National Park Service
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Natural Resource Stewardship and Science

Vegetation Classification and Mapping Project Report, Cedar Breaks National Monument

Natural Resource Technical Report NPS/NCPN/NRTR—2011/470

ON THE COVER
Cedar Breaks
Photograph by: Karin Edwards

Vegetation Classification and Mapping Project Report, Cedar Breaks National Monument

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Publication series addresses natural resource topics that are of interest and applicability to a broad readership in the National Park Service (NPS) and to others in the management of natural resources, including the scientific community, the public, and the NPS conservation and environmental constituencies. Manuscripts are peer-reviewed to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and is designed and published in a professional manner.

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Contents

Contents (continued)

Contents (continued)

Contents (continued)

Figures

Page

Figures (continued)

Page

Tables

Page

Appendices

Page

Summary

The Northern Colorado Plateau Inventory and Monitoring Network cooperated with the U.S. Geological Survey - National Park Service Vegetation Mapping Program to describe and map vegetation at Cedar Breaks National Monument (CEBR). This collaborative effort involved many project partners, particularly the Rocky Mountain Geographic Science Center of the U.S. Geological Survey, the Western Region office of NatureServe, engineering-environmental Management, Inc., and their cooperators.

The mapping area includes approximately 4,840 hectares (11,960 acres), encompassing the entire monument as well as an environs of adjacent public and private lands. Ecologists and photo interpreters identified plant associations within CEBR and determined an effective mapping approach using 1:12,000-scale, true color aerial photography and digital orthophotography. Field crews collected vegetation and environmental data from 172 vegetation classification plots and 110 observation points in 2006 to prepare the initial classification and vegetation map. During July 24-27, 2007, the primary photo interpreter conducted a vegetation map verification trip and updated the draft map using the resultant recommendations prior to full-scale accuracy assessment. Assessment of CEBR vegetation map accuracy entailed random selection and sampling an additional 303 data plots in the late summer of 2007.

Analysis of the classification plot and accuracy assessment plot data revealed 71 National Vegetation Classification plant associations, vegetation alliances, or park special vegetation types within CEBR and environs. Sixteen plant associations were documented exclusively from accuracy assessment data, the remainder from vegetation classification plots and observation points.

Vegetation and land use mapping units were interpreted to as detailed a level as possible from high-resolution, 9” x 9” stereo pairs of 1:12,000-scale true color aerial photography. A combination of methods was used to delineate and interpret vegetation polygons for the mapping component of the CEBR project area, including the use of ERDAS Imagine software facilitated by heads-up (on-screen) digitizing. The project used the program standard minimum mapping unit of 0.5 ha (1.24 acres) with few exceptions.

Twenty-six map classes were developed and interpreted for CEBR, resulting in 1,253 polygons. A total of 1,195 polygons represent 20 natural or semi-natural vegetation map classes covering 82% of the mapping project area. Six land use/land cover and geologic map classes describe 58 polygons (5% of polygons and 18% of the area). Average polygon size across all map classes is 4.7 ha (11.6 acres). Lands within CEBR make up 2,481 ha (6,130 acres) or 51% of the total project area. The most common map class is Subalpine fir - Engelmann Spruce Forest Complex with 240 polygons covering 25.6% of the mapping area.

Map accuracy was assessed within the CEBR boundary only. Primary analyses of the field data were presented and evaluated at an accuracy assessment meeting held from December 4-5, 2007.

Results from a thematic accuracy assessment of 20 vegetation map classes remaining after accuracy assessment analysis indicated an estimate of 88.1% overall map accuracy (Kappa statistic = 87.1%). Six map classes did not meet the 80% standard for either producer’s or user’s

accuracy, but were retained because of their relative rarity and/or value to park managers. These map classes are described in the Accuracy Assessment section of this report, as is the justification for retaining them.

Products resulting from the CEBR vegetation mapping project include:

Available in this report:

- project summary of methods and results
- illustrated dichotomous field key to the vegetation associations
- illustrated guide to the vegetation map classes
- detailed descriptions of vegetation associations
- samples of completed field forms
- field manual used to guide plot and observation point data collection

Available elsewhere[1]:

- geodatabase containing map polygon attribute, land use, aerial photography flight lines, plot data and monument and project boundaries
- ground photography of vegetation plots, observation points, and accuracy assessment points in hard copy and digital formats
- all field data (plot, observation point, and accuracy assessment point) stored in a Microsoft Access database
- hard copy vegetation maps
- metadata for all digital products

Geospatial products are in Universal Transverse Mercator (UTM) projection, Zone 12, using the North American Datum of 1983.

[1] This document and most of the digital products are available on the internet at: http://biology.usgs.gov/npsveg/. Hard copies of the orthophotos, stereo photos, and original data forms are retained by NCPN and the monument.

Acknowledgments

This project was completed through the effort and dedication of numerous individuals and organizations. Details of the role of each person mentioned here is described in more detail in the Project Overview section. Angela Evenden, Mike Story and Tammy Cook (NPS), Karl Brown (NPS) and Mike Mulligan (USGS) provided project oversight and coordination. Funding for this project was provided through the USGS-NPS National Vegetation Mapping Program, NPS Fire Program, and the Northern Colorado Plateau Inventory and Monitoring Network. Janet Coles (NPS) provided project management and coordination.

Numerous individuals collected classification plot, observation point, and accuracy assessment field data. We appreciate the hard work of NPS seasonal field crew members Bruce Condie, Elizabeth Ballenger, Amy Tendick, and Sarah Topp, and e²M contract field crew members Matt Smith, Buddy Smith, Karin Edwards, Jim VonLoh, Peter Williams, and Stephanie Shoemaker.

Gwen Kittel (NatureServe) prepared the preliminary vegetation classification and assigned final association names. Marion Reid (NatureServe) created the local plant association description template and Jim Von Loh and Matt Smith (e²M) wrote the draft local plant association descriptions. Gwen Kittel prepared the final local and global plant association descriptions. Beverly Friesen (USGS-RMGSC), Gwen Kittel, and Peter Williams wrote sections of the final report.

Beverly Friesen (USGS-RMGSC) developed the initial map class concepts, completed the photo interpretation, and developed the map class attributes. Aneth Wight (NPS) produced the final vegetation map coverage.

Database management support and development were skillfully performed by Margaret Beer, Russ DenBleyker, and Helen Thomas (NPS). Their preparation of a project MS Access database for classification plot, observation point, and accuracy assessment data simplified entry and analysis.

We are grateful to these and other contributors for the success of the project.

Acronyms and Abbreviations

AA	Accuracy Assessment
APFO	Aerial Photography Field Office (USDA)
BLM	United States Bureau of Land Management
BOR	United States Bureau of Reclamation
BPU	Biophysical Unit
BRCA	Bryce Canyon National Park
CEBR	Cedar Breaks National Monument
CEGL	Community Element Code
CNHP	Colorado Natural Heritage Program
DBH	Diameter at Breast Height (4.5 feet)
DCA	Detrended Correspondence Analysis
DEM	Digital Elevation Model
DOQQ	Digital Orthophotograph Quarter Quadrangle
DRC	Diameter at Root Crown
e^2M	engineering-environmental Management, Inc.
ES	Ecological System
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
GPS	Global Positioning System
I&M	Inventory and Monitoring Program
ISA	Indicator Species Analysis
ITIS	Integrated Taxonomic Information System
MMU	Minimum Mapping Unit
NAD	North American Datum
NCPN	Northern Colorado Plateau Network
NM	National Monument
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NVC	National Vegetation Classification
NVCS	National Vegetation Classification Standard
QA/QC	Quality Assurance/Quality Control
RMGSC	Rocky Mountain Geographic Science Center
RSGIG	Remote Sensing and Geographic Information Group (BOR)
SEUG	Southeast Utah Group of the National Park Service
TNC	The Nature Conservancy
TSN	Taxonomic Serial Number
UNESCO	United Nations Education, Science, and Cultural Organization
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

Introduction

Vegetation Classification and Mapping Project, Cedar Breaks National Monument

The Cedar Breaks National Monument (CEBR) Vegetation Mapping Project was organized and coordinated by the Northern Colorado Plateau Network (NCPN) Inventory and Monitoring (I&M) Program between 2002 and 2011, with assistance from several project cooperators. The purpose of this project was to classify, describe and map existing plant associations on 4,840 hectares (11,960 acres) within CEBR and its environs, and to provide this information in written, tabular, digital, and spatial formats useful to park resource managers, the NCPN I&M Program, and other users. The basic project components include a classification and description of CEBR vegetation and land cover/land use, and a spatial database providing an interpretation of the plant communities from aerial imagery.

In 2001, the NCPN I&M Program launched a multi-year project to complete vegetation classifications and maps for network park units. Funding was provided by the U.S. Geological Survey (USGS) – National Park Service (NPS) Vegetation Mapping Program and the Northern Colorado Plateau Network. The CEBR Vegetation Classification and Mapping Project was initiated by the NCPN, the Bureau of Reclamation Remote Sensing and Geographic Information Group (RSGIG), CEBR natural resources staff, NatureServe, and private contractors. Project tasks were coordinated with the USGS-NPS Vegetation Mapping Program. Vegetation classification plot and observation point data collection occurred in 2006. Map accuracy assessment was completed in 2007.

Project methods, results, and products are documented in this report. This introductory section summarizes the NPS I&M Program and the USGS-NPS Vegetation Mapping Program and the CEBR mapping project area. Following sections document the methods and results for each of the major tasks in the project: scoping, vegetation classification and description, vegetation mapping, and map accuracy assessment.

The USGS-NPS Vegetation Mapping Program

The National Vegetation Mapping Program is a cooperative project between the USGS and the NPS to inventory, classify, describe, and map vegetation in more than 270 national park units within the United States. Consistent vegetation classification, mapping, and accuracy assessment protocols and standards are applied across projects supported by this program. The National Vegetation Mapping Program is administered by the USGS Center for Biological Informatics in cooperation with the NPS I&M Program. Through implementation of the NPS Natural Resource Challenge (NPS 1999), significant funding became available for completing important natural resource baseline inventories in park units, including vegetation classification and mapping. This support provided the NPS with the opportunity to move forward with dozens of new park unit vegetation classification and mapping projects, including CEBR. Vegetation classification and mapping products produced by this program are incorporated into the USGS National Biological Information Infrastructure Program, which serves as an information-sharing network (http://biology.usgs.gov/npsveg/).

Northern Colorado Plateau Network Inventory and Monitoring Program

The National Park Service developed an inventory and long-term monitoring program for park natural resources over the last two decades of the twentieth century. This effort was enhanced by the NPS Natural Resource Challenge (NPS 1999); as a part of this initiative, the NCPN was formed in 2000 to develop an integrated inventory and monitoring program for 16 park units in Utah, Colorado, Arizona, and Wyoming.

A goal of the NPS I&M Program is to complete baseline inventories of biological and geophysical resources for each park unit. These inventories cover 12 basic data sets needed by park staff to guide resource management. Vegetation classification and mapping constitute one of these data sets. Early in the development of its I&M program, the NCPN made completing vegetation maps for each network park unit a priority. In addition to assisting park management, vegetation maps and classification information were seen as contributing significantly to NCPN long-term monitoring efforts. In 2001, the network began implementation of a strategy to complete vegetation mapping in all network park units. The CEBR vegetation mapping project is the twelfth of the network-coordinated projects to be completed.

Vegetation Mapping Program Standards

The NPS I&M Program established guidance and standards for all vegetation mapping projects in a series of documents:

Protocols

- National Vegetation Classification System (TNC and ESRI 1994a, NatureServe 2003a)
- Field methods and mapping procedures (TNC and ESRI 1994b)
- Statistically rigorous and consistent accuracy assessment procedures (ESRI and TNC 1994)
- Guidelines for using existing vegetation data (TNC 1996)

Standards

- National Vegetation Classification Standard (FGDC 1997)
- Spatial Data Transfer Standard (FGDC 1998b)
- Content Standard for Digital Geospatial Metadata (FGDC 1998a)
- United States National Map Accuracy Standards (USGS 1999)
- Integrated Taxonomic Information System
- Program-defined standards for map attribute accuracy and minimum mapping unit

These documents are available on the USGS-NPS Vegetation Program Web site (http://biology.usgs.gov/npsveg/standards.html).

National Vegetation Classification Standard

The National Vegetation Classification (NVC) is the system used in NCPN vegetation mapping projects (TNC and ESRI 1994a), and is based on the National Vegetation Classification Standard adopted by the Federal Geographic Data Committee (FGDC 1997). The NVC evolved from work conducted primarily by The Nature Conservancy (TNC), NatureServe, and the Natural Heritage Program network over more than two decades (Grossman et al. 1998). The structure of the NVC is based in part on an earlier international vegetation classification developed by the United Nations Educational, Cultural, and Scientific Organization (UNESCO 1973, Driscoll et al. 1984). Use of a standardized classification system helps to ensure data compatibility throughout the NPS and other agencies. The FGDC Vegetation Subcommittee provides oversight to keep this standard current and relevant. The substantial revisions to the upper levels of the NVC hierarchy adopted by the Vegetation Subcommittee as Version 2 (FGDC 2008) are not used in this project.

Vegetation classification systems attempt to recognize and describe repeating assemblages of plants in similar habitats. The NVC is a hierarchical system that incorporates physiognomic characters and floristic data to define seven levels of terrestrial vegetation classification. The five upper levels (class, subclass, group, subgroup, and formation) are based on physiognomic features. The two lower levels (alliance and association) are distinguished by differences in floristic composition. The physiognomic units have a broad geographic perspective and the floristic units have utility in local and site-specific applications (Grossman et al. 1998). The physiognomic levels of the NVC are based on physical, structural, and environmental characteristics identifiable from satellite imagery, aerial photography, or ground observations (Table 1). Specific criteria defining these physiognomic units are based on ecologic characteristics that vary among major vegetation groups (FGDC 1997).

The vegetation alliance and plant association levels form the base of the NVC hierarchy and are determined by the most abundant or diagnostic species comprising the various layers of a homogenous vegetation community. An association is here defined as a plant community type with a consistent species composition, uniform physiognomy, and similar habitat conditions (Flahault and Schroter 1910). Species composition differentiates associations (TNC and ERSI 1994a). An alliance is "a physiognomically uniform group of plant associations sharing one or more dominant or diagnostic species which, as a rule, are found in the uppermost strata of the vegetation" (Reid and Comer 1998). NatureServe coordinates plant association data for the NCPN vegetation mapping projects. Associations are added to the NVC and older concepts are refined as new data become available.

Other Standards

In addition to vegetation classification, the FGDC sets standards for map spatial accuracy and for metadata employed in NPS vegetation mapping projects. Standards for map products stipulate map scales of 1:24,000 or finer, and minimum polygon size of 0.5 ha (1.24 acres). Positional accuracy for vegetation maps must meet National Map Accuracy Standards, which specify horizontal errors of less than 10.2 m (33.5 ft.) on the ground for 1:12,000-scale maps.

All digital vegetation products resulting from this project are accompanied by FGDC-compliant metadata. Metadata are “data about the data,” and describe the content, quality, condition, and

other characteristics of the spatial dataset. Metadata are critical elements that expedite the interpretation and exchange of information among users.

Table 1. National Vegetation Classification System hierarchy for terrestrial vegetation (FGDC 1997).

Level	Criteria Delineating Level	Example
Class	Structure (height, cover) of dominant vegetation strata	Woodland
Subclass	Growth form characters including leaf type (evergreen, deciduous) for woody plants and persistence (perennial, annual) for herbaceous species	Evergreen woodland
Group	Leaf morphology (broad-leaf, microphyllous, xeromorphic), leaf phenology, and climatic conditions	Temperate or subpolar needle-leaved evergreen woodland
Subgroup	Relative degree of human disturbance	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland
Formation	Additional physiognomic characteristics, general environmental conditions, relative landscape position, and hydrologic regimes	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland
Alliance	Dominant or diagnostic species of uppermost or dominant stratum	*Pinus edulis* – (*Juniperus* spp.) Woodland Alliance
Association	Other dominant or diagnostic species from any stratum	*Pinus edulis* – *Juniperus* spp. / *Quercus gambelii* Woodland

Project Area Description

Location and Setting

Cedar Breaks National Monument (CEBR) was created on August 22, 1933, by proclamation of President Franklin D. Roosevelt. The monument was established "for the preservation of spectacular cliffs, canyons, and features of scenic, scientific, and educational interest contained therein." The purpose of CEBR, as described in the Strategic Plan for FY2001-FY2005 is to "preserve the geology, vistas, natural and ecological processes, and other features of scenic, scientific, and education interest" and "to provide opportunities for research, public enjoyment, inspiration, and appreciation of the resources of Cedar Breaks National Monument through interpretation and other educational endeavors." The monument is currently administered by Zion National Park (O'Dell 2005). Over the past decade, annual visitation averages about 543,000 visitors (NPS 2010).

CEBR is located in southwest Utah, approximately 29 km (18 miles) east of Cedar City, Utah, in Iron County (Figure 1). The nearest municipality is Brian Head, approximately 4.8 km (3 miles) north of the CEBR entrance. Parowan is the Iron County seat and had a population of 2,565, nearly 7.6% of the population of Iron County (33,779) in 2000. Iron County has a population density of 10.2 people per square mile. CEBR is accessible via UT 143 (approaching from the east) and UT 148 (approaching from the north or south). Most lands adjacent to CEBR are administered by Dixie National Forest, including the Ashdown Gorge Wilderness Area on the western boundary of the monument. Recently, Iron County commissioners have proposed expanding the boundaries of the monument to include the Ashdown Gorge Wilderness Area (Fertig 2009). There are also some areas of private ownership adjacent to the northeast boundaries of the monument (Figure 2).

CEBR encompasses 2,481 ha (6,130 acres) within the monument boundary, as well as 2,630 hectares (5,831 acres) of adjacent, primarily USFS lands in the environs for a total mapped project area of 4,840 hectares (11,960 acres).

Topography and Geologic History

CEBR lies on the western rim of the Markagunt Plateau, in the High Plateaus section of the Colorado Plateau physiographic province. The High Plateaus represent a transitional tectonic region between the Colorado Plateau to the east and the Basin and Range physiographic province to the west. While a visitor at one of the rim overlooks is standing on a high plateau of relatively horizontal strata characteristic of the Colorado Plateau, the spectacular views to the west are some of the finest in southern Utah of a Basin and Range landscape (Hatfield et al. 2000).

The Markagunt Plateau within CEBR is flat to gently rolling terrain, covered by interspersed stands of spruce-fir forest and wet subalpine meadows. The top of the Markagunt Plateau tilts gently eastward, and water from the meadows generally drains in this direction, away from the dramatic amphitheaters (or "breaks") created by the headward erosion of the west-flowing Ashdown Creek. A series of tributary drainage heads have scalloped a 5 km (3 miles)-wide section of the plateau rim. Elevations in CEBR range from 3,250 meters (10,662 feet) in the northeastern section above the amphitheater rim, to 2,469 meters (8,100 feet) on Ashdown Creek on the western boundary (O'Dell 2005). The terrain below the rim is precipitous and sparsely

vegetated. Although easily viewed from the many scenic overlooks along the rim, the amphitheater cliffs and the gorges below them that make up the majority of CEBR are difficult to access and rarely visited.

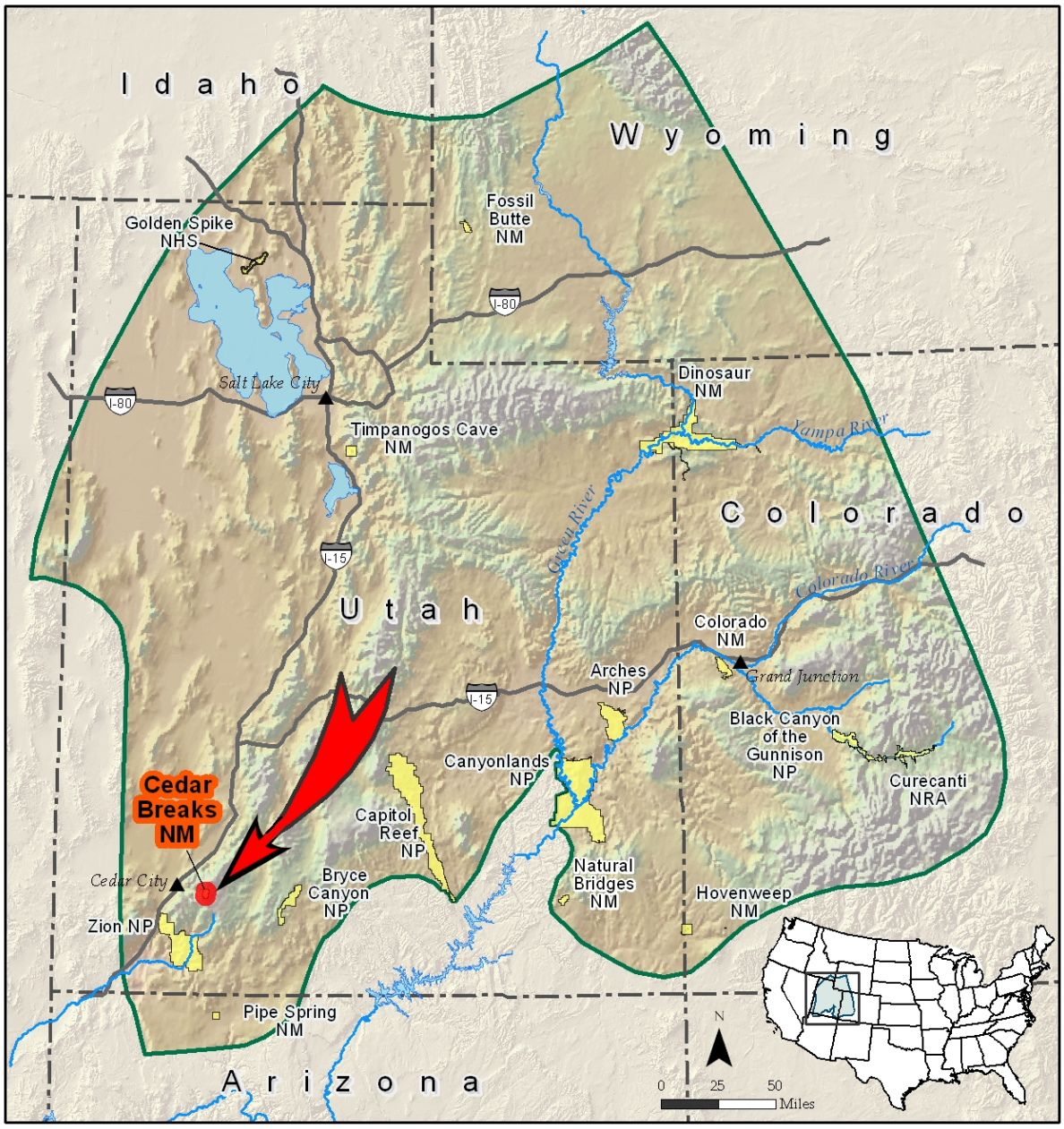

Figure 1. Location of CEBR on the Colorado Plateau.

