shrubs form a consistent open layer (≥5% cover), go to Key III Shrubland and Shrub Steppe Map Classes, to verify stand is not a shrub steppe type.
Rocky Mountain Montane-Subalpine Grassland Complex (H_RMGC)

7b) Herbaceous vegetation occupies mesic sites and wetlands including seeps, and springs, along perennial drainages, mesic meadows and depressions. Dominated or codominated by species of *Carex*, *Dodecatheon, Elymus, Juncus, Leymus, Poa* and *Polygonum.* Mesic shrubs *Dasiphora fruticosa* ssp. *floribunda* and *Symphoricarpos oreophilus* may be present to abundant. **(8)**

8a) Stand is a mesic meadow. Mesic species such as *Elymus trachycaulus,* sometimes with an open shrub canopy of *Dasiphora fruticosa* ssp. *floribunda* often dominate with other mesic herbaceous species forming a mixture of mesic forbs and graminoids including *Achillea millefolium, Juncus parryi,* and *Potentilla pulcherrima,* sometimes with wet meadow species present such as *Polygonum bistortoides* or *Ranunculus alismifolius.* The mesic introduced grass *Poa pratensis* is abundant on some sites.
Montane Mesic Meadow Complex (H_MESC)

8b) Stand is a wet meadow. Wetland species such as *Carex nebrascensis, Carex scopulorum*, *Dodecatheon alpinum, Juncus balticus, Juncus nevadensis, Leymus cinereus* and *Polygonum bistortoides* dominate or codominate stands. Some stands have low cover of shrubs *(Artemisia tridentata, Salix boothii,* and *Rosa woodsii)* or mesic upland species
Montane Wet Meadow Complex (H_WET)

KEY V: THE SPARSE MAP CLASSES OF GREAT BASIN NP

1a) Barren sites (<2% vascular plant cover) or sparse vegetation (<10% vascular plant cover) occurring in avalanche chutes.
Unvegetated Avalanche Chute Talus & Rock (G_AVAL)

1b) Barren sites or sparse vegetation occurring outside avalanche chutes **(2)**

2a) Sparsely vegetated site. **(3)**

2b) Barren rock. **(4)**

3a) Sparse vascular herbaceous vegetation is dominated by cushion plants forming alpine fell-field. Characteristic species are *Aquilegia scopulorum, Astragalus kentrophyta, Eriogonum holmgrenii, Cymopterus nivalis, Erigeron leiomerus,* and *Phlox pulvinata.* Total vascular plant cover typically ranges form 5-35%. Sites often have over 50% ground cover of gravel and rock.
Alpine Cushion Plant Fell-field Complex (SV_FELL)

3b) Foothill to alpine sparsely vegetated rock outcrop sites with less than 10% total vascular plant cover. Sites are characterized by either woody species such as *Abies concolor, Cercocarpus ledifolius,* and *Pinus flexilis* or by herbaceous species such as *Castilleja nana, Hulsea algida, Juniperus communis, Petrophyton caespitosum, Ribes* spp. or *Polemonium viscosum.*
Mixed Rock &Talus Shrubland Complex (S_RT)

4a) Barren Talus and Scree fields with <2% total vascular plant cover.
Bare Talus, Scree & Fell-field Complex (G_TALS)

4b) Barren Rock Outcrop and Scree fields with <2% total vascular plant cover.
Unvegetated Rock Cliff & Outcrop (G_ROCK)

Appendix E: Plant Association Descriptions for Great Basin National Park, Nevada

REVISED US NATIONAL VEGETATION CLASSIFICATION

Vegetation Communities of Great Basin National Park

31 January 2011

by

NatureServe

1101 Wilson Blvd., 15th floor
Arlington, VA 22209

4001 Discovery, Suite 270
Boulder, CO 80303

This subset of the International Ecological Classification Standard covers vegetation communities of Great Basin National Park. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC mary_russo@natureserve.org, and/or Keith Schulz, Vegetation Ecologist, Boulder, CO <keith_schulz@natureserve.org>.

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[1] NatureServe is an international organization including NatureServe regional offices, a NatureServe central office, U.S. State Natural Heritage Programs, and Conservation Data Centres (CDC) in Canada and Latin America and the Caribbean. Ecologists from the following organizations have contributed the development of the ecological systems classification:

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Canada
Alberta Natural Heritage Information Centre, Edmonton, AB, Canada; Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada; British Columbia Conservation Data Centre, Victoria, BC, Canada; Manitoba Conservation Data Centre. Winnipeg, MB, Canada; Ontario Natural Heritage Information Centre, Peterborough, ON, Canada; Quebec Conservation Data Centre, Quebec, QC, Canada; Saskatchewan Conservation Data Centre, Regina, SK, Canada; Yukon Conservation Data Centre, Yukon, Canada

Latin American and Caribbean
Centro de Datos para la Conservacion de Bolivia, La Paz , Bolivia; Centro de Datos para la Conservacion de Colombia, Cali,Valle, Columbia; Centro de Datos para la Conservacion de Ecuador, Quito, Ecuador; Centro de Datos para la Conservacion de Guatemala, Ciudad de Guatemala , Guatemala; Centro de Datos para la Conservacion de Panama, Querry Heights , Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo , Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora , Mexico; Netherlands Antilles Natural Heritage Program, Curacao , Netherlands Antilles; Puerto Rico-Departmento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

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1. Forest & Woodland

1.B.2. Cool Temperate Forest

1.B.2.Nb. Western North American Cool Temperate Forest

M020. Rocky Mountain Subalpine & High Montane Conifer Forest

G224. Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland

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Great Basin *Pinus flexilis* Woodland Alliance

Great Basin Limber Pine Woodland Alliance
Identifier: A2035

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland (G224)
Alliance	**Great Basin *Pinus flexilis* Woodland Alliance (A2035)**

GRBA COMPONENT ASSOCIATIONS

Association	*Pinus flexilis - (Populus tremuloides) / Arctostaphylos patula* Forest (CEGL005434)
	Pinus flexilis / Artemisia tridentata ssp. *vaseyana* Woodland [Park Special] (CEPS009588)
	Pinus flexilis / Symphoricarpos oreophilus Woodland (CEGL005321)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)
GRBA Biophysical Setting (BpS)	Limber-Bristlecone Pine Woodland (1020)
	Limber-Bristlecone Pine Woodland – mesic (1020m)
NPS-VIP Map Unit	Great Basin *Pinus flexilis* Woodland Alliance (W_PIFL)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: Woodlands included in this alliance occur intermittently from timberline to lower montane and foothill zones in mountains in the Great Basin and southern California. Elevations range from 850-3500 m. Sites are typically xeric on exposed, wind-swept rocky slopes and ridges from subalpine to foothills and prairie breaks. Some stands are on eroded substrates and resemble 'badlands' while others may occur on lava flows. These open woodlands occur on all aspects, but are most common on dry south- and west-facing slopes. Soils are typically shallow, skeletal and coarse-textured, such as gravelly, sandy loams or loams, but may include alkaline clays. Exposed bedrock is common and many stands have over 50% bare soil. The vegetation is characterized by an open canopy typically 3-10 m tall, but individuals may reach 15 m. Stands are solely dominated or codominated by the evergreen needle-leaved tree *Pinus flexilis*. Other trees species that may be present to codominant vary by geography and elevation zones throughout the woodland's range and include *Picea engelmannii*, or *Pseudotsuga menziesii* in the subalpine; *Pinus contorta, Pinus ponderosa*, or *Pseudotsuga menziesii* in the montane zone; and *Juniperus osteosperma* or *Juniperus scopulorum* in the lower montane transition zone from woodlands to grasslands or shrublands. In California, other associates may include *Abies concolor, Pinus albicaulis, Pinus balfouriana, Pinus contorta, Pinus jeffreyi*, and *Pinus longaeva*.

The understory vegetation is typically sparse because sites are dry and have a large cover of rock. A sparse shrub layer may be present that includes tall shrubs such as *Arctostaphylos patula, Artemisia tridentata, Cercocarpus ledifolius, Rhus trilobata,* and *Symphoricarpos oreophilus*. *Arctostaphylos uva-ursi, Artemisia arbuscula, Artemisia nova, Juniperus communis, Mahonia repens,* and *Purshia tridentata*, are the most frequent low shrubs. The herbaceous layer is often sparse and is composed of graminoids such as *Poa fendleriana Carex rossii,* and *Pseudoroegneria spicata*. Scattered forbs may include species of *Antennaria, Arenaria, Astragalus, Erigeron, Eriogonum, Hymenoxys,* Penstemon and *Thermopsis*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from 2908-3090 m (9535-10,140 feet) in elevation on gentle to steep slopes (10-53% grades). Topographic positions include low slopes, channel beds, high slopes, ridges and summits. Substrates are rocky and include colluvium, scree, bedrock and till, most composed of granite and quartzite. Soils are moderately to rapidly drained and composed of loam, loamy sand, sandy loam, silt loam, and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This woodland alliance is characterized by a sparse to open canopy. Total canopy cover may be as low as 10% and as high as 50%. Most stands have a sparse subcanopy ranging from 5-15% cover. *Pinus flexilis* is clearly the dominant species occurring in all strata with *Populus tremuloides* codominating in some stands, most frequently in the subcanopy. *Picea engelmannii, Abies concolor, Pseudotsuga menziesii*, and *Pinus longaeva* are canopy associates in some stands. Understories are shrubby with *Arctostaphylos patula, Symphoricarpos oreophilus*, or *Artemisia tridentata* ssp. *vaseyana* dominant. Other shrub associates include *Amelanchier utahensis, Ceanothus martinii, Chrysothamnus viscidiflorus, Juniperus communis, Mahonia repens, Ribes cereum*, and *Sambucus caerulea (= Sambucus nigra* ssp. *caerulea)*. Herbaceous cover is absent, sparse or open (not exceeding 15%), the only constant species being *Carex rossii* and *Poa fendleriana*. Other herbaceous species may include *Antennaria microphylla, Antennaria parvifolia, Aquilegia caerulea, Arabis drummondii, Arabis holboellii, Balsamorhiza sagittata, Erigeron pumilus, Erigeron tener, Monardella odoratissima, Penstemon speciosus, Pseudostellaria jamesiana*, and *Thalictrum fendleri*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus flexilis*
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Short shrub/sapling	Broad-leaved deciduous shrub	*Symphoricarpos oreophilus*
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos patula*, *Artemisia tridentata* ssp. *vaseyana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Arctostaphylos patula*, *Artemisia tridentata* ssp. *vaseyana*, *Pinus flexilis*, *Populus tremuloides*, *Symphoricarpos oreophilus*

CLASSIFICATION

Global Comments: It may be difficult to determine which tree species are dominant in a mixed, montane or subalpine forest stand, especially when *Pinus flexilis* is seral on *Pseudotsuga menziesii* habitat type sites. Some stands included in this alliance are too sparse to be classified as woodlands, especially those growing on lava (Eggler 1941).

Global Related:

- Limber Pine Forest (#86700) (Holland 1986b) ?
- Limber Pine Series (Sawyer and Keeler-Wolf 1995) ?
- Limber Pine: 219 (Eyre 1980) ?
- Southern California Subalpine Forest (#86500) (Holland 1986b) ?

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Sierra Look, near Dead Lake, Baker Creek Trail, Wheeler Peak Road, Blue Ridge, Lehman Creek Trail and Highland Ridge.
Global Range: Stands included in this woodland alliance occur on mountains and plateaus in the Great Basin and Colorado Plateau, southern California. **Nations:** US
States/Provinces: CA, NV, UT
Federal Lands: NPS (Great Basin, Yosemite);

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (12 plots): GRBA.144, GRBA.159, GRBA.161, GRBA.166, GRBA.167, GRBA.176, GRBA.177, GRBA.178, GRBA.253, GRBA.255, GRBA.511, GRBA.743.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Eddleman and Jaindl 1994, Eyre 1980, Holland 1986b, Keeler-Wolf and Thomas 2000, L Sawyer and Keeler-Wolf 1995

Pinus longaeva Woodland Alliance

Great Basin Bristlecone Pine Woodland Alliance
Identifier: A0518

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland (G224)
Alliance	***Pinus longaeva* Woodland Alliance (A0518)**

GRBA COMPONENT ASSOCIATIONS

Association	*Pinus longaeva / (Ericameria discoidea, Ribes montigenum)* Woodland (CEGL005447)
	Pinus longaeva / Arctostaphylos patula Woodland [Park Special](CEPS009591)
	Pinus longaeva / Symphoricarpos oreophilus Woodland [Park Special] (CEPS009593)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)
GRBA Biophysical Setting (BpS)	Limber-Bristlecone Pine Woodland (1020)
	Limber-Bristlecone Pine Woodland – mesic (1020m)
NPS-VIP Map Unit	*Pinus longaeva* Subalpine Woodland (W_PILO1)
	Pinus longaeva Montane Woodland (W_PILO2)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This widely scattered subalpine woodland alliance grows on all slopes, especially ridges and upper slopes below timberline. It grows on dolomitic, limestone- or granite-derived soils. This woodland may occur under the driest conditions of the California subalpine woodlands. The growing season is limited by drought in the summer and cold in the

winter. Precipitation, mostly as snow, falls in the winter. Stands are found between 2600 and 3600 m elevation. This alliance is dominated by *Pinus longaeva* as the sole or dominant tree in the canopy. *Pinus flexilis* may also be present. The shrub *Cercocarpus intricatus* is often present.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland alliance is known from elevations ranging from 2843-3450 m (9325-11,320 feet) on gentle to steep slopes. Sites include midslopes, high slopes, ridges, summits, plateaus and moraines on all aspects. Substrates are typically rocky and composed of bedrock, till and colluvium with moderately to rapidly drained soils of silt loam, clay loam, silty clay, sandy loam, loamy sand and sandy clay loam. At some sites soil is not present.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This needle-leaved woodland alliance is characterized by a relatively short-statured sparse to open canopy (5-55% cover) dominated by *Pinus longaeva*. *Pinus flexilis* is the most consistent canopy associate and may occasionally codominate. Other canopy species often present at lower covers include *Picea engelmannii, Abies concolor, Populus tremuloides*, and *Pseudotsuga menziesii*. Subcanopies are strongly dominated by *Pinus longaeva*. Understories are shrub-dominated with sparse to open cover (5-35%). Dominants include *Ericameria discoidea, Ribes montigenum, Symphoricarpos oreophilus, Arctostaphylos patula*, and/or *Artemisia tridentata* ssp. *vaseyana*. Other shrub associates may include *Cercocarpus ledifolius, Chrysothamnus viscidiflorus, Juniperus communis, Mahonia repens*, and *Ribes cereum*. Herbaceous cover is inconsistent and may be almost absent to open (up to 25% total cover). However, no single species was observed to exceed 3% cover. The most constant herbaceous species are the graminoids *Carex rossii* and *Poa fendleriana*. Forbs include *Astragalus platytropis, Castilleja nana, Cymopterus nivalis, Erigeron jonesii, Erigeron tener, Pedicularis centranthera, Penstemon leiophyllus var. francisci-pennellii, Phlox pulvinata, Physaria chambersii, Selaginella watsonii, Stenotus acaulis, Trifolium gymnocarpon*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus flexilis*, *Pinus longaeva*
Short shrub/sapling	Broad-leaved deciduous shrub	*Ribes montigenum*, *Symphoricarpos oreophilus*
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos patula*, *Artemisia tridentata* ssp. *vaseyana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Arctostaphylos patula*, *Artemisia tridentata* ssp. *vaseyana*, *Pinus longaeva*, *Ribes montigenum*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Penstemon leiophyllus* var. *francisci-pennellii* (globally imperiled, G3T2)

CLASSIFICATION

Global Comments: *Pinus longaeva* is the sole or dominant tree in the canopy.

Global Related Concepts:

- Bristlecone Pine Forest (Holland 1986b) ?

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Mount Washington, Pole Canyon, above Brown Lake, Highland Ridge, Lincoln Canyon, Big Springs Wash, Decathon Canyon, and Chinese Wall.

Global Range: Scattered stands of this subalpine woodland occur in California and Nevada's White Mountains, in the Desert Ranges, and in isolated pockets throughout the Intermountain West.

Nations: US

States/Provinces: CA**,** NV, UT

Federal Lands: NPS (Bryce Canyon, Capitol Reef, Cedar Breaks, Great Basin); USFS (Dixie)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (19 plots): GRBA.195, GRBA.199, GRBA.200, GRBA.201, GRBA.227, GRBA.233, GRBA.254, GRBA.262, GRBA.263, GRBA.264, GRBA.427, GRBA.500, GRBA.501. GRBA.504, GRBA.505, GRBA.517, GRBA.711, GRBA.813, GRBA.816.

Local Description Authors: M. Hall

Global Description Authors: M. Schindel

References: Faber-Langendoen et al. 2011, Holland 1986b, Sawyer and Keeler-Wolf 1995

Pinus longaeva / (Ericameria discoidea, Ribes montigenum) Woodland

Great Basin Bristlecone Pine / (White-stem Goldenbush, Western Prickly Gooseberry) Woodland
Identifier: CEGL005447

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland (G224)
Alliance	*Pinus longaeva* Woodland Alliance (A0518)
Association	***Pinus longaeva / (Ericameria discoidea, Ribes montigenum)* Woodland (CEGL005447)**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)
GRBA Biophysical Setting (BpS)	Limber-Bristlecone Pine Woodland (1020) Limber-Bristlecone Pine Woodland – mesic (1020m)
NPS-VIP Map Unit	*Pinus longaeva* Subalpine Woodland (W_PILO1)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from elevations ranging from 3020-3450 m (9905-11320 feet) on gentle to somewhat steep slopes. Sites include mid to high slopes, plateaus, ridges and summits on all aspects. Substrates are rocky and composed of bedrock, glacial till and colluvium. Soils are moderately to rapidly drained and composed of silty clay, loamy sand, and clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to moderately closed (10-55%) canopy dominated by *Pinus longaeva* with *Pinus flexilis* sometimes codominant. Other canopy associates include *Abies concolor, Pseudotsuga menziesii, Populus tremuloides*, and *Picea engelmannii*. The understory is characterized by a very sparse to open (5-35%) shrub layer dominated by *Ericameria discoidea* and/or *Ribes montigenum*. Other common

shrub species include *Arctostaphylos patula, Juniperus communis, Ribes cereum, Rubus idaeus*, and *Symphoricarpos oreophilus*. The herbaceous is very sparse to open (5-35% cover) and typically dominated by the graminoids *Carex rossii* and *Poa fendleriana*, although in some stands *Phlox pulvinata* may codominate. A variety of forbs may be present and include *Aquilegia scopulorum, Arabis drummondii, Astragalus platytropis, Castilleja nana, Cymopterus nivalis, Erigeron jonesii, Penstemon leiophyllus var. francisci-pennellii, Trifolium gymnocarpon*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus flexilis*, *Pinus longaeva*
Short shrub/sapling	Broad-leaved deciduous shrub	*Ericameria discoidea*, *Ribes montigenum*
Herb (field)	Forb	*Cymopterus nivalis*
Herb (field)	Graminoid	*Carex rossii*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Carex rossii*, *Cymopterus nivalis*, *Ericameria discoidea*, *Pinus flexilis*, *Pinus longaeva*, *Ribes montigenum*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Aquilegia scopulorum* (endemic, G3?); **Other**: *Penstemon leiophyllus* var. *francisci-pennellii* (endemic, G3T2)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Jan-2011).

CLASSIFICATION

Status: Standard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Chinese Wall, Mount Washington, between Snake Creek and Big Wash, south of Brown Lake, Baker Lake, Pole Canyon, and Highland Ridge.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (15 plots): GRBA.199, GRBA.200, GRBA.201, GRBA.227, GRBA.233, GRBA.262, GRBA.263, GRBA.264, GRBA.427, GRBA.500, GRBA.501, GRBA.504, GRBA.505, GRBA.813, GRBA.816.
Local Description Authors: M. Hall
References: Western Ecology Working Group n.d.

G222. Rocky Mountain Subalpine & Montane Aspen Forest & Woodland

Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance
Rocky Mountain Quaking Aspen Forest & Woodland Alliance
Identifier: A2036

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Rocky Mountain Subalpine & Montane Aspen Forest & Woodland (G222)
Alliance	**Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance (A2036)**

GRBA COMPONENT ASSOCIATIONS

Association	*Populus tremuloides / Artemisia tridentata* Forest (CEGL000572)
	Populus tremuloides / Bromus carinatus Forest (CEGL000573)
	Populus tremuloides / Invasive Perennial Grasses Forest (CEGL003748)
	Populus tremuloides / Juniperus communis Forest (CEGL000587)
	Populus tremuloides / Ribes spp. Woodland [Park Special] (CEPS009589)
	Populus tremuloides / Symphoricarpos oreophilus Forest (CEGL000610)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Aspen Forest and Woodland (CES306.813)
GRBA Biophysical Setting (BpS)	Aspen Woodland (1011)
NPS-VIP Map Unit	Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance (F_POTR1)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This alliance is widespread in the western United States. Stands are found on a variety of landscape positions but are consistently in mesic habitats. Stands in this alliance often occur between grasslands and other forest types. The soils are usually deep, well-developed, and loamy. Stands in this alliance often originate following disturbance. The dominant species of the canopy is *Populus tremuloides*. Common associates include *Acer glabrum, Amelanchier alnifolia, Symphoricarpos oreophilus, Bromus carinatus (=Bromus marginatus), Calamagrostis rubescens, Thalictrum fendleri, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii*, and *Hesperostipa comata (= Stipa comata)*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from 2086-3048 m (6842-10,000 feet) in elevation on gentle to steep slopes. Sites include low levels, low slopes, toeslopes, midslopes and high slopes on all aspects often on colluvial slopes. Soils are moderately well-drained to well-drained and composed of loam, loamy sand, silt loam, sandy clay and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This woodland and forest alliance is characterized by an open to dense canopy (20-80% cover) of *Populus tremuloides* which is the clear dominant. *Pinus flexilis, Picea engelmannii*, and *Abies concolor* may be present but are never codominant. Stands may have either shrub- or herbaceous-dominated understories. In shrub-dominated communities, total shrub cover can be very dense (up to 90%) and be dominated by *Artemisia tridentata, Juniperus communis, Ribes* spp., or *Symphoricarpos oreophilus*. Other shrub associates may include *Amelanchier utahensis, Chrysothamnus viscidiflorus, Ericameria nauseosa, Mahonia repens, Prunus virginiana, Rosa woodsii, Rubus idaeus*, and *Sambucus caerulea (= Sambucus nigra* ssp. *caerulea)*. Herbaceous communities are variable, but may be

dominated by *Achillea millefolium, Juncus balticus, Poa secunda, Poa wheeleri*, and/or *Elymus trachycaulus*. Other herbaceous associates include *Allium bisceptrum, Antennaria microphylla, Astragalus piutensis, Castilleja linariifolia, Collinsia parviflora, Fritillaria atropurpurea, Lithospermum ruderale, Lupinus argenteus, Monardella odoratissima, Pedicularis centranthera, Penstemon watsonii, Poa fendleriana, Pseudostellaria jamesiana, Senecio integerrimus, Stellaria longipes*, and *Trifolium gymnocarpon*. Some occurrences are highly degraded and the dominant herbaceous vegetation is non-native.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata*
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis*
Herb (field)	Forb	*Achillea millefolium*
Herb (field)	Graminoid	*Elymus trachycaulus*, *Juncus balticus*, *Poa secunda*, *Poa wheeleri*

CHARACTERISTIC SPECIES

Great Basin National Park: *Populus tremuloides*

CLASSIFICATION

Global Comments: This alliance is floristically similar to other forest alliances that are dominated by *Populus tremuloides* alone or in combination with *Betula papyrifera*. Among these are *Populus tremuloides - Betula papyrifera* Forest Alliance (A269), *Populus tremuloides* Temporarily Flooded Forest Alliance (A300), and *Picea glauca - Abies balsamea - Populus* ssp. Forest Alliance (A418). Stands in Texas may best be treated as *Populus tremuloides* communities or merely as other communities with a component of aspen. Texas stands of *Populus tremuloides* are of limited extent and variable in structure. Further information is needed. Stands in Nevada, described by Blackburn et al. (1968a, 1968b, 1971), are restricted to stream terraces, do not have enough tree canopy cover to be classified as forests, and would be better classified as woodlands. More study is needed especially if these sites have a flood regime. Stands in California need association-level description.

Global Related Concepts:

- Aspen Forest (Holland 1986b) ?
- Aspen Series (Sawyer and Keeler-Wolf 1995) ><
- Aspen: 16 (Eyre 1980) ><
- Aspen: 217 (Eyre 1980) ><

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Snake Creek Trail, Shingle Canyon, Lions Meadow, Wheeler Peak Campground, Horse Heaven, Big Springs Wash and Decathon Canyon.

Global Range: Forests included in the alliance have been described from across the western United States including the Black Hills. Its northern extent is in Canada in Saskatchewan. Additional associations need to be described in California, Arizona, and western Texas.

Nations: CA, US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, SD, TX, UT, WA, WY

Federal Lands: BIA (Blackfeet); NPS (Bandelier, Black Canyon of the Gunnison, Bryce Canyon, Capitol Reef, Cedar Breaks, Colorado, Craters of the Moon, Curecanti, Dinosaur,

Florissant Fossil Beds, Fossil Butte, Glacier, Grand Canyon, Grand Teton, Great Basin, Great Sand Dunes, Jewel Cave, Rockefeller, Rocky Mountain, Yosemite, Zion); PC (Waterton Lakes); USFS (Arapaho-Roosevelt, Ashley, Bighorn, Black Hills, Bridger-Teton, Caribou-Targhee, Custer, Deschutes, Dixie, Fishlake, Fremont, Grand Mesa, Gunnison, Humboldt-Toiyabe, Manti-La Sal, Medicine Bow, Pike-San Isabel, Rio Grande, Routt, San Juan, Shoshone, Uinta, Uncompahgre, Valles Caldera, Wasatch-Cache, White River NF)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (9 plots): GRBA.141, GRBA.143, GRBA.154, GRBA.191, GRBA.512, GRBA.713, GRBA.719, GRBA.730, GRBA.738.

Local Description Authors: M. Hall

Global Description Authors: A.S. Weakley, mod. K.A. Schulz and J. Drake

References: Alexander 1986, Bader 1932, Baker 1982b, Baker and Kennedy 1985, Blackburn et al. 1968b, Blackburn et al. 1968c, Blackburn et al. 1969b, Blackburn et al. 1969d, Blackburn et al. 1971, Bond 1959, Boyce 1977, Bunin 1975a, Bunin 1975c, Cooper and Heidel 1997, Cooper and Pfister 1981, Costello 1954, Cox 1968, Crouch 1983, Curry 1962, DeByle 1985, DeByle and Winokur 1985, Dick-Peddie 1993, Dorn 1969, Eyre 1980, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2011, Ferchau 1973, Giese 1975, Girard et al. 1989, Hansen et al. 1988a, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Hoffman and Alexander 1987, Holland 1986b, Johnston 1987, Johnston and Hendzel 1985, Jones 1985, Keammerer and Peterson 1981, Keammerer and Stoecker 1975, Keammerer and Stoecker 1980, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999b, Knight 1994, Komarkova et al. 1988a, Komarkova et al. 1988b, Langenheim 1962, Lewis 1975a, Lynn et al. n.d., MNNHP 1993, MTNHP unpubl. data, Marr et al. 1973a, Marr et al. 1973b, Morgan 1969, Mueggler 1988, Mueggler and Campbell 1982, Mueggler and Campbell 1986, Murphy 1982, Mutel 1976, Paulsen 1969, Peet 1975, Peet 1981, Plumb 1988, Potter and Moir 1961, Powell 1988a, Reed 1971, Richard et al. 1996, Rominger and Paulik 1983, Sawyer and Keeler-Wolf 1995, Severson and Thilenius 1976, Shepherd 1975, Shepperd 1990, Smith 1991, Terwilliger et al. 1979a, Wasser and Hess 1982, Williams and Lillybridge 1983, Youngblood and Mueggler 1981

G219. Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland

Picea engelmannii Dry-Mesic Forest Alliance

Engelmann Spruce Dry-Mesic Forest Alliance
Identifier: A2103

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland (G219)
Alliance	***Picea engelmannii* Dry-Mesic Forest Alliance (A2103)**

GRBA COMPONENT ASSOCIATIONS

Association	*Picea engelmannii - (Pinus flexilis) / Carex rossii* Woodland (CEGL005433)
	Picea engelmannii / Juniperus communis Forest CEGL005925)
	Picea engelmannii / Moss Forest (CEGL000371)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)
GRBA Biophysical Setting (BpS)	Spruce (1011)
NPS-VIP Map Unit	*Picea engelmannii* Forest Complex (F_PIEN1)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is found at high elevations throughout the park from 2840-3279 m (9320-10,760 feet) on gentle to steep slopes (up to 65% gradients). Sites include low slopes, midslopes, high slopes, ridges and summits mostly on north-, northeast-, and northwest-facing aspects. Substrates are rocky and are composed of colluvium, bedrock and till. Soils include sandy loam, sandy clay loam, silt loam and loamy clay.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This woodland and forest alliance is characterized by an open canopy dominated by *Picea engelmannii* or codominated by *Pinus flexilis*. Canopy cover ranges from 20-55%. *Pseudotsuga menziesii, Populus tremuloides, Abies concolor*, and *Pinus longaeva* may be found scattered in some stands. The subcanopy and shrub layer tend to be very poorly developed, sparse or absent. The shrub layer consists mostly of regenerating *Picea engelmannii* and *Pinus flexilis* with *Juniperus communis* dominant in some stands. *Ericameria discoidea* may be present at low cover. The herbaceous layer ranges from absent, sparse or open up to 25%; the most consistent associates being the graminoids *Carex rossii* and *Poa fendleriana* present at low covers. The spikemoss *Selaginella watsonii* is also commonly present at low cover. A variety of forbs are common and may include *Antennaria microphylla, Arenaria congesta, Arnica cordifolia, Chamerion angustifolium, Comandra umbellata, Erigeron pumilus, Erigeron tener, Eriogonum umbellatum, Lupinus argenteus, Monardella odoratissima, Orthilia secunda, Polemonium pulcherrimum, Pseudostellaria jamesiana, Trifolium gymnocarpon*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Picea engelmannii*, *Pinus flexilis*
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis*

CHARACTERISTIC SPECIES

Great Basin National Park: *Ericameria discoidea*, *Picea engelmannii*, *Pinus flexilis*, *Pseudostellaria jamesiana*, *Selaginella watsonii*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Dec-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Johnson Lake, Dead Lake, Baker Creek, near Teresa Lake, Shingle Creek, Blue Canyon, south of Brown Lake, Stella Lake, Lehman and Shingle divides, Buck Mountain and Blue Ridge.

Global Range: This alliance occurs in Rocky Mountains and in high plateaus and mountains in the Colorado Plateau and Great Basin.
Nations: US
States/Provinces: AZ, CO, ID, MT, NM, NV, OR, WA, WY
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (27 plots): GRBA.146, GRBA.160, GRBA.162, GRBA.165, GRBA.193, GRBA.202, GRBA.203, GRBA.204, GRBA.205, GRBA.206, GRBA.207, GRBA.209, GRBA.211, GRBA.213, GRBA.214, GRBA.217, GRBA.218, GRBA.223, GRBA.226, GRBA.258, GRBA.259, GRBA.421, GRBA.502, GRBA.739, GRBA.812, GRBA.224, GRBA.225.
Local Description Authors: M. Hall
Global Description Authors:
References: Faber-Langendoen et al. 2011

Picea engelmannii - (Pinus flexilis) Great Basin Krummholz Alliance

Engelmann Spruce - (Limber Pine) Great Basin Krummholz Alliance
Identifier: A2102

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland (G219)
Alliance	***Picea engelmannii - (Pinus flexilis)* Great Basin Krummholz Alliance (A2102)**

GRBA COMPONENT ASSOCIATIONS

Association	*Picea engelmannii - (Pinus flexilis) / (Astragalus platytropis)* Krummholz (CEGL005432)
	Pinus flexilis / Selaginella watsonii Krummholz (CEGL005435)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)
GRBA Biophysical Setting (BpS)	Spruce (1011)
NPS-VIP Map Unit	*Picea engelmannii - (Pinus flexilis)* Great Basin Krummholz Shrubland Alliance (S_PIEN)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is restricted to high-elevation krummholz over 3300 m (10,800 feet) in elevation on moderate to steep slopes. Sites include exposed high slopes, summits and ridges on all aspects and are subject to desiccating winds. Soils include loam and loamy sand derived from granite, quartzite and limestone.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This sparse and windswept alliance is characterized by stunted and matted *Picea engelmannii* with *Pinus flexilis* sometimes codominant which form a open to dense short- or tall-shrub layer (25-70% cover) often with an understory of *Astragalus platytropis* and/or *Erigeron leiomerus*. Emergent canopy trees may be present and may reach 40% cover. No other tree associates were recorded during sampling. This environment supports few other species. Shrubs include *Juniperus communis, Ribes montigenum*, and *Rubus idaeus*.

Herbaceous cover is absent to sparse. Species may include *Aquilegia caerulea, Arenaria congesta, Astragalus platytropis, Calamagrostis purpurascens, Carex elynoides, Carex rossii, Castilleja nana, Cymopterus nivalis, Elymus elymoides, Erigeron compositus, Eriogonum holmgrenii, Festuca minutiflora, Geum rossii var. turbinatum, Leptodactylon pungens, Mertensia franciscana, Minuartia obtusiloba, Minuartia rubella, Oxytropis parryi, Poa secunda, Polemonium pulcherrimum, Polemonium viscosum, Potentilla glandulosa* ssp. *nevadensis, Silene acaulis, Trifolium gymnocarpon*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Picea engelmannii*, *Pinus flexilis*

CHARACTERISTIC SPECIES

Great Basin National Park: *Astragalus platytropis*, *Erigeron leiomerus*, *Picea engelmannii*, *Pinus flexilis*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Eriogonum holmgrenii* (globally critically imperiled, G1)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Dec-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from high-elevation areas of Baker Ridge, Pyramid Peak and Lincoln Peak.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (6 plots): GRBA.145, GRBA.328, GRBA.423, GRBA.425, GRBA.904, GRBA.905.
Local Description Authors: M. Hall
Global Description Authors:
References: Faber-Langendoen et al. 2011

G218. Rocky Mountain Subalpine Moist Spruce - Fir Forest & Woodland

Picea engelmannii / Ribes montigenum Forest

Engelmann Spruce / Western Prickly Gooseberry Forest
Identifier: CEGL000374

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Rocky Mountain Subalpine Moist Spruce - Fir Forest & Woodland (G218)
Alliance	*Picea engelmannii* Mesic-Wet Forest Alliance (A2104)
Association	***Picea engelmannii / Ribes montigenum* Forest**

OTHER CLASSIFICATIONS

Ecological System:	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)
GRBA Biophysical Setting (BpS)	Spruce (1011)
NPS-VIP Map Unit	*Picea engelmannii* Forest Complex (F_PIEN1)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This Engelmann spruce forest association is found in Wyoming, Colorado, Utah and Nevada and may extend as far south as Arizona and New Mexico. *Picea engelmannii* forms a sparse to dense canopy of with scattered *Pinus flexilis, Pseudotsuga menziesii* or *Populus tremuloides*. *Ribes montigenum* is the dominant shrub in an otherwise sparse understory with 5-30% cover. *Acer glabrum*, typical of drainage channels, is present in the tall-shrub layer. Short shrubs include *Ericameria discoidea, Juniperus communis, Sambucus racemosa* and *Symphoricarpos* sp. *Oreochrysum parryi, Fragaria vesca* and *Carex rossii* are the most abundant plants in the herbaceous layer.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is found at elevations from 3011-3310 m (9880-10,860 feet) on moderate to steep slopes (16-70%). Sites include midslopes and high slopes on colluvium, bedrock and till. Soils are well- to rapidly drained and composed of silt loam, loamy sand, clay loam, and silt.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This forest and woodland alliance is characterized by a sparse to dense (10-75% cover) canopy dominated by *Picea engelmannii* often with lesser amounts of *Pinus flexilis*. *Pseudotsuga menziesii* is present in some stands. The understory is composed of a sparse to open short-shrub layer with *Ribes montigenum* dominating, often with equal amounts of regenerative *Picea engelmannii*. The only other frequent shrub species include. The herbaceous layer may be absent, sparse or open (up to 25% cover) with no clear dominants. Common graminoids include *Poa fendleriana* and *Carex rossii*. Common forbs include *Achillea millefolium, Antennaria microphylla, Arenaria congesta, Arnica cordifolia, Chamerion angustifolium, Erigeron tener, Heuchera rubescens var. alpicola, Osmorhiza depauperata, Polemonium pulcherrimum, Primula parryi*, and *Stellaria longifolia*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Needle-leaved shrub	*Picea engelmannii*
Short shrub/sapling	Broad-leaved deciduous shrub	*Ribes montigenum*

CHARACTERISTIC SPECIES

Great Basin National Park: *Chamerion angustifolium*, *Erigeron tener*, *Picea engelmannii*, *Pinus flexilis*, *Ribes montigenum*

Global: *Oreochrysum parryi*, *Sambucus racemosa*

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Aquilegia scopulorum* (G3?)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (1-Feb-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Related Concepts:

- *Picea engelmannii/Ribes montigenum* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:I.A.9.c. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from the Baker Creek cliff base, Summit Trail trailhead, Alpine Lakes Trail, Buck Mountain Peak, and the west slope of Blue Ridge.
Global Range: This forest association is found in Wyoming, Colorado, Utah and Nevada and may extend as far south as Arizona and New Mexico.
Nations: US
States/Provinces: AZ?, CO, NM?, NV, UT:S5, WY:S4
Federal Lands: NPS (Great Basin, Great Sand Dunes); USFS (Shoshone)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (8 plots): GRBA.169, GRBA.189, GRBA.194, GRBA.219, GRBA.220, GRBA.221, GRBA.222, GRBA.712.
Local Description Authors: M. Hall
Global Description Authors: K. Forrest, mod. M.J. Russo and K. A. Schulz
References: Billings 1969, Bourgeron and Engelking 1994, Driscoll et al. 1984, Jones and Ogle 2000, Larson and Moir 1987, Pfister 1972, Steele et al. 1983, Wasser and Hess 1982, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Populus tremuloides - (*Picea engelmannii, Abies* spp., *Pseudotsuga menziesii*) Avalanche Chute Shrubland Alliance

Quaking Aspen - (Engelmann Spruce, Fir species, Douglas-fir) Avalanche Chute Shrubland Alliance
Southern Rocky Mountain Avalanche Chute Shrubland Alliance
Identifier: A2712

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Rocky Mountain Subalpine Moist Spruce - Fir Forest & Woodland (G218)
Alliance	***Populus tremuloides* - (*Picea engelmannii, Abies* spp., *Pseudotsuga menziesii*) Avalanche Chute Shrubland Alliance (A2712)**

GRBA COMPONENT ASSOCIATIONS

Association	*Abies concolor* - *Populus tremuloides* Avalanche Chute Shrubland (CEGL005420)
	Picea engelmannii - *Populus tremuloides* Avalanche Chute Shrubland (CEGL005431)

OTHER CLASSIFICATIONS

Ecological System:	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)
GRBA Biophysical Setting (BpS)	Aspen-Mixed Conifer (1061) Aspen-Subalpine Conifer (1061s)
NPS-VIP Map Unit	Southern Rocky Mountain Avalanche Chute Shrubland Complex (S_AVAL)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from elevations ranging from 2858-3013 m (9377-9880 feet) on moderate to steep slopes. Sites include colluvial slopes on north and northeast aspects in avalanche chutes. Some sites are upland slopes and others are mesic with a channel running down it. Soils are well-drained and composed of loam, loamy sand and silt loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance has two distinct expressions. The first and more common expression is a stunted, short-statured spruce-fir-aspen shrubland dominated by *Populus tremuloides* codominant with either *Abies concolor* or *Picea engelmannii*. Cover may be open to almost completely closed. Short and dwarf-shrubs may contribute substantial relative cover. Species include *Amelanchier utahensis, Ericameria discoidea, Juniperus communis, Ribes cereum, Ribes inerme, Ribes montigenum*, and *Symphoricarpos oreophilus*. Herbaceous cover may be as high as 40%. Dominant species include *Aquilegia caerulea, Artemisia michauxiana, Chamerion angustifolium*, and *Monardella odoratissima*. Other species may include *Achnatherum lettermanii, Arenaria congesta, Carex rossii, Castilleja linariifolia, Crepis acuminata, Elymus lanceolatus, Frasera speciosa, Heuchera rubescens*, and *Woodsia oregana*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved shrub	*Abies concolor*, *Picea engelmannii*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Populus tremuloides*
Short shrub/sapling	Broad-leaved deciduous shrub	*Ribes inerme*, *Ribes montigenum*
Herb (field)	Forb	*Aquilegia caerulea*, *Artemisia michauxiana*, *Chamerion angustifolium*, *Monardella odoratissima*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Aquilegia caerulea*, *Artemisia michauxiana*, *Chamerion angustifolium*, *Monardella odoratissima*, *Picea engelmannii*, *Populus tremuloides*, *Ribes inerme*, *Ribes montigenum*

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance was sampled from Mount Washington and mountains above Baker Creek and west of Lexington Arch, but is more widespread at higher elevations in the park where snow accumulates.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2008 field data (3 plots): GRBA.168, GRBA.314, GRBA.321.
Local Description Authors: M.E. Hall
References: Western Ecology Working Group n.d.

G221. Rocky Mountain Subalpine-Montane Limber Pine - Bristlecone Pine Woodland

Populus tremuloides - Pinus flexilis Forest
Quaking Aspen - Limber Pine Forest
Identifier: CEGL000540

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Rocky Mountain Subalpine & High Montane Conifer Forest (M020)
Group	Rocky Mountain Subalpine-Montane Limber Pine - Bristlecone Pine Woodland (G221)
Alliance	*Pinus flexilis - Populus tremuloides* Forest Alliance (A0425)
Association	***Populus tremuloides - Pinus flexilis* Forest**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)
GRBA Biophysical Setting (BpS)	Aspen-Mixed Conifer (1061) Aspen-Subalpine Conifer (1061s)
NPS-VIP Map Unit	*Populus tremuloides - Pinus flexilis* Forest (F_PTPF)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This mixed deciduous-and-evergreen woodland occurs on mountain slopes from western Wyoming south to southern Utah and west to eastern Nevada. Stands generally grow on fairly steep, south-facing slopes with a variety of geologic substrates, at altitudes above 2650 m (8700 feet). *Populus tremuloides* dominates the tree overstory, and *Pinus flexilis* contributes substantial cover. Other conifers may be present, but *Pinus flexilis* clearly contributes more cover. The composition of the undergrowth varies widely among stands, and no species is present in all stands. The large amount of *Pinus flexilis* in the overstory, relative to other conifers, sets this association apart from other *Populus tremuloides* - conifer associations.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from elevations ranging from 3011-3279 m (9880-10,760 feet) on moderate to steep slopes. Sites include low to high slopes on all aspects. Substrates are rocky and include bedrock, till and colluvium. Soils include well-drained sandy clay loam, silty clay loam, silty clay, and silt loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This forest and woodland association is characterized by a short-statured canopy codominated by *Populus tremuloides* and *Pinus flexilis*. Canopy cover is sparse to open ranging from 10-55% cover. Regenerative *Populus tremuloides* may be quite dense in some stands. The shrub layer is variable with *Juniperus communis* typically forming an open short-shrub layer. Other shrub species may include *Ericameria discoidea, Symphoricarpos oreophilus*, and *Mahonia repens*. The herbaceous layer is sparse to open (5-35% cover) and dominated by graminoids, including *Carex rossii, Poa fendleriana*, and *Elymus elymoides* ssp. *brevifolius*. Forbs are present at low cover and may include *Achillea millefolium, Arenaria congesta, Erigeron pumilus, Erigeron tener, Eriogonum umbellatum, Lupinus argenteus, Monardella odoratissima, Pseudostellaria jamesiana*, and *Trifolium gymnocarpon*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus flexilis*
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis*
Herb (field)	Graminoid	*Carex rossii*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Pinus flexilis*, *Populus tremuloides*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G3 (27-Sep-2004). The G2G3 rank is based on the assumptions that this association occurs over a fairly wide geographic range, but that there are few occurrences in that range and they are small.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Mueggler (1988), in his classification of aspen types in the U.S. Forest Service's Intermountain Region, recognized a number of community types in which *Populus tremuloides* shares the overstory with *Abies lasiocarpa, Abies concolor, Pinus contorta*, or *Pseudotsuga menziesii*. He named the *Populus tremuloides - Pinus flexilis* cover type to recognize those uncommon stands in which *Pinus flexilis* is the dominant conifer and the overstory is a mixture of *Populus tremuloides* and *Pinus flexilis*.
Global Related Concepts:

- *Populus tremuloides - Pinus flexilis* Cover Type (Mueggler 1988) =
- *Populus tremuloides - Pinus flexilis* Potential Native Plant Community (Eddleman and Jaindl 1994) =
- *Populus tremuloides-Pinus flexilis* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:I.B.2.b. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Wheeler Peak Campground, Shingle Creek, Stella Lake and Bald Mountain.
Global Range: The geographic range is estimated to encompass 186,480 square km (72,000 square miles), primarily on the Colorado Plateau and in the Great Basin, from the Gros Ventre Mountains of northwestern Wyoming south to the Paunsaugunt Plateau of southern Utah, and west to the Snake Mountains of eastern Nevada. This is the area over which Mueggler (1988) documented his cover type.
Nations: US
States/Provinces: CO, ID, NV:S2S3, UT:S2S3, WY
Federal Lands: NPS (Craters of the Moon, Great Basin, Great Sand Dunes)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 field data (6 plots): GRBA.190, GRBA.192, GRBA.210, GRBA.212, GRBA.215, GRBA.216.
Local Description Authors: M.E. Hall
Global Description Authors: G.P. Jones, mod. K.A. Schulz

References: Bell et al. 2009, Bourgeron and Engelking 1994, Driscoll et al. 1984, Eddleman and Jaindl 1994, Mueggler 1988, Peterson pers. comm., Western Ecology Working Group n.d.

M022. Southern Rocky Mountain Lower Montane Forest

G225. Rocky Mountain Douglas-fir - White Fir - Blue Spruce Mesic Forest

Abies concolor - Populus tremuloides Mesic Forest Alliance

White Fir - Quaking Aspen Mesic Forest Alliance
Identifier: A2112

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Rocky Mountain Douglas-fir - White Fir - Blue Spruce Mesic Forest (G225)
Alliance	***Abies concolor - Populus tremuloides* Mesic Forest Alliance (A2112)**

GRBA COMPONENT ASSOCIATIONS

Association	*Populus tremuloides - Abies concolor / Poa pratensis* Semi-natural Forest (CEGL002947)
	Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest (CEGL000523)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)
GRBA Biophysical Setting (BpS)	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (gb1061) Aspen-Mixed Conifer (1061)
NPS-VIP Map Unit	*Abies concolor - Populus tremuloides* Forest Complex (F_ABPO)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is found at Great Basin at elevations from 2536-2828 m (8320-9280 feet) on gentle to somewhat steep slopes (6-49%) on all aspects. Sites include low and middle slopes and floodplains with substrates comprised mainly of colluvium. Soils include sandy clay loam, silty clay loam, loam and silt loam. In some cases little to no soil is present and there is high cover of large rock (67%); however, most stands have high cover (50-95%) of litter/duff on the soil surface.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by an open to somewhat closed canopy dominated by *Abies concolor* and *Populus tremuloides* with total canopy cover ranging from 15-75%. Both conifers and aspen have 25-75% relative tree canopy cover. Other canopy associates may include *Pseudotsuga menziesii, Pinus flexilis, Picea engelmannii*, and *Pinus longaeva*. Tall-shrub cover is sparse to very open (5-15%) with *Ribes cereum* and *Prunus virginiana* as the most common species. Regenerative tree seedlings are common. The short-shrub layer varies from sparse to very dense (5-85% cover) with *Symphoricarpos oreophilus* being the most constant dominant species. Other short-shrub associates include *Juniperus communis, Rosa woodsii, Rubus idaeus*, and *Cercocarpus ledifolius*. Herbaceous cover is typically low and ranges from 5-15%, but occasionally exceeds 50% cover of introduced species *Poa pratensis*. Graminoids are the most consistent lifeforms and may include *Poa fendleriana, Carex rossii, Elymus trachycaulus*, and *Pseudoroegneria spicata*. Forb cover is low and may include *Trifolium gymnocarpon, Achillea millefolium, Arabis holboellii, Pseudostellaria jamesiana*, and *Lupinus argenteus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Short shrub/sapling	Broad-leaved deciduous shrub	*Symphoricarpos oreophilus*
Herb (field)	Graminoid	*Elymus trachycaulus*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Carex rossii*, *Elymus trachycaulus*, *Ligusticum porteri*, *Poa fendleriana*, *Populus tremuloides*, *Symphoricarpos oreophilus*, *Thalictrum fendleri*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (invasive/exotic, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Dec-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Baker Creek, Dead Lake Trail, Snake Creek, upper Strawberry Creek, and Lehman Creek.
Global Range: This alliance occurs in Southern Rocky Mountains and in high plateaus and mountains in the Colorado Plateau and Great Basin.
Nations: US
States/Provinces: AZ, CO, NM, NV, UT
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (7 plots): GRBA.104, GRBA.138, GRBA.147, GRBA.152, GRBA.156, GRBA.186, GRBA.710.
Local Description Authors: M.E. Hall
Global Description Authors:
References: Western Ecology Working Group n.d.

Abies concolor / Symphoricarpos oreophilus Forest

White Fir / Mountain Snowberry Forest
Identifier: CEGL000263

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Rocky Mountain Douglas-fir - White Fir - Blue Spruce Mesic Forest (G225)
Alliance	*Abies concolor* - *Pseudotsuga menziesii* Mesic Forest Alliance (A0553)
Association	***Abies concolor / Symphoricarpos oreophilus* Forest**

OTHER CLASSIFICATIONS

Ecological System	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
GRBA Biophysical Setting (BpS)	Mixed Conifer
NPS-VIP Map Unit	*Abies concolor* - *Pseudotsuga menziesii* Forest & Woodland Complex (W_ACPM)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This forest association has been reported from mountains in Colorado, Utah, New Mexico and Arizona along the Mogollon Rim. Elevation ranges from 2075-3200 m (6800-10,500 feet). Stands are found on cool, dry sites often occurring on moderate to steep mid slopes with northern aspects, but they also occur on southern and western slopes at the higher elevations. Parent material often is limestone and Tertiary sandstone. Soil surface textures are sandy loam to loam and contain little gravel. The upper tree canopy is typically dominated by either *Pinus ponderosa* or *Pseudotsuga menziesii* with scattered *Abies concolor*. This association is characterized by the presence of successfully reproducing *Abies concolor*, which may also dominate or codominate the tree canopy or shrub layers. Associated trees include *Pinus flexilis, Populus angustifolia*, and *Populus tremuloides*. The sparse to moderately dense short-shrub layer is characteristically dominated by *Symphoricarpos oreophilus* often with *Rosa woodsii, Amelanchier alnifolia*, or several other shrubs present. The herbaceous layer is sparse. Common graminoids are *Carex rossii* and *Poa fendleriana*. Forbs are noticeably sparse.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from elevations ranging from 2465-2926 m (8085-9600 feet) on moderate to steep slopes. Sites include low slopes, midslopes, high slopes, ridges and summits with surficial geology composed of limestone, granite and quartzite often in the form of colluvium. Soils are well- to rapidly drained and composed of loam, silt loam, clay loam, loamy sand, sandy clay loam, and silty clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by an open to closed canopy (15-75% cover) clearly dominated by *Abies concolor*. Other canopy species which may occur at lower cover include *Picea engelmannii, Pinus flexilis*, and *Pseudotsuga menziesii*, but these are never codominant. The understory is shrubby and varies from nearly absent to open and dominated by *Symphoricarpos oreophilus*. *Mahonia repens* is often present but not dominant. Herbaceous cover is usually sparse with *Poa fendleriana* frequently present.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*
Short shrub/sapling	Broad-leaved deciduous shrub	*Symphoricarpos oreophilus*
Herb (field)	Graminoid	*Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: Two similar associations, *Abies concolor* / *Erigeron eximius* and *Abies concolor* / Sparse, are described by DeVelice et al. (1986) for northern New Mexico and southern Colorado.

Global Similar Associations:
Global Related Concepts:

- *Abies concolor - Pseudotsuga menziesii / Symphoricarpos oreophilus* Plant Association (Johnston 1987) =
- *Abies concolor - Pseudotsuga menziesii / Symphoricarpos oreophilus* Plant Association (Johnston 1984) =
- *Abies concolor / Symphoricarpos oreophilus* (Freeman and Dick-Peddie 1970) ?
- *Abies concolor / Symphoricarpos oreophilus* Habitat Type (Youngblood and Mauk 1985) =
- *Abies concolor / Symphoricarpos oreophilus* Plant Association (Larson and Moir 1987) =
- *Abies concolor / Symphoricarpos oreophilus* Plant Association (Stuever and Hayden 1997b) =
- *Abies concolor/Symphoricarpos oreophilus* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:I.A.9.c. (Driscoll et al. 1984) >
- White-fir / Snowberry (Roberts et al. 1992) =

ELEMENT DISTRIBUTION

Great Basin National Park Range: This forest association is common at the park especially on cooler northerly slopes and relatively mesic mid and low slopes and was sampled from near Buck Mountain in the north to Highland Ridge in the southern part of the park.
Global Range: This coniferous forest association has been reported from mountains and high plateaus in New Mexico, Colorado, Utah, and in Arizona along the Mogollon Rim.
Nations: US
States/Provinces: AZ:S4, CO:SU, NM:S5, NV, UT:S5, WY
Federal Lands: NPS (Bryce Canyon, Cedar Breaks, Grand Canyon, Great Basin, Great Sand Dunes, Zion); USFS (Pike-San Isabel, San Juan)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (10 plots): GRBA.106, GRBA.108, GRBA.109, GRBA.249, GRBA.250, GRBA.252, GRBA.256, GRBA.257, GRBA.333, GRBA.707.
Local Description Authors: M. Hall
Global Description Authors: L.D. Engelking
References: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, DeVelice et al. 1986, Driscoll et al. 1984, Edwards 1987, Freeman and Dick-Peddie 1970, Johnston 1984, Johnston 1987, Lamb 1975, Larson and Moir 1987, Roberts et al. 1992, Stuever and Hayden 1997b, Western Ecology Working Group n.d., Youngblood and Mauk 1985

G228. Southern Rocky Mountain Ponderosa Pine Forest & Woodland

***Pinus ponderosa - Abies concolor / Symphoricarpos oreophilus* Woodland [Provisional]**
Ponderosa Pine - White Fir / Mountain Snowberry Woodland
Identifier: CEGL005442

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Southern Rocky Mountain Ponderosa Pine Forest & Woodland (G228)
Alliance	*Pinus ponderosa* / Mixed Shrub Woodland Alliance (A1986)
Association	***Pinus ponderosa - Abies concolor / Symphoricarpos oreophilus* Woodland [Provisional]**

OTHER CLASSIFICATIONS

Ecological System	Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648
GRBA Biophysical Setting (BpS)	Ponderosa Pine (1054)
NPS-VIP Map Unit	*Pinus ponderosa* – (*Pseudotsuga menziesii*) Woodland Complex (W_PPPM1)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 2411-2509 m (7912-8229 feet) on gentle to somewhat steep slopes. Sites include stream terraces, low slopes and high slopes on north, east and northwest aspects. Substrates are rocky with variable soil drainage composed of sandy loam, loamy sand, clay loam, and silty clay.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to open (10-30% cover) canopy dominated by *Pinus ponderosa* or codominated by *Abies concolor* and *Pseudotsuga menziesii*. Other canopy associates may include *Pinus flexilis* and *Pinus longaeva* at low covers. A sparse canopy of *Juniperus scopulorum* and *Cercocarpus ledifolius* may be present. The understory is characterized by an open shrub layer dominated by *Symphoricarpos oreophilus*. Other shrub associates may include *Acer glabrum, Apocynum cannabinum, Arctostaphylos patula, Artemisia tridentata* ssp. *vaseyana, Ceanothus martinii, Chrysothamnus viscidiflorus, Gutierrezia sarothrae*, and *Holodiscus dumosus*. The herbaceous layer is sparse without apparent dominants. Species may include *Achnatherum hymenoides, Achnatherum lettermanii, Achnatherum nevadense, Arabis drummondii, Artemisia dracunculus, Astragalus calycosus, Bromus inermis, Cirsium arizonicum, Ipomopsis aggregata, Solidago canadensis*, and *Symphyotrichum spathulatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*, *Pinus ponderosa*, *Pseudotsuga menziesii*
Short shrub/sapling	Broad-leaved deciduous shrub	*Symphoricarpos oreophilus*

CHARACTERISTIC SPECIES

Great Basin National Park: *Pinus ponderosa*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Dec-2010).

CLASSIFICATION

Status: Provisional

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association was sampled on north aspects above South Fork Big Wash and North Fork Big Wash on slopes and in canyon bottoms.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2008 and 2009 field data (4 plots): GRBA.311, GRBA.312, GRBA.450, GRBA.452.
Local Description Authors: M.E. Hall
References: Western Ecology Working Group n.d.

Pinus ponderosa / Interior Chaparral Woodland Alliance

Ponderosa Pine Interior Chaparral Woodland Alliance
Identifier: A2110

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Southern Rocky Mountain Ponderosa Pine Forest & Woodland (G228)
Alliance	***Pinus ponderosa* / Interior Chaparral Woodland Alliance (A2110)**

GRBA COMPONENT ASSOCIATIONS

Association	*Pinus ponderosa / Arctostaphylos patula* Woodland (CEGL000842)
	Pinus ponderosa - (Pinus longaeva) / Cercocarpus intricatus Woodland [Provisional] (CEGL005441)

OTHER CLASSIFICATIONS

Ecological System	Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648
GRBA Biophysical Setting (BpS)	Ponderosa Pine (1054)
NPS-VIP Map Unit	*Pinus ponderosa – (Pseudotsuga menziesii)* Woodland Complex (W_PPPM1)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland alliance is known from elevations ranging from 2177-2520 m (7140-8270 feet) on somewhat steep to steep slopes. Sites include rocky summits, ridges, toeslopes and midslopes on variable aspects. Soils are rapidly drained and composed of loamy sand.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by an extremely sparse to open canopy (5-20% cover) of *Pinus ponderosa* occasionally codominant with *Abies concolor*. The subcanopy is sparse and may include scattered individuals of *Juniperus scopulorum* and *Pinus monophylla*. The understory is characterized by a sparse to moderately dense (5-40% cover) shrub layer dominated by *Cercocarpus intricatus* or *Arctostaphylos patula*. Other shrubs may include *Ceanothus martinii, Ephedra viridis, Glossopetalon spinescens, Gutierrezia sarothrae, Mahonia repens*, and *Peraphyllum ramosissimum*. Herbaceous cover is extremely sparse with no apparent dominants and was never observed to exceed 5%.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*, *Pinus ponderosa*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Cercocarpus intricatus*
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos patula*

CHARACTERISTIC SPECIES

Great Basin National Park: *Cercocarpus intricatus*, *Pinus ponderosa, Cercocarpus intricatus, Arctostaphylos patula*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (4-Jan-2011).

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance was sampled from slopes above South Fork of Big Wash and on the trail to Dead Lake from Snake Creek drainage. Stands were also observed about 3 km northwest of Lexington Arch, although a recent fire had killed many of the ponderosa pines.
Global Range: This alliance occurs in Southern Rocky Mountains and in high plateaus and mountains in the Colorado Plateau and Great Basin.
Nations: US
States/Provinces: AZ, NM, NV, UT
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2009 field data (3 plots): GRBA.701, GRBA.741, GRBA.818.
Local Description Authors: M.E. Hall
References: Western Ecology Working Group n.d.