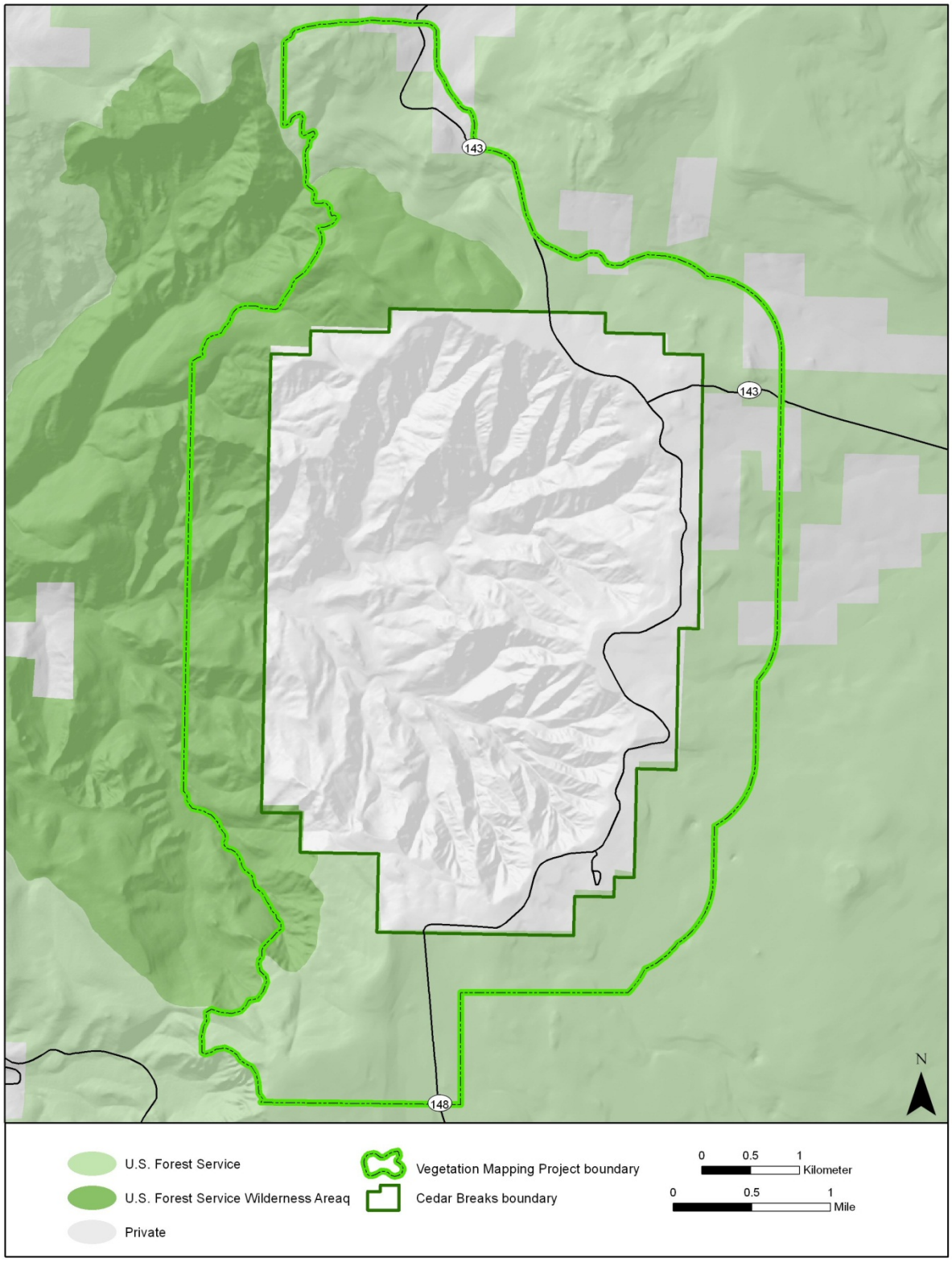

Figure 2. Map of the CEBR vegetation mapping project area boundary showing adjacent land ownership.

Climate

The climate of CEBR is influenced by tropical Gulf and Pacific, and polar Pacific air masses. The high elevation of the Markagunt Plateau results in short, cool summers and relatively long, cold winters. Deep, drifting snow typically closes automobile access to the rim overlooks from November to mid-May (O'Dell 2005). Residual snow drifts last into the early summer and contribute substantially to the hydrology of the meadows and cliff-face seeps.

Records of climatic conditions collected at the town of Brian Head, Utah (WRCC 2009) during the period 1991 to 2009 show an annual average precipitation of 87 cm (34.3 inches), most of which falls in the form of winter snows (Figure 3). The town of Brian Head is roughly 275 m (900 feet) lower in elevation than the rim areas of CEBR, but weather data collected at the Blowhard Mountain Radar station, just south of the park and at a slightly higher elevation, show similar conditions. May and June have the lowest average monthly precipitation, but July and August bring regular monsoonal thunderstorms and higher monthly precipitation (Figure 4). Precipitation in the form of snow averages 917 cm (361.1 inches) annually, with only July and August having zero average snowfall. Snow depths in March and April generally exceed 178 cm (70 inches). The average minimum temperature in January is -12º C (10º F), while the average maximum temperature in July reaches 21.3º C (70.4º F).

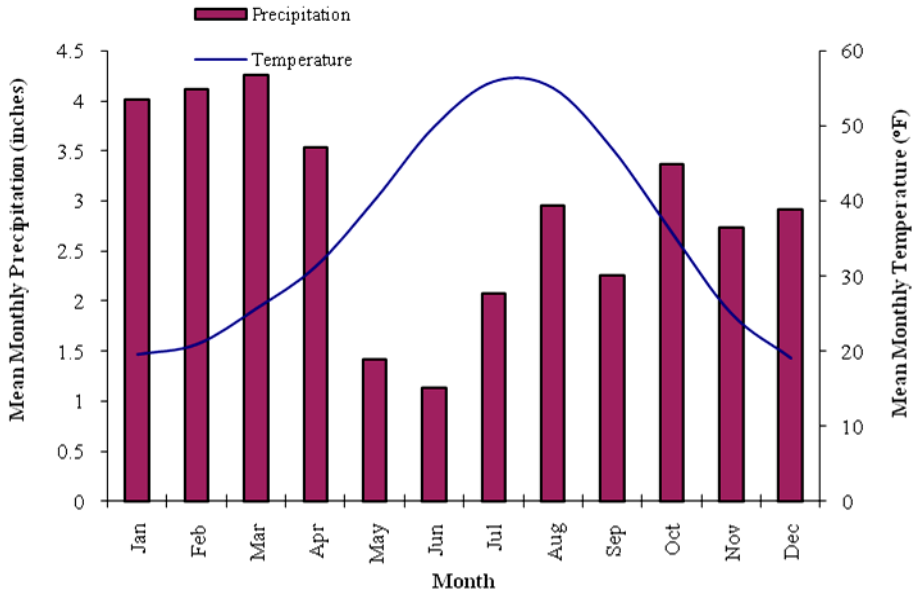

Figure 3. Climate data for CEBR (WRCC 2009).

USU Weeds Survey Crew

Figure 4. Summer thunderstorm at CEBR.

Geology and Vegetation

Uplift of the Markagunt Plateau began along the Hurricane Fault zone during the last of the major Basin and Range deformational events in the region (Figure 5). Uplift began in relatively recent times, approximately 10 million years ago, and the erosion of the breaks at CEBR could begin only after this uplift had established the westward gradient of Ashdown Creek (Hatfield et al. 2000).

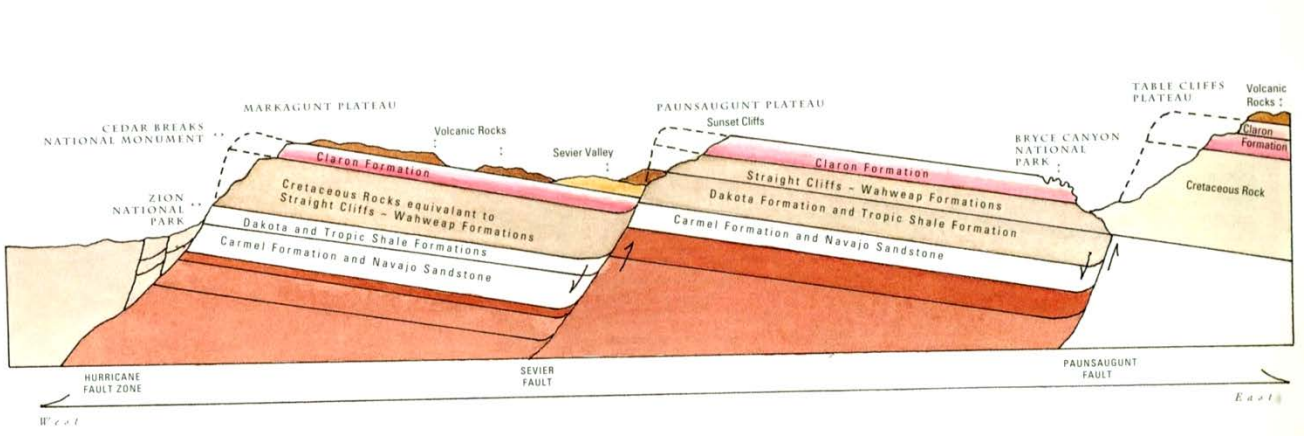

Figure 5. A diagram of the Markagunt Plateau showing the Hurricane Fault Zone.

While CEBR is much higher in elevation than Bryce Canyon National Park (BRCA), 64 km (40 miles) to the east, the two parks share a common geology and many similar erosional features. The most striking similarity is the dominance of the Claron Formation in the scenery of each park. However, subtle variations in the rock layers and the much higher elevation of the Markagunt Plateau have produced significant local differences, especially in vegetation. The lowest elevations of CEBR lie within the same Montane Forest Belt that Buchanan (1992) described for the highest elevations at BRCA; the vegetation at CEBR is characterized by the Subalpine Forest Belt on the plateau top. The amphitheaters at CEBR are much deeper than those at BRCA, but tend to have fewer concentrations of the hoodoos, fins, alcoves and arches for which BRCA is known. The top of the Markagunt Plateau also shows a much greater influence by glacial and periglacial processes than is seen on the Paunsaugunt (Hatfield et al. 2000). The geology and related vegetation communities within CEBR are discussed below to provide context for the vegetation map units.

The Claron Formation at CEBR is eroding eastward as a result of physical weathering and mass wasting processes. It has been estimated that the rim of the Claron Formation recedes 24-120 cm (9.5-47 inches) per century (Fertig 2009). Freeze-thaw cycles and chemical weathering loosen the surface material, while sheet and gully erosion rapidly remove the debris. The steep gradient results in rapid erosion and the removal of large quantities of material. Protective soils and vegetation cannot develop on the steep slopes, further enhancing the erosive power of wind and water. The result is an environment that is not conducive to soil development. Established vegetation exhibits pedestaling and may be buried or eroded downslope.

Straight Cliffs Formation (Upper Cretaceous, approximately 85 million years ago). The oldest geologic stratum exposed within CEBR is the Late Cretaceous Straight Cliffs Formation, rocks that represent gradual transition from shallow marine conditions to coastal swamps, lagoons and fluvial environments. This formation is poorly exposed in CEBR, but outcrops occur along Ashdown Creek on the western boundary of the monument at the lowest elevations. Exposures are characterized by lagoonal and marine gray and brownish mudstones and sandstones deposited as the great Cretaceous Sea retreated from the region. These substrates typically support woodlands or forests of white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), Rocky Mountain juniper (*Juniperus scopulorum*), quaking aspen (*Populus tremuloides*), two-needle pinyon pine (*Pinus edulis*) and/or curl-leaf mountain mahogany *(Cercocarpus ledifolius*) with a variety of understory shrub and herbaceous species including greenleaf manzanita (*Arctostaphylos patula*), common juniper (*Juniperus communis*), creeping barberry (*Mahonia repens*), Gambel oak (*Quercus gambelii*), mountain snowberry (*Symphoricarpos oreophilus*), and muttongrass (*Poa fendleriana*) (Figure 6) .

Wahweap / Grand Castle Formation (Upper Cretaceous, approximately 80 million years ago). This formation is approximately 300 m (1,000 feet) thick, and characterized by exposures of mostly fluvial mud-, sand- and siltstones, variously identified as the Wahweap, the Wahweap with overlying Kaiparowits, or the Grand Castle Formation. Hatfield et al. (2000) has designated this stratum the Wahweap/Grand Castle Formation, and this report follows that taxonomy. Deposited in an environment of swampy ponds, where water from the Cretaceous inland sea was slowly retreating, this formation preserved contains fossils of many plants and animals, including dinosaurs. In CEBR, exposures of the formation form the majority of land downslope from the

Claron breaks in the Ashdown Creek drainage basin and represent steep to very steep, mid- to high-elevation slopes. Wahweap/Grand Castle Formation substrates typically support woodlands or forests of white fir, ponderosa pine, Douglas-fir, blue spruce (*Picea pungens*), Rocky Mountain juniper, quaking aspen, and/or curl-leaf mountain mahogany with a variety of understory species including greenleaf manzanita, common juniper, and creeping barberry (Figure 7).

Figure 6. Pinyon – juniper woodland and ponderosa pine – (Douglas-fir) woodland on the Straight Cliffs Formation in CEBR.

Figure 7. Ponderosa pine woodland and blue spruce / manzanita woodland on the Wahweep Formation in CEBR.

Pink Member of the Claron Formation (Eocene, approximately 50-60 million years ago). Above the Wahweap/Grand Castle Formation, the terrain is formed in the Eocene and Paleocene Claron Formation, divided into the Pink (lower, sometimes called Red) and White (upper) members. In general, the Claron Formation defines the spectacular scenery of CEBR, eroding into multi-hued cliffs and barren badlands dotted with hoodoos and fins. Of fluvial and lacustrine origin, the formation records a transition from fluvial environments to one of broad deltas and shallow lakes. The Pink Claron Formation is approximately 396 m (1,300 feet) thick, and composed of alternating beds of sandy limestone, calcareous sand- and mudstones, and minor conglomerates. (Hatfield et al. 2000). A significant bed of limestone at the base of the Pink Claron forms a cliff

band, and a similar bed of limestone at the top of the White Claron provides a contrasting caprock to the adjacent badland slopes.

The Pink Claron breaks vegetation community includes sparse woodlands of bristlecone pine (*Pinus longaeva)* and/or ponderosa pine with associated shrubs such as greenleaf manzanita, common juniper, and creeping barberry, as well as nearly homogenous shrublands of greenleaf manzanita. Limited areas of soil development occur on the Pink Claron, particularly on north-facing slopes. These soils support stands of various mixes of conifers in low to moderate cover, including bristlecone pine, limber pine (*Pinus flexilis*) and ponderosa pine, as well as blue spruce, Engelmann spruce (*Picea engelmannii*), Douglas-fir, and subalpine fir (*Abies lasiocarpa*), with the particular species combination dependent on elevation. A large flat area on top of the plateau in the southeast corner of CEBR with underlying geology of Pink Claron formation supports grasslands, forblands, or shrub-herbaceous stands dominated by one or more of the following species: Kentucky bluegrass (*Poa pratensis*), slender wheatgrass (*Elymus trachycaulus*), smooth brome (*Bromus inermis*), little desertparsley *(Lomatium minimum*), gooseberry currant (*Ribes montigenum*), and whitestem goldenbush (*Ericameria discoidea*) (Figure 8).

Figure 8. Sparse bristlecone pine woodlands on the Pink Claron Formation in CEBR.

White Member of the Claron Formation (Eocene, approximately 50-60 million years ago). Above the Pink Member of the Claron Formation, the White Member is approximately 110 m (360 feet) thick in CEBR (Hatfield et al. 2000). Composed of limestones interbedded with thin purplish-gray mudstones and siltstones, it was deposited in an environment of broad shallow lakes and preserved fossils of freshwater gastropods. In CEBR, the White Member of the Claron Formation is exposed along the entire rim as steep high slopes or as moderately-sloping areas of caprock.

Both the White Claron and the Pink Claron provide habitat for most of the rare endemic plant species of the monument. Many of these are cushion plants, including the Panguitch buckwheat (*Eriogonum panguicense*) on calcareous environments along the White Claron rims (Fertig 2009). The characteristic tree species of the Claron barrens is the bristlecone pine, or occasionally limber pine. In certain areas, subalpine forest communities more characteristic of the plateau top can extend downslope from the plateau rim; these communities include subalpine fir, Engelmann spruce, quaking aspen, white fir, and blue spruce trees, subalpine grassland

communities of Letterman's needlegrass (*Achnatherum lettermanii*), Sandberg bluegrass (*Poa secunda*), Kentucky bluegrass, smooth brome, and/or western wheatgrass (*Pascopyrum smithii*), or shrublands of whitestem goldenbush and sulphur-flower buckwheat (*Eriogonum umbellatum*) more characteristic of the plateau top can extend quite far downslope from the plateau rim (Figure 9).

Figure 9. Bristlecone pine woodland and sulfur-flower buckwheat forbland on the White Claron Formation in CEBR.

Brian Head Formation (Oligocene and Eocene, approximately 35 to 23 million years ago). The geology of the top of the Markagunt Plateau is complex, and includes a mix of poorly understood strata. The Brian Head Formation consists of soft sandstones (of fluvial, eolian and volcanic derivation), ash-flow and airfall tuff, and a few limestone beds. Some of the Brian Head sediments were derived from tuff deposited by extensive volcanic fields to the north and west of the Markagunt Plateau. These soft volcanic clay rocks are prone to landslides (Hatfield et al. 2000). Covering a large part of the plateau above the rim, particularly in the northern portion of the CEBR, the Brian Head Formation supports a variety of grasslands dominated by slender wheatgrass, Kentucky bluegrass, smooth brome, Letterman's needlegrass, or tufted hairgrass (*Deschampsia caespitosa*), forblands characterized by Eggleston's sedge (*Carex egglestonii*), Rocky Mountain goldenrod (*Solidago multiradiata*), Porter's licorice-root (*Ligusticum porteri*), American bistort (*Polygonum bistortoides*), and silvery lupine (*Lupinus argenteus*), shrublands of Arizona willow (*Salix arizonica*) or gooseberry currant, and occasional small stands of woodlands or forests dominated by subalpine fir, Engelmann spruce and/or quaking aspen (Figure 10).

Markagunt Megabreccia (Miocene, approximately 22 to 20 million years ago). Overtopping the Brian Head Formation are two named formations of volcanic ash-flow tuffs (the Isom and Leach Canyon formations, of Oligocene and Miocene age), capped by the Markagunt Megabreccia (Miocene). The Markagunt Megabreccia contains a chaotic assemblage of angular clasts and enormous blocks of older formations, including the Brian Head, Isom and Leach Canyon formations, as well as other formations not included in the CEBR stratigraphy. Its history is poorly understood, but it appears to be the result of massive "gravity slides" of these structurally unstable formations, possibly as a result of the continuing uplift of the Markagunt Plateau. The result is a landscape with many house- to city-block-size fragments completely out of stratigraphic context. The Megabreccia slides were followed in the Pleistocene by various

icefield processes, possibly including small glaciers, which further rearranged rocks of the plateau top. Quaternary-age eolian deposits and landslides (such as the one that created Alpine Pond) then added to the modern landscape (Hatfield et al. 2000). A few small pockets of Markagunt Megabreccia occur in the central portion of CEBR above the rim and support forests of Subalpine fir – Engelmann spruce / gooseberry currant and Quaking aspen – subalpine fir / Tall Forbs as well as herbaceous stands dominated by Kentucky bluegrass, sulfur-flower buckwheat, or Rocky Mountain goldenrod (Figure 11).

Figure 10. Mixed herbaceous meadow with oneflower Helianthella blooming and subalpine fir – Engelmann spruce forest (dead stand) on the Brian Head Formation in CEBR.

Figure 11. Subalpine grassland and subalpine fir – Engelmann spruce / gooseberry currant forest on the Markagunt Megabreccia Formation in CEBR.

Subalpine plant communities established above the rim in CEBR form an open landscape of forests and meadows. Subalpine fir and Engelmann spruce trees dominate, although in the past two decades an estimated 80-90 percent of the mature Engelmann spruce trees have been killed by spruce bark beetles (*Dendroctonus rufipennis*). This appears to be the stand-replacing event that studies have shown occurs every 300 to 500 years in the process of forest succession (O'Dell 2005). Small stands of quaking aspen (often decadent), as well as Douglas-fir, limber pine, or bristlecone pine also occur on the plateau top. Understory species can include aspen bluebells (*Mertensia arizonica*) on mesic soils, and gooseberry currant, creeping barberry, common juniper, and Ross' sedge (*Carex rossii*) on dry sites. These forests are associated with rocky clay loams derived from weathered volcanics and limestones (Fertig 2009).