G226. Southern Rocky Mountain White Fir - Douglas-fir Dry Forest

Abies concolor - Pseudotsuga menziesii Dry Forest & Woodland Alliance

White Fir - Douglas-fir Dry Forest & Woodland Alliance
Identifier: A2100

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Southern Rocky Mountain White Fir - Douglas-fir Dry Forest (G226)
Alliance	***Abies concolor - Pseudotsuga menziesii* Dry Forest & Woodland Alliance (A2100)**

GRBA COMPONENT ASSOCIATIONS

Association	*Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest	(CEGL000431)
	Abies concolor / Arctostaphylos patula Forest	(CEGL000242)
	Abies concolor / Cercocarpus ledifolius Woodland	(CEGL000885)

OTHER CLASSIFICATIONS

Ecological System	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)
GRBA Biophysical Setting (BpS)	Mixed Conifer
NPS-VIP Map Unit	*Abies concolor - Pseudotsuga menziesii* Forest & Woodland Complex (W_ACPM)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is found at elevations ranging from 2331-2962 m (7650-9720 feet) on gentle to somewhat steep (2-43%) slopes with northwest-, east-, northeast-, and north-facing slopes. Sites are found on low slopes, midslopes, stream terraces and interfluves with rocky substrates including glacial deposits, colluvium, and bedrock. Soils include sandy and silty loam and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by an open (10-40%) canopy of *Abies concolor*. *Pinus flexilis, Picea engelmannii, Pinus ponderosa*, and *Pseudotsuga menziesii* are frequently scattered throughout stands but never codominate. *Populus tremuloides* may contribute substantial cover in some stands, and *Juniperus scopulorum* may occasionally form a subcanopy. The shrub layer is sparse to open (1-25% cover) with *Symphoricarpos oreophilus, Mahonia repens*, and *Arctostaphylos patula* the most common dominants. Other shrub associates may include *Juniperus communis, Gutierrezia sarothrae, Artemisia tridentata, Ribes cereum, Cercocarpus ledifolius*, and *Prunus virginiana*. Herbaceous cover is sparse to open (1-15%) with individual species rarely attaining more than 10% cover. Common species include *Pseudostellaria jamesiana, Carex rossii, Poa fendleriana, Penstemon watsonii, Trifolium gymnocarpon, Collinsia parviflora*, and *Erigeron jonesii*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Arctostaphylos patula*, *Mahonia repens*, *Symphoricarpos oreophilus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (3-Dec-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Osceola/Strawberry Crossing, Blue Canyon, Baker Creek, Dead Lake, Snake Creek and upper Mill Creek.
Global Range: This alliance occurs from Southern Rocky Mountains west into the high plateaus and mountains in the Colorado Plateau and Great Basin.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (12 plots): GRBA.049, GRBA.105, GRBA.107, GRBA.125, GRBA.149, GRBA.153, GRBA.158, GRBA.163, GRBA.715, GRBA.174, GRBA.451, GRBA.810.
Local Description Authors: M. Hall
Global Description Authors: K. A. Schulz
References: Faber-Langendoen et al. 2011

Populus tremuloides - Abies concolor / Arctostaphylos patula Forest

Quaking Aspen - White Fir / Greenleaf Manzanita Forest
Identifier: CEGL000522

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Forest (1.B.2.Nb)
Macrogroup	Southern Rocky Mountain Lower Montane Forest (M022)
Group	Southern Rocky Mountain White Fir - Douglas-fir Dry Forest (G226)

Alliance	*Abies concolor - Populus tremuloides* Dry Forest Alliance (A2111)
Association	***Populus tremuloides - Abies concolor / Arctostaphylos patula* Forest (CEGL000522)**

OTHER CLASSIFICATIONS

Ecological Systems:	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)
GRBA Biophysical Setting (BpS)	Aspen-Mixed Conifer (1061)
NPS-VIP Map Unit	*Abies concolor - Populus tremuloides* Forest Complex (F_ABPO)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This forest association is known from the Snake River Range in east-central Nevada and on the Markagunt Plateau in southwestern Utah. Stands occur from 2500 to 2900 m (8300-9500 feet) in elevation, on gentle to steep slopes, at all aspects. Soils are derived from quartz, silts and sandstones. The forest canopy is dominated by a combination of *Populus tremuloides* (15-50%) and *Abies concolor* (5-30%). The shrub layer consists of predominantely *Arctostaphylos patula*. Other shrubs that may be present include *Juniperus communis, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer contributes sparse cover and includes graminoids *Carex rossii* and *Bromus anomalus*. Forbs include *Achillea millefolium* and *Cirsium wheeleri*. *Populus tremuloides* and *Abies concolor* seedlings provide sparse cover.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is found at Great Basin at elevations from 2570-2990 m (8440-9800 feet) on gentle to somewhat steep slopes (8-44%) on all aspects. Sites include low, middle and upper slopes with substrates comprised mainly of colluvium. Soils include sandy loam, silty clay loam, and sandy clay loam. In some cases little to no soil is present. Soil surface has 40-80% litter/duff cover and up to 29% rock cover.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This community is characterized by an open to somewhat closed canopy codominated by *Populus tremuloides* and *Abies concolor* and other conifers with total canopy cover ranging from 15-75%. Both conifers and aspen have 25-75% relative tree canopy cover. Other canopy associates may include *Pseudotsuga menziesii, Pinus flexilis, Picea engelmannii*, and *Pinus longaeva*. The short-shrub layer varies from sparse to very dense (5-80% cover) with *Arctostaphylos patula* typically dominant. Regeneration of *Abies concolor* is common. Other short-shrub associates include *Amelanchier utahensis, Mahonia repens*, and *Symphoricarpos oreophilus*. If *Cercocarpus ledifolius* is present, then the understory is strongly dominated by *Arctostaphylos patula*. Herbaceous cover is typically low and ranges from 5-15%. Graminoids are the most consistent lifeforms and may include *Poa fendleriana, Carex rossii, Bromus carinatus (=Bromus marginatus), Elymus trachycaulus*, and *Pseudoroegneria spicata*. Forb cover is low and may include *Trifolium gymnocarpon, Achillea millefolium, Arabis holboellii, Pseudostellaria jamesiana*, and *Lupinus argenteus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos patula*
Herb (field)	Graminoid	*Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Arctostaphylos patula*, *Carex rossii*, *Poa fendleriana*, *Populus tremuloides*, *Symphoricarpos oreophilus*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (23-Feb-1994).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Great Basin National Park Comments: Some of these stands are seral *Abies concolor / Arctostaphylos patula* Forest (CEGL000242).
Global Similar Associations:

- *Populus tremuloides - Abies concolor / Symphoricarpos oreophilus* Forest (CEGL000523)

Global Related Concepts:

- *Populus tremuloides-Abies concolor/Arctostaphylos patula* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:I.B.2.b. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Baker Creek, Dead Lake Trail, Snake Creek, Wheeler Peak Overlook, and Lehman Creek.
Global Range: This forest association is known from the Snake River Range in east-central Nevada and on the Markagunt Plateau in southwestern Utah.
Nations: US
States/Provinces: NV:S4, UT
Federal Lands: NPS (Cedar Breaks, Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (8 plots): GRBA.124, GRBA.126, GRBA.148, GRBA.157, GRBA.164, GRBA.179, GRBA.185, GRBA.744.
Local Description Authors: M. Hall
Global Description Authors: G. Kittel
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Mueggler 1988, Western Ecology Working Group n.d.

1.B.2.Nc. Western North American Cool Temperate Woodland & Scrub

M026. Intermountain Singleleaf Pinyon - Western Juniper Woodland

G247. Great Basin Pinyon - Juniper Woodland

Pinus monophylla - Juniperus osteosperma / Artemisia nova Woodland

Singleleaf Pinyon - Utah Juniper / Black Sagebrush Woodland
Identifier: CEGL000831

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla - (Juniperus osteosperma)* / Shrub Understory Woodland Alliance (A2108)

Association ***Pinus monophylla - Juniperus osteosperma / Artemisia nova*** **Woodland (CEGL000831)**

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019) Black Sagebrush (1079an), Class D
NPS-VIP Map Unit	*Pinus monophylla - (Juniperus osteosperma) / Artemisia* spp. Woodland Complex (W_PJSG)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This woodland association occurs in the Great Basin. Elevations range from 1830-2030 m (6000-6650 feet). Stands occur on mesas, hills and rocky ridges. Aspects are variable with southeast and northeast reported. Slopes are gentle to moderate. The soils are variable but typically shallow, fine-textured and lithic. Clay loams are common, but soil texture ranges to clay. Litter from trees may cover up to half the ground surface. Pavement is often high with 30-40% cover. Cover of rock or bare ground may also be significant (to 25%). The vegetation is characterized by an open to dense tree canopy (10-80% cover) typically codominated by *Pinus monophylla* and *Juniperus osteosperma*. The short-shrub layer is sparse to moderately dense (10-25% cover) and is dominated by *Artemisia nova*. *Chrysothamnus viscidiflorus* and *Gutierrezia sarothrae* are frequent associates. Other associated shrubs may include low cover of *Ephedra nevadensis, Ericameria nauseosa, Grayia spinosa*, and trace *Quercus gambelii*. The sparse to moderately dense herbaceous layer is dominated by graminoids with scattered forbs. Associated graminoids include *Achnatherum hymenoides (= Oryzopsis hymenoides), Elymus elymoides, Hesperostipa comata, Achnatherum thurberianum, Poa secunda*, and *Pseudoroegneria spicata* ssp. *inermis*. Although forb cover is generally sparse, it may be very diverse. Common forbs include *Cryptantha cinerea var. jamesii (= Cryptantha jamesii), Eriogonum caespitosum, Gilia ochroleuca, Lomatium foeniculaceum* ssp. *macdougalii (= Lomatium macdougalii)*, and *Sphaeralcea coccinea*. Disturbed stands may have high cover of the introduced annual grass *Bromus tectorum* or *Halogeton glomeratus*, an introduced forb.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 1825-2195 m (5990-7200 feet) on gentle to steep slopes. Sites include low, high slopes, alluvial fan remnants, and ridges on all aspects. Parent materials are alluvium or colluvium derived from limestone or quartzite. Soils are composed of poorly drained to well-drained sandy loams, silt loams, sandy clay, loamy sand, or sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to open (10-50% cover) canopy dominated by *Pinus monophylla* and *Juniperus osteosperma*. No other canopy associates were observed. The understory is characterized by a sparse to open shrub layer dominated by *Artemisia nova*. Other common shrub species include *Cercocarpus intricatus, Chrysothamnus viscidiflorus, Ephedra nevadensis, Ephedra viridis, Opuntia erinacea, Purshia stansburiana*, and *Symphoricarpos longiflorus*. The herbaceous layer is absent, sparse or open. *Elymus elymoides* and *Poa fendleriana* are the most constant herbaceous species but were never observed to exceed10% cover. A variety of forbs are common and may include *Arabis holboellii, Chaenactis douglasii, Cryptantha confertiflora, Cryptantha humilis, Descurainia sophia, Eriogonum heracleoides, Pedicularis centranthera, Penstemon pachyphyllus, Stenotus acaulis*, and *Streptanthus cordatus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Herb (field)	Dwarf-shrub	*Artemisia nova*
Herb (field)	Graminoid	*Elymus elymoides*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia nova*, *Elymus elymoides*, *Juniperus osteosperma*, *Pinus monophylla*, *Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Descurainia sophia* (exotic/invasive, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (1-Feb-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Related Concepts:

- *Pinus - Juniperus - Artemisia* Association (Ostler et al. 2000) >
- *Pinus monophylla / Juniperus osteosperma / Artemisia nova / Agropyron inerme* Community (Blackburn et al. 1968c) =
- *Pinus monophylla / Juniperus osteosperma / Artemisia nova* Community (Blackburn et al. 1969c) =
- *Pinus monophylla / Juniperus osteosperma / Artemisia nova* Community (Blackburn et al. 1969d) =
- *Pinus monophylla-Juniperus osteosperma/Artemisia nova* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Swallow Canyon, Lexington Creek, Chokeberry Creek, Lincoln Canyon, near Snake Creek, near Mill Creek, Big Wash, and Pine Creek.
Global Range: This Great Basin woodland association is reported from Nevada, southwestern Utah, California, and southern Idaho.
Nations: US
States/Provinces: CA:S3, ID:S2S3, NV:S5, UT, WY
Federal Lands: NPS (Great Basin, Zion)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003field data (14 plots): GRBA.025, GRBA.034, GRBA.041, GRBA.043, GRBA.045, GRBA.046, GRBA.071, GRBA.079, GRBA.081, GRBA.121, GRBA.123, GRBA.173, GRBA.182, GRBA.266.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Blackburn et al. 1968c, Blackburn et al. 1969c, Blackburn et al. 1969d, Bourgeron and Engelking 1994, Bradley et al. 1992, Cogan et al. 2004, Driscoll et al. 1984, Ostler et al. 2000, Peterson 2008, Western Ecology Working Group n.d., Wright et al. 1979

Pinus monophylla - Juniperus osteosperma / Artemisia tridentata ssp. *vaseyana* - Mixed Shrub Woodland

Singleleaf Pinyon - Utah Juniper / Mountain Big Sagebrush - Mixed Shrub Woodland
Identifier: CEGL005436

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla - (Juniperus osteosperma) /* Shrub Understory Woodland Alliance (A2108)
Association	***Pinus monophylla - Juniperus osteosperma / Artemisia tridentata*** **ssp.** ***vaseyana*** **- Mixed Shrub Woodland**

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland **(**1019) Montane Sagebrush Steppe-upland (1126u), Class D
NPS-VIP Map Unit	*Pinus monophylla - (Juniperus osteosperma) /Artemisia* spp. Woodland Complex (W_PJSG)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 2157-2414 m (7080-7920 feet) on moderate to steep slopes. Sites include low to high slopes, ridges and summits on all aspects. Substrates are rocky and composed of colluvium, bedrock, and glacial deposits derived from granite and limestone.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to moderately dense (10-50% cover) canopy dominated by *Pinus monophylla* and *Juniperus osteosperma*. Occasionally, *Abies concolor* or *Cercocarpus ledifolius* may occur as canopy associates. The understory is characterized by sparse to moderately dense (5-50%) shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana*. In some stands *Amelanchier utahensis* or *Ephedra viridis* may codominate. Other common shrub associates include *Chrysothamnus viscidiflorus, Ericameria nauseosa, Eriogonum microthecum, Gutierrezia sarothrae, Holodiscus dumosus, Mahonia repens, Prunus virginiana, Purshia glandulosa*, and *Symphoricarpos oreophilus*. The herbaceous layer may be very sparse to moderately dense (up 50% cover), the most common dominants being *Poa fendleriana* and *Pseudoroegneria spicata*. The exotic *Bromus tectorum* has invaded many stands and may be the dominant herbaceous species. Forbs are of little importance and no species has high constancy.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Amelanchier utahensis*
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	Dwarf-shrub	*Ephedra viridis*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia tridentata* ssp. *vaseyana*, *Juniperus osteosperma*, *Pinus monophylla*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Dec-2010).

CLASSIFICATION

Status: Standard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Can Young Canyon, Pine Creek, Chokecherry Canyon, near Snake Creek, Baker Creek, Lexington Arch, Lexington Creek, Board Creek, and between Burnt Mill and Lehman canyons.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (12 plots): GRBA.031, GRBA.053, GRBA.080, GRBA.084, GRBA.086, GRBA.116, GRBA.134, GRBA.183, GRBA.239, GRBA.242, GRBA.115, GRBA.803.
Local Description Authors: M. Hall
References: Western Ecology Working Group n.d.

Pinus monophylla - Juniperus osteosperma / Artemisia tridentata Woodland

Singleleaf Pinyon - Utah Juniper / Big Sagebrush Woodland
Identifier: CEGL000832

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla - (Juniperus osteosperma) /* Shrub Understory Woodland Alliance (A2108)
Association	***Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Woodland (CEGL000832)**

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019) Montane Sagebrush Steppe-upland (1126u), Class D
NPS-VIP Map Unit	*Pinus monophylla - (Juniperus osteosperma) / Artemisia* spp. Woodland Complex (W_PJSG)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This woodland association occurs in the Great Basin. Elevations range from 1220-2300 m (4000-7550 feet). Stands occur on mesas, hills and rocky ridges on gentle to steep slopes on all aspects. The soils are shallow to moderately deep, calcareous, lithic loams or clays. The vegetation is characterized by an open to moderately dense tree canopy (10-40% cover) typically codominated by *Pinus monophylla* and *Juniperus osteosperma*. *Juniperus osteosperma* is often more abundant at lower elevation. The short-shrub layer is typically sparse (10-15% cover) and is dominated by *Artemisia tridentata*. *Chrysothamnus viscidiflorus* or *Purshia tridentata* are frequent associates. Other associated shrubs may include low cover of *Amelanchier* spp., *Ephedra nevadensis, Ephedra viridis, Ericameria nauseosa, Grayia spinosa*, and species of *Gutierrezia, Opuntia, Tetradymia*, and *Yucca*. The sparse to moderately dense herbaceous layer is dominated by graminoids with scattered forbs. Frequent graminoids are *Elymus elymoides* and *Poa secunda*. Although forb cover is generally sparse, it may be very

diverse. Frequent forbs include species of *Astragalus, Balsamorhiza, Machaeranthera, Eriogonum*, and *Phlox*. Disturbed stands may have high cover of the introduced annual grass *Bromus tectorum*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 1801-2139 m (5910-7020 feet) on gentle to steep slopes. Sites include channel beds, low to middle slopes and alluvial fan remnants on all aspects on substrates of colluvium, alluvium, and bedrock derived from granite, limestone and quartzite. Soils are composed of moderately well-drained to well-drained silt loam, sandy loam, loamy sand, and silty clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to open (10-45% cover) canopy dominated by *Pinus monophylla* and *Juniperus osteosperma*. The understory is characterized by a sparse to moderately dense (5-50%) shrub layer dominated by *Artemisia tridentata* ssp. *tridentata*. Other common shrub associates include *Artemisia nova, Ephedra nevadensis, Ephedra viridis, Gutierrezia sarothrae, Opuntia erinacea, Opuntia polyacantha, Peraphyllum ramosissimum, Purshia stansburiana*, and *Symphoricarpos longiflorus*. The herbaceous layer may be nearly absent or dominated by bunch grasses. Species include *Poa fendleriana, Elymus elymoides*, and *Achnatherum hymenoides*. A variety of forbs may be present and common species include *Allium nevadense, Balsamorhiza hookeri, Cryptantha humilis, Descurainia sophia, Erigeron argentatus, Lathyrus brachycalyx*, and *Packera multilobata*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *tridentata*,
Herb (field)	Graminoid	*Achnatherum hymenoides*, *Elymus elymoides*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia tridentata* ssp. *tridentata*, *Juniperus osteosperma*, *Pinus monophylla*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Descurainia sophia* (exotic/invasive, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (19-Sep-2000).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Related Concepts:

- *Pinus - Juniperus - Artemisia* Association (Ostler et al. 2000) >
- *Pinus monophylla - Juniperus osteosperma / Artemisia tridentata / Bromus tectorum* Community (Blackburn et al. 1969b) =

- *Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Community (Blackburn et al. 1968a) =
- *Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Community (Blackburn et al. 1969c) =
- *Pinus monophylla-Juniperus osteosperma/Artemisia tridentata* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Spring Creek, Swallow Canyon, Strawberry Creek, Lexington Creek Cave Canyon, Snake Creek, Kious Basin, and Cedar Spur.
Global Range: This Great Basin association is known from Nevada and Utah.
Nations: US
States/Provinces: AZ, NV:S5, UT
Federal Lands: NPS (Grand Canyon, Grand Canyon-Parashant, Great Basin, Zion)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (15 plots): GRBA.027, GRBA.029, GRBA.030, GRBA.035, GRBA.036, GRBA.048. GRBA.068, GRBA.070, GRBA.087, GRBA.096, GRBA.097, GRBA.120, GRBA.181, GRBA.260, GRBA.411.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Barney and Frischknecht 1974, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1969b, Blackburn et al. 1969c, Bourgeron and Engelking 1994, Bradley et al. 1992, Bunting 1987, Cogan et al. 2004, Driscoll et al. 1984, Everett 1987, Johnson and Payne 1968, Koniak 1985, Ostler et al. 2000, Peterson 2008, Western Ecology Working Group n.d., Wright et al. 1979

Pinus monophylla - (Juniperus osteosperma) / Cercocarpus intricatus Woodland

Singleleaf Pinyon - (Utah Juniper) / Littleleaf Mountain-mahogany Woodland
Identifier: CEGL005437

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla - (Juniperus osteosperma) /* Shrub Understory Woodland Alliance (A2108)
Association	***Pinus monophylla - (Juniperus osteosperma) / Cercocarpus intricatus* Woodland**

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019)
NPS-VIP Map Unit	*Pinus monophylla - (Juniperus osteosperma) /* Mixed Shrub Woodland Complex (W_PJMX)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 2026-2406 m (6650-7891 feet) on flat to steep slopes. Sites include channel beds, gullies, low to high slopes, and ridges on all aspects. Substrates include alluvium, bedrock and colluvium derived of limestone, granite, quartzite, and schist. Soils are well- to rapidly drained and composed of sandy clay loam, sandy loam, loamy sand, silty clay loam, and clay sand.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to moderately dense (10-65% cover) canopy codominated by *Pinus monophylla* and *Juniperus osteosperma*. The understory is characterized by sparse to open tall-shrub layer and subcanopy dominated by *Cercocarpus intricatus*. Other shrubs may be subdominant and include *Artemisia nova, Brickellia microphylla, Ephedra viridis, Glossopetalon spinescens, Peraphyllum ramosissimum*, and *Symphoricarpos longiflorus*. The herbaceous layer may be essentially absent or dominated by bunch grasses including *Poa fendleriana* and *Elymus elymoides*. Common forbs include *Arabis holboellii, Collinsia parviflora, Descurainia sophia, Eriogonum racemosum, Lathyrus brachycalyx, Petradoria pumila, Phlox longifolia*, and *Stephanomeria spinosa*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Short shrub/sapling	Broad-leaved evergreen shrub	*Cercocarpus intricatus*
Herb (field)	Graminoid	*Elymus elymoides*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Cercocarpus intricatus*, *Juniperus osteosperma*, *Pinus monophylla*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Descurainia sophia* (exotic/invasive, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Dec-2010).

CLASSIFICATION

Status: Standard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Chokecherry Canyon, Snake Creek granite quarry, Baker Creek, Everett Mine, Young Canyon, Upper Sage Creek, McGraff Canyon, and Lexington Creek.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (16 plots): GRBA.055, GRBA.077, GRBA.078, GRBA.129, GRBA.170, GRBA.171,
Local Description Authors: M.E. Hall
Global Description Authors:
References: Western Ecology Working Group n.d.

Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius Woodland

Singleleaf Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland
Identifier: CEGL000828

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla - (Juniperus osteosperma)* / Shrub Understory Woodland Alliance (A2108)
Association	***Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL000828)**

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019)
NPS-VIP Map Unit	*Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (W_PJCL)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This widespread woodland association is known from elevations ranging from 2057-2406 m (6746-7891 feet) on gentle to steep slopes. Sites are variable and range from gullies, low slopes, midslopes, high slopes and toeslopes on all aspects. Substrates include colluvium and alluvium derived from limestone, quartzite, granite and schist. Soils are somewhat well-drained to rapidly drained and composed of sandy loam, loamy sand, silt loam, silty clay, and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by an open to dense (15-55% cover) canopy dominated by *Pinus monophylla* or codominated by *Juniperus osteosperma*. No other canopy associates were documented. The understory is characterized by a subcanopy or shrub layer which may be sparse to somewhat dense ranging from 5-50% cover and dominated by *Cercocarpus ledifolius*. Numerous other shrubs occur and include *Amelanchier utahensis, Artemisia tridentata* ssp. *vaseyana, Chrysothamnus viscidiflorus, Ephedra viridis, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens, Opuntia erinacea, Opuntia polyacantha, Purshia glandulosa*, and *Symphoricarpos oreophilus*. The herbaceous layer is absent to open, not exceeding 25% cover, often without one species occurring as a clear dominant, although the graminoids *Poa fendleriana, Elymus elymoides*, and *Pseudoroegneria spicata* may contribute as much as 10% cover in some stands. Forbs are present at very low cover, the most frequent of which are *Arabis holboellii, Collinsia parviflora, Descurainia sophia, Lathyrus brachycalyx, Petradoria pumila, Phlox longifolia*, and *Stephanomeria spinosa*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Tree subcanopy	Broad-leaved evergreen tree	*Cercocarpus ledifolius*
Herb (field)	Graminoid	*Elymus elymoides*, *Poa fendleriana*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Cercocarpus ledifolius*, *Juniperus osteosperma*, *Pinus monophylla*, *Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (invasive/exotic, High), *Poa pratensis* (invasive/exotic, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Related Concepts:

- *Pinus monophylla/Cercocarpus ledifolius* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Chokecherry Canyon, Can Young Canyon, Upper Sage Creek, McGraff Canyon, Lexington Creek, Pole Canyon, and Baker Creek.
Nations: US
States/Provinces: NV:S5
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (10 plots): GRBA.075, GRBA.082, GRBA.089, GRBA.091, GRBA.180, GRBA.240, GRBA.241, GRBA.705, GRBA.714, GRBA.717.
Local Description Authors: M. Hall
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Heinze et al. 1962, Western Ecology Working Group n.d.

***Pinus monophylla - Juniperus osteosperma / Betula occidentalis - Rosa woodsii* Woodland [Park Special]**

Singleleaf Pinyon - Utah Juniper / Water Birch - Woods' Rose Woodland
Identifier: CEPS009607

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla – (Juniperus osteosperma)* Riparian Woodland Alliance (A2710)]
Association	***Pinus monophylla - Juniperus osteosperma / Betula occidentalis - Rosa woodsii* Woodland [Park Special] (CEPS009607)**

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019) Montane Riparian (1154)
NPS-VIP Map Unit	*Pinus monophylla - Juniperus osteosperma /* Mixed Riparan Shrub Woodland Complex (W_PJRP)
USFWS Wetland Classification	Palustrine

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 2109-2209 m (6920-7250 feet) on moderate and gentle slopes. Sites include temporarily flooded benches and stream terraces on southeast and east aspects. Soils are poorly to well-drained sandy loam or loamy sand.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a closed (50-65% cover) canopy dominated by *Pinus monophylla* and *Juniperus osteosperma*. Scattered *Populus tremuloides* may be present. The understory is characterized by a sparse to open shrub layer dominated by *Betula occidentalis, Rhus trilobata var. trilobata*, and *Rosa woodsii*. Other common shrub species include *Artemisia tridentata* ssp. *vaseyana, Gutierrezia sarothrae, Mahonia repens, Opuntia erinacea, Opuntia polyacantha*, and *Sambucus caerulea (= Sambucus nigra* ssp. *caerulea)*. The herbaceous layer is graminoid-dominated by *Juncus balticus, Pseudoroegneria spicata*, and *Leymus cinereus*. The only notable forbs are *Lithospermum ruderale* and *Lupinus argenteus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula occidentalis*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa woodsii*
Herb (field)	Graminoid	*Juncus balticus*, *Leymus cinereus*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Betula occidentalis*, *Juniperus osteosperma*, *Pinus monophylla*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Dec-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Lehman Creek and Strawberry Creek.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 field data (2 plots): GRBA.056, GRBA.095.
Local Description Authors: M. Hall
Global Description Authors:
References: Western Ecology Working Group n.d.

Pinus monophylla - (Juniperus osteosperma) / Herbaceous Understory Woodland Alliance

Singleleaf Pinyon - (Utah Juniper) / Herbaceous Understory Woodland Alliance
Identifier: A2109

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	***Pinus monophylla - (Juniperus osteosperma)* / Herbaceous Understory Woodland Alliance (A2109)**

GRBA COMPONENT ASSOCIATIONS

Association	*Pinus monophylla - Juniperus osteosperma / Poa (fendleriana, secunda)* Woodland (CEGL005440)

OTHER CLASSIFICATIONS

Ecological System	Great Basin Pinyon-Juniper Woodland (CES304.773)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019)
NVIP Map Unit	*Pinus monophylla - (Juniperus osteosperma) /* Herbaceous Understory Woodland Alliance (W_PJGR)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland alliance is known from elevations ranging from 2031-2135 m (6660-7000 feet) on gentle. Sites sampled include a step in lower slope and bench on high slope. Substrates are alluvium and colluvium derived of deltaic deposits and quartzite. Soils are composed of moderately well-to well drained drained sandy loams and sandy clay.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This needle-leaved woodland is characterized by an open to moderately dense canopy (20-45% cover) dominated by *Pinus monophylla* and *Juniperus osteosperma*. No other canopy associates were documented. Scattered shrubs may be present, but sparse and do not form a layer. However, some stands may have substantial regenerative *Pinus monophylla* and *Juniperus osteosperma*. The understory is characterized by an open to moderately dense herbaceous layer (15-35% cover) composed of a variety of graminoids and forbs. Characteristic graminoids include *Elymus elymoides, Poa fendleriana*, and *Poa secunda*. No forbs achieve high cover, but diversity may be quite high. Species include *Arabis holboellii, Astragalus lentiginosus, Atriplex rosea, Balsamorhiza hookeri, Cryptantha humilis, Descurainia californica, Descurainia sophia, Eriogonum* spp*., Frasera albomarginata, Packera multilobata, Pedicularis centranthera, Penstemon pachyphyllus, Petradoria pumila*, and *Streptanthus cordatus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*
Herb (field)	Graminoid	*Poa fendleriana*, *Poa secunda*

CHARACTERISTIC SPECIES

Great Basin National Park: *Juniperus osteosperma*, *Pinus monophylla*, *Poa fendleriana*, *Poa secunda*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Descurainia sophia* (exotic/invasive, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Jan-2011).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Baker Flat, Big Wash, Strawberry Creek, Can Young Canyon, Lower Snake Creek, Cottontail Creek, and Sage Creek.
Nations: US
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (10 plots): GRBA.003, GRBA.054,
Local Description Authors: M. Hall mod by K. A. Schulz
Global Description Authors:
References: Faber-Langendoen et al. 2011

Pinus monophylla - Juniperus osteosperma / Sparse Understory Woodland

Singleleaf Pinyon - Utah Juniper / Sparse Understory Woodland
Identifier: CEGL000829

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Great Basin Pinyon - Juniper Woodland (G247)
Alliance	*Pinus monophylla - (Juniperus osteosperma) /* Sparse Understory Woodland Alliance (A2709)
Association	***Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland (CEGL000829)**

OTHER CLASSIFICATIONS

Ecological Systems	Great Basin Pinyon-Juniper Woodland (CES304.773) Inter-Mountain Basins Cliff and Canyon (CES304.779)
GRBA Biophysical Setting (BpS)	Pinyon-Juniper Woodland (1019)
NPS-VIP Map Unit	*Pinus monophylla* – (*Juniperus osteosperma*) / Grass & Sparse Understory Woodland Complex (W_PJSP)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This widespread woodland association is known from the Great Basin and northern Mojave Desert. Elevations normally range from 1370-2314 m (4500-7589 feet). Stands occur on flat to moderately sloping sites on all aspects. The soils are variable, but typically shallow and lithic. Litter from trees often covers about half the ground surface. Cover of rock, pavement or bare ground may also be significant depending on the site. The vegetation is characterized by an open to moderately dense tree canopy (10-65% cover) dominated by *Pinus monophylla* without a significant understory. *Juniperus osteosperma* may be present to codominant. Shrub cover, if present, is sparse (<10% cover). *Artemisia tridentata, Purshia tridentata*, and *Chrysothamnus viscidiflorus* are most consistent. Other shrubs include *Amelanchier* spp., *Eriogonum microthecum, Cercocarpus montanus, Gutierrezia sarothrae,*

Purshia tridentata, Quercus gambelii, Quercus turbinella, and species of *Opuntia*. Herbaceous cover is typically sparse and dominated by perennial graminoids with scattered forbs.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This woodland association is known from elevations ranging from 1978-2314 m (6490-7589 feet) on moderate to steep slopes. Sites include low to high slopes, draws, floodplains and remnant alluvial fans on all aspects. Substrates are rocky with parent materials of colluvium and alluvium derived of granitic quartzite, granite and limestone. Soils are composed of well- to rapidly drained sandy loam, loamy sand, and sandy silt.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This woodland association is characterized by an open to moderately closed (10-65% cover) canopy dominated by *Pinus monophylla* and *Juniperus osteosperma*. No other canopy associates were observed. The shrub stratum is sparse to almost absent, although on some sites regenerative *Pinus monophylla* and *Juniperus osteosperma* may be present at high cover. Shrub species have low constancy, the most common of which include *Artemisia tridentata* ssp. *vaseyana, Ephedra viridis, Eriogonum microthecum, Gutierrezia sarothrae*, and *Opuntia erinacea*. The herbaceous layer is very sparse with graminoids contributing the most cover, but no one species exceeding 5% cover. Forb cover is very sparse, but diversity may be quite high. Species include *Arabis holboellii, Astragalus lentiginosus, Atriplex rosea, Balsamorhiza hookeri, Cryptantha humilis, Descurainia californica, Descurainia sophia, Frasera albomarginata, Packera multilobata, Pedicularis centranthera, Penstemon pachyphyllus, Petradoria pumila*, and *Streptanthus cordatus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus osteosperma*, *Pinus monophylla*

CHARACTERISTIC SPECIES

Great Basin National Park: *Juniperus osteosperma*, *Pinus monophylla*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Descurainia sophia* (exotic/invasive, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: This pinyon-juniper type may have several shrub species but all occur in small amounts usually totaling less than 10% cover.
Global Related Concepts:

- *Juniperus osteosperma / Pinus monophylla* Community (Blackburn et al. 1969d) =
- *Pinus monophylla - Juniperus osteosperma* Association (Peterson 1984) =
- *Pinus monophylla / Juniperus osteosperma* Dominated Community (Blackburn et al. 1968c) =
- *Pinus monophylla-Juniperus osteosperma* (Bourgeron and Engelking 1994) =
- *Pinus monophylla* Association (Peterson 1984) =
- DRISCOLL FORMATION CODE:II.A.2.a. (Driscoll et al. 1984) >

- Singleleaf pinyon-Utah juniper Series (Sawyer and Keeler-Wolf 1995) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Big Wash, Strawberry Creek, Can Young Canyon, Lower Snake Creek, Cottontail Creek, and Sage Creek.
Global Range: This woodland association occurs in the Great Basin and northern Mojave Desert.
Nations: US
States/Provinces: AZ, CA:S4, NV:S5, UT
Federal Lands: NPS (Grand Canyon, Grand Canyon-Parashant, Great Basin, Zion)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (8 plots): GRBA.054, GRBA.083,GRBA.093, GRBA.102, GRBA.172, GRBA.265, GRBA.732, GRBA.808.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Armstrong 1969, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1969e, Bourgeron and Engelking 1994, Bradley et al. 1992, Cogan et al. 2004, Driscoll et al. 1984, Heinze et al. 1962, Peterson 1984, Peterson 2008, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d., Wright et al. 1979

G249. Intermountain Basins Curl-leaf Mountain-mahogany Scrub & Woodland

Cercocarpus ledifolius Woodland Alliance

Curl-leaf Mountain-mahogany Woodland Alliance
Identifier: A0586

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Temperate Woodland & Scrub (1.B.2.Nc)
Macrogroup	Intermountain Singleleaf Pinyon - Western Juniper Woodland (M026)
Group	Intermountain Basins Curl-leaf Mountain-mahogany Scrub & Woodland (G249)
Alliance	***Cercocarpus ledifolius* Woodland Alliance (A0586)**

GRBA COMPONENT ASSOCIATIONS

Association	*Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Provisional] (CEGL005355)
	Cercocarpus ledifolius / Artemisia tridentata ssp. *vaseyana* Woodland (CEGL001022)
	Cercocarpus ledifolius / Pseudoroegneria spicata Scrub (CEGL000967)
	Cercocarpus ledifolius / Symphoricarpos oreophilus Woodland (CEGL000970)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland (CES304.772)
GRBA Biophysical Setting (BpS)	Mountain-Mahogany (1062)
NPS-VIP Map Unit	*Cercocarpus ledifolius* Shrubland & Woodland Complex (W_CELE)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: Plant associations in this alliance occur in semi-arid, mountainous habitats of the interior western United States. Annual precipitation averages 25-45 cm, with a significant proportion falling as winter snow. These woodlands often form small patchy stands on rocky

outcrops or escarpments in forested areas, or may form the only tree cover in steppe regions. Elevations where the alliance is found range from 600 m to over 2650 m. Soils are typically rocky and immature, and are always of coarser texture than soils of adjacent coniferous woodlands or forests. The vegetation in this alliance is characterized by an open canopy of *Cercocarpus ledifolius*. These woodlands may occur as scattered communities in arid steppe or on rocky outcrops or steep escarpments within forests. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis*, or *Pinus monophylla* occur in local areas. Evergreen or cold-deciduous shrubs often grow in these woodlands and include *Artemisia tridentata* ssp. *vaseyana, Purshia tridentata, Artemisia tridentata, Amelanchier alnifolia, Holodiscus dumosus, Ericameria nauseosa (= Chrysothamnus nauseosus), Ribes* spp., *Prunus virginiana*, and *Symphoricarpos* spp. The understory is typically dominated by bunch grasses, including *Festuca idahoensis, Leymus ambiguus, Pseudoroegneria spicata, Elymus elymoides, Calamagrostis rubescens*, and *Achnatherum* spp. Adjacent vegetation is usually *Pinus ponderosa* forest, *Artemisia* shrubland, or *Festuca - Achnatherum* grassland.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from 2456-3044 m (8060-9990 feet) in elevation on gentle to steep slopes. Sites include low, middle and high slopes on all aspects often on talus and colluvium derived from quartzite. Soils are sand, loamy sand, sandy clay loam and silt loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This woodland alliance is characterized by a sparse to almost completely closed canopy dominated by *Cercocarpus ledifolius*. Scattered *Abies concolor, Pinus monophylla, Pinus flexilis*, and *Populus tremuloides* are common in the canopy and subcanopy. The understory of this alliance is typically shrub-dominated and varies from sparse to dense (5-70% cover) and, less commonly, graminoid and dominated by *Festuca idahoensis* or *Pseudoroegneria spicata*. Shrub dominants include *Arctostaphylos patula, Artemisia tridentata* ssp. *vaseyana*, and *Symphoricarpos oreophilus*. Other shrub associates include *Amelanchier utahensis, Artemisia nova, Chrysothamnus viscidiflorus, Eriogonum microthecum, Gutierrezia sarothrae, Holodiscus dumosus, Mahonia repens, Opuntia polyacantha, Prunus virginiana*, and *Sambucus caerulea (= Sambucus nigra* ssp. *caerulea)*. Herbaceous cover varies from absent to open, and diversity can be quite high. Common graminoids include *Elymus trachycaulus, Hesperostipa comata, Poa fendleriana, Poa secunda*, and *Pseudoroegneria spicata*. Common forbs include *Balsamorhiza sagittata, Collinsia parviflora, Comandra umbellata, Descurainia californica, Descurainia sophia, Erigeron jonesii, Eriogonum umbellatum, Fritillaria atropurpurea, Hackelia patens, Lithospermum ruderale, Machaeranthera canescens, Packera multilobata, Pseudostellaria jamesiana*, and *Viola purpurea*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Broad-leaved evergreen tree	*Cercocarpus ledifolius*

CHARACTERISTIC SPECIES

Great Basin National Park: *Arctostaphylos patula*, *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus ledifolius*, *Festuca idahoensis*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CLASSIFICATION

Global Comments: The *Cercocarpus ledifolius* woodland and shrubland alliances are poorly distinguished in the literature, as most authors describe the species as having either a tall-shrub or small-tree growth form within a single association. Some associations may have shrub-dominated stands in one area and also have a woodland physiognomy in another. The woodland physiognomy appears to be more typical, based on available literature. Near the northern edge of its range in Montana and Idaho, *Cercocarpus ledifolius* is described as occurring primarily in the shrub form (Mueggler and Stewart 1980, Tisdale 1986). These northern variants are the only described stands which appear to be clearly distinct from the woodland alliance.

The woodland stands may have a different subspecies (or variety) as a dominant than the shrubland. In Wyoming, the heritage program is proposing to recognize two *Cercocarpus ledifolius* alliances, based upon varieties of *Cercocarpus ledifolius*. The most widespread proposed alliance (in Wyoming) is dominated by *Cercocarpus ledifolius var. ledifolius*, which grows up to about 1.5 m tall. The other proposed alliance, dominated by *Cercocarpus ledifolius var. intercedens*, is found only along the western border of the state, and the growth form is as small trees 4-5 m tall. The two taxa are obviously different in Wyoming, in stature and leaf characteristics, and are easily separated. Further review of the two current *Cercocarpus ledifolius* alliances may warrant treatment as proposed for Wyoming.

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Snake Meadows, Snake Creek divide, Baker Creek, below Wheeler Peak, Mather Creek and Lehman Creek.
Global Range: This alliance occurs in the northern Great Basin, from northeastern California north across Nevada, into southeastern Oregon, southern Idaho, western Montana, and southern Utah. It has not been reported from Wyoming or Colorado, or further south in the western U.S., but may occur there.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Bryce Canyon, Capitol Reef, Cedar Breaks, Dinosaur, Grand Canyon, Great Basin, John Day Fossil Beds, Yosemite)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (19 plots): GRBA.004, GRBA.514, GRBA.052, GRBA.103, GRBA.136, GRBA.137, GRBA.142, GRBA.150, GRBA.151, GRBA.187, GRBA.188, GRBA.244, GRBA.245, GRBA.509, GRBA.704, GRBA.708, GRBA.720, GRBA.729, GRBA.805.
Local Description Authors: M. Hall
Global Description Authors: M.S. Reid/D. Sarr
References: Beatley 1976, Blackburn et al. 1969d, Cooper et al. 1995, DeVelice 1992, Dealy 1975, Faber-Langendoen et al. 2011, Gruell et al. 1985, Hall 1973, Heinze et al. 1962, Moseley 1987b, Mozingo 1987, Mueggler and Stewart 1980, Sawyer and Keeler-Wolf 1995, Tisdale 1986

1.B.3. Temperate Swamp & Flooded Forest

1.B.3.Nc. Western North American Flooded & Swamp Forest

M034. Rocky Mountain & Great Basin Flooded & Swamp Forest

G506. Rocky Mountain & Great Basin Montane Riparian Forest

Abies concolor Riparian Forest & Woodland Alliance

White Fir Riparian Forest & Woodland Alliance
Identifier: A2707

REVISED USNVC CLASSIFICATION

Division	Western North American Flooded & Swamp Forest (1.B.3.Nc)
Macrogroup	Rocky Mountain & Great Basin Flooded & Swamp Forest (M034)
Group	Rocky Mountain & Great Basin Montane Riparian Forest (G506)
Alliance	***Abies concolor* Riparian Forest & Woodland Alliance (A2707)**

GRBA COMPONENT ASSOCIATIONS

Association	*Abies concolor - (Populus tremuloides) / Salix boothii / Carex scopulorum* Forest (CEGL005418)
	Abies concolor - Populus tremuloides / Carex scopulorum Forest (CEGL005419)
	Populus tremuloides - Abies concolor / Mesic Graminoid Forest [Park Special] (CEPS009586)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)
GRBA Biophysical Setting (BpS)	Montane Riparian (1154)
NPS-VIP Map Unit	*Abies concolor* Riparian Forest & Woodland Alliance (W_ACRIP)
USFWS Wetland Classification	Palustrine

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This palustrine alliance is known from 2307-2529 m (7571-8300 feet) elevation on moderate slopes. Positions include seasonally or intermittently flooded stream terraces along valleys on north and northeast aspects. Substrates include fluvial deposits of well-drained sandy or silt loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This forest and woodland alliance is characterized by a sparse to open (10-50%) canopy dominated by *Abies concolor* or codominated by *Populus tremuloides*. *Juniperus scopulorum* and *Pseudotsuga menziesii* may occasionally contribute up to 10% cover. In most stands the understory is characterized by an open (10-25% cover) tall-shrub layer dominated by *Salix boothii*. Other shrub associates may include *Betula occidentalis, Mahonia repens, Prunus virginiana, Rosa woodsii, Salix bebbiana*, and *Symphoricarpos oreophilus*. All stands with or without shrubby understories have an open to dense (10-60%) graminoid herbaceous layer dominated by *Carex scopulorum* or *Bromus carinatus*. Other graminoids may include *Juncus balticus, Carex nebrascensis*, *Carex vallicola*, and *Glyceria striata*. The exotic *Poa pratensis* is present in all sampled stands at low cover. A variety of forbs may be present at low cover and can include *Achillea millefolium, Aconitum columbianum, Angelica kingii, Arnica cordifolia, Cardamine cordifolia, Cicuta maculata, Geum macrophyllum, Mertensia franciscana, Osmorhiza occidentalis, Pseudostellaria jamesiana, Thermopsis rhombifolia, Trifolium repens, Urtica dioica*, and *Vicia americana*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Salix boothii*
Herb (field)	Graminoid	*Carex scopulorum*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Carex scopulorum*, *Populus tremuloides*, *Salix boothii*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Dactylis glomerata* (exotic/invasive, Medium/Insignificant), *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Lehman Creek and Mill Creek.
Global Range: This alliance is known from the Southern Rocky Mountains west into the high plateaus and mountains in the Colorado Plateau and Great Basin.
Nations: US
States/Provinces: AZ, NM, NV, UT
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (5 plots): GRBA.609, GRBA.610, GRBA.613, GRBA.620, GRBA.621.
Local Description Authors: M.E. Hall
Global Description Authors: K. A. Schulz
References: Western Ecology Working Group n.d.

Picea engelmannii Riparian Forest & Woodland Alliance

Engelmann Spruce Riparian Forest & Woodland Alliance
Identifier: A2105

REVISED USNVC CLASSIFICATION

Division	Western North American Flooded & Swamp Forest (1.C.3.Nc)
Macrogroup	Rocky Mountain & Great Basin Flooded & Swamp Forest (M034)
Group	Rocky Mountain & Great Basin Montane Riparian Forest (G506)
Alliance	***Picea engelmannii* Riparian Forest & Woodland Alliance (2105)**

GRBA COMPONENT ASSOCIATIONS

Association	*Picea engelmannii - Populus tremuloides /* Mesic Forb Forest [Park Special] (CEPS009587)
	Picea engelmannii / Carex scopulorum Woodland (CEGL005446)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)
GRBA Biophysical Setting (BpS)	Subalpine-Upper Riparian (1160)
NPS-VIP Map Unit	*Picea engelmannii* Riparian Forest & Woodland Alliance (F_PIEN2)
USFWS Wetland Classification	Palustrine

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This palustrine alliance occurs at elevations from 2610-2938 m (8460-9636 feet) on moderate to somewhat steep slopes (12-30% grades). Sites

include channel walls, stream terraces, seeps, and basin floors on all aspects. Some stands occupy upland areas that would otherwise support mesophytic vegetation, but soil conditions are saturated as a result of their proximity to seeps and springs. Soils are saturated, poorly drained, somewhat poorly drained and moderately well-drained and composed of clay loam, silt loam and sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by a sparse to dense canopy dominated by short to medium-statured *Picea engelmannii* or codominated by *Populus tremuloides*. *Abies concolor, Pseudotsuga menziesii*, and *Pinus flexilis* may be present at lower cover but never codominate. Understories are herb-dominated with a sparse or absent shrub stratum. *Mahonia repens, Symphoricarpos oreophilus, Juniperus communis, Ribes montigenum*, and *Salix boothii* may be present but at low covers. The herbaceous layer may be sparse to very dense (up to 85% cover) and characterized by graminoids or mesic forbs. In graminoid-dominated communities, *Carex scopulorum* is dominant and forms open to dense stands (30-60% cover). Forb-dominated communities are diverse and variable. Species may include *Achillea millefolium, Angelica kingii, Aquilegia formosa, Arnica cordifolia, Corallorhiza maculata, Dodecatheon alpinum, Epilobium ciliatum, Mimulus guttatus, Osmorhiza depauperata, Osmorhiza occidentalis, Phleum alpinum, Platanthera dilatata var. leucostachys (= Platanthera leucostachys), Pseudostellaria jamesiana, Pyrola minor, Saxifraga odontoloma, Stellaria calycantha, Symphyotrichum foliaceum var. apricum, Taraxacum officinale, Trifolium gymnocarpon*, and *Trifolium repens*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Picea engelmannii*
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Herb (field)	Graminoid	*Carex scopulorum*

CHARACTERISTIC SPECIES

Great Basin National Park: *Angelica kingii*, *Aquilegia formosa*, *Carex scopulorum*, *Picea engelmannii*, *Populus tremuloides*, *Saxifraga odontoloma*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Taraxacum officinale* (exotic/invasive)

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Baker Creek, Pine Creek, Ridge Creek, Snake Creek and Lehman Creek.

Great Basin National Park Range: This subalpine riparian forest alliance is known from the Rocky Mountains west into the high plateaus and mountain ranges in the Colorado Plateau and Great Basin.

Nations: US

States/Provinces: AZ, CO, ID, MT, NM, OR, NV, WY

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (7 plots): GRBA.135, GRBA.605, GRBA.606, GRBA.607, GRBA.155, GRBA.709, GRBA.750.

Local Description Authors: M. Hall

Global Description Authors: K. A. Schulz

References: Faber-Langendoen et al. 2011

Populus angustifolia Riparian Forest & Woodland Alliance

Narrowleaf Cottonwood Riparian Forest & Woodland Alliance
Identifier: A0641

REVISED USNVC CLASSIFICATION

Division	Western North American Flooded & Swamp Forest (1.C.3.Nc)
Macrogroup	Rocky Mountain & Great Basin Flooded & Swamp Forest (M034)
Group	Rocky Mountain & Great Basin Montane Riparian Forest (G506)
Alliance	***Populus angustifolia* Riparian Forest & Woodland Alliance (A0641)**

GRBA COMPONENT ASSOCIATIONS

Association	*Populus angustifolia / Artemisia tridentata* ssp. *tridentata* - *Prunus virginiana* Woodland [Park Special] (CEPS009614)
	Populus angustifolia / Cornus sericea WoodlandCEGL002664)
	Populus angustifolia / Prunus virginiana Woodland (CEGL000651)
	Populus angustifolia / Rosa woodsii Forest (CEGL000653)

OTHER CLASSIFICATIONS

Ecological Systems	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045)
	Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
GRBA Biophysical Setting (BpS)	Montane Riparian System (1154)
NPS-VIP Map Unit	*Populus angustifolia* Riparian Forest & Woodland Alliance (F_POAN)
USFWS Wetland Classification	Palustrine

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This riparian forest and woodland alliance is known from elevations ranging from 2084-2353 m (6835-7720 feet). Sites include gentle to moderately sloping channel beds and stream terraces which are seasonally or intermittently flooded. Substrates include fluvium and alluvium composed of moderately poorly drained to well-drained loam and sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by a short-statured open to somewhat closed canopy dominated by *Populus angustifolia*. Other tree species present at lower cover may include *Abies concolor, Juniperus scopulorum*, and *Pinus monophylla*. *Cornus sericea* forms a subcanopy in some stands. Understories are mainly sparsely to moderately densely shrub-dominated by *Artemisia tridentata* ssp. *tridentata, Prunus virginiana, Rosa woodsii*, and *Betula occidentalis*. Other shrub associates include *Symphoricarpos oreophilus, Acer glabrum, Chrysothamnus viscidiflorus, Ericameria nauseosa, Peraphyllum ramosissimum*, and *Rhus trilobata*. Herbaceous cover is sparse to dense, ranging from 5-60% cover, but few species have high constancy. Species may include *Maianthemum stellatum, Achillea millefolium, Ambrosia psilostachya, Aquilegia formosa, Artemisia ludoviciana, Leymus cinereus, Lupinus argenteus, Penstemon eatonii*, and *Thalictrum fendleri*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus angustifolia*
Tree subcanopy	Broad-leaved deciduous tree	*Cornus sericea*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula occidentalis*, *Prunus virginiana*

Tall shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *tridentata*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa woodsii*

CHARACTERISTIC SPECIES

Great Basin National Park: *Betula occidentalis*, *Cornus sericea*, *Populus angustifolia*, *Rosa woodsii*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

ELEMENT DISTRIBUTION

Great Basin National Park Range: This riparian alliance was sampled along Snake Creek, South Fork Big Wash, and North Fork Big Wash drainages.
Great Basin National Park Range: This foothill to montane riparian forest alliance is known from the Rocky Mountains west into the high plateaus and mountain ranges in the Colorado Plateau and Great Basin.
Nations: US
States/Provinces: AZ, CO, ID, MT, NM, OR, NV, WY
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (6 plots): GRBA.139, GRBA.140, GRBA.406, GRBA.414, GRBA.416, GRBA.747.
Local Description Authors: M.E. Hall
Global Description Authors:
References: Western Ecology Working Group n.d.

Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance

Rocky Mountain Quaking Aspen Riparian Forest & Woodland Alliance
Identifier: A2106

REVISED USNVC CLASSIFICATION

Division	Western North American Flooded & Swamp Forest (1.B.3.Nc)
Macrogroup	Rocky Mountain & Great Basin Flooded & Swamp Forest (M034)
Group	Rocky Mountain & Great Basin Montane Riparian Forest (G506)
Alliance	**Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance (A2106)**

GRBA COMPONENT ASSOCIATIONS

Association	*Populus tremuloides / Betula occidentalis* Forest (CEGL002650)
	Populus tremuloides / Prunus virginiana - Symphoricarpos oreophilus Forest [Park Special] (CEPS009645)
	Populus tremuloides / Rosa woodsii Forest (CEGL003149)

OTHER CLASSIFICATIONS

Ecological Systems	Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)
	Rocky Mountain Aspen Forest and Woodland (CES306.813)
GRBA Biophysical Setting (BpS)	Aspen Forest and Woodland (1011)
	Montane Riparian System (1154)
	Subalpine-Upper Riparian (1160)
NPS-VIP Map Unit	Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance (F_POTR2)
USFWS Wetland Classification	Palustrine

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This palustrine alliance is occurs at elevations between 2084 and 2297 m (6835-7538 feet) on gentle to moderately sloping channel beds, stream terraces, and benches on all aspects. Sites are seasonally or intermittently flooded or saturated; standing water is often present. Surficial geology is composed of alluvium and fluvium. Soils vary from well-drained to poorly drained and are composed of sandy loam, loamy sand and loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This forest and woodland alliance is characterized by a sparse to dense canopy (10-90% cover) dominated by *Populus tremuloides*. *Abies concolor* is constant in most stands but never codominant. Other canopy associates may include *Pinus monophylla, Juniperus scopulorum*, and *Picea engelmannii* at low covers. Understories tend to be shrub-dominated by *Betula occidentalis, Prunus virginiana*, or *Rosa woodsii* and range from sparse to open cover. Other shrub associates may include *Amelanchier utahensis, Artemisia tridentata, Chrysothamnus viscidiflorus, Mahonia repens, Salix boothii, Salix exigua*, and *Symphoricarpos oreophilus*. Herbaceous cover ranges from open to dense (15-80% cover) and a variety of species may occur, but the exotic graminoid *Poa pratensis* is dominant, ranging from 10-40% cover, with no other species attaining high cover. Other frequently occurring species include *Achillea millefolium, Allium bisceptrum, Aquilegia formosa, Cardamine breweri, Glyceria striata, Juncus balticus, Ligusticum porteri, Lupinus argenteus, Maianthemum stellatum, Mertensia franciscana, Rumex crispus, Stellaria longipes, Thalictrum fendleri, Thermopsis rhombifolia, Trifolium repens*, and *Viola nephrophylla*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula occidentalis*
Short shrub/sapling	Broad-leaved deciduous shrub	*Prunus virginiana*, *Rosa woodsii*
Herb (field)	Graminoid	*Poa pratensis*

CHARACTERISTIC SPECIES

Great Basin National Park: *Betula occidentalis*, *Populus tremuloides*, *Prunus virginiana*, *Rosa woodsii*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Snake Creek Trail, Shingle Canyon, Lions Meadow, Wheeler Peak Campground, Horse Heaven, Big Springs Wash and Decathon Canyon.

Global Range: This subalpine riparian forest alliance is known from the Rocky Mountains west into the high plateaus and mountain ranges in the Colorado Plateau and Great Basin.

Nations: US

States/Provinces: AZ, CO, ID, MT, NM, OR, NV, WY

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (6 plots): GRBA.101, GRBA.402, GRBA.600, GRBA.601, GRBA.602, GRBA.615.
Local Description Authors: M. Hall
Global Description Authors:
References: Faber-Langendoen et al. 2011

2. Shrubland & Grassland

2.B.2. Temperate Grassland, Meadow & Shrubland

2.B.2.Na. Western North American Grassland & Shrubland

M168. Rocky Mountain-Vancouverian Subalpine & High Montane Mesic Grass & Forb Meadow

Rocky Mountain Subalpine-Montane Mesic Herbaceous Meadow

Festuca viridula - Deschampsia caespitosa - Ligusticum spp. Rocky Mountain-Vancouverian Meadow Group

Greenleaf Fescue - Tufted Hairgrass - Wild Lovage species Rocky Mountain-Vancouverian Meadow Group
Identifier: G271

REVISED USNVC CLASSIFICATION

Division	Western North American Grassland & Shrubland (2.B.1.Na)
Macrogroup	Rocky Mountain-Vancouverian Subalpine & High Montane Mesic Grass & Forb Meadow (M168)
Group	**Rocky Mountain Subalpine-Montane Mesic Herbaceous Meadow (G271)**
Group (Scientific)	***Festuca viridula - Deschampsia caespitosa - Ligusticum* spp. Rocky Mountain-Vancouverian Meadow Group (G271)**

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	*Dasiphora fruticosa* ssp. *floribunda* Shrub Herbaceous Alliance (A1534)
Association	*Dasiphora fruticosa* ssp. *floribunda / Elymus trachycaulus* Shrub Herbaceous Vegetation [Park Special] (CEPS009601)
Alliance	*Elymus trachycaulis* Herbaceous Alliance (A2706)
Association	*Elymus trachycaulis* Herbaceous Vegetation (CEGL005427)
Alliance	*Juncus nevadensis* Herbaceous Alliance [Provisional] (A2037)
Association	*Juncus nevadensis - Poa secunda* Herbaceous Vegetation [Park Special] (CEPS009603)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)
GRBA Biophysical Setting (BpS)	Wet Meadow (1145)
NPS-VIP Map Unit	Montane Mesic Meadow Complex (H_MESC)
USFWS Wetland Classification	Palustrine

ELEMENT CONCEPT

Global Summary: This Rocky Mountain and northern Vancouverian group is restricted to sites from lower montane to subalpine where finely textured soils, snow deposition, rocky substrates, or windswept dry conditions limit tree establishment. Many occurrences are small-patch in spatial character, and are often found in mosaics with woodlands, more dense shrublands, or just below alpine communities. This group is typically found above 2000 m in elevation in the southern part of its range and above 600 m in the northern part. These upland communities occur on gentle to moderate-gradient slopes and relatively moist habitats. The soils are typically

seasonally moist to saturated in the spring but, if so, will dry out later in the growing season. These sites are not as wet as those found in Vancouverian & Rocky Mountain Alpine Snowbed, Wet Meadow & Dwarf-Shrubland Group (G520) and Vancouverian & Rocky Mountain Montane Wet Meadow Group (G521), although some species are certainly shared with wet meadows, such as *Deschampsia*. These are typically lush meadows dominated by a diversity of tall forbs, with grasses intermingled in many of them. The vegetation is typically forb-rich, with forbs often contributing more to overall herbaceous cover than graminoids. However, some stands are comprised of dense grasslands, these often being taxa with relatively broad and soft blades, but where the moist habitat promotes a rich forb component. Important taxa include *Erigeron* spp., many Asteraceae spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Phlox* spp., *Lomatium* spp., *Thalictrum occidentale, Valeriana sitchensis, Rudbeckia occidentalis, Xerophyllum tenax, Balsamorhiza sagittata*, and *Wyethia* spp. Important grasses include *Deschampsia caespitosa, Koeleria macrantha*, perennial *Bromus* spp., *Luzula glabrata*, and a number of *Carex* species. In the Cascades, this group includes *Festuca viridula* meadows. *Dasiphora fruticosa* ssp. *floribunda* and *Symphoricarpos* spp. are occasional but not abundant. Burrowing mammals can increase the forb diversity.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This ecological group is known from elevations ranging from 2694-2929 m (8836-9607 feet) on gentle slopes. Sites include seasonally or temporarily flooded basin floors in mountain valleys and occasionally in seepage areas on midslopes. Soils are moderately well-drained to well-drained and composed of sandy loam, loam, clay loam, and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This ecological group is characterized by mixed herbaceous and perennial graminoid vegetation. Total herbaceous cover is moderately dense to dense (50-90 %). The two dominant graminoids are *Elymus trachycaulus* and *Juncus nevadensis*. Dominant forbs include *Achillea millefolium, Dodecatheon alpinum, Elymus trachycaulus, Lewisia pygmaea, Polygonum bistortoides, Ranunculus alismifolius*, and *Trifolium longipes*. Some stands are heavily invaded by *Taraxacum officinale*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Elymus trachycaulus*, *Juncus nevadensis*

CHARACTERISTIC SPECIES

Great Basin National Park: *Achillea millefolium*, *Elymus trachycaulus*, *Juncus nevadensis*, *Lewisia pygmaea*, *Polygonum bistortoides*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Taraxacum officinale* (exotic/invasive)

CLASSIFICATION

Global Comments: For now, this group is kept as a separate unit, but it probably should be merged with the Middle-Southern Rocky Mountain Subalpine-Montane Mesic Herbaceous Meadow Group (G269). The Rockies and Cascades support a number of forb types found on talus and rocky scree slopes, which are not sparsely vegetated, and which often have little to no grass component, though Carices may be abundant. These types often have heavy snow loading in winter, or are adjacent to snowfields, and subsurface moisture below the rocks/scree is

significant throughout the growing season. These forb types are poorly documented; for now they are placed in this group, as many of the taxa are also found in mesic grassy meadows. Splitting them into a separate group would be hard to justify floristically.

Global Related Concepts:

- Idaho Fescue - Tufted Hairgrass (308) (Shiflet 1994) ><
- Tall Forb (409) (Shiflet 1994) ><
- Tufted Hairgrass - Sedge (313) (Shiflet 1994) ><

ELEMENT DISTRIBUTION

Great Basin National Park Range: This group is known from Chinese Wall, the Glacier Trail and Pyramid Peak.

Global Range: This group is very widespread in the Rocky Mountain cordillera from New Mexico (where it is uncommon) and Colorado north into Canada, and west into the eastern Cascades. It also occurs in the mountain ranges of Nevada, northern Utah and Wyoming, as well as the "island ranges" of central Montana.

Nations: CA, US

States/Provinces: AB, BC, CO, ID, MT, NM, NV, OR, WA, WY

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (5 plots): GRBA.112, GRBA.128, GRBA.734, GRBA.736, GRBA.740.

Local Description Authors: M. Hall

Global Description Authors: M.S. Reid and T. Luna

References: Buckner 1977, Ellison 1954, Fritz 1981, Gregory 1983, Hall 1971, Marr 1977a, Meidinger and Pojar 1991, Potkin and Munn 1989, Shiflet 1994, Starr 1974, Western Ecology Working Group n.d.

M049. Southern Rocky Mountain Montane Grassland & Shrubland

G276. Southern Rocky Mountain Cercocarpus-Mixed [Dry] Foothill Shrubland Group

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Cercocarpus intricatus - Glossopetalon spinescens Shrubland

Littleleaf Mountain-mahogany - Spiny Greasebush Shrubland

Identifier: CEGL005426

REVISED USNVC CLASSIFICATION

Division	Western North American Grassland & Shrubland (2.C.1.Na)
Macrogroup	Southern Rocky Mountain Montane Grassland & Shrubland (M049)
Group	Southern Rocky Mountain Cercocarpus-Mixed [Dry] Foothill Shrubland (G276)
Alliance	*Cercocarpus intricatus* Shrubland Alliance (A2659)
Association	**Cercocarpus intricatus - Glossopetalon spinescens Shrubland (CEGL005426)**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Cliff and Canyon (CES304.779)
GRBA Biophysical Setting (BpS)	Antelope Bitterbrush (1144) Montain Shrub (1126ms)
NPS-VIP Map Unit	*Cercocarpus intricatus* – (*Peraphyllum ramosissimum*) Shrubland Complex (S_CIPR)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association occurs at elevations from 2036-2231 m (6680-7320 feet) on moderate to steep slopes. Sites include ridges, sloped benches on midslopes and high slopes on warmer east to southwest aspects. Substrates are rocky with 28 to 76% total rock (small and large rock and bedrock) and composed colluvium and bedrock derived from limestone. Soils are well- to rapidly drained and composed of silt loam, sandy loam, and sandy clay loam. Ground cover was sparse with bare soil ranging from 15-67% cover and of litter was low (<24% cover).

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This shrubland association is characterized by an open to moderately dense (20-50% cover) short shrub layer (0.5-2 m tall) that is codominated by *Cercocarpus intricatus* and *Glossopetalon spinescens*. Scattered *Pinus monophylla* or *Juniperus osteosperma* trees may be present but do not form a canopy (<5% cover). Serveral other shrubs are usually present with lower cover such as especially *Ephedra viridis, Symphoricarpos oreophilus, Chrysothamnus viscidiflorus,* and *Gutierrezia sarothrae* with *Peraphyllum ramosissimum, Artemisia arbuscula* and *Purshia stansburiana* less common. The herbaceous layer is usually sparse (<10% cover) with scattered forbs and grasses especially *Brickellia microphylla, Carex rossii, Castilleja* spp.,
Elymus elymoides, Erigeron spp*., Hymenopappus filifolius, Phlox* spp., *Poa fendleriana*and *Stenotus acaulis.*

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Cercocarpus intricatus, Glossopetalon spinescens Symphoricarpos oreophilus*
Herb (field)	Graminoid	*Carex rossii, Poa fendleriana*
Herb (field)	Forb	*Castilleja* spp*., Erigeron* spp*., Hymenopappus filifolius, Phlox* spp*., Stenotus acaulis*

CHARACTERISTIC SPECIES

Great Basin National Park: *Cercocarpus intricatus, Glossopetalon spinescens*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Dec-2010).

CLASSIFICATION

Status: Standard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Big Wash area, Shingle Canyon and Lehman Creek.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (5 plots): GRBA.130, GRBA.234, GRBA.235, GRBA.236, GRBA.702,
Local Description Authors: K. A. Schulz
References: Western Ecology Working Group n.d.

G268. Southern Rocky Mountain Montane-Subalpine Grassland

Festuca arizonica - Festuca thurberi - Muhlenbergia montana Grassland Group

Arizona Fescue - Thurber's Fescue - Mountain Muhly Grassland Group
Identifier: G268

REVISED USNVC CLASSIFICATION

Division	Western North American Grassland & Shrubland (2.C.1.Na)
Macrogroup	Southern Rocky Mountain Montane Grassland & Shrubland (M049)
Group	**Southern Rocky Mountain Montane-Subalpine Grassland (G268)**
Group (Scientific)	***Festuca arizonica - Festuca thurberi - Muhlenbergia montana* Grassland Group (G268)**

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	*Achnatherum lettermanii* Herbaceous Alliance (A2524)
Association	*Achnatherum lettermanii* Herbaceous Vegetation (CEGL005354)
Alliance	*Poa fendleriana* Herbaceous Alliance (A1336)
Association	*Poa fendleriana - Astragalus kentrophyta* Herbaceous Vegetation [Park Special] (CEPS009610)
Alliance	*Poa secunda - Arenaria congesta - Cirsium eatonii* Herbaceous Alliance [Provisional] (A2041)
Association	*Poa secunda - Arenaria congesta* Herbaceous Vegetation [Park Special] (CEPS009611)
	Poa secunda - Cirsium eatonii Post-burn Herbaceous Vegetation [Park Special] (CEPS009612)
Alliance	Post-fire Ruderal Herbacous Vegetation Alliance [Provisional] (A2043)
Association	*Balsamorhiza sagittata* Herbaceous Vegetation [Park Special] (CEPS009598)
Alliance	*Pseudoroegneria spicata* Herbaceous Alliance (A1265)
Association	*Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660)

OTHER CLASSIFICATIONS

Ecological System	Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
GRBA Biophysical Setting (BpS)	Montane-Subalpine Grassland (1146)
NPS-VIP Map Unit	Rocky Mountain Montane-Subalpine Grassland Complex (H_RMGC)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This Rocky Mountain grassland group typically occurs between 2200 and 3000 m elevation on flat to rolling plains and parks or on lower sideslopes that are dry, but it may extend up to 3350 m on warm aspects. Soils resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acidic, and usually well-drained. Vegetation is characterized by an open to dense perennial graminoid layer. Larger occurrences usually consist of a mosaic of two or three plant associations with one of the following dominant bunch grasses: *Blepharoneuron tricholepis, Danthonia parryi, Festuca arizonica, Muhlenbergia montana*, or *Pseudoroegneria spicata* at lower elevation / warmer aspects, or *Danthonia intermedia, Festuca idahoensis, Festuca thurberi, Muhlenbergia filiculmis* at subalpine elevation / cooler aspects. The common subdominants include *Bouteloua gracilis, Hesperostipa comata*, or *Poa secunda*. *Bouteloua gracilis* often dominates sites with warm aspects and heavy grazing history. Forb species such as *Potentilla hippiana* may be present to codominant. These large-patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole pine, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the "matrix" of high-elevation plateaus and inter-montane valleys. Small-patch representations of this group do occur at high elevations of the Trans-Pecos where they present as occurrences of *Festuca arizonica - Blepharoneuron tricholepis* Herbaceous Vegetation (CEGL004508). These occurrences often occupy sites adjacent to Madrean Oriental Chaparral Group (G280).

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This ecological group is known from elevations ranging from 2498-3245 m (8193-10,643 feet) on low to middle slopes. Substrates are very rocky and composed of slate, limestone and dolomite. Soils are well-drained to rapidly drained and composed of silt loam and sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This ecological group is characterized an open to dense (20-70% cover) layer of perennial graminoid vegetation. Shrubs may reach 10% cover in some stands. Species include *Ericameria discoidea, Eriogonum microthecum, Mahonia repens, Ribes montigenum, Symphoricarpos oreophilus*, and *Tetradymia canescens*. Dominant graminoids include *Achnatherum lettermanii, Poa fendleriana, Pseudoroegneria spicata*, and *Hesperostipa comata*. Forbs may codominate in some stands and include *Astragalus kentrophyta, Arenaria congesta, Cirsium eatonii*, and *Balsamorhiza sagittata*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Forb	*Arenaria congesta*, *Astragalus kentrophyta*, *Balsamorhiza sagittata*, *Cirsium eatonii*
Herb (field)	Graminoid	*Achnatherum lettermanii*, *Hesperostipa comata*, *Poa fendleriana*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Achnatherum lettermanii*, *Arenaria congesta*, *Astragalus kentrophyta*, *Balsamorhiza sagittata*, *Cirsium eatonii*, *Hesperostipa comata*, *Poa fendleriana*, *Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Taraxacum officinale* (exotic/invasive)

CLASSIFICATION

Global Comments: Montane grasslands are very similar and intergrade with their montane and subalpine counterparts. The transition of this group to the Northern Rocky Mountain Montane Grassland Group (G267) probably occurs somewhere in central Colorado or southern Wyoming. This Southern Rockies grassland group may co-occur with patches of the more mesic Rocky Mountain Subalpine-Montane Mesic Herbaceous Meadow Group (G271), which is distinguished by dominance of mesic forb and grass species such as *Deschampsia caespitosa* and *Mertensia ciliata*.

Global Related Concepts:

- Rocky Mountain Alpine and Subalpine Grassland, Bunchgrass Series - 141.41 (Brown et al. 1979) =
- Rocky Mountain Alpine and Subalpine Grassland, Bunchgrass Series, *Festuca arizonica* Association - 141.412 (Brown et al. 1979) <
- Rocky Mountain Alpine and Subalpine Grassland, Bunchgrass Series, *Festuca thurberi* Association - 141.411 (Brown et al. 1979) <
- Rocky Mountain Alpine and Subalpine Grassland, Bunchgrass Series, Mixed Grass-Forb Association - 141.413 (Brown et al. 1979) <
- Rocky Mountain Montane Grassland, Mixed Meadow Series - 142.41 (Brown et al. 1979) =
- Rocky Mountain Montane Grassland, Mixed Meadow Series, Mixed Forb-Grass Association - 142.411 (Brown et al. 1979) <

ELEMENT DISTRIBUTION

Great Basin National Park Range: This grassland group is scattered across the park and was sampled on a slope above Strawberry Creek basin and slopes below Bald Mountain and Wheeler Peak south to near Lincoln Peak and Mount Washington south and north of Lexington Arch.
Global Range: This grassland group occurs between 2200 and 3000 m elevation in the Southern Rocky Mountains and extends west to high plateaus and mountains in the Colorado Plateau and the Great Basin.
Nations: US
States/Provinces: AZ, CO, NM, NV, UT, WY
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (7 plots): GRBA.301, GRBA.303, GRBA.308, GRBA.317, GRBA.329, GRBA.508, GRBA.814.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Bowns and Bagley 1986, Brown 1982, Brown et al. 1979, Hess 1981, Hess and Wasser 1982, Moir 1967, Passey et al. 1982, Shepherd 1975, Stewart 1940, Turner 1975, Turner and Dortignac 1954, Western Ecology Working Group n.d.

Pseudoroegneria spicata Herbaceous Vegetation

Bluebunch Wheatgrass Herbaceous Vegetation
Identifier: CEGL001660

REVISED USNVC CLASSIFICATION

Division	Western North American Grassland & Shrubland (2.C.1.Na)
Macrogroup	Southern Rocky Mountain Montane Grassland & Shrubland (M049)
Group	Southern Rocky Mountain Montane-Subalpine Grassland (G268)
Alliance	Southern Rocky Mountain *Pseudoroegneria spicata* Herbaceous Alliance (A2044)
Association	***Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660)**

OTHER CLASSIFICATIONS

Ecological System	Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
GRBA Biophysical Setting (BpS)	Montane-Subalpine Grassland (1146)
NPS-VIP Map Unit	Rocky Mountain Montane-Subalpine Grassland Complex (H_RMGC)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This grassland association occurs on rock outcrops, talus, mesas, plateaus, windswept bluffs, ridgetops and mountains in northern Colorado, northeastern and northern Utah and western and southwestern Wyoming. It frequently occurs on moderately to steep, mid- to high-slope landforms, although gentle slopes are not uncommon. Sites are relatively xeric and are often found on southerly aspects at lower elevations or on harsh or on windswept areas at higher elevation sites. Substrates are typically shallow, often calcareous, rocky soils. Ground surface often has significant cover of bare ground, gravel and/or rock (10-90% cover). Stands are also reported east of the Continental Divide in Rocky Mountain National Park on a windward knoll and at Grand Teton National Park from a very steep northeast-facing high slope. The vegetation is characterized by an open herbaceous layer that is typically dominated by the cool-season, perennial bunchgrass *Pseudoroegneria spicata* with low to moderate cover (5-30%) and low-growing forbs. *Koeleria macrantha* is repeatedly present in low abundance. Other dry grasses may be present with low cover (less than half the cover of *Pseudoroegneria spicata*). A

sparse dwarf-shrub layer (<10% cover) occurs with a variety of woody species of *Artemisia, Atriplex confertifolia, Cercocarpus, Eriogonum, Gutierrezia, Krascheninnikovia* or *Tetradymia* depending on elevation and substrate. There are several to many low-growing forbs (cushion plants) present with low cover, such as *Arenaria* spp., *Arenaria hookeri, Astragalus* spp., *Paronychia sessiliflora, Phlox* spp., *Stenotus acaulis, Tetraneuris acaulis (= Hymenoxys acaulis)*, and *Townsendia incana*. There are no clear dominants in this list, and the percent cover of each species present will vary from site to site. A diverse and abundant forb layer probably indicates a degraded occurrence.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from 2498-2755 m (8193-9036 feet) in elevation on moderate to somewhat steep slopes. Sites include mid and high slopes on colluvium on north and southeast aspects. Substrates are rapidly drained or moderately well-drained loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This herbaceous alliance is characterized by graminoid vegetation dominated by *Pseudoroegneria spicata*. Other common graminoids include *Poa secunda, Achnatherum lettermanii*, and *Poa fendleriana*. Total herbaceous cover ranges from 30-70%. A short-shrub layer may be present with up to 5% cover. Species may include *Artemisia arbuscula, Artemisia tridentata, Chrysothamnus viscidiflorus, Eriogonum microthecum, Eriogonum microthecum var. laxiflorum, Mahonia repens, Symphoricarpos oreophilus*, and *Tetradymia canescens*. Forbs are present at low covers and include *Agoseris aurantiaca, Antennaria microphylla, Calochortus nuttallii, Castilleja linariifolia, Collinsia parviflora, Comandra umbellata, Lithospermum ruderale, Lupinus argenteus, Penstemon watsonii*, and *Stephanomeria spinosa*.
exotics *Poa pratensis* and *Bromus tectorum* (on dry sites).

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Hesperostipa comata*, *Pseudoroegneria spicata*

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (30-Nov-1998).

CHARACTERISTIC SPECIES

Great Basin National Park: *Pseudoroegneria spicata*

CLASSIFICATION

Global Comments: This association needs to be compared with *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666) of Pryor Mountains and Bighorn Canyon in south-central Montana, the Tendoy Mountains in southwest Montana and as described in Dinosaur National Monument in northwestern Colorado. It is distinguished by its lack of significant cover by cushion plants. Both associations occur on windswept ridgelines on calcareous substrates, have relatively sparse vegetation cover and contain cushion plants. The range of this association needs further review, especially disjunct stands, because the diagnostic grass in this association can be readily confused with awned *Elymus lanceolatus* (note if rhizomes are present, whereas *Pseudoroegneria spicata* has no rhizomes). Also *Pseudoroegneria spicata* ssp. *inermis* (awnless) is often confused with *Pascopyrum smithii* (note asymmetrical glume) or other wheatgrasses

Global Related Concepts:

- *Agropyron spicatum* var. *inerme* Western Slope Grassland (Baker 1982b) =
- *Pseudoroegneria spicata - Arenaria hookeri* Plant Association (Baker and Kennedy 1985) =
- *Pseudoroegneria spicata* (Bourgeron and Engelking 1994) =
- Grassland *spicata* Grasslands (Hull and Hull 1974) B

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from hillsides south of Strawberry creek road and west of the North Fork of Lexington Arch road.
Global Range: This association occurs in Piceance Basin and Dinosaur National Park in western Colorado and the Cache Valley of northeastern Utah. Stands are reported from Fossil Butte National Monument and Grand Teton National Park in Wyoming and Rocky Mountain National Park in Colorado
Nations: US
States/Provinces: NV, CO, MT, NV, UT, WY
Federal Lands: NPS (Dinosaur, Fossil Butte, Grand Teton, Great Basin, Rocky Mountain)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2008 field data (2 plots): GRBA.303, GRBA.317.
Local Description Authors: K. Schulz
Global Description Authors: D. Zoellner
References: Baker 1982b, Baker and Kennedy 1985, Bourgeron and Engelking1994, CONPS 2003, Cogan et al. 2005. Coles et al. 2008a, Driscoll et al. 1984, Hull and Hull 1974, Jones and Ogle 2000, Peterson 2008, Rondeau personal communication, Western Ecology Working Group of NatureServe, no date.

CHARACTERISTIC SPECIES

Great Basin National Park: *Cercocarpus intricatus, Glossopetalon spinescens*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Dec-2010).

CLASSIFICATION

Status: Standard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Big Wash area, Shingle Canyon and Lehman Creek.
Nations: US
States/Provinces: NV, CO, MT, NV, UT, WY
Federal Lands: NPS (Great Basin)

2.B.2.Nd. Western North American Interior Sclerophyllous Chaparral Shrubland

M094. Cool Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub Group [Provisional]

Arctostaphylos patula Shrubland Alliance

Greenleaf Manzanita Shrubland Alliance
Identifier: A0788

REVISED USNVC CLASSIFICATION

Division	Western North American Interior Sclerophyllous Chaparral Shrubland (2.B.2.Nd)
Macrogroup	Cool Interior Chaparral (M094)
Group	Western North American Montane Sclerophyll Scrub [Provisional] (G282)
Alliance	***Arctostaphylos patula* Shrubland Alliance (A0788)**

GRBA COMPONENT ASSOCIATIONS

Association	*Arctostaphylos patula* Shrubland (CEGL002696)
	Arctostaphylos patula / Ceanothus martinii Shrubland (CEGL005422)

OTHER CLASSIFICATIONS

Ecological Systems	Mogollon Chaparral (CES302.741)
	Great Basin Semi-Desert Chaparral (CES304.001)
GRBA Biophysical Setting (BpS)	Antelope Bitterbrush **(**1144)
	Montain Shrub (1126ms)
NPS-VIP Map Unit	*Arctostyphylos patula* Shrubland Alliance (S_ARPA)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: These are montane shrublands found on the eastern slope of the Sierra Nevada and into the western Great Basin and Colorado Plateau in summer-dry habitats from 800 to 3000 m elevation. Much of the precipitation comes as winter snow, but summer drought stress is characteristic. These shrublands are mostly found on steep, usually south-facing slopes, where soils are rocky and well-drained. These are typically zonal disclimax or, occasionally, edaphic climax brushfields which occur in association with dry needle-leaved evergreen forests or woodlands. These shrublands are typically established after stand-replacing fires or clearcut logging in *Pinus ponderosa* or *Pseudotsuga menziesii* forest, and are seral to forest after several decades. Excessively rocky or droughty, fire-prone sites in the forest may support relatively persistent stands of this alliance. These shrublands are strongly dominated by *Arctostaphylos patula* and may be almost monotypic. They are an important component of the Sierra Nevada/southern Cascade montane chaparral and may form large inclusions in dry pine forests following disturbance. Common shrub associates include *Ceanothus velutinus, Ceanothus cordulatus, Arctostaphylos nevadensis, Chrysolepis sempervirens (= Castanopsis sempervirens), Cercocarpus montanus*, and *Ribes* spp. Eastward, steppe species, such as *Artemisia tridentata, Purshia tridentata*, and *Cercocarpus ledifolius*, become common associates. Herbaceous vegetation is typically sparse and poorly described across the range of this alliance. Reported associates in northern California include *Elymus elymoides, Pyrola picta*, and *Stephanomeria lactucina*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This shrubland alliance is uncommon at Great Basin and found at elevations from 2550-2893 m (8362-9489 feet) on moderate to somewhat

steep slopes (19-32%). Sites are limestone colluvial midslopes on all aspects with soils composed of silty and sandy clay.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by a short-shrub layer dominated by *Arctostaphylos pungens* or codominated by *Ceanothus martinii* or *Symphoricarpos oreophilus*. Trees are absent or with scattered individuals. Total shrub cover ranges from open to extremely dense (30-90% cover). No other shrubs attain significant cover, but may include *Cercocarpus ledifolius, Artemisia tridentata* ssp. *vaseyana, Amelanchier utahensis, Ribes cereum*, and *Mahonia repens*. Herbaceous cover may be absent, sparse or open. Species include *Astragalus tenellus, Cirsium neomexicanum, Elymus lanceolatus, Solidago velutina, Bromus ciliatus, Carex rossii, Machaeranthera canescens, Tragopogon dubius, Achnatherum hymenoides, Achnatherum lettermanii, Achnatherum parishii var. depauperatum, Erigeron ursinus, Hackelia patens, Lithospermum ruderale, Pascopyrum smithii, Penstemon concinnus, Petradoria pumila, Poa glauca* ssp. *rupicola, Pseudoroegneria spicata*, and *Stephanomeria spinosa*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Symphoricarpos oreophilus*
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos pungens*, *Ceanothus martinii*

CHARACTERISTIC SPECIES

Great Basin National Park: *Arctostaphylos pungens*, *Ceanothus martinii*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Penstemon concinnus* (globally vulnerable, G3)

CLASSIFICATION

Global Comments: While this alliance is currently known only from the eastern slope of the Sierra Nevada, it is likely to be much more widespread. *Arctostaphylos patula* is widespread in the Great Basin. With further field inventory and classification work on successional and disturbance-dependent shrublands such as these, the alliance may prove to be similarly widespread.

ELEMENT DISTRIBUTION

Great Basin National Park Range: This manzanita alliance occurs in the southern part of the park and was sampled on hillslopes above the North Fork of Lexington Creek and on the west side of Mount Washington.

Global Range: These shrublands are reported from the eastern slope of the Sierra Nevada in Nevada and California and from the Colorado Plateau in southwestern Utah and western Colorado. *Arctostaphylos patula* is reported to form dense shrublands from southern Oregon and east across the Great Basin in montane habitats to Montana, northwestern Colorado, and northern Arizona (Mozingo 1987). The alliance likely occurs in these areas as well.

Nations: US

States/Provinces: AZ, CA, CO, NV, UT

Federal Lands: BLM (Uncompahgre Plateau); NPS (Bryce Canyon, Cedar Breaks, Colorado, Dinosaur, Grand Canyon, Great Basin, Yosemite, Zion)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2008 field data (3 plots): GRBA.310, GRBA.318, GRBA.320.
Local Description Authors: M. Hall
Global Description Authors: M.S. Reid/D. Sarr
References: Barbour and Major 1977, Conard and Radosevich 1982, Faber-Langendoen et al. 2011, Mozingo 1987, Townsend 1966

2.B.6. Temperate & Boreal Freshwater Shrubland, Wet Meadow & Marsh

2.B.6.Na. Western North American Grassland & Shrubland

M75. Western North American Montane Wet Shrubland & Wet Meadow

G504. Rocky Mountain & Great Basin Montane Alder & Birch Riparian Shrubland

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Alnus incana - Betula occidentalis Riparian/Seep Shrubland Group

Gray Alder - Water Birch Riparian/Seep Shrubland Group
Identifier: G504

REVISED USNVC CLASSIFICATION

Division	Western North American Flooded & Swamp Forest (2.B.6.Nb)
Macrogroup	Western North American Montane Wet Shrubland & Wet Meadow (M075)
Group	**Rocky Mountain & Great Basin Montane Alder & Birch Riparian Shrubland (G504)**
Group (Scientific)	***Alnus incana - Betula occidentalis* Riparian/Seep Shrubland Group (G504)**

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	*Acer glabrum* Mesic-Wet Shrubland Alliance (A0952)
Association	*Acer glabrum* Drainage Bottom Shrubland (CEGL001062)
Alliance	*Betula occidentalis* Riparian/Seep Shrubland Allince (A967)
Association	*Betula occidentalis / Cornus sericea* Shrubland (CEGL001161)
Association	*Betula occidentalis* / Mesic Graminoids Shrubland (CEGL002654)

OTHER CLASSIFICATIONS

Ecol Ecological System	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045)
	Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
GRBA Biophysical Setting (BpS)	Montane Riparian (1154)
	Subalpine-Upper Riparian (1160)
NPS-VIP Map Unit	Montane Riparian Shrubland Complex (S_RIP)
USFWS Wetland Classification	Palustrine

ELEMENT CONCEPT

Global Summary: This group consists of tall (>1.5 m) shrubs found in riparian areas, seeps and avalanche chutes. It occurs in the mountains and lowlands throughout the western interior United States (Great Basin, Rocky Mountains) and western Canada (Rocky Mountains). This riparian group typically occurs adjacent to streams and in mountain meadows. Landforms associated with this group are stream benches, banks, alluvial bars, and floodplains in narrow to moderately wide valleys and hillside seeps in the mountains and foothills, and steep moist avalanche chutes. Sites are young, active channel shelves that lie between active and flood-stage streambanks along second-order and larger streams in moderately graded (3-5%) valleys. Soils are shallow, skeletal alluvium over water-worked cobbles and gravels. Soils may have signs of saturation (mottles). Active channel shelves have surface soil textures that are loamy sands, while older sites are silts

and loam. Surface water is present for brief periods during the growing season, but the water table usually lies well below soil surface. Available water-holding capacity is low. *Alnus incana* and/or *Betula occidentalis* form a dense canopy. These shrubs can be quite tall (>1.5 m), and some regard them as trees. The diverse understory shrub layer may include *Amelanchier utahensis, Cornus sericea, Paxistima myrsinites, Sorbus scopulina* and *Sorbus sitchensis, Ribes hudsonianum, Dasiphora fruticosa* ssp. *floribunda (= Pentaphylloides floribunda), Oplopanax horridus, Prunus virginiana, Symphoricarpos albus, Salix drummondiana, Salix exigua*, and *Salix monticola*. Avalanche tracks may also have a number of tree species that never have a chance to grow much taller than the shrub layer, including *Abies lasiocarpa, Populus balsamifera* ssp. *trichocarpa*, and *Populus tremuloides*. The forb layer is sparse and may include *Canadanthus modestus (= Aster modestus), Castilleja* spp., *Erythronium grandiflorum, Galium triflorum, Heracleum sphondylium, Heracleum maximum (= Heracleum lanatum), Maianthemum stellatum, Myosotis asiatica (= Myosotis alpestris), Rudbeckia laciniata, Senecio triangularis, Symphyotrichum spathulatum (= Aster occidentalis), Thalictrum fendleri, Thalictrum occidentale, Urtica dioica, Veratrum viride*, and *Xerophyllum tenax*. The graminoid layer is usually dominated by 1 or 2 species that include *Agrostis stolonifera, Calamagrostis canadensis, Carex microptera, Carex nebrascensis, Carex pellita (= Carex lanuginosa), Carex utriculata, Glyceria* spp., and *Juncus balticus*. Fern and fern allies can be dense with at least 40% cover. The dominant species typically are *Gymnocarpium dryopteris* and *Athyrium filix-femina*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This group is known from elevations ranging from 2103-2170 m (6900-7117 feet) on gentle to somewhat steep slopes. Sites include low slopes and channel beds often where fluvium has accumulated. Soils are seasonally or semipermanently flooded but well-drained and composed of silt or sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This group occurs as a short woodland or tall shrubland characterized by open to dense stands of *Betula occidentalis* with or without *Cornus sericea* or stands dominated by *Acer glabrum*. *Pinus monophylla* and *Juniperus osteosperma* may be present in the canopy at low cover. Other shrubs associated with this group include *Artemisia tridentata* ssp. *tridentata, Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Holodiscus dumosus, Mahonia repens, Ribes aureum, Ribes cereum, Rosa woodsii, Salix exigua*, and *Symphoricarpos oreophilus*. Herbaceous cover is open to dense and may be the dominant understory component. Dominant species include *Achillea millefolium, Achnatherum* spp., *Leymus cinereus, Maianthemum stellatum*, and *Thalictrum fendleri*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula occidentalis*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer glabrum*, *Cornus sericea*
Herb (field)	Forb	*Maianthemum stellatum*
Herb (field)	Graminoid	*Achnatherum* spp., *Leymus cinereus*

CHARACTERISTIC SPECIES

Great Basin National Park: *Acer glabrum*, *Achnatherum nelsonii*, *Betula occidentalis*, *Cornus sericea*, *Maianthemum stellatum*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

CLASSIFICATION

Global Comments: Need to review the *Alnus incana* Alliance in northern California Coast Ranges. Probably can include stands that occur in the Sierra Nevada and southern Cascades. *Alnus incana* stands in the Klamath Mountains intermix with *Alnus viridis* and are included in Vancouverian Lowland Riparian & Wet Slope Group (G322).

Global Related Concepts:

- Riparian (422) (Shiflet 1994) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This group is known from Snake Creek, Strawberry Creek, and Grey Cliffs campground.

Global Range: This group is known from throughout the Great Basin, eastern Sierra Nevada, and Rocky Mountains of the U.S. and Canada.

Nations: CA, US

States/Provinces: AB, BC, CA, CO, MT, NV, OR, WA, WY

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2008 field data (3 plots): GRBA.032, GRBA.094, GRBA.330.

Local Description Authors: M. Hall

Global Description Authors: G. Kittel

References: Butler 1979, Butler 1985, Crowe and Clausnitzer 1997, Faber-Langendoen et al. 2011, Hansen et al. 1989, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, MacKenzie and Moran 2004, Malanson and Butler 1984, Manning and Padgett 1995, Muldavin et al. 2000a, NCC 2002, Padgett et al. 1989, Sawyer et al. 2009, Shiflet 1994, Szaro 1989, Tuhy et al. 2002, Walford 1996, Walford et al. 2001

G527. Rocky Mountain & Great Basin Montane Riparian & Seep Shrubland

Salix spp. Riparian & Seep Shrubland Group

Willow species Riparian & Seep Shrubland Group

Identifier: G527

REVISED USNVC CLASSIFICATION

Division	Western North American Freshwater Shrubland, Wet Meadow & Marsh (2.B.6.Nb)
Macrogroup	Western North American Montane Wet Shrubland & Wet Meadow (M075)
Group	**Rocky Mountain & Great Basin Montane Riparian & Seep Shrubland (G527)**

Group (Scientific) *Salix* spp. Riparian & Seep Shrubland Group (G527)

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	*Salix bebbiana* Temporarily Flooded Shrubland Alliance (A0971)
Association	*Salix bebbiana* / Mesic Graminoids Shrubland (CEGL001174)
Alliance	*Salix boothii* Temporarily Flooded Shrubland Alliance (A0972)
Association	*Salix boothii* / Mesic Forbs Shrubland (CEGL001180)
Association	*Salix boothii* / Mesic Graminoids Shrubland (CEGL001181)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
GRBA Biophysical Setting (BpS)	Montane Riparian (1154)
	Subalpine-Upper Riparian (1160)
NPS-VIP Map Unit	Montane Riparian Shrubland Complex (S_RIP)
USFWS Wetland Classification	Palustrine

ELEMENT CONCEPT

Global Summary: This group is found throughout the Rocky Mountain cordillera from New Mexico north into Montana and northwestern Alberta, and also occurs in mountainous areas of the intermountain interior west and on the Colorado Plateau. These are montane to subalpine riparian shrublands occurring as narrow bands of shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Generally, the group is found at higher elevations, but can be found anywhere from 1500-3475 m, and may occur at even lower elevations in the Canadian Rockies. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Many of the plant associations found within this group are associated with beaver activity. This group often occurs as part of a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. The shrub species that can be dominant reflect the large elevational gradient of this group and include *Alnus incana, Betula glandulosa, Betula occidentalis, Cornus sericea, Salix bebbiana, Salix boothii, Salix brachycarpa, Salix drummondiana, Salix eriocephala, Salix geyeriana, Salix monticola, Salix planifolia*, and *Salix wolfii*. Generally the upland vegetation surrounding these wet shrublands is either conifer or aspen forest.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This palustrine ecological group is known from elevations ranging from 2121-2675 m (6959-8774 feet) on gentle to somewhat steep slopes. Sites include seasonally flooded or saturated valley floors, channel beds, benches on midslopes and stream terraces. Substrates consist of alluvium or fluvial deposits with poorly drained to rapidly drained soils composed of silt loam, silty clay, clay loam, and sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This shrubland group is characterized by a tall-shrub layer dominated by *Salix bebbiana* or *Salix boothii*. *Prunus virginiana, Symphoricarpos oreophilus*, or *Betula occidentalis* may codominate in some stands. In some stands *Rosa woodsii* may form an open to somewhat dense short-shrub layer. Total shrub cover varies from open to very dense (15-90%). The understory is composed of various mesophytic forbs and graminoids. Dominants include *Aconitum columbianum, Carex aquatilis, Carex praegracilis, Carex scopulorum, Cirsium vulgare, Elymus trachycaulus, Equisetum arvense, Juncus balticus, Mimulus guttatus, Scirpus microcarpus, Thermopsis rhombifolia, Vicia americana*, and *Viola nephrophylla*. *Poa pratensis* has invaded some stands and may be the dominant herbaceous species.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Prunus virginiana*, *Salix bebbiana*, *Salix boothii*, *Symphoricarpos oreophilus*
Herb (field)	Graminoid	*Elymus trachycaulus*

CHARACTERISTIC SPECIES

Great Basin National Park: *Carex aquatilis*, *Elymus trachycaulus*, *Juncus balticus*, *Mimulus guttatus*, *Prunus virginiana*, *Salix bebbiana*, *Salix boothii*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

CLASSIFICATION

Global Related Concepts:

- Riparian (422) (Shiflet 1994) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This group is known from Strawberry Creek, Lexington Creek, Lehman Creek, and Baker Creek.
Global Range: This group is found throughout the Rocky Mountain cordillera from New Mexico north into Montana and the Canadian Rockies of Alberta and British Columbia (including the isolated "island" mountain ranges of central and eastern Montana), and in mountainous areas of the Intermountain West and on the Colorado Plateau.
Nations: CA, US
States/Provinces: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (6 plots): GRBA.304, GRBA.305, GRBA.331, GRBA.603, GRBA.604, GRBA.608.
Local Description Authors: M. Hall
Global Description Authors: G. Kittel
References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Crowe and Clausnitzer 1997, Faber-Langendoen et al. 2011, Kittel 1993, Kittel 1994, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Manning and Padgett 1995, Muldavin et al. 2000a, Padgett 1982, Padgett et al. 1988a, Padgett et al. 1988b, Shiflet 1994, Steen and Coupe 1997, Szaro 1989, Walford 1996, Willoughby 2007

G521. Vancouverian & Rocky Mountain Montane Wet Meadow

Carex spp. - *Calamagrostis* spp. Montane Wet Meadow Group

Sedge species - Reedgrass species Montane Wet Meadow Group
Identifier: G521

REVISED USNVC CLASSIFICATION

Division	Western North American Freshwater Shrubland, Wet Meadow & Marsh (2.B.6.Nb)
Macrogroup	Western North American Montane Wet Shrubland & Wet Meadow (M075)
Group	**Vancouverian & Rocky Mountain Montane Wet Meadow (G521)**

Group (Scientific) *Carex* spp. - *Calamagrostis* spp. Montane Wet Meadow Group (G521)

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	*Carex nebrascensis* Seasonally Flooded Herbaceous Alliance (A1417)
Association	*Carex nebrascensis* Herbaceous Vegetation (CEGL001813)
Alliance	*Carex scopulorum* Seasonally Flooded Herbaceous Alliance (A1420)
Association	*Carex scopulorum* Herbaceous Vegetation (CEGL001822)
Alliance	*Dodecatheon* - *Mimulus* - *Veronica* Wet Meadow Alliance [Provisional] (A2107)

Association	*Dodecatheon alpinum* Herbaceous Vegetation [Park Special] (CEPS009590)
Alliance	*Juncus balticus* Herbaceous Alliance (A1374)
Association	*Juncus balticus* Herbaceous Vegetation (CEGL001838)
Alliance	*Juncus nevadensis* Herbaceous Alliance [Provisional] (A2037)
Association	*Juncus nevadensis - Poa secunda* Herbaceous Vegetation [Park Special] (CEPS009603)
Alliance	*Leymus cinereus* Herbaceous Alliance (A1204)
Association	*Leymus cinereus* Herbaceous Vegetation (CEGL001479)
Alliance	*Polygonum bistortoides* Herbaceous Alliance [Provisional] (A2042)
Association	*Polygonum bistortoides* Herbaceous Vegetation [Park Special] (CEPS009613)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
GRBA Biophysical Setting (BpS)	Wet Meadow (1145wm)
NPS-VIP Map Unit	Montane Wet Meadow Complex (H_WET)
USFWS Wetland Classification	Palustrine

ELEMENT CONCEPT

Global Summary: This group contains the wet meadows found in montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (about 1000-3600 m) from California's Transverse and Peninsular ranges north to British Columbia's coastal mountains and from throughout the Rocky Mountains of Canada and the U.S. (including the Black Hills of South Dakota) and mountain ranges of the intermountain interior west. Wet meadows occur in open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Wet meadows can be tightly associated with snowmelt and typically are not subjected to high velocity disturbance, but can be flooded by slow-moving waters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Vegetation of this group can manifest as a mosaic of several plant associations, or be a monotypic stand of a single association which is dominated by graminoids or forbs. Varying dominant herbaceous species include graminoids *Calamagrostis canadensis, Calamagrostis stricta, Carex bolanderi, Carex exsiccata, Carex illota, Carex microptera, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia caespitosa, Eleocharis quinqueflora, Glyceria striata (= Glyceria elata), Juncus drummondii, Juncus nevadensis*, and *Scirpus* and/or *Schoenoplectus* spp. Forb species include *Camassia quamash, Cardamine cordifolia, Dodecatheon jeffreyi, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi*, and *Veratrum californicum*. Common but sparse shrubs may include *Salix* spp., *Vaccinium uliginosum, Betula glandulosa*, and *Vaccinium macrocarpon*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This ecological group is known from elevations ranging from 1760-3092 m (5770-10,144 feet) on flat to moderate slopes. Sites include seasonally, semipermanently, and permanently flooded seeps, mountain valley floors, stream

terraces and drainages. Soils poorly to well-drained and composed of muck, silty clay, clay loam, loam, sandy clay loam, and sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This ecological group is characterized by perennial graminoid and mixed herbaceous vegetation. Mesophytic shrubs may contribute low cover. Dominant species include *Carex nebrascensis, Carex scopulorum, Dodecatheon alpinum, Juncus balticus, Juncus nevadensis, Leymus cinereus*, and *Polygonum bistortoides*. Other herbaceous species include *Achillea millefolium, Agrostis stolonifera, Angelica kingii, Carex hassei, Carex microptera, Deschampsia caespitosa, Mimulus guttatus, Rorippa nasturtium-aquaticum, Stellaria longipes*, and *Trifolium longipes*. Some stands have been heavily invaded by the exotic species *Taraxacum officinale* and *Poa pratensis*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Forb	*Dodecatheon alpinum*, *Polygonum bistortoides, Achillea millefolium*
Herb (field)	Graminoid	*Carex nebrascensis*, *Carex scopulorum*, *Juncus balticus*, *Juncus nevadensis, Leymus cinereus*

CHARACTERISTIC SPECIES

Great Basin National Park: *Carex nebrascensis*, *Carex scopulorum*, *Dodecatheon alpinum*, *Juncus balticus, Juncus nevadensis, Leymus cinereus*, *Polygonum bistortoides*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

CLASSIFICATION

Global Related Concepts:

- Alpine Grassland (213) (Shiflet 1994) >
- Alpine Rangeland (410) (Shiflet 1994) ><
- Montane Meadows (216) (Shiflet 1994) >
- Tall Forb (409) (Shiflet 1994) ><
- Tufted Hairgrass - Sedge (313) (Shiflet 1994) ><

ELEMENT DISTRIBUTION

Great Basin National Park Range: This montane-subalpine wetland group occurs in seeps and wet meadows near mountain streams and was mostly sampled in Baker Creek and Snake Creek drainages with additional occurrences in a long meadow north of Strawberry Creek and below Stella Lake.

Global Range: This group occurs in the mountains in California's Transverse and Peninsular ranges north to British Columbia's coastal ranges and is found throughout the Rocky Mountains (including the Black Hills of South Dakota) of the U.S. and Canada as well as the intermountain ranges of the interior west, ranging in elevation from montane to alpine (1000-3600 m).

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008, 2009, 2010 and 2011 field data (17 plots): GRBA.65, GRBA.110, GRBA.111, GRBA.112, GRBA.113, GRBA.302, GRBA.309, GRBA.332, GRBA.334, GRBA.336, GRBA.733, GRBA.735, GRBA.742, GRBA.745, GRBA.746, GRBA.748, GRBA_AA_1107.
Local Description Authors: M. Hall, mod by K. Schulz
Global Description Authors: P. Comer, mod. G. Kittel and C. Chappell
References: Banner et al. 1993, Barbour and Major 1988, Cooper 1986b, Crowe and Clausnitzer 1997, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, Faber-Langendoen et al. 2011, Holland and Keil 1995, Kittel et al. 1999b, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Lloyd et al. 1990, MacKenzie and Moran 2004, MacKinnon et al. 1990, Manning and Padgett 1995, Meidinger and Pojar 1991, Meidinger et al. 1988, Nachlinger 1985, Padgett et al. 1988a, Reed 1988, Sanderson and Kettler 1996, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Steen and Coupe 1997

Carex scopulorum Herbaceous Vegetation

Holm's Rocky Mountain Sedge Herbaceous Vegetation
Identifier: CEGL001822

REVISED USNVC CLASSIFICATION

Division	Western North American Freshwater Shrubland, Wet Meadow & Marsh (2.B.6.Nb)
Macrogroup	Western North American Montane Wet Shrubland & Wet Meadow (M075)
Group	Vancouverian & Rocky Mountain Montane Wet Meadow (G521)
Alliance	*Carex scopulorum* Wet Meadow Alliance (A1420)
Association	***Carex scopulorum* Herbaceous Vegetation (CEGL001822)**

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
GRBA Biophysical Setting (BpS)	Wet Meadow (1145wm)
NPS-VIP Map Unit	Montane Wet Meadow Complex (H_WET)
USFWS Wetland Classification	Palustrine

ELEMENT CONCEPT

Global Summary: From Christy (2004): Habitat is depressions and seepy alluvial fans in subalpine heath. Stands of this association occur in transitional areas between the slightly wetter *Carex nigricans* Herbaceous Vegetation (CEGL001816) and slightly drier associations of *Carex spectabilis* and upland *Phyllodoce* heath, and intergrade with both. Stands on alluvial fans occur below springs and seeps and may be laced with rivulets and or irrigated by sheetflow. Trees are absent. Shrubs are sparse, *Salix commutata* being the most abundant in 25% of the plots, but with a very low cover. *Carex scopulorum* is the primary herbaceous species with an average cover of 49% and ranging from 10-90%. Other species with significant patches include *Deschampsia caespitosa, Eleocharis quinqueflora, Muhlenbergia filiformis, Eleocharis palustris*, and *Juncus balticus*. The other 40 species occur at low constancy and cover and are mostly wetland taxa indicative of perennial saturation.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This herbaceous association is known from elevations ranging from 2860-3092 m (9380-10,141 feet) on gentle to moderate slopes. Sites include seasonally flooded midslopes, low slopes and basin floors in drainages or areas of groundwater discharge. Substrates include poorly drained muck, loam and silty loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a dense to completely closed herbaceous layer dominated by *Carex scopulorum* which has >60% cover. Other graminoids include *Carex microptera, Calamagrostis stricta*, and *Deschampsia caespitosa*. A variety of forbs may be present, and *Rorippa nasturtium-aquaticum* and *Polygonum bistortoides* may be subdominant. Other species include *Achillea millefolium, Angelica kingii, Aquilegia scopulorum, Arabis drummondii, Arnica mollis, Artemisia michauxiana, Cardamine cordifolia, Dodecatheon alpinum, Mimulus guttatus, Saxifraga odontoloma*, and *Stellaria calycantha*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum bistortoides*, *Rorippa nasturtium-aquaticum*
Herb (field)	Graminoid	*Carex scopulorum*

CHARACTERISTIC SPECIES

Great Basin National Park: *Carex microptera*, *Carex scopulorum*, *Rorippa nasturtium-aquaticum*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Aquilegia scopulorum* (endemic, G3?); **Exotic/Invasive**: *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: Christy (2004) describes an *Eleocharis quinqueflora* phase: Habitat is depressions or seepy slopes in subalpine heath. It occurs at the wet end of the *Carex scopulorum* association and intergrades with the *Carex nigricans* association. Stands contain more *Eleocharis quinqueflora* than *Carex*. *Carex nigricans* and *Carex brunnescens* may form significant patches.
Global Related Concepts:

- *Carex scopulorum* var. *prionophylla* and *bracteosa* Association (Kovalchik 1993) =
- *Carex scopulorum* (Crowe and Clausnitzer 1997) =
- *Carex scopulorum* (Kovalchik 1987) =
- *Carex scopulorum* (Bourgeron and Engelking 1994) =
- *Carex scopulorum* Association (Christy 2004) =
- *Carex scopulorum* Association (Crowe et al. 2004) =
- DRISCOLL FORMATION CODE:V.C.6.a. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Baker Creek and Snake Creek.
Global Range: This association occurs from California to British Columbia (Christy 2004) and eastward.
Nations: CA?, US

States/Provinces: BC?, CA:S3, CO, ID:S3, MT:S4, NV, OR:S4, UT?, WA:S3S4, WY
Federal Lands: NPS (Great Basin, Great Sand Dunes); USFS (Deschutes, Fremont, Malheur, Wallowa-Whitman)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (3 plots): GRBA.309, GRBA.735, GRBA.742.
Local Description Authors: M.E. Hall
Global Description Authors: Christy (2004)
References: Bourgeron and Engelking 1994, Campbell 1973, Christy 2004, Cole 1977b, Cole 1982, Crowe and Clausnitzer 1997, Crowe et al. 2004, Driscoll et al. 1984, Evenden 1990, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Jankovsky-Jones et al. 1999, Kagan et al. 2004, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, MTNHP 2002b, Manning and Padgett 1989, Manning and Padgett 1991, Seyer 1981, WNHP unpubl. data, Western Ecology Working Group n.d.

Dodecatheon alpinum Herbaceous Vegetation [Park Special]

Alpine Shootingstar Herbaceous Vegetation
Identifier: CEPS009590

REVISED USNVC CLASSIFICATION

Division	Western North American Freshwater Shrubland, Wet Meadow & Marsh (2.B.6.Nb)
Macrogroup	Western North American Montane Wet Shrubland & Wet Meadow (M075)
Group	Vancouverian & Rocky Mountain Montane Wet Meadow (G521)
Alliance	*Dodecatheon* - *Mimulus* - *Veronica* Wet Meadow Alliance [Provisional] (A2107)
Association	***Dodecatheon alpinum* Herbaceous Vegetation [Park Special] (CEPS009590)**

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
GRBA Biophysical Setting (BpS)	Wet Meadow (1145wm)
NPS-VIP Map Unit	Montane Wet Meadow Complex (H_WET)
USFWS Wetland Classification	Palustrine

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This wetland association is rare and only known from Snake and Baker creeks, ranging in elevation from 2515-2688 m (8249-8816 feet) on nearly flat to gentle slopes. Sites include seasonally flooded seeps occupying gentle slopes or basin floors. Soils are poorly drained and mucky with standing water often present.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a very dense (>90% cover) mixed graminoid and forb herbaceous layer dominated by *Dodecatheon alpinum* and often codominated by *Juncus balticus, Trifolium longipes, Elymus trachycaulus*, and/or *Polygonum bistortoides*. Herbaceous associates are highly variable. Other graminoids may include *Carex hassei, Carex nebrascensis, Carex scopulorum, Deschampsia caespitosa*, and *Juncus nevadensis*. Forb associates may include *Achillea millefolium, Epilobium ciliatum, Geum macrophyllum, Mimulus guttatus, Platanthera dilatata, Rorippa nasturtium-aquaticum, Stellaria longipes*, and *Viola nephrophylla*. The exotic species *Taraxacum officinale* and *Poa pratensis* and often present as well.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Forb	*Dodecatheon alpinum*, *Polygonum bistortoides*, *Trifolium longipes*
Herb (field)	Graminoid	*Elymus trachycaulus*, *Juncus balticus*

CHARACTERISTIC SPECIES

Great Basin National Park: *Dodecatheon alpinum*, *Juncus balticus*, *Polygonum bistortoides*, *Trifolium longipes*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Poa pratensis* (exotic/invasive, Medium), *Taraxacum officinale* (exotic/invasive)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Dec-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Baker Creek and Snake Creek.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (5 plots): GRBA.110, GRBA.733, GRBA.745, GRBA.746, GRBA.748.
Local Description Authors: M. Hall
References: Western Ecology Working Group n.d.

2.B.7. Salt Marsh

2.B.7.Nd. North American Western Interior Brackish Marsh

M082. Cool Semi-Desert Alkali-Saline Wetland

G537. Intermountain Basins Alkaline-Saline Shrub Wetland

Sarcobatus vermiculatus / Artemisia tridentata Shrubland

Greasewood / Big Sagebrush Shrubland
Identifier: CEGL001359

REVISED USNVC CLASSIFICATION

Division	North American Western Interior Brackish Marsh (2.B.7.Nd)
Macrogroup	Cool Semi-Desert Alkali-Saline Wetland (M082)
Group	Intermountain Basins Alkaline-Saline Shrub Wetland (G537)
Alliance	*Sarcobatus vermiculatus* Intermittently Flooded Shrubland Alliance (A1046)
Association	**Sarcobatus vermiculatus / Artemisia tridentata Shrubland (CEGL001359)**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Greasewood Flat (CES304.780)
GRBA Biophysical Setting (BpS)	NA
NPS-VIP Map Unit	*Sarcobatus vermiculatus* Shrubland Alliance (S_SAVE)
USFWS Wetland Classification	Upland/Palustrine

ELEMENT CONCEPT

Global Summary: This mixed bottomland shrubland is characteristic of stream terraces and floodplains of the Intermountain West. The presence of other shrubs in the canopy indicates less saline conditions than found in *Sarcobatus vermiculatus* Disturbed Shrubland (CEGL001357). Soils are deep and generally sandy, but a few sites are on well-drained silt loams or clays. The sagebrush element may be either *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *wyomingensis*, and either the sagebrush or *Sarcobatus vermiculatus* may have the greater cover. *Atriplex canescens, Ericameria nauseosa*, and *Chrysothamnus viscidiflorus* are other common minor elements of the shrub canopy. Total shrub cover is between 5 and 30%. The understory is variable; cover by herbaceous species may be sparse to dense, or exotic species may dominate the field layer.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from elevations ranging 1618-1769 m (5305-5800 feet) on flat to gentle slopes. Sites include sand deposits on lower alluvial fans and valleys and a bench along a channel. Soils are well- to rapidly drained loamy sands.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by an open (15-40%) short-shrub layer codominated by *Artemisia tridentata* and *Sarcobatus vermiculatus*. Other associated shrubs include *Chrysothamnus viscidiflorus, Ephedra nevadensis, Ericameria nauseosa*, and *Atriplex confertifolia*. Cover of native grasses is sparse to absent and may include *Achnatherum hymenoides, Elymus elymoides, Hesperostipa comata, Pleuraphis jamesii*, and *Poa fendleriana*. Some stands have substantial invasion by the exotic graminoid *Bromus tectorum*. Forb cover is sparse but may include *Centaurea solstitialis, Chaenactis douglasii*, and *Astragalus kentrophyta*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Sarcobatus vermiculatus*
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia tridentata*, *Sarcobatus vermiculatus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Erodium cicutarium* (exotic/invasive, Medium/Low)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Related Concepts:

- *Sarcobatus vermiculatus/Artemisia tridentata* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:III.C.2.a. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: Stands were sampled along Snake Creek below the hatchery and in the administration area near Baker.

Global Range: This mixed bottomland shrubland is characteristic of stream terraces and floodplains of the Intermountain West. Stands are reported from the Colorado Plateau and Great Basin from western Colorado and Utah, extending to Big Horn Basin across western Wyoming and south-central Montana.

Nations: US

States/Provinces: CO, MT:S4, NV, UT, WY

Federal Lands: NPS (Arches, Capitol Reef, Colorado, Dinosaur, Fossil Butte?, Great Basin, Hovenweep, Mesa Verde)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (3 plots): GRBA.039, GRBA.441, GRBA.443.

Local Description Authors: M.E. Hall

Global Description Authors: J. Coles, mod. K.A. Schulz

References: Bourgeron and Engelking 1994, Clark et al. 2009, Coles et al. 2008a, Coles et al. 2009a, Driscoll et al. 1984, Lesica and DeVelice 1992, MTNHP 2002b, Peterson 2008, Romme et al. 1993, Thomas et al. 2009b, Von Loh et al. 2007, Von Loh et al. 2008, Western Ecology Working Group n.d.

3. Desert & emi-Desert

3.B.1. Cool Semi-Desert Scrub & Grassland

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

M170. Great Basin & Intermountain Dwarf Sage Shrubland & Steppe

G308. Intermountain Low & Black Sagebrush Shrubland & Steppe

Artemisia arbuscula ssp. *arbuscula / Pseudoroegneria spicata* Shrub Herbaceous Vegetation

Low Sagebrush / Bluebunch Wheatgrass Shrub Herbaceous Vegetation

Identifier: CEGL001412

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Dwarf Sage Shrubland & Steppe (M170)
Group	Intermountain Low & Black Sagebrush Shrubland & Steppe (G308)
Alliance	*Artemisia arbuscula* ssp. *arbuscula / Pseudoroegneria spicata* Shrub Herbaceous Alliance (A1566)
Association	***Artemisia arbuscula* ssp. *arbuscula / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001412)**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
GRBA Biophysical Setting (BpS)	Low Sagebrush Steppe (1124)
NPS-VIP Map Unit	*Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance (S_ARAR)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This dwarf-shrubland occurs on foothills and open steep slopes from 1370 to 2930 m (4500-9600 feet) in elevation. Slopes are generally quite steep, 24% average, 37%

maximum. Soils often have a hard layer constricting drainage. The soil surface is generally gravelly with up to 50% open bare gravelly soils. This montane dwarf-shrub steppe association is dominated by *Artemisia arbuscula*. *Artemisia nova* and *Artemisia tridentata* may also be present, adding to the shrubby aspect of this type. Shrubs can be widely spaced, and there is generally equal to sometimes greater cover provided by the herbaceous cover. Shrub cover ranges from 7 to 20%. Herbaceous cover ranges from 20 to 30% cover. *Pseudoroegneria spicata* is the dominant grass. *Koeleria macrantha (= Koeleria cristata)* and *Poa secunda* are commonly also present. Forbs are less abundant but can include *Phlox hoodii, Linum perenne, Sedum lanceolatum, Eriogonum umbellatum*, and *Arenaria congesta*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from 2273-2407 m (7460-7900 feet) in elevation on moderate to somewhat steep slopes. Sites include low, mid and high slopes, boulderfields and colluvial slopes. Soils are well-drained sandy clay and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This shrub herbaceous association is characterized by an open (5-35% cover) short-shrub layer dominated by *Artemisia arbuscula* ssp. *arbuscula* with a moderately dense (25-45% cover) herbaceous layer dominated by *Pseudoroegneria spicata* and *Poa fendleriana*. Other shrub species that may be present at lower cover include *Tetradymia canescens, Purshia glandulosa, Eriogonum microthecum, Mahonia repens*, and *Cercocarpus intricatus*. A variety of forbs may be present and include *Achillea millefolium, Allium bisceptrum, Comandra umbellata* ssp. *pallida, Crepis occidentalis, Cryptantha humilis, Descurainia sophia, Eriogonum caespitosum, Hackelia patens, Lathyrus brachycalyx, Penstemon watsonii, Petradoria pumila, Phlox stansburyi*, and *Sedum lanceolatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia arbuscula* ssp. *arbuscula*
Herb (field)	Graminoid	*Poa fendleriana*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia arbuscula* ssp. *arbuscula*, *Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Descurainia sophia* (exotic/invasive, Medium/Low

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: This association includes dwarf-shrublands to grasslands and needs to be reviewed. Of the references listed below, only two (Tiedemann and Klock 1977, Schuller and Evans 1986) were not available to the Global description author. Available literature indicates this is an herbaceous shrubland, and no reference indicated these were grasslands.

Global Related Concepts:

- *Artemisia arbuscula - Agropyron - Festuca* SD-19-11 (Hall 1973) =
- *Artemisia arbuscula - Agropyron spicatum* Habitat Type (Zamora and Tueller 1973) =
- *Artemisia arbuscula / Agropyron spicatum* Community Type (Jensen et al. 1988a) =
- *Artemisia arbuscula / Agropyron spicatum* Community Type (Jensen et al. 1988b) =
- *Artemisia arbuscula / Agropyron spicatum* Habitat Type (Lewis 1975a) =
- *Artemisia arbuscula / Agropyron spicatum* Habitat Type (Mueggler and Stewart 1980) =
- *Artemisia arbuscula / Agropyron spicatum* Habitat Type (Hironaka et al. 1983) =
- *Artemisia arbuscula / Poa secunda* Community Type (Blackburn et al. 1971) =
- *Artemisia arbuscula/Pseudoroegneria spicata* (Bourgeron and Engelking 1994) =
- DRISCOLL FORMATION CODE:IV.A.3.a. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This uncommon association is known from Cedar Spur and upper Ridge Creek.

Global Range: This association is known from central Oregon, southeastern Washington, northeastern Nevada, southeastern Idaho, western Wyoming and southeastern Montana. It may also occur in New Mexico.

Nations: US

States/Provinces: ID:S3, MT:S3, NM?, NV:S4S5, OR:S3, WA:S2, WY

Federal Lands: NPS (Craters of the Moon, Grand Teton, Great Basin, John Day Fossil Beds)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (3 plots): GRBA.038, GRBA.117, GRBA.612.

Local Description Authors: M. Hall

Global Description Authors: G. Kittel

References: Bell et al. 2009, Blackburn et al. 1971, Bourgeron and Engelking 1994, Cogan et al. 2005, Driscoll et al. 1984, Hall 1973, Hironaka et al. 1983, Jensen et al. 1988a, Jensen et al. 1988b, Kagan et al. 2004, Lewis 1975a, MTNHP 2002b, Mueggler and Stewart 1980, Peterson 2008, Schuller and Evans 1986, Tiedemann and Klock 1977, Western Ecology Working Group n.d., Zamora and Tueller 1973

Artemisia nova Shrubland Alliance

Black Sagebrush Shrubland Alliance

Identifier: A1105

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Dwarf Sage Shrubland & Steppe (M170)
Group	Intermountain Low & Black Sagebrush Shrubland & Steppe Group (G308)
Alliance	***Artemisia nova* Shrubland Alliance (A1105)**

GRBA COMPONENT ASSOCIATIONS

Association	*Artemisia nova / Achnatherum hymenoides* Shrubland(CEGL001422)
	Artemisia nova / Poa fendleriana Shrubland (CEGL002698)
	Artemisia nova / Pseudoroegneria spicata Shrubland (CEGL001424)

OTHER CLASSIFICATIONS

Ecological System	Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)

GRBA Biophysical Setting (BpS)	Black Sagebrush Shrubland (1079an)
NPS-VIP Map Unit	*Artemisia nova* Shrubland Alliance (S_ARNO)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: Associations within this alliance occur at intermediate elevations (1400-2500 m) in the Intermountain and Rocky Mountain West, a region of semi-arid, continental climate regime. Soils are typically young, shallow, coarse-textured, and often derived from calcareous parent materials. *Artemisia nova* associations occur on well-drained slopes and ridges and often grow with other *Artemisia* associations on deeper soils. In the Columbia River Basin, the vegetation in this alliance occupies the driest habitats of all the *Artemisia*-dominated alliances. This alliance is characterized by the dominance of the dwarf-shrub *Artemisia nova*, which must contribute at least 40% of the total shrub cover in any stand, and by cover of perennial graminoids that is typically less than 20%. Associated shrub species that occur in stands of this alliance include *Chrysothamnus viscidiflorus, Atriplex confertifolia, Artemisia tridentata, Artemisia arbuscula, Artemisia cana, Symphoricarpos oreophilus, Grayia spinosa, Purshia tridentata*, and *Gutierrezia sarothrae*. The ground layer is dominated by perennial bunch grasses which may exceed the height of the shrubs but typically have <20% total cover. Recurrent species include *Pseudoroegneria spicata, Achnatherum hymenoides (= Oryzopsis hymenoides), Achnatherum speciosum (= Stipa speciosa), Achnatherum thurberianum (= Stipa thurberiana), Hesperostipa comata (= Stipa comata), Elymus elymoides, Poa fendleriana*, *Poa secunda*, and *Koeleria macrantha*. In southern stands, *Bouteloua gracilis* and *Pleuraphis jamesii (= Hilaria jamesii)* may also be important. Common forbs include *Balsamorhiza sagittata, Senecio integerrimus, Packera multilobata (= Senecio multilobatus), Stenotus armerioides, Heterotheca villosa, Phlox hoodii, Sphaeralcea coccinea*, and *Castilleja angustifolia*. At the edges of intermountain basins, this alliance is usually contiguous with *Atriplex confertifolia* shrublands.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This shrubland alliance is known from lower elevations in the park ranging from 1854-2036 m (6085-6680 feet) on gentle to moderately steep slopes. Sites include remnant or current alluvial fans, benches, and slopes on all aspects. Substrates are typically alluvium, but less commonly colluvium. Soils are composed of moderately well-drained to rapidly drained sandy clay loam, loamy sand, silt loam, and silty clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This microphyllous dwarf-shrubland is characterized by an open to moderately dense short-shrub layer clearly dominated by *Artemisia nova*. Other shrubs, including *Artemisia tridentata, Atriplex canescens, Atriplex confertifolia, Chrysothamnus viscidiflorus, Ephedra nevadensis, Ephedra viridis, Gutierrezia sarothrae*, and *Opuntia erinacea*, may occur but are never codominant. Scattered *Pinus monophylla* and *Juniperus osteosperma* are common. The herbaceous layer is sparse to open and dominated by graminoids, including *Achnatherum hymenoides, Poa fendleriana*, or *Pseudoroegneria spicata*. Common forbs include *Arabis holboellii, Castilleja applegatei* ssp. *martinii, Cryptantha confertiflora, Cryptantha flavoculata, Cryptantha humilis, Descurainia sophia, Erigeron argentatus, Erigeron pumilus, Packera multilobata, Phacelia crenulata*, and *Streptanthus cordatus*. The exotic *Bromus tectorum* is common in stands and may codominate.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Dwarf-shrub	*Artemisia nova*
Herb (field)	Forb	*Arabis holboellii*
Herb (field)	Graminoid	*Achnatherum hymenoides*, *Poa fendleriana*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Arabis holboellii*, *Artemisia nova*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High), *Descurainia sophia* …

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (4-Jan-2011).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Mill Creek, Snake Creek, Big Wash Overlook, Shingle Creek, Pine Creek, Lincoln Canyon Creek, and Burnt Mill Canyon.
Global Range: Associations in this alliance occur in the mountains of the Mojave Desert, throughout the Great Basin, and east into western and central Wyoming, Montana, Colorado, Utah, and northwestern New Mexico. It also occurs in the upper Columbia River Basin of southeastern Idaho.
Nations: US
States/Provinces: CA, CO, ID, MT, NM, NV, OR, UT, WY
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (15 plots): GRBA.023, GRBA.024, GRBA.026, GRBA.028, GRBA.033, GRBA.040, GRBA.069, GRBA.072, GRBA.073, GRBA.074, GRBA.114, GRBA.131, GRBA.721, GRBA.804, GRBA_AA_0318.
Local Description Authors: M.E. Hall
Global Description Authors: D. Sarr
References: Baker 1983c, Baker 1983d, Baker and Kennedy 1985, Barbour and Major 1977, Beatley 1976, Blackburn and Tueller 1970, Blackburn et al. 1968c, Blackburn et al. 1969d, Blackburn et al. 1971, Brotherson and Brotherson 1979, Caicco and Wellner 1983f, Chappell et al. 1997, Fautin 1946, Fisser 1962, Fisser 1970, Francis 1986, Heinze et al. 1962, Hironaka 1978, Hironaka et al. 1983, Hughes 1977, Jensen et al. 1988a, Johnston 1987, Leary and Peterson 1984, Lewis 1975a, Lucky McMine Application n.d., Milton and Purdy 1983, ORNHP unpubl. data, Peterson 1984, Rickard and Beatley 1965, Roberts et al. 1992, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Soil Conservation Service 1978, Tweit and Houston 1980, Western Ecology Working Group n.d., Zamora and Tueller 1973

M169. Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe

G303. Intermountain Dry Tall Sagebrush Shrubland

Artemisia tridentata ssp. *tridentata / Agropyron cristatum* Semi-natural Shrubland [Park Special]

Basin Big Sagebrush / Crested Wheatgrass Semi-natural Shrubland
Identifier: CEPS009566

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe (M169)
Group	Intermountain Dry Tall Sagebrush Shrubland Group (G303)
Alliance	Artemisia tridentata / Ruderal Understory Shrubland Alliance (A2039)
Association	***Artemisia tridentata* ssp. *tridentata* / Ruderal Understory Shrubland [Park Special] (CEPS009566)**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
GRBA Biophysical Setting (BpS)	Montane Sagebrush Steppe – upland (1126u)
NPS-VIP Map Unit	*Artemisia tridentata* ssp. *tridentata* Shrubland Complex (S_ARTR)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This shrubland association is known from elevations ranging from 1645-2298 m (5400-7540 feet) on flat to moderate slopes. Sites are typically disturbed and include alluvial benches, valley floors, midslopes and high slopes on substrates of alluvial deposits with some areas being seasonally flooded. Soils are well-drained and composed of sandy loam and sandy clay loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This microphyllous shrubland association is characterized by a sparse to open (5-30% cover) short-shrub layer of *Artemisia tridentata* ssp. *tridentata* with a sparse to moderately dense (5-40% cover) herbaceous layer dominated by the exotic grass *Agropyron cristatum*. Other shrub associates include *Ericameria nauseosa, Grayia spinosa, Gutierrezia sarothrae, Mahonia repens, Purshia glandulosa*, and *Rosa woodsii*. Herbaceous diversity is low and species may include *Achnatherum hymenoides, Elymus elymoides, Mentzelia albicaulis, Salsola paulsenii, Sisymbrium altissimum*, and *Streptanthus cordatus*. The exotic grass *Bromus tectorum* may occasionally be subdominant.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	Graminoid	*Agropyron cristatum*

CHARACTERISTIC SPECIES

Great Basin National Park: *Agropyron cristatum*, *Artemisia tridentata* ssp. *tridentata*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Agropyron cristatum* (exotic/invasive, Medium/Low), *Bromus tectorum* (exotic/invasive, High), *Salsola paulsenii* (exotic/invasive, Low), *Sisymbrium altissimum* (exotic/invasive)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (15-Nov-2010).