Subalpine meadows in CEBR often provide a tremendous display of wildflowers from late June to early August. Buchanan (1992) divides these meadows into "semi-moist" and "marshy" types and mentions that the division between the two can be quite distinct, a function of their different soils. Dry meadows are characterized by forbs such as the Markagunt penstemon (*Penstemon leiophyllus*), oneflower helianthella (*Helianthella uniflora*), elkweed (*Swertia radiata*), and giant red Indian paintbrush (*Castilleja miniata*) (Fertig 2009). Marshy meadows support brilliant displays of darkthroat shooting star (*Dodecatheon pulchellum*), Parry primrose (*Primula parryi*), monkshood (*Aconitum columbianum*), elephanthead lousewort (*Pedicularis groenlandica*) and fringed gentian (*Gentianopsis detonsa*) (Buchanan 1992).

Surficial Deposits (Pleistocene and Holocene, approximately one million years ago to present): Surficial deposits are common on the mesas and ridges, slopes, and along tributary drainages within CEBR. The processes of weathering, erosion, and sedimentation contribute to the formation of soil, new alluvium, talus, colluvium, and landslide deposits. Surficial deposits may be devoid of vegetation and delineated as rock slides, channel bottoms, barrens, or other unvegetated land cover mapping units.

Alluvial and colluvial fan deposits at the base of Red Claron slopes and along the heads of tributary drainages support woodlands or forests of blue spruce, white fir, subalpine fir, quaking aspen, ponderosa pine, and curl leaf mountain mahogany with understories of greenleaf manzanita, common juniper or creeping barberry. Sparse shrublands of Rocky Mountain maple (*Acer glabrum*) also occur here. Small landslide or talus deposits located above the rim support forests of subalpine fir – Engelmann spruce / current spp. (Figure 12a and b).

Small, narrow bands of wind-blown, aeolian deposists along the rim in the White Claron Formation support sparse whitestem goldenbush dwarf-shrublands and forblands of Panguitch buckwheat (Figure 12c).

Small alluvial deposits above the rim (including several small pockets of peat) support mesic meadows dominated by water sedge (*Carex aquatilis*), tufted hairgrass – American bistort, or Arizona willow (Figure 12d).

Below the rim, substantial Quaternary age alluvial terraces and colluvial slope deposits bury the Late Cretaceous strata along the Ashdown Creek tributary drainages. Older alluvial deposits support a variety of mixed conifer/quaking aspen forests of the Montane Forest Belt described by Buchanan (1992). White fir and blue spruce are characteristic of this belt, although quaking aspen stands are also common (Figure 12e). Understories include creeping barberry or common juniper in mesic areas, while more xeric areas trend toward understories of greenleaf manzanita, Rocky Mountain maple, or curl leaf mountain mahogany. Newer alluvial deposits occurring in small spring areas, on alluvial terraces and sloping banks along the bottom of Ashdown Gorge also support scattered numbers of narrow-leaved cottonwood (*Populus angustifolia*) trees with sparse or undeveloped understories (Figure 12f).

Figure 12. Ditch reedgrass (a) and gooseberry currant (b) on colluvial deposits. Aeolian deposits above the rim with Panguitch buckwheat (c) and alluvial (peat) deposits supporting water sedge herbaceous vegetation (d). Alluvial deposits in tributary drainages below the rim supporting blue spruce forests (e) and narrowleaf cottonwood woodlands (f).

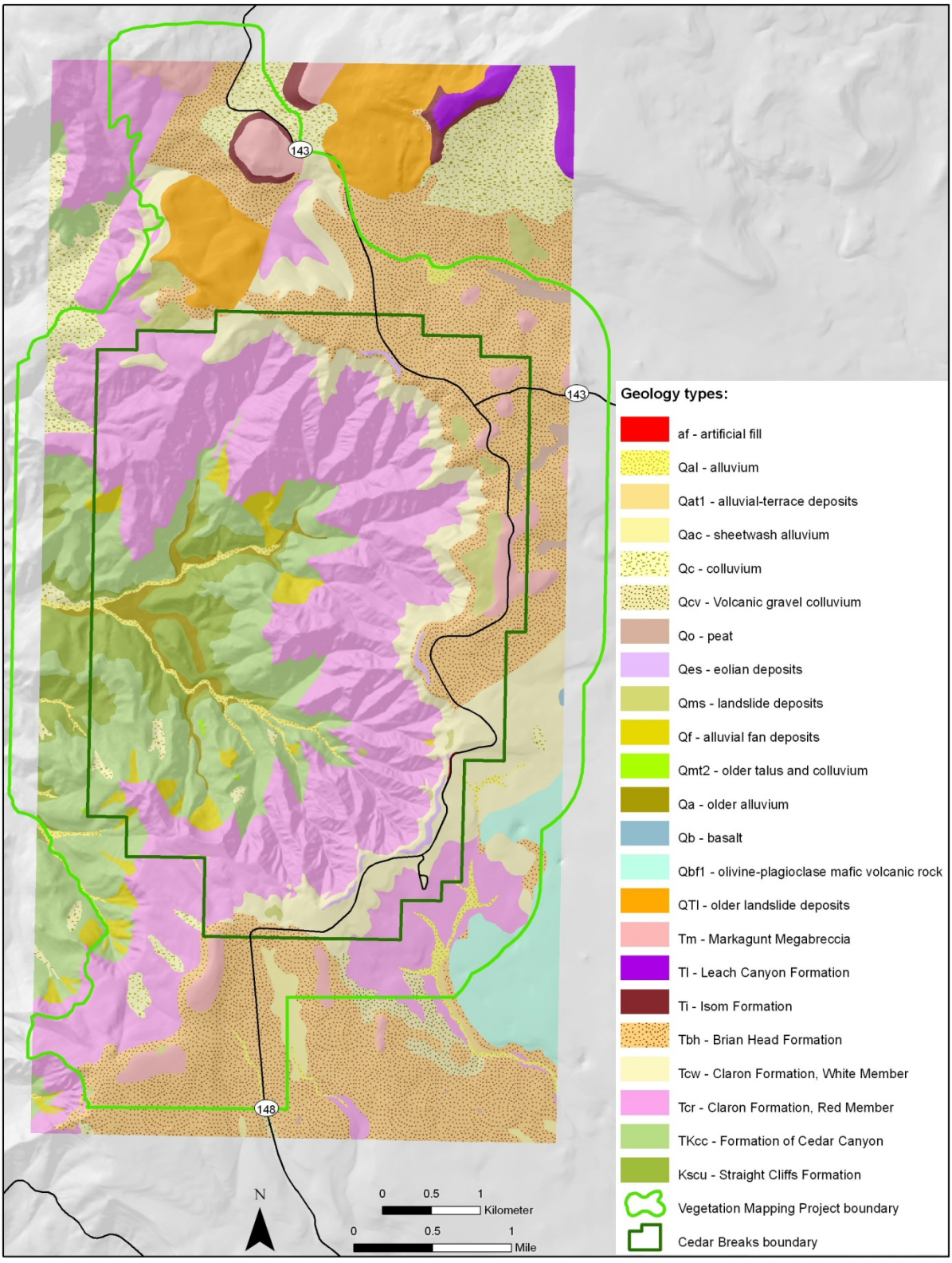

Figure 13. Geology map of CEBR and vicinity.

Soils

The following soils information is summarized from the USDA Forest Service (1996).

The most common and widespread soil map unit below the breaks in CEBR is the Studebaker - Rodell families - Rock outcrop complex, occurring on moderately steep to very steep rocky canyon sideslopes and formed in colluviums and residuum derived from sandstones. These soils are shallow and excessively drained with occasional outcrops of limestone bedrock and some exposures of soft shale.

The Claron breaks are represented by the Badland - Elve family - Rock outcrop complex soil map unit, occurring on steep or very steep barren areas of shale that are dissected by many intermittent drainages. Runoff is high and erosion is active. Shallow gullies and severe rills in the surface are common. These excessively-drained, moderately deep soils are residuum and colluvium derived from strongly-calcareous sandstones. Rock outcrop consists of barren or nearly barren exposures of interbedded limestone, sandstone and shale, and occurs mainly as nearly vertical cliffs and ledges.

Woodlands and forests above the rim are represented by a variety of soil map units; three of the most common are described herein. Areas closest to the rim and some forested slopes on the upper breaks are characterized by the Amesmont-Vandamore-Starman soil families complex, occurring on steep to very steep, southern and western sideslopes. Formed in residuum and colluvium derived from limestone, these soils are deep to very deep and well-drained. On undulating to rolling high elevation areas above the rim are pockets of the soil map unit Scandard, cool-Quazar, warm families complex, occurring on level to moderately steep slopes. Formed in residuum and colluvium derived from basalt, andesite, and tertiary volcanic rocks, these are very deep, well-drained soils. Gravels and cobbles cover 10-85% of the surface. In areas above the rim where the Claron rock formation extends are pockets of soil map unit Rogert-Rogert, dry families complex, occurring on level to moderately sloping sites. Formed in residuum derived from limestone, these are shallow and somewhat excessively-drained soils. Rock fragments (mostly gravels) cover 40 to 70 percent of the surface.

Unforested meadows above the rim are represented by two common soil map units. The first is the Wildcow-Venable families association, occurring on level to moderately sloping valleys and open, rolling slopes. Formed in alluvium and colluvium derived from basalt and tertiary volcanic rocks, these soils are very deep, and very poorly to very well-drained; the water table is at or near the surface for most of the year. The other common soil map unit is the Clayburn-Menbar families association, occurring on level to moderately steep slopes of valley bottoms and fans, and often occurring adjacent to perennial streams. Formed in mixed alluvium and residuum derived from calcareous limestone, these soils are very deep and are somewhat poorly drained to well-drained; a fluctuating groundwater table occurs below 0.5 meters (21 inches).

Hydrology and Water Resources

The heavy snowpacks and cool summer climate of the plateau-top areas of CEBR insure that melting snow provides a fairly dependable supply of soil moisture to the subalpine vegetation communities, particularly the meadow basins. However, standing water is limited on the Markagunt Plateau in CEBR, with the exception of the small Alpine Pond near the rim. Alpine Pond supports a small population of exotic brook trout (*Salvelinus fontinalis*) (O'Dell 2005).

The long spring snowmelt also helps maintain the many bedrock seeps and springs emerging in the Claron Formation below the rim. These springs are typically low in volume, and supply many of the minor drainage heads with localized flows. Bedrock seeps also contribute to cave and sinkhole formations in the limestone layers of the Claron Formation (Hatfield et al. 2000). Ashdown Creek is the only perennial stream in CEBR. Summer rainstorms, particularly local monsoonal thunderstorms, can quickly cause flash floods in the branches of Ashdown Creek, and the lower sections of the gorge undergo frequent summer high water events. Much of the water used to supply CEBR facilities is pumped from wells drawing from aquifers in the Claron, Wahweap/Grand Castle and Straight Cliffs formations (Thornberry-Ehrlich 2006).

Figure 14. Perennial flow in Ashdown Creek. The bare soil in the foreground, as well as the incised nature of the stream both illustrate the tendency to extreme flash floods.

Land Use and Settlement History

Excavations of ancient campsites have shown that Desert Archaic peoples visited the CEBR area as approximately 9,000 years ago, principally to collect chert from the lower slopes of Brian Head Peak. Chert was used for tool making, but archaeological evidence suggests that it was collected here primarily for trade (NPS 2009a). To Native Americans, the multi-colored badlands of CEBR were known as “the circle of painted cliffs,” or the “place where the rocks are sliding down all the time” (Evenden et al. 2002).

European visitation to the area began after the town of Parowan was established in 1851. The early settlers built a wagon road in Parowan Canyon in order to harvest timber, and the road was eventually extended south to the plateau top in the vicinity of the breaks (Hinton 2009). By 1868, demand for the resources available on the Markagunt Plateau was great enough that another settlement was established below what was then known as Monument Peak. The name of the peak was changed to Brian Head sometime after the settlement was established, and the town is

now known by that name. In its early days, Brian Head was a seasonal community, used by Parowan residents who logged and grazed cattle in the CEBR area during the summer (NPS 2009a). Buchanan (1992) reported that much of the Markagunt Plateau received a "high level of grazing pressure from domestic livestock for approximately 100 years," and the area within present-day CEBR would have experienced some of the earliest impacts from this grazing. Heavy use by both sheep and cattle continued on areas within CEBR until 1906, after which livestock numbers were greatly reduced. Some degree of grazing within the Monument boundaries continued even after it was established in 1933 (Skabelund 1965). Trespass grazing by sheep occasionally occurs and adjacent lands are still heavily grazed. Boundary fence maintenance is an ongoing challenge due to windthrow and other forms of toppling dead trees, as well as heavy snowpack (Robinson 2004).

Early settlers named the area Cedar Breaks after the abundance of juniper (locally known as "cedar") trees and the abrupt cliffs or breaks (Evenden et al. 2002). Recognition of Cedar Breaks as a scenic attraction began to grow after World War I, and by 1919 a movement had begun to transfer the breaks and the surrounding rim areas from the Dixie National Forest to the NPS. In the same year the first automobile was driven up the Parowan Canyon wagon road by S.A Halterman. By 1921 Mr. Halterman was shuttling visitors by automobile to the top of the breaks on a weekly basis (Hinton 2009). Around the same time Minnie Adams Burton built a tourist lodge known as "Minnie's Mansion" on land now inside the northern perimeter of the monument. Minnie's Mansion had a short life, but in its heyday it was famous for the July 24th Utah Pioneer Day celebrations held there (NPS 2009a). Dixie National Forest responded to the increasing tourist trade by building a rim road, campgrounds and toilet facilities (Hinton 2009).

Automobile access to the rim from the south became possible after the highway connecting Cedar City to Utah 89 in Long Valley was completed in 1923. A short spur road was built north to connect this highway to the developments along the rim. In the same year the Union Pacific Railroad completed a spur railroad from Lund, Utah, to Cedar City, with the intention creating a "loop tour" with stops at Cedar Breaks as well as Zion, Bryce Canyon and the north rim of the Grand Canyon. Utah Parks Company, a subsidiary of the railroad, was set up to provide bus transportation to and from the Cedar City railhead, and to provide hotel and restaurant support at each of the destinations. In 1924 the Utah Parks Company completed the Cedar Breaks Lodge and accompanying cabins near the rim (Hinton 2009). Utah Parks ran the Cedar Breaks Lodge until 1970, when ownership of all the UP lodges was transferred to the NPS. The Cedar Breaks Lodge was subsequently determined to be uneconomical to maintain and was demolished in 1972 (NPS 2009a).

Cedar Breaks National Monument was finally established under federal legislation in 1933. In 1937 the Civilian Conservation Corps sent a detail from Zion National Park to build the CEBR Visitor Center and Ranger Cabin, both of which are now on the national register of historic places (NPS 2009a). Park visitation began to increase substantially after World War II, and has consistently stayed at about 550,000 to 600,000 visitors annually for the past decade (NPS 2009b). Increased visitation has brought more impacts to the CEBR environment, although the inaccessibility of the slopes below the rim has limited anthropogenic disturbance in those areas. Campsites and parking areas are frequently full during the summer, increasing the incidence of off-trail hiking, off-road parking and driving, and out-of-bounds camping (O'Dell 2005). Park

visitation provides a significant vector for exotic plant introduction, especially along roadsides and trails. On the other hand, Buchanan (1992) observed that the exclusion of grazing from the monument's meadows since the 1930s resulted in a rejuvenation of the native meadow flora.

The death of large stands of Engelmann spruce during the recent spruce beetle epidemic has increased concerns about wildfire, visitor safety, and the potential for damage to structures from falling trees. Hazardous tree removal has accelerated in recent years, and a major fuels reduction project was conducted in 2003 on 40.5 ha (100 acres) of dead spruce trees. Approximately 5,000 standing dead trees totaling one million board-feet were removed from the park. No prescribed broadcast burning of forests or meadows has been conducted within the monument, although the brush piles from the fuels reduction project were burned (O'Dell 2005, Fields 2009).

CEBR may be affected by developments outside the boundary where commercial logging, hunting and grazing occur up to the monument boundary on both private and Forest Service lands, potentially impacting CEBR resources and in some cases visually impacting the scenic values of the monument. The naturalness of CEBR vistas has been degraded by the installation of a large FAA radar dome and a NOAA Nexrad radar dome on Blowhard Mountain and the expanding suburbs of Cedar City visible on the western horizon. (O'Dell 2005)

Previous Vegetation Studies

Fertig (2009) provides a detailed, comprehensive discussion and chronology of botanic studies and collections within CEBR, and the interested reader is referred there. The following section summarizes information from this source.

Botanic studies prior to the establishment of the monument are poorly documented, but began at least as early as the mid-1920s, and the earliest confirmed specimens in the CEBR herbarium were collected by Angus Woodbury in 1925 and 1926. At least two more collections were made in 1929, and in 1930 George Goodman and C. Leo Hitchcock collected a number of specimens for the New York Botanical Garden, including holotypes of *Draba subalpina* and *Eriogonum panguicense* var. *alpestre*. During the late 1930s, after the establishment of the monument, G.Y. Croft began collecting for the CEBR herbarium. Many prominent taxonomists also visited Cedar Breaks, including Ralph Gierisch, Alice Eastwood, and John T. Howell. Another 48 new species were added to the list of known species in CEBR in this period, bringing the total to more than 60 taxa. Collecting was less frequent in succeeding decades, with just 36 species added to the flora during the 1940s and another 45 in the 1950s. The 1960s and early 1970s saw the addition of just 16 new taxa.

Since 1977, a number of botanical surveys were completed. Hayle Buchanan and S. Dickman added 17 new species to the monument flora between 1977 and 1979, and added 120 collections to the herbarium. In 1981, Brent Palmer collected more than 220 specimens for the CEBR herbarium and documented 76 new taxa. Palmer's work resulted in an unpublished monument checklist containing 245 species. In 1988 and 1989, Cathie Jean added 49 new species to the Cedar Breaks flora during the course of her vegetation mapping project. In the last decade, Walt Fertig and D.N. Reynolds located at least 30 new taxa during a rare plant survey of CEBR, while other investigators added seven more. As of 2007, 345 taxa were confirmed or reliably reported for CEBR. None of the species documented for the park is federally listed as threatened or endangered, although 14 species have previously been candidates for federal listing, 8 species

are currently managed as sensitive by the USFS and BLM, and 17 species (5 percent of the total flora) are defined as locally endemic.

The Vegetation Mapping section of this report provides information regarding two previous attempts to map the vegetation of CEBR that were incorporated into this project. The vintage of these data and any additional metadata is unknown. The polygons were more general than current NPS standards and were only used as a guide for this project.

Exotic Plant Management

Of the 345 vascular plant species documented for CEBR, 18 species (5.2 percent) are non-native, but none are on the Utah noxious weed list. A survey of non-native plants was conducted in CEBR by a team from Zion National Park in 1997. A second survey was conducted in 2004 by Utah State University, under the direction of the NCPN. During the summer of 2004, approximately 21 percent of CEBR was surveyed, all above the rim of the breaks. Species of concern were absent in 96.8 percent of the areas inventoried, and only six exotic species were documented: smooth brome, cheatgrass (*Bromus tectorum*), lambsquarters (*Chenopodium album*), orchardgrass (*Dactylis glomerata*), timothy (*Phleum pratense*), and yellow salsify (*Tragopogon dubius*). With the exception of a few patches of cheat grass along the northern boundary of CEBR, all weed infestations were close to roadways. Of the approximately 17 ha (42 acres) of exotic plant species documented, smooth brome dominated roughly 16 ha (40 acres) or 94.3% of the total area. Smooth brome was originally introduced into CEBR for roadside revegetation, and has begun to spread into campsites and meadow edges (Dewey and Anderson 2005).

USU Weeds Survey Crew

Figure 15. The most common exotic plant species in CEBR is smooth brome (*Bromus inermis*).

Project Overview

General Approach and Timeline

The goals of this project were to inventory, describe, and map the existing vegetation at CEBR and its environs. The CEBR project is part of a larger effort undertaken by the NCPN to classify and map vegetation in all 16 network parks. In order to facilitate coordination among network mapping projects, the NCPN developed standardized databases, mapping conventions, reporting standards, and naming conventions.

The NCPN vegetation classification and mapping program was launched in July 2001 at a scoping meeting among network park staff, NCPN staff, and potential project cooperators. Following this meeting, the NCPN prepared a multi-year, multi-park project proposal to the USGS/NPS Vegetation Characterization Program to cost-share network I&M funding with the National Vegetation Characterization Program funding to complete vegetation maps for all network parks (Evenden 2001). A meeting to determine the CEBR project boundary and plot sampling needs, discuss photointerpretation approaches, and define additional park special data was held June 22-23, 2004. Table 2 is a timeline for the completion of major project components.

The NCPN negotiated interagency agreements with the USDA Aerial Photo Field Office and the USDI Bureau of Reclamation Remote Sensing and Geographic Information Group to acquire aerial photography for each park, including CEBR. Stereo aerial photography and orthophotography for CEBR were flown on June 26, 2002.

Table 2. Timeline for CEBR vegetation mapping project tasks.

TASK DESCRIPTION	2002	2003-2004	2005-2006	2007	2008	2009	2010-2011
Planning and Scoping		▬					
Acquire Aerial Imagery	▬						
Field Data Collection			▬				
Photo Interpretation				▬			
Vegetation Classification				▬		▬	
Local & Global Descriptions					▬	▬	▬
Field Key to Plant Associations				▬			▬
Accuracy Assessment					▬		
Final Report and Products							▬

Vegetation classification plot and observation point data for CEBR were collected by e²M and NCPN ecologists during July and August of 2006. Because of the park size and access limitations, field sampling strategy was not guided by a gradsect polygon or biophysical unit coverage, but was instead guided by an interview with CEBR staff, evaluation of the preliminary

vegetation map, unique aerial photograph signatures, geology/soils maps, slope, aspect, and by accessibility.

Vegetation plot data were entered into a MS Access database developed for the project and were analyzed during the fall of 2006 by ecologists contracted by e^2M; the analysis was reviewed by NatureServe ecologists. The final assignment of CEBR classification plots to plant associations of the National Vegetation Classification and the local and global plant association descriptions based on the classification were completed by NatureServe ecologists in 2007, with minor revisions through October 2010. An illustrated field key to CEBR plant associations was developed and tested prior to map accuracy assessment (AA) in 2007, and revised and finalized in 2010.

Aerial photointerpretation (PI) for the CEBR vegetation map was completed by the USGS PI staff between the spring and summer of 2007. Map units or classes were defined for the project by the primary photointerpreter with input from NCPN staff and an e²M ecologist. A combination of methods was used to delineate and interpret vegetation polygons for the mapping component of the CEBR project area. The spatial layer of vegetation physiognomy was developed through image analysis using ERDAS Imagine software. Rare vegetation classes were delineated through on-screen digitizing and attributed manually. Polygon attribution was completed by the primary photointerpreter, following standards developed by NCPN for all network park mapping projects (Evenden 2004). A guide to the map classes was drafted in May 2009, with final revisions made through the winter of 2010-2011.

The draft vegetation map and associated spatial database were completed for CEBR in early 2007. Accuracy assessment (AA) data collection was completed by NCPN and e^2M ecologists during the late summer of 2007. AA data were entered into the CEBR project database and then analyzed, with results tabulated into a contingency matrix. An AA meeting for CEBR was held December 4-5, 2007 at the NatureServe office in Boulder, Colorado with project cooperators from NPS, NatureServe, USGS, and e^2M to recommend which map classes should be retained and which could be combined because they failed to meet the 80% accuracy standard. A final AA meeting for CEBR was held February 28, 2008 in Cedar City, UT with project cooperators and CEBR staff to decide which map classes should be retained and which should be combined. Final revisions were made to the vegetation classification, field keys, vegetation map, and spatial database from fall 2010 to winter 2011. All geospatial products associated with this project are in the UTM projection, Zone 12, NAD83 datum.

Primary Partners and Project Roles

Many individuals working for several agencies and organizations were involved in completing the CEBR Vegetation Mapping Project. The roles of each contributor are described below.

engineering-environmental Management, Inc.

- *Jim Von Loh, Senior Biologist* – prepared project work plan, attended kick-off meeting, wrote draft association local descriptions, collected observation point data, advised PI staff, participated in AA meeting
- *Matthew Smith, Consulting Ecologist* – collected plot, observation point, and fuels data
- *Buddy Smith, Consulting Ecologist* – collected plot, observation point, and fuels data
- *Stephanie Shoemaker, Consulting Ecologist* – collected plot, observation point, fuels, and AA data

- *Karin Edwards, Consulting Ecologist* – collected plot, observation point, and fuels data
- *Peter Williams, Consulting Ecologist* – collected plot, observation point, fuels, and AA data

Colorado Natural Heritage Program

- *Karin Decker, Ecologist* – editor of the final report

National Park Service, Northern Colorado Plateau Network

- *Angie Evenden, Ph.D., Vegetation Program Manager* – set NCPN project standards, organized project meetings, managed budgets, agreements and contracts
- *Janet Coles, Vegetation Ecologist* – overall project coordination and management, managed field data collection, organized project meetings, managed budgets, agreements and contracts
- *Amy Tendick, Ecologist* – primary author of the final report, coordinated creation of final products, collected AA data, finalized vegetation map, edited final AA field key and map class guide, participated in both AA meetings
- *Margaret Beer, Data Manager* – project database development
- *Helen Thomas* – project database support, photo database development
- *Russ Den Bleyker* – project database support and QC
- *Liz Ballenger, Biological Technician* – led field crew training for plot, observation point, and fuels data collection, field crew leader for AA data collection, collected AA data
- *Bruce Condie, Sarah Topp, Biological Technicians* – collected AA data
- *Gery Wakefield, GIS Team Leader* – provided project boundary coverage, developed target accuracy assessment plots for field sampling using NVMP standards, generated final accuracy assessment contingency table
- *Aneth Wight, GIS Technician* – provided support to field sampling crews, produced geodatabase, provided plots database support, wrote final project metadata

National Park Service, Cedar Breaks National Monument

- *Steve Robinson, Senior Ranger* –participated in scoping meeting
- *Paul Roelandt, Superintendent*- participated in final AA decision-making meeting

U.S. Department of Agriculture Aerial Photo Field Office

- *Cindy Sessions, Contracting Officer* – procured aerial photography (9" x 9" stereo coverage)
- *Mark Cox, Photography Specialist* – provided QA/QC of photography, developed photo index

USDI Bureau of Reclamation Remote Sensing and Geographic Information Group

- *Alan Bell, Photography Specialist* – provided aerial photo contract specifications, subcontracted with Horizons, Inc. for aerial photography and production of color DOQQs for project area, provided QA/QC of orthoimagery

USGS Rocky Mountain Geographic Mapping Center

- *Tom Owens, Photography Specialist* – analyzed aerial photography, PI training, reviewed legacy data, attended kick-off meeting
- *Keith Landgraf, Photointerpreter and Image Processor* – conducted PI
- *Bev Friesen, Photointerpreter and Image Processor* – attended kick-off meeting, conducted PI, participated in AA meeting.
- *Steve Blauer, Photointerpreter and Image Processor* –conducted PI, participated in AA meeting.

NatureServe

- *Marion Reid, Senior Regional Ecologist* – project manager, reviewed classification, participated in AA meeting
- *Gwen Kittel, Regional Ecologist* – prepared preliminary classification, assigned final NVC names, wrote draft AA field key and draft local descriptions, wrote final global and local descriptions, participated in AA meeting, contributed to the final report
- *Mary Russo, Ecology Data Manager* – entered CEBR local and global descriptions into NatureServe's Biotics database, formatted descriptions, completed plant species crosswalk
- *Kristin Snow, Assistant Ecologist/Ecological Information Manager* – developed format for NCPN plant association local and global descriptions

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

- *Mike Story, NPS Program Leader* – provided national level program oversight
- *Karl Brown, Ph.D., Vegetation Mapping Program Leader* – provided national level program oversight, attended kick-off meeting
- *Tammy Hamer, Vegetation Mapping Program Biologist* – facilitated generation of final products

Aerial Photography

High-quality aerial photography of an appropriate scale is an important part of all USGS-NPS National Vegetation Mapping Program projects. Orthophotography provides a base image for mapping vegetation in a digital format and is the basis for interpreting vegetation patterns. Stereo photographs acquired vertically from the air, with adequate overlap, allow three-dimensional, high-resolution photointerpretation when viewed under a stereoscope (Avery 1978). At the beginning of the NCPN vegetation mapping program, network staff decided to acquire new stereo pair aerial photography, as well as orthorectified imagery at a 1:12,000 scale for eleven of the 16 network park units, including CEBR.

To maximize cost savings, the NCPN acquired aerial photography concurrently for several park units. In order to minimize shadow effects associated with canyon topography and maximize vegetative expression, the goal was to minimize the sun angle by flying as close as possible to noon on or near the summer solstice (June 21). True color aerial photography was chosen because it minimizes the effects of shadows in deep canyons. It was also determined that true color photography would best illustrate the vegetation patterns of the park units being mapped.

Stereoscopic Aerial Photo Coverage

NCPN contracted with Horizons, Inc. to acquire new 23 cm x 23 cm (9 in x 9 in) true color aerial photographs for CEBR. The imagery was acquired on June 26, 2002, by Blue Skies Consulting, LLC of Albuquerque, New Mexico. The photography was acquired at a nominal elevation of 6,000 ft (1,829 m) above ground level in a Cessna T210N aircraft. A Wild RC10 camera with 15.2 cm (6 in) lens was used with Kodak Aerocolor negative film. The target scale for this photography was 1:12,000 (1 in = 1,000 ft). The mission was designed with approximately 30% sidelap between flight lines and 60% overlap between photos. The project encompassed 245 linear km (152 miles) and 250 individual photos (Figure 16).

Figure 17 is an example of the 23 cm x 23 cm aerial stereo photographs for CEBR. These photographs were used for photo interpretation during the mapping phase of the project, and by field crews during classification plot and AA point data collection. The film negatives for this

aerial photo coverage are permanently stored at the APFO in Salt Lake City, Utah. The APFO made two sets of color prints. One set was distributed to CEBR; the other is retained at the NCPN offices in Moab, Utah.

Digital Orthophotos

The USBOR Remote Sensing and Geographic Information Group in Denver, Colorado, provided oversight for production of 1:12,000 scale digital orthophotography for CEBR from new imagery. This work was subcontracted to Horizons, Inc. of Rapid City, South Dakota. The photography was flown on June 27, 2002, at a mean above ground level elevation of 6,096 m (20,000 ft). Sidelap was approximately 40% and overlap about 60%. Airborne global positioning system (GPS) data were collected for each exposure. A Zeiss RMK 15/23 camera with a 15.2 cm (6 in) lens was used with AGFA100 film.

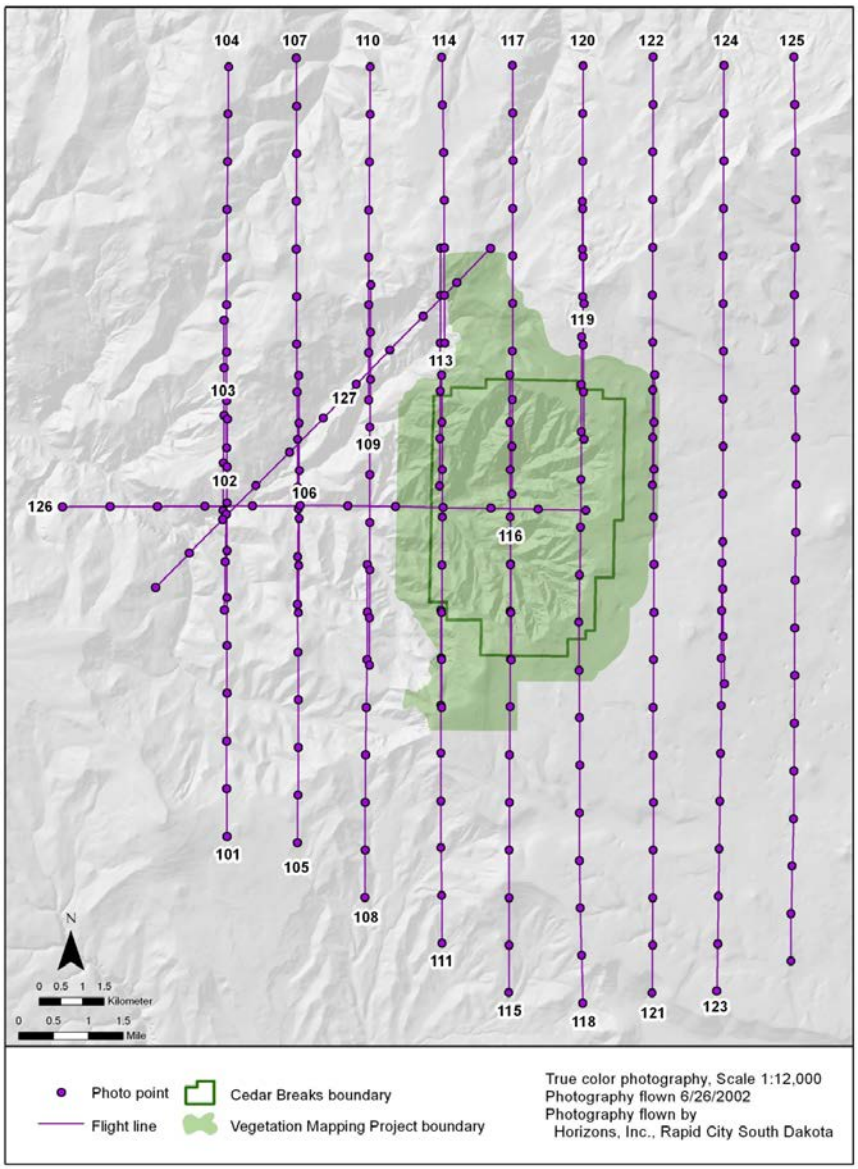

Figure 16. Flight lines for the 2002 stereo aerial photograph coverage of CEBR.

Figure 17. Example of a 9" x 9" stereo aerial photograph taken for the CEBR vegetation classification and mapping project.

The original film was scanned at 21 microns to create pixels of approximately 0.84 m. Horizons, Inc. created a photographic mosaic by extracting the high quality image from the center of each photograph and stitching them together digitally. The photographic mosaic was then magnified to the 1:12,000 scale and corrected through a computational process that warps and stretches the image between known control points. The orthorectification process removes distortion caused by tilting of the camera and scale variation of the terrain. Control points for the orthorectification

were obtained from USGS digital elevation model (DEM) 10 m data, aero triangulation data, and airborne GPS data. The X, Y, Z, omega, phi, and kappa for each photograph were calculated by Horizons, Inc. Final adjustments to the digital orthophoto database were solved using Erio Technologies ALBANY software. ALBANY is a simultaneous least squares bundle adjustment, which is designed for use with airborne GPS. Color adjustment of the final orthophoto coverage was achieved by visually matching the tone, contrast, and brightness to the original film. Each scanned image was checked for missing data.

The composite image covering the project area was inspected for tone balance and image distortion. In areas of image distortion, imagery from a slightly different angle on an adjacent photo was inserted where possible. The final orthophotos were visually inspected for accuracy and consistency. Some areas of the final orthophoto imagery remain blurred due to the extreme terrain and limitations of the USGS DEM data. Film negatives for CEBR 2002 color digital orthophotos are permanently archived in airtight containers at the USBOR RSGIG offices in Denver, Colorado.

Project Boundary and Map Extent

A project environs adding a band approximately 0.8 km (0.5 mile) wide outside the park boundary was chosen by network and CEBR staff at the June, 2004 scoping meeting for the east and west sides of the Monument (Figure 2). Steve Robinson, Senior Ranger at CEBR, requested that a larger area to the north of CEBR be included in the project boundary, as the Brian Head ski area was nearby with a continuous fuel bed from CEBR, and that it was downwind of the prevailing winds. A slightly larger environs area on the south was also chosen which included a continuous fuel bed from CEBR and the headwaters of Shooting Star Creek, a main tributary of Ashdown Creek.

The total project mapping area is 4,840 hectares (11,960 acres). Of this area, 2,481 ha (6,130 acres) are within the CEBR boundary and 2,630 ha (5,831 acres) are in the environs. The environs were delineated to provide data to support management coordination on adjacent private and USFS managed lands.

Minimum Mapping Unit

At the request of park staff, the photointerpreters agreed to map features as polygons to the extent that they could see them, including polygons smaller than the standard 0.5 ha (1.24 acre) minimum mapping unit (MMU).

Ecological System Classification

The NCPN used the ecological system (ES) classification structure developed by NatureServe (Comer et al. 2003, NatureServe 2003) as a framework for organizing and presenting plant community data. An ES is defined as a group of plant associations from two or more alliances that tend to co-exist in a given landscape due to similar ecologic processes, substrates, and/or environmental gradients. The ES classification was developed to provide larger scale classification units for application to resource management, mapping, and conservation. Current estimates are that Utah contain more than 80 ecological systems (NatureServe 2008). This approach complements the NVC; the finer-scale associations provide a basis for interpreting larger-scale ES patterns and concepts. A description of each of ecological system identified in CEBR appears in Appendix A.

The ecological system classification addresses natural landscapes. Land-use categories used to identify developed areas are described elsewhere in this report. Twenty-four ES units are known to occur within the CEBR vegetation mapping project area (in alphabetic order with NatureServe identifying codes):

- Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe (CES304.084)
- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
- Great Basin Semi-Desert Chaparral (CES304.001)
- Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)
- Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland (CES304.772)
- Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
- Inter-Mountain Basins Shale Badland (CES304.789)
- Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)
- Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
- Rocky Mountain Aspen Forest and Woodland (CES306.813)
- Rocky Mountain Alpine Turf (CES306.816)
- Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)
- Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
- Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)
- Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)
- Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)
- Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
- Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)
- Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)
- Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
- Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
- Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
- Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

Vegetation Classification and Description

Pre-Field Methods

Preliminary Classification List

NatureServe updated the preliminary list of plant associations and vegetation alliances for CEBR (prepared in 2002 during work plan preparation by e^2M) in 2004. Previous vegetation classification work, floristic information for CEBR, the monument's plant species list and expert local knowledge were used to refine the list, resulting in a preliminary list of plant associations for the vegetation mapping project area. This association list was a useful gauge for estimating and planning field work and for assigning provisional association names to vegetation classification plots and observation points.

Legacy Data Review

Existing vegetation data for CEBR were reviewed for possible use in the classification during work plan preparation. No previous studies of vegetation within CEBR were identified as useful to the classification effort. The vegetation classification presented in this report was derived from new field data collected specifically for the CEBR vegetation mapping project.

Field Methods

The primary purpose of classification plot data was to document the composition and structure of CEBR vegetation and associated environmental conditions. These data became the basis for classifying the vegetation at the park. Field methods used in gathering new data for this project followed national program standards (e.g., TNC and ESRI 1994a, 1994b). Data gathered during this project contributed to understanding vegetation relationships across broader landscapes beyond the boundaries of the park. The plot dataset was enhanced by collecting observation point data, whose primary purpose was to support photo interpretation.

In addition to the basic vegetation data collected at each plot, the NCPN and park staff defined fuels and summary data fields to meet needs of network managers. Plot forms and individual data field descriptions appear in Appendix B.

Field Sampling Approach

The sampling area included CEBR in its entirety (excluding the steep, dangerous, and highly erosive Claron formation cliffs and breaks), as well as USFS lands in the environs. Private lands in the environs as were not visited. Because the project area is relatively small and access reasonable for most areas except the breaks, no areas to be sampled were selected in advance of the 2005 field season. Parameters used to collect field data included an evaluation of the preliminary vegetation maps, unique aerial photograph signatures, geology/soils, slope, aspect, and accessibility.

Field crews were led by ecologists with experience sampling plant communities in national parks and other landscapes in the Colorado Plateau and vicinity. The list of 88 potential plant associations provided a starting point for naming communities sampled in the field. The sampling goal was to collect between three and five plots in every plant association encountered within the CEBR project area. However, some common associations were sampled more often to represent their range of variability, including among geologic substrates, and some rare types were sampled less often, as a result of difficulties encountering these types. An effort was made

to achieve good spatial distribution of classification plots across the landscape and to capture the full range of variation of each plant association. Field data were collected following USGS-NPS protocols during July and August of 2006. A total of 172 classification plots and 110 observation points were sampled.

Plot Data Collection

Field crews located classification plots subjectively within the community of interest in order to best represent the association being sampled. Ecotones (areas where two or more plant communities intermix) were avoided, or if sufficiently large were represented by observation point data to inform photointerpreters. Highly disturbed areas were also avoided unless they covered several hectares. Classification plots were generally located in stands exceeding the minimum mapping unit (MMU) of 0.5 hectares. A few classification plots were sampled in smaller patches of distinctive vegetation or communities of rare species. Plot size and shape requirements were consistent with National Vegetation Mapping Program guidelines (TNC and ESRI 1994a). Plot size was determined by the physiognomy of the community being sampled (Table 3). Plot shape was adjusted as needed to sample linear bands of vegetation in drainage bottoms. Plot size and shape were recorded for all plots.

Table 3. Plot sizes used for vegetation classification sampling at CEBR.

Vegetation Class	Area (m^2)	Length X Width (m)
Forest and Woodland	400	20 X 20
Shrubland	400	20 X 20, 40 X 10
Herbaceous	100	10 X 10

Within each classification plot, field staff estimated and recorded an array of vegetation and environmental data using the field forms in Appendix B and data definitions in Appendix C. Four categories of data were collected for vegetation plots (Table 5):

- location and plot identifiers
- environmental description
- vegetation description
- other information

Location and Plot Identifiers. CEBR staff requested that the vegetation classification plot locations not be permanently marked. The bounds of each plot were marked temporarily using measuring tapes. The Universal Transverse Mercator (UTM) coordinates at the center of each plot were recorded (Zone 12, NAD83) on Trimble or Garmin hand-held GPS receivers. Other data fields documenting the location of each plot are listed in Table 4 and are described in detail in Appendix C. Locations were recorded on topographic maps or digital orthophotography during each field trip to avoid duplication of effort and ensure that the park was adequately sampled.

Environmental Description. The physical characteristics of each classification plot were documented in both categorical and narrative fields (Table 4; Appendix B). These characteristics included physical site features (elevation, slope, aspect, topography), hydrology, geology, and soils. Ground surface characterization included estimates of the cover of rocks, sand, litter, bare soil, biological soil crust, moss, and lichen. A narrative field was provided for a general description of the plot setting and the influence of physical factors on the vegetation.

Table 4. General plot data categories and specific data components collected at each vegetation classification plot.

Plot Data Category	Data Components
Location and Plot Identifiers	Plot code, park name, site name, state, county, quad name, quad code, GPS unit, GPS file ID, UTM coordinates, UTM zone, GPS error, 3D differential, survey date, surveyor names, directions to plot, plot dimensions, photograph documentation
Environmental Description	Elevation, slope, aspect, topographic position, landform, geology, Cowardin wetland type, hydrologic regime, ground cover, soil texture, soil drainage, evidence of disturbance and animal use
Vegetation Description	Height and cover of all strata, cover by species, physiognomic type, provisional association name, plot representativeness
Other Information	Narrative description of the setting of the plot; describes adjacent communities, note unusual ecological processes, continue descriptions from other narrative fields

Vegetation Description. Every vascular plant species in each plot was assigned to one of 14 physiognomic strata (Appendix B). Within each stratum, the investigator recorded average height and percent canopy cover for all species using the scales in Table 5. Consistent and repeatable cover estimates were obtained by relating the area occupied by an individual species to the area of the entire classification plot. When it was not possible to identify a species in the field, plant material was collected and pressed for later identification. All plant material collected for identification was destroyed in analysis. Provisional plant association names were assigned to each plot using the preliminary association list and professional judgment.

Table 5. Vegetation cover and height classes used in the CEBR vegetation mapping project.