CLASSIFICATION

Status: Nonstandard

ELEMENT DISTRIBUTION

Great Basin National Park Range: This shrubland is known from Mount Washington, Bald Mountain, Lincoln Peak, Baker Ridge, Wheeler Peak, and Pyramid Peak.
Global Range: This shrubland is known from Colorado Plateau and Great Basin and is likely more widespread in the intermountain western U.S.
Nations: US
States/Provinces: NV, UT
Federal Lands: NPS (Bryce Canyon, Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2009, and 2010 field data (4 plots): GRBA.017, GRBA.132, GRBA.430, GRBA.440.
Local Description Authors: M. Hall
Global Description Authors: K. A. Schulz
References: Western Ecology Working Group n.d.

Artemisia tridentata Dry Shrubland Alliance [Provisional]

Big Sagebrush Dry Shrubland Alliance
Identifier: A2113

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe (M169)
Group	Intermountain Dry Tall Sagebrush Shrubland (G303)
Alliance	***Artemisia tridentata* Dry Shrubland Alliance [Provisional] (A2113)**

GRBA COMPONENT ASSOCIATIONS

Association	*Artemisia tridentata / Elymus elymoides* Shrubland (CEGL001001)
	Artemisia tridentata ssp. *tridentata / Pleuraphis jamesii* Shrubland (CEGL001015)
	Peraphyllum ramosissimum - *Artemisia tridentata* Shrubland(CEGL005430)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
GRBA Biophysical Setting (BpS)	Montane Sagebrush Steppe – upland (1126u)
NPS-VIP Map Unit	*Artemisia tridentata* ssp. *tridentata* Shrubland Complex (S_ARTR)
	Cercocarpus intricatus – (*Peraphyllum ramosissimum*) Shrubland Complex (S_CIPR)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from elevations ranging from 2165-2023 m (6640-7101 feet) on gentle to very steep slopes. Sites include channel beds, stream terraces and talus slopes. Parent materials may be colluvial or alluvial with soils that are well- to rapidly drained silt loam, sandy clay loam, and loamy sand.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by a sparse to open (10-40% cover) shrub layer dominated by *Artemisia tridentata* or codominated by *Peraphyllum ramosissimum*. Scattered *Juniperus osteosperma* and *Pinus monophylla* individuals are common. Other common shrub species include *Artemisia nova, Cercocarpus ledifolius, Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is grassy with bunch grasses *Achnatherum hymenoides, Elymus elymoides, Elymus lanceolatus*, and *Poa fendleriana* dominating. *Bromus tectorum* is a frequent invader and dominates some stands. No forbs have significant cover or high frequency.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Peraphyllum ramosissimum*
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata*
Herb (field)	Graminoid	*Elymus elymoides*, *Elymus lanceolatus*, *Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia tridentata*, *Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Chinese Wall, Mount Washington, between Snake Creek and Big Wash, south of Brown Lake, Baker Lake, Pole Canyon, and Highland Ridge.
Nations: CA?, US
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (4 plots): GRBA.261, GRBA.407, GRBA.409, GRBA.801.
Local Description Authors: M. Hall
References: Faber-Langendoen et al. 2011

G302. Intermountain Mesic Tall Sagebrush Shrubland & Steppe Group

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Artemisia tridentata ssp. ***tridentata / Leymus cinereus*** **Shrubland**
Basin Big Sagebrush / Great Basin Wildrye Shrubland
Identifier: CEGL001016

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe (M169)
Group	Intermountain Mesic Tall Sagebrush Shrubland & Steppe Group (G302)
Alliance	*Artemisia tridentata* ssp. *tridentata* Mesic Shrubland (A1992)
Association	***Artemisia tridentata* ssp. *tridentata / Leymus cinereus* Shrubland (CEGL001016)**

OTHER CLASSIFICATIONS

Ecological Systems	Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)

GRBA Biophysical Setting (BpS)	Montane Sagebrush Steppe – upland (1126u) Basin wildrye (1126bw), Class C
NPS-VIP Map Unit	*Artemisia tridentata* ssp. *tridentata* Shrubland Complex (S_ARTR)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This widely distributed sagebrush shrubland is a transitional community found on floodplains, terraces of perennial streams and along the edges of seasonally flooded washes and gullies of the high desert steppe of the western United States or associated relatively mesic upland sites (swales) with high water tables. Elevations range from 1600 to 2170 m (5250-7120 feet). On terraces, slopes are level to gentle, and the substrate is alluvium or loess. Mesic upland site are gentle to steep, with substrates derived from shale and sandstone. Soils generally have silty or clay loam textures and are moderately well-drained. Stands of this association are characterized by a shrub layer dominated by *Artemisia tridentata* ssp. *tridentata* standing 1-3 m tall and an herbaceous layer dominated by *Leymus cinereus* 0.5-1.5 m tall. Some stands may take the form of a *Leymus cinereus* grassland with *Artemisia tridentata* ssp. *tridentata* on the margins, but more often stands are shrublands with grass growing in openings between shrub canopies. Total vegetation cover ranges from 20 to 90%. *Sarcobatus vermiculatus* and *Ericameria nauseosa (= Chrysothamnus nauseosus)* may also be present in the shrub stratum. *Leymus cinereus* dominates the understory with 15 to 90% cover. Various other grasses are likely to be present, including *Bromus tectorum, Distichlis spicata*, and other grasses associated with more mesic or riparian environments. Forbs species vary among sites.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from elevations ranging from 2203-2670 m (7230-8757 feet) on flat and somewhat steep slopes usually on relatively mesic sites. Topographic positions include high slopes on east and southeast aspects and low-level flat areas. Substrates include well- to rapidly drained sandy loam derived of quartzite and alluvium.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to moderately dense (10-40% cover) short-shrub layer of *Artemisia tridentata* ssp. *tridentata*. Scattered individuals of *Juniperus osteosperma* may be present. Other common shrubs include *Chrysothamnus viscidiflorus, Ephedra viridis, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens, Rosa woodsii*, and *Symphoricarpos oreophilus*. The herbaceous layer is open to dense and dominated by *Leymus cinereus*, although *Comandra umbellata* codominates in one stand. Other graminoids include *Poa fendleriana, Poa glauca*, and *Bromus carinatus (=Bromus marginatus)*. Forb diversity is high and species include *Agoseris glauca, Allium bisceptrum, Arabis holboellii, Artemisia ludoviciana, Astragalus piutensis, Calochortus nuttallii, Castilleja linariifolia, Collinsia linearis, Crepis acuminata, Crepis intermedia, Melica bulbosa*, and *Polygonum douglasii* ssp. *johnstonii*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *tridentata*,
Herb (field)	Forb	*Comandra umbellata*
Herb (field)	Graminoid	*Leymus cinereus*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia tridentata* ssp. *tridentata*, *Leymus cinereus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Collinsia linearis* (endemic, G3?); **Exotic/Invasive**: *Poa pratensis* (exotic/invasive, Medium)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (7-Apr-1998). This plant association was formerly widespread in the western United States but is now rare due to habitat loss and degradation of stands. The association is believed to be extirpated in Washington. In other western states, high-quality examples are of rare occurrence, and most stands are small and fragmented. Livestock use has reduced the quality of stands and continues to threaten remaining occurrences. Agricultural conversion has also eliminated habitat previously occupied by the association. Exotic species, including *Poa pratensis* or *Bromus tectorum*, may become locally dominant, nearly replacing the diagnostic graminoid. Incision of smaller streams and intermittent drainages throughout the West also has affected this association by dropping the water table and causing stands to dry out to the point that they will no longer support *Leymus cinereus*.

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Related Concepts:

- *Artemisia tridentata / Elymus cinereus* Plant Association (Johnston 1987) >
- *Artemisia tridentata* ssp. *tridentata/Leymus cinereus* (Bourgeron and Engelking 1994) =
- *Artemisia tridentata* ssp. *tridentata / Leymus cinereus* Habitat Type (Hess 1981) =
- *Artemisia tridentata* ssp. *tridentata / Leymus cinereus* Habitat Type (Wasser and Hess 1982) =
- DRISCOLL FORMATION CODE:III.A.2.b. (Driscoll et al. 1984) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This shrubland association is know from mesic areas north of Baker Creek and below Horse Heaven, and a stream terrace along North Fork Big Wash.
Global Range: This was formerly a widespread association in the western United States. Today it is known from California to Washington and east to Montana and Colorado.
Nations: US
States/Provinces: CA:S1, CO:S1, ID:S1, MT:S1, NV, OR:S2, WA:S1, WY:S1S2
Federal Lands: NPS (Craters of the Moon, Dinosaur, Fossil Butte, Great Basin, John Day Fossil Beds); USFS (Arapaho-Roosevelt, Shoshone)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003and 2009 field data (3 plots): GRBA.403, GRBA.731, GRBA.811.
Local Description Authors: M. Hall
Global Description Authors: M. Jankovsky-Jones, mod. J. Coles and K.A. Schulz
References: Baker 1982b, Baker 1983b, Bell et al. 2009, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Coles et al. 2008a, Driscoll et al. 1984, Hess 1981, IDCDC 2005, Johnston 1987, Jones and Fertig 1996, Jones and Ogle 2000, Kagan et al. 2004, Kittel et al. 1994, Kittel et al. 1999a, MTNHP 2002b, Peterson 2008, Walford 1996, Wasser and Hess 1982, Western Ecology Working Group n.d.

G304. Intermountain Mountain Big Sagebrush Shrubland & Steppe Group

Artemisia tridentata ssp. *vaseyana* Shrubland Alliance

Mountain Big Sagebrush Shrubland Alliance
Identifier: A0831

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe (M169)
Group	Intermountain Mountain Big Sagebrush Shrubland & Steppe Group (G304)
Alliance	***Artemisia tridentata*** **ssp.** ***vaseyana*** **Shrubland Alliance (A0831)**

GRBA COMPONENT ASSOCIATIONS

Association	*Artemisia tridentata* ssp. *vaseyana* - *Symphoricarpos oreophilus / Elymus trachycaulus* ssp. *trachycaulus* Shrubland (CEGL001034)
	Artemisia tridentata ssp. *vaseyana* - *Symphoricarpos oreophilus / Pseudoroegneria spicata* Shrubland (CEGL001038)
	Artemisia tridentata ssp. *vaseyana / Poa (glauca, secunda)* Shrubland (CEGL005423)
	Artemisia tridentata ssp. *vaseyana / Poa fendleriana* Shrubland (CEGL002812)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
GRBA Biophysical Setting (BpS)	Montane Sagebrush Steppe – upland (1126u)
	Montane Sagebrush Steppe-mountain (>9500') (1126m)
NPS-VIP Map Unit	*Artemisia tridentata* ssp. *vaseyana* / Grass Understory Shrubland Complex (S_ARTRV)
	Artemisia tridentata ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland Alliance (S_ARTSY)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This alliance is widespread in mountainous areas across the western U.S. The alliance forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests. Sites are variable and range from flats to steep slopes to ridgetops with deep to shallow rocky soil. The vegetation included in this alliance is characterized by a moderate to dense shrub layer in which *Artemisia tridentata* ssp. *vaseyana* is either dominant or contributes >40% to the total sagebrush shrub cover. Other shrub species present may include *Artemisia rigida, Artemisia arbuscula, Chrysothamnus* spp., *Symphoricarpos oreophilus, Purshia tridentata, Ribes cereum, Rosa woodsii, Ceanothus velutinus*, and *Amelanchier alnifolia*. Perennial graminoids typically dominate the herbaceous layer, but their total cover is generally <20%. Total herbaceous cover can be higher, depending on the density of the shrub layer and environmental factors. The most widespread species are *Pseudoroegneria spicata* and *Festuca idahoensis*, which occur from the Columbia Basin to the northern Rockies, although they may not be the most abundant species in individual stands. Other locally important species may include *Leymus cinereus, Leucopoa kingii (= Festuca kingii), Festuca thurberi, Festuca viridula, Pascopyrum smithii, Bromus carinatus (=Bromus marginatus), Elymus trachycaulus, Koeleria macrantha, Achnatherum occidentale (= Stipa occidentalis), Poa fendleriana, Poa secunda*, and *Bouteloua gracilis*. The forb layer is variable and can be very diverse. Species of *Castilleja, Potentilla, Erigeron, Phlox, Astragalus, Geum, Lupinus*, and *Eriogonum* are characteristic. Other common forbs include *Balsamorhiza sagittata, Achillea millefolium, Antennaria rosea*, and *Eriogonum umbellatum*. Diagnostic of this

shrubland alliance is the *Artemisia tridentata* ssp. *vaseyana* dominating the shrub layer or with >40% relative cover, and total perennial graminoid cover typically less than 20%.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from elevations ranging from 2292-3014 m (7520-9885 feet) on gentle to steep slopes. Sites are variable from upland to palustrine and include basin floor, low to high slopes, valley floors, channel beds, saddles, stream benches, ridges and summits. Parent materials may consist of colluvium, alluvium or glacial deposits. Soils are moderately well-drained to rapidly drained sandy loam, silty clay, clay loam, silt loam, silty clay loam, and loamy sand.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by an open to dense (15-60% cover) short-shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana* often codominant with *Symphoricarpos oreophilus*. Scattered individuals of *Abies concolor, Picea engelmannii, Pinus flexilis*, and *Pinus monophylla* are common. Other common shrub associates include *Amelanchier utahensis, Artemisia frigida, Artemisia tridentata* ssp. *tridentata, Chrysothamnus viscidiflorus, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens*, and *Opuntia erinacea*. Understories are characteristically dominated by bunch grasses and may form a sparse to dense (up to 70% cover) herbaceous layer. Dominant grasses include *Elymus trachycaulus* ssp. *trachycaulus, Pseudoroegneria spicata, Poa secunda, Poa glauca*, and *Poa fendleriana*. Common forbs include *Arabis holboellii, Castilleja linariifolia, Collinsia parviflora, Comandra umbellata, Crepis occidentalis, Erigeron jonesii, Eriogonum racemosum, Fritillaria atropurpurea, Hackelia patens, Lomatium foeniculaceum, Lupinus argenteus, Penstemon watsonii*, and *Senecio integerrimus*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Symphoricarpos oreophilus*
Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	Graminoid	*Elymus trachycaulus* ssp. *trachycaulus*, *Poa fendleriana*, *Poa glauca*, *Poa secunda*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Great Basin National Park: *Artemisia tridentata* ssp. *vaseyana*, *Elymus trachycaulus* ssp. *trachycaulus*, *Poa fendleriana*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CLASSIFICATION

Global Related Concepts:

- Big Sagebrush Series (Sawyer and Keeler-Wolf 1995) ><
- SRM Cover Type #402 - Mountain Big Sagebrush (Shiflet 1994) =
- Western Shrub and Grasslands Combinations: 55: Sagebrush-Steppe (*Artemisia-Agropyron*) (Kuchler 1964) ><
- Western Shrub: 38: Great Basin Sagebrush (*Artemisia*) (Kuchler 1964) ><

ELEMENT DISTRIBUTION

Great Basin National Park Range: This shrubland alliance is widespread at middle and upper elevations and is known from the Strawberry Creek area south to Pole Canyon, Baker Creek, Snake Creek, Horse Heaven, Lexington Arch, and Decathon Road.

Global Range: This shrubland alliance occurs in mountainous regions from eastern California, Oregon, and Washington, across the Great Basin in Nevada, the northern Rocky Mountain foothills of Idaho, and in Colorado, Wyoming, and Montana. It has not been reported from Utah, Arizona, or New Mexico, but it is very likely to occur in these states at high elevations. In addition, the alliance probably extends north into Alberta, Canada.

Nations: CA?, US

Federal Lands: NPS (Black Canyon of the Gunnison, Bryce Canyon, Capitol Reef, Craters of the Moon, Curecanti, Dinosaur, Fossil Butte, Grand Teton, Great Basin, Rocky Mountain, Yosemite, Zion); USFS (Arapaho-Roosevelt, Bighorn, Bridger-Teton, Deschutes, Gunnison, Medicine Bow, Routt, Shoshone, White River NF)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (23 plots): GRBA.050, GRBA.051, GRBA.098, GRBA.099, GRBA.100, GRBA.127, GRBA.246, GRBA.247, GRBA.248, GRBA.251, GRBA.420, GRBA.510, GRBA.515, GRBA.516, GRBA.706, GRBA.716, GRBA.718, GRBA.725, GRBA.726, GRBA.727, GRBA.728, GRBA.737, GRBA.749

Local Description Authors: M. Hall

Global Description Authors: D. Sarr, mod. M.S. Reid

References: Baker 1983c, Baker and Kennedy 1985, Boyce 1977, Bramble-Brodahl 1978, Caicco and Wellner 1983a, Chappell et al. 1997, Cooper et al. 1999, Current 1984, Faber-Langendoen et al. 2011, Francis 1983, Giese 1975, Hess 1981, Hess and Wasser 1982, Hironaka et al. 1983, Jensen et al. 1988a, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1987, Komarkova 1986, Kuchler 1964, Lewis 1971, Lewis 1975a, McArthur and Welch 1986, Mooney 1985, Nelson and Jensen 1987, ORNHP unpubl. data, Rzedowski 1981, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Smith 1966, Tart 1996, Terwilliger and Smith 1978, Terwilliger and Tiedemann 1978, Tiedemann et al. 1987, Tueller and Eckert 1987, West 1983c, Winward 1970

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*Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland

Utah Serviceberry - (Mountain Big Sagebrush, Wyoming Big Sagebrush) Shrubland

Identifier: CEGL002820

REVISED USNVC CLASSIFICATION

Division	Western North American Cool Semi-Desert Scrub & Grassland (3.B.1.Ne)
Macrogroup	Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe (M169)
Group	Intermountain Mountain Big Sagebrush Shrubland & Steppe Group (G304)
Alliance	*Artemisia tridentata* ssp. *vaseyana* – Mixed Shrubland Alliance (A0831)
Association	***Amelanchier utahensis - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland (CEGL002820)**

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
GRBA Biophysical Setting (BpS)	Montane Steppe (1126ms)
NPS-VIP Map Unit	*Amelanchier utahensis - (Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland (S_AMARTV)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This association has been described from Dinosaur National Monument, the Roan Plateau and the Piceance Basin in northwestern Colorado and adjacent Utah. It also occurs in southwestern Wyoming and Nevada. Sites are on level to moderately sloping hills, valleys and benches. Elevation ranges from 2165 to 2600 m, and stands may be oriented to any aspect. The deep, well-drained soils are derived from sandstone, shale, loess or limestone and range in texture from clay loam and silt loam to loamy sand. Organic litter is typically a significant component of the ground surface cover. The vegetation is characterized by the codominance in the canopy of *Artemisia tridentata* (ssp. *vaseyana* or ssp. *wyomingensis*, or sometimes a hybrid of the two) and *Amelanchier utahensis* with 15 to 55% total cover. It often takes the appearance of a tall shrubland type in which clumps of serviceberry grow in a matrix of sagebrush. Although serviceberry and sagebrush are visually dominant, in some stands *Symphoricarpos oreophilus* may have the highest cover of the three shrub species. *Chrysothamnus viscidiflorus, Mahonia repens*, and *Purshia tridentata* may be minor components of the shrub canopy. *Quercus gambelii*, if present, has less than 1% cover. Graminoids tend to dominate the well-developed herbaceous layer; typical species are *Pascopyrum smithii (= Agropyron smithii), Melica spectabilis (= Bromelica spectabilis), Carex geyeri, Koeleria macrantha, Poa fendleriana, Achnatherum nelsonii* ssp. *dorei (= Stipa columbiana), Hesperostipa comata (= Stipa comata)*, and *Achnatherum lettermanii (= Stipa lettermanii)*. The forb component of the understory is usually diverse and may contribute significant cover, especially in stands that have been grazed. *Achillea millefolium, Balsamorhiza sagittata, Comandra umbellata, Crepis acuminata, Eriogonum umbellatum, Lathyrus lanszwertii var. leucanthus (= Lathyrus leucanthus), Lupinus argenteus, Penstemon caespitosus, Sphaeralcea coccinea*, and *Viola nuttallii* are common species. *Poa pratensis* may be the dominant grass in areas that have a history of grazing.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This association is known from elevations ranging from 2390-2506 m (7839-8219 feet) on moderate to steep slopes. Sites include south- and southeast-facing mid and lower slopes on rocky substrates such as colluvium, bedrock and till. Soils are well-drained and composed of sandy loam, silty loam, and loamy sand.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by an open to dense tall-shrub layer dominated by *Amelanchier arborea* and a open short-shrub layer of *Artemisia tridentata* ssp. *tridentata*. Other common shrubs include *Chrysothamnus viscidiflorus, Eriogonum microthecum, Mahonia repens, Opuntia polyacantha, Rosa woodsii*, and *Symphoricarpos oreophilus*. The herbaceous layer is dominated by graminoids including *Poa fendleriana, Poa secunda*, and on more disturbed sites, the exotic *Bromus tectorum* may invade stands. Forb diversity may be high and include *Hackelia patens, Packera multilobata, Arabis holboellii, Astragalus tenellus, Calochortus nuttallii, Chaenactis douglasii, Collinsia parviflora, Comandra umbellata, Crepis occidentalis, Cryptantha confertiflora, Cryptantha humilis, Descurainia pinnata, Erigeron divergens, Eriogonum racemosum, Linum lewisii, Lithospermum ruderale, Lupinus argenteus, Lupinus caudatus, Mentzelia albicaulis, Penstemon eatonii, Penstemon speciosus*, and *Penstemon watsonii*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Amelanchier arborea*

Short shrub/sapling	Broad-leaved evergreen shrub	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	Graminoid	*Poa fendleriana*, *Poa secunda*

CHARACTERISTIC SPECIES

Great Basin National Park: *Amelanchier arborea*, *Artemisia tridentata* ssp. *tridentata*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Bromus tectorum* (exotic/invasive, High)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Jul-2005).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: There is some overlap between this community and the various sagebrush - snowberry associations in the IVC, but the codominance of *Artemisia tridentata* and *Amelanchier utahensis* distinguishes it from them. This association is not ecotonal between sagebrush shrublands and mixed mountain shrublands; instead, it appears to occupy its own habitat and can cover extensive areas.
Global Related Concepts:

- Mixed Montane Shrublands (Keammerer and Stoecker 1975) >
- Serviceberry - Sagebrush Shrubland (Keammerer and Peterson 1981) =
- Upland Sagebrush Community (Keammerer and Stoecker 1975) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This shrubland is known from Snake Creek and Big Wash.
Global Range: This association is currently known from the highlands of Dinosaur National Monument and Black Canyon of the Gunnison National Park, as well as the Roan Plateau and Piceance Basin in northwestern Colorado and northeastern Utah. It also occurs at Fossil Butte National Monument in southwestern Wyoming and is likely more widespread.
Nations: US
States/Provinces: CO, NV, UT, WY
Federal Lands: NPS (Black Canyon of the Gunnison, Curecanti, Dinosaur, Fossil Butte, Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (3 plots): GRBA.044, GRBA.313, GRBA.703.
Local Description Authors: M. Hall
Global Description Authors: J. Coles, mod. K.A. Schulz
References: Coles et al. 2008a, Coles et al. 2010, Keammerer and Peterson 1981, Keammerer and Stoecker 1975, Western Ecology Working Group n.d.

4. Polar & High Montane Scrub & Grassland

4.B.1. Alpine Scrub, Forb Meadow & Grassland

4.B.1.Nb. Western North American Alpine Scrub, Forb Meadow & Grassland

M099. Rocky Mountain Alpine Scrub, Forb Meadow & Grassland

G316. Rocky Mountain Alpine Dwarf-Shrubland Group

Ribes (cereum, montigenum) - Ericameria discoidea Shrubland [Provisional]

(Wax Currant, Western Prickly Gooseberry) - White-stem Goldenbush Shrubland
Identifier: CEGL005445

REVISED USNVC CLASSIFICATION

Division	Western North American Alpine Scrub, Forb Meadow & Grassland (4.B.1.Nb)
Macrogroup	Rocky Mountain Alpine Scrub, Forb Meadow & Grassland (M099)
Group	Rocky Mountain Alpine Dwarf-Shrubland (G316)
Alliance	*Ribes montigenum* Shrubland Alliance (A0926)
Association	***Ribes (cereum, montigenum) - Ericameria discoidea* Shrubland [Provisional] (**CEGL005445)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine Turf (CES306.816)
GRBA Biophysical Setting (BpS)	Limber-Bristlecone Pine Woodland – mesic (1020m), Class A Spruce (1056), Class A Alpine (1144), Class B
NPS-VIP Map Unit	*Ribes montigenum* (*Juniperus communis*) Shrubland Complex (S_RMJC)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This high-elevation shrubland association is known from 3107-3462 m (10,190-11,355 feet) on moderate to somewhat steep slopes. Sites include high slopes and avalanche chutes on rocky substrates that include colluvium, bedrock and till. Soils are well-drained to rapidly drained soils composed of loamy sand and silt loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This association is characterized by a sparse to open short- or dwarf-shrub layer dominated by *Ribes montigenum, Ribes cereum*, and *Ericameria discoidea*. Scattered trees, including *Picea engelmannii* and *Pinus flexilis*, may be present. The only other shrubs documented include *Juniperus communis* and *Ceanothus martinii*. The herbaceous layer is sparse to open and diverse. Common species include *Arenaria congesta, Artemisia michauxiana, Astragalus kentrophyta var. tegetarius, Elymus elymoides, Erigeron tener, Eriogonum umbellatum, Monardella odoratissima, Phlox pulvinata, Poa fendleriana, Poa secunda, Trifolium gymnocarpon*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Ericameria discoidea*, *Ribes cereum*, *Ribes montigenum*
Herb (field)	Graminoid	*Poa fendleriana*

CHARACTERISTIC SPECIES

Great Basin National Park: *Ericameria discoidea*, *Ribes cereum*, *Ribes montigenum*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Exotic/Invasive: *Taraxacum officinale* (exotic/invasive)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Dec-2010).

CLASSIFICATION

Status: Provisional

ELEMENT DISTRIBUTION

Great Basin National Park Range: This association is known from Wheeler Peak, Bald Mountain and Lincoln Peak.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (4 plots): GRBA.208, GRBA.231, GRBA.325, GRBA.503.
Local Description Authors: M.E. Hall
References: Western Ecology Working Group n.d.

G314. Rocky Mountain Alpine Turf & Fell-Field

***Carex elynoides - Kobresia myosuroides - Phlox pulvinata* Alpine Turf & Fell-Field Group**
Blackroot Sedge - Pacific Bog Sedge - Cushion Phlox Alpine Turf & Fell-Field Group
Identifier: G314

REVISED USNVC CLASSIFICATION

Division	Western North American Alpine Scrub, Forb Meadow & Grassland (4.B.1.Nb)
Macrogroup	Rocky Mountain Alpine Scrub, Forb Meadow & Grassland (M099)
Group	**Rocky Mountain Alpine Turf & Fell-Field (G314)**
Group (Scientific)	***Carex elynoides - Kobresia myosuroides - Phlox pulvinata* Alpine Turf & Fell-Field Group (G314)**

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	*Aquilegia scopulorum - Eriogonum holmgrenii - Geum rossii* Alpine Fell-field Herbaceous Alliance (A2702)
Association	*Aquilegia scopulorum - Eriogonum holmgrenii* Fell-field Herbaceous Vegetation (CEGL005421)
	Astragalus kentrophyta - Eriogonum holmgrenii Fell-field Herbaceous Vegetation [Park Special] (CEPS009597)
	Cymopterus nivalis - Erigeron leiomerus - Poa secunda Herbaceous Vegetation [Park Special] (CEPS009600)
	Geum rossii - Phlox pulvinata Fell-field Herbaceous Vegetation (CEGL005428)
Alliance	*Carex elynoides* Herbaceous Alliance (A1303)
Association	*Carex elynoides - Geum rossii* Herbaceous Vegetation (CEGL001853)
	Carex elynoides - Phlox pulvinata - Poa secunda Herbaceous Vegetation (CEGL005424)
Alliance	*Geum rossii* Herbaceous Alliance (A1645)
Associatin	*Geum rossii - Calamagrostis purpurascens* Herbaceous Vegetation [Park Special] (CEPS009602)
	Geum rossii Herbaceous Vegetation (CEGL001964)
Alliance	*Lomatium graveolens* var. *alpinum* Herbaceous Alliance [Placeholder] (A2045)
Association	*Lomatium graveolens* var. *alpinum* Herbaceous Vegetation [Park Special] (CEGL002740)
Alliance	*Phlox pulvinata* Herbaceous Alliance (A1651)

Association	*Phlox pulvinata* Herbaceous Vegetation [Provisional] (CEGL002740)

OTHER CLASSIFICATIONS

Ecological Systems	Rocky Mountain Alpine Fell-Field (CES306.811) Rocky Mountain Alpine Turf (CES306.816)
GRBA Biophysical Setting (BpS)	Alpine (1144)
NPS-VIP Map Units	Alpine Cushion Plant Fell-field Complex (SV_FELL) Alpine Turf Complex (H_TURF)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This widespread group occurs at and above upper treeline throughout the Rocky Mountain cordillera and alpine areas of mountain ranges in Utah and Nevada, and isolated alpine sites in the northeastern Cascades. It includes both wind-scoured fell-fields and dry turf. Fell-fields are typically free of snow during the winter as they are found on ridgetops, upper slopes and exposed saddles, whereas dry turf is found on gentle to moderate slopes, flat ridges, valleys, and basins where the soil has become relatively stabilized and the water supply is more-or-less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. Fell-field substrates are generally shallow, stony, low in organic matter, and poorly developed with wind deflation often resulting in a gravelly pavement. Alpine turf sites have deeper, more developed soils, although there may be moderately high cover of cobbles and boulders present.

The vegetation is generally composed of low-growing perennial forbs and graminoids. On fell-field sites, total vegetation cover ranges from sparse to moderate cover dominated by cushion plants, whereas on turf sites, it ranges from open to moderately dense or dense cover dominated by graminoids or a mixture of graminoids and forbs (especially cushion plants). The graminoids are typically rhizomatous, sod-forming sedges such as *Carex elynoides, Carex scirpoidea, Carex siccata, Carex nardina, Carex rupestris*, and *Kobresia myosuroides*. Most fell-field plants are cushioned or matted, frequently succulent, flat to the ground in rosettes, and often densely haired and thickly cutinized. Common species include *Arenaria capillaris, Geum rossii, Minuartia obtusiloba, Myosotis asiatica, Paronychia pulvinata, Phlox pulvinata, Silene acaulis, Trifolium dasyphyllum*, and *Trifolium parryi*. Many other graminoids, forbs, and prostrate shrubs can also be found, including *Calamagrostis purpurascens, Deschampsia caespitosa, Dryas octopetala, Festuca brachyphylla, Festuca idahoensis, Leucopoa kingii, Poa arctica, Poa glauca, Poa secunda* (Great Basin), *Saxifraga* spp., *Selaginella densa, Solidago* spp., and *Polygonum bistortoides*. Fell-fields are usually found within or adjacent to alpine dry turf with many of the same prostrate and mat-forming plants found in both, frequently with broad transition zones.

Although alpine dry turf may form the matrix or large patches of the alpine zone, it typically intermingles with alpine bedrock and scree, ice field, fell-field, alpine dwarf-shrubland, and alpine/subalpine wet meadow systems. Great Basin alpine areas tend to be drier with smaller turf patches and include some species common in desert scrub such as *Poa secunda*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This group is known from elevations ranging from 3043-3981 m (9981-13,057 feet) on gentle to steep slopes. Sites include exposed and windswept midslopes, high slopes, swales, benches, ridges and summits on rocky substrates including

colluvium, glacial deposits and bedrock. The system may be classified as upland or palustrine. Soils are

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This group is represented by forb, graminoid or mixed forb/graminoid herbaceous associations which may be very sparse to dense with up to 80% herbaceous cover. Woody species are almost nonexistent, but an occasional tree or shrub may be present. Dominant species include *Aquilegia scopulorum, Astragalus platytropis, Calamagrostis purpurascens, Carex elynoides, Castilleja nana, Cymopterus nivalis, Erigeron leiomerus, Eriogonum holmgrenii, Festuca brachyphylla, Geum rossii, Packera werneriifolia, Phlox pulvinata, Poa secunda, Potentilla rubricaulis, Selaginella watsonii*, and *Silene acaulis*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Forb	*Aquilegia scopulorum*, *Astragalus platytropis*, *Eriogonum holmgrenii*, *Geum rossii*, *Monardella odoratissima*, *Phlox pulvinata*
Herb (field)	Graminoid	*Calamagrostis purpurascens*, *Carex elynoides*, *Poa secunda*

CHARACTERISTIC SPECIES

Great Basin National Park: *Aquilegia scopulorum*, *Astragalus platytropis*, *Calamagrostis purpurascens*, *Eriogonum holmgrenii*, *Geum rossii*, *Monardella odoratissima*, *Phlox pulvinata*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Aquilegia scopulorum* (endemic, G3?), *Eriogonum holmgrenii* (endemic, G1)

CLASSIFICATION

Classification Confidence: 2 - Moderate

Global Comments: Alpine turf and fell-field are included together for several reasons. Although these types can be quite different and can have relatively abrupt boundaries in saddles, there is often a long transition on broad alpine slopes.

Global Related Concepts:

- AT Alpine Tundra (mesic to dry sites) (Ecosystems Working Group 1998) >
- Alpine Rangeland (410) (Shiflet 1994) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alpine group is known from high-elevation sites on Bald Mountain, Baker Ridge, Pyramid Peak, Mount Washington, Lincoln Peak, and Highland Ridge.

Global Range: This group occurs above upper treeline throughout the North American Rocky Mountain cordillera, including alpine areas of ranges in the Great Basin, and isolated alpine sites in the northeastern Cascades.

Nations: CA, US

Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (17 plots): GRBA.196, GRBA.197, GRBA.198, GRBA.306, GRBA.307, GRBA.322,

GRBA.323, GRBA.324, GRBA.326, GRBA.327, GRBA.422, GRBA.424, GRBA.426, GRBA.428, GRBA.817, GRBA.901, GRBA.903.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Baker 1980a, Bamberg 1961, Bamberg and Major 1968, Billings 2000, Cooper et al. 1997, Ecosystems Working Group 1998, Faber-Langendoen et al. 2011, Komarkova 1976, Komarkova 1980, Shiflet 1994, Willard 1963, Zwinger and Willard 1996

Aquilegia scopulorum - Eriogonum holmgrenii - Geum rossii Alpine Fell-field Herbaceous Alliance

Utah Columbine - Snake Range Buckwheat - Ross' Avens Alpine Fell-field Herbaceous Alliance
Identifier: A2702

REVISED USNVC CLASSIFICATION

Division	Western North American Alpine Scrub, Forb Meadow & Grassland (4.B.1.Nb)
Macrogroup	Rocky Mountain Alpine Scrub, Forb Meadow & Grassland (M099)
Group	Rocky Mountain Alpine Turf & Fell-Field (G314)
Alliance	***Aquilegia scopulorum - Eriogonum holmgrenii - Geum rossii* Alpine Fell-field Herbaceous Alliance (A2702)**

GRBA COMPONENT ASSOCIATIONS

Association	*Aquilegia scopulorum - Eriogonum holmgrenii* Fell-field Herbaceous Vegetation (CEGL005421)
	Astragalus kentrophyta - Eriogonum holmgrenii Fell-field Herbaceous Vegetation [Park Special] (CEPS009597)
	Cymopterus nivalis - Erigeron leiomerus - Poa secunda Herbaceous Vegetation [Park Special] (CEPS009600)
	Geum rossii - Phlox pulvinata Fell-field Herbaceous Vegetation (CEGL005428)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine Fell-Field (CES306.811)
GRBA Biophysical Setting (BpS)	Alpine (1144)
NPS-VIP Map Unit	Alpine Cushion Plant Fell-field Complex (SV_FELL)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This herbaceous alliance is known from alpine zones at elevations ranging from 3422-3535 m (11224-1160 feet) on moderate to somewhat steep slopes. Sites include high slopes, ridges and summits on all aspects. Substrates are very rocky and include bedrock, till and talus derived from quartzite sandstone, schist and limestone. Soils are thin and include moderately well-drained to rapidly drained sandy loam, silty clay, clay loam, and silt loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This alliance is characterized by a sparse to open herbaceous layer dominated mostly by forbs, including *Aquilegia scopulorum, Eriogonum holmgrenii, Geum rossii, Phlox pulvinata, Erigeron leiomerus, Astragalus kentrophyta, Cymopterus nivalis*, or in some cases the graminoid *Poa secunda*. Occasional stunted *Picea engelmannii* and *Pinus longaeva* may be present but scattered. The shrub layer is essentially absent. Other herbaceous species that may be present include *Castilleja nana, Carex elynoides, Cerastium beeringianum, Elymus scribneri, Erigeron compositus, Erigeron simplex, Festuca brachyphylla, Packera werneriifolia, Potentilla diversifolia, Potentilla rubricaulis, Primula nevadensis, Symphyotrichum foliaceum*, and *Trifolium gymnocarpon*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Forb	*Aquilegia scopulorum*, *Astragalus kentrophyta*, *Cymopterus nivalis*, *Erigeron leiomerus*, *Eriogonum holmgrenii*, *Geum rossii*, *Phlox pulvinata*
Herb (field)	Graminoid	*Poa secunda*

CHARACTERISTIC SPECIES

Great Basin National Park: *Aquilegia scopulorum*, *Astragalus kentrophyta*, *Cymopterus nivalis*, *Erigeron leiomerus*, *Eriogonum holmgrenii*, *Geum rossii*, *Phlox pulvinata*, *Poa secunda*

OTHER NOTEWORTHY SPECIES

Great Basin National Park: Vulnerable: *Aquilegia scopulorum* (endemic, G3?), *Eriogonum holmgrenii* (endemic, G1), *Primula nevadensis* (endemic, G2)

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Mount Washington, Lincoln Peak, Baldy Point, and Pyramid Peak.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003, 2008 and 2009 field data (7 plots): GRBA.196, GRBA.197, GRBA.198, GRBA.306, GRBA.324, GRBA.422, GRBA.817.
Local Description Authors: M.E. Hall
References: Western Ecology Working Group n.d.

Carex elynoides Herbaceous Alliance

Blackroot Sedge Herbaceous Alliance
Identifier: A1303

REVISED USNVC CLASSIFICATION

Division	Western North American Alpine Scrub, Forb Meadow & Grassland (4.B.1.Nb)
Macrogroup	Rocky Mountain Alpine Scrub, Forb Meadow & Grassland (M099)
Group	Rocky Mountain Alpine Turf & Fell-Field (G314)
Alliance	***Carex elynoides* Herbaceous Alliance (A1303)**

GRBA COMPONENT ASSOCIATIONS

Association	*Carex elynoides* - *Geum rossii* Herbaceous Vegetation (CEGL001853)
	Carex elynoides - *Phlox pulvinata* - *Poa secunda* Herbaceous Vegetation (CEGL005424)

OTHER CLASSIFICATIONS

Ecological Systems	Rocky Mountain Alpine Turf (CES306.816)
GRBA Biophysical Setting (BpS)	Alpine (1144)
NPS-VIP Map Unit	Alpine Turf Complex (H_TURF)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: Vegetation types within this short alpine or subalpine sod grassland alliance occur on open, dry, windswept slopes at high elevations in the Rocky Mountains. Sites occupy gentle to moderately sloping (3-26%) upland terrain of southerly to easterly exposures at elevations ranging from 2400 to 4200 m. Stands are found on granitic or metamorphic

colluvium. Soils are skeletal and loamy. Coarse fragments are abundant, and pH varies from 5.4 to 6.6. They are found on well-drained sites which receive little or no snow cover. Stands on Trail Ridge, Colorado, are free of snow and frost very early; plants were observed blooming in mid May. Most moisture is received from summer rains. *Carex elynoides* dominates the graminoid layer with at least 60% cover, forming an extensive turf. *Kobresia myosuroides* commonly occurs with *Carex elynoides* in the graminoid stratum. Typically the forb layer is conspicuous with at least 20% cover. Forb species include *Geum rossii, Trifolium dasyphyllum, Arenaria fendleri, Oreoxis alpina* (*Oreoxis bakeri* in New Mexico stands), *Potentilla diversifolia*, and *Phlox caespitosa*. *Selaginella densa* is commonly found in the fern layer.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known at Great Basin from elevations ranging from 3435-3520 m (11,226-11,545 feet) on gentle to steep slopes (9-70%). Topographic positions include high slopes, high levels and summits on southwest and north aspects. Substrates include loam and silt loam soils derived of quartzite and limestone.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This herbaceous alliance is characterized by open stands of *Carex elynoides* ranging from 20-40% cover. Trace cover of short shrubs *Ericameria discoidea* and *Ribes montigenum* may be present. Many other herbaceous species may be present but are never codominant. Graminoids may include *Poa secunda, Festuca brachyphylla, Poa glauca* spp. *rupicola, Elymus elymoides*, and *Elymus scribneri*. Forb diversity is high with the only constant species being *Phlox pulvinata*. Other forbs include *Geum rossii, Arenaria congesta, Potentilla glandulosa* spp. *nevadensis, Astragalus platytropis, Cymopterus nivalis, Erigeron leiomerus, Trifolium gymnocarpon, Androsace septentrionalis, Antennaria corymbosa, Antennaria microphylla, Antennaria rosea, Arabis drummondii*, and *Astragalus kentrophyta*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex elynoides*

CHARACTERISTIC SPECIES

Great Basin National Park: *Carex elynoides*, *Phlox pulvinata*

CLASSIFICATION

Global Related Concepts:

- *Carex* spp. Series (Johnston 1987) B

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alpine turf alliance occurs on several of the major peaks and was sampled on Bald Mountain and Lincoln Peak including Highland Ridge.
Global Range: This alliance has been described from mountains of Idaho, Montana, Colorado, Nevada, and New Mexico. It likely occurs in Utah and Wyoming.
Nations: US
States/Provinces: CO, ID, NV, MT, NM,
Federal Lands: NPS (Great Basin, Great Sand Dunes, Rocky Mountain); USFS (Arapaho-Roosevelt, Beaverhead, Challis, Lolo, Salmon)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2008 and 2009 field data (5 plots): GRBA.307, GRBA.323, GRBA.326, GRBA.327, GRBA.903.

Local Description Authors: M. Hall
Global Description Authors: D. Culver
References: Baker 1980a, Baker 1983a, Bamberg 1961, Benedict 1977b, Braun 1969, Caicco 1983, Cooper and Lesica 1992, Eddleman 1963, Eddleman 1967, Faber-Langendoen et al. 2011, Hermann 1970, Hess 1981, Johnson 1970a, Johnston 1987, Komarkova 1976, Komarkova and Webber 1978, Langenheim 1962, Loder 1964, Marr and Willard 1970, Moir and Smith 1970, Moseley 1985, Olmsted and Taylor 1977a, Paulsen 1960, Ramaley 1919a, Scott-Williams 1965, Starr 1983, Welden 1981, Welden 1985, Willard 1963, Willard 1979

6. Rock Vegetation

6.B.2. Temperate & Boreal Cliff, Scree & Rock Vegetation

6.B.2.Nb. Western North American Temperate Cliff, Scree & Rock Vegetation

M113. Rocky Mountain Cliff, Scree & Rock Vegetation

G565. Rocky Mountain Cliff, Scree & Rock Vegetation

Nonvascular Rocky Mountain Cliff, Scree & Rock Group

Nonvascular Rocky Mountain Cliff, Scree & Rock Group
Identifier: G565

REVISED USNVC CLASSIFICATION

Division	Western North American Temperate Cliff, Scree & Rock Vegetation (6.B.2.Nb)
Macrogroup	Rocky Mountain Cliff, Scree & Rock Vegetation (M113)
Group	**Rocky Mountain Cliff, Scree & Rock Vegetation (G565)**
Group (Scientific)	**Nonvascular Rocky Mountain Cliff, Scree & Rock Group (G565)**

GRBA COMPONENT ALLIANCES AND ASSOCIATIONS

Alliance	Hulsea algida Herbaceous Alliance (A2615)
Association	*Hulsea algida* - *Selaginella watsonii* Herbaceous Vegetation [Provisional] (CEGL005429)
Alliance	Polemonium - Castilleja - Ribes - Trisetum Alpine Rock Sparse Vegetation [Provisional] (A2711)
Association	*Petrophyton caespitosum* Sparse Vegetation [Park Special] (CEPS009605)
	Polemonium viscosum - *Castilleja nana* Alpine Rock Sparse Vegetation [Provisional] (CEGL005443)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine Bedrock and Scree (CES306.809)
GRBA Biophysical Setting (BpS)	NA
NPS-VIP Map Unit	Bare Talus, Scree and Fell-fields (G_TALS)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This group consists of barren and sparsely vegetated rock outcrops and cliff faces located throughout the Rocky Mountains west into Great Basin and northeastern Cascade Ranges. These sparsely vegetated surfaces (generally <10% plant cover) are found from foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous (intrusives), sedimentary, and metamorphic bedrock types. It also occurs on unstable scree and talus slopes that can occur below cliff faces. In general these are the dry, sparsely vegetated places. The biota reflects what is surrounding them, unless it is an extreme parent material. There is often very high cover of nonvascular lichens and, in wetter places, mosses. There may be small patches of dense vascular vegetation and can include scattered trees and/or

shrubs. Characteristic trees include species from the surrounding landscape, such as *Pseudotsuga menziesii, Pinus ponderosa, Pinus flexilis, Populus tremuloides, Abies concolor, Abies lasiocarpa*, or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present, such as species of *Holodiscus, Ribes, Physocarpus, Rosa, Juniperus*, and *Jamesia americana, Mahonia repens, Rhus trilobata*, or *Amelanchier alnifolia*. Soil development is limited, as is herbaceous cover. Characteristic nonvascular species information is not available

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This ecological group is known from elevations ranging from 3155-3635(10,348-11,933 feet) on flat to steep slopes. Sites include low to high slopes, ridges and summits on moraines with substrates composed of talus, scree, bedrock and glacial till. Soils are extremely thin and rapidly drained.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This sparsely vegetated group is characterized by herbaceous or dwarf-shrub physiognomy. Total cover does not exceed 10% and may be as little as 1%. The characteristic dwarf-shrub is *Petrophyton caespitosum*. Dominant herbaceous species include *Hulsea algida, Polemonium viscosum, Castilleja nana*, and *Selaginella watsonii*. *Ribes montigenum, Ericameria discoidea*, and *Juniperus communis* are common shrub associates. Other herbaceous species may include *Androsace septentrionalis, Arenaria congesta, Astragalus kentrophyta, Astragalus kentrophyta var. tegetarius, Erigeron tener, Eriogonum holmgrenii, Phlox pulvinata, Poa secunda, Potentilla nivea*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Dwarf-shrub	*Petrophyton caespitosum*
Herb (field)	Forb	*Castilleja nana*, *Hulsea algida*, *Polemonium viscosum*, *Selaginella watsonii*

CHARACTERISTIC SPECIES

Great Basin National Park: *Castilleja nana*, *Hulsea algida*, *Petrophyton caespitosum*, *Polemonium viscosum*, *Selaginella watsonii*

CLASSIFICATION

Global Comments: Need moss and other nonvascular species information.

Global Related Concepts:

- CL Cliff (Ecosystems Working Group 1998) >
- RO Rock (Ecosystems Working Group 1998) >
- TA Talus (Ecosystems Working Group 1998) >

ELEMENT DISTRIBUTION

Great Basin National Park Range: This group is known from Chinese Wall, the Glacier Trail and Pyramid Peak.

Global Range: This group is located throughout the Rocky Mountain, including the isolated island ranges of central Montana, Great Basin and northeastern Cascade Ranges in western North America.

Nations: CA, US

States/Provinces: AB, AZ, BC, CO, ID, MT, NM, NV, OR, TX, UT, WA, WY

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (6 plots): GRBA.228, GRBA.229, GRBA.230, GRBA.232, GRBA.506, GRBA.902.
Local Description Authors: M. Hall
Global Description Authors: G. Kittel and M.S. Reid
References: Andrews and Righter 1992, Comer et al. 2003, Ecosystems Working Group 1998, Faber-Langendoen et al. 2011, Hess and Wasser 1982, Larson et al. 2000a, NCC 2002, Neely et al. 2001, Peet 1981

Polemonium spp. - *Castilleja* spp. - *Ribes* spp. - *Trisetum* spp. Alpine Rock Sparsely Vegetated Alliance [Provisional]

Jacob's-ladder species - Indian-paintbrush species - Currant species - Oatgrass species Alpine Rock Sparsely Vegetated Alliance
Identifier: A2711

REVISED USNVC CLASSIFICATION

Division	Western North American Temperate Cliff, Scree & Rock Vegetation (6.B.2.Nb)
Macrogroup	Rocky Mountain Cliff, Scree & Rock Vegetation (M113)
Group	Rocky Mountain Cliff, Scree & Rock Vegetation Group (G565)
Alliance	***Polemonium* spp. - *Castilleja* spp. - *Ribes* spp. - *Trisetum* spp. Alpine Rock Sparsely Vegetated Alliance [Provisional] (A2711)**

GRBA COMPONENT ASSOCIATIONS

Association	*Petrophyton caespitosum* Sparse Vegetation [Park Special] (CEPS009605)
Association	*Polemonium viscosum* - *Castilleja nana* Alpine Rock Sparse Vegetation [Provisional] (CEGL005443)

OTHER CLASSIFICATIONS

Ecological System	Rocky Mountain Alpine Bedrock and Scree (CES306.809)
GRBA Biophysical Setting (BpS)	NA
NPS-VIP Map Unit	Bare Talus, Scree and Fell-fields (G_TALS)
USFWS Wetland Classification	Upland

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This alliance is known from elevations ranging from 3155-3635(10,348-11,933 feet) on flat to steep slopes. Sites include low to high slopes, ridges and summits on moraines with substrates composed of talus, scree, bedrock and glacial till. Soils are extremely thin and rapidly drained.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This sparsely vegetated group is characterized by herbaceous or dwarf-shrub physiognomy. Total cover does not exceed 10% and may be as little as 1%. The characteristic dwarf-shrub is *Petrophyton caespitosum*. Dominant herbaceous species include *Polemonium viscosum, Castilleja nana*, and *Selaginella watsonii*. *Ribes montigenum, Ericameria discoidea*, and *Juniperus communis* are common shrub associates. Other herbaceous species may include *Androsace septentrionalis, Arenaria congesta, Astragalus kentrophyta, Astragalus kentrophyta var. tegetarius, Erigeron tener, Eriogonum holmgrenii, Phlox pulvinata, Poa secunda, Potentilla nivea*, and *Trisetum spicatum*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Herb (field)	Dwarf-shrub	*Petrophyton caespitosum*

Herb (field)	Forb	*Castilleja nana*, *Polemonium viscosum*, *Selaginella watsonii*

CHARACTERISTIC SPECIES

Great Basin National Park: *Castilleja nana*, *Petrophyton caespitosum*, *Polemonium viscosum*, *Selaginella watsonii*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Jan-2011).

CLASSIFICATION

Status: Provisional

ELEMENT DISTRIBUTION

Great Basin National Park Range: This alliance is known from Chinese Wall, the Glacier Trail and Pyramid Peak.
Nations: US
States/Provinces: NV
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2003 and 2009 field data (5 plots): GRBA.228, GRBA.229, GRBA.230, GRBA.506, GRBA.902.
Local Description Authors: M. Hall
Global Description Authors:
References: Western Ecology Working Group n.d.

6.C.2. Cool Semi-Desert Cliff, Scree & Rock Vegetation

6.C.2.Nb. North American Cool Semi-Desert Cliff, Scree & Rock Vegetation

M118. Intermountain Basin Cliff, Scree & Badland Sparse Vegetation

G570. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

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Atriplex spp. - *Cercocarpus* spp. - *Ephedra* spp. Intermountain Basins Sparse Vegetation Group

Saltbush species - Mountain-mahogany species - Joint-fir species Intermountain Basins Sparse Vegetation Group
Identifier: G570

REVISED USNVC CLASSIFICATION

Division	North American Cool Semi-Desert Cliff, Scree & Rock Vegetation (6.C.2.Nb)
Macrogroup	Rocky Mountain Cliff, Scree & Rock Vegetation (M118)
Group	**Intermountain Cliff, Scree & Badland SparseVegetation (G570)**
Group (Scientific)	***Atriplex* spp. - *Cercocarpus* spp. - *Ephedra* spp. Intermountain Basins Sparse Vegetation Group (G570)**

GRBA COMPONENT ALLIANCE AND ASSOCIATIONS

Alliance	Sparse Wooded Vegetation Alliance (A2705)
Association	*Abies concolor* Rock Outcrop Sparse Vegetation [Park Special] (CEPS009594)
Association	*Cercocarpus ledifolius* Rock Outcrop Sparse Vegetation [Park Special] (CEPS009599)
Association	*Pinus flexilis* Bedrock Sparse Vegetation [Park Special] (CEPS009606)

OTHER CLASSIFICATIONS

Ecological System	Inter-Mountain Basins Cliff and Canyon (CES304.779)
GRBA Biophysical Setting (BpS)	NA
NPS-VIP Map Unit	Bare Talus, Scree and Fell-fields (G_TALS)
USFWS Wetland Classification	Upland

ELEMENT CONCEPT

Global Summary: This group consists of barren and sparsely vegetated substrates from a variety of landscapes in the interior western U.S. from the Columbia Plateau south to the Great Basin and Colorado Plateau, east into Wyoming basins and plains. Landforms include cliffs and canyon sides, mesas and plateaus, and mountains. Sparse vegetation also occurs on special substrates such as shale outcrops, active sand dunes, badlands and volcanic deposits such as lava, cinder, ash, tuff and basalt dikes. Rock substrates include bedrock and unstable talus and scree slopes. Some substrates, such as marine shales, are strongly alkaline and/or saline which chemically limits plant growth. Active substrates such as scree slopes are difficult sites for plants to grow. Physical properties of substrates may also limit plant growth. Some massive rock substrates lack cracks where vascular plants can root. Badland sites often have heavy clay soils that reduce water infiltration increasing erosion rates and reducing soil moisture for plants. Vegetation is variable depending on environmental variables of the sites, which range from relatively low-elevation semi-desert to subalpine cliffs and rock outcrops. Lower elevation sites often have herbaceous or shrub species present, whereas foothill, montane and subalpine sites may also include trees. Most of the species also occur in non-sparse vegetation groups. However, some of the sites with harsh soil properties have a high number of endemic perennial species. Characteristic shrub species in lower elevation semi-desert, lava field, and badland areas include *Artemisia tridentata, Atriplex canescens, Atriplex corrugata, Atriplex gardneri, Artemisia pedatifida, Atriplex confertifolia, Ephedra* spp., *Eriogonum corymbosum, Eriogonum ovalifolium, Fallugia paradoxa, Grayia spinosa, Purshia tridentata, Salvia dorrii*, and *Sarcobatus vermiculatus*. Characteristic herbs include species of *Achnatherum, Camissonia, Cleome, Eriogonum*, and *Mentzelia*. Foothill sites include *Pinus edulis* and *Pinus ponderosa* (Colorado Plateau), *Pinus monophylla, Pinus longaeva* (Great Basin), *Juniperus osteosperma, Cercocarpus intricatus, Cercocarpus ledifolius*, and *Ephedra* spp. At montane and subalpine elevations, scattered trees may be present, such as *Pinus ponderosa, Pinus flexilis, Abies concolor, Pseudotsuga menziesii*, and *Picea engelmannii*. Shrubs may include *Arctostaphylos patula, Artemisia tridentata, Cercocarpus ledifolius, Ephedra* spp., *Holodiscus* spp., and *Purshia tridentata*.

ENVIRONMENTAL DESCRIPTION

Great Basin National Park Environment: This sparsely vegetated or wooded group is known from elevations ranging from 2632-2975 m on gentle to very steep slopes. Sites include exposed low slopes, high slopes, outcrops and cliffs with substrates composed of limestone. Soils are composed of moderately well-drained to rapidly drained silt loam and sandy loam.

VEGETATION DESCRIPTION

Great Basin National Park Vegetation: This group is characterized by sparse wooded vegetation not exceeding 5% cover. Dominant species may include short-statured *Abies concolor, Cercocarpus ledifolius*, or *Pinus flexilis*. Numerous shrubs may be present at low or trace cover, the most common of which are *Symphoricarpos oreophilus, Cercocarpus ledifolius*, and *Juniperus communis*. The only notable herbaceous species are *Hesperostipa comata* and *Penstemon watsonii*.

MOST ABUNDANT SPECIES

Great Basin National Park

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies concolor*, *Pinus flexilis*
Tree canopy	Broad-leaved evergreen tree	*Cercocarpus ledifolius*

CHARACTERISTIC SPECIES

Great Basin National Park: *Abies concolor*, *Cercocarpus ledifolius*, *Pinus flexilis*
Classification Confidence: 2 - Moderate
Global Comments: This group is very diverse floristically and so it is difficult to determine indicator species. More diagnostic is the sparse cover of vascular plants and/or presence and sometimes dominance of nonvascular (lichen) species. This broadly defined lithomorphic group was developed by NatureServe.
Global Related Concepts:

- Littleleaf Mountain-Mahogany (417) (Shiflet 1994) ><
- Pinyon - Juniper: 239 (Eyre 1980) ><

ELEMENT DISTRIBUTION

Great Basin National Park Range: Although widespread in the park, stands in this group were only sampled from below Mount Washington and near Granite Peak.
Global Range: This barren and sparsely vegetated group occurs in the interior western U.S. from the Columbia Plateau south to the Great Basin and Colorado Plateau, east into Wyoming basins and plains.
Nations: US
States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY
Federal Lands: NPS (Great Basin)

ELEMENT SOURCES

Great Basin National Park Plots: This description is based on 2008 and 2009 field data (3 plots): GRBA.319, GRBA.507, GRBA.513.
Local Description Authors: M. Hall
Global Description Authors: K.A. Schulz
References: Barbour and Billings 2000, Brodo et al. 2001, Day and Wright 1985, Eyre 1980, Faber-Langendoen et al. 2011, Graybosch and Buchanan 1983, Hansen et al. 2004c, Shiflet 1994, Tisdale et al. 1965, Welsh 1979, Welsh and Chatterly 1985

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FIELD DEFINITIONS FOR LOCAL AND GLOBAL DESCRIPTIONS

Local descriptions describe vegetation associations as they occur at specific National Parks. Data from field observation points and quantitative plots were used to write the local, park-specific descriptions. These descriptions were entered into NatureServe Central Databases and reports with local and global descriptions for each association were generated for each Park. The following section lists the content of those reports with definitions of each field in the report.