Species and Strata Canopy Cover Classes				Strata Height Classes	
Code	*Range*	*Code*	*Range*	*Code*	*Range*
(t)	few	6	>55-65%	01	<0.5 m
T	0-1%	7	>65-75%	02	0.5-1 m
P	1-5%	8	>75-85%	03	>1-2 m
1-a	5-10%	9	>85-95%	04	>2-5 m
1-b	10-15%	10	>95%	05	>5-10 m
2	15-25%			06	>10-15 m
3	25-35%			07	>15-20 m
4	35-45%			08	>20-35 m
5-a	>45-50%			09	>35-50 m
5-b	50-55%			10	> 50 m

Other Information**.** Field crews were encouraged to record general observations on how well the classification plot represented the stand, the relationship of site conditions to vegetative patterns, characteristics of adjacent vegetation, and site disturbance history. The overall character of the vegetation and features of each classification plot were recorded in at least two 35 mm color slide photographs.

Data Processing and Analysis

One hundred seventy-two vegetation classification plots were sampled within the mapping project area during the 2006 field season (Figure 18). Plot data were manually entered into the CEBR Vegetation Mapping Project Database, developed by the NCPN data management staff and e^2M database designer. This MS Access database is compatible with the data standards of the PLOTS Database System developed for the USGS-NPS Vegetation Mapping Program by TNC (1997). The NCPN database offers greater flexibility in overall data management than does the NatureServe PLOTS database, and is designed to accommodate all project field data recorded in plots, observation points, and accuracy assessment points. Data standards were established by NCPN for all vegetation mapping projects, allowing compatibility of data across network park units. Fields associated with the CEBR plots database are described in Appendix C.

Each 35 mm slide associated with the project was scanned into a digital format. The 809 digital images of plots, observation points, accuracy assessment points and scenery were stored in a photograph database. A unique identifier allows each photograph to be linked with the plots and spatial databases.

Observation Points

In addition to classification plots, field crews collected vegetation and environmental data at 110 observation points within CEBR. Vegetation information was recorded only for the most abundant species present at each sampling location. Observation points varied in size, but usually approximated the minimum mapping unit (MMU) of 0.5 hectares and the data collected at observation points reflected the vegetation of a loosely defined area around the point (the "stand") rather than a measured plot (Appendix B). Overall conditions at each observation point were documented by one or more 35mm color slide photographs. These data were intended primarily to support modeling and photo-interpretation of the aerial imagery for mapping, but were also used to help describe plant associations. Field crews could choose to sample an observation point instead of a full classification plot when:

- they were sampling the environs outside the park boundary
- the vegetation was highly disturbed, ecotonal, or otherwise anomalous and therefore unlikely to be classified under the NVC
- vegetation occupied inaccessible areas where the plant community could only be viewed from a distance
- project photointerpreters requested documentation of a specific photo signature or area
- they wished to document special features as requested by CEBR staff such as fuels concentrations or weed patches
- they wanted to document a vegetation type that consistently occurred in stands smaller than 0.5 ha (1.24 acres).

A thorough quality assessment and quality check (QA/QC) was performed on all classification plot and observation point data following entry to the MS Access database. Individual plot data records were reviewed with the individual field data sheets in hand. Additional QA/QC was performed using a set of queries designed to identify inconsistencies across data fields and check for missing data. NCPN technicians standardized the scientific names in the database and noted name changes on the field forms. The primary authority used for plant names for the CEBR vegetation mapping project and all other NCPN I&M projects is *A Utah Flora* (Welsh et al. 2003). It is important to note that NatureServe, a primary project partner, follows Kartesz (1999) as its primary nomenclatural authority. As a result, nomenclature used in the body of this report follows Kartesz (1999), whereas nomenclature in the project database follows Welsh et al. (2003). Differences between the two nomenclatural authorities are reconciled in a crosswalk table (Appendix D).

Following completion of QA/QC procedures, the database was made available to e^2M and NatureServe ecologists for vegetation classification analysis. Slide labels were printed from the database. A GIS data layer (point data) was developed to document classification plot locations.

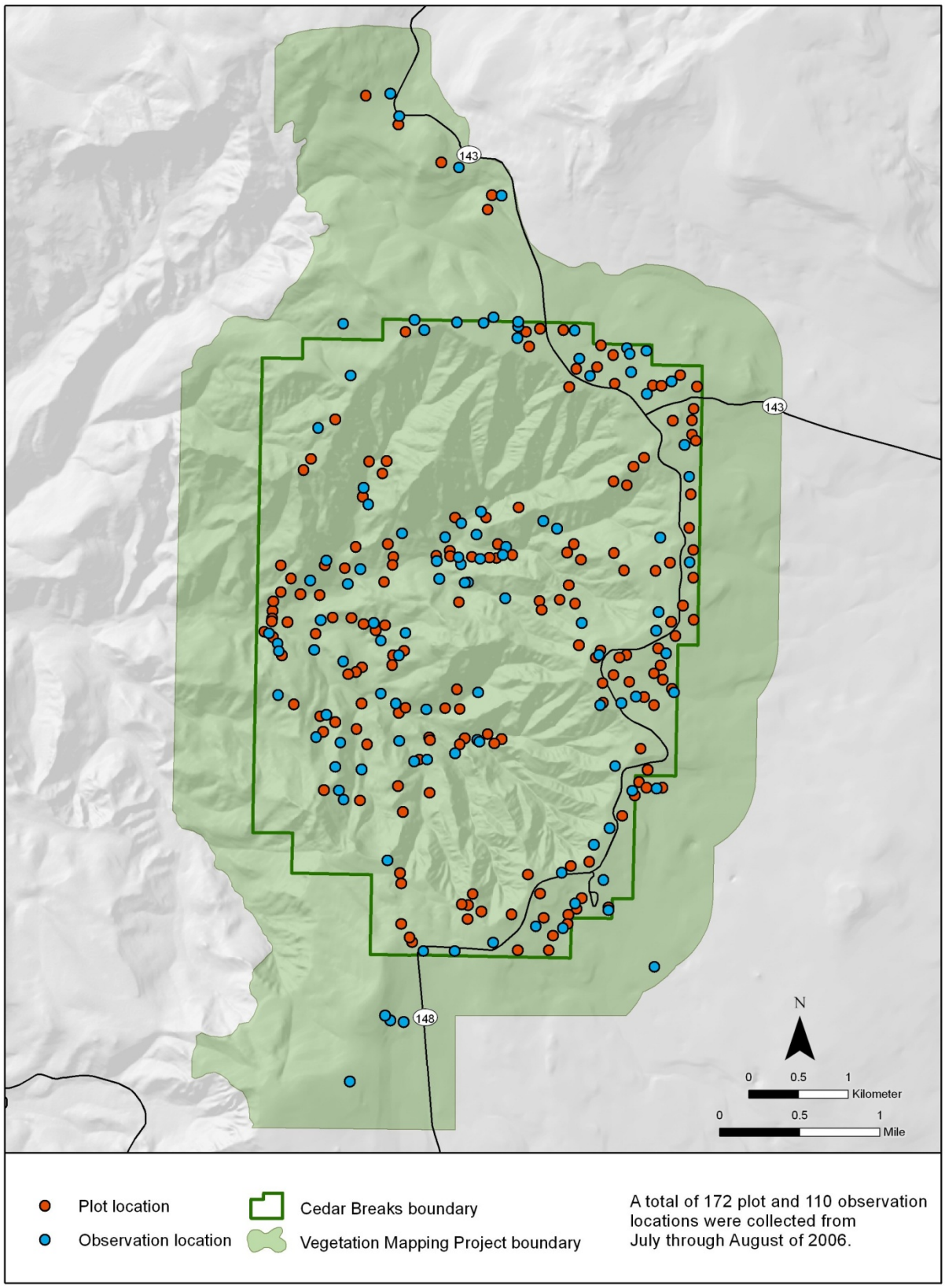

Figure 18. Vegetation plot and observation point locations in the CEBR mapping project area.

Classification Data Analysis

Vegetation classification was accomplished through a multivariate analysis of vegetation plot data augmented by observation point data. Species cover data were exported in list format from the MS Access database, and imported into PC-ORD (McCune and Mefford, 1999). Midpoints of canopy cover classes were used in all data analysis procedures. Exploratory multivariate statistical analyses (summary statistics, outlier analysis, ordination, cluster analysis and indicator species analysis) were used with the objectives of summarizing the compositional and structural characteristics of the plant communities and assessing possible spatial patterns related to environmental gradients.

Data from CEBR and BRCA were combined into one data set for the purposes of efficiency and because ecologists surmised that some plant communities would be shared between the two parks. The combined data set of 579 classification plots and 558 species was first evaluated to find outliers, which can potentially distort the matrix. Outlier analysis revealed very few outliers in the CEBR and BRCA data. As is often the case in heterogeneous ecological datasets, outliers often represent uncommon and therefore undersampled vegetation types. The outliers were retained in subsequent analyses. An initial cluster analysis (McCune and Mefford 1999) suggested 15-18 potential groups, using the "25% information remaining" point as an arbitrary cut point. To explore whether these 16 groups represented real ecological units, analysts conducted an Indicator Species Analysis (ISA, Dufrêne and Legendre 1997, as cited in McCune and Grace 2002) on the dataset divided into 2 to 64 groups, as sorted by the cluster analysis. One object of ISA is to find the number of groups that maximizes the number of significant indicator species, that is, species that have high fidelity and abundance to a single group, while minimizing the p value (the likelihood that species would be found in other groups). This analysis was initially performed on BRCA data alone.

Cluster analysis and ISA were conducted on the combined data from BRCA and CEBR. As with the BRCA data, multiple ISA showed the lowest average p-value and the greatest number of significant species to occur with 15 groups. Most of these groups were retained for further analysis. One group was large and heterogeneous with no significant indicator species. This group was divided into *a priori* groups based on present ecological understanding and position in the initial cluster analysis (as per McCune and Grace 2002) and the ISA repeated on all groups. This second Indicator Species Analysis confirmed all groups to have significant indicator species. Detrended Correspondence Analysis (DCA, Hill and Gauch 1980) was also conducted. An overlay of ISA group membership on a graph of DCA values for axis 1 and axis 2 also illustrates the ecological space occupied by the 16 groups (Figure 19). Groups were further inspected for NVC Group, Alliance and Association level memberships.

Each of the sixteen groups was subjected to additional cluster analyses, ordinations and tabular analysis (Mueller-Dombois and Ellenberg 1974) to determine whether they could be further subdivided. Analyses were repeated on subsets of each group until the smallest units remaining corresponded approximately to NVC associations or alliances.

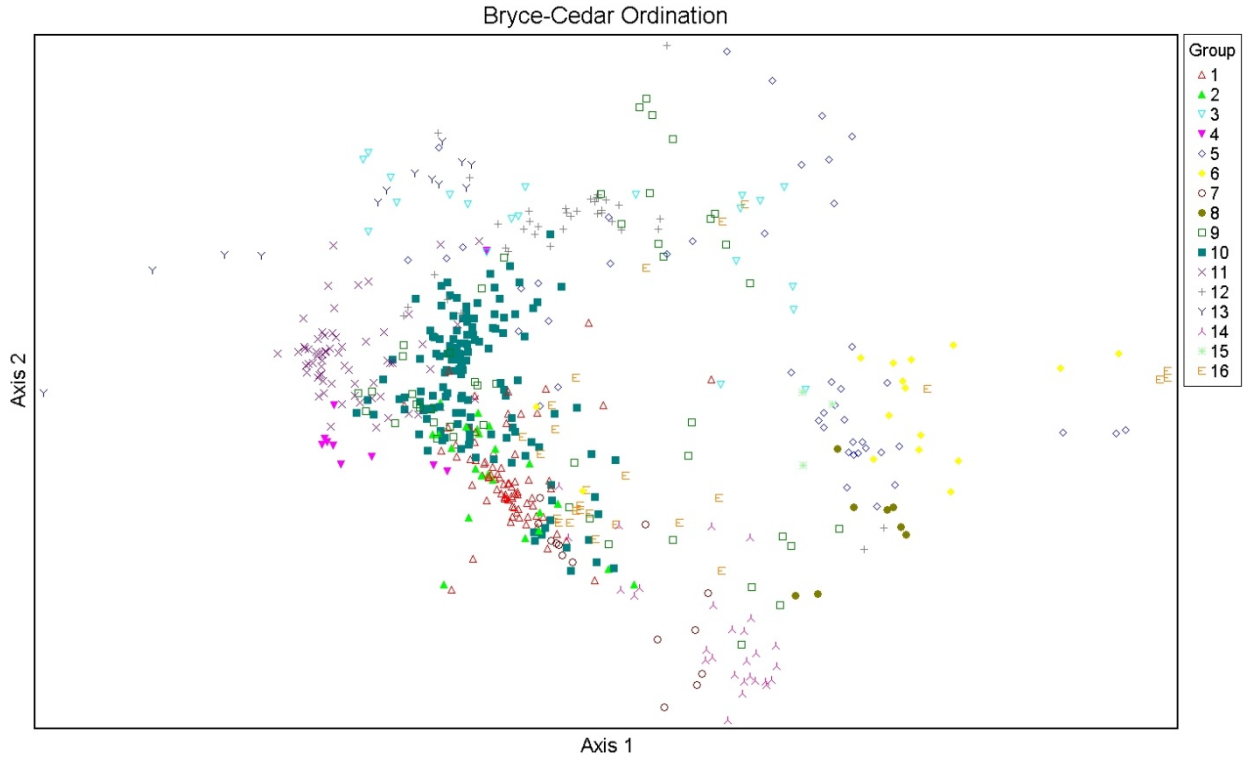

Figure 19. Ordination of the entire 580 plots from BRCA and CEBR.

Axis 1 is closely aligned with a moisture gradient increasing from left to right, and Axis 2 corresponds to soil nutrient levels, increasing from top to bottom. Note that stands dominated by *Salix arizonica*, a wetland species, occupy the furthest right hand plots in group # 16, and *Atriplex canescens*, a drought and salt tolerant shrub, dominates the stands on the far left, in group 13. Quaking aspen (open circles) and spruce-fir woodlands (inverted Ys) (groups 7 and 14, respectively) occupy the lower center of the graph, and shrublands of dwarf black sage (+), rabbit brush (open squares) and saltbush scrub (inverted open blue triangles) occupy upper center portion of the graph. Ponderosa pine and white fir woodlands occur in the center (green closed squares and open red triangles), with pinyon-juniper woodlands to the left (burgundy Xs) in drier habitats, and Gambel oak shrublands (closed inverted pink triangles) just below that, on better soils.

Because the CEBR plots are intended to fit into an existing national classification instead of a stand-alone, site-specific classification, the analysis techniques described above were used in combination with our ecological experience and the plot environmental data to assign plots to preliminary associations. Some of the more difficult groups, including mixed white-fir and Great Basin bristlecone pine woodland plant communities, were compared with plots from other NCPN units. The association assignment for each classification plot was made on the basis of multiple factors, not merely on its position in a cluster analysis or ordination.

The preliminary classification was reviewed by NCPN, CEBR, and NatureServe ecologists. Each plot association assignment was examined and adjustments were made when necessary to ensure consistency with NVC concepts. NatureServe was also responsible for deciding whether to add new associations to the NVC or assign unusual types to a “Park Special” category.

Classification Results

The draft classification for CEBR was issued by NatureServe in the spring of 2007, and underwent several revisions prior to release of the final classification in October 2010. Following AA data collection in 2007, vegetation types not previously recognized from CEBR were analyzed for possible inclusion in the classification. Nineteen plant associations discovered during AA were added to the CEBR final classification. Revisions included amending the classification to include new associations identified during the AA phase, amending local descriptions based on finding a rare plant association to be much more common during the AA phase, and updating assignments of plant associations to ecological systems.

The vegetation of the CEBR mapping project area is classified into 71 community types (Table 6). Of these, 41 are described at the plant association level, four are described at the vegetation alliance level, and 26 are described as 'park specials' because they are described from only one or two plots, are known only from CEBR, and have no known literature references describing the same or closely related types. Park specials are not assigned to NVC plant associations or vegetation alliances. Sixteen plant associations are documented exclusively from data gathered during the AA (Appendix E). When comparing the vegetation between BRCA and CEBR, whose classification analyses were prepared jointly, and accounting for the differences in diversity in each unit, BRCA had 22% (28/126) overlap with CEBR vegetation, and CEBR had 38% overlap (28/74) with BRCA vegetation. Although similar geology and close proximity give rise to similar vegetation in the two units, BRCA covers a much larger area with a greater diversity of habitats, and CEBR includes elevations much higher than those of BRCA.

The vegetation of the CEBR mapping project area is moderately diverse, including 30 NVC alliances and 24 ecological systems. Nine of the plant communities are shrubland types (five riparian), 41 are forest or woodland types (four riparian), and 21 are herbaceous vegetation types (fifteen wetland). Quaking aspen and blue spruce forest types are the most frequent vegetation associations, accounting for 10 and 7 associations, respectively, although two subalpine fir and Engelmann spruce associations accounted for most of the forested acreage in the monument. Each plant association, vegetation alliance, or park special is represented by from one to 34 plot samples (Appendix E). Vegetation types represented by a single plot may have been rare in CEBR, or were simply undersampled as a result of difficult access. Many of the vegetation types that appeared to be rare after the initial sampling were found to be more common during AA.

Subalpine fir and Engelmann spruce forests are the most abundant forests within CEBR. Ponderosa pine and mixed white fir woodlands are common at lower elevations, and Great Basin bristlecone pine mixed woodlands occur on breaks of the Claron Formation. Dry grasslands, wildflower dotted mesic meadows and western prickly gooseberry shrublands occur interspersed on the plateau top between the spruce-fir forests and aspen stands.

Table 6. Classified plant associations for the CEBR vegetation mapping project area, arranged by ecological system within each physiognomic group*.

NVCS Association	Common Name	Code
UPLAND ASSOCATIONS		
UPLAND FORESTS		
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)		
Abies concolor – Populus tremuloides Forest Alliance	White Fir – Quaking Aspen Forest Alliance	A.419
Populus tremuloides - Abies concolor / Arctostaphylos patula Forest	Quaking Aspen – White Fir / Greenleaf Manzanita Forest	CEGL000522
Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest	Quaking Aspen – White Fir / Mountain Snowberry Forest	CEGL000523
Populus tremuloides - Abies lasiocarpa / Tall Forbs Forest	Quaking Aspen – Subalpine Fir / Tall Forbs Forest	CEGL000533
Populus tremuloides – Pseudotsuga menziesii / Juniperus communis Forest	Quaking Aspen – Douglas-fir / Common Juniper Forest	CEGL000545
Populus tremuloides - Pseudotsuga menziesii / Sparse Understory Forest	Quaking Aspen – Douglas-fir / Sparse Understory Forest	Park Special
Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	Quaking Aspen – Douglas-fir / Mountain Snowberry Forest	CEGL000546
Rocky Mountain Aspen Forest and Woodland (CES306.813)		
Populus tremuloides / Juniperus communis Forest	Quaking Aspen / Common Juniper Forest	CEGL000587
Populus tremuloides / Ribes montigenum Forest	Quaking Aspen / Gooseberry Currant Forest	CEGL000600
Populus tremuloides / Thalictrum fendleri Forest	Quaking Aspen / Fendler Meadow-rue Forest	CEGL000619
Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)		
Abies lasiocarpa - Picea engelmannii / Ligusticum porteri Forest	Subalpine Fir – Engelmann Spruce / Porter's Licorice-root Forest	Park Special
Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme) Forest	Subalpine Fir – Engelmann Spruce / (Gooseberry Currant, Prickly Currant, Whitestem Gooseberry) Forest	CEGL000331
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)		
Abies concolor - Pseudotsuga menziesii / Acer glabrum Forest	White Fir – Douglas-fir / Rocky Mountain Maple Forest	CEGL000240
Abies concolor / Arctostaphylos patula Forest	White Fir / Greenleaf Manzanita Forest	CEGL000242
Abies concolor / Juniperus communis Forest	White Fir / Common Juniper Forest	CEGL000249

Table 6. Classified plant associations for the CEBR vegetation mapping project area, arranged by ecological system within each physiognomic group*.

NVCS Association	Common Name	Code
Abies concolor / Mahonia repens Forest	White Fir / Creeping Oregon-grape Forest	CEGL000251
Abies concolor / Symphoricarpos oreophilus Forest	White Fir / Mountain Snowberry Forest	CEGL000263
Picea pungens / Arctostaphylos patula Forest	Blue Spruce / Greenleaf Manzanita Forest	CEGL005364
Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula Colorado Plateau Woodland	Ponderosa Pine - Douglas-fir / Greenleaf Manzanita Colorado Plateau Woodland	Park Special
Pseudotsuga menziesii / Arctostaphylos patula Woodland	Douglas-fir / Greenleaf Manzanita Woodland	CEGL000423
Pseudotsuga menziesii / Juniperus communis Woodland	Douglas-fir / Common Juniper Forest	CEGL000439
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)		
Picea pungens / Acer glabrum Forest	Blue Spruce / Rocky Mountain Maple Forest	Park Special
Picea pungens / Juniperus communis Forest	Blue Spruce / Common Juniper Forest	CEGL000392
Picea pungens / Mahonia repens Forest	Blue Spruce / Creeping Oregon-grape Forest	CEGL000395
Picea pungens / Purshia tridentata Forest	Blue Spruce / Bitterbrush Forest	Park Special
Pseudotsuga menziesii / Ribes montigenum Forest	Douglas-fir / Gooseberry Currant Forest	Park Special
UPLAND WOODLANDS		
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)		
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland	Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland	CEGL002940
Pinus edulis – Juniperus spp. / Cercocarpus montanus – Mixed Shrub Woodland	Two-needle Pinyon – Juniper Species / Alderleaf Mountain-mahogany Mixed Shrub Woodland	CEGL000780
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland (CES304.772)		
Cercocarpus ledifolius / Arctostaphylos patula Woodland	Curl-leaf Mountain-mahogany / Greenleaf Manzanita Woodland	CEGL005355
Cercocarpus ledifolius / Chrysothamnus nauseosus Woodland	Curl-leaf Mountain-mahogany / Rubber Rabbitbrush Woodland	Park Special
Cercocarpus ledifolius Woodland Alliance	Curl-leaf Mountain-mahogany Woodland Alliance	A.586
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)		
Pinus longaeva Woodland	Intermountain Bristlecone Pine Woodland	CEGL002380
Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)		

Table 6. Classified plant associations for the CEBR vegetation mapping project area, arranged by ecological system within each physiognomic group*.