- **rUSNVC Scientific Name (local and global)**

The standard Association, Alliance or Group name from rUSNVC databases, based on Latin names of dominant and diagnostic plant species. The Association is the finest level of the Revised USNVC. Species occurring in the same stratum are separated by a hyphen (-), and those occurring in different strata are separated by a slash (/). Species occurring in the uppermost strata are listed first, followed successively by those in lower strata. Within the same stratum, the order of species names generally reflects decreasing levels of dominance, constancy, or indicator value. In physiognomic types where there is a dominant herbaceous layer with a scattered woody layer, Association names can be based on species found in either the herbaceous layer or the woody layer, whichever is more diagnostic of the type. If both layers are used, then the uppermost layer is always listed first, regardless of which may be more diagnostic.

Species less consistently found in all occurrences of the Association are placed in parentheses (). In cases where a particular genus is dominant or diagnostic, but individual species of the genus may vary among occurrences, only the specific epithets are placed in parentheses. Association names conclude with the Class Name in which they are classified.

In cases where diagnostic species are unknown or in question, a more general term may be used as a species placeholder (e.g., *Sphagnum* spp., Mixed Herbs, Mesic Graminoids). An environmental or geographic term, or one that is descriptive of the height of the vegetation (e.g., Dwarf Forest, Northern Shrubland), can also be used as a modifier when such a term is necessary to adequately characterize the Association. For reasons of standardization and brevity, however, this is kept to a minimum. For Provisional Associations, [Provisional] is added at the end of the name (ex. *Salix wolfii* Shrubland [Provisional]).

Vascular plant species nomenclature for Association and Alliance names follows the nationally standardized list of Kartesz (1999), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990) and Anderson et al. (1990) for mosses, Egan (1987, 1989, 1990, 1991) and Esslinger and Egan (1995) for lichens, and Stotler and Crandall-Stotler (1977) for liverworts/hornworts.

SYNONYMS

- **rUSNVC English Name (local and global)**

The standard Association, Alliance or Group name from Revised USNVC databases, but with a translation of the scientific names using standard NatureServe Central Ecology-accepted common names for the plant taxa used in the name.

- **Revised USNVC Identifier (local and global)**

A unique identifier code for the Association from Revised USNVC databases. Associations have a code that begins with the string "CEGL" (Community Element GLobal) followed by a unique 6-digit number. Units that are not defined in the Revised USNVC are listed as “nonstandard” in this field.

LOCAL INFORMATION

- **Environmental Description**

A summary of available information on the environmental conditions associated with the Association and any other important aspects of the environment which affect this particular type within the park, including elevation ranges and, where relevant, information on large landscape context, geology and soils.

- **Vegetation Description**

A summary of available information on the vegetation, species composition (including dominant and diagnostic taxa, as well as problematic exotic species), structure (defining strata and their heights and percent cover), and variability of the vegetation of this Association as it occurs on the park.

- **Most Abundant Species**

Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the Association as it occurs in the park.

- **Stratum**

For each component plant species, the stratum (or strata) in which it occurs in the Association within the park.
Values for Stratum are

Tree (canopy & subcanopy)
Tree canopy
Tree subcanopy
Shrub/sapling (tall & short)
Tall shrub/sapling
Short shrub/sapling
Herb (field)
Nonvascular
Floating aquatic
Submerged aquatic

- **Lifeform**

The lifeform of each component plant species that is present within each designated stratum of the community as it occurs within the park. Lifeform definitions are from Table 3.1, page 37, of Whittaker, R. H. 1975. Communities and ecosystems. Second edition. Macmillan Publishing Co., New York. 387 pp.
Values for Lifeforms are

Needle-leaved tree
Broad-leaved deciduous tree
Broad-leaved evergreen tree
Thorn tree
Evergreen schlerophyllous tree
Succulent tree
Palm tree
Tree fern
Bamboo
Needle-leaved shrub
Broad-leaved deciduous shrub
Broad-leaved evergreen shrub
Thorn shrub
Evergreen schlerophyllous shrub
Palm shrub
Dwarf-shrub
Semi-shrub
Succulent shrub
Ephiphyte
Vine/Liana
Forb
Graminoid
Succulent forb
Aquatic herb (floating & submergent)
Moss
Alga
Lichen
Fern or fern ally
Other/unknown
Other shrub
Other herbaceous
Liverwort/hornwort

- **Species Name**

Global scientific name (and common name) for each floristic component species of the Association as it occurs within the park.

- **Characteristic Species**

Component plant species that are characteristic for the Association as it occurs within the park.

- **Other Noteworthy Species**

Other noteworthy species (i.e., species that are not necessarily diagnostic of the Association, but that are worth noting for some other reasons, such as those that are rare species or exotic invasives) that are found within the Association in the park.

- **Classification Comments**

Comments about classification criteria used to define the Association or description of any remaining issues associated with its classification on the park.

- **Other Comments**

Additional comments about the Association within the park.

- **Local Range**

A description of the total range (including present and historic, if known) of the Association within the park.

- **Plots**

List of plot codes for plots used in the identification and classification of the Association on the park.

- **Local Description Authors**

Name(s) of the person(s) primarily responsible for authorship of the current description of this Association on the park.

GLOBAL INFORMATION

Revised USNVC Below the Association, Alliance, or Group name being described the Revised USNVC is listed from Division to Association with of the classification unit being described Bolded. If higher level units (Alliance or Group) are being described then component classification units are listed. The hierarchy code follows the Division Name, the Macrogroup code follows the Macrogroup name, the Group code follows the Group name, the Alliance key follows the Alliance name, and the element code follows the Association name.

- **Summary of the Revised USNVCS Hierarchy Levels and Criteria for Natural Vegetation.**

Hierarchy Level	Criteria
Upper:	Physiognomy plays a predominant role.
L1 - Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.
L2 - Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions.
L3 – Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.
Mid:	Floristics and physiognomy play predominant roles
L4 – Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
L5 – Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
L6 – Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology and disturbance regimes.
Lower:	Floristics plays a predominant role
L7 – Alliance	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes.

• L8 – Association	• Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

OTHER CLASSIFICATION

- **Ecological System(s)**

A list of the Ecological Systems of which the Association is a member (NatureServe 2003). Ecological Systems are groups of plant associations unified by similar ecological conditions and processes (e.g., fire, riverine flooding), underlying environmental features (e.g., shallow soils, serpentine geology), and/or environmental gradients (e.g., elevation, hydrology in coastal zones). They should form relatively robust, cohesive, and distinguishable units on the ground. In most landscapes, the Ecological System will manifest itself on the ground as a spatial aggregation at an intermediate scale (e.g., between the IVC Alliance and Formation scales).

GRBA Biophysical Setting (BpS)
Name and codes of Biophysical Setting x-walked to the classification units.

NPS-VIP Map Unit
Map Class name and code for current NPS VIP mapping project at GRBA

USFWS Wetland Classification System
Systems developed for the classification of wetlands by the U.S. Fish and Wildlife Service to classify. System refers to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphic, chemical, or biological factors. As defined in Cowardin et al. (1979), the values are:

> **Marine** - consists of open ocean overlying the continental shelf and its associated high-energy coastline.
> **Estuarine** - consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.
> **Riverine** - includes all wetlands and deepwater habitats contained with a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5%.
> **Lacustrine** - includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 hectare (20 acres).
> **Palustrine** - includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5%.

GLOBAL DESCRIPTION

- **Concept Summary**

A description of the range, structure, composition, environmental setting and dynamics associated with the community. Information includes a general understanding of the type, often with some concept of its distribution; environmental setting in which the type occurs and a summary of the important disturbance regimes, successional status, and temporal dynamics for this community rangewide; community structure/physiognomy; species by strata (dominant and diagnostic taxa); and key diagnostic characteristics that distinguishes it from similar types.

- **Environmental Description**

A summary of available information on the environmental conditions of the Association rangewide and any other important aspects of the environment which affect this particular type, including elevation ranges and, where relevant, information on large landscape context, geology and soils.

- **Vegetation Description**

A summary of available information on the leaf type and phenology, species composition (including dominant and diagnostic taxa, as well as problematic exotic species), structure (defining strata and their heights and percent cover), and variability of the vegetation of this Association rangewide and any additional comments relating to the vegetation.

- **Most Abundant Species**

Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the Association as it occurs rangewide.

- **Stratum**

For each component plant species, the stratum (or strata) in which it occurs in the Association rangewide. Values for Stratum are

Tree (canopy & subcanopy)
Tree canopy
Tree subcanopy
Shrub/sapling (tall & short)
Tall shrub/sapling
Short shrub/sapling
Herb (field)
Nonvascular
Floating aquatic
Submerged aquatic

- **Lifeform**

The lifeform of each component plant species that is present within each designated stratum of the community as it occurs rangewide. Lifeform definitions are from Table 3.1, page 37, of Whittaker, R. H. 1975. Communities and ecosystems. Second edition. Macmillan Publishing Co., New York. 387 pp. Values for Lifeforms are

Needle-leaved tree
Broad-leaved deciduous tree
Broad-leaved evergreen tree
Thorn tree
Evergreen schlerophyllous tree
Succulent tree
Palm tree
Tree fern
Bamboo
Needle-leaved shrub
Broad-leaved deciduous shrub
Broad-leaved evergreen shrub
Thorn shrub
Evergreen schlerophyllous shrub
Palm shrub
Dwarf-shrub
Semi-shrub
Succulent shrub
Ephiphyte
Vine/Liana
Forb
Graminoid
Succulent forb
Aquatic herb (floating & submergent)
Moss
Alga
Lichen
Fern or fern ally
Other/unknown
Other shrub
Other herbaceous
Liverwort/hornwort

- **Species Name**

Global scientific name (and common name) for each floristic component species of the Association as it occurs rangewide.

- **Characteristic Species**

Component plant species that are characteristic for the Association as it occurs rangewide.

- **Other Noteworthy Species**

Other noteworthy species (i.e., species that are not necessarily diagnostic of the Association, but that are worth noting for some other reasons, such as those that are rare species or exotic invasives) that are found within the Association rangewide.

DISTRIBUTION

- **Range**

A description of the total range (present and historic, if known) of the Association rangewide, using names of nations, subnations or states, ecoregions, etc.

- **States/Provinces**

The two-letter postal codes for U.S. states and Canadian provinces in which the Association occurs. Mexican two-letter state abbreviations are preceded by "MX". When the occurrence of the Association in a state/province is uncertain, a ? is appended. The state code may be followed by the State Rank when known.

- **Federal Lands**

List of federal lands where the Association occurs or is believed to occur. Names used are shortened versions of the official name of the Federal land unit with "National Park, National Forest," etc. dropped from the name. A ? indicates that presence is uncertain. Federal Agency Abbreviations are:

BIA = Bureau of Indian Affairs
BLM = Bureau of Land Management
COE = U.S. Army Corps of Engineers
DOD = Department of Defense
DOE = Department of Energy
NPS = National Park Service
PC = Parks Canada
TVA = Tennessee Valley Authority
USFS = U.S. Forest Service
USFWS = U.S. Fish and Wildlife Service

CONSERVATION STATUS

- **Global Rank**

The Heritage Conservation Status Global Rank which best characterizes the relative rarity or endangerment of the Association worldwide. Values for Global Rank are:

G1 = Critically imperiled globally = Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s)
G2 = Imperiled globally = Generally 6-20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s)
G3 = Rare or uncommon = Generally 21-100 occurrences; either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factor(s)
G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern = Uncommon but not rare (although it may be quite rare in parts of its range, especially at the periphery); apparently not vulnerable in most of its range
G5 = Demonstrably widespread, abundant and secure = Common, widespread, and abundant (although it may be quite rare in parts of its range, especially at the periphery); not vulnerable in most of its range
G#G# = Numeric range rank (range no greater than 2) = Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate; for example, a G1G3 rank indicates the rank could be G1, G2, or G3
GNR = Not yet ranked = Status has not yet been assessed
GNA = Rank not applicable
GH = Historical = Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with potential for restoration (e.g., *Castanea dentata* Forest)
GX = Extirpated = Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species
GU = Unrankable = Status cannot be determined at this time

Qualifiers:

? = Inexact numeric rank = A question mark added to a rank expresses an uncertainty about the rank in the range of 1 in either way on the 1-5 scale; for example, a G2? rank indicates that the rank is thought to be G2, but could be G1 or G3 (Note: G1? and G5? are both valid ranks)

Q = Questionable taxonomy = A "Q" added to a rank denotes questionable taxonomy; it modifies the degree of imperilment and is only used in cases where the type would have a less imperiled rank if it were not recognized as a valid type (i.e., if it were combined with a more common type); a GUQ rank often indicates that the type is unrankable because of daunting taxonomic questions

For non-natural types, a **Global Rank** of **GNA** = **Rank not applicable** is assigned. They are further identified as one from the following:

Cultural - indicates that the Association is cultivated. Planted/cultivated areas are defined as being dominated by vegetation that has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. The majority of these areas are planted and/or maintained for the production of food, feed, fiber, or seed.

Ruderal - indicates that the Association is considered ruderal. Ruderal communities are vegetation resulting from succession following anthropogenic disturbance of an area. They are generally characterized by unnatural combinations of species (primarily native species, though they often contain slight to substantial numbers and amounts of species alien to the region as well). In many landscapes, ruderal communities occupy large areas - sometimes more than any other category of communities - and can provide important biodiversity functions.

Modified/Managed - indicates that the Association is modified or managed. Modified/managed communities are vegetation resulting from the management or modification of natural/near-natural vegetation, but producing a structural and floristic combination not clearly known to have a natural analogue. Modified vegetation may be easily restorable by either management, time, or restoration of ecological processes. It is not yet clear how to deal with these communities in the IVC.

Invasive - indicates that the Association is weedy and invasive. Invasive communities are dominated by invasive alien species. Although these communities are often casually considered as "planted/cultivated," they are spontaneous, self-perpetuating, and not the (immediate) result of planting, cultivation, or human maintenance. Land occupied by invasive communities is generally permanently altered (converted) unless restoration efforts are undertaken. It is also important to recognize that these communities are novel; they are not merely a community "transplanted" from the native range of the dominant species. *Melaleuca* in south Florida, kudzu in the southeastern United States, tamarisk in the western United States, and red mangrove in Hawaii all form communities which have no equivalent in the native range of the dominant species (associated species, processes, landscape context, fauna, etc. are all significantly different).

- **Global Rank Date**

The date the Global Rank was last ***reviewed*** (regardless of whether the rank was changed).

- **Global Rank Reasons**

Reasons that the Heritage Conservation Status Global Rank for the Association was assigned, including key ranking variables and other considerations used.

CLASSIFICATION INFORMATION

- **Status**

The status of the Association in relation to the standard IVC. Values for Classification Status are:

Standard – the Association has been formally recognized, described, and accepted by NatureServe Central Ecology as a standard Association in the IVC.

Nonstandard – the Association has not been accepted by NatureServe Central Ecology as a standard Association (i.e., it does not follow the standard classification).

Provisional* – the Association is a candidate for acceptance into the standard classification but has not yet been comprehensively reviewed by NatureServe Central Ecology.

- **Confidence**

The degree of confidence associated with the classification of the Association. This confidence is based on the quality and type of data used in the analysis, as well as the extent to which the entire (or potential) range of the Association was considered. Values for Circumscription Confidence are:

1 – Strong: Classification is based on quantitative analysis of verifiable, high-quality field data (species lists and associated environmental information) from plots that are published in full or are archived in a

publicly accessible database. A sufficient number of high-quality plots covering the expected geographic distribution and habitat variability of the vegetation type, as well as plots from related types across the region, have been used in the analysis.

2 – Moderate: Classification is based either on quantitative analysis of a limited data set of high-quality, published/accessible plots and/or plots from only part of the geographic range, or on a more qualitative assessment of published/accessible field data of sufficient quantity and quality.

3 – Weak: Classification is based on limited, or unpublished/inaccessible plot data or insufficient analysis, anecdotal information, or community descriptions that are not accompanied by plot data. These types have often been identified by local experts. Although there is a high level of confidence that these types represent recognized vegetation entities, it is not known whether they would meet national standards for floristic types in concept or in classification approach if sufficient data were available.

- **Comments**

Comments about classification criteria used to define the Association, or to describe any remaining issues associated with the classification. Any potentially confusing relationships with other existing Associations should be indicated if there is a potential that further scrutiny may result in a change in the classification of the Association. Discussion of any atypical occurrences and why they are included in this Association concept may also be addressed. In addition, rationale for choosing nominal species that are not dominant and other comments about nominal species pertaining to the classification of the Association should be included. Comments may explain confusion about the similarity between types that may not be distinguishable.

- **Similar Associations**

The Global Name and Elcode of any closely related or apparently similar IVC association(s) which may be mistaken for this Association. They may be in the same or different Formation or Alliance. This includes only types whose classification is not at issue (e.g., two types have similar sounding names but are differentiated by the degree of canopy closure and lower frequency of associated light-requiring species). Notes regarding the relationship and/or distinction of each particular Similar Association may follow.

- **Related Concepts**

Name used by agencies or other published or unpublished classification systems to describe Associations that may be related to this Association. These might include Society of American Foresters (SAF) cover types, Kuchler PNV types, U.S. Fish and Wildlife Service (USFWS) wetland types, or other local or regional vegetation classifications. The Other Community Name is followed by the associated Reference and Relationship. The Related Concept Reference is the source reference for the Related Concept. Relationship indicates whether the type designated in Other Community Name is more, less, or equally inclusive of the IVC Association concept. Values for Relationship are:

B – Broader: the concept of the Other Community is broader than the Association concept
F – Finer: the concept of the Other Community is finer (more narrow) than the Association concept
I – Intersects: the concepts of the Other Community and the Association overlap (i.e., neither fully includes the other) and are related in a way that is more complex than a simple "broader/finer" relationship
= - Equivalent: concept designated in Other Community Name is equivalent to the Association concept
? – Unknown: the relationship of the Other Community to the Association has not been determined

Note: Names used by Heritage Programs/CDCs are listed in the section entitled Subnational Distribution with Crosswalk data.

SOURCES

- **Description Authors**

Name(s) of the person(s) primarily responsible for authorship of the current version of the Association's *description* and *characterization* including descriptions in Environment, Vegetation, and Dynamics. The abbreviation mod. before a name indicates that modifications were subsequently made to the original description by the person(s) listed.

REFERENCES

Short citations of all references used in documenting the classification/concept and characterization of this Association.

Citation for Field Definitions for Local and Global Descriptions

Anderson, J.R., E.E. Hardy, and J.T. Roach. 1976. Land use and land cover classification system for use with remote sensing data. Geological Survey Professional Paper 964. United States Government Printing Office, Washington D.C.

Anderson, L. E. 1990. A checklist of Sphagnum in North America north of Mexico. The Bryologist 93:500-501.

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Egan, R. S. 1987. A fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. The Bryologist 90:77-173.

Egan, R. S. 1989. Changes to the "Fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada," edition I. The Bryologist 92:68-72.

Egan, R. S. 1990. Changes to the "Fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada," edition II. The Bryologist 93:211-219.

Egan, R. S. 1991. Changes to the "Fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada," edition III. The Bryologist 94:396-400.

Esslinger, T. L., and R. S. Egan. 1995. A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. The Bryologist 98:467-549.

Fleming, G.P., P.P. Coulling, K.D. Patterson, and K. Taverna. 2006. The natural communities of Virginia: classification of ecological community groups. Second approximation. Version 2.2. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. <http://www.dcr.virginia.gov/natural_heritage/nctoc.shtml>

Kartesz, J.T. 1999. A Synonymized Checklist and Atlas with Biological Attributes for the Vascular Flora of the United States, Canada, and Greenland. First Edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

NatureServe. 2003. A Working Classification of Terrestrial Ecological Systems in the Coterminous United States. International Terrestrial Ecological Systems Classification. NatureServe, Arlington, VA. 61 pp. + appendices.
Stotler, R., and B. Crandall-Stotler. 1977. A checklist of liverworts and hornworts of North America. The Bryologist 80:405-428.

Appendix F: GRBA Mapping Conventions and Visual Key

Great Basin National Park- Map Units

Appendix E. describes the map units for the Great Basin National Park (GRBA) Vegetation Inventory Project. Its purpose is to:

- Provide a visual key to the GRBA map units;
- Describe the vegetation of each map unit and its corresponding imagery (i.e. photo) signature;
- Provide a representative ground photograph/image for each map unit;
- Describe the link between each map unit and the revised U.S. National Vegetation Classification (rUSNVC);
- Provide visual examples of each map unit with digital overhead images and delineated overlays.

The map units for GRBA were based on a combination of rUSNVC plant associations, local requests (i.e. Park Specials), the limitations of the digital imagery, and land use / land cover classes. The vegetation described in this section reflects the classification designed specifically for this project. Non-vegetated and land-use map units are not described in this key. For more information on the development of the mapping scheme for GRBA please reference the mapping sections of this report and the digital information (i.e. lookup tables, metadata) included on the project DVD.

This key follows the physiognomic grouping of each map unit starting with forest/woodland types. Each map unit is fully described by a variety of characteristics and features. First the rUSNVC crosswalk (if applicable) to associations and the common plant species for each association is presented. Next is a description of the mapping concept and a representative ground photograph. A map of the distribution for each mapping unit across the study area follows along with an example of the 2007 DMI digital basemap ortho-imagery (color infrared bands). The imagery snapshot examples also include representative polygon outlines that highlight the map unit signatures. Many of the map unit descriptions rely heavily on the vegetation field data collected in 2003, 2008, 2009, and 2010. The sample ground photographs were taken during the 2003, 2008, 2009, 2010 field data collection efforts.

Coniferous Forest and Woodlands

Map Code **White Fir – Quaking Aspen Forest Complex**
F_ABPO ***Abies concolor - Populus tremuloides* Forest Complex**

Representative Ground Photo

Common Species

White fir (*Abies concolor*)
Quaking Aspen (*Populus tremuloides*)
Engelmann spruce (*Picea engelmannii*)
Limber pine (*Pinus flexilis*)
Utah serviceberry (*Amelanchier utahensis*)
Greenleaf manzanita (*Arctostaphylos patula*)
Creeping barberry (*Mahonia repens*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Ross' sedge (*Carex rossii*)
Slender wheatgrass (*Elymus trachycaulus*)

rUSNVC Associations

-*Populus tremuloides* - *Abies concolor* / A*rctostaphylos patula* Forest
-*Populus tremuloides* - *Abies concolor* / *Poa pratensis* Semi- natural Forest
-*Populus tremuloides* - *Abies concolor* / *Symphoricarpos oreophilus* Forest
-*Populus tremuloides* - *Abies concolor* / Mesic Graminoid Forest [Park Special]

Description

Frequency: White fir with quaking aspen trees is a common forest type at GRBA occurring in the montane and lower subalpine areas of the park
Physiognomy: F_ABPO polygons contain moderate to dense stands of medium to tall conifer trees (> 5 meters) with an almost even mix of similar sized deciduous trees. The understories for this map unit are often diverse and contain mixes of evergreen and deciduous shrubs with pockets of herbaceous vegetation.
Condition: Good. White fir with quaking aspen trees are fairly widespread at GRBA and appear disease free at this time. Heavy fuel loading caused by fire suppression, severe wildfires, landslides, avalanches, insect infestations, and invasion by non-native plant species are potential threats to this type.
CIR Signature: On the imagery canopies of F_ABPO appear as small orange spots (white fir trees) with solid pink colors (quaking aspen) in the canopy openings. Dark shadows from the taller white fir trees are often present.
Mapping Notes: The F_ABPO map unit was created to address upland white fir stands that contained high cover of quaking aspen and other associated conifer species. This even mix of white fir and quaking aspen may represent a transistional state where the white fir is slowly replacing the quaking aspen. White fir trees appeared similar to the limber pine and Engelman spruce trees and some confusion may have occurred during the mapping of this type with F_PFPT and F_PIEN3 map units.

Range and Distribution

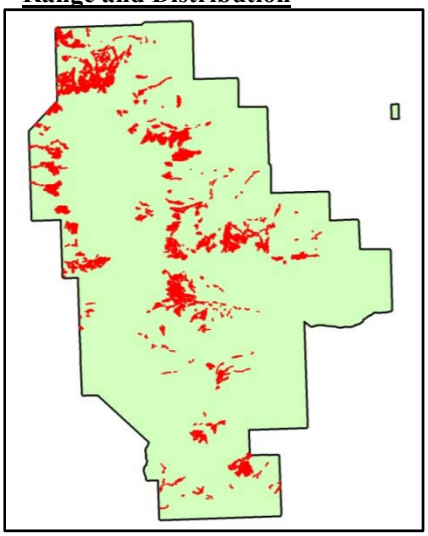
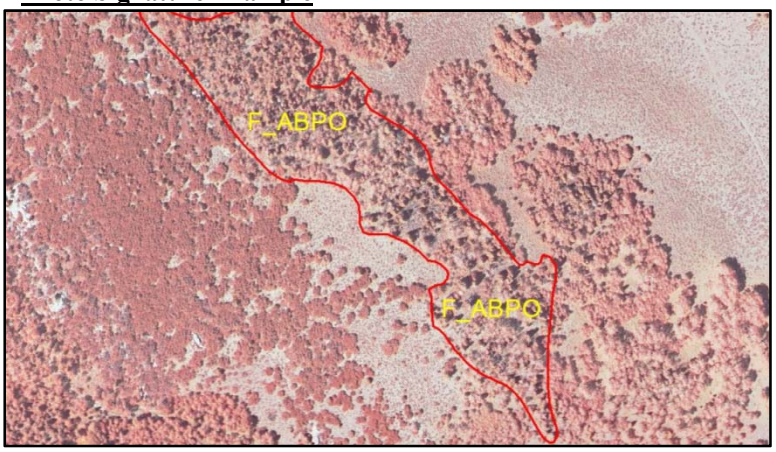


Photo Signature Example



Map Code **Engelmann Spruce Forest Complex**
F_PIEN1 ***Picea engelmannii* Forest Complex**

Representative Ground Photo

Common Species

Engelmann spruce (*Picea engelmannii*)
Quaking Aspen (*Populus tremuloides*)
Limber pine (*Pinus flexilis*)
Common juniper (*Juniperus communis*)
Whitestem goldenbush (*Ericameria discoidea*)
Gooseberry currant (*Ribes montigenum*)
Ballhead sandwort (*Arenaria congesta*)
Heartleaf arnica (*Arnica cordifolia*)
Ross' sedge (*Carex rossii*)
Muttongrass (*Poa fendleriana*)
Tuber starwort (*Pseudostellaria jamesiana*)
Watson's spikemoss (*Selaginella watsonii*)
Snowline wintergreen (*Pyrola minor*)

rUSNVC Associations

-*Picea engelmannii* / Moss Forest
-*Picea engelmannii* - (*Pinus flexilis*) / *Carex rossii* Woodland
-*Picea engelmannii* / *Juniperus communis* Forest
-*Picea engelmannii* / *Ribes montigenum* Forest

Description

Frequency: Woodland and forest communities dominated by Engelmann spruce are common throughout the subalpine portion of GRBA.
Physiognomy: F_PIEN1 polygons contain moderate to dense stands of tall conifer trees (> 15 meters) with sparse evergreen and deciduous shrubs and some occasional herbaceous vegetation in the understory.
Condition: Good. Engelmann spruce trees at GRBA are widespread and appear disease free at this time. Heavy fuel loading caused by fire suppression, severe wildfires, avalanches, landslides, insect infestations, and invasion by non-native plant species are potential threats to this type. Higher elevation sites may be impacted by global warming.
CIR Signature: On the imagery canopies of F_PIEN1 appear as pointed dark brown spots (trees) with various colors ranging from gray (bare soil) to light brown (shrubs and herbaceous vegetation) in the canopy openings.
Mapping Notes: The F_PIEN1 map unit was created to address upland Engelmann spruce areas at GRBA that contain little quaking aspen. Englemann spruce trees appeared similar to limber pine and white fir trees on the imagery and some confusion may have occurred during the mapping of these closely related conifer types.

Range and Distribution

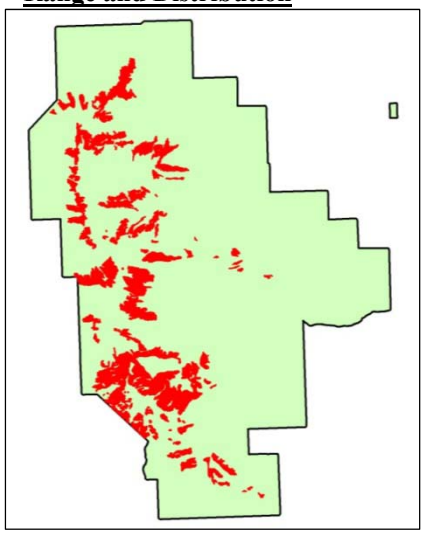
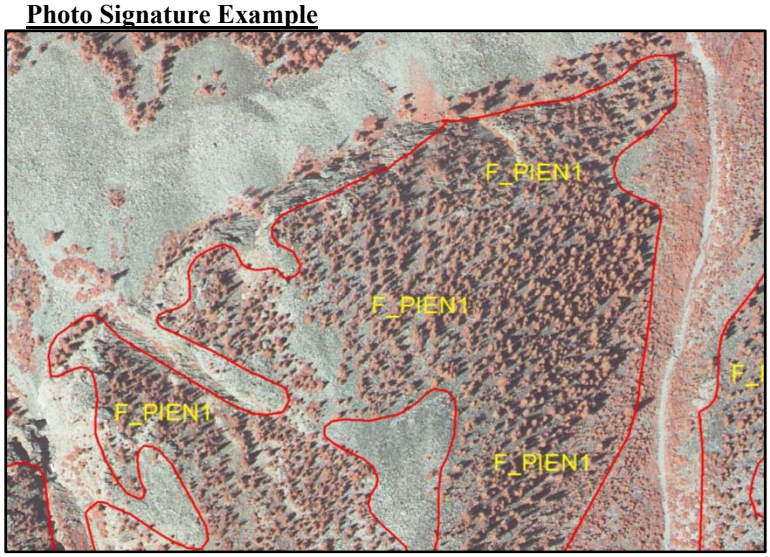


Photo Signature Example



Map Code **Engelmann Spruce Riparian Forest & Woodland Alliance**
F_PIEN2 ***Picea engelmannii* Riparian Forest & Woodland Alliance**

Representative Ground Photo

Common Species

Engelmann spruce (*Picea engelmannii*)
Quaking Aspen (*Populus tremuloides*)
Limber pine (*Pinus flexilis*)
Booth's willow (*Salix boothii*)
Western columbine (*Aquilegia formosa*)
Bluntseed sweetroot (*Osmorhiza depauperata*)
Brook saxifrage (*Saxifraga odontoloma*)
Baltic rush (*Juncus balticus*)
Mountain sedge (*Carex scopulorum*)
King's angelica (*Angelica kingii)*
Sierra bog orchid (*Platanthera leucostachys*)

rUSNVC Associations

-*Picea engelmannii* / *Carex scopulorum* Woodland
-*Picea engelmannii* - *Populus tremuloides* / Mesic Forb Forest [Park Special]

Description

Frequency: Engelmann spruce riparian woodlands are rare at GRBA occurring along subalpine streams.
Physiognomy: F_PIEN2 polygons contain moderate to dense stands of tall conifer trees (> 15 meters) with common high elevation, deciduous, riparian trees, shrubs and mesic herbaceous vegetation in the understory.
Condition: Good. Engelmann trees occurring in riparian corridors are fairly rare at GRBA but appear overall healthy and stable. Riparian areas at GRBA are commonly used for campgrounds and picnic areas and these may act as potential vectors for non-native plant introduction and establishment. Higher elevation sites may also be impacted by global warming and future climate change events.
CIR Signature: On the imagery canopies of F_PIEN2 appear as pointed, dark brown spots (trees) with smaller orange dots (shrubs) and red background colors (herbaceous vegetation) in the canopy openings. Polygons of F_PIEN2 often contained linear streams and other obvious water features.
Mapping Notes: The F_PIEN2 map unit includes only Engelmann spruce stands that occur in riparian cooridors and contain common, tall deciduous shrubs in the understory. Polygons of this type often contained varying amounts of quaking aspen but it was never the dominant tree species. The diverse nature of riparian areas at GRBA may have led to some confusion during the mapping between F_PIEN2 and the similar F_POTR2 and F_ACRIP types.

Range and Distribution

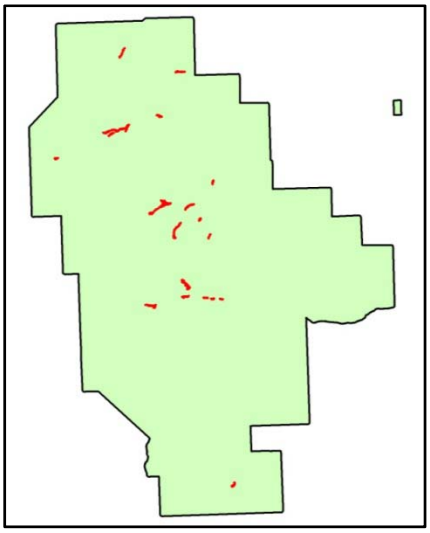
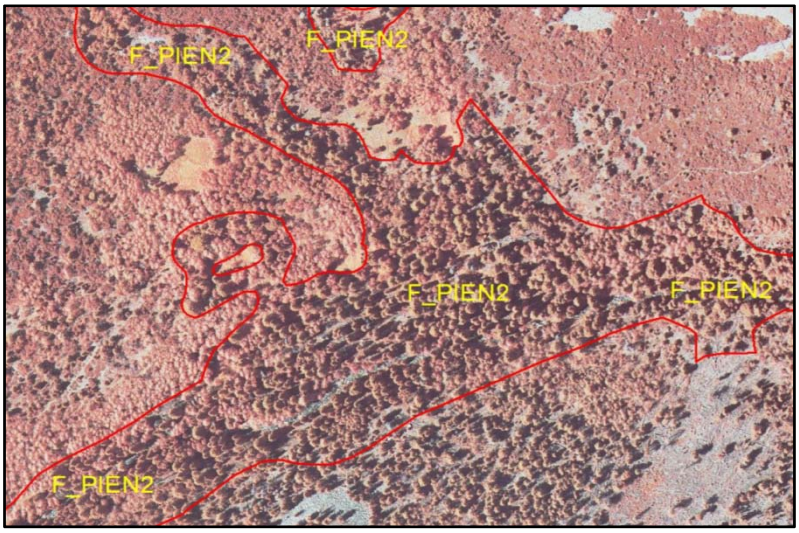


Photo Signature Example



Map Code **Engelmann Spruce – Quaking Aspen Forest**
F_PIEN3 ***Picea engelmannii - Populus tremuloides* Forest**

Representative Ground Photo

Common Species

Engelmann spruce (*Picea engelmannii*)
Quaking Aspen (*Populus tremuloides*)
Limber pine (*Pinus flexilis*)
Greenleaf manzanita (*Arctostaphylos patula*)
Creeping barberry (*Mahonia repens*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Fringed brome (*Bromus ciliatus*)
Ross' sedge (*Carex rossii*)

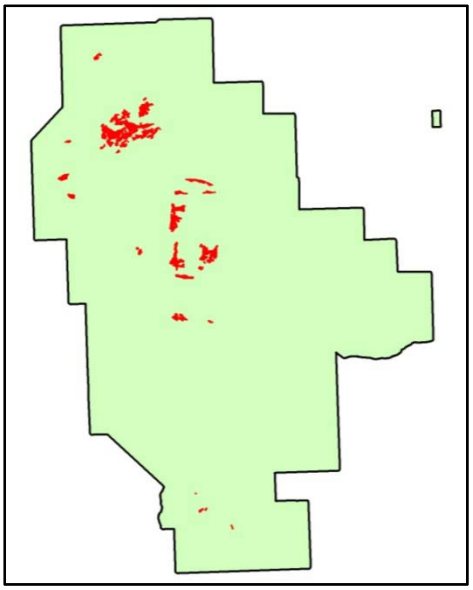
rUSNVC Associations

-*Picea engelmannii - Populus tremuloides / Arctostaphylos patula* Forest
-(Other Unknown Understory Species)

Description

Frequency: Engelmann spruce with quaking aspen trees is a common forest type at GRBA occurring in the subalpine areas of the park.
Physiognomy: F_PIEN3 polygons contain moderate to dense stands of medium-sized conifer trees (5 - 15 meters) with an almost even mix of similar sized or taller deciduous trees. The understories for this map unit are often mesic and contain some deciduous shrubs and pockets of thick herbaceous vegetation.
Condition: Good - Fair. Engelmann spruce with quaking aspen trees are somewhat rare at GRBA and some areas show evidence of dead trees. Heavy fuel loading caused by fire suppression, severe wildfires, avalanches, landslides, insect infestations, and invasion by non-native plant species are threats to this type.
CIR Signature: On the imagery canopies of F_PIEN3 appear as pointed dark brown spots (Engelmann spruce trees) with solid pink colors (quaking aspen) in the canopy openings. Dead trees in the canopy appear as gray points.
Mapping Notes: The F_PIEN3 map unit was created to address upland Engelmann spruce stands that contained high cover of quaking aspen. This even mix of the two species may represent a transistional state where the Engelmann spruce is slowly replacing the quaking aspen. Engelmann spruce trees appeared similar to the white fir and limber pine trees on the imagery and some confusion may have occurred during the mapping of these types.

Range and Distribution



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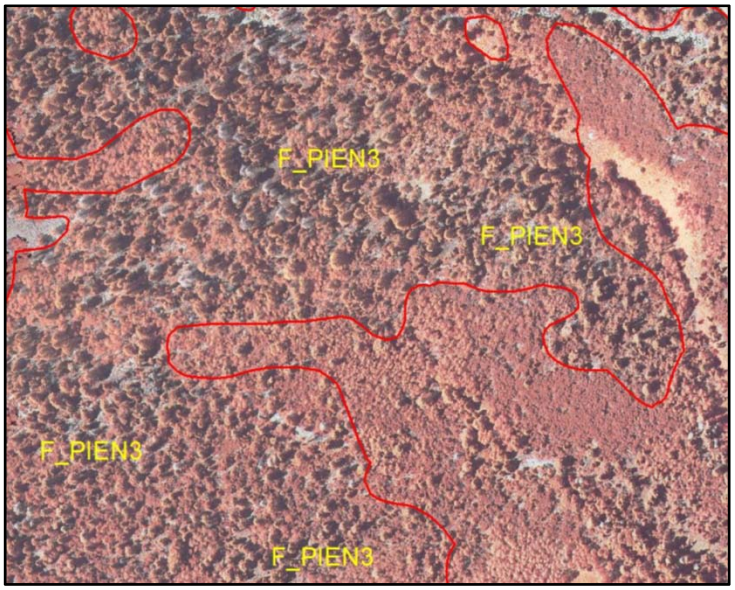


Map Code	Narrowleaf Cottonwood Riparian Forest & Woodland Alliance
F_POAN	***Populus angustifolia*** **Riparian Forest & Woodland Alliance**

Representative Ground Photo

Common Species

Narrowleaf Cottonwood (*Populus angustifolia*)
Quaking Aspen *(Populus tremuloides)*
White fir (*Abies concolor*)
Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*)
Water birch (*Betula occidentalis*)
Rocky Mountain juniper (*Juniperus scopulorum*)
Chokecherry (*Prunus virginiana*)
Skunkbush sumac (*Rhus trilobata*)
Woods' rose (*Rosa woodsii*)
Starry false lily of the valley (*Maianthemum stellatum*)
Western white clematis (*Clematis ligusticifolia*)
Basin wildrye (*Leymus cinereus*)

rUSNVC Associations

-*Populus angustifolia* / *Cornus sericea* Woodland
--*Populus angustifolia* / *Prunus virginiana* Woodland
-*Populus angustifolia* / *Rosa woodsii* Forest
- *Populus angustifolia* / *Artemisia tridentata* ssp. *tridentata* - *Prunus virginiana* Woodland [Park Special]

Description

Frequency: Narrowleaf cottonwood riparian forest and woodlands are fairly rare along the major basin and foothill streams in the eastern portion of GRBA and at the new administrative area in Baker, NV.
Physiognomy: F_POAN polygons contain moderate to dense stands of short to medium-sized deciduous trees (5 - 15 meters) with common, deciduous riparian trees, shrubs and mesic herbaceous vegetation in the understory.
Condition: Good - Fair. Narrowleaf cottonwood trees occurring in riparian corridors are likely impacted by flash flooding events and may be threatened by prolonged drought and water shortages. Riparian areas at GRBA are commonly used for campgrounds and picnic areas and these may act as potential vectors for non-native plant introduction and establishment.
CIR Signature: On the imagery canopies of F_POAN appear as bushy, dark red spots (trees) with smaller orange dots (shrubs) and red background colors (herbaceous vegetation) in the canopy openings. Polygons of F_POAN were usually linear in shape and often contained meandering streams and other obvious water features.
Mapping Notes: The F_POAN map unit occurred along linear drainages where it intermixed with quaking aspen, tall willow and birch shrubs, and individual ponderosa pine and pinyon-juniper trees. The similarity of the narrowleaf cottonwood to quaking aspen and dciduous tall shrubs may have led to some confusion in the mapping of F_POAN versus S_RIP and F_POTR2 polygons.

Range and Distribution

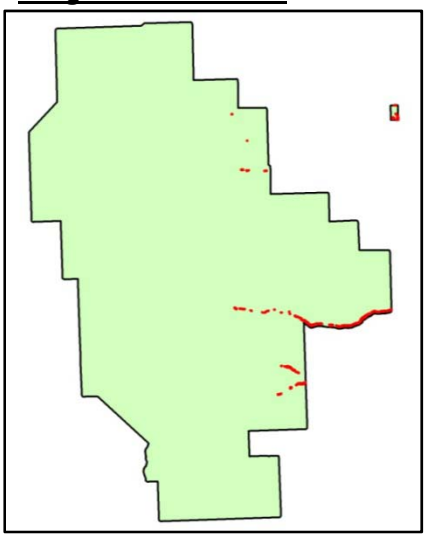
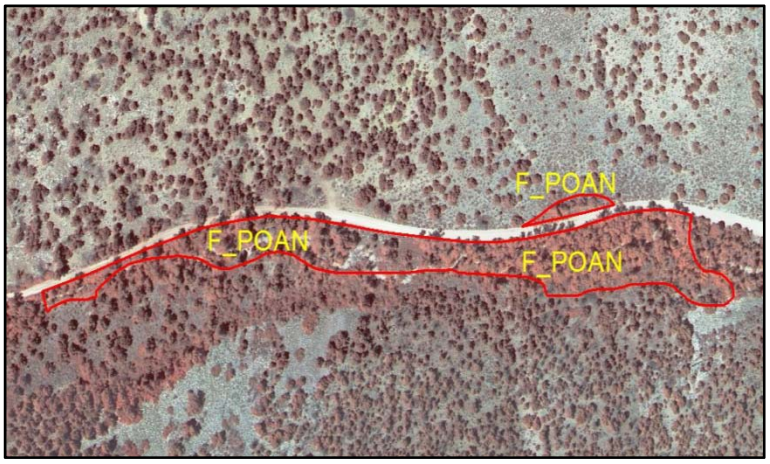


Photo Signature Example



Map Code	Rocky Mountain Quaking Aspen Forest & Woodland Alliance
F_POTR1	Rocky Mountain *Populus tremuloides* Forest & Woodland Alliance

Representative Ground Photo

Common Species

Quaking Aspen *(Populus tremuloides)*
White fir (*Abies concolor*)
Limber pine (*Pinus flexilis*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Creeping barberry (*Mahonia repe*ns)
Silvery lupine (*Lupinus argenteus*)
Slender wheatgrass (*Elymus trachycaulus*)
Watson's penstemon (*Penstemon watsonii*)
Mutton grass (*Poa fendleriana*)

rUSNVC Associations

-*Populus tremuloides* / *Artemisia tridentata* Forest
-*Populus tremuloides* / *Bromus carinatus* Forest
-*Populus tremuloides* / *Juniperus communis* Forest
-*Populus tremuloides* / Invasive Perennial Grasses Forest
-*Populus tremuloides* / *Symphoricarpos oreophilus* Forest
-*Populus tremuloides* / *Ribes* spp.Woodland [Park Special]

Description

Frequency: The quaking aspen woodland and forest map unit was one of the most common types at GRBA occurring across all of the montane and lower subalpine areas of the park.
Physiognomy: F_POTR1 polygons contain moderate to dense stands of medium and tall deciduous trees (5 - 15 meters) with sparse deciduous shrubs and some pockets of mesic herbaceous vegetation in the understory.
Condition: Good. Quaking aspen trees at GRBA are widespread and appear disease free at this time. Heavy fuel loading caused by fire suppression, severe wildfires, insect infestations, and invasion by non-native plant species are threats to this type.
CIR Signature: On the imagery canopies of F_POTR1 have a very characteristic pink signature. Even-aged stands of F_POTR are smooth and solid, whereas stands with various tree sizes appear coarse in texture.
Mapping Notes: The F_POTR1 map unit was created to address upland quaking aspen stands at GRBA that contain few associated conifer trees in the canopy layer. However some of the quaking aspen polygons likey hava a significant conifer sub-canopy that could not be viewed from the aerial imagery.

Range and Distribution

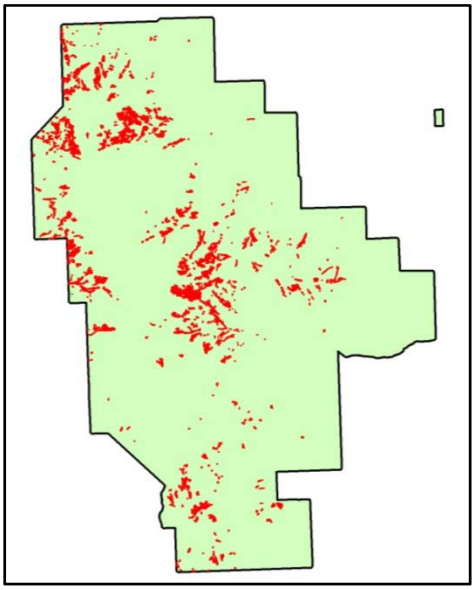
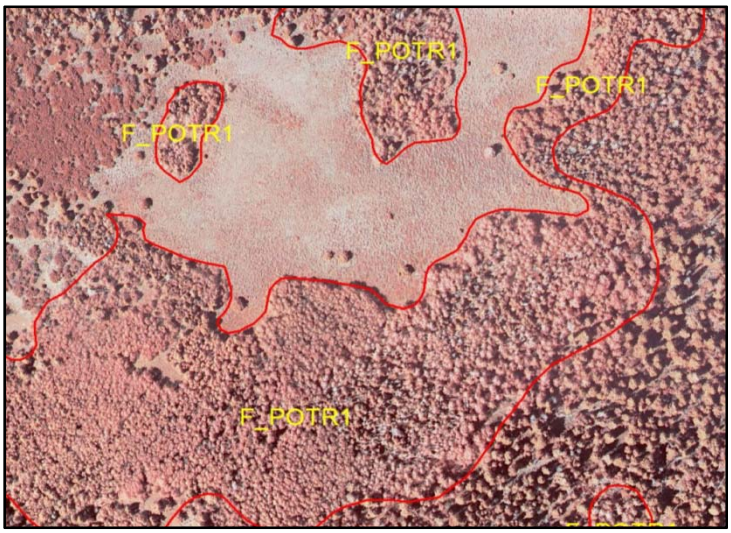


Photo Signature Example



Map Code	Rocky Mountain Quaking Aspen Riparian Forest & Woodland Alliance
F_POTR2	Rocky Mountain *Populus tremuloides* Riparian Forest & Woodland Alliance

Representative Ground Photo

Common Species

Quaking Aspen *(Populus tremuloides)*
White fir (*Abies concolor*)
Narrowleaf cottonwood (*Populus angustifolia*)
Rocky Mountain juniper (*Juniperus scopulorum*)
Chokecherry (*Prunus virginiana*)
Water birch (*Betula occidentalis*)
Redosier dogwood (*Cornus sericea*)
Booth's willow (*Salix boothii*)
Woods' rose (*Rosa woodsii*)
Western columbine (*Aquilegia formosa*)
Western white clematis (*Clematis ligusticifolia*)
Smooth horsetail (*Equisetum laevigatum*)
Baltic rush (*Juncus balticus*)

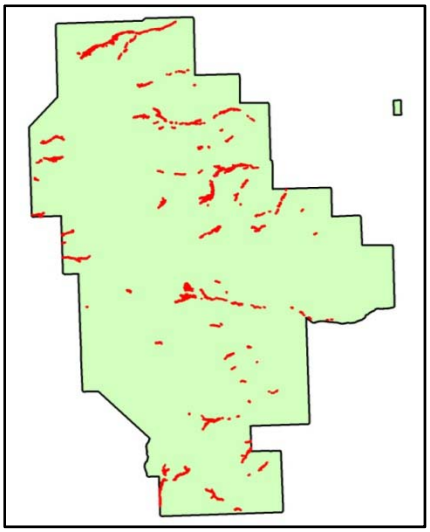
rUSNVC Associations

-*Populus tremuloides* / *Betula occidentalis* Forest
-*Populus tremuloides* / *Prunus virginiana* - *Symphoricarpos oreophilus* Forest [Park Special]
-*Populus tremuloides* / *Rosa woodsii* Forest

Description

Frequency: Quaking aspen riparian woodlands are common along foothill, montane and lower subalpine streams.
Physiognomy: F_POTR2 polygons contain dense stands of medium to tall deciduous trees (5 – 15 meters) with deciduous, riparian trees, shrubs and mesic herbaceous vegetation in the understory.
Condition: Good. Quaking aspen trees occurring in riparian corridors are fairly common at GRBA and appear overall healthy and stable. Riparian areas at GRBA are commonly used for campgrounds and picnic areas and these may act as potential vectors for non-native plant introduction and establishment.
CIR Signature: On the imagery canopies of F_POTR2 have a very characteristic pink signature due to the broad leaf growth of this species. Even-aged stands of quaking aspen are smooth and solid, whereas stands with various tree sizes appear coarse in texture. All polygons of F_POTR2 contain some smaller orange dots (shrubs) and red background colors (herbaceous vegetation) in the canopy openings. Polygons of F_POTR2 also contained linear streams and other obvious water features.
Mapping Notes: Riparian and wetland features are important for wildlife and natural resource management at GRBA and an effort was made to map all of the mesic sites regardless of size. As a result some polygons of this and the other wetland and riparian vegetation map units are below the standard minimum mapping unit size of 0.5-hectare.

Range and Distribution



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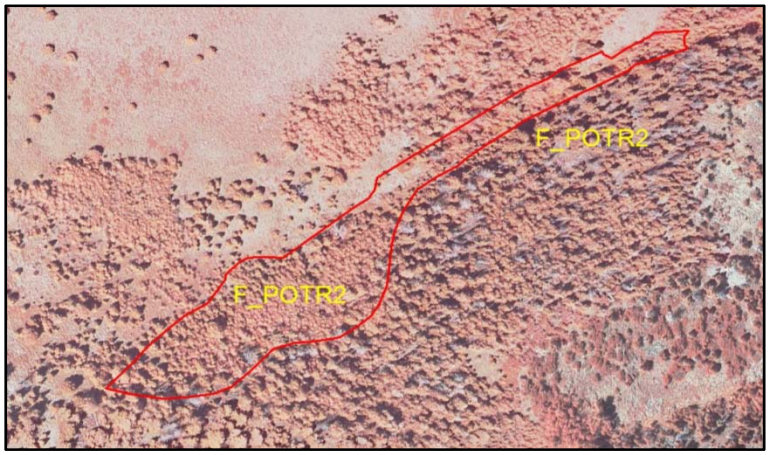


Map Code	Quaking Aspen - Limber Pine Forest
F_PTPF	***Populus tremuloides – Pinus flexilis*** **Forest**

Representative Ground Photo

Common Species

Limber pine *(Pinus flexilis)*
Quaking Aspen *(Populus tremuloides)*
Engelmann spruce (*Picea engelmannii*)
Common juniper (*Juniperus communis*)
Whitestem goldenbush (*Ericameria discoidea*)
Kentucky bluegrass (*Poa pratensis*)
Ross' sedge (*Carex rossii*)
Mountain monardella (*Monardella odoratissima*)

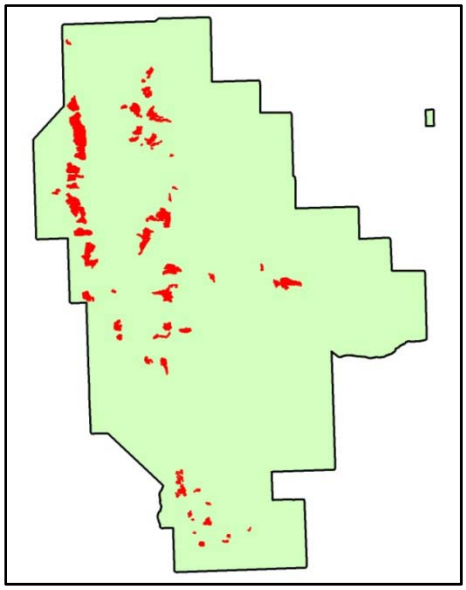
rUSNVC Association

- *Populus tremuloides* - *Pinus flexilis* Forest

Description

Frequency: Limber pine with quaking aspen trees is a common forest type at GRBA occurring in upper montane and lower subalpine areas (especially on the western-side of the park).
Physiognomy: F_PTPF polygons contain moderate to dense stands of medium-sized conifer trees (5 - 15 meters) with an almost even mix of similar sized deciduous trees. The understories for this map unit are often sparse and contain some evergreen and deciduous shrubs with pockets of herbaceous vegetation.
Condition: Good. Limber pine with quaking aspen trees are fairly widespread at GRBA and appear disease free at this time. Heavy fuel loading caused by fire suppression, severe wildfires, insect infestations, and invasion by non-native plant species are threats to this type.
CIR Signature: On the imagery canopies of F_PTPF appear as small brown spots (limber pine trees) with solid pink colors (quaking aspen) in the canopy openings.
Mapping Notes: The F_PTPF map unit was created to address upland limber pine stands that contained high cover of quaking aspen. This even mix of the two species may represent a transistional state where the limber pine is slowly replacing the quaking aspen. Limber pine trees appeared similar to white fir and Engelman spruce trees on the imagery and some confusion may have occurred during the mapping of this type with F_ABPO and F_PIEN3.

Range and Distribution



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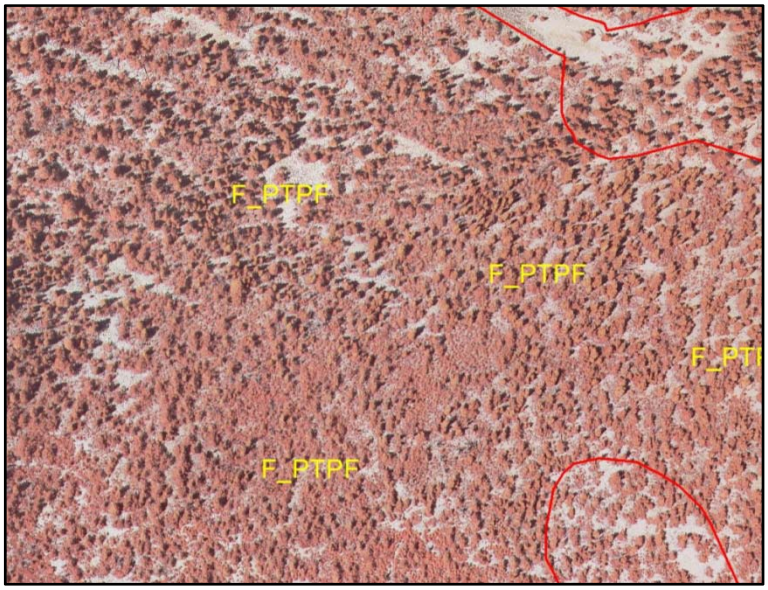


Map Code **White Fir – Douglas-fir Forest & Woodland Complex**
W_ACPM ***Abies concolor - Pseudotsuga menziesii* Forest & Woodland Complex**

Representative Ground Photo

Common Species

White Fir (*Abies concolor*)
Douglas-fir (*Pseudotsuga menziesii*)
Engelmann spruce (*Picea engelmannii*)
Quaking Aspen *(Populus tremuloides)*
Limber pine (*Pinus flexilis*)
Ponderosa pine (*Pinus ponderosa*)
Rocky Mountain juniper (*Juniperus scopulorum*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Curl-leaf mountain mahogany (*Cercocarpus ledifolius*)
Greenleaf manzanita (*Arctostaphylos patula*)
Creeping barberry (*Mahonia repens*)
Ross' sedge (*Carex rossii*)

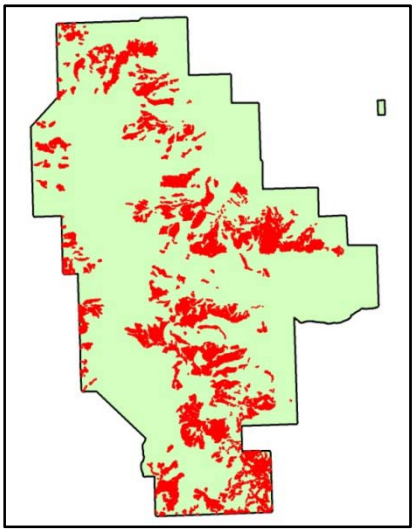
rUSNVC Associations

-*Abies concolor* / *Arctostaphylos patula* Forest
-*Abies concolor* / *Cercocarpus ledifolius* Woodland
-*Abies concolor* / *Symphoricarpos oreophilus* Forest
-*Abies concolor* - *Pseudotsuga menziesii* /*Carex rossii* Forest
-*Pseudotsuga menziesii* / *Arctostaphylos patula* Woodland

Description

Frequency: White fir woodland and forest communities are one of the most prevalent types at GRBA occurring across all of the montane and lower subalpine areas.
Physiognomy: W_ACPM polygons contain moderate to dense stands of tall conifer trees (> 15 meters) with sparse evergreen and deciduous shrubs and some occasional herbaceous vegetation in the understory.
Condition: Good. White fir trees at GRBA are widespread and appear disease free at this time. Heavy fuel loading caused by fire suppression, severe wildfires, insect infestations, and invasion by non-native plant species are threats to this type.
CIR Signature: On the imagery canopies of W_ACPM appear as rounded orange-brown spots (trees) with various colors ranging from gray (bare soil) to light brown (shrubs and herbaceous vegetation) in the canopy openings.
Mapping Notes: The W_ACPM map unit was created to address upland white fir stands at GRBA that contain little quaking aspen and various minor associates of other conifer species such as Douglas-fir and limber pine. White fir trees appeared similar to limber pine and Engelman spruce trees on the imagery and some confusion may have occurred during the mapping of these closely related conifer types.

Range and Distribution



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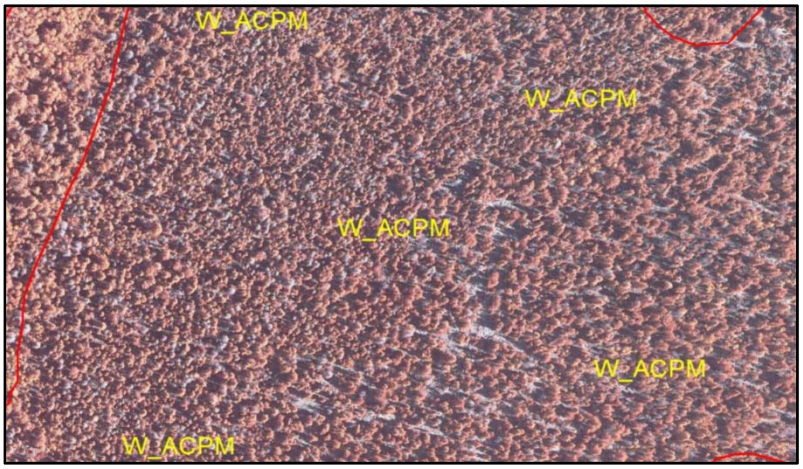


Map Code **White Fir Riparian Forest & Woodland Alliance**
W_ACRIP ***Abies concolor* Riparian Forest & Woodland Alliance**

Representative Ground Photo

Common Species

White fir (*Abies concolor*)
Quaking aspen (*Populus tremuloides*)
Ponderosa pine (*Pinus ponderosa*)
Rocky Mountain juniper (*Juniperus scopulorum*)
Bebb willow (*Salix bebbiana*)
Booth's willow (*Salix boothii*)
Woods' rose (*Rosa woodsii*)
Nebraska sedge (*Carex nebrascensis*)
Kentucky bluegrass (*Poa pratensis*)

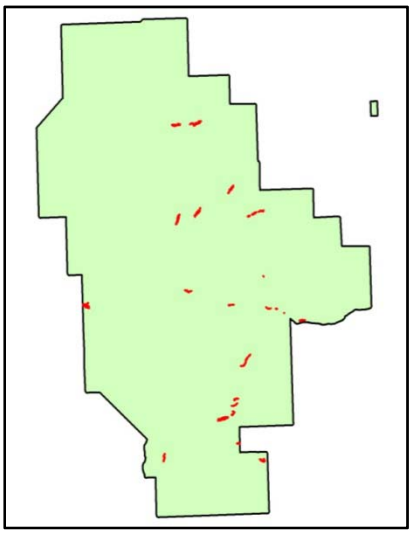
rUSNVC Associations

-*Abies concolor* - (*Populus tremuloides*) / *Salix boothii* / *Carex scopulorum* Forest
-*Abies concolor* - *Populus tremuloides* / *Carex* scopulorum Forest
-*Populus tremuloides* - *Abies concolor* / Mesic Graminoid Forest
-*Populus tremuloides* - *Abies concolor* / *Symphoricarpos* oreophilus Forest

Description

Frequency: White fir riparian woodlands are rare along montane and lower subalpine streams at GRBA.
Physiognomy: W_ACRIP polygons contain moderate to dense stands of very tall conifer trees (up to 30 meters) with common deciduous, riparian trees, shrubs and mesic herbaceous vegetation in the understory.
Condition: Good. White fir trees occurring in riparian corridors are fairly rare at GRBA but appear overall healthy and stable. Riparian areas at GRBA are commonly used for campgrounds and picnic areas and these may act as potential vectors for non-native plant introduction and establishment.
CIR Signature: On the imagery canopies of W_ACRIP appear as pointed, orange-brown spots (trees) with smaller orange dots (shrubs) and red background colors (herbaceous vegetation) in the canopy openings. Polygons of W_ACRIP often contained linear streams and other obvious water features.
Mapping Notes: The W_ACRIP map unit includes only white fir stands that occur in riparian cooridors and contain common, tall deciduous shrubs in the understory. Polygons of this type often contained varying amounts of quaking aspen but it was never the dominant tree species. The diverse nature of riparian areas at GRBA may have led to some confusion during the mapping of this type when compared to F_POTR2 and F_PIEN2.

Range and Distribution



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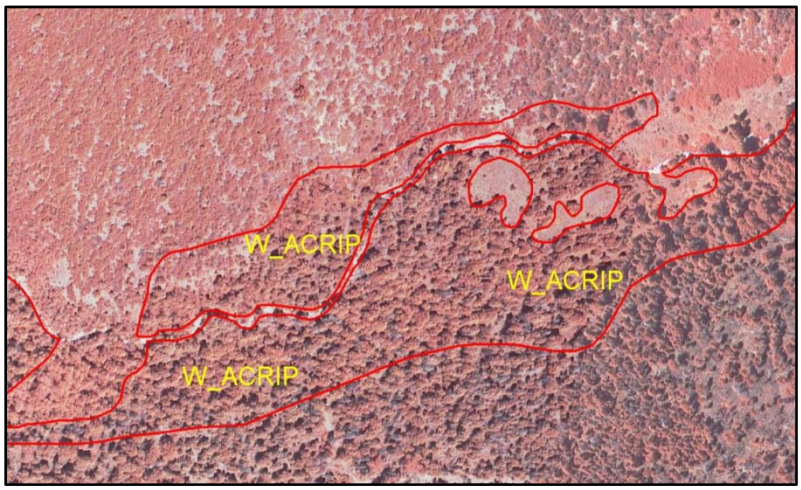


Map Code	**Curl-leaf Mountain-mahogany Shrubland & Woodland Complex**
W_CELE	***Cercocarpus ledifolius* Shrubland & Woodland Complex**

Representative Ground Photos

Common Species

Curl-leaf mountain mahogany *(Cercocarpus ledifolius)*
White fir (*Abies concolor*)
Singleleaf pinyon (*Pinus monophylla*)
Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*)
Greenleaf manzanita (*Arctostaphylos patula*)
Mountain snowberry (*Symphoricarpos oreophilus)*
Creeping barberry (*Mahonia repens*)
Muttongrass (*Poa fendleriana*)
Cheatgrass (*Bromus tectorum*)
Slender wheatgrass (*Elymus trachycaulus)*

rUSNVC Associations

-*Cercocarpus ledifolius* / *Arctostaphylo patula* Woodland [Provisional]
-*Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland
-*Cercocarpus ledifolius* / *Pseudoroegneria spicata* Scrub
-*Cercocarpus ledifolius* / *Symphoricarpos oreophilus* Woodland

Description

Frequency: Curl-leaf mountain mahogany is a very common plant species occurring throughout the foothill, montane and lower subalpine areas of GRBA.
Physiognomy: W_CELE polygons contain moderate to dense stands of both tall shrubs (0.5 – 1 meter) and short trees (1 – 5 meters) with sparse evergreen and deciduous shrubs and some herbaceous vegetation in the understory.
Condition: Good. Curl-leaf mountain mahogany at GRBA is widespread and appears generally healthy. Heavy fuel loading caused by fire suppression, severe wildfires, insect infestations, and invasion by non-native plant species are threats to this type.
CIR Signature: On the imagery W_CELE has a very characteristic reddish-brown color with some texture related to the varying size of the individual plants.
Mapping Notes: The W_CELE map unit contains both shrubland and woodlands and the height of the indivudal stands is noted in the **ht_mod** modifier polygon attribute field. W_CELE shrublands were attributed with < 1 meter and woodlands with 1- 5 meters. In low elevation areas W_CELE mixed with pinyon-juniper woodland types.

Range and Distribution

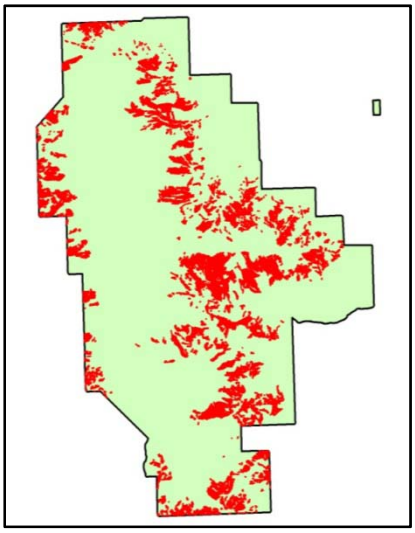
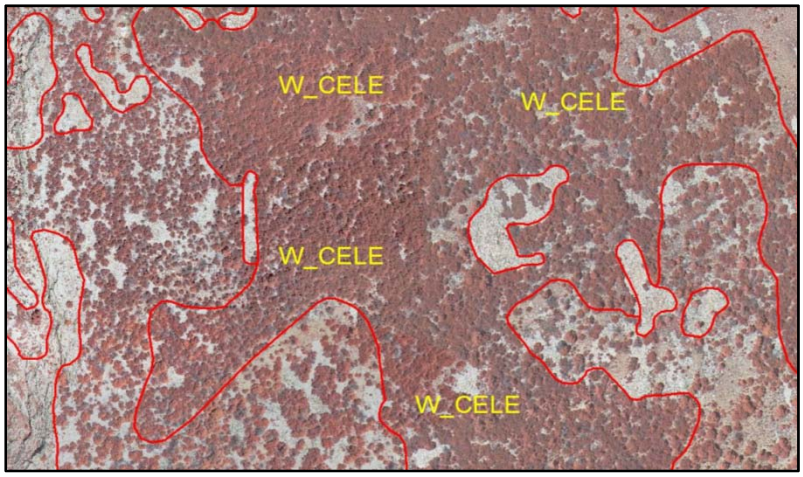


Photo Signature Example



Map Code	Great Basin Limber Pine Woodland Alliance
W_PIFL	Great Basin *Pinus flexilis* Woodland Alliance

Representative Ground Photo

Common Species

Limber pine *(Pinus flexilis)*
White fir (*Abies concolor*)
Engelmann spruce (*Picea engelmannii*)
Limber pine (*Pinus flexilis*)
Douglas-fir (*Pseudotsuga menziesii*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Greenleaf manzanita (*Arctostaphylos patula*)
Muttongrass (*Poa fendleriana*)
Ross' sedge (*Carex rossii*)

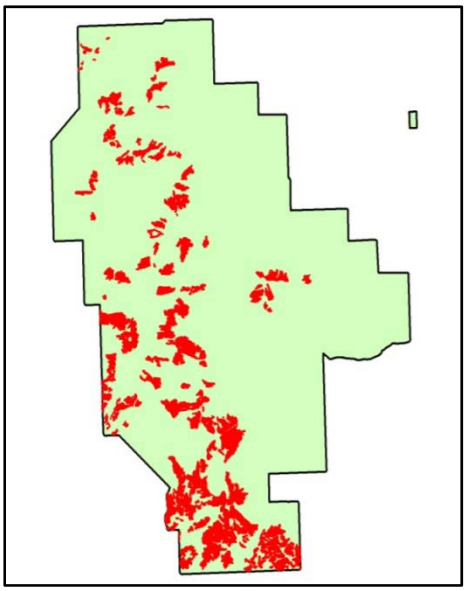
rUSNVC Associations

-*Pinus flexilis* - (*Populus tremuloides*) / *Arctostaphylos patula* Forest
-*Pinus flexilis* / *Artemisia tridentata* ssp. *vaseyana* Woodland [Park Special]
-*Pinus flexilis* / *Symphoricarpos oreophilus* Woodland

Description

Frequency: Communities of limber pine trees are common throughout the upper montane and subalpine areas of GRBA.
Physiognomy: W_PIFL polygons contain moderate to dense stands of tall conifer trees (> 15 meters) with sparse evergreen and deciduous shrubs and some occasional herbaceous vegetation in the understory.
Condition: Good. Limber pine trees at GRBA are widespread and appear disease free at this time. Heavy fuel loading caused by fire suppression, severe wildfires, insect infestations, and invasion by non-native plant species are threats to this type.
CIR Signature: On the imagery canopies of W_PIFL appear as pointed orange-brown spots (trees) with various colors ranging from gray (bare soil) to light brown (shrubs and herbaceous vegetation) in the canopy openings.
Mapping Notes: The W_PIFL map unit was created to address upland limber pine stands at GRBA that contain little quaking aspen. Limber pine trees appeared similar to white fir and Engelman spruce trees and some confusion may have occurred during the mapping of these closely related conifer woodland types.

Range and Distribution



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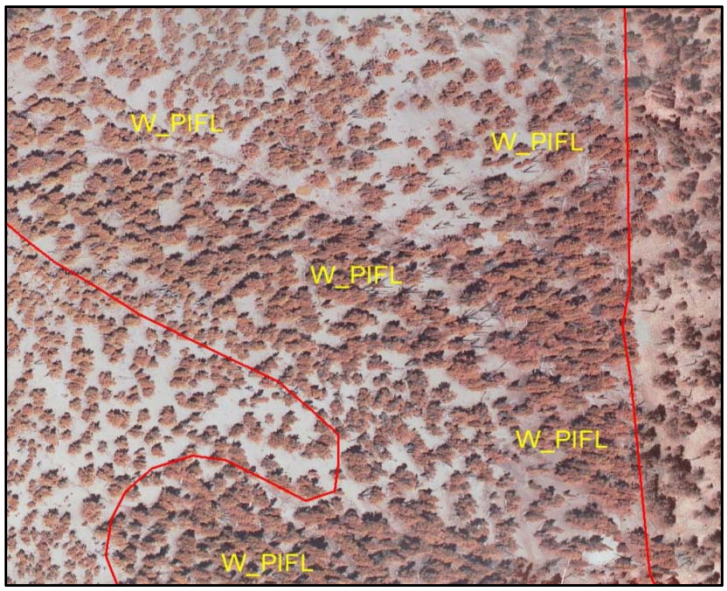


Map Code **Great Basin Bristlecone Pine Subalpine Woodland**
W_PILO1 ***Pinus longaeva* Subalpine Woodland**

Representative Ground Photo

Common Species

Great Basin bristlecone pine *(Pinus longaeva)*
White fir (*Abies concolor*)
Engelmann spruce (*Picea engelmannii*)
Limber pine (*Pinus flexilis*)
Common juniper (*Juniperus communis*)
Gooseberry currant (*Ribes montigenum*)
Hollyleaf clover (*Trifolium gymnocarpon*)
Ross' sedge (*Carex rossii*)
Dwarf alpine Indian paintbrush (*Castilleja nana*)
Snowline springparsley (*Cymopterus nivalis*)
Whitestem goldenbush (*Ericameria discoidea*)

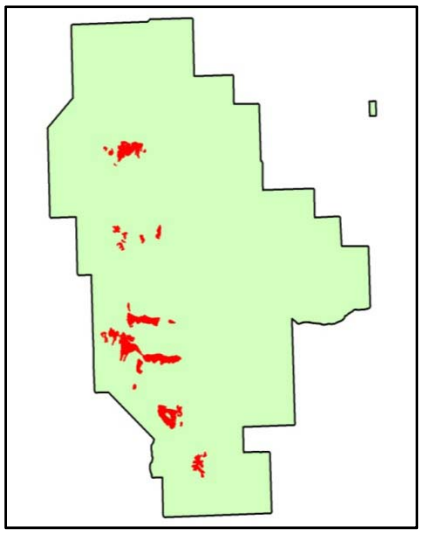
rUSNVC Associations

-*Pinus longaeva* / (*Ericameria discoidea, Ribes montigenum*) Woodland
-(Other Unclassified Understory Species)

Description

Frequency: Communities of subalpine bristlecone pine trees are fairly common throughout the higher elevation areas of GRBA.
Physiognomy: W_PILO1 polygons contain moderate to sparse stands of tall conifer trees (> 15 meters) with sparse evergreen and deciduous shrubs and some occasional alpine herbaceous vegetation in the understory.
Condition: Good. Subalpine bristlecone pine trees at GRBA represent some of the oldest living trees in North America. Localized patches are likely prone to rock slide and avalanche events. Overall this type is potentially threatened by global warming and climate change.
CIR Signature: On the imagery canopies of W_PILO1 appear as bushy, orange-brown spots (trees) with various colors ranging from gray (bare soil) to light brown (shrubs and herbaceous vegetation) in the canopy openings.
Mapping Notes: The W_PILO1 map unit was created to address higher elevation areas dominated by bristlecone pine. Stands of this type contained different understory species and the trees were older than the montane W_PILO2 map unit. High elevation bristecone pine trees appeared similar to limber pine and Engelman spruce trees and some confusion may have occurred during the mapping of these subalpine conifer types.

Range and Distribution



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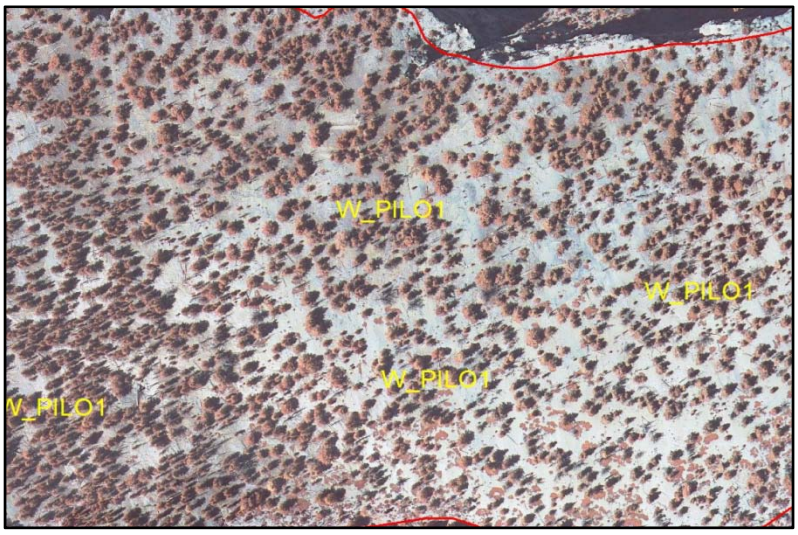


Map Code **Great Basin Bristlecone Pine Montane Woodland**
W_PILO2 ***Pinus longaeva* Montane Woodland**

Representative Ground Photo

Common Species

Great Basin bristlecone pine *(Pinus longaeva)*
Limber pine (*Pinus flexilis*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Greenleaf manzanita (*Arctostaphylos patula*)
Wax currant (*Ribes cereum*)
Muttongrass (*Poa fendleriana*)
Ross' sedge (*Carex rossii*)

rUSNVC Associations

-*Pinus longaeva* / *Arctostaphylos patula* Woodland [Park Special]
-*Pinus longaeva* / *Symphoricarpos oreophilus* Woodland [Park Special]

Description

Frequency: Communities of montane bristlecone pine trees are rare throughout the entire GRBA area.
Physiognomy: W_PILO2 polygons contain moderate to sparse stands of tall conifer trees (> 15 meters) with sparse evergreen and deciduous shrubs and some occasional herbaceous vegetation in the understory.
Condition: Good –Fair. Montane bristlecone pine trees are fairly rare at GRBA and the cause of their rarity is unknown.
CIR Signature: On the imagery canopies of W_PILO2 appear as bushy, orange-brown spots (trees) with various colors ranging from gray (bare soil) to red (shrubs and herbaceous vegetation) in the canopy openings. Recently burned areas show evidence of dead and down trees (gray poles and black areas).
Mapping Notes: The W_PILO2 map unit was created to address lower elevation montane areas dominated by bristlecone pine. Stands of this type contained different understory species and the trees were not as old as the higher elevation W_PILO1 map unit. Single bristecone pine trees were common in some of the other montane map units and their similar appearance to the other conifer trees may have caused some confusion during the mapping.

Range and Distribution

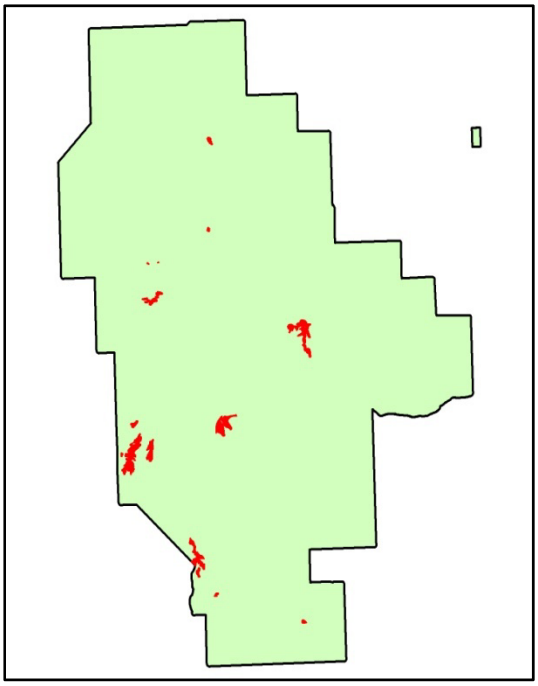
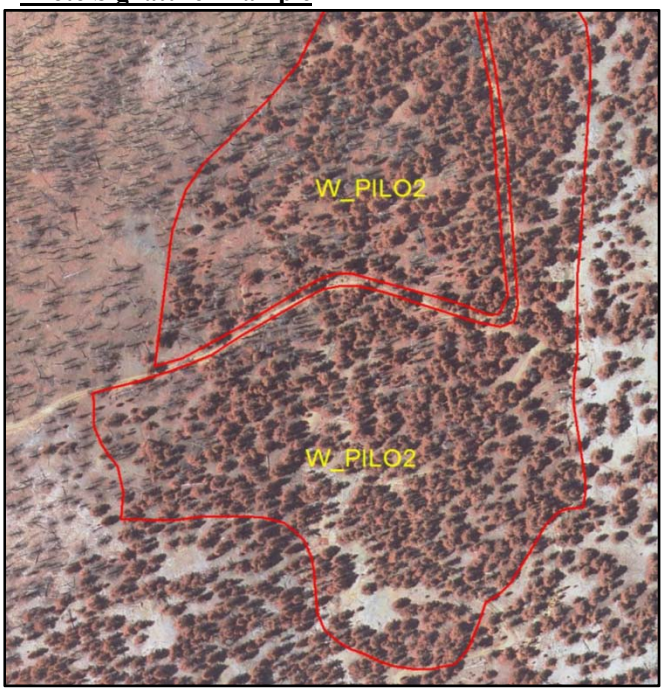


Photo Signature Example



Map Code	Singleleaf Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland
W_PJCL	***Pinus monophylla - Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland**

Representative Ground Photo

Common Species

Singleleaf pinyon (*Pinus monophylla*)
Utah juniper (*Juniperus osteosperma*)
Curl-leaf mountain-mahogany *(Cercocarpus ledifolius)*
Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*)
Creeping barberry (*Mahonia repens*)
Plains pricklypear (*Opuntia polyacantha*)

rUSNVC Association

-*Pinus monophylla - Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland

Description

Frequency: Pinyon-juniper woodlands with curl-leaf mountain-mahogany trees and shrubs are common throughout the eastern foothill section of GRBA.
Physiognomy: W_PJCL polygons contain dense stands of 2–5 meters tall conifer trees with evergreen shrubs of equal to lesser height.
Condition: Good –Fair. Pinyon juniper with mountain-mahogany is widespread and one of the more prevalent type in the foothill region of GRBA. Due to the lack of wildfire and other natural disturbances this map unit along with the other pinyon-juniper types is spreading and encroaching into big sagebrush and other basin plant communities.
CIR Signature: On the imagery dense canopies of W_PJCL appear as dark orange-brown spots (trees) with mixed dark red/brown spots (shrubs).
Mapping Notes: The W_PJCL map unit represents a continuim of pinyon-juniper with montain mahogany shrubs that start in the lower foothills and upper basin area and extends into in the montane zone. In the lower regions the polygons of W_PJCL have tall trees, open canopies and small mountain-mahogany shrubs. In the upper foothills the mountain-mahogany becomes tall and tree-like. In the higher montane zone the pinyon-juniper trees start to drop out and are replaced by solid stands of W_CELE.

Range and Distribution

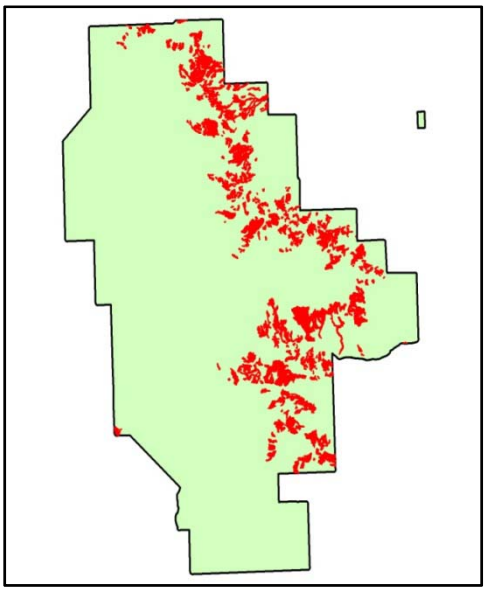
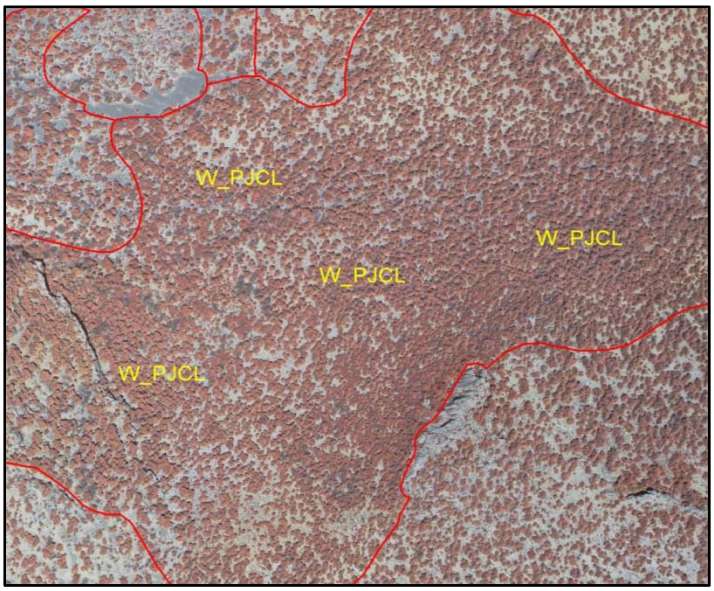


Photo Signature Example



Map Code	Singleleaf Pinyon - (Utah Juniper) / Mixed Shrub Woodland Complex
W_PJMX	***Pinus monophylla - (Juniperus osteosperma)*** **Mixed Shrub Woodland Complex**

Representative Ground Photo

Common Species

Singleleaf pinyon (*Pinus monophylla*)
Utah juniper (*Juniperus osteosperma*)
Black sagebrush (*Artemisia nova*)
Spiny greasebush (*Glossopetalon spinescens*)
Stansbury cliffrose (*Purshia stansburiana*)
Squaw apple (*Peraphyllum ramosissimum*)
Littleleaf mountain mahogany (*Cercocarpus intricatus*)
Mormon tea (*Ephedra viridis*)
Desert snowberry (*Symphoricarpos longiflorus*)
Tumbling saltweed (*Atriplex rosea*)

rUSNVC Associations

-*Pinus monophylla* - *Juniperus osteosperma* / G*lossopetalon spinescens* - *Artemisia tridentata* –P*urshia stansburiana* Woodland [Provisional]
-*Pinus monophylla* - (*Juniperus osteosperma*) / *Cercocarpus intricatus* Woodland
-*Pinus monophylla* - *Juniperus osteosperma* / *Peraphyllum ramosissimum* Woodland

Description

Frequency: Pinyon-juniper woodlands with mixed shrub understories are common throughout the eastern foothill section of GRBA.
Physiognomy: W_PJMX polygons contain moderate to dense stands of 2–5 meters tall conifer trees with short (< 1 meter) evergreen and deciduous shrubs in the canopy openings.
Condition: Good –Fair. Pinyon juniper with various short and draw shrubs is widespread and one of the more prevalent types at GRBA. Due to the lack of wildfire and other natural disturbances this map unit along with the other pinyon-juniper types is spreading and encroaching into big sagebrush and other basin plant communities.
CIR Signature: On the imagery polygons of W_PJMX are mostly open with dark brown spots (trees) and light gray to pink dots (mixed shrubs) in the canopy openings.
Mapping Notes: The W_PJMX map unit represents pinyon-juniper woodlands that contain a variable mix of short and dwarf shrubs. This map unit was created to help separate open pinyon-juniper woodlands with scattered shrubs in the understory from stands with no understory component (W_PJSP) and stands with dense shrub understories (W_PJCL and W_PJSG).

Range and Distribution

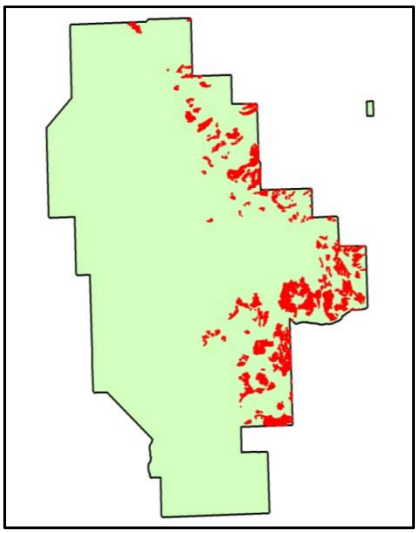


Photo Signature Example

Map Code Singleleaf Pinyon - Utah Juniper / Mixed Riparian Shrub Woodland Complex
W_PJRP *Pinus monophylla - Juniperus osteosperma* / Mixed Riparian Shrub Woodland Complex

Representative Ground Photo

Common Species

Singleleaf pinyon (*Pinus monophylla*)
Utah juniper (*Juniperus osteosperma*)
quaking aspen Populus tremuloides
water birch (*Betula occidentalis*)
Woods' rose (*Rosa woodsii*)
chokecherry (*Prunus virginiana*)
Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*)
Skunkbush sumac (*Rhus trilobata* var. t*rilobata*)
Baltic rush (*Juncus balticus*)
Basin wildrye (*Leymus cinereus*)

rUSNVC Associations

-*Pinus monophylla - Juniperus osteosperma* / *Betula occidentalis - Rosa woodsii* Woodland [Park Special]
-*Pinus monophylla - Juniperus osteosperma* / *Prunus virginiana* Woodland

Description

Frequency: Pinyon-juniper woodlands with riparian shrub understory vegetation are relatively rare along creeks and streams in the foothill section of GRBA.
Physiognomy: W_PJRP polygons contain moderate to dense stands of 2-5 meters tall conifer trees with medium-sized (1-2 meter) deciduous shrubs occurring in the canopy openings.
Condition: Fair. Pinyon-juniper woodlands with riparian shrubs are only found along some drainages and streams and may represent areas where pinyon pine and juniper trees are encroaching on riparian corridors. W_PJRP near picnic sites, campgrounds, visitor centers, roads and other developments show some signs of human disturbance and contain a higher percentage of non-native species.
CIR Signature: On the imagery W_PJRP polygons appears as dark brown spots with smaller yellow and orange dots in the canopy openings.
Mapping Notes: The W_PJRP map unit is similar in appearance to the other conifer dominated riparian map units (especially the W_PPPM2 type), and some confusion may have occurred between them during the mapping.

Range and Distribution

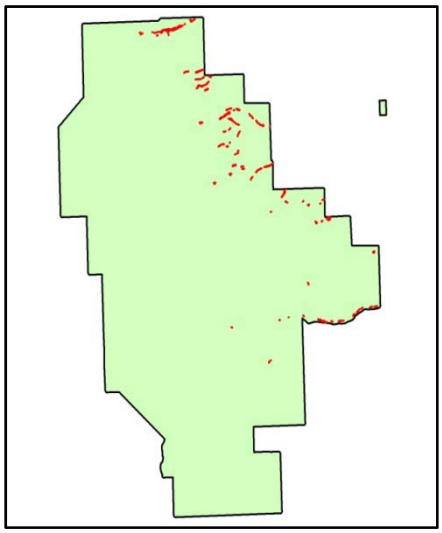
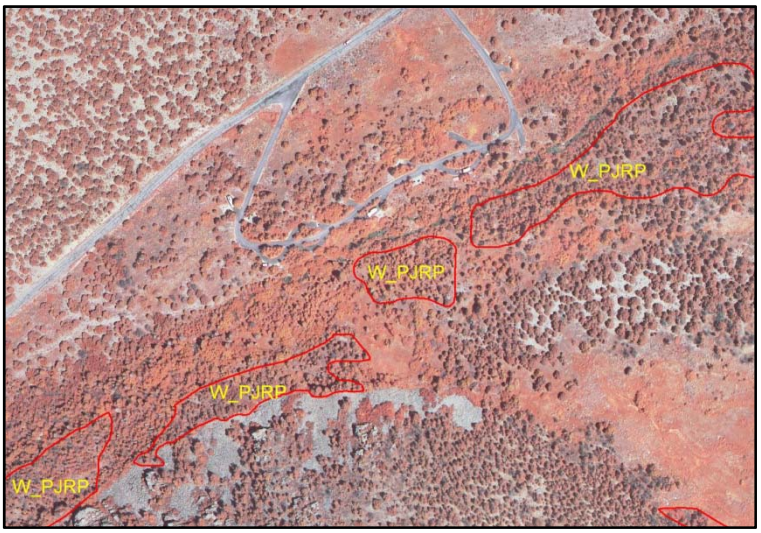


Photo Signature Example



Map Code	Singleleaf Pinyon - (Utah Juniper) / Sagebrush Woodland Complex
W_PJSG	***Pinus monophylla - (Juniperus osteosperma) / Artemisia* spp. Woodland Complex**

Representative Ground Photo

Common Species

Singleleaf pinyon (*Pinus monophylla*)
Utah juniper (*Juniperus osteosperma*)
Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*)
Mountain big sagebrush (*Artemisia tridentata* ssp. v*aseyana*)
Black sagebrush (*Artemisia nova*)
Little sagebrush (*Artemisia arbuscula*)
Antelope bitterbrush (*Purshia tridentata*)
Indian ricegrass (*Achnatherum hymenoides*)
Cheatgrass (*Bromus tectorum*)
Squirreltail (*Elymus elymoides*)
Bluebunch wheatgrass (*Pseudoroegneria spicata*)

rUSNVC Associations

-*Pinus monophylla* - *Juniperus osteosperma* / *Artemisia arbuscula* Woodland
-*Pinus monophylla* - *Juniperus osteosperma* / *Artemisia nova* Woodland
-*Pinus monophylla* - *Juniperus osteosperma* / *Artemisia tridentata* ssp.*vaseyana* - Mixed Shrub Woodland
-*Pinus monophylla* - *Juniperus osteosperma* / *Artemisia tridentata* ssp.*vaseyana* / *Pseudoroegneria spicata* Woodland
-*Pinus monophylla* - *Juniperus osteosperma* / *Artemisia tridentata* Woodland
-*Pinus monophylla* - *Juniperus osteosperma* / *Purshia tridentata* Woodland

Description

Frequency: Pinyon-juniper woodlands with sagebrush or antelope bitterbrush understory vegetation are common throughout the eastern foothill section of GRBA.
Physiognomy: W_PJSG polygons contain moderate to dense stands of 1–5 meters tall conifer trees with short (< 1 meter) evergreen shrubs in canopy openings.
Condition: Good –Fair. Pinyon juniper with sagebrush and/or antelope bitterbrush is widespread and one of the more prevalent types at GRBA. Due to the lack of wildfire and other natural disturbances this map unit along with the other pinyon-juniper types is spreading and encroaching into big sagebrush and other basin plant communities.
CIR Signature: On the imagery dense canopies of W_PJSG appears as dark brown spots with light gray dots in the background.
Mapping Notes: The W_PJSG map unit contains various sagebrush species including low and black sagebrush on shallow, shale soils and taller antelope bitterbrush, mountain and basin big sagebrush on more developed soils.

Range and Distribution

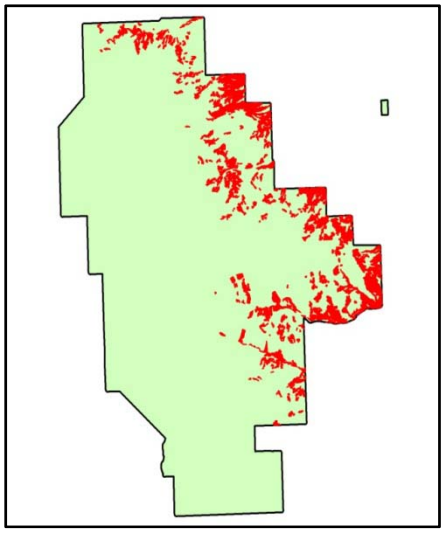
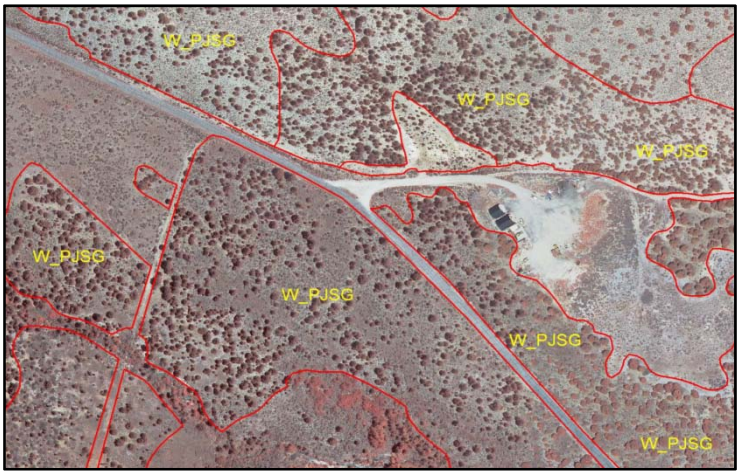


Photo Signature Example



Map Code	**Singleleaf Pinyon - (Utah Juniper) / Grass & Sparse Understory Woodland Complex**
W_PJSP	***Pinus monophylla - (Juniperus osteosperma)* / Grass & Sparse Understory Woodland Complex**

Representative Ground Photos

Common Species

Singleleaf pinyon (*Pinus monophylla*)
Utah juniper (*Juniperus osteosperma*)
Sandberg bluegrass (*Poa secunda*)
Cheatgrass (*Bromus tectorum*)
Herb sophia (*Descurainia sophia*)
Mormon tea (*Ephedra viridis*)

rUSNVC Associations

-*Pinus monophylla - Juniperuz osteosperma* / *Poa* (*fendleriana, secunda*) Woodland
-*Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland

Description

Frequency: Pinyon-juniper woodlands with sparse grass or no understory vegetation are common throughout the eastern foothill section of GRBA.
Physiognomy: W_PJSP polygons contain moderate to dense stands of 2–5 meters tall conifer trees.
Condition: Good –Fair. Pinyon juniper with little understory vegetation is widespread and one of the more prevalent types at GRBA. Due to the lack of wildfire and other natural disturbances this map unit along with the other pinyon-juniper types is spreading and encroaching into big sagebrush and other basin plant communities.
CIR Signature: On the imagery dense canopies of W_PJSP appears as thick, dark brown spots and as brown spots on a gray background (clay or shale soil) when less dense.
Mapping Notes: The PJSP map unit contains both dense, thick stands of pinyon-juniper trees that crowded or shaded out most understory vegetation and as open stands that occur on shallow, shale soils with only sparse grasses and forbs in the understory. The presence of a grass understory was noted in the polygon comments field for this type.

Range and Distribution

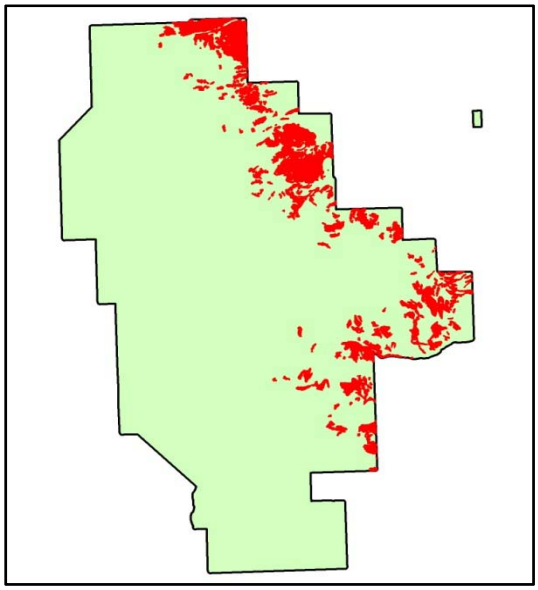
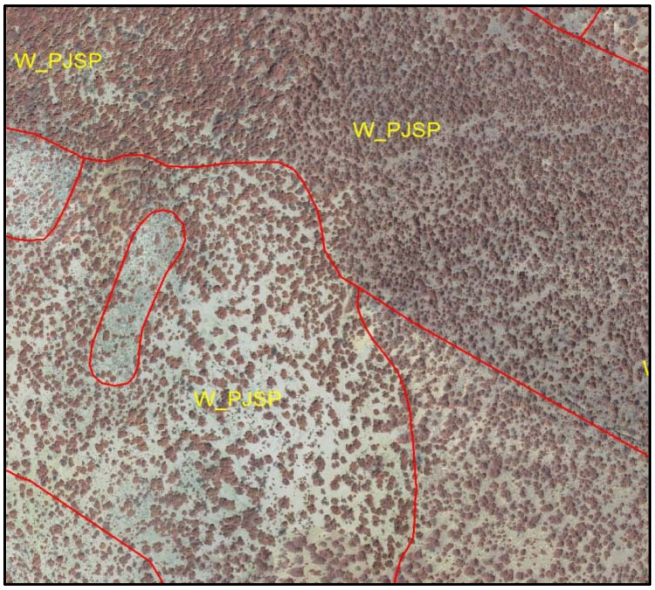


Photo Signature Example



Map Code **Ponderosa Pine – (Douglas Fir) Woodland Complex**
W_PPPM1 ***Pinus ponderosa* – (*Pseudotsuga menziesii*) Woodland Complex**

Representative Ground Photo

Common Species

Ponderosa pine (Pinus ponderosa)
White fir (*Abies concolor*)
Douglas-fir (*Pseudotsuga menziesii*)
Limber pine (*Pinus flexilis*)
Greenleaf manzanita (*Arctostaphylos patula*)
Rocky Mountain maple (*Acer glabrum*)
Curl-leaf mountain mahogany (*Cercocarpus ledifolius*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Creeping barberry (*Mahonia repens*)

rUSNVC Association

-*Pinus ponderosa* - (*Pinus longaeva*) / *Cercocarpus intricatus* Woodland
-*Pinus ponderosa* - *Abies concolor* / *Symphoricarpos oreophilus* Woodland
-*Pinus ponderosa* / *Arctostaphylos patula* Woodland

Description

Frequency: Communities of upland ponderosa pine trees are rare throughout the entire GRBA but locally common along the montane sections of the Wheeler Peak Road and on recently burned areas in the Big Wash drainages of south central and east central portions of GRBA.
Physiognomy: W_PPPM1 polygons contain moderate to dense stands of tall conifer trees (> 15 meters) with sparse evergreen and deciduous shrubs in the understory. Understories in recently burned sites with ponderosa pine vary from no vegetation to dense cover of shrubs and herbaceous vegetation.
Condition: Good –Fair. Upland ponderosa pine trees are fairly rare at GRBA and their rarity may be a result of man-made conditions such as wildfire suppression.
CIR Signature: On the imagery canopies of W_PPPM1 appear as bushy, dark brown spots (trees) with orange and red spots (shrubs) in the canopy openings. Recently burned areas with ponderosa pine show evidence of dead and down trees (gray poles and black areas) with red and pink understory colors.
Mapping Notes: The W_PPPM1 map unit was created to address areas were ponderosa pine trees formed the dominant overstory vegetation. Ponderosa pine trees were also common in most of the other montane map units but were only minor associates. Douglas-fir was added to this map unit since some of the polygons contain similar sized Douglas-fir trees instead of ponderosa pine. This type is vary similar to the other conifer montane map units and some confusion may have occurred during the mapping.

Range and Distribution

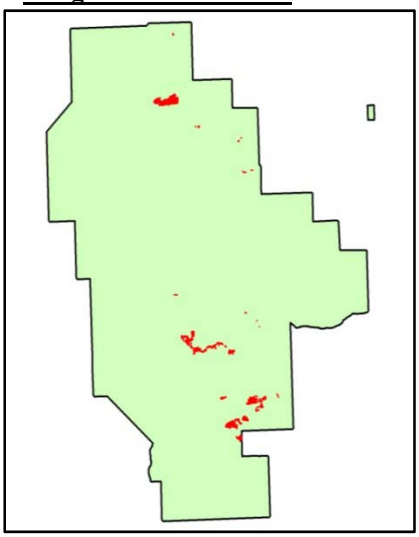
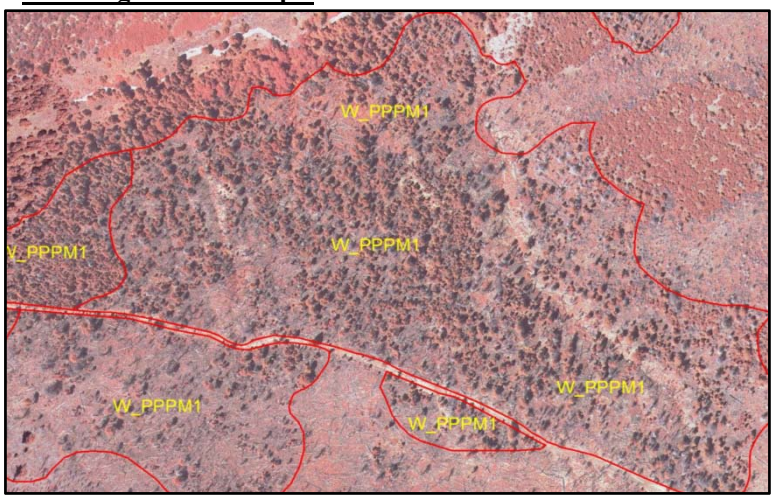


Photo Signature Example



Map Code **Ponderosa Pine (Douglas-fir) Riparian Forest Alliance**
W_PPPM2 ***Pinus ponderosa* – (*Pseudotsuga menziesii*) Riparian Forest Alliance**

Representative Ground Photo

Common Species

Ponderosa pine (*Pinus ponderosa*)
Quaking aspen (*Populus tremuloides*)
White fir (*Abies concolor*)
Douglas-fir (*Pseudotsuga menziesii*)
Rocky Mountain juniper (*Juniperus scopulorum*)
Woods' rose (*Rosa woodsii*)
Creeping barberry (*Mahonia repens*)
Blue elderberry (*Sambucus nigra* ssp. *caerulea*)
Willows (*Salix* spp.)
Baltic rush (*Juncus balticus*)
Ross' sedge (*Carex rossii*)

rUSNVC Associations

-*Pinus ponderosa* - *Abies concolor* Riparian Forest
-(Other Unclassified Understory Species)

Description

Frequency: Ponderosa pine riparian woodlands are rare along foothill and montane streams in the eastern section of GRBA.
Physiognomy: W_PPPM2 polygons contain moderate to dense stands of very tall conifer trees (often > 30 meters) with common deciduous, riparian shrubs and mesic herbaceous vegetation in the understory.
Condition: Good –Fair. Ponderosa pine trees in riparian corridors are fairly rare at GRBA and their rarity may be a result of man-made conditions such as wildfire suppression and disturbance from roads, campgrounds, etc… More research is likely needed to determine if ponderosa pine trees represent a natural riparian community, a community that is declining, or if ponderosa pine trees have encroached into these more mesic sites.
CIR Signature: On the imagery canopies of W_PPPM2 appear as bushy, dark brown spots (trees) with orange spots (shrubs) and red background colors (herbaceous vegetation) in the canopy openings.
Mapping Notes: The W_PPPM2 map unit was created to address ponderosa pine trees that were found growing in mesic riparian and wetland areas with different associated understory species than the upland W_PPPM1 class. Douglas-fir was added to this map unit since some of the polygons contains similar sized Douglas-fir trees instead of ponderosa pine. This type is vary similar to the other conifer riparian map units and some confusion may have occurred during the mapping.

Range and Distribution

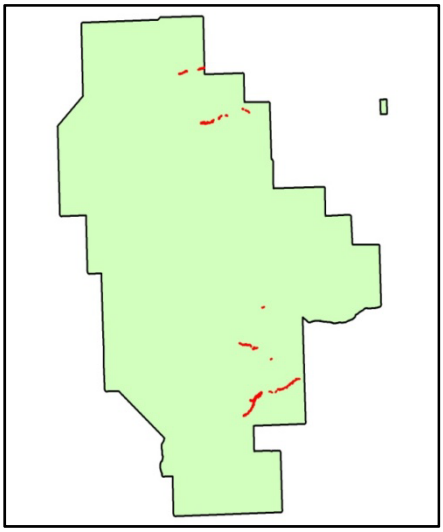


Photo Signature Example

Shrublands

Map Code	Utah Serviceberry - (Mountain Big Sagebrush, Wyoming Big Sagebrush) Shrubland
S_AMARTV	***Amelanchier utahensis - Artemisia tridentata (***ssp. ***vaseyana,*** ssp. ***wyomingensis)*** **Shrubland**

Representative Ground Photos

Common Species

Utah Serviceberry (*Amelanchier utahensis)*
Mountain Big Sagebrush *(Artemisia tridentate* ssp. *vaseyana*)
Wood's Rose (*Rosa woodsii*)
Mountain Snowberry (*Symphoricarpos oreophilus*)
Cheatgrass (*Bromus tectorum*)
Needle and thread grass (*Hesperostipa comata*)
James galleta grass (*Pleuraphis jamesii*)
Sandberg bluegrass (*Poa secunda*)

rUSNVC Association

-*Amelanchier utahensis - Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*) Shrubland

Description

Frequency: S_AMARTV is a rare type only found along the Snake Creek Drainage and some other minor streams in the central portion of GRBA.
Physiognomy: S_AMARTV contains tall (> 1 meter) deciduous Utah serviceberry shrubs with an understory of shorter, mountain big sagebrush, common snowberry, Wood's rose and various grasses.
Condition: Good. Threats to this map unit include invasion by non-native grasses and wildfires.
CIR Signature: On the imagery the Utah serviceberry shrubs appeared as coarse pink stipples against a gray (sagebrush) and tan (grass) background.
Mapping Notes: S_AMARTV was very similar in appearance to the ARTRV and ARTSY map units and some sparse examples of this map unit may have been mapped as ARTRV.

Range and Distribution

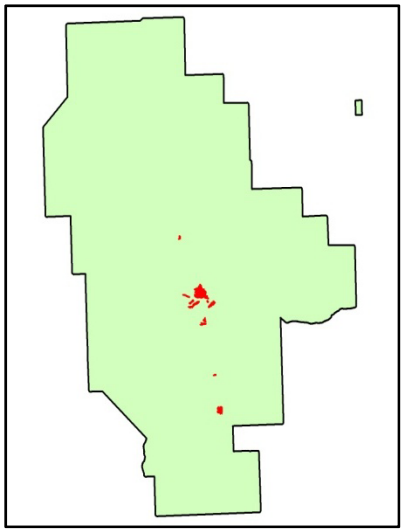
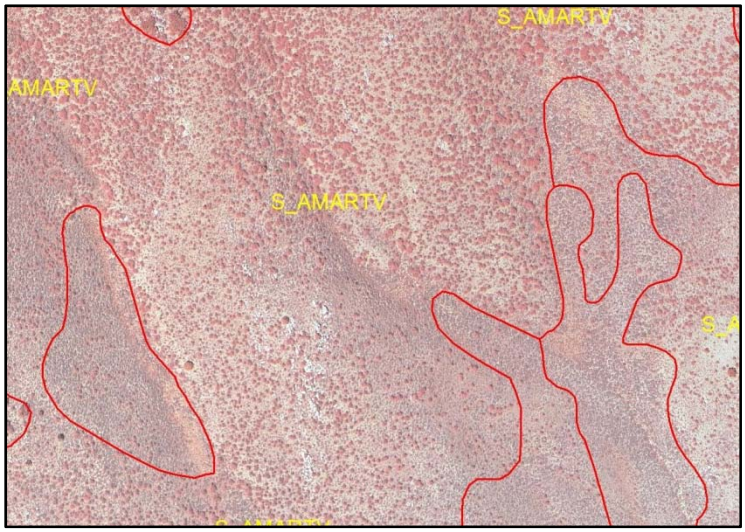


Photo Signature Example



Map Code	Low Sagebrush Shrub Herbaceous Alliance
S_ARAR	***Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance**

Representative Ground Photo

Common Species

Low Sagebrush (*Artemisia arbuscula* ssp. *arbuscula)*
Desert bitterbrush (*Purshia glandulosa*)
Spineless horsebrush (*Tetradymia canescens*)
Bluebunch wheatgrass (*Pseudoroegneria spicata*)
Muttongrass (*Poa fendleriana*)
Watson's penstemon (*Penstemon watsonii*)
Grassy rockgoldenrod (*Petradoria pumila*)

rUSNVC Association

-*Artemisia arbuscula* ssp. *arbuscula* / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation
-(Other Unclassified Understory Species)

Description

Frequency: Low sagebrush shrubs were fairly common on rocky, dry shoulder-slopes in the montane and lower subalpine zones of GBRA.
Physiognomy: Polygons of S_ARAR were dominated by short evergreen shrubs with an understory of native upland grasses and forbs.
Condition: Good. S_ARAR occurs in mostly remote areas and as a result is only mildly threatened by non-native grass and forb invasion. Some localized patches may be prone to landslides, avalanches and wildfires events.
CIR Signature: On the imagery S_ARAR is characterized by a smooth light gray color.
Mapping Notes: The short-statured nature of low sagebrush made it appear similar to dry upland grasslands, sparse mountain sagebrush, and to black sagebrush. Further ground-truthing of S_ARAR would likely help refine and improve the accuracy of this type.

Range and Distribution

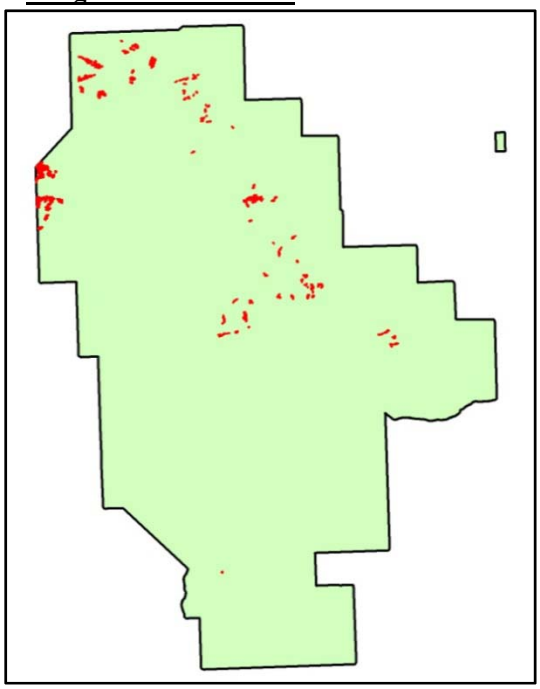
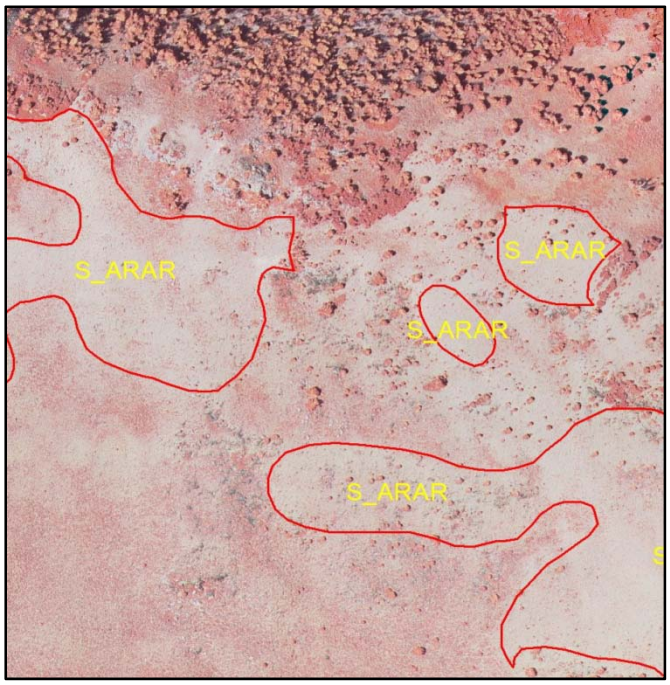


Photo Signature Example



Map Code **Black Sagebrush Shrubland Alliance**
S_ARNO ***Artemisia nova* Shrubland Alliance**

Representative Ground Photo

Common Species

Black Sagebrush (*Artemisia nova*)
Nevada jointfir (*Ephedra nevadensis*)
Broom snakeweed (*Gutierrezia sarothrae*)
Antelope bitterbrush (*Purshia tridentata*)
Utah juniper (*Juniperus osteosperma)*
Indian ricegrass (*Achnatherum hymenoides*)
Cheatgrass (*Bromus tectorum*)
Squirreltail (*Elymus elymoides*)
Muttongrass (*Poa fendleriana*)

rUSNVC Associations

-*Artemisia nova* / *Achnatherum hymenoides* Shrubland
-*Artemisia nova* / *Poa fendleriana* Shrubland
-*Artemisia nova* / *Pseudoroegneria spicata* Shrubland

Description

Frequency: Black sagebrush was found throughout the upper basin and lower foothill regions of eastern GRBA. Limestone derived substrates are typical of this type.
Physiognomy: Polygons of S_ARNO are dominated by low-growing evergreen shrubs with pinion pine and Utah juniper emergent trees.
Good – Fair. The suppression of wildfires may allow for some encroachment of pinion pine and Utah juniper trees along the upper basin region of GRBA. Disturbance events such as fire and grazing may allow more non-native grasses and forbs to become established.
CIR Signature: On the imagery S_ARNO is characterized by a slightly mottled, light gray color.
Mapping Notes: The short-statured nature of black sagebrush made it appear similar to dry upland grasslands, sparse mountain sagebrush, and to low sagebrush. Further ground-truthing of S_ARNO would likely help refine and improve the accuracy of this type.

Range and Distribution

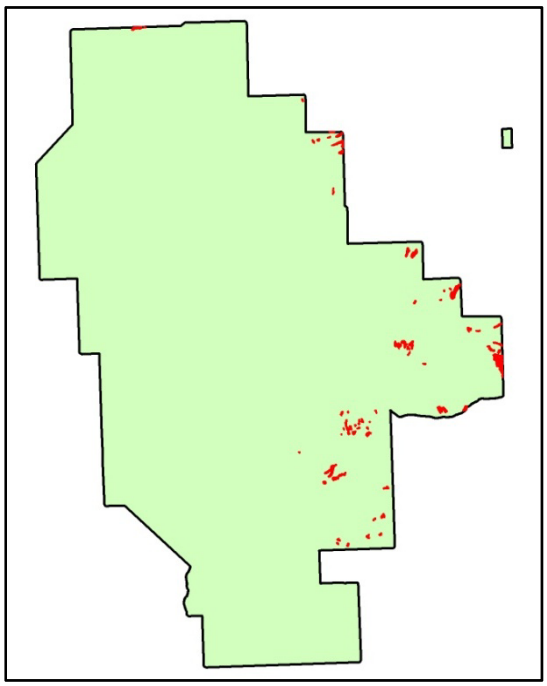
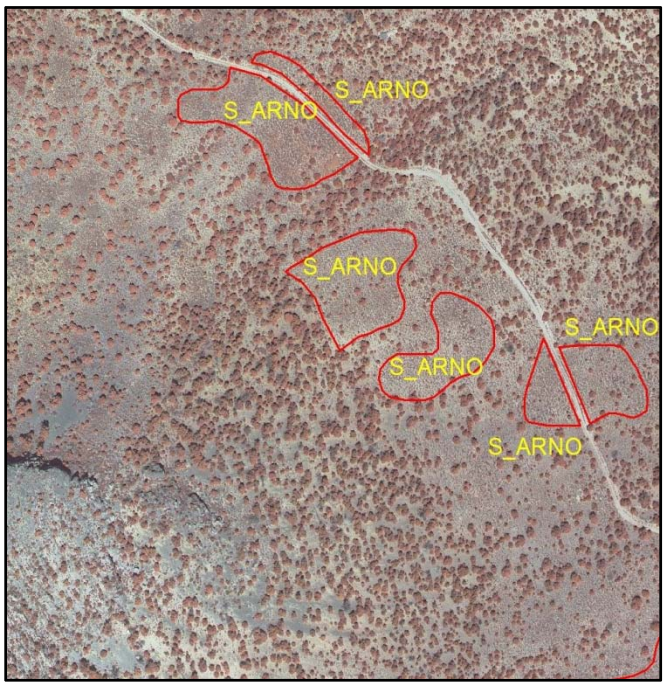


Photo Signature Example



Map Code **Greenleaf Manzanita Shrubland Alliance**
S_ARPA ***Arctostaphylos patula* Shrubland Alliance**

Representative Ground Photo

Common Species

Greenleaf manzanita *(Arctostaphylos patula*)
Martin's ceanothus (*Ceanothus martinii*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Curl-leaf mountain mahogany (*Cercocarpus ledifolius*)
Creeping barberry (*Mahonia repens*)
Threenerve goldenrod (*Solidago velutina*)
Looseflower milkvetch (*Astragalus tenellus*)
Streambank wheatgrass (*Elymus lanceolatus*)

rUSNVC Associations

-*Arctostaphylos patula* Shrubland
-*Arctostaphylos patula* / *Ceanothus martinii* Shrubland

Description

Frequency: Small patches of greenleaf manzanita are common throughout GRBA. Greenleaf manzanita is also a common understory species in coniferous forests and is an early colonizer on recently burned sites.
Physiognomy: Stands of S_ARPA are dominated by low to medium-sized, broad-leaved evergreen shrubs.
Condition: Good. Greenleaf manzanita shrubs are widespread at GRBA and can quickly recover from wildfire events. The thick growing nature of this plant community makes it resistant to invasion from most non-native grasses and forbs.
CIR Signature: The S_ARPA map unit has a highly recognizable signature consisting of overlapping dark red splotches.
Mapping Notes: Greenleaf manzanita was found sporadically growing in the understory of almost all of the woodland types at GRBA. However, pure, large patches of S_ARPA were hard to find and as a result some of the polygons may be below the minimum mapping unit.

Range and Distribution

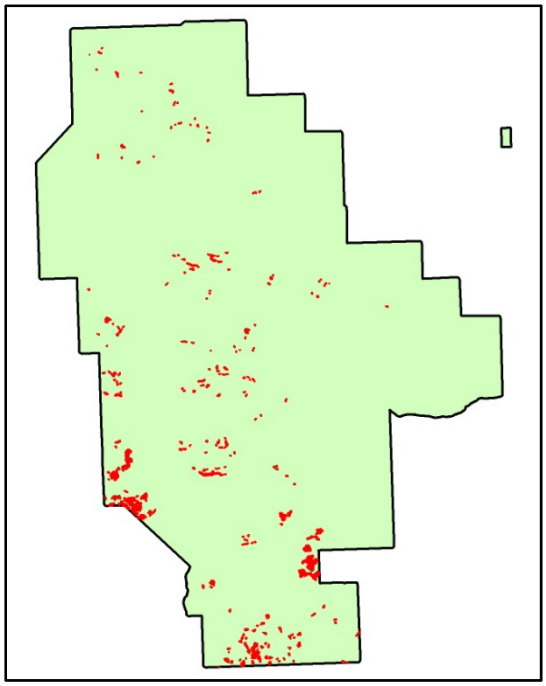
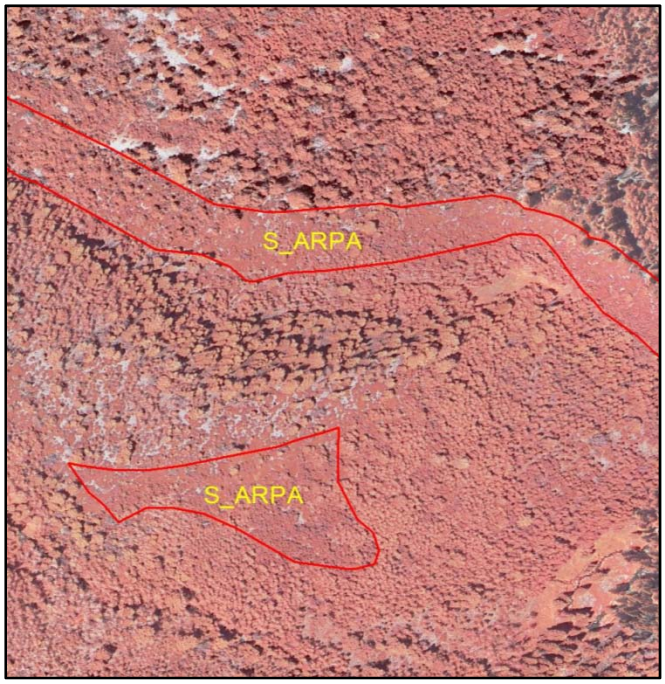


Photo Signature Example



Map Code **Basin Big Sagebrush Shrubland Complex**
S_ARTR ***Artemisia tridentata* ssp. *tridentata* Shrubland Complex**

Representative Ground Photo

Common Species

Basin Big Sagebrush (*Artemisia tridentata* ssp. *tridentata*)
Rubber rabbitbrush (*Ericameria nauseosa*)
Squaw apple (*Peraphyllum ramosissimum*)
Fernbush (*Chamaebatiaria millefolium*)
Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Desert bitterbrush (*Purshia glandulosa*)
Bastard toadflax (*Comandra umbellata*)
Basin wildrye (*Leymus cinereus*)
Crested wheatgrass (*Agropyron cristatum*)
Cheatgrass (*Bromus tectorum*)

rUSNVC Associations

-*Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland
-*Artemisia tridentata* / *Elymus elymoides* Shrubland
-*Artemisia tridentata* ssp. *tridentata* /*Agropyron cristatum* Semi-natural Shrubland
-*Artemisia tridentata* ssp. *tridentata* /*Leymus cinereus* Shrubland
-*Artemisia tridentata* ssp. *tridentata* /*Pleuraphis jamesii* Shrubland
-*Artemisia tridentata* ssp. *tridentata* - *Peraphyllum ramosissimum* - *Chamaebatiaria millefolium* Shrubland

Description

Frequency: Basin big sagebrush shrublands with various understory species are common throughout the eastern basin region of the GRBA (including the administrative area) and can be found along lower foothill drainages.
Physiognomy: S_ARTR polygons are dominated by tall to medium-sized evergreen shrublands with understories consisting of mainly native grasses, cheatgrass, and minor deciduous short and dwarf-shrubs.
Condition: Good – Fair. The suppression of wildfires may allow for some encroachment of pinion pine and Utah juniper trees into this type along the lower edge of the pinion-juniper foothills region of GRBA. Disturbance events such as fire and grazing may allow more non-native grasses and forbs to become established.
CIR Signature: Polygons of S_ARTR had a textured gray appearance.
Mapping Notes: The S_ARTR type had a similar appearance to the other sagebrush map units and some overlap and confusion likely exists in the mapping. More ground-truthing of the sagebrush types may allow for further refinement and increased accuracy.