NVCS Association	Common Name	Code
Juniperus scopulorum - Cercocarpus ledifolius Woodland	Rocky Mountain Juniper – Curl-leaf Mountain-mahogany Woodland	CEGL000744
Rocky Mountain Subalpine Dry- Mesic Spruce-Fir Forest and Woodland (CES306.828)		
Abies lasiocarpa - Picea engelmannii / Juniperus communis Woodland	Subalpine Fir – Engelmann Spruce / Common Juniper Woodland	CEGL000919
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)		
Pinus ponderosa / Arctostaphylos patula Woodland	Ponderosa Pine / Greenleaf Manzanita Woodland	CEGL000842
Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland	Ponderosa Pine / Curl-leaf Mountain-mahogany / Greenleaf Manzanita Woodland	Park Special
Pinus ponderosa / Purshia tridentata Woodland	Ponderosa Pine / Bitterbrush Woodland	CEGL000867
UPLAND SHRUBLANDS		
Great Basin Semi-Desert Chaparral (CES304.001)		
Arctostaphylos patula Shrubland	Greenleaf Manzanita Shrubland	CEGL002696
Rocky Mountain Alpine Turf (CES306.816)		
Ribes montigenum Shrubland	Gooseberry Currant Shrubland	CEGL001133
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)		
Ericameria discoidea Dwarf-shrubland Herbaceous Sparse Vegetation	Whitestem Goldenbush Dwarf-shrubland Herbaceous Sparse Vegetation	Park Special
Symphoricarpos oreophilus Shrubland	Mountain Snowberry Shrubland	CEGL002951
UPLAND GRASSLANDS		
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)		
Achnatherum lettermanii Herbaceous Vegetation	Letterman Needlegrass Herbaceous Vegetation	CEGL005354
Inter-Mountain Basins Shale Badland (CES304.789)		
Eriogonum panguicense Herbaceous Vegetation	Panguitch Buckwheat Herbaceous Vegetation	Park Special
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)		
Bromus inermis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	Smooth Brome - (Western Wheatgrass) Semi-natural Herbaceous Vegetation	CEGL005264
Elymus trachycaulus Herbaceous Vegetation	Slender Wheatgrass Herbaceous Vegetation	Park Special

Table 6. Classified plant associations for the CEBR vegetation mapping project area, arranged by ecological system within each physiognomic group*.

NVCS Association	Common Name	Code
Poa pratensis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	Kentucky Bluegrass – (Western Wheatgrass) Semi-natural Herbaceous Vegetation	CEGL005265
Poa secunda Herbaceous Vegetation	Curly Bluegrass Herbaceous Vegetation	CEGL001657
RIPARIAN, WETLAND AND MESIC ASSOCIATIONS		
RIPARIAN AND WETLAND WOODLANDS AND SHRUBLANDS		
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)		
Populus angustifolia - Picea pungens / Acer glabrum Woodland	Narrowleaf Cottonwood – Blue Spruce / Rocky Mountain Woodland	Park Special
Populus angustifolia Temporarily Flooded Terrace Woodland	Narrowleaf Cottonwood Temporarily Flooded Terrace Woodland	Park Special
Salix exigua Temporarily Flooded Shrubland	Coyote Willow Temporarily Flooded Shrubland	CEGL001197
Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)		
Picea pungens / Equisetum arvense Woodland	Blue Spruce / Field Horsetail Woodland	CEGL000389
Picea pungens / Salix brachycarpa Woodland	Blue Spruce / Shortfruit Willow Woodland	Park Special
RIPARIAN AND WETLAND SHRUBLANDS		
Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe (CES304.084)		
Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa pratensis Semi-natural Shrubland	Silver Sagebrush / Kentucky Bluegrass Semi-natural Shrubland	CEGL002988
Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)		
Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa Shrubland	Shrubby-cinquefoil / Tufted Hairgrass Shrubland	CEGL001107
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)		
Acer glabrum Colluvial Slope Shrubland	Rocky Mountain Maple Colluvial Slope Shrubland	Park Special
Salix arizonica Shrubland	Arizona Willow Shrubland	Park Special
RIPARIAN AND WETLAND HERBACEOUS COMMUNITIES		
Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)		
Carex aquatilis Herbaceous Vegetation	Water Sedge Herbaceous Vegetation	CEGL001802

Table 6. Classified plant associations for the CEBR vegetation mapping project area, arranged by ecological system within each physiognomic group*.

NVCS Association	Common Name	Code
Carex scirpoidea Seasonally Flooded Herbaceous Vegetation	Canadian Single-spike Sedge	Park Special
Deschampsia caespitosa - Polygonum bistortoides Herbaceous Vegetation	Tufted Hairgrass – American Bistort Herbaceous Vegetation	CEGL003485
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)		
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Vegetation	CEGL003081
Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)		
Aster adscendens Herbaceous Vegetation	Western Aster Herbaceous Vegetation	Park Special
Calamagrostis scopulorum Herbaceous Vegetation	Jones Reedgrass Herbaceous Vegetation	Park Special
Carex egglestonii Herbaceous Vegetation	Eggleston Sedge Herbaceous Vegetation	Park Special
Erigeron ursinus Herbaceous Vegetation	Bear Daisy Herbaceous Vegetation	Park Special
Eriogonum umbellatum - Potentilla hippiana Herbaceous Vegetation	Sulfur Buckwheat – Woolly Cinquefoil Herbaceous Vegetation	Park Special
Helianthella uniflora Herbaceous Vegetation	Oneflower Helianthella Herbaceous Vegetation	Park Special
Ligusticum porteri Herbaceous Alliance	Porter's Licorice-root Herbaceous Alliance	A.1601
Lomatium minimum - Arenaria fendleri Herbaceous Vegetation	Little Desert Parsley – Fendler Sandwort Herbaceous Vegetation	Park Special
Lupinus argenteus Herbaceous Alliance	Silvery Lupine Herbaceous Alliance	A.1605
Solidago multiradiata Herbaceous Vegetation	Rocky Mountain Goldenrod Herbaceous Vegetation	Park Special
Viguiera multiflora Herbaceous Vegetation	Showy Goldeneye	Park Special

* Plant associations as determined from the vegetation plot, observation point, and accuracy assessment point data. Associations are ordered by physiognomy and grouped by ES. Identification codes are provided for plant associations and ecological systems. Because ES units are not constrained by physiognomy, they may appear more than once in the table.

† NatureServe assigns CEGL codes to track NVC associations within their databases. Park Specials are not part of the NVC and therefore do not have a CEGL code.

‡ The NatureServe codes following each Ecological System unit name provide a means of tracking the evolution of the concept in NatureServe's Biotics Tracking Database.

Plant Community Descriptions

This section provides a summary of CEBR vegetation by physiognomic group. Appendix F provides detailed local and global descriptions of the 71 plant associations, vegetation alliances and park special vegetation types within CEBR. Local descriptions are based on classification plot and observation point data from CEBR and environs. Global descriptions characterize the plant association across its range and are based primarily on published and unpublished literature.

Most of the vegetation types at CEBR fit into existing NVC association concepts, or were considered significant enough to create new NVC associations. Criteria used to identify a new association within the NVC include one or more of the following: 1) high confidence in the type (i.e. many plots), 2) type is known from another location outside the study area, and/or 3) type is known from the literature. Twenty-six associations were considered unique to CEBR; NatureServe designated these as 'Park Specials'. Four types fit into vegetation alliance concepts but lacked sufficient information to justify creating new associations. "Provisional" represents an accepted NVC association, but with limited documentation and it is therefore not posted to the NatureServe Explorer web site.

Upland Forest Associations

CEBR is dominated by subalpine-fir – Engelmann spruce woodlands in the middle and upper elevations. The most commonly sampled plant association was the Subalpine fir - Engelmann spruce / (Western Prickly Gooseberry, Bristly Black Currant, White-stem Gooseberry) Forest. Many stands have abundant standing dead spruce trees, however all stands sampled also had live mature Engelmann spruce trees, making it possible to accurately classify these forests. In addition, nearly all stands have abundant regenerating Engelmann spruce seedlings and saplings. At lower elevations, mixed white-fir forest types occur; mixed conifer stands with white fir present in the canopy are identified as white fir associations. These forests often had 2-5 conifer species in the canopy, but the presence of white fir distinguishes these forests from mixed stands with ponderosa pine and Douglas-fir. White fir was used as an indicator species that was always present as a mature tree, but often not the dominant or most abundant tree in the upper canopy. Also common at high elevations in CEBR are quaking aspen forests growing in monocultures or mixed with evergreen tree species including white fir, subalpine fir, and Douglas-fir. Pockets and stringers of blue spruce forest occur below the breaks at lower elevations in CEBR, most commonly following tributary drainage courses. The forest associations of CEBR include:

- *Abies concolor - Populus tremuloides* Forest Alliance
- *Abies concolor - Pseudotsuga menziesii / Acer glabrum* Forest
- *Abies concolor / Arctostaphylos patula* Forest
- *Abies concolor / Juniperus communis* Forest
- *Abies concolor / Mahonia repens* Forest
- *Abies concolor / Symphoricarpos oreophilus* Forest
- *Abies lasiocarpa - Picea engelmannii / Ligusticum porteri* Forest [Park Special]
- *Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme)* Forest
- *Picea pungens / Acer glabrum* Forest [Park Special]
- *Picea pungens / Arctostaphylos patula* Forest
- *Picea pungens / Juniperus communis* Forest
- *Picea pungens / Mahonia repens* Forest
- *Pseudotsuga menziesii / Arctostaphylos patula* Forest

- *Pseudotsuga menziesii / Juniperus communis* Forest
- *Pseudotsuga menziesii / Ribes montigenum* Forest [Park Special]
- *Populus tremuloides - Abies concolor / Arctostaphylos patula* Forest
- *Populus tremuloides - Abies concolor / Symphoricarpos oreophilus* Forest
- *Populus tremuloides - Abies lasiocarpa /* Tall Forbs Forest
- *Populus tremuloides - Pseudotsuga menziesii / Juniperus communis* Forest
- *Populus tremuloides - Pseudotsuga menziesii /* Sparse Understory Forest [Park Special]
- *Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest
- *Populus tremuloides / Juniperus communis* Forest
- *Populus tremuloides / Ribes montigenum* Forest
- *Populus tremuloides / Thalictrum fendleri* Forest

Upland Woodland Associations

Ponderosa pines characterize the most common woodland type below the breaks at the lower elevations of CEBR, which occupies nearly every available habitat, from riparian corridors and washes to rock outcrops, mesa tops, ridge tops, on generally south or west-facing gentle to steep slopes. All ponderosa pine stands are subject to fire.

On the barrens and steep, rocky slopes of the Claron formation, Great Basin bristlecone pine woodlands occur in nearly pure stands or more commonly as a community of mixed conifer species, sometimes with every conifer species documented from CEBR one stand. The presence of mature Great Basin bristlecone pine was used as an indicator tree species for this community type. Other less common woodland types include curl-leaf mountain-mahogany and pinyon-juniper woodlands. These woodlands are generally found on moderate to steep, west or south-facing slopes at the lowest elevations in CEBR. The upland woodland associations of CEBR include:

- *Abies lasiocarpa - Picea engelmannii / Juniperus communis* Woodland
- *Cercocarpus ledifolius / Arctostaphylos patula* Woodland (Provisional)
- *Cercocarpus ledifolius / Chrysothamnus nauseosus* Woodland [Park Special]
- *Cercocarpus ledifolius* Woodland Alliance
- *Juniperus scopulorum - Cercocarpus ledifolius* Woodland
- *Picea pungens / Purshia tridentata* Woodland [Park Special]
- *Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius* Woodland
- *Pinus edulis - Juniperus* spp. */ Cercocarpus montanus* - Mixed Shrubs Woodland
- *Pinus longaeva* Woodland
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Colorado Plateau Woodland [Park Special]
- *Pinus ponderosa / Arctostaphylos patula* Woodland
- *Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Park Special]
- *Pinus ponderosa / Purshia tridentata* Woodland

Upland Shrubland Associations

Most of the shrublands in CEBR occur as small patches, often on side slopes, in transitions between herbaceous and forested stands, and on the edges of wind-swept cliffs. The most common shrublands encountered are dominated by gooseberry currant or Rocky Mountain maple. Shrubland stands are more common in the environs. The upland shrubland associations of CEBR include:

- *Acer glabrum* Colluvial Slope Shrubland [Park Special]

- *Arctostaphylos patula* Shrubland
- *Artemisia cana (*ssp. *bolanderi,* ssp. *viscidula) / Poa pratensis* Semi-natural Shrubland
- *Ericameria discoidea* Dwarf-shrubland Herbaceous Sparse Vegetation [Park Special]
- *Ribes montigenum* Shrubland
- *Symphoricarpos oreophilus* Shrubland

Upland Herbaceous Associations

Upland dry herbaceous communities are common on the upper plateaus of CEBR. Dry, wind-swept herbaceous and sub-shrub communities occur along the edge of the breaks. Sparsely vegetated flat areas indicate late-lying snow, and can contain interesting wildflower dominated communities. Some non-native grasses were introduced historically as forage for livestock and for erosion control along roadsides. "Semi-natural Herbaceous Vegetation" indicates dominance by one or more species not native to North America. The upland herbaceous associations of CEBR include:

- *Achnatherum lettermanii* Herbaceous Vegetation
- *Aster adscendens* Herbaceous Vegetation [Park Special]
- *Bromus inermis - (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation
- *Calamagrostis scopulorum* Herbaceous Vegetation [Park Special]
- *Carex egglestonii* Herbaceous Vegetation [Park Special]
- *Deschampsia caespitosa - Polygonum bistortoides* Herbaceous Vegetation
- *Elymus trachycaulus* Herbaceous Vegetation [Park Special]
- *Erigeron ursinus* Herbaceous Vegetation [Park Special]
- *Eriogonum panguicense* Herbaceous Vegetation [Park Special]
- *Eriogonum umbellatum - Potentilla hippiana* Herbaceous Vegetation [Park Special]
- *Helianthella uniflora* Herbaceous Vegetation [Park Special]
- *Viguiera multiflora* Herbaceous Vegetation [Park Special]
- *Ligusticum porteri* Herbaceous Alliance
- *Lomatium minimum - Arenaria fendleri* Herbaceous Vegetation [Park Special]
- *Lupinus argenteus* Herbaceous Alliance
- *Poa pratensis - (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation
- *Solidago multiradiata* Herbaceous Vegetation [Park Special]

Riparian and Wetland Forest and Woodland Associations

Wetland and riparian areas are scattered in CEBR, occurring on springs or in intermittent washes. Wetland or riparian forests sampled include blue spruce and narrow-leaf cottonwood woodlands along tributary drainages and along the main branch of Ashdown Creek. The riparian and wetland forest and woodland associations of CEBR include:

- *Picea pungens / Equisetum arvense* Woodland
- *Picea pungens / Salix brachycarpa* Woodland [Park Special]
- *Populus angustifolia - Picea pungens / Acer glabrum* Woodland [Park Special]
- *Populus angustifolia* Temporarily Flooded Terrace Woodland [Park Special]

Riparian and Wetland Shrubland Associations

Wetland and riparian shrublands are rare in CEBR, with most occurring on wet meadows. Wet meadows and streams are more prominent on the east side of CEBR, with most occurring in the eastern environs. The most interesting community is dominated by the imperiled Arizona willow (*Salix arizonica*, G3G2), which occurs as a shrubland community. The riparian and wetland shrubland associations of CEBR include:

- *Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa* Shrubland
- *Salix arizonica* Shrubland [Park Special]
- *Salix exigua* Temporarily Flooded Shrubland

Riparian and Wetland Herbaceous Associations

The riparian and wetland herbaceous associations in CEBR occur almost exclusively in wet meadows on the east side and in adjacent environs. Lush grasslands and wildflower dotted mesic meadows occur interspersed among forest patches. The riparian and wetland herbaceous associations of CEBR include:

- *Carex aquatilis* Herbaceous Vegetation
- *Carex scirpoidea* Seasonally Flooded Herbaceous Vegetation [Park Special]
- *Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Vegetation
- *Poa secunda* Herbaceous Vegetation

Field Key Preparation

An illustrated dichotomous field key to plant associations of the CEBR mapping area was developed for this project (Appendix G). The key is designed to assist users in identifying plant associations in the field and has two levels. The first level is defined by the physiognomy of the vegetation, i.e., forest, woodland, tall shrubland, shrubland, dwarf-shrubland, graminoid, or forb. The second level focuses on the dominant species' canopy cover. Brief environmental descriptions are included with the floristic descriptions to aid in field identification of the plant associations. To increase the utility of the key, individual plant associations are cross-referenced to map classes.

The association field key was constructed from data collected during the classification phase of the mapping project and revised following accuracy assessment of the map. Because the key is based on a sample of the vegetation, it may not account for all associations occurring within CEBR, nor does it explain the full range of variation of the extant plant associations.

The field key was tested by NatureServe using CEBR vegetation classification plot data prior to its use by AA field crews. A NatureServe ecologist selected random plots representing each association, removed the association identifier from the data and attempted to run each plot through the key using information contained in the plots database. Additional testing of the key occurred in the field before and during the AA phase of this project. Areas where the key was confusing or unclear were identified and solutions proposed. The field key in Appendix G is the final version containing revisions based on these suggestions and contains the new plant associations discovered during the AA phase of the project.

Assessment of Global Rarity

CEBR lies in the High Plateaus region in the southwest corner of the Colorado Plateau. The High Plateaus region is a transitional tectonic region as well as a watershed divide between the Colorado Plateau and the Basin and Range Provinces (Wenker 2004). As such, CEBR represents a unique landscape setting and contains several unique plant assemblages. One plant association at CEBR is considered globally imperiled (NatureServe 2008); however, not enough is known about many of the plant associations present (especially those labeled “park specials”) to evaluate global rarity. Almost all vegetation types within CEBR are subject to change over time

with the strong driving forces of drought, erosion, fire, insect damage and disease, and potentially climate change most likely representing the change agents.

The Nature Conservancy and the Natural Heritage Network rate the rarity and degree of imperilment of plant communities by applying a global conservation status rank. The global scale for ranking ranges from 1 to 5; a rank of 1 indicates critical imperilment due to rarity, endemism, and/or threats, and a rank of 5 indicates little or no risk of extirpation or elimination of the plant community. Only one plant association occurring within CEBR is considered imperiled (G2): *Populus tremuloides / Ribes montigenum* Forest (Figure 20). Twenty-nine associations are ranked vulnerable to secure (G3, G4, and G5) and the remaining 41 associations are not yet ranked or are new to the NVCS.

Photo Credit: NPS/NCPN

Figure 20. The globally imperiled *Populus tremuloides / Ribes montigenum* Forest association at CEBR.

Fuels Data Collection

Natural and prescribed fires are an established element of the CEBR ecosystem. Under the current fire management plan (NPS 2010), all fires are managed intensively, and suppressed if the prescribed conditions are not present. The death of large stands of Engelmann spruce from the recent spruce beetle outbreak has increased concerns about wildfire, visitor safety, and the potential for damage to structures from falling trees. Hazardous tree removal has accelerated in recent years, followed by burning of the debris piles, but no prescribed burning of forests or meadows has been conducted within CEBR since 1999 (Fields 2009, Rohrer 2011). Fire fuels data were collected as part of the CEBR vegetation mapping project in order to assist park resource managers with fire planning and management. The attributes described below were selected in consultation with fuels management experts to supplement the vegetation classification plot data in providing a complete picture of fire fuels for CEBR. These data were entered in the CEBR plots database. Fuels data were not analyzed as part of this project.

Field forms, protocols, and definitions for collecting fuels data appear in Appendix B.1. Quantitative fuels data were collected for all woodland or forest classification plots in CEBR. Overstory trees (>5 in. DBH) were recorded throughout the entire plot (20 m x 20 m square) and tree saplings were recorded in a 10 m x 10 m subplot (the NW plot quadrangle). Trunk diameter at breast height (DBH) was recorded for every seedling/sapling within the subplot. The following measurements recorded for every standing (live or dead) overstory tree species in the macroplot:

- trunk diameter at breast height (DBH); trunk diameter at root crown (DRC) for multiple stemmed *Pinus edulis* or *Juniperus* spp. trees
- crown base height
- crown ratio
- structural stage (position in the canopy)
- damage code

Data on dead and downed woody material, litter, and duff were collected using a Brown's fuels transect. Two fifty-meter transects (one transect only in *Pinus edulis – Juniperus* spp. woodlands and deciduous woodlands) were laid out from the northwest corner of the macroplot at two randomly selected azimuths. One-, 10-, and 100-hour fuels were tallied along pre-determined sections of the transect line. Large woody intercepts (1,000-hour fuels) were recorded for DBH and decay class along the entire length of the transect line. Litter and duff depth measurements were recorded at 10 points (5 meters apart) along each transect line. Additional fuels comments were recorded when necessary and an Anderson Fuel model number was assigned using the Fire Behavior Fuel Model Key.

Photo Credit: NPS/NCPN

Figure 21. A typical Brown's fuel transect on the plateau in CEBR.

Vegetation Mapping

Methods

The process of mapping vegetation and land use in the CEBR project area followed five steps:

1. Field reconnaissance
2. Map class and polygon attribute development
3. Mapping
4. Field verification
5. Spatial database development

Each step built upon information created during the previous stage. Field reconnaissance was intended to familiarize the photointerpreters with CEBR, patterns of vegetation distribution, and environmental factors useful for developing mapping models. Map class development followed this reconnaissance and was based on intensive review of the aerial imagery in concert with data from the vegetation classification plot sampling. The mapping phase applied the map class concepts in order to draw consistent, homogenous polygons on the base orthoimagery. Field verification was performed subsequent to the completion of mapping work and previous to accuracy assessment to verify how well mapping from aerial imagery represented what was observed on the ground. The draft polygon set was digitized and given additional attributes (spatial database development).

Field Reconnaissance

RMGSC cartographers joined the lead project ecologist during a field session on August 19 and 20, 2006. This field session had multiple goals:

- Compare actual vegetation with signatures on the orthophotos and stereo imagery;
- Understand environmental factors influencing local vegetation patterns; and
- Identify the information that could be extracted from the project imagery.