Range and Distribution

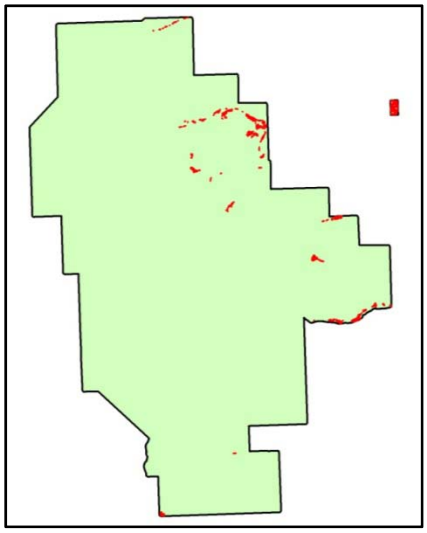
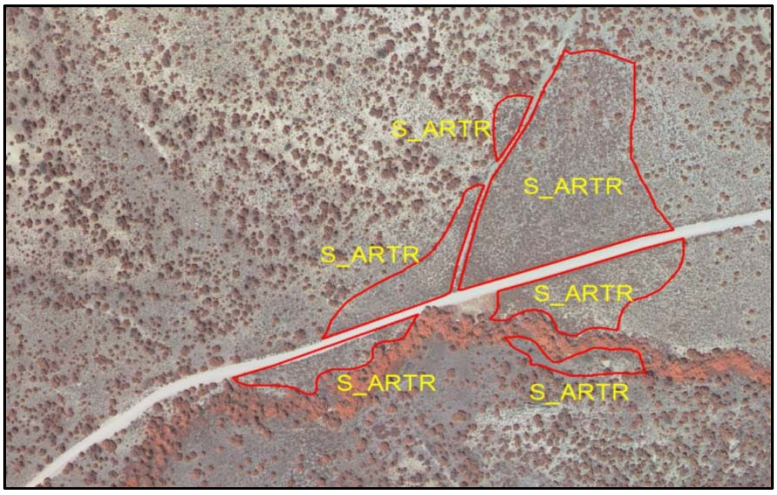


Photo Signature Example



Map Code	Mountain Big Sagebrush / Grass Understory Shrubland Complex
S_ARTRV	***Artemisia tridentata* ssp. *vaseyana* / Grass Understory Shrubland Complex**

Representative Ground Photo

Common Species

Mountain Big Sagebrush *(Artemisia tridentata* ssp. *vaseyana*)
Curl-leaf mountain mahogany (*Cercocarpus ledifolius*)
Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Slender buckwheat (*Eriogonum microthecum*)
Squirreltail (*Elymus elymoides*)
Slender wheatgrass (*Elymus trachycaulus*)
Muttongrass (*Poa fendleriana*)
Sandberg bluegrass (*Poa secunda*)
Bluebunch wheatgrass (*Pseudoroegneria spicata*)
Bastard toadflax (*Comandra umbellata*)
Silvery lupine (*Lupinus argenteus*)

rUSNVC Associations

-*Artemisia tridentata* ssp. *vaseyana* / *Poa* (*glauca, secunda*) Shrubland
-*Artemisia tridentata* ssp. *vaseyana* / *Poa fendleriana* Shrubland
-*Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland

Description

Frequency: Mountain big sagebrush shrublands with various understory species are common throughout the foothill, montane, and lower subalpine sections of GRBA.
Physiognomy: S_ARTRV polygons are dominated by medium-sized evergreen shrublands with understories consisting of mainly native grasses, cheatgrass, and minor deciduous short and dwarf-shrubs.
Condition: Good – Fair. The suppression of wildfires may allow for some encroachment of pinion pine and Utah juniper trees into this type along the lower edge of the pinion-juniper foothills region of GRBA. Disturbance events such as fire and grazing may allow more non-native grasses and forbs to become established.
CIR Signature: Polygons of S_ARTRV had a smooth gray appearance with some streaks of red and pink relating to higher cover of understory species.
Mapping Notes: The S_ARTRV type had a similar appearance to the other sagebrush map units and some overlap and confusion likely exists in the mapping. More ground-truthing of the sagebrush types may allow for further refinement and increased accuracy.

Range and Distribution

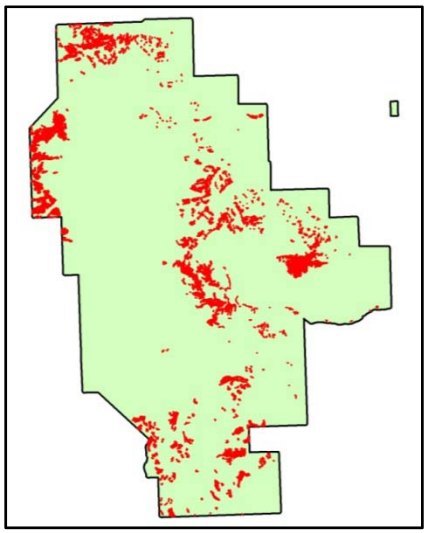
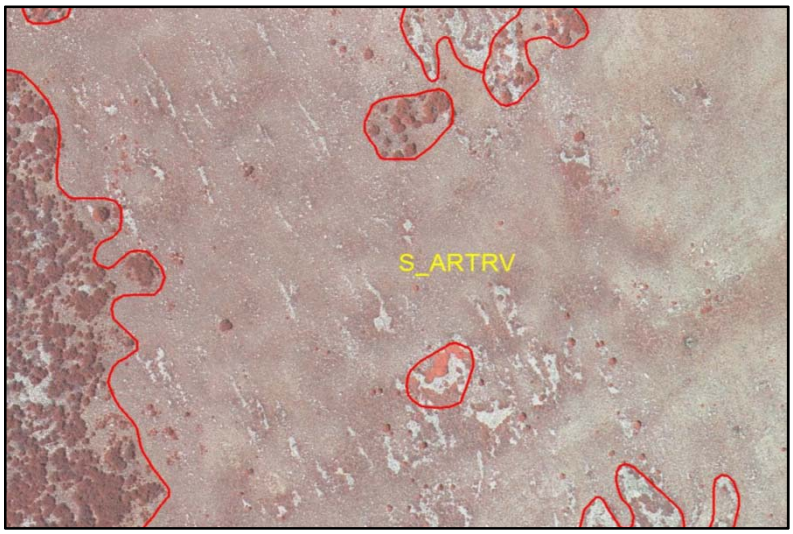


Photo Signature Example



Map Code	Mountain Big Sagebrush – Common Snowberry Shrubland Alliance
S_ARTSY	***Artemisia tridentata* ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland Alliance**

Common Species

Mountain Big Sagebrush (*Artemisia tridentata* ssp. *vaseyana*)
Mountain snowberry (*Symphoricarpos oreophilus*)
American vetch (*Vicia americana*)
Slender wheatgrass (*Elymus trachycaulus*)
Bluebunch wheatgrass (*Pseudoroegneria spicata*)
Muttongrass (*Poa fendleriana*)

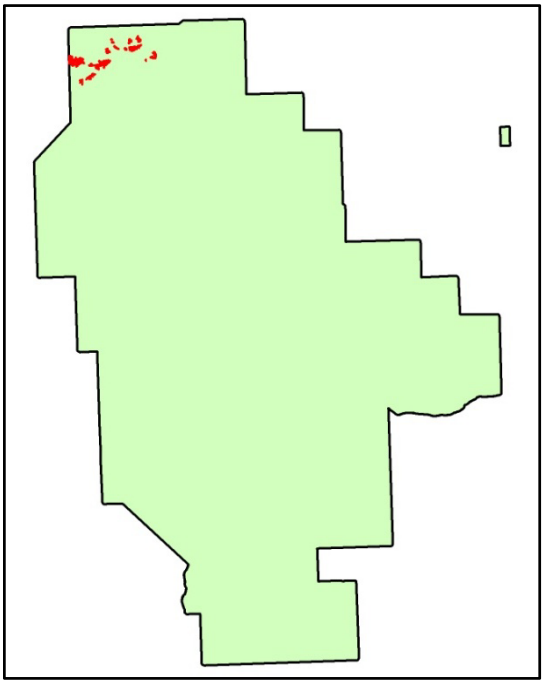
rUSNVC Associations

-*Artemisia tridentata* ssp. *vaseyana* – *Symphoricarpos oreophilus* / *Elymus trachycaulus* ssp. *trachycaulus* Shrubland
-*Artemisia tridentata* ssp. *vaseyana* – *Symphoricarpos oreophilus* / *Pseudoroegneria spicata* Shrubland

Representative Ground Photo

Frequency: Polygons with a near even mix of mountain snowberry and mountain big sagebrush are found in the northwest corner of GRBA. Other areas with the same combination of species can be found throughout the montane section of GRBA, but the cover of mountain snowberry is greatly reduced in these polygons.
Physiognomy: S_ARTSY polygons contain a mix of deciduous short shrubs with emergent evergreen shrubs.
Condition: Good. Areas with S_ARTSY are relatively remote and less likely to be invaded by non-native species. The suppression of wildfires may allow for some encroachment of white fir and quaking aspen into this type.
CIR Signature: The S_ARTSY map unit had an unique signature consisting of a mix of gray and pink dots representing the two dominant shrub species. Single quaking aspen and white fir trees appearing as larger spots are common to polygons of this type.
Mapping Notes: Originally the S_ARTSY map class was included as part of the S_AMARTV map class but further analysis revealed the lack of Utah serviceberry shrubs and allowed this type to be identified and split out.

Range and Distribution



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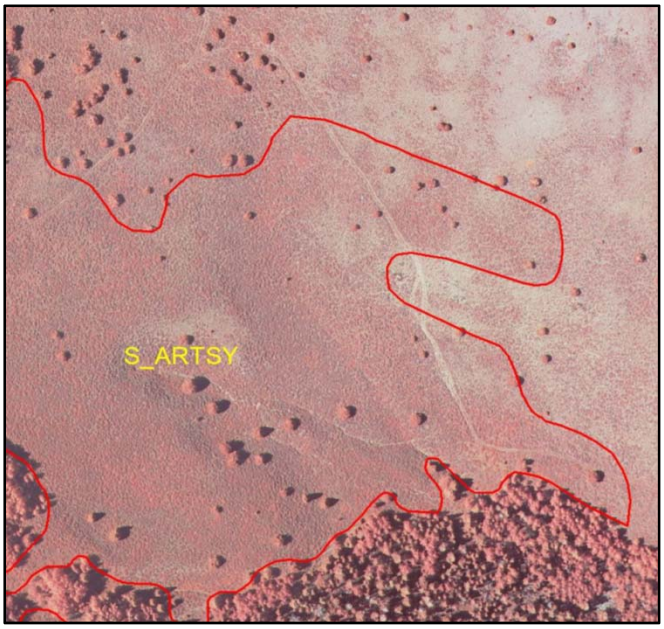


Map Code S_AVAL **Southern Rocky Mountain Avalanche Chute Shrubland Complex**

Common Species

White Fir *(Abies concolor)*
Limber pine *(Pinus flexilis)*
Engelmann spruce (*Picea engelmannii*)
Quaking aspen (*Populus tremuloides*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Gooseberry currant (*Ribes montigenum*)
Common juniper (*Juniperus communis*)
Fireweed (*Chamerion angustifolium*)
Ross' sedge (*Carex rossii*)
Fendler's meadow-rue (*Thalictrum fendleri*)

Representative Ground Photos

rUSNVC Associations

-*Abies concolor* - *Populus tremuloides* Avalanche Chute Shrubland
-*Picea engelmannii* - *Populus tremuloides* Avalanche Chute Shrubland
-*Symphoricarpos oreophilus* Shrubland
-*Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional]

Description

Frequency: Avalanche chutes dominated by shrubs and short, often broken trees are common in the montane and subalpine zones at GRBA.
Physiognomy: Polygons of S_AVAL can contain near homogenous stands of deciduous sapling trees, coniferous sapling trees, various deciduous shrubs or mixes of all three.
Condition: Fair. Avalanche chutes by their nature are prone to periodic rock slides that can dramatically alter the vegetation. S_AVAL likely represents a late transitional state that is reverting back to forest or riparian shrublands.
CIR Signature: On the imagery, the S_AVAL exhibited a varied signature ranging from solid red for deciduous shrubs and trees to brown for evergreen species. Polygons of this type were often linear in shape and contained down trees, rocks, boulders and talus.
Mapping Notes: The S_AVAL map unit was used to map all avalanche chutes that were re-vegetated with shrubs or short trees. When possible, the dominant vegetation was noted in the polygon comments field.

Range and Distribution

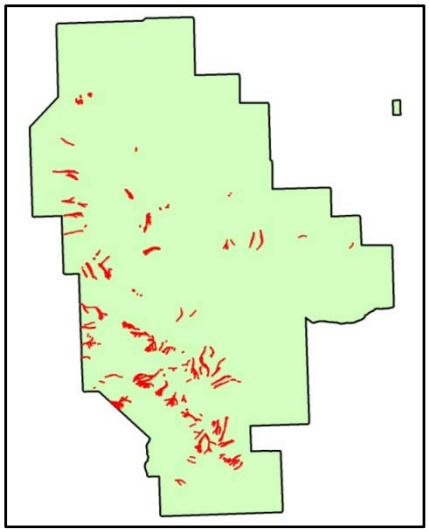
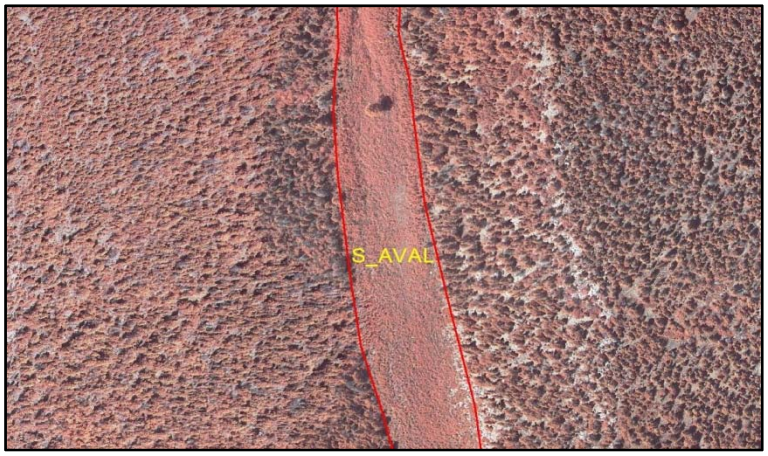


Photo Signature Example



Map Code	Littleleaf Mountain-mahogany – (Squaw Apple) Shrubland Complex
S_CIPR	***Cercocarpus intricatus* – (*Peraphyllum ramosissimum*) Shrubland Complex**

Representative Ground Photo

Common Species

Littleleaf Mountain-mahogany *(Cercocarpus ledifolius)*
Squaw apple (*Peraphyllum ramosissimum*)
Spiny greasebush (*Glossopetalon spinescens*)
Utah juniper (*Juniperus osteosperma*)
Singleleaf pinyon (*Pinus monophylla*)
Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Desert snowberry (*Symphoricarpos longiflorus*)
Broom snakeweed (*Gutierrezia sarothrae*)
Mormon tea (*Ephedra viridis*)
Indian paintbrush (*Castilleja* spp.)

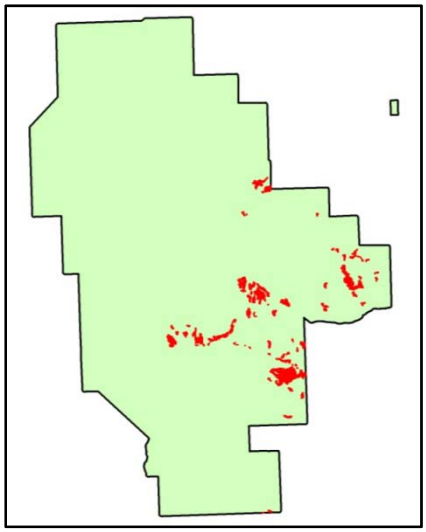
rUSNVC Associations

-*Cercocarpus intricatus – Glossopetalon spinescens* Shrubland
-*Peraphyllum ramosissimum – Artemisia tridentata* Shrubland

Description

Frequency: Littleleaf mountain-mahogany shrublands were common in the southeast and south-central sections of GRBA occurring on shallow, clay soils.
Physiognomy: Polygons of S_CIPR are dominated by short, evergreen shrubs with an understory of other short shrubs and dry grasses.
Condition: Good. S_CIPR shrublands occur on dry soils that are resistant to invasion from more mesic non-native grasses and forbs. Some cheatgrass is common in polygons of this type but usually only occurs at low levels. The suppression of wildfires may allow for some encroachment of pinion pine and Utah juniper trees.
CIR Signature: On the imagery littleleaf mountain-mahogany appeared as small brown to red spots on a gray and white areas representing bare soil.
Mapping Notes: Squaw apple shrubs are a common component of the S_CIPR map unit and an effort was made to initially map squaw apple dominated areas separately. The linework for the original squaw apple polygons has been retained in the GRBA vegetation layer and their locations are noted in the polygon comments field.

Range and Distribution



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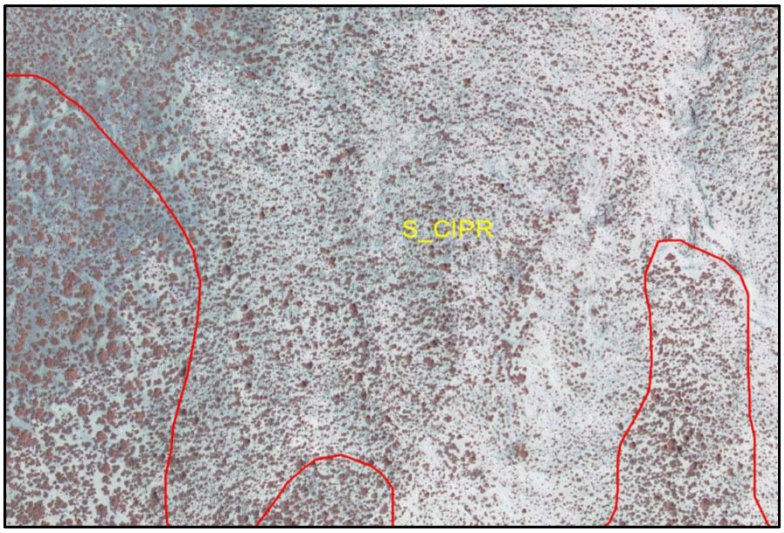


Map Code	Rubber Rabbitbrush Shrubland Alliance
S_ERNA	***Ericameria nauseosa*** **Shrubland Alliance**

Representative Ground Photo

Common Species

Rubber Rabbitbrush (*Ericameria nauseosa*)
Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*)
Cheatgrass (*Bromus tectorum*)
Crested wheatgrass (*Agropyron cristatum*)
Curveseed butterwort (*Ceratocephala testiculata*)
Beardtongue (*Penstemon* spp.)

rUSNVC Associations

-*Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland
-(Other Unclassified Understory Species)

Description

Frequency: Polygons of S_ERNA were rare to the main part of GRBA, only found along roadways and in one larger patch at the Lehman Caves Visitor Center. S_ERNA was more prevalent at the administrative area in Baker, NV in disturbed roadside ditches.
Physiognomy: S_ERNA is dominated by cold-deciduous shrubs with an annual grassland understory.
Condition: Poor. This map unit is an early successional type found on disturbed roadsides, degraded lands, and former agricultural fields.
CIR Signature: On the imagery the S_ERNA map unit had a characteristic coarse light red signature with white areas representing bare soil.
Mapping Notes: This map unit was primarily used to map disturbed sites near roads and developments in GRBA. Other early successional map units like DS_GUSA and H_AINV likely intermix and share similar species.

Range and Distribution

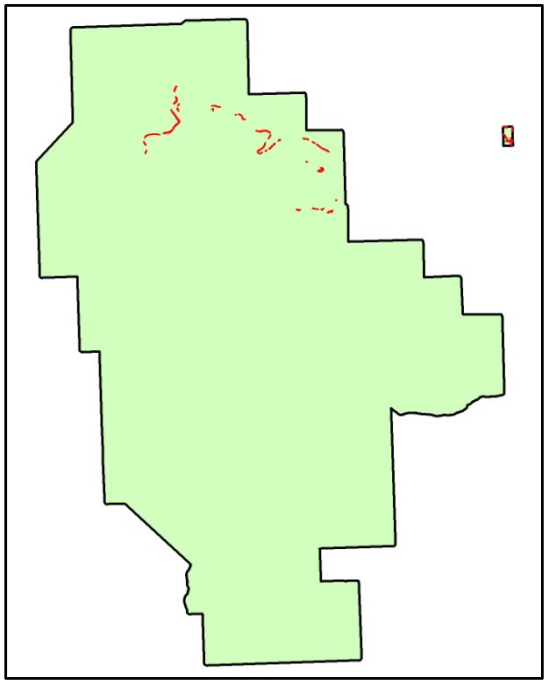
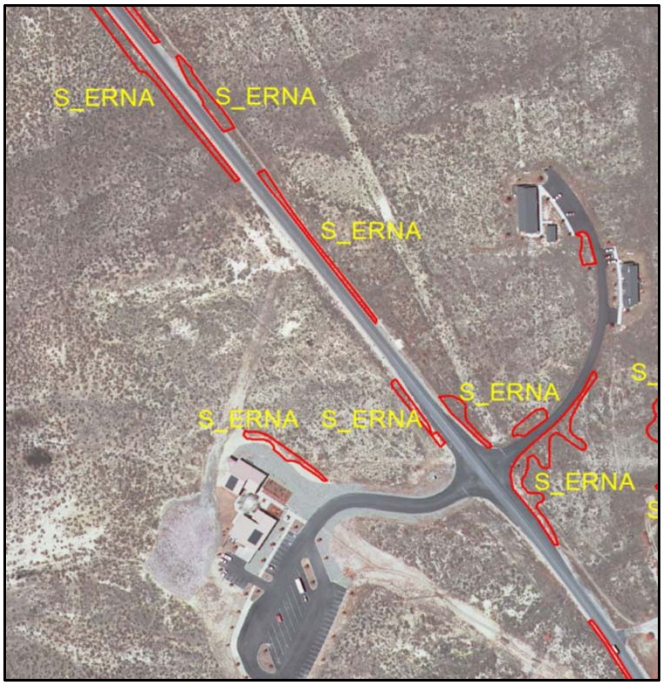


Photo Signature Example



Map Code **Post-fire Shrubland Complex**
S_FIRE

Representative Ground Photo

Common Species

Chokecherry (*Prunus virginiana*)
Mountain snowberry (*Symphoricarpos oreophilus*)
Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Common mullen (*Verbascum thapsus*)
Cheatgrass (*Bromus tectorum*)
Eaton's thistle (*Cirsium eatonii*)
Bridge penstemon (*Penstemon rostriflorus*)
Letterman's needlegrass (*Achnatherum lettermanii*)
Sandberg bluegrass (*Poa secunda*)

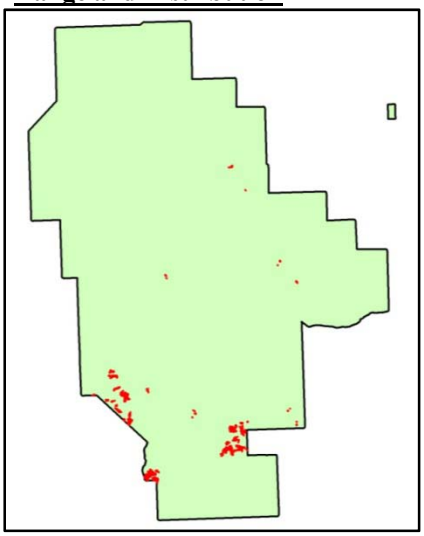
rUSNVC Associations

-*Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional]
- *Prunus virginiana* - *Penstemon rostriflorus* Post-burn Shrubland [Park Special]
-*Poa secunda* - *Cirsium eatonii* Post-burn Herbaceous Vegetation [Park Special]
-*Symphoricarpos oreophilus* Shrubland

Description

Frequency: Patches of recently burned vegetation can be regularly found throughout the southern half of GRBA and sporadically in the northern half.
Physiognomy: The vegetation in the post-burned areas is predominately early successional deciduous short shrubs and herbaceous vegetation that will likely revert back to coniferous forest in some areas.
Condition: Fair. Wildfires have been suppressed in the past and this likely limits their size and their overall influence on the natural vegetation at GRBA. Removal of established vegetation by fire can create open areas prone to invasion by non-native grasses and forbs.
CIR Signature: On the imagery post-fire shrublands usually contained dead and down tree evidence. The color of this map unit ranged from dark red to light pink depending on the local species composition.
Mapping Notes: Areas that had recent burns contained various assemblages of plant species at GRBA due in part to the severity of the burn, the length of time since it occurred, and the seed sources available for re-establishment. The S_FIRE map unit was created to address fairly recent burned areas that contained a variable mix of shrub species that did not fit into any other shrub map unit. Older, more established burned areas with mature vegetation were typically mapped using other map unit such as S_ARPA or H_RMGC if the dominants could be recognized. All polygons with burn evidence, regardless of map unit, were indicated as such in the polygon comments field.

Range and Distribution



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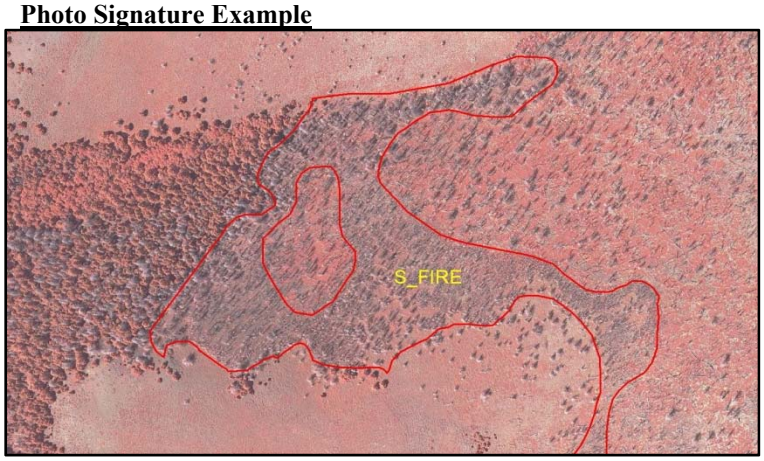


Map Code S_MOTA **Montane Talus & Rock Outcrop Shrubland Complex**

Representative Ground Photo

Common Species

Chokecherry (*Prunus virginiana*)
Rocky Mountain maple (*Acer glabrum*)
Woods' rose (*Rosa woodsii*)
Rockspirea (*Holodiscus dumosus*)
Basin wildrye (*Leymus cinereus*)

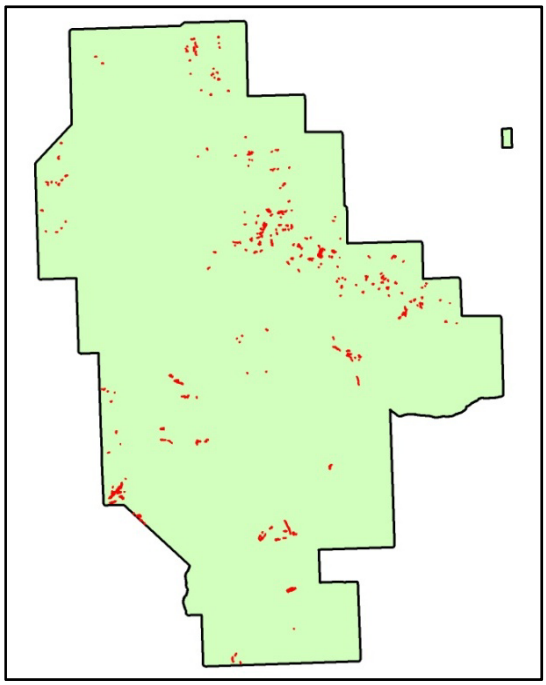
rUSNVC Associations

-*Prunus virginiana* - Mixed Shrub Talus Shrubland [Provisional]
-(Other Unclassified Shrublands)

Description

Frequency: Tall deciduous shrubs occurring alongside talus and rock formations are common throughout the montane zone of GRBA.
Physiognomy: The S_MOTA map unit contains a mix of tall deciduous shrubs.
Condition: Good. The S_MOTA type is likely influenced by the amount of water shed from surrounding rock formations and prolonged drought could cause the plant associations in this map unit to decline. Localized patches of S_MOTA may be impacted by land-slide and avalanche events.
CIR Signature: On the imagery the S_MOTA map unit had a consistent coarse texture due to the height of the shrubs and exhibited a light pink color. Polygons of this type were also usually associated with nearby gray talus or rock formations.
Mapping Notes: The S_MOTA map unit was created for tall deciduous shrubs found along the base of rock formations and as rings or bands around talus slopes. The S_MOTA differs from the similar S_RT map unit due to the presence of taller, more riparian-like shrubs and generally lacks an evergreen tree/sapling component.

Range and Distribution



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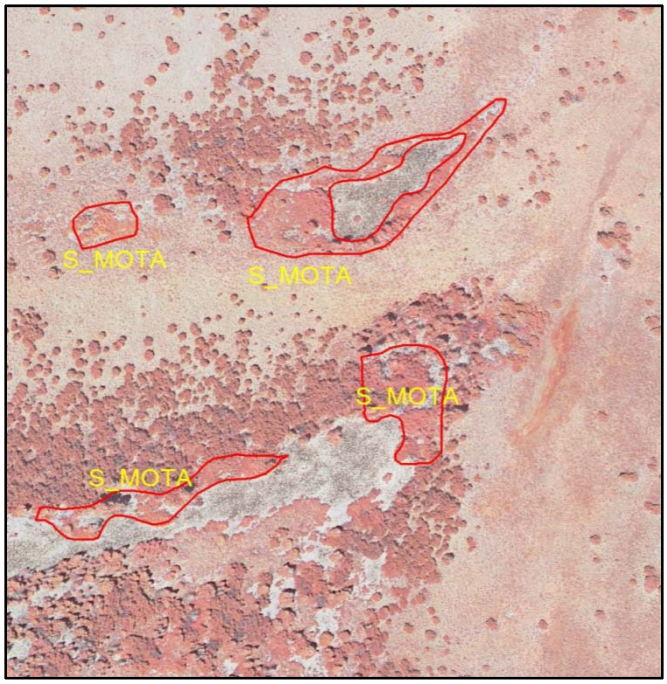


Map Code	Engelmann Spruce – (Limber Pine) Great Basin Krummholz Alliance
S_PIEN	***Picea engelmannii – (Pinus flexilis)*** **Great Basin Krummholz Alliance**

Representative Ground Photos

Common Species

Engelmann spruce (*Picea engelmannii*)
Limber pine *(Pinus flexilis)*
Gooseberry currant (*Ribes montigenum*)
Common juniper (*Juniperus communis*)
Ross' avens (*Geum rossii*)
Rockslide yellow fleabane (*Erigeron leiomerus*)
Whitestem goldenbush (*Ericameria discoidea*)
Ross' sedge (*Carex rossii*)
Watson's spikemoss (*Selaginella watsonii*)

rUSNVC Associations

-*Picea engelmannii* - (*Pinus flexilis*) / (*Astragalus platytropis*) Krummholz
-*Pinus flexilis* / *Selaginella watsonii* Krummholz

Description

Frequency: Krummholz, flagged and stunted conifer trees are common at upper treeline throughout GRBA.
Physiognomy: Polygons of S_PIEN are dominated by short to medium-sized evergreen shrubs and trees.
Condition: Good. Localized patches are likely prone to rock slides and avalanches. Overall this type is potentially threatened by global warming and climate change.
CIR Signature: Polygons of S_PIEN appear as widely spaced patches of brown on gray and tan talus and bare rock. The texture of S_PIEN is rough compared to similar alpine herbaceous and shrub vegetation and the trees appear shorter than nearby forest polygons.
Mapping Notes: S_PIEN was used to map high elevation trees and some of the polygons likely contain small patches of SV_FELL, S_RMJC, and H_TURF. Also the precise elevation of treeline at GRBA varies and some of the higher elevation F_PIEN1 and W_PIFL polygons may contain Krummholz evidence.

Range and Distribution

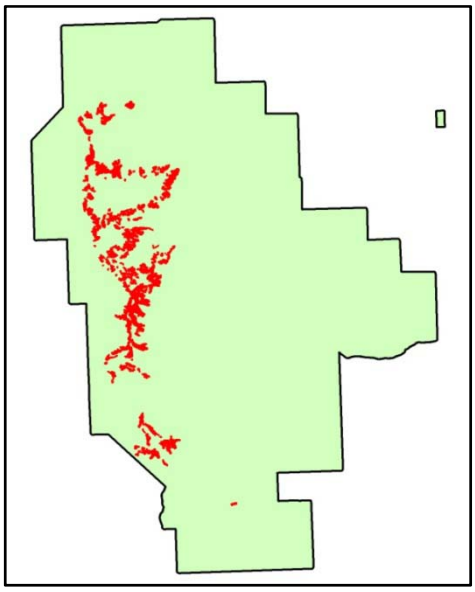
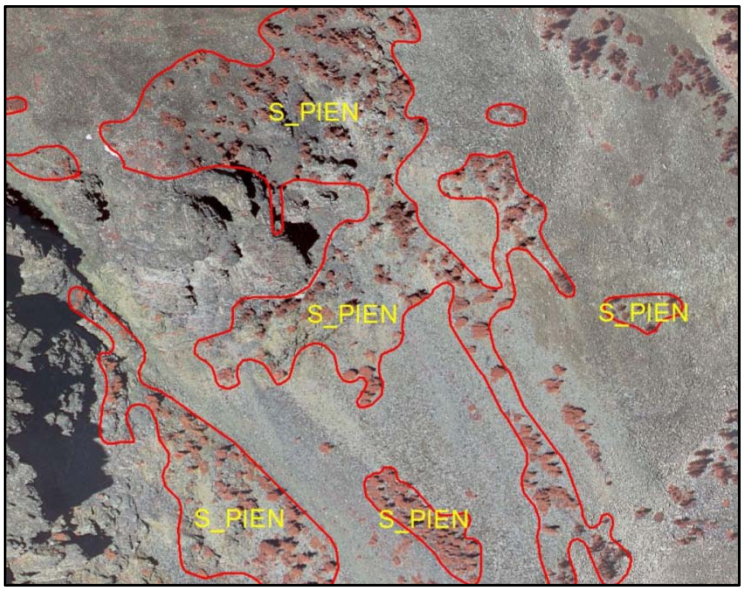


Photo Signature Example



Map Code **Antelope Bitterbrush Shrubland Complex**
S_PUTR ***Purshia tridentata* Shrubland Complex**

Representative Ground Photo

Common Species

Antelope bitterbrush (Purshia tridentata)
Mountain Big Sagebrush *(Artemisia tridentata* ssp. *vaseyana*)
Utah juniper (*Juniperus osteosperma*)
Singleleaf pinyon (*Pinus monophylla*)
Bluebunch wheatgrass (Pseudoroegneria spicata)
Muttongrass (Poa fendleriana)
Cheatgrass (Bromus tectorum)
Needle and thread grass (Hesperostipa comata)
Slender buckwheat (*Eriogonum microthecum)*

rUSNVC Associations

-*Purshia tridentata* - *Artemisia tridentata* ssp. *tridentata* Shrubland
-*Purshia tridentata* / *Hesperostipa comata* Shrub Herbaceous Vegetation

Description

Frequency: Antelope bitterbrush shrublands with various understory species are rare and only occur as pure stands in the central, northeast corner of GRBA. Antelope bitterbrush is also a common understory and associated species primarily found in S_ARTRV, S_ARNO, and S_ARTR polygons.
Physiognomy: S_PUTR polygons are dominated by medium-sized evergreen shrublands with understories consisting of mainly native grasses, cheatgrass, and minor deciduous short and dwarf-shrubs.
Condition: Good – Fair. The suppression of wildfires may allow for some encroachment of pinion pine and Utah juniper trees into this type along the lower edge of the pinion-juniper foothills region of GRBA. Disturbance events such as fire and grazing may allow more non-native grasses and forbs to become established.
CIR Signature: Polygons of S_PUTR had a smooth gray appearance with some streaks of red and pink relating to higher cover of understory species.
Mapping Notes: The S_PUTR type had a similar appearance to the sagebrush map units and some overlap and confusion likely exists in the mapping of these types.

Range and Distribution

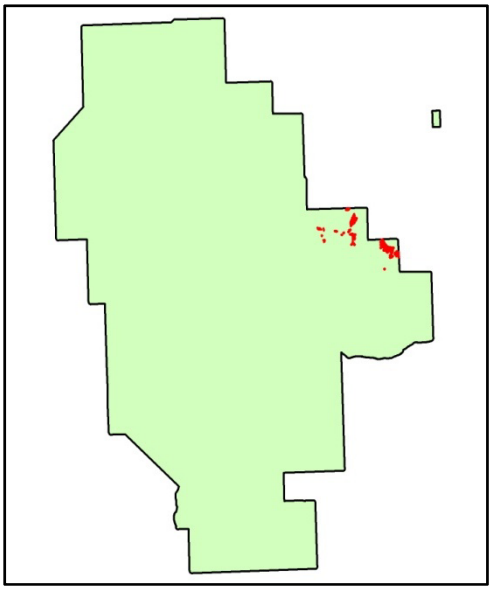
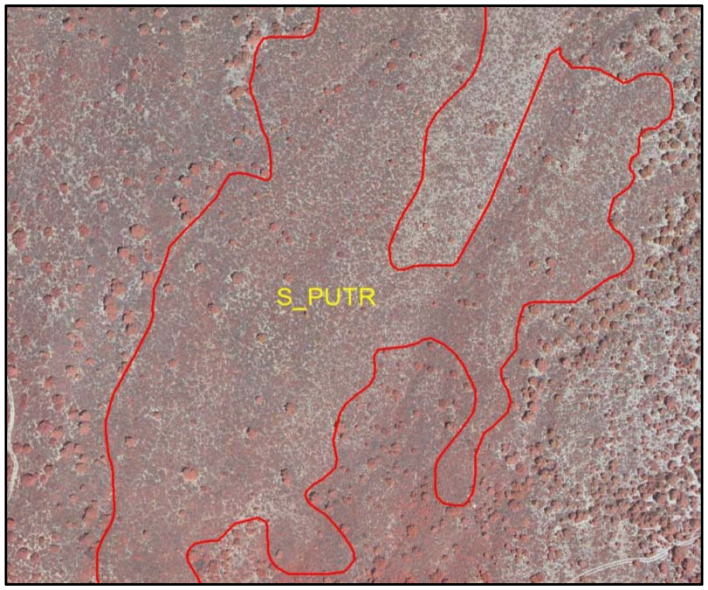


Photo Signature Example



Map Code S_RIP — Montane Riparian Shrubland Complex

Representative Ground Photo

Common Species

Rocky Mountain maple (*Acer glabrum*)
Water birch (*Betula occidentalis*)
Salix boothii (*Booth's willow*)
Bebb willow (*Salix bebbiana*)
Narrowleaf willow (*Salix exigua*)
Woods' rose (*Rosa woodsii*)
Quaking aspen(*Populus tremuloides*)
Northern bog violet (*Viola nephrophylla*)
Starry false lily of the valley (*Maianthemum stellatum*)
Baltic rush (*Juncus balticus*)
Field horsetail (*Equisetum arvense*)
Sedges (*Carex* spp.)

rUSNVC Associations

-*Acer glabrum* Drainage Bottom Shrubland
-*Betula occidentalis* / *Cornus sericea* Shrubland
-*Betula occidentalis* / Mesic Graminoids Shrubland
-*Salix bebbiana* / Mesic Graminoids Shrubland
-*Salix boothii* / Mesic Graminoids Shrubland
-*Rosa woodsii* Shrubland
-*Salix boothii* / Mesic Forbs Shrubland
-*Salix exigua* / Mesic Graminoids Shrubland

Description

Frequency: Riparian shrublands are common along streams and drainages throughout the basin, foothill, montane and subalpine regions of GRBA.
Physiognomy: Polygons of S_RIP contain tall deciduous shrubs with some emergent conifer trees.
Condition: Good –Fair. Most of the remote riparian shrublands at GRBA are in good health with no evidence of disturbance. The riparian shrublands near picnic areas, campgrounds, visitor centers, roads and other developments however show some signs of human disturbance and also contain a higher percentage of non-native species. In general, the close proximity of this type to water makes it prone to over-use by native ungulates and other wildlife.
CIR Signature: On the imagery this type has a characteristic light pink to red color depending on the dominant deciduous species. Individual shrubs can be seen and appear shorter and with smaller canopies then similar W_POAN and F_POTR2 polygons.
Mapping Notes: Due to the intricate mixing of willow, birch and alder species, S_RIP was used to map all of the riparian shrubs at GRBA. Further analysis by elevation and more ground-truthing may allow this map unit to be further refined and split into individual shrub associations.

Range and Distribution

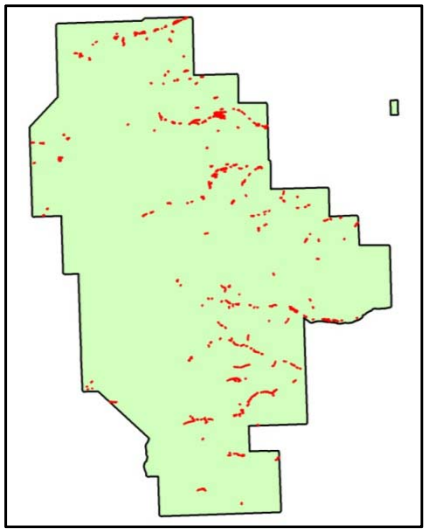
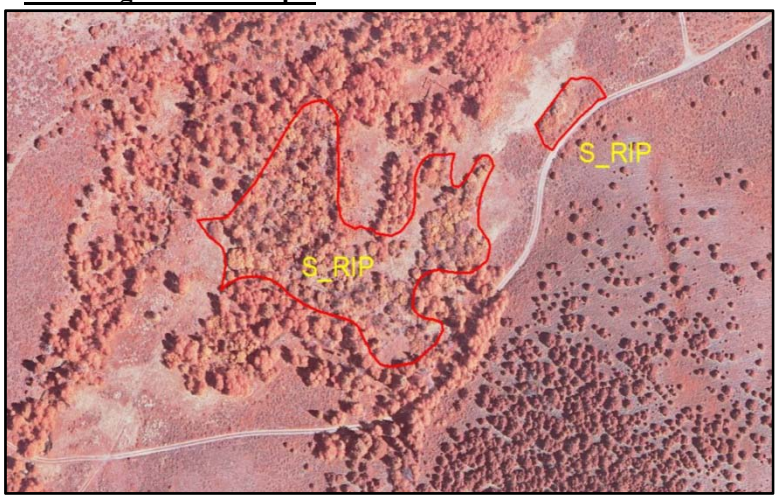


Photo Signature Example



Map Code	Western Prickly Gooseberry - (Common Juniper) Shrubland Alliance
S_RMJC	***Ribes montigenum* - (*Juniperus communis*) Shrubland Alliance**

Representative Ground Photo

Common Species

Gooseberry currant (*Ribes montigenum*)
Common juniper (*Juniperus communis*)
Ross' avens (*Geum rossii*)
Mountain monardella (*Monardella odoratissima*)
Whitestem goldenbush (*Ericameria discoidea*)
Ross' sedge (*Carex rossii*)
Watson's spikemoss (*Selaginella watsonii*)

rUSNVC Associations

-*Ribes* (*cereum, montigenum*) - *Ericameria discoidea* Shrubland
-(Other Unclassified *Juniperus communis* Shrublands)

Signature Description

Frequency: Western prickly gooseberry patches with common juniper dwarf-shrubs are rare and widely scattered in the upper subalpine and lower alpine regions of GRBA.
Physiognomy: Polygons of S_RMJC are dominated by short deciduous shrubs with an occasional low-growing evergreen dwarf-shrub component.
Condition: Good. Localized patches are likely prone to rock slide and avalanche events. Overall this type is potentially threatened by global warming and climate change.
CIR Signature: Polygons of S_RMJC appear as patches of light pink on gray and tan scree and talus. The texture of S_RMJC is rough compared to similar alpine herbaceous vegetation and lighter than nearby Krummholz polygons.
Mapping Notes: S_RMJC was used to map high elevation shrubs and some of the polygons likely contain small patches of SV_FELL, S_PIEN, and H_TURF or lack the western prickly gooseberry component.

Range and Distribution

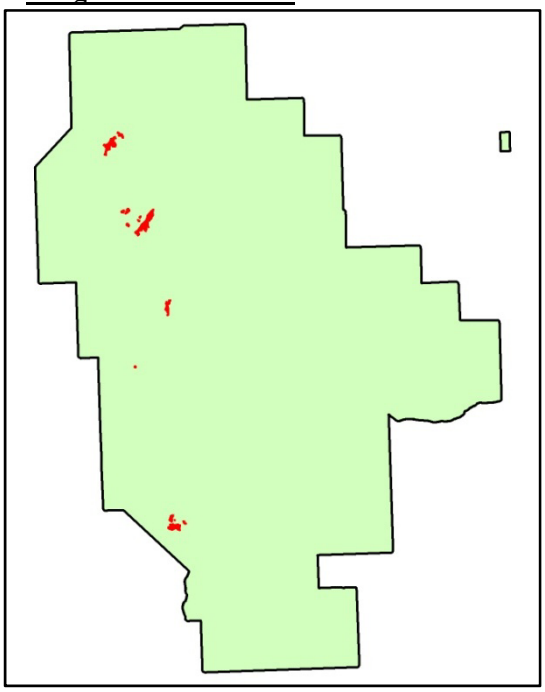
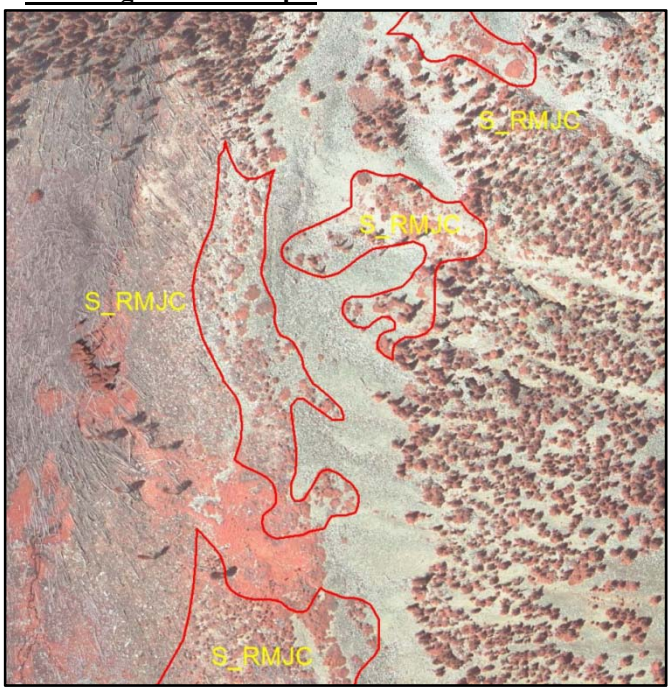


Photo Signature Example



Map Code S_RT **Mixed Rock & Talus Shrubland Complex**

Representative Ground Photo

Common Species

White fir (*Abies concolor*)
Limber pine (*Pinus flexilis*)
Curl-leaf mountain mahogany (*Cercocarpus ledifolius*)
Sticky polemonium (*Polemonium viscosum*)
Mat rockspirea (*Petrophyton caespitosum*)
Spike trisetum (*Trisetum spicatum*)
Dwarf alpine Indian paintbrush (*Castilleja nana*)
Ross' sedge (*Carex rossii*)

rUSNVC Associations

-*Abies concolor* Rock Outcrop Sparse Vegetation [Park Special]
-*Pinus flexilis* Bedrock Sparse Vegetation
-*Cercocarpus ledifolius* Rock Outcrop Sparse Vegetation [Park Special]
-*Hulsea algida* - *Selaginella watsonii* Herbaceous Vegetation [Provisional]
-*Petrophyton caespitosum* Sparse Vegetation [Park Special]
-*Polemonium viscosum* - *Castilleja nana* Alpine Rock Sparse Vegetation [Provisional]

Description

Frequency: Mixed shrubs occurring alongside talus and rock formations are common throughout GRBA.
Physiognomy: The S_RT map unit contains a mix of cold deciduous short shrubs with emerging short conifer trees.
Condition: Good. The S_RT type is likely influenced by the amount of water shed from surrounding rock formations and prolonged drought could cause the associations in this map unit to decline. Localized patches of S_RT may be impacted by land-slide and avalanche events.
CIR Signature: On the imagery the S_RT map unit varied in color from a coarse light pink to brick red color depending on species composition. Polygons of this type were also usually associated with nearby gray talus or rock formations.
Mapping Notes: The S_RT map unit was created for mixed short to medium sized shrub/tree communities that occurred along talus and bare rock formations. The S_RT type is very similar to the S_MOTA map unit and some species overlap likely exists between them.

Range and Distribution

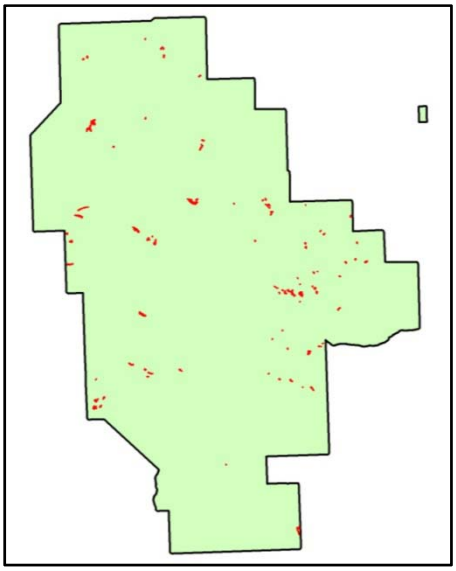
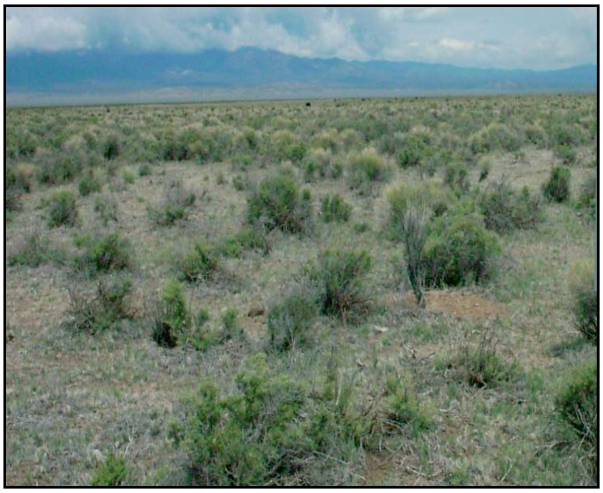


Photo Signature Example

Map Code	Greasewood Intermittently Shrubland Alliance
S_SAVE	***Sarcobatus vermiculatus* Shrubland Alliance**

Representative Ground Photo



Common Species

Greasewood (*Sarcobatus vermiculatus*)
Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*)
Shadscale saltbush (*Atriplex confertifolia*)
Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Cheatgrass (*Bromus tectorum*)
Inland saltgrass (*Distichlis spicata*)
Crested wheatgrass (*Agropyron cristatum*)
Alkali sacaton (*Sporobolus airoides)*

rUSNVC Associations

-*Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland
-(Other Unclassified Understory Species)

Description

Frequency: Greasewood only occurs at the administrative area in Baker, NV where it intermingles with basin big sagebrush on undisturbed, upland sites.
Physiognomy: S_SAVE polygons contain sparse vegetation dominated by medium-sized evergreen shrubs.
Condition: Fair. This map unit is a late successional type found on alkaline soils. Threats to this type include invasion by non-native grasses and forbs and disturbance from nearby roads and developments.
CIR Signature: On the imagery the S_SAVE map unit had a characteristic mottled, light red/purple signature with white areas representing bare soil.
Mapping Notes: The S_SAVE map unit was primarily used to map undisturbed, sandy sites near roads and developments surrounding the administrative area. The S_SAVE map unit is similar in appearance to the S_ERNA and S_ARTR map units and some confusion between these shrubland types likely occurred during the mapping.

Range and Distribution

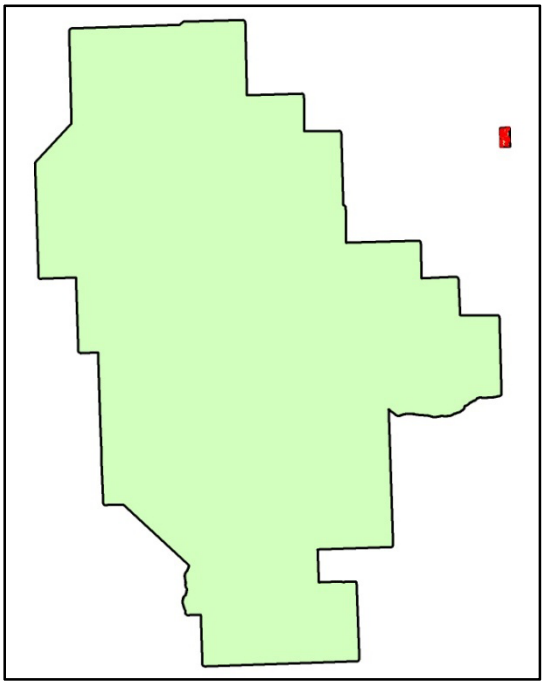
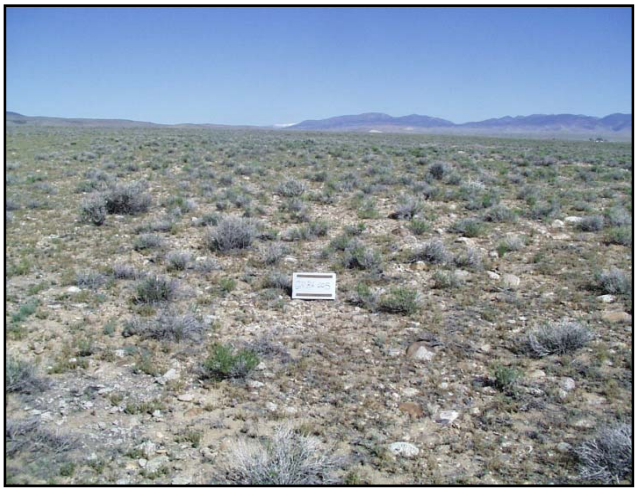


Photo Signature Example

DWARF SHRUBLANDS

Map Code **Broom Snakeweed Dwarf-shrubland Alliance**
DS_GUSA ***Gutierrezia sarothrae* Dwarf-shrubland Alliance**

Representative Ground Photo



Common Species

Broom snakeweed (*Gutierrezia sarothrae*)
Shadscale saltbush (*Atriplex confertifolia*)
Green molly (*Kochia americana*)
Sagebrush cholla (*Opuntia pulchella*)
Indian ricegrass (*Achnatherum hymenoides*)
Winged four o'clock (*Mirabilis alipes*)

rUSNVC Alliance

-*Gutierrezia sarothrae* Dwarf-shrubland Alliance

Description

Frequency: DS_GUSA only occurs in large enough areas to map at the administrative area in Baker, NV. Broom snakeweed is also present throughout the lower elevation areas of GRBA as a minor associate in the S_ERNA, H_AINV, and S_ARTR map units; commonly found along roadways and on disturbed sites.
Physiognomy: DS_GUSA polygons contain sparse vegetation dominated by deciduous, dwarf shrubs.
Condition: Poor. This map unit is an early successional type found on disturbed meadows, mesic drainages and former agricultural fields.
CIR Signature: On the imagery the DS_GUSA map unit had a characteristic smooth, light gray signature with white areas representing bare soil.
Mapping Notes: This map unit was primarily used to map disturbed sites near developments at the administrative area. Other pockets of DS_GUSA likely occur along roadways and on recently disturbed sites. The DS_GUSA map unit is similar in appearance to the S_ERNA and H_AINV types and some confusion between these early successional types likely occurred during the mapping.

Range and Distribution

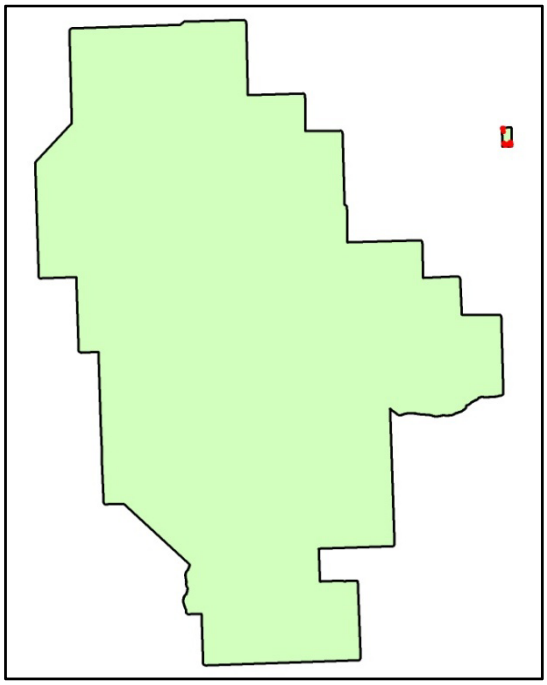
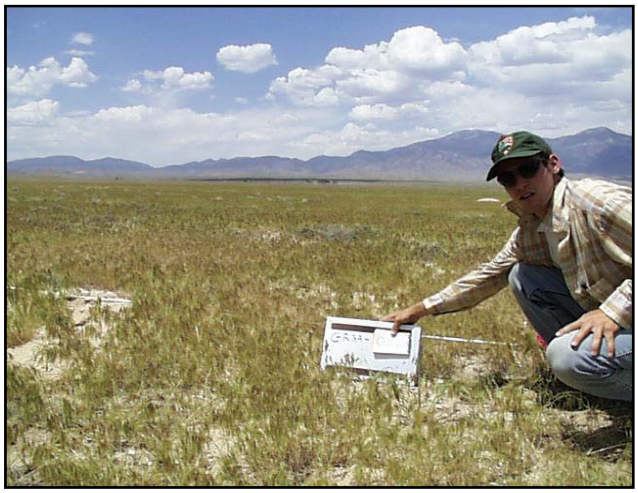


Photo Signature Example

HERBACEOUS VEGETATION

Map Code **Annual Invasive Complex**
H_AINV

Representative Ground Photo



Common Species

Cheatgrass (*Bromus tectorum*)
Whitestem goldenbush (*Ericameria discoidea*)
Bud sagebrush (*Picrothamnus desertorum*)
Indian ricegrass (*Achnatherum hymenoides*)

rUSNVC Associations

Bromus tectorum Semi-natural Herbaceous Vegetation
-(Other Unclassified Annual Herbaceous Vegetation Species)

Description

Frequency: Only one polygon of H_AINV occurs in the main section of GRBA near the entrance to the park. At the administrative area in Baker, NV this type is more prevalent due to past disturbance events and former ranching and farming activities. Large areas of cheatgrass also occur outside of GRBA on the basin floor.
Physiognomy: H_AINV polygons contain high cover of annual non-native grasses with some minor shrub, forb and native grass components.
Condition: Poor. This map unit is an early successional type found on disturbed meadows, mesic drainages and former agricultural fields.
CIR Signature: On the imagery the H_AINV map unit had a characteristic coarse gray signature with white areas representing bare soil.
Mapping Notes: This map unit was primarily used to map disturbed sites near developments in GRBA. Other pockets of H_AINV likely occur along the park boundary and on disturbed, post-fire sites. Further ground-truthing, especially in disturbed areas would help refine and improve this mapping unit.

Range and Distribution

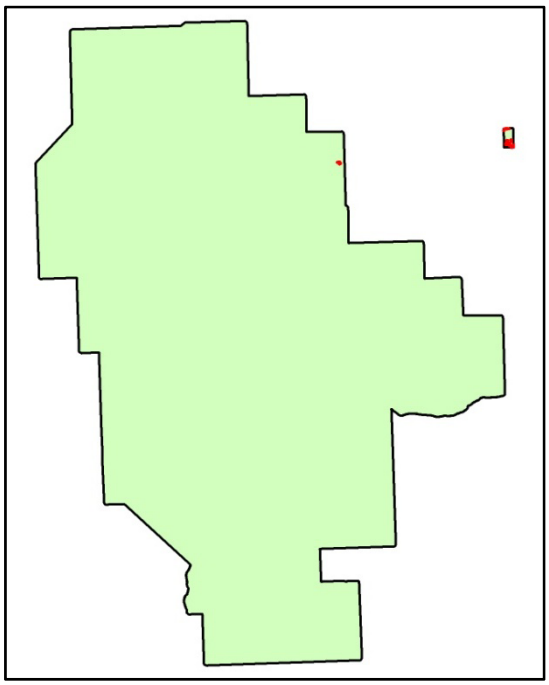
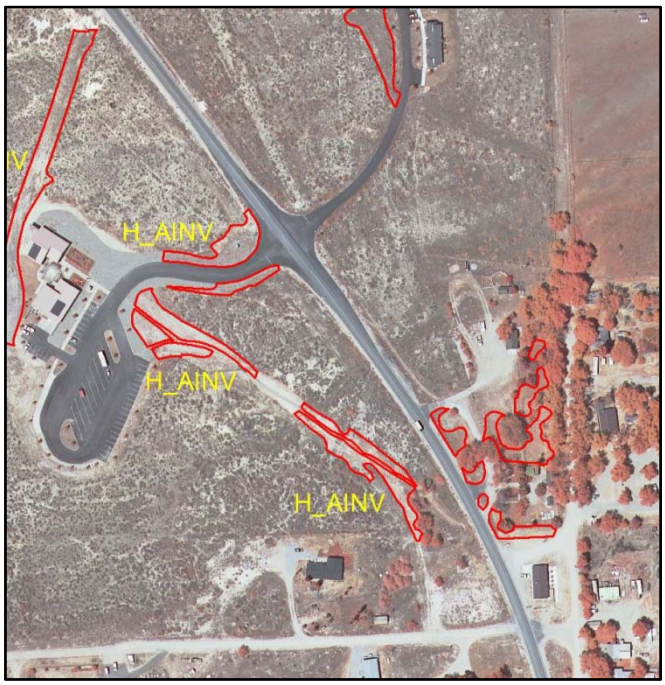


Photo Signature Example



Map Code	Southern Rocky Mountain Avalanche Chute Herbaceous Vegetation Complex
H_AVAL	

Representative Ground Photo

Common Species

Alpine biscuitroot (*Lomatium graveolens* var. *alpinum*)
Engelmann spruce (*Picea engelmannii*)
Gooseberry currant (*Ribes montigenum*)
Common juniper (*Juniperus communis*)
Limber pine (*Pinus flexilis*)

rUSNVC Associations

-*Lomatium graveolens* var. *alpinum* Herbaceous Vegetation
-(Other Unclassified Herbaceous Vegetation)

Description

Frequency: Avalanche chutes dominated by herbaceous vegetation are rare in the montane and subalpine zones at GRBA.
Physiognomy: Polygons of H_AVAL contain perennial herbaceous vegetation consisting of localized patches of grasses and forbs with occasional shrubs and short trees.
Condition: Fair. Avalanche chutes by their nature are prone to periodic rock slides that can dramatically alter the vegetation. H_AVAL likely represents an early transitional state occurring directly after an avalanche event and before the establishment of trees and shrubs.
CIR Signature: On the imagery, the H_AVAL exhibited a varied signature ranging from red spots on a gray background to a smooth red color. Polygons of this type were often linear in shape and contained down trees, rocks, boulders and talus.
Mapping Notes: The H_AVAL map unit was only used when no evidence of short trees or shrubs was found. Some avalanche areas dominated by herbaceous vegetation were also burned by recent wildfires.

Range and Distribution

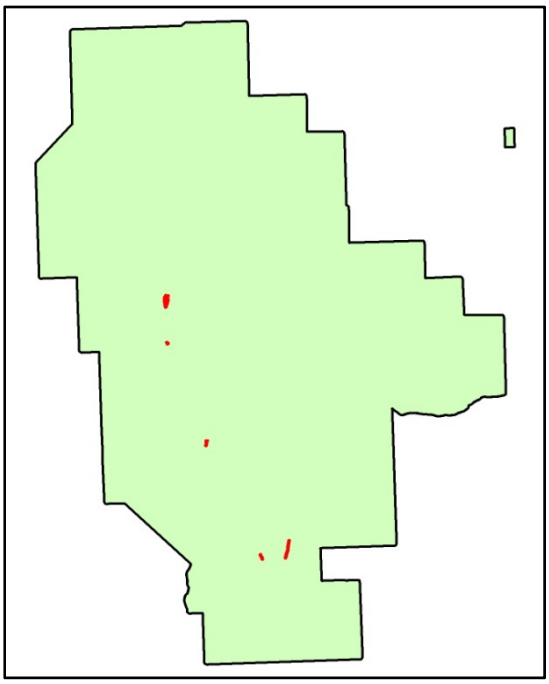
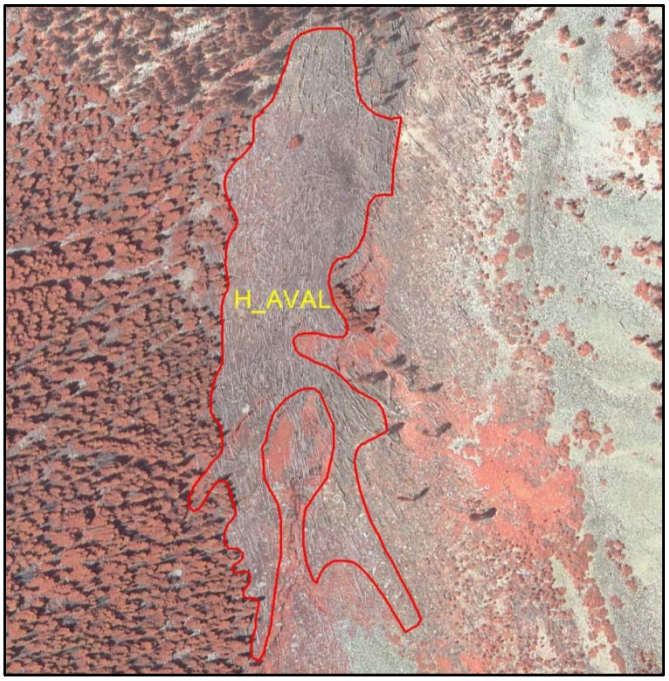


Photo Signature Example



Map Code H_MESC **Montane Mesic Meadow Complex**

Common Species

Shrubby cinquefoil (*Dasiphora fruticosa ssp. floribunda)*
Basin wildrye (*Leymus cinereus*)
Longstalk clover (*Trifolium longipes*)
Slender wheatgrass (*Elymus trachycaulus*)
Kentucky bluegrass (*Poa pratensis*)
Common yarrow (*Achillea millefolium*)
American bistort (*Polygonum bistortoides*)

rUSNVC Associations

-*Dasiphora fruticosa* ssp. *floribunda / Elymus trachycaulus* Shrub Herbaceous Vegetation [Park Special]
-*Elymus trachycaulis* Herbaceous Vegetation
-*Leymus cinereus* Herbaceous Vegetation

Representative Ground Photo

Description

Frequency: Upland mesic meadows are found throughout the montane life zone of GRBA and extend into the foothills and subalpine zones.
Physiognomy: Polygons contain thick, perennial herbaceous vegetation consisting of mixtures of grasses, forbs, and some short growing deciduous shrubs.
Condition: Good-Fair -depending on location and amount of available water. Threats to polygons of H_MESC likely include over-use by wildlife, invasion of non-native grass and forb species, and the overall pressure to develop and transport water out of the GRBA area.
CIR Signature: Polygons of H_MESC exhibit a characteristic light yellow to pink signature with a smooth texture and no open water features are apparent. Shrubby cinquefoil shrubs, if present, appear as small dark red stipples.
Mapping Notes: The H_MESC map class was used to separate mesic upland grassland sites from wetland herbaceous vegetation (H_WET) and drier grasslands (H_RMJC). The presence of shrubby cinquefoil shrubs was noted in the polygon comments field if found.

Range and Distribution

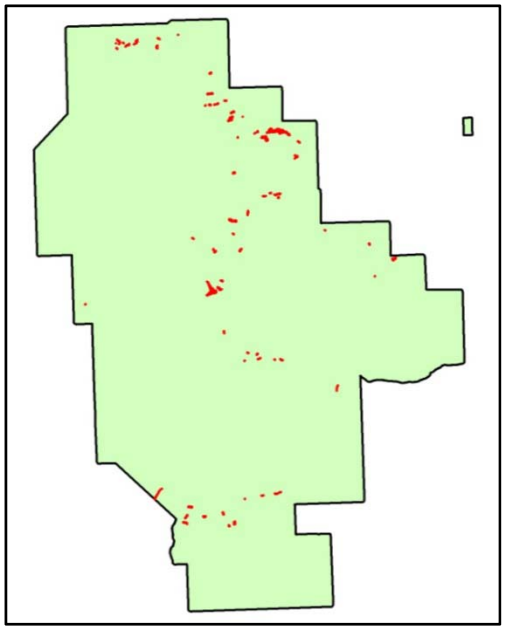
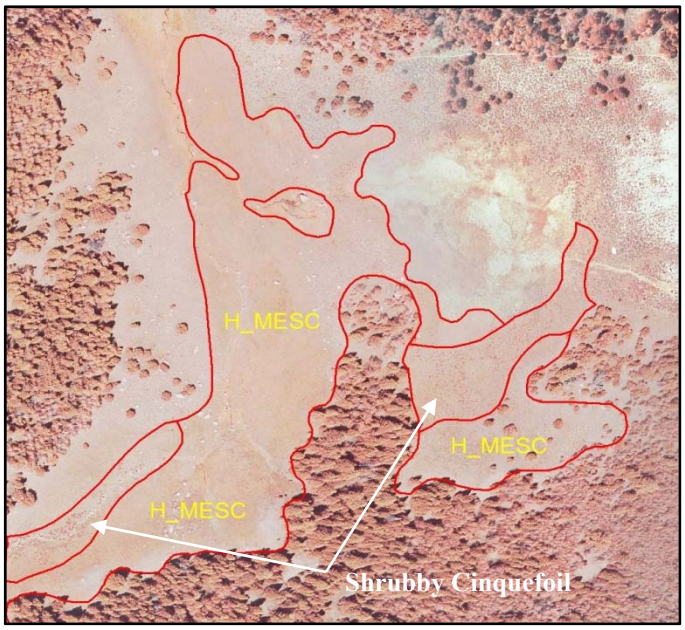


Photo Signature Example



Map Code H_PINV — Perennial Invasive Grassland Complex

Representative Ground Photo

Common Species

Smooth brome (*Bromus inermis*)
Crested wheatgrass (*Agropyron cristatum*)
Redtems stork's bill (*Erodium cicutarium*)
Slender wheatgrass (*Elymus trachycaulus*)
Red fescue (*Festuca rubra*)
Barbwire Russian thistle (*Salsola paulsenii*)

rUSNVC Associations

-*Agropyron cristatum* - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Veg.
-*Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation

Description

Frequency: Only three polygons of H_PINV occur in the main section of GRBA near the entrance to the park. At the administrative area in Baker, NV this type is more prevalent due to past disturbance events and former ranching and farming activities.
Physiognomy: H_PINV polygons contain perennial non-native grasses with some minor forb and native grass components.
Condition: Poor. This map unit is an early successional type found on disturbed meadows, mesic drainages and former agricultural fields.
CIR Signature: On the imagery the H_PINV map unit had a characteristic smooth dark red to purple color.
Mapping Notes: This map unit was primarily used to map disturbed sites near developments in GRBA. Other pockets of H_PINV likely occur but were mapped as H_RMGC, H_AINV, and H_MESC or were too small to delineate. Further ground-truthing, especially in disturbed areas would help refine and improve this mapping unit. Mapping of H_PINV polygons was partially based on where perennial non-native vegetation was known to occur.

Range and Distribution

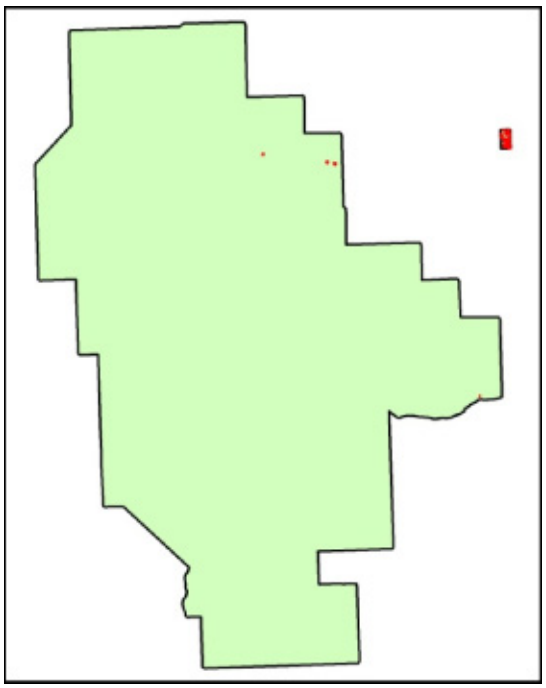
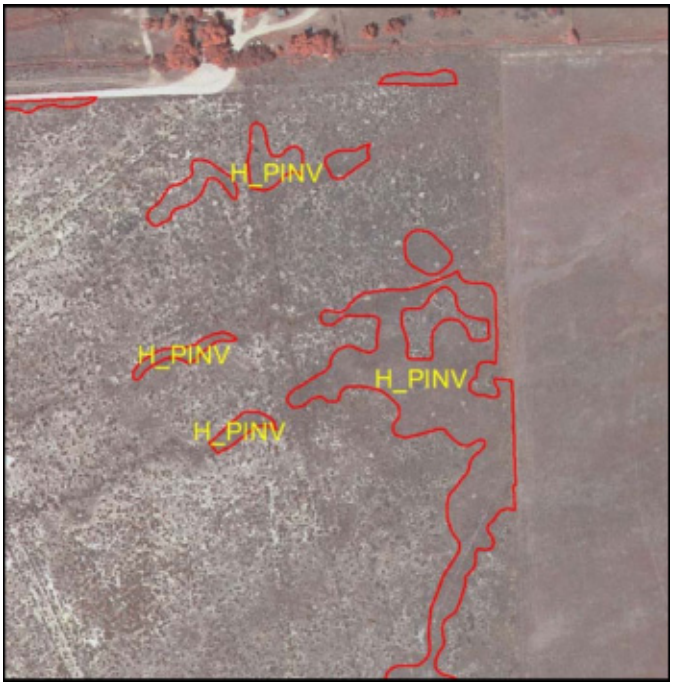


Photo Signature Example



Map Code H_RMGC **Rocky Mountain Montane - Subalpine Grassland Complex**

Representative Ground Photo

Common Species

Yellow rabbitbrush (*Chrysothamnus viscidiflorus*)
Bluebunch wheatgrass (*Pseudoroegneria spicata*)
Letterman's needlegrass (*Achnatherum lettermanii*)
Arrowleaf balsamroot (*Balsamorhiza sagittata*)
Muttongrass (*Poa fendleriana*)
Sandberg bluegrass (*Poa secunda*)
Needle and thread grass (*Hesperostipa comata*)
Western mountain aster (*Symphyotrichum spathulatum*)
Mountain monardella (*Monardella odoratissima*)
Spiny milkvetch (*Astragalus kentrophyta*)

rUSNVC Associations

-*Achnatherum lettermanii* Herbaceous Vegetation
-*Balsamorhiza sagittata* Herbaceous Vegetation [Park Special]
-*Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional]
-*Poa fendleriana - Astragalus kentrophyta* Herbaceous Vegetation [Park Special]
-*Poa secunda - Arenaria congesta* Herbaceous Vegetation [Park Special]
-*Poa secunda - Cirsium eatonii* Post-burn Herbaceous Vegetation [Park Special]
-*Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation
-*Pseudoroegneria spicata* Herbaceous Vegetation

Description

Frequency: H_RMGC native upland grasslands are rare on the east-side and common on the west-side of GRBA.
Physiognomy: This map unit consists of native, perennial grasses and forbs with some dwarf and short shrubs.
Condition: Fair. Stands of this type are rare and some may be early successional as a result of past wildfires. Encroachment by sagebrush and woodland species is likely.
CIR Signature: The H_RMGC type appears as a smooth pink color with some isolated stipples caused by single tree and/or shrubs.
Mapping Notes: The signature of the H_RMGC map unit is closely aligned with the H_MESC and H_PINV map units and some confusion likely occurred during the mapping of these similar herbaceous vegetation types. This map class was used to characterize uplands grasslands from more mesic herbaceous vegetation. Included in this map class are short yellow rabbitbrush shrubs that appeared grass-like on the imagery. More ground-truthing may allow for further refinement and splitting of the various associations into separate map units.

Range and Distribution

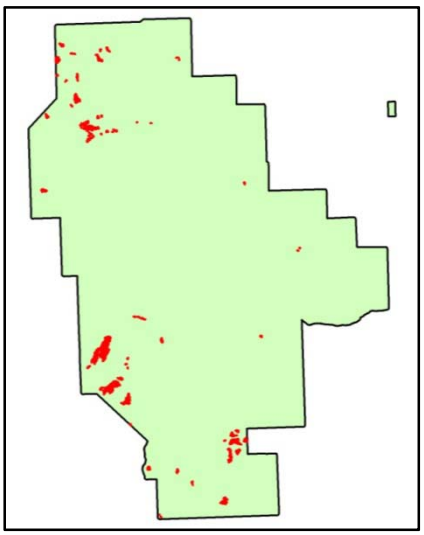


Photo Signature Example

Map Code **Alpine Turf Complex**
H_TURF

Common Species

Ross' avens (*Geum rossii*)
Nearly black sedge (*Carex subnigricans*)
Cushion phlox (*Phlox pulvinata*)
Sandberg bluegrass (*Poa secunda*)
Blackroot sedge (*Carex elynoides*)
Purple reedgrass (*Calamagrostis purpurascens*)
Rocky Mountain cinquefoil (*Potentilla rubricaulis*)
Alpine buttercup (*Ranunculus adoneus*)
Watson's spikemoss (*Selaginella watsonii*)

Representative Ground Photo

rUSNVC Associations

-*Carex elynoides* - *Geum rossii* Herbaceous Veg.
-*Carex elynoides* - *Phlox pulvinata* - *Poa secunda* Herbaceous Vegetation
-*Carex subnigricans* - *Geum rossii – Sibbaldia procumbens* Snowbed [Provisional]
-*Geum rossii* - *Calamagrostis purpurascens* Herbaceous Vegetation [Park Special]
-*Geum rossii* Herbaceous Vegetation

Description

Frequency: The H_TURF map unit is common in mesic, high elevation areas at or above treeline.
Physiognomy: This type includes low-growing mats of mostly perennial herbaceous vegetation consisting of various sedge and grass species with occasional dwarf-shrubs and forbs.
Condition: Good. Localized patches are likely prone to rock slide and avalanche events. Overall this type is potentially threatened by global warming and climate change.
CIR Signature: Polygons of H_TURF appear as bright pink and red on gray and tan scree and talus. The texture of H_TURF was smooth compared to similar Krummholz shrub vegetation and was denser than the SV_FELL type.
Mapping Notes: H_TURF was used to map high elevation mesic grasses and sedges. Small patches of SV_FELL, S_PIEN, and S_RMJC are likely contained in some of the polygons of this type.

Range and Distribution

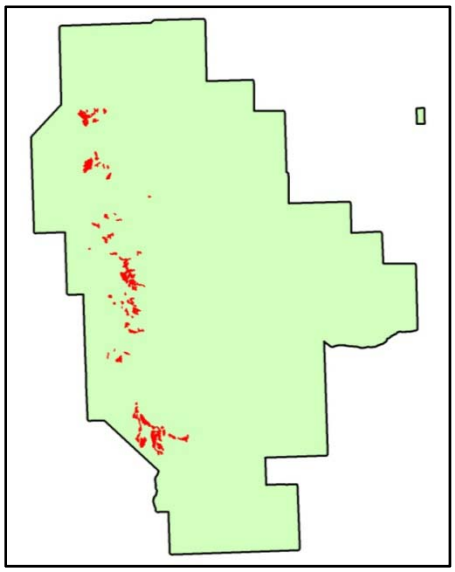


Photo Signature Example

Map Code **Wet Meadow Complex**
H_WET

Representative Ground Photo

Common Species

Nebraska sedge (*Carex nebrascensis*)
Mountain sedge (*Carex scopulorum*)
Alpine shootingstar (*Dodecatheon alpinum*)
Baltic rush (*Juncus balticus*)
Sierra rush (*Juncus nevadensis*)
Basin wildrye (*Leymus cinereus*)
American bistort (*Polygonum bistortoides*)
Hansen's clover (*Trifolium longipes* ssp. *hansenii*)
Bluegrasses (*Poa* spp.)

rUSNVC Associations

-*Carex nebrascensis* Herbaceous Vegetation
-*Carex scopulorum* Herbaceous Vegetation
-*Juncus balticus* Herbaceous Vegetation
-*Leymus cinereus* Herbaceous Vegetation
-*Juncus nevadensis* - *Poa secunda* Herbaceous Vegetation
-*Dodecatheon alpinum* Herbaceous Vegetation [Park Special]
-*Polygonum bistortoides* Herbaceous Vegetation [Park Special]

Description

Frequency: Wetland herbaceous vegetation is found throughout GRBA around small seeps, springs and streams.
Physiognomy: Polygons contain perennial herbaceous vegetation consisting of mostly grasses, sedges, and rushes.
Condition: Good-Fair -depending on location and amount of available water. Threats to polygons of H_WET likely include over-use by wildlife, invasion of non-native grass and forb species, and the overall pressure to develop and transport water out of the GRBA area.
CIR Signature: On the imagery polygons of H_WET exhibit a characteristic light pink to orange signature with a smooth texture. Small linear streams and ponds with blue open water are often associated with this map unit.
Mapping Notes: The H_WET map class was used to separate true wetland herbaceous vegetation from mesic grasslands and forb dominated sites (H_MESC). Polygons of both map units were similar in appearance and some overlap and confusion likely exists in the vegetation layer. Due to the importance of wetland vegetation the minimum mapping unit for H_WET polygons was decreased to the limits of the imagery (< 1 acre).

Range and Distribution

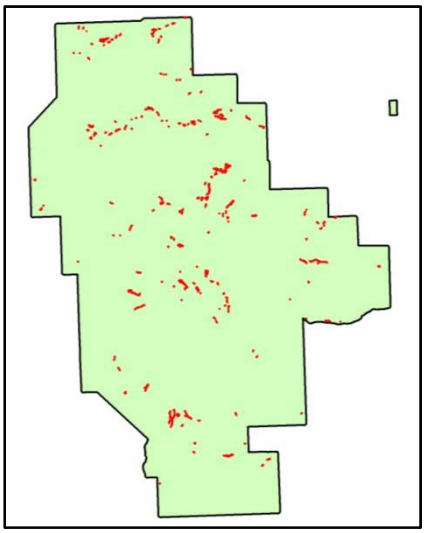
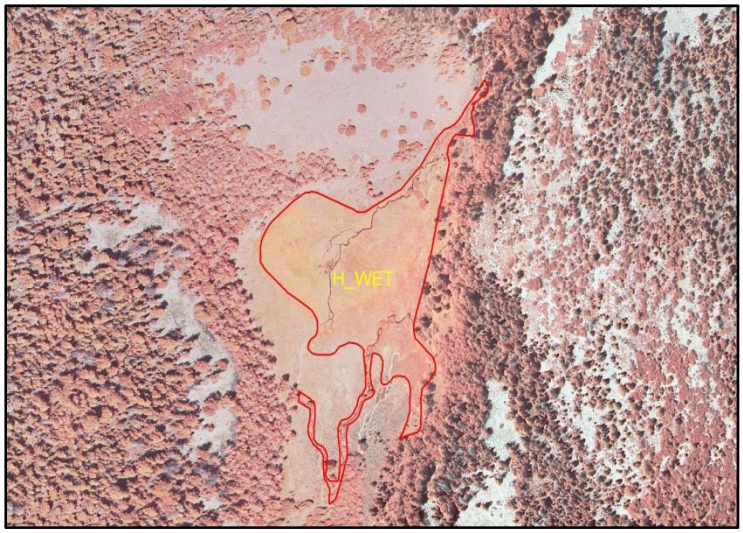


Photo Signature Example



SPARSE VEGETATION

Map Code SV_FELL **Alpine Cushion Plant Fell-field Complex**

Representative Ground Photo

Common Species

Ross' avens (*Geum rossii)*
Utah columbine (*Aquilegia scopulorum*)
Spiny milkvetch (*Astragalus kentrophyta*)
Snake Range buckwheat (*Eriogonum holmgrenii*)
Snowline springparsley (*Cymopterus nivalis*)
Rockslide yellow fleabane (*Erigeron leiomerus*)
Sandberg bluegrass (*Poa secunda*)
Cushion phlox (*Phlox pulvinata)*
Dwarf alpine Indian paintbrush (*Castilleja nana*)

rUSNVC Associations

- *Aquilegia scopulorum* - *Eriogonum holmgrenii* Fell-field Herbaceous Vegetation
- *Astragalus kentrophyta* - *Eriogonum holmgrenii* Fell-field Herbaceous Vegetation [Park Special]
- *Cymopterus nivalis* - *Erigeron leiomerus*- *Poa secunda* Herbaceous Vegetation [Park Special]
- *Geum rossii* - *Phlox pulvinata* Fell-field Herbaceous Vegetation
- *Phlox pulvinata* Herbaceous Vegetation [Provisional]

Description

Frequency: Patches of SV_FELL are common at or above treeline on high elevation scree and talus slopes.
Physiognomy: SV_FELL consists of primarily sparse, low-growing perennial herbaceous vegetation. Various high altitude plant species comprise this map unit and vary in composition based on location.
Condition: Good. Localized patches are likely prone to rock slide and avalanche events. Overall this type is potentially threatened by global warming and climate change.
CIR Signature: This map unit appears as small patches of pink and red on gray and tan scree and talus. The texture of SV_FELL is smooth compared to similar Krummholz shrub vegetation.
Mapping Notes: SV_FELL was used to map high elevation scree and talus fields that contained at least 5-10% total cover. Small patches of H_TURF, S_PIEN, and S_RMJC are likely contained in some of the polygons of this type. SV_FELL was extremely patchy and heterogeneous. When the total vegetation cover of this type was below 5% the G_ROCK and G_TALS map units were used and the presence of alpine vegetation was noted in the polygon comments field.

Range and Distribution

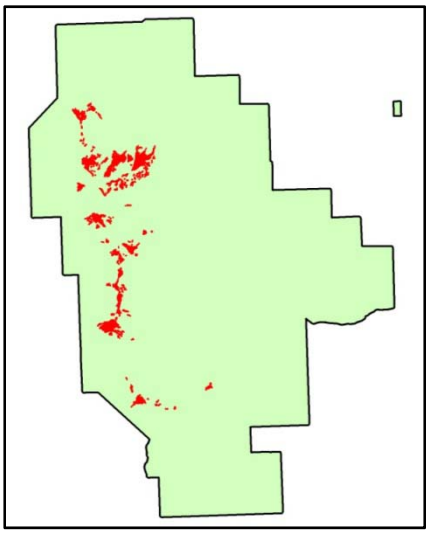
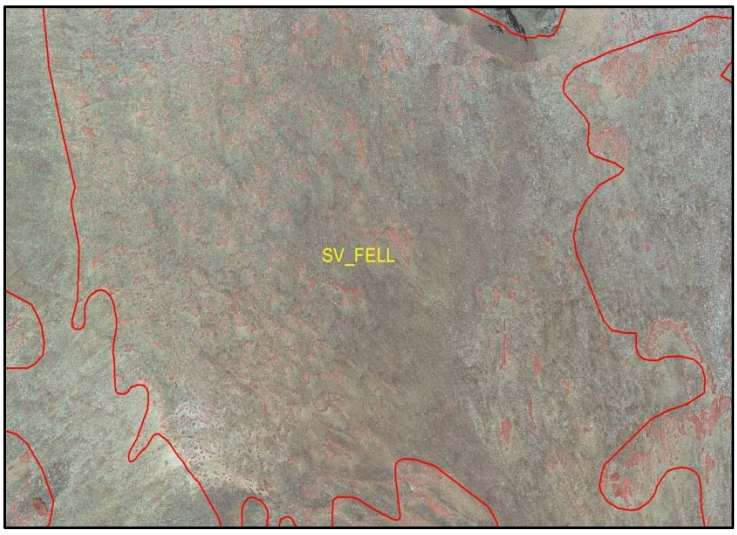


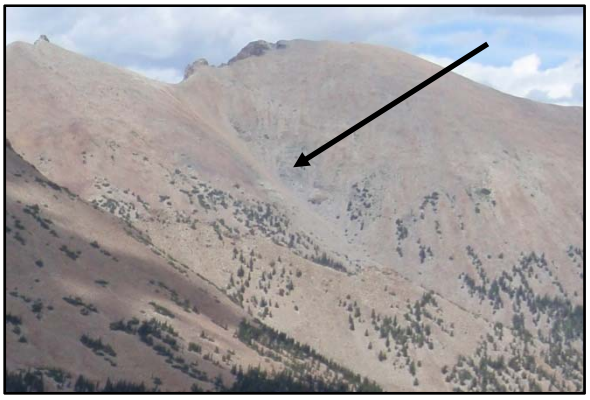
Photo Signature Example



BARREN GEOLOGY AND SNOW

Map Code **Unvegetated Avalanche Chute Talus & Rock**
G_AVAL

Representative Ground Photo



Common Species
N/A

rUSNVC Association
- No Association Bare Geology

Description
Frequency: Barren avalanche chutes were common in the high altitude areas of GRBA.
Physiognomy: None –unvegetated.
Condition: N/A.
CIR Signature: On the imagery G_AVAL polygons appear as linear bands with smooth (talus) or coarse (boulder) textures and various colors from gray to tan depending on the geologic parent material.
Mapping Notes: G_AVAL polygons were similar to the S_AVAL and H_AVAL map units and some G_AVAL polygons may contain patches of sparse vegetation that were either overlooked or were too small to map. The G_AVAL map unit was added to help distinguish barren avalanche features from bare rock and talus.

Range and Distribution

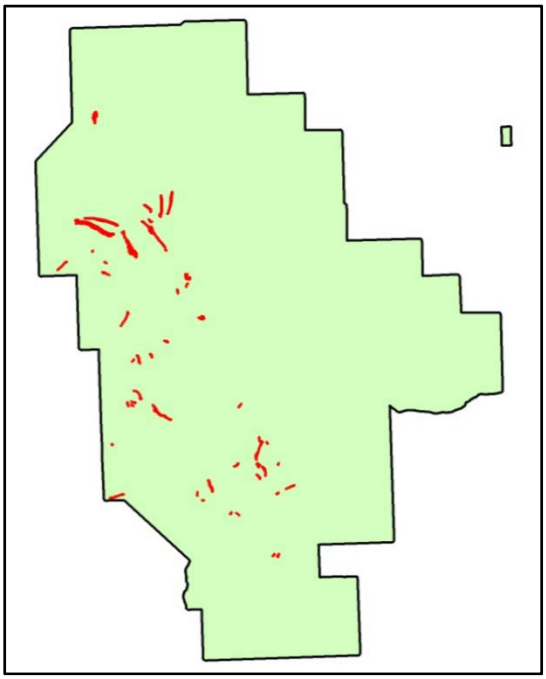
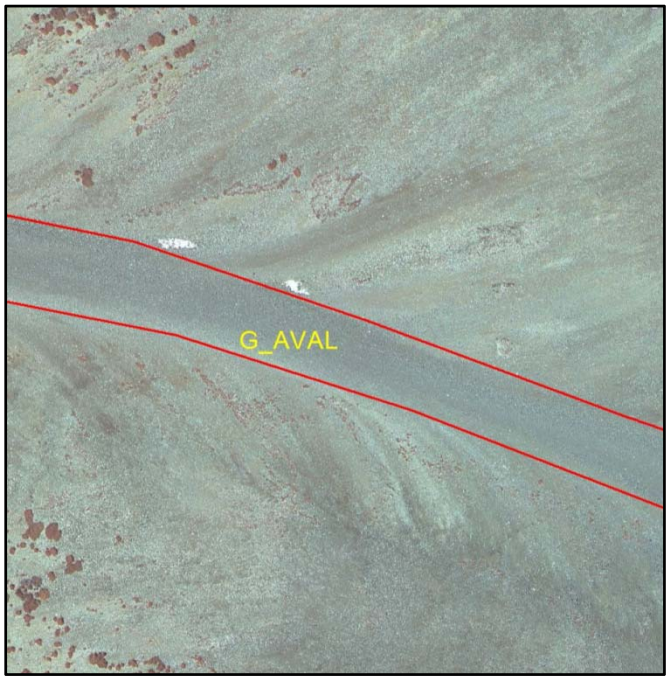


Photo Signature Example



Map Code G_ROCK **Unvegetated Rock Cliffs & Outcrops**

Representative Ground Photo

Common Species
N/A

rUSNVC Association
- *No Association Bare Geology*

Description
Frequency: Barren polygons of G_ROCK are common throughout GRBA.
Physiognomy: None –unvegetated.
Condition: N/A.
CIR Signature: Polygons of G_ROCK exhibit various colors and textures depending on the geologic parent material. Colors for this map unit range from gray to tan to white.
Mapping Notes: Barren rock formations with little (< 5% cover) or no vegetation cover were mapped with the G_ROCK map unit. Unvegetated talus and avalanche chutes were mapped with separate map units. Some areas may have sparse or small vegetation patches of the S_MOTA or S_RT map units. The similar L_ROCK (Bare Rock/Sand) land-use map unit was used instead of this map unit to attribute cleared and man-made bare ground/rock sites around the administrative area.

Range and Distribution

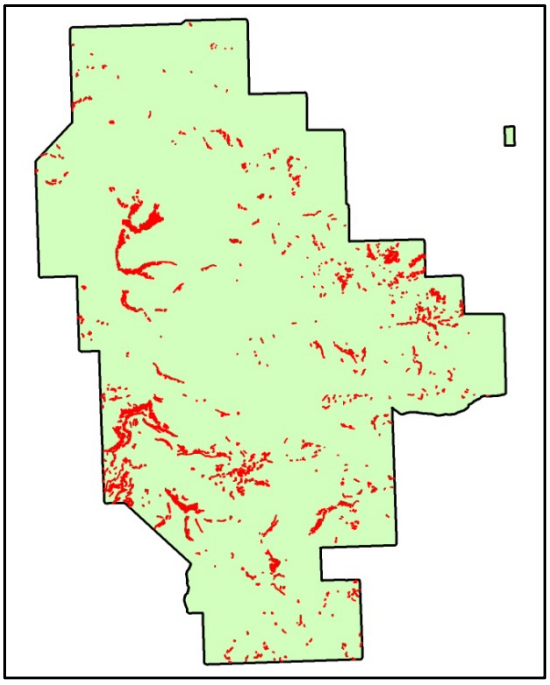
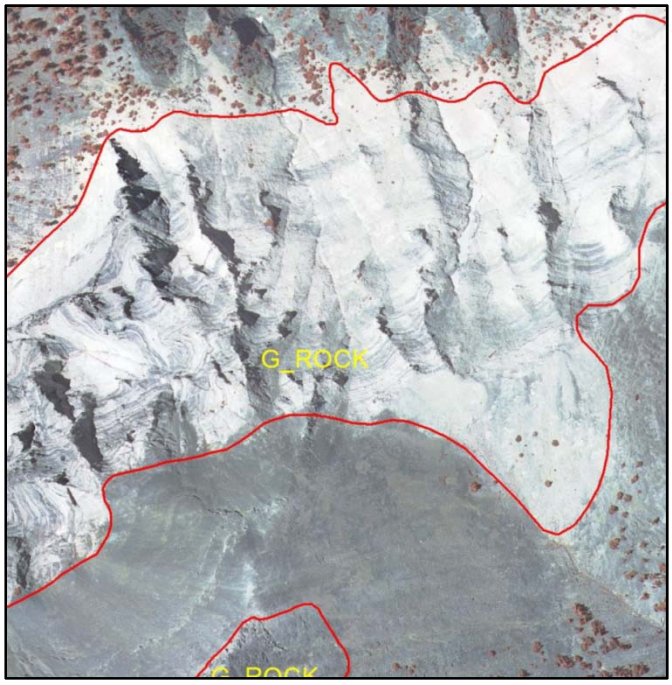


Photo Signature Example



Map Code G_SNOW **Glaciers & Snowfields**

Representative Ground Photo

Common Species
N/A

rUSNVC Association
- *No Association Bare Geology*

Description
Frequency: Small patches of permanent snow and some glacier fields are common in the high altitude areas of GRBA.
Physiognomy: None –unvegetated.
Condition: N/A.
CIR Signature: Polygons with snow are bright white and smooth compared to glaciers that are dull white and rough. Polygons of G_SNOW usually have dark shadows from nearby rock formations.
Mapping Notes: Some of the GRBA snow patches mapped at the time the imagery was acquired may not be permanent and will likely revert to talus (G_TALS) and rock (G_ROCK) when melted.

Range and Distribution

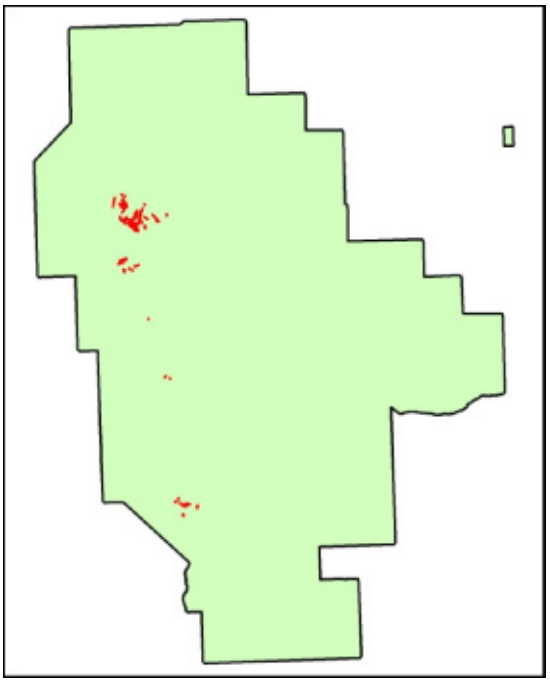
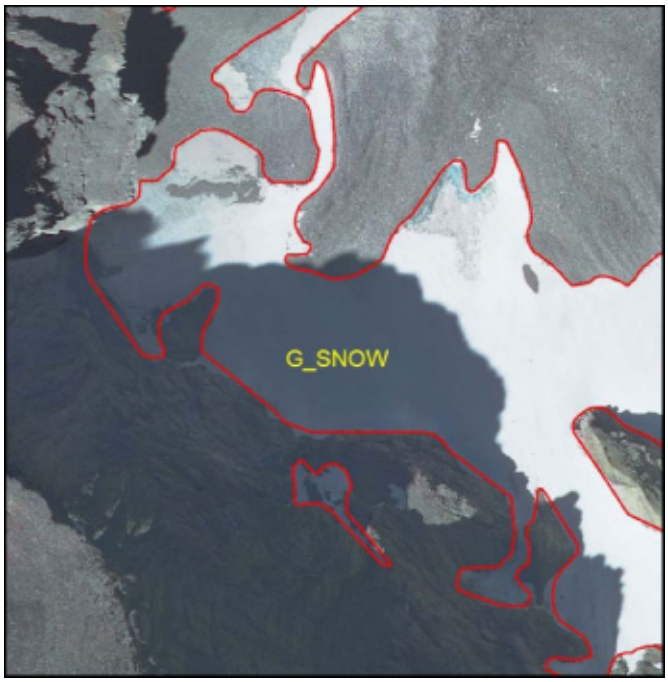


Photo Signature Example



Map Code G_TALS **Bare Talus, Scree & Fell-fields**

Representative Ground Photo

Common Species
N/A

rUSNVC Association
- No Association Bare Geology

Description
Frequency: G_TALS is common throughout GRBA and is very prevalent at higher elevation on mountain slopes.
Physiognomy: None –unvegetated.
Condition: N/A.
CIR Signature: Polygons of G_TALS exhibit various colors and textures depending on the geologic parent material. Colors range from gray to tan to white. Textures are coarse for large cobbles and boulders and smooth for scree and talus.
Mapping Notes: Talus slopes with little (< 5% cover) or no vegetation cover were mapped with this map unit. Unvegetated rock and avalanche chutes were mapped with separate map units. Some areas may have sparse or small vegetation patches of H_TURF, S_PIEN, S_RMJC, or SV_FELL at high elevation and S_MOTA or S_RT in lower areas.

Range and Distribution

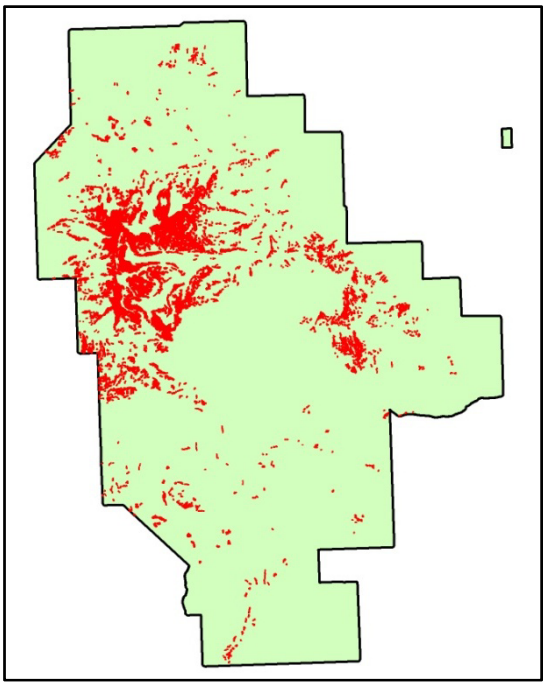
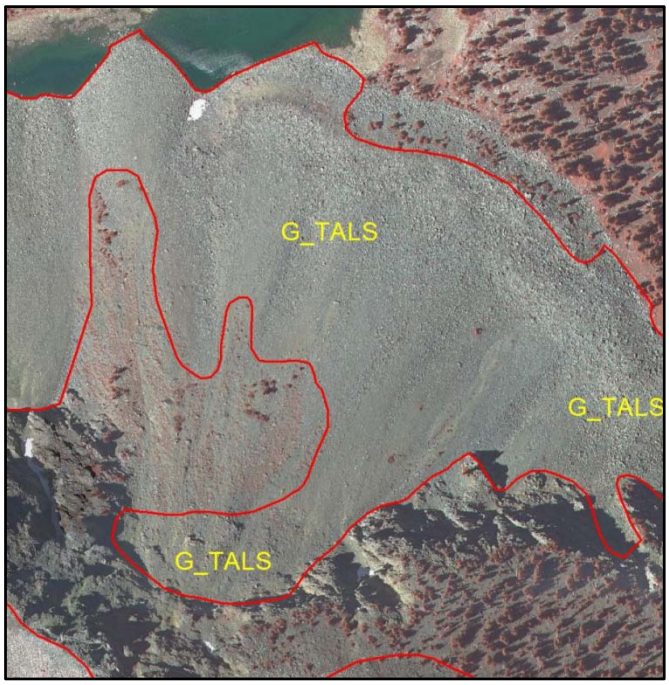
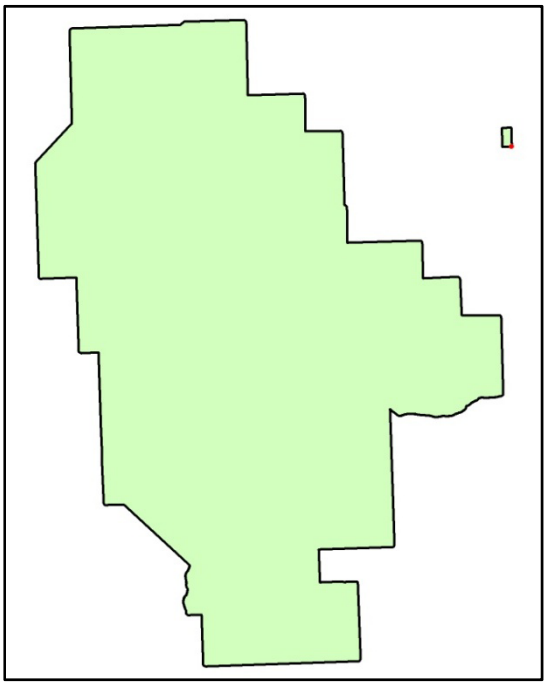


Photo Signature Example

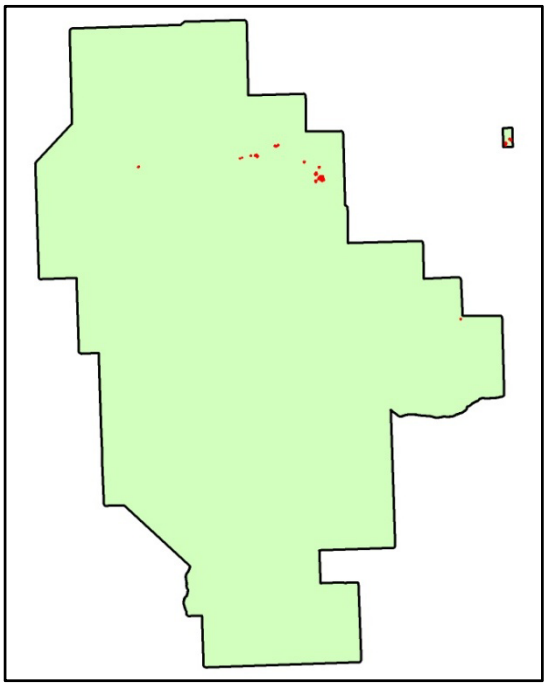


LAND USE – LAND COVER

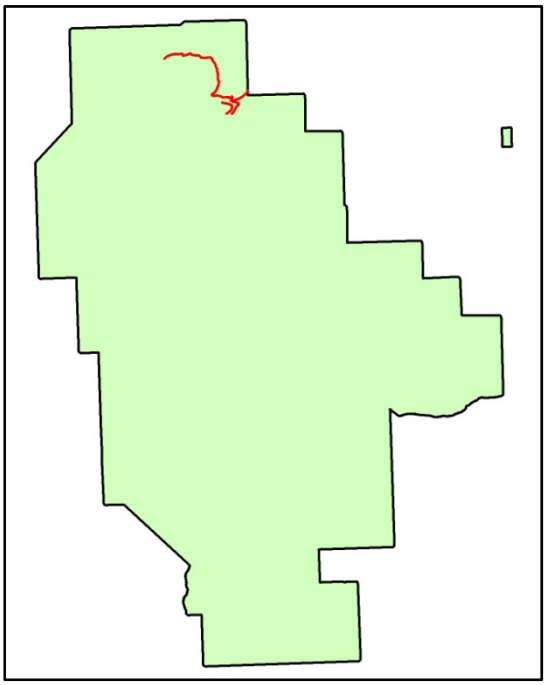
L_AGRI Agricultural Business



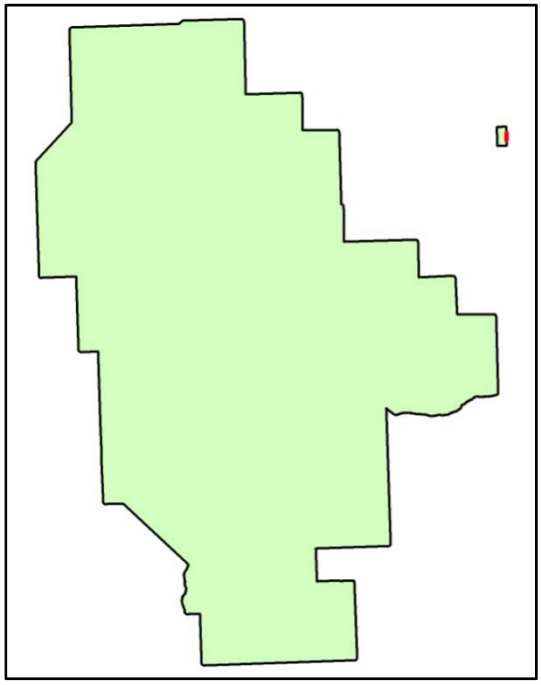
L_FACL NPS Facilities



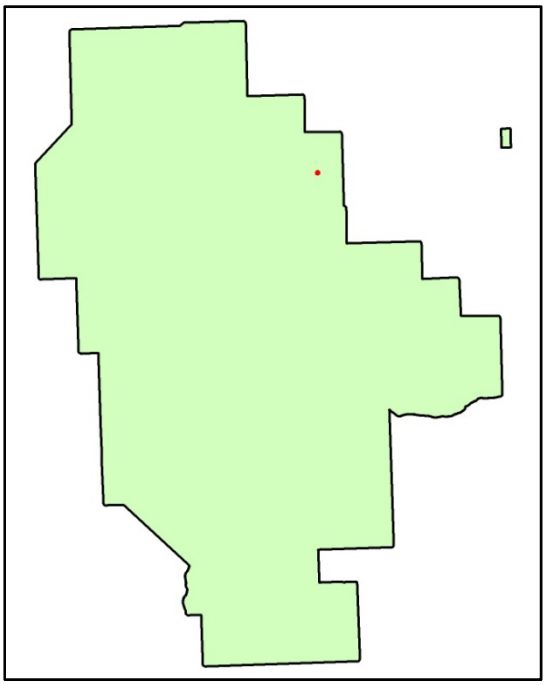
L_CANL Canal / Ditch



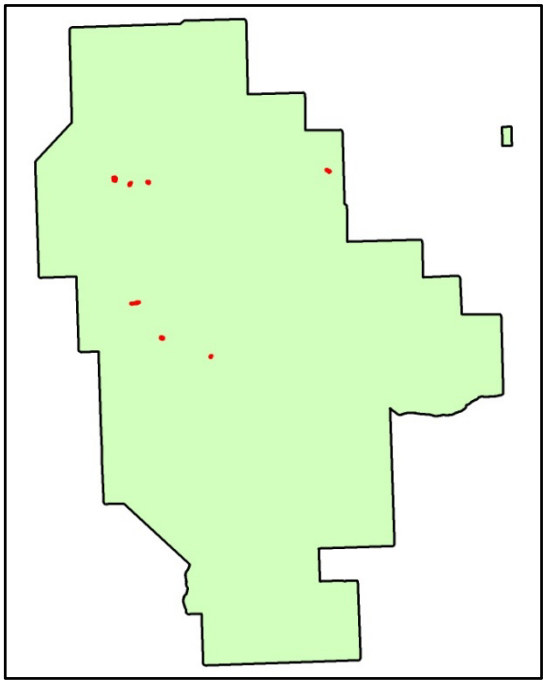
L_FILD Planted / Cultivated



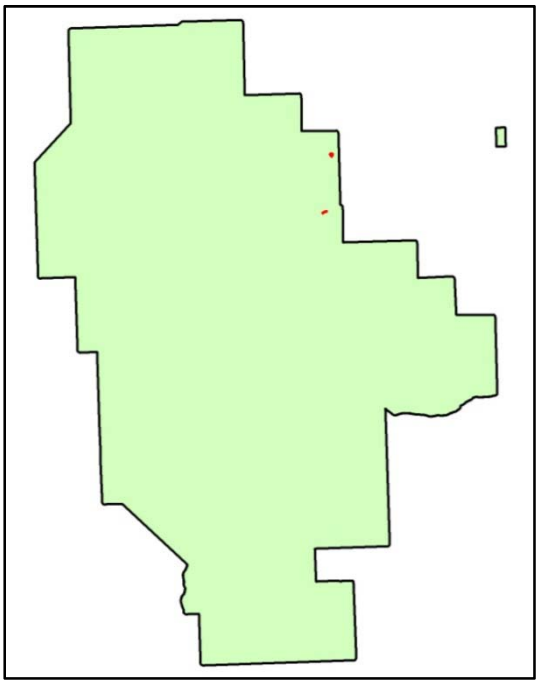
L_ORCH Orchard / Vineyards / Groves



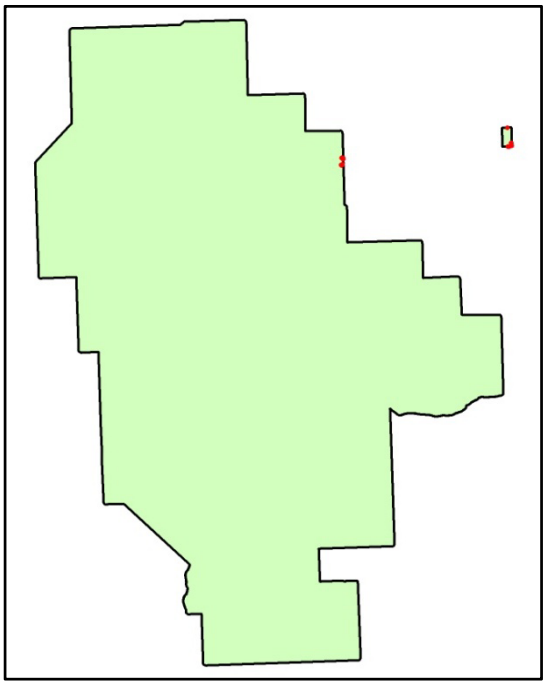
L_POND Lake / Pond



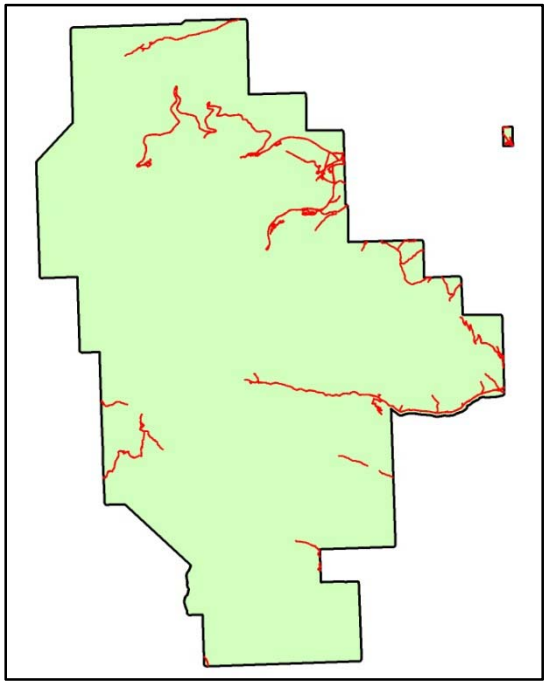
L_PITS Quarries / Strip Mines/ Gravel Pits



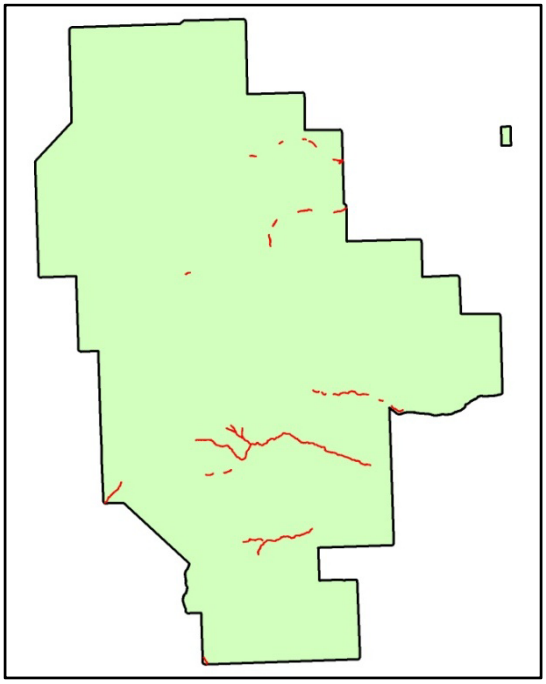
L_RESD Residential



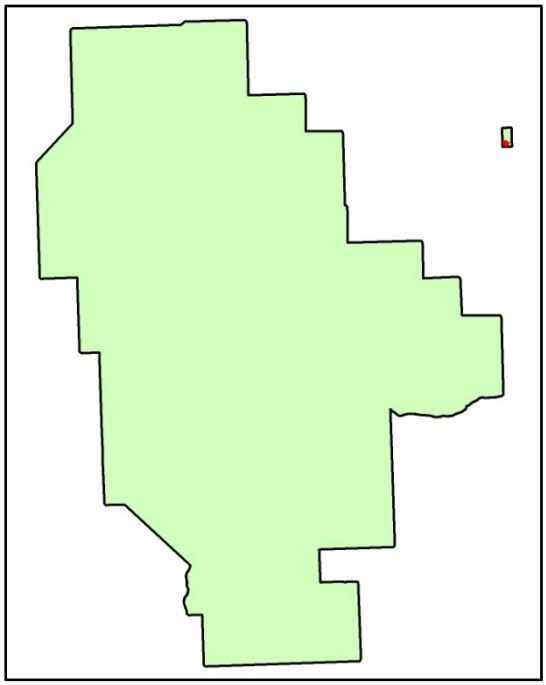
L_ROAD Transportation



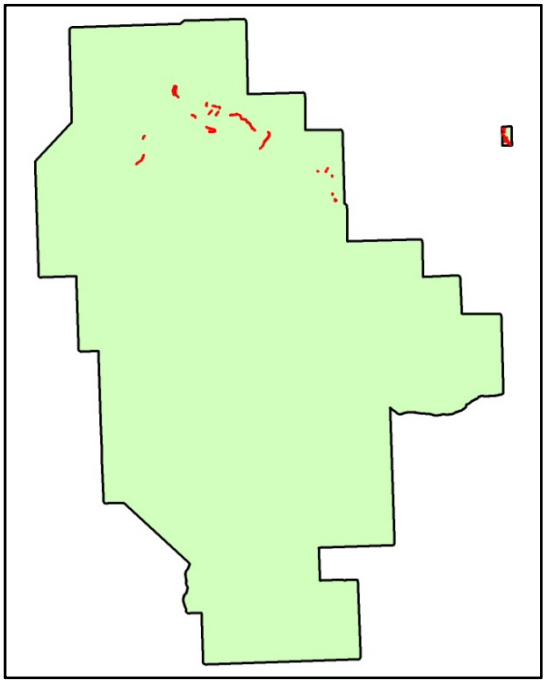
L_STRM Stream / River



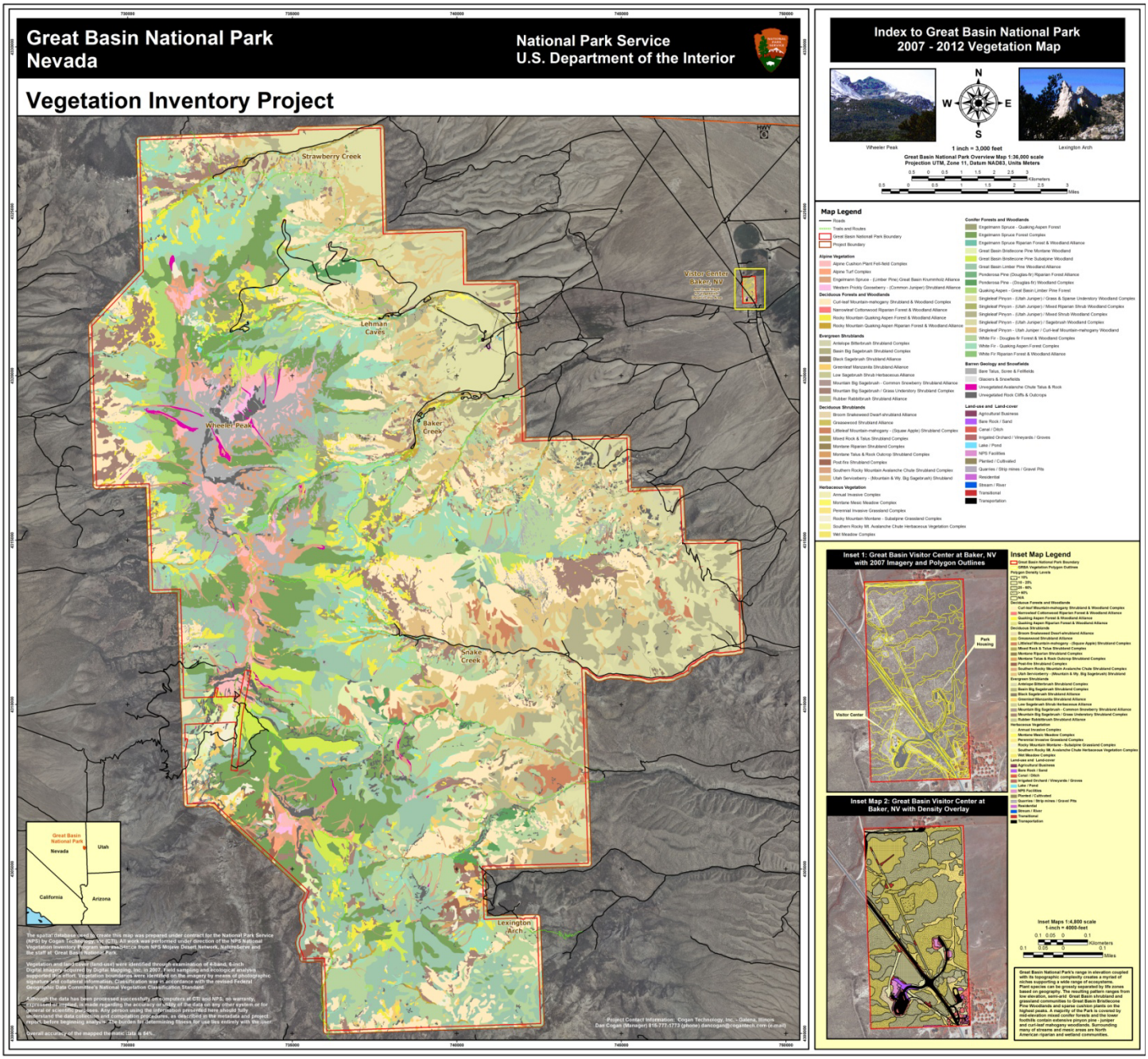
L_ROCK Bare Rock / Sand



L_TRAN Transitional



Appendix G: GRBA Vegetation Map



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 148/116818, September 2012

National Park Service
U.S. Department of the Interior

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