Hardcopy plots were created from the project photography. Notes were written directly on the plots and later converted to an annotation layer for use in a GIS. GPS waypoints and corresponding digital photographs were taken to document areas of different vegetation types and land use features in a diverse sampling of CEBR and its environs. Observation point data were collected during field reconnaissance to provide supplemental documentation of the vegetation and substrate. These values were checked against the original classification plot and observation point data that were collected from July 11 to August 15, 2006. Fourteen additional observation points were collected from August 18 and 20, 2006 concurrent with this field visit.

A ruggedized tablet computer was used to record data in the field. Each plant association and its location, soils, and other environmental variables were discussed with the project ecologist. An attempt was made to answer line work questions, such as how the size of the machine-assisted polygons matched what was observed on the ground and what might have been missed or incorporated into a larger feature.

Map Class and Polygon Attribute Development

The goal of map class development was to identify meaningful units to represent existing vegetation, bedrock exposures, and land use features for the CEBR vegetation mapping project area. A list of provisional plant associations and potential park specials was produced by e2M and NatureServe using the U.S. National Vegetation Classification System (USNVC). The provisional list was based on the species list and experiences and observations while collecting classification plot and observation point data in the field during the summer of 2006. These data were obtained in an MS Access database format and point files were created for display in image-processing and GIS software to help guide the interpretation. Preliminary map classes specific to this project were developed by the USGS-RMGSC to characterize vegetation types within CEBR and the environs. Standard land cover/ land-use map classes (Anderson et al. 2002) were used to map developed areas, including water bodies, facilities, and roads. Unvegetated natural areas were mapped according to geologic substrate. The map units were adjusted during the project as new information became available.

The current standard for the USGS-NPS Vegetation Classification and Mapping Program projects is to map to the plant association level of the NVC. However, the level of detail possible in a vegetation map is limited by the quality of available imagery, the skill and experience of the photointerpreter, and the quantity and quality of supporting information. Distinguishing floristic relationships on aerial photography is often difficult and as a result similar plant associations may be grouped into a single map class, often at the vegetation alliance level. At CEBR, the relationships between map classes and plant associations are complex.

The NCPN adopted a convention for naming map classes to facilitate use of vegetation maps and mapping data across multiple parks. Each map class representing a single NVC plant association was assigned the NatureServe common name (e.g., White Fir / Greenleaf Manzanita Forest). Map classes representing complexes of associations followed the convention of being named for the unifying botanic and environmental factors (e.g., Mixed Mountain Shrubland Complex). Map classes representing non-vegetated features are named based on landscape features or geologic substrate.

To facilitate tracking and management of vegetation map class information, NCPN developed a map class coding system. Photointerpreters tend to assign a unique number to each map class as a shorthand way of labeling polygons. These numeric codes have been retained within the spatial database and map class guide (Appendix J). The CPN developed a five-letter alphacode system for map classes to be used in all park vegetation mapping projects. Each alphacode begins with the first letter of the corresponding NVC Class (F = Forest, W = Woodland, S = Shrubland, H = Herbaceous, N = nonvascular, and C = Complex). The subsequent four letters generally abbreviate the map class name. For example, the Aspen Forest Complex map class is represented by the alphacode “F-ASPE.” For map classes representing coarser levels of the NVC, geologic exposures, and other non-vegetated features, generic names incorporating vegetation and landscape features were used. Geologic exposures were given the prefix G = geology and developed sites the prefix L = land cover/land use.

Photo interpretation and polygon labeling and attribution procedures were standardized for all NCPN vegetation mapping projects (Evenden 2004). After a map class was assigned to each polygon, the polygon was assigned attributes to characterize vegetation structure (density,

pattern, height; Table 7), land use and disturbance. At CEBR, these vegetation attributes were only assigned to forest and woodland types. All map polygons were assigned to a land cover / land use type (Anderson et al. 2002). In addition, all polygons were assigned to higher levels of the NVC hierarchy, with the exception of non-vegetated map classes, which were coded as 'unclassified' or 'unvegetated' in the NVC columns.

Table 7. Physiognomic attributes of polygons. In some cases, these attributes were assigned to individual polygons; otherwise, they were assigned to an entire map class.

Category	Attribute	Description
Vegetation Canopy Density (Applied to forest, woodland, and shrub-dominated map classes)	A	Closed Tree Canopy/Continuous (> 60% cover)
	B	Open Tree Canopy/Discontinuous (25- 60% cover)
	C	Dispersed – Sparse Tree Canopy (10-25% cover)
	D	Dense Shrub Canopy (> 40% cover)
	E	Light Shrub Canopy (10 – 40% cover)
Vegetation Pattern (Applied to all vegetation map classes)	1	Clumped/Bunched
	2	Linear
	3	Gradational/Transitional
	4	Regularly Alternating
	5	Homogenous
Vegetation Height (Applied to woody terrestrial vegetation map classes only)	F	Forest and Woodlands > 30 meters tall
	G	Forest and Woodlands 15 – 30 meters
	H	Forest and Woodlands 5 – 15 meters
	I	Forest and Woodlands 1 – 5 meters
	J	Forest and Woodlands < 0.5 meters
	K	Shrublands 1 – 5 meters
	L	Shrublands 0.5 – 1 meters
	M	Shrublands 0 – 0.5 meters

NCPN photointerpretation standards (Evenden 2004) defined a suite of polygon modifiers to describe altered vegetation, landforms, transportation and utilities, and other situations. Some of these were used in CEBR, and some of the modifiers used were created specifically for CEBR by the NCPN project ecologist. Table 8 is a list of the modifiers used in the CEBR project.

Table 8. Modifiers used to provide additional information for map polygons in the CEBR vegetation mapping project area.

Category	Code	Name	Description
Vegetation Modifiers	b	Logged	Applies to systems disturbed by logging
	d	Douglas-fir	White fir forests where Douglas-fir is the dominant tree species in the canopy layer or mixed conifer stands where Douglas-fir is the co-dominant to dominant in the canopy layer
	k	Insect damage	Applies to systems disturbed by insects/disease (in CEBR, this applies strictly to spruce beetle infestations in stands of *Picea engelmannii* trees)
	r	Resprouts	Refers to places where forest or woodland stands consist mostly of resprouts or very young new trees

Mapping

A combination of methods was used to delineate and interpret vegetation polygons for the mapping component of the CEBR project area. RMGSC cartographers acquired or created a number of ancillary spatial datasets: soils, geology, fire data, climate, fauna, invasive species, and CEBR and project boundaries. Digital elevation model (DEM) data were downloaded from the USGS Seamless Data Server (http://seamless.usgs.gov) and processed into a 10-meter ERDAS Imagine file. Slope and aspect information were derived from the DEM coverage.

Vegetation information was obtained from Zion National Park from a survey that occurred in 1988 for the CEBR area. Mylar overlays and MOSS data layers were used to create this dataset. After receiving the files, the data were subsequently transferred to current digital orthophotos and output to a shapefile. Two classifications were nested within the original spatial dataset: a habitat type classification with 18 categories (145 polygons) and a community level classification with 29 classes (127 polygons). The polygon delineation was fairly coarse and the shapefile was used only as a reference for the current work. Another vegetation dataset that was acquired from the NPS was a USFS layer. This dataset was clipped to the CEBR area; this subset contained 125 polygons with 16 map classes. The age of these data and any additional metadata is unknown; therefore these general polygons were only used as a guide for the current project.

Physiognomic Class Image Analysis

A spatial layer of vegetation physiognomy was developed through image analysis using ERDAS Imagine software. For this process, a principal component (PCA) layer was created from the 1-m resolution digital orthoimagery. Photo interpreters analyzed the PCA band 1 for observable spectral thresholds that were consistent with photo-interpretive features. Vegetation was grouped into coarse categories. A sieving process eliminated groups of pixels that did not meet the minimum mapping unit (MMU) threshold and recoded them to adjacent pixel values. The process resulted in a spatial dataset of vegetation classified to general physiognomic type. The intent of the analysis was not to determine a map unit name, but to generate logical boundaries between visually distinctive features.

ArcGIS Procedures

Rare vegetation classes were delineated through on-screen digitizing and attributed manually. This method was used if the map class appeared in few locations and all occurrences were easily identified by project ecologists, could readily be interpreted from the stereo photographs, or represented a land-use type (e.g., roads). A trained photo interpreter drew polygons in ArcGIS using the base imagery at a computer workstation. In order to see finer detail, the interpreter also examined the 9- x 9-inch 1:12,000-scale aerial photographs in stereo in conjunction with the electronic version of the orthophotos.

ERDAS Imagine Processing

The principal component file from the physiognomic class analysis was used to create a tree density layer for the classification. The tree dataset was combined with the physiognomic data and output to a shapefile. The shapefile in turn was converted to an “areas of interest” (AOI) file and subsequently displayed over the project imagery using ERDAS Imagine software. Classification plots and observation points were added to the display and used as a digital guide for adding map class names to the associated polygons. Field data, reconnaissance notes, and the 9- x 9-inch stereo aerial photographs were also used to interpret patterns of color, texture, and

landscape position. CEBR and environs were interpreted and mapped to the same level of detail. All polygons were given a final manual check to attribute finer levels and make necessary corrections.

The raster file was then converted to an Arc/Info coverage using ERDAS Imagine raster to vector tools. Small unclassified areas were identified and manually coded. A 7- x 7-pixel majority neighborhood process was used to smooth edges, and remove extraneous linear features. Islands that were created from converting raster to vector output were identified with a roving 3- x 3-pixel neighborhood window. A clump process created unique polygons; those that were smaller than 0.25 hectares were removed using an eliminate command. The few remaining unattributed polygons were manually recoded to the appropriate neighbor values. Other small, but meaningful values that were lost in the eliminate command were added back into the classification.

Field Verification

The draft database was taken into the field July 24 - 26, 2007 to validate the polygons and attributes. An Xplore tablet PC with an integrated GPS was used to automate the process. Global Mapper, version 7, software was loaded on the tablet and used with the shapefiles and corresponding digital imagery to verify the spatial database. A mapbook was created as well as a backup for ease of use in the field, with 51 tiles showing the outlines of the spatial database, imagery, field notes, and classification plot and observation point data.

Spatial Database Development

Each polygon was assigned a map class number and name, Anderson land cover / land use class, and vegetation density, height, and pattern attributes (for forest and woodland types only). Additionally, polygons were assigned to an SRM rangeland cover type and an SAF forest cover type. The final spatial database was provided to the NCPN as Arc coverage. In order to improve the utility of the map and related data, the spatial database was moved into a geodatabase format, the general structure of which is illustrated in Figure 22. This format allows text and image information to be incorporated and linked to spatial coordinates. A detailed description of the geodatabase is provided in Appendix C.

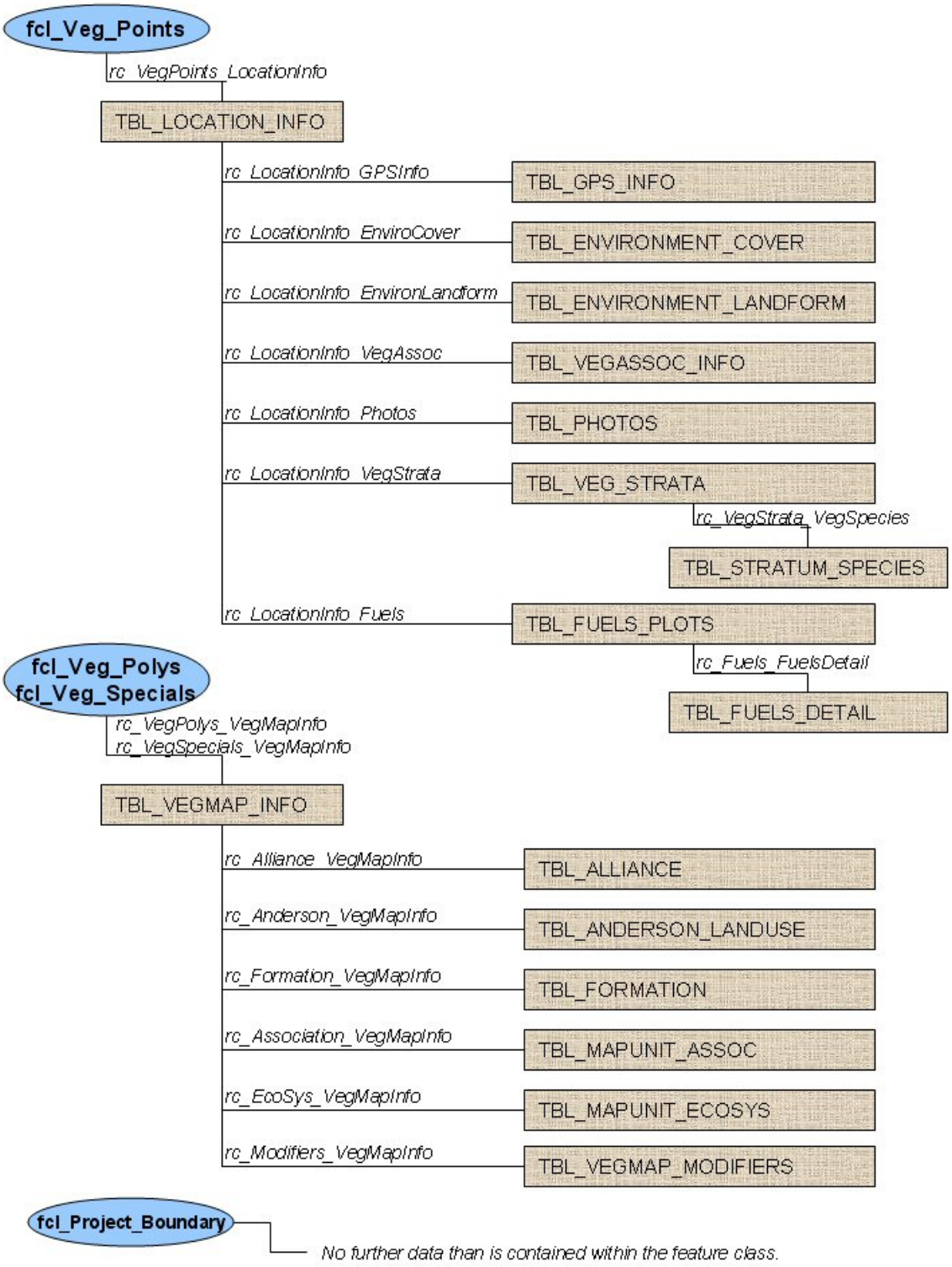

Figure 22. Structure of the CEBR geodatabase.

Results

Table 11 shows the relationship of vegetation map classes to ecological systems, ordered roughly by physiognomy: upland forests, upland woodlands, riparian woodlands and shrublands, upland shrublands, riparian shrublands, upland herbaceous vegetation, wet meadow herbaceous vegetation, and sparse vegetation. Appendix A provides summary descriptions of each ecological system. The geologic and Anderson land use map classes could not be placed within the ecological system classification.

Map Classes

The original set of 39 map classes was ultimately reduced to a final set of 26 map classes (Table 9). Of these, 20 are vegetation map classes, four are unvegetated geologic map classes, and two are land cover / land-use map classes. Of the 20 vegetation map classes, seven represent single NVC plant associations and the remaining 13 vegetation map classes represent polygons delineating multiple plant associations, including vegetation alliances and complexes.

Ecological systems (Comer et al. 2003) were developed by NatureServe to complement the NVC by creating a mappable classification unit representing groups of biologic communities in similar environments and shaped by similar ecologic processes, and are used to organize the vegetation map classes for CEBR. Ecological systems typically occur in patches of tens to thousands of hectares and are expected to persist for 50 or more years. The timeframe allows successional dynamics to be integrated into the concept of each ecological system.

Map Class Descriptions

Appendix J provides detailed descriptions of all vegetation map classes used in the final version of the CEBR vegetation mapping project. Each map class description includes:

- a summary of the ecological concept of the map class. Reference is made to the abundance and distribution of the map class within CEBR and the entire project area
- a list of plant associations and common plant species occurring within the map class
- a qualitative description of the photographic signature along with representative samples from the orthophotography
- ground photographs
- statistics and accuracy assessment results

Map Polygons

The CEBR vegetation map consists of 1,253 polygons totaling 4,840 hectares (11,960 acres). Average polygon size is 4.7 ha (11.6 acres). Lands within CEBR make up 2,481 ha (6,130 acres) or 51% of the total project area. Of the total, 1,195 polygons (95%) represent natural or semi-natural vegetation map classes covering 82% of the mapping project area. Map classes representing unvegetated areas and developed or other land cover / land use areas account for the remaining 58 polygons (5% of polygons and 18% of the area).

The polygon count includes adjacent polygons that have the same map code but different density, height, or pattern attributes. The most common vegetated map class is Subalpine Fir – Engelmann Spruce Forest Complex with 240 polygons covering 25.6% of the mapping area. The

largest average polygon size among the vegetated types belongs to Bristlecone Pine Woodland at 5.5 ha (13.6 acres) per polygon.

Figure 23 is a map of the vegetation of CEBR created from the GIS spatial database. Because a geodatabase format was used to store and organize spatial information, there are far more data in the spatial database than can be conveyed in a two-dimensional map. Maps can be produced with vegetation polygons labeled in many different ways at different levels of resolution. Table 10 provides summary statistics for CEBR vegetation map polygons. Included data are map class number and name, number of polygons interpreted within CEBR and within the environs area, and the area occupied by interpreted polygons per each mapping unit.

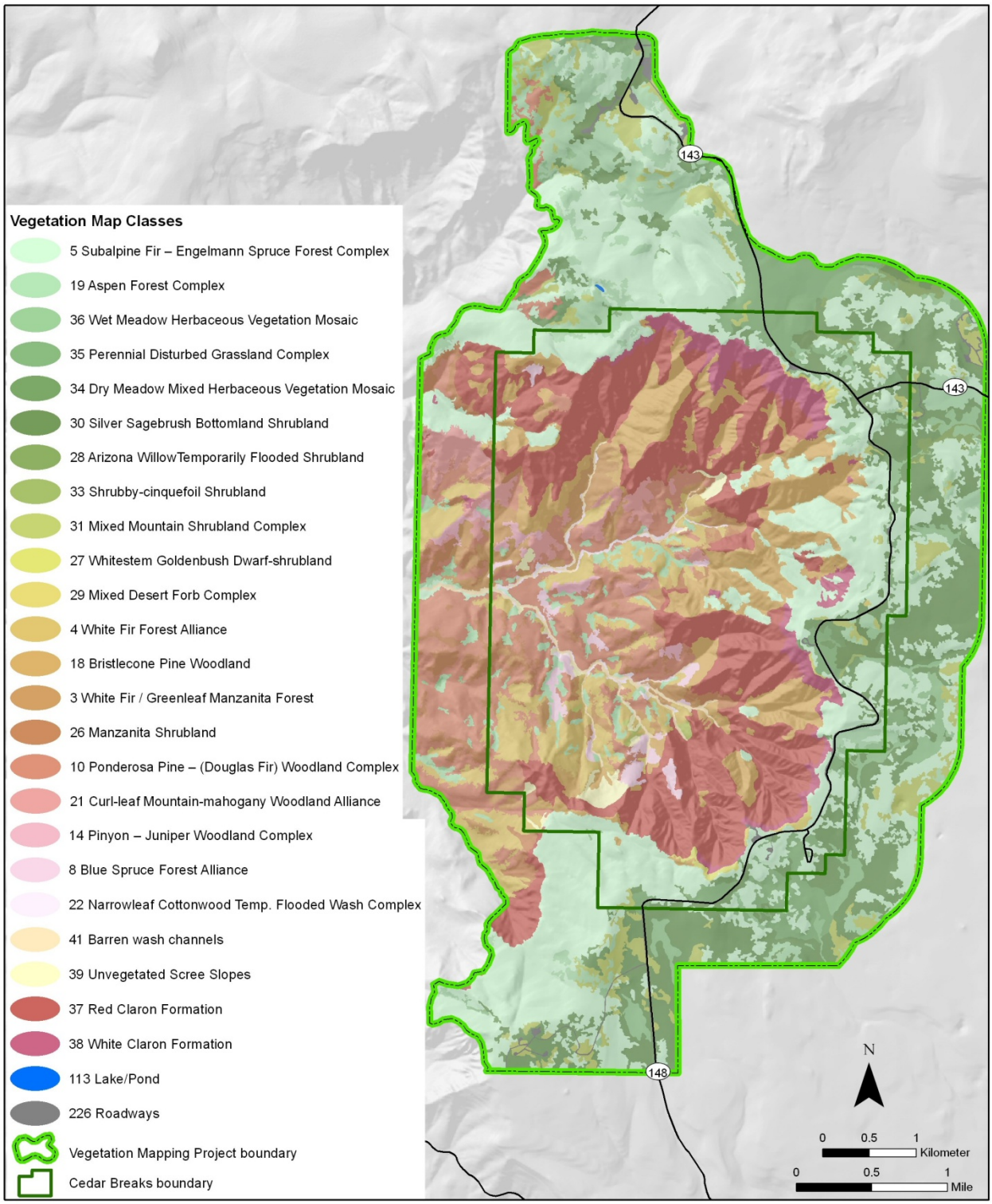

Figure 23. The CEBR vegetation map.

Table 9. Map classes used in the final (post-AA) CEBR vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CEBR vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)				
3	F-WFGM	White Fir / Greenleaf Manzanita Forest	Abies concolor / Arctostaphylos patula Forest	1 : 1
Multiple Ecological Systems: Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823) Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)				
4	F-ABIE	White Fir Forest Alliance	Abies concolor / Juniperus communis Forest Abies concolor / Mahonia repens Forest Abies concolor / Symphoricarpos oreophilus Forest Abies concolor – Pseudotsuga menziesii / Acer glabrum Forest	1 : many
Multiple Ecological Systems: Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828) Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)				
5	F-SFES	Subalpine Fir – Engelmann Spruce Forest Complex	Abies lasiocarpa – Picea engelmanii / Juniperus communis Woodland Abies lasiocarpa – Picea engelmanii / Ligusticum porteri Woodland [Park Special] Abies lasiocarpa – Picea engelmanii / Ribes (montigenum, lacustre, inerme) Woodland	1 : many
Multiple Ecological Systems: Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825) Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)				
8	F-PICE	Blue Spruce Forest Alliance	Picea pungens / Acer glabrum Forest [Park Special] Picea pungens / Arctostaphylos patula Forest Picea pungens / Equisetum arvense Woodland Picea pungens / Juniperus commuis Forest Picea pungens / Mahonia repens Forest Picea pungens / Purshia tridentata Woodland [Park Special] Picea pungens / Salix brachycarpa Woodland [Park Special]	1 : many
Multiple Ecological Systems: Rocky Mountain Aspen Forest and Woodland (CES306.813) Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)				
19	F-ASPE	Aspen Forest Complex	Abies concolor – Populus tremuloides Forest Alliance Populus tremuloides – Abies concolor / Arctostaphylos patula Forest Populus tremuloides – Abies concolor / Symphoricarpos oreophilus Forest Populus tremuloides – Abies lasiocarpa / Tall Forbs Forest	1 : many

Table 9. Map classes used in the final (post-AA) CEBR vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CEBR vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
			Populus tremuloides / Juniperus communis Forest Populus tremuloides / Ribes montigenum Forest Populus tremuloides / Thalictrum fendleri Forest Populus tremuloides – Pseudotsuga menziesii / Juniperus communis Forest Populus tremuloides – Pseudotsuga menziesii / Sparse understory Forest [Park Special] Populus tremuloides – Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)				
18	W-PILO	Bristlecone Pine Woodland	Pinus longaeva Woodland	1 : 1
Multiple Ecological Systems: Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823) Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)				
10	W-PODO	Ponderosa Pine – (Douglas-fir) Woodland Complex	Pinus ponderosa / Arctostaphylos patula Woodland Pinus ponderosa – Pseudotsuga menziesii / Arctostaphylos patula Colorado Plateau Woodland Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland [Park Special] Pinus ponderosa / Purshia tridentata Woodland Pseudotsuga menziesii / Arctostaphylos patula Forest Pseudotsuga menziesii / Juniperus communis Forest Pseudotsuga menziesii / Ribes montigenum Forest [Park Special]	1 : many
Multiple Ecological Systems: Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835) Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)				
14	W-PIJU	Pinyon – Juniper Woodland Complex	Juniperus scopulorum – Cercocarpus ledifolius Woodland Pinus edulis – Juniperus osteosperma / Cercocarpus ledifolius Woodland Pinus edulis – Juniperus spp. / Cercocarpus montanus – Mixed Shrubs Woodland	1 : many
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland (CES304.772)				
21	W-CLMM	Curl-leaf Mountain-mahogany Woodland Alliance	Cercocarpus ledifolius / Arctostaphylos patula Woodland Cercocarpus ledifolius / Chrysothamnus nauseosus Woodland [Park Special] Cercocarpus ledifolius Woodland Alliance	1 : many
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)				

Table 9. Map classes used in the final (post-AA) CEBR vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CEBR vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
22	W-COTT	Narrowleaf Cottonwood Temporarily Flooded Wash Complex	Populus angustifolia - Picea pungens / Acer glabrum Woodland [Park Special] Populus angustifolia Temporarily Flooded Terrace Woodland [Park Special] Salix exigua Temporarily Flooded Shrubland	1 : many
Great Basin Semi-Desert Chaparral (CES304.001)				
26	S-MANZ	Manzanita Shrubland	Arctostaphylos patula Shrubland	1 : 1
Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe (CES304.084)				
30	S-ARCA	Silver Sagebrush Bottomland Shrubland	Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa pratensis Semi-natural Shrubland	1 : 1
Multiple Ecological Systems: Rocky Mountain Alpine Turf (CES306.816) Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)				
31	S-MXMO	Mixed Mountain Shrubland Complex	Acer glabrum Colluvial Slope Shrubland [Park Special] Ribes montigenum Shrubland Symphoricarpos oreophilus Shrubland	1 : many
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)				
28	S-AZWI	Arizona Willow Temporarily Flooded Shrubland	Salix arizonica Shrubland [Park Special]	1 : 1
33	S-CINQ	Shrubby-cinquefoil Shrubland	Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa Shrubland	1 : 1
Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824) Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)				

Table 9. Map classes used in the final (post-AA) CEBR vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CEBR vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
34	H-HERB	Dry Meadow Mixed Herbaceous Vegetation Mosaic	Achnatherum lettermanii Herbaceous Alliance Aster adscendens Herbaceous Vegetation [Park Special] Calamagrostis scopulorum Herbaceous Vegetation [Park Special] Carex egglestonii Herbaceous Vegetation [Park Special] Erigeron ursinus Herbaceous Vegetation [Park Special] Elymus trachycaulus Herbaceous Vegetation [Park Special] Helianthella uniflora Herbaceous Vegetation [Park Special] Ligusticum porteri Herbaceous Alliance Lomatium minimum - Arenaria fendleri Herbaceous Vegetation [Park Special] Lupinus argenteus Herbaceous Alliance Poa secunda Herbaceous Vegetation Solidago multiradiata Herbaceous Vegetation [Park Special] Viguiera multiflora Herbaceous Vegetation [Park Special]	1 : many
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)				
35	H-DIST	Perennial Disturbed Grassland Complex	Bromus inermis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation Poa pratensis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	1 : many
Multiple Ecological Systems: Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)				
36	H-MEAD	Wet Meadow Herbaceous Vegetation Mosaic	Carex aquatilis Herbaceous Vegetation Carex scirpoidea Seasonally Flooded Herbaceous Vegetation [Park Special] Deschampsia caespitosa – Polygonum bistortoides Herbaceous Vegetation Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	1 : many
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)				
27	S-ERDI	Whitestem Goldenbush Dwarf-shrubland	Ericameria discoidea Dwarf-shrubland Herbaceous Sparse Vegetation [Park Special]	1 : 1
Multiple Ecological Systems: Inter-Mountain Basins Shale Badland (CES304.789) Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)				
29	H-MXDE	Mixed Desert Forb Complex	Eriogonum panguicense Herbaceous Vegetation [Park Special] Eriogonum umbellatum - Potentilla hippiana Herbaceous Vegetation [Park Special]	1 : many

Table 9. Map classes used in the final (post-AA) CEBR vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CEBR vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
Non-Vegetated and Anderson Land Use Map Classes:				
37	G-REDC	Red Claron Formation	Geologic exposures of the Red Claron Formation	N/A
38	G-WHIC	White Claron Formation	Geologic exposures of the White Claron Formation	N/A
39	G-SCRE	Scree	Unvegetated scree slopes	N/A
41	G-WASH	Barren Washes	Barren wash channels	N/A
113	L-POND	Lake/Pond	A non-flowing, naturally-existing, body of water	N/A
226	L-ROAD	Roadways	Roadways	N/A

Table 10. Summary statistics for polygons of each map class developed for the CEBR vegetation mapping project.

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)							
F-WFGM	White Fir / Greenleaf Manzanita Forest	30	9	39	84.1	23.3	107.5
	Subtotal	*30*	*9*	*39*	*84.1*	*23.3*	*107.5*
Multiple Ecological Systems: Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823) Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)							
F-ABIE	White Fir Forest Alliance	41	11	52	147.8	66.4	214.2
	Subtotal	*41*	*11*	*52*	*147.8*	*66.4*	*214.2*
Multiple Ecological Systems: Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828) Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)							
F-SFES	Subalpine Fir – Engelmann Spruce Forest Complex	95	145	240	445.1	794.4	1239.5
	Subtotal	*95*	*145*	*240*	*445.1*	*794.4*	*1239.5*
Multiple Ecological Systems: Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825) Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)							
F-PICE	Blue Spruce Forest Alliance	15	1	16	37.2	0.2	37.4
	Subtotal	*15*	*1*	*16*	*37.2*	*0.2*	*37.4*
Multiple Ecological Systems: Rocky Mountain Aspen Forest and Woodland (CES306.813) Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)							
F-ASPE	Aspen Forest Complex	69	78	147	77.7	228.7	306.4
	Subtotal	*69*	*78*	*147*	*77.7*	*228.7*	*306.4*
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)							
W-PILO	Bristlecone Pine Woodland	60	5	65	350.1	6.4	356.5
	Subtotal	*60*	*5*	*65*	*350.1*	*6.4*	*356.5*

Table 10. Summary statistics for polygons of each map class developed for the CEBR vegetation mapping project.

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area
Multiple Ecological Systems: Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823) Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)							
W-PODO	Ponderosa Pine – (Douglas Fir) Woodland Complex	48	34	82	211.5	197.5	409.1
	Subtotal	*48*	*34*	*82*	*211.5*	*197.5*	*409.1*
Multiple Ecological Systems: Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835) Rocky Mountain Foothill Limber Pin-Juniper Woodland (CES306.955)							
W-PIJU	Pinyon – Juniper Woodland Complex	5	3	8	12.9	8.3	21.2
	Subtotal	*5*	*3*	*8*	*12.9*	*8.3*	*21.2*
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland (CES304.772)							
W-CLMM	Curl-leaf Mountain- mahogany Woodland Complex	12	7	19	36.8	33.8	70.6
	Subtotal	*12*	*7*	*19*	*36.8*	*33.8*	*70.6*
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)							
W-COTT	Narrowleaf Cottonwood Temporarily Flooded Wash Complex	36	1	37	13.6	0.7	14.3
	Subtotal	*36*	*1*	*37*	*13.6*	*0.7*	*14.3*
Great Basin Semi-Desert Chaparral (CES304.001)							
S-MANZ	Manzanita Shrubland	44	16	60	46.9	57.8	104.8
	Subtotal	*44*	*16*	*60*	*46.9*	*57.8*	*104.8*

Table 10. Summary statistics for polygons of each map class developed for the CEBR vegetation mapping project.

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area
Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe (CES304.084)							
S-ARCA	Silver Sagebrush Bottomland Shrubland	2	11	13	13.4	16.7	30.1
	Subtotal	*2*	*11*	*13*	*13.4*	*16.7*	*30.1*
Multiple Ecological Systems: Rocky Mountain Alpine Turf (CES306.816) Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)							
S-MXMO	Mixed Mountain Shrubland Complex	16	92	108	14.9	162.0	176.9
	Subtotal	*16*	*92*	*108*	*14.9*	*162.0*	*176.9*
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)							
S-AZWI	Arizona Willow Temporarily Flooded Shrubland	3	11	14	2.6	19.4	21.9
S-CINQ	Shrubby-cinquefoil Shrubland	1	0	1	1.0	0.0	1.0
	Subtotal	*4*	*11*	*15*	*3.6*	*19.4*	*22.9*
Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824) Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)							
H-HERB	Dry Meadow Mixed Herbaceous Vegetation Mosaic	65	80	145	97.2	434.7	531.9
	Subtotal	*65*	*80*	*145*	*97.2*	*434.7*	*531.9*
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)							
H-DIST	Perennial Disturbed Grassland Complex	42	32	74	78.1	131.4	209.5
	Subtotal	*42*	*32*	*74*	*78.1*	*131.4*	*209.5*

Table 10. Summary statistics for polygons of each map class developed for the CEBR vegetation mapping project.

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area
Multiple Ecological Systems: Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)							
H-MEAD	Wet Meadow Herbaceous Vegetation Mosaic	20	46	66	18.9	87.5	106.4
	Subtotal	*20*	*46*	*66*	*18.9*	*87.5*	*106.4*
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)							
S-ERDI	Whitestem Goldenbush Dwarf-shrubland	4	0	4	10.5	0.0	10.5
	Subtotal	*4*	*0*	*4*	*10.5*	*0.0*	*10.5*
Multiple Ecological Systems: Inter-Mountain Basins Shale Badland (CES304.789) Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)							
H-MXDE	Mixed Desert Forb Complex	5	0	5	4.6	0.0	4.6
	Subtotal	*5*	*0*	*5*	*4.6*	*0.0*	*4.6*
UNVEGETATED AND ANDERSON LAND USE MAP CLASSES							
G-REDC	Red Claron Formation	7	7	14	606.6	55.6	662.2
G-WHIC	White Claron Formation	9	3	12	100.2	1.8	102.0
G-SCRE	Scree	12	4	16	24.7	0.8	25.5
G-WASH	Barren Washes	8	1	9	23.5	3.3	26.7
L-POND	Lake/Pond	0	1	1	0.0	0.3	0.3
L-ROAD	Roadways	1	5	6	20.6	28.4	49.1
	Subtotal	*37*	*21*	*58*	*775.6*	*90.2*	*865.8*
	Total All Map Classes	**650**	**603**	**1253**	**2,480.5**	**2,359.6**	**4,840.1**

* Note: Total polygon area may be less in the full mapping project area because of cumulative rounding error.

Discussion

Producing vegetation maps for the parks of the Northern Colorado Plateau, including CEBR, is made more challenging by the massive, sheer cliffs and steep, shale and scree slopes that are a common feature. The cliffs and talus slopes often make field access difficult, confound the generation of slope and aspect data, and create problematic shadows on the aerial photographs and orthoimagery. In addition to requiring the application of special techniques to overcome these challenges, the mapping process revealed opportunities for future improvement.

Things that worked well: Quality base data is essential to high quality scientific results. For the vegetation mapping at CEBR, high quality orthophotography allowed for both confident manual interpretation and a solid source for deriving physiognomic classes and tree coverage densities (which were very useful in the subsequent Definiens (i.e., eCognition) segmentation). A semi-automated approach was used for this project as a possible means of augmenting or replacing the traditional process of manual photo-interpretation to improve the consistency, efficiency, repeatability, and cost effectiveness of vegetation mapping. This process removes potential sources of transcription error as well by eliminating the need to scan Mylar overlays, orthorectify and warp them to the orthoimagery, clean up the linework digitally, and re-attribute the polygons.

Accurate classification plot and observation point data and detailed local descriptions of the vegetation associations were provided by the project ecologists. These and additional data collected by the project photointerpreters on two field reconnaissance trips provided a strong basis of understanding for interpreting the imagery, modeling, and delineating map classes. The lead project ecologist participated in these trips and shared valuable knowledge and insight with the cartographers.

Areas for Improvement: The semi-automated approach used for mapping met with mixed success. In some cases, additional field data would have been helpful in clarifying map class relationships. In other situations, modeling would not be successful in distinguishing between two closely related map classes, no matter how many field plots were collected (especially true for the “less confident” (rare) map classes such as the sagebrush and willow communities). Given the high quality and quantity of the classification plot data, the photointerpreters were optimistic about creating an association-level map. In retrospect, a savings in time and cost would have been realized if plant associations had been combined into vegetation alliance-level map classes at the onset of the project. Instead, plant associations were grouped following the AA to attain the requisite program accuracy.

Accuracy Assessment

Methods

Introduction

Accuracy assessment (AA) is a statistical test of how well polygon map class attributes represent vegetation on the ground. The AA compares field observations with the map class assignment of the sampled polygon. Errors occur when mapped polygon labels differ from field observations. Results of the AA allow users to evaluate the utility of the vegetation mapping data for particular applications. AA results are represented in two forms (Hop et al. 2005): "producer's accuracy" (the probability that an AA point was mapped correctly, also referred to as "errors of omission"), and "user's accuracy" (the probability that the map represents what was found on the ground, also referred to as "errors of commission"). High producer's accuracy combined with low user's accuracy indicates that the map class is under-mapped. Conversely, low producer's accuracy combined with high user's accuracy indicates that a type is over-mapped. Ideally, a map has both high user's and producer's accuracy.

Sampling Design

A stratified random sampling approach was used to determine AA sampling locations. The AA included most vegetation map classes and was limited to lands within the CEBR boundary; private and federal outside of CEBR were not included in the accuracy evaluation. Sample sizes for each evaluated map class were selected using the USGS-NPS Vegetation Mapping Program guidelines (ESRI and TNC 1994):

Scenario A: The class is abundant. It covers more than 50 ha (124 acres) and consists of at least 30 polygons. The recommended sample size is 30.

Scenario B: The class is relatively abundant. It covers more than 50 ha, but consists of fewer than 30 polygons. The recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.

Scenario C: The class is relatively rare. It covers less than 50 ha but consists of more than 30 polygons. The recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.

Scenario D: The class is rare. It has more than five but fewer than 30 polygons and covers less than 50 ha. The recommended number of samples is five. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than five sample sites will likely result in multiple samples within the same (small) polygon. Collecting five samples will allow accuracy to be estimated, although the estimate will not be very precise.

Scenario E: The class is very rare. It has fewer than five polygons and occupies less than 50 ha. In this case, it is recommended that the existence of the class be confirmed by a visit to each polygon. The rationale for the recommendation is that with fewer than five sample sites

(assuming one site per polygon), no estimate of level of confidence can be established for the sample and the accuracy of the class can only be confirmed through a field census.

AA sampling points were selected for each vegetation map class using guidelines A–E. Two land-use map classes (L-XXXX) and four geologic classes (G-XXXX) were excluded because they are essentially unvegetated. The primary set of AA evaluation sites included 303 points. Secondary and tertiary sets of points were generated in case some of the points in the primary set could not be accessed safely. A 40 m (131 ft) interior buffer from polygon edges was generated for the map coverage to help ensure that 0.5 ha sampling points would fall cleanly within the polygon. The 40 m buffer worked in most situations; however, for small or linear polygons the buffer was reduced or eliminated. Sheer cliffs and steep talus were excluded from the AA point selection pool due to poor or dangerous access. Location Universal Transverse Mercator (UTM) coordinates for all AA points were downloaded to Global Positioning System (GPS) receivers for field sampling. The points and polygons were printed on paper maps with an orthophotograph background to guide the field crews.

Field Data Collection

AA point data were collected at CEBR during the late summer of 2007. Field crews used GPS receivers, digital orthophotograph plots, and topographic maps to navigate precisely to each pre-selected AA point. The crews evaluated an area approximately 5,000m^2 centered on the AA point coordinates (Appendix B). Environmental data collected in the field included elevation, slope, aspect, topographic position, landform, unvegetated surface elements, and descriptive comments. Vegetation data included leaf type and physiognomic class, as well as height and canopy cover for the dominant species in each stratum. The illustrated field key was used to identify the plant association that best described the AA plot. In most cases, only one plant association name was recorded. When vegetation relationships were less clear, a secondary or tertiary plant association name was also recorded. Plant associations occurring within 50 m of the AA point boundary were also recorded if they represented an association type that was different from the type recorded for the AA point. One or more 35 mm color slides were acquired at each AA point to provide visual documentation of the site.

The field team collected data at 303 AA points (Figure 24); the resultant data were manually entered into the MS Access project database and a thorough quality assurance/quality check (QA/QC) was performed on the data prior to analysis. Nomenclature standards and other data management procedures were the same as for the classification plot data (see Vegetation Classification and Description section). Photographic slides were converted to digital format and cataloged in the same database as the classification plot and observation point photographs.

Data Analysis

All 303 AA sample points collected were used in the final AA data analysis. The field data were converted into a spatial data layer with coordinates and attributes. The first step in the AA analysis intersected the AA point data with the map polygon data. The primary, secondary, and tertiary plant association names (and associations within 50m, if recorded) assigned in the field to each AA point were compared to the map class code for that polygon. If any of the three names agreed with the labeled map class for a given polygon, the point was considered correct. All other points were considered mismatches and marked incorrect.

The principal investigator, Bev Friesen (USGS) then generated three contingency tables: (1) based on primary field call only, (2) based on all field calls, and (3) based on all three field calls plus the field call for associations within 50m, in which producer's and user's accuracy were calculated for each map class along with a Kappa Index. Producer's accuracy was calculated by dividing the number of samples that agreed with their corresponding map class by the total number of samples in that class. User's accuracy was calculated by dividing the number of samples that agreed with the corresponding map class by the total number of samples where the field call belonged to that category.

The primary photointerpreter and project ecologists met in Boulder, CO December 4-5, 2007 to analyze the map errors revealed in the preliminary contingency tables and to discuss mapping classes and their refinement where necessary. Meeting results are summarized in the following section. This meeting was attended by Amy Tendick (NPS-NCPN), Marion Reid (NatureServe), Gwen Kittel (NatureServe), Bev Friesen (USGS), and Jim Von Loh (e^2M). Each AA point mismatch (disagreement between field call and polygon label) was evaluated for the type of error (true or false). Sources of "false" error include GPS positional error, questionable field determinations, edge error, and inclusions (small patches of vegetation within larger map polygons). Mismatches were corrected when a false error was identified. All other mismatches were deemed true errors. Patterns of error were analyzed and possible solutions for raising map class accuracy formulated (Appendix I). Following the AA meeting, the CEBR vegetation map was revised by Bev Friesen (USGS) to reflect the changes and decisions made at the meeting and recorded by Janet Coles (NPS-NCPN).

On February 28, 2008, a final meeting was held among the CEBR staff and project cooperators in Cedar City, Utah to complete the AA process. Participants from CEBR and Zion National Park, NCPN, NPS-WASO Natural Resource Stewardship and Science, and the USGS attended this half-day meeting and discussed the alternative solutions developed during the AA analysis, and decided on the best solution for natural resource management purposes. In some cases, meeting participants recommended combining certain map classes to achieve higher levels of accuracy and more meaningful vegetation map classes. In other cases, the group recommended retaining map classes with lower accuracy, as discussed below. In addition, several new suggestions arose during this meeting. All decisions were documented (Appendix I) and later implemented to create the final vegetation database.

The original set of 35 map classes was ultimately reduced to a final set of 26 vegetation, geology, and land-use map classes. The primary photointerpreter (Bev Friesen) edited the vegetation map, incorporating mapping-related decisions made about some map classes at the 2008 AA meeting. The final contingency table was produced by project cartographers to represent the corrected data set (Table 13). Both the edited vegetation map and the final contingency table were delivered to NCPN staff in January 2009. Final edits were made to the vegetation map in January 2011 by Amy Tendick (NPS-NCPN) to improve map accuracy, but these edits were not incorporated into the contingency table, so as not to skew final accuracy numbers. The spatial database was revised to reflect the final combinations of map classes.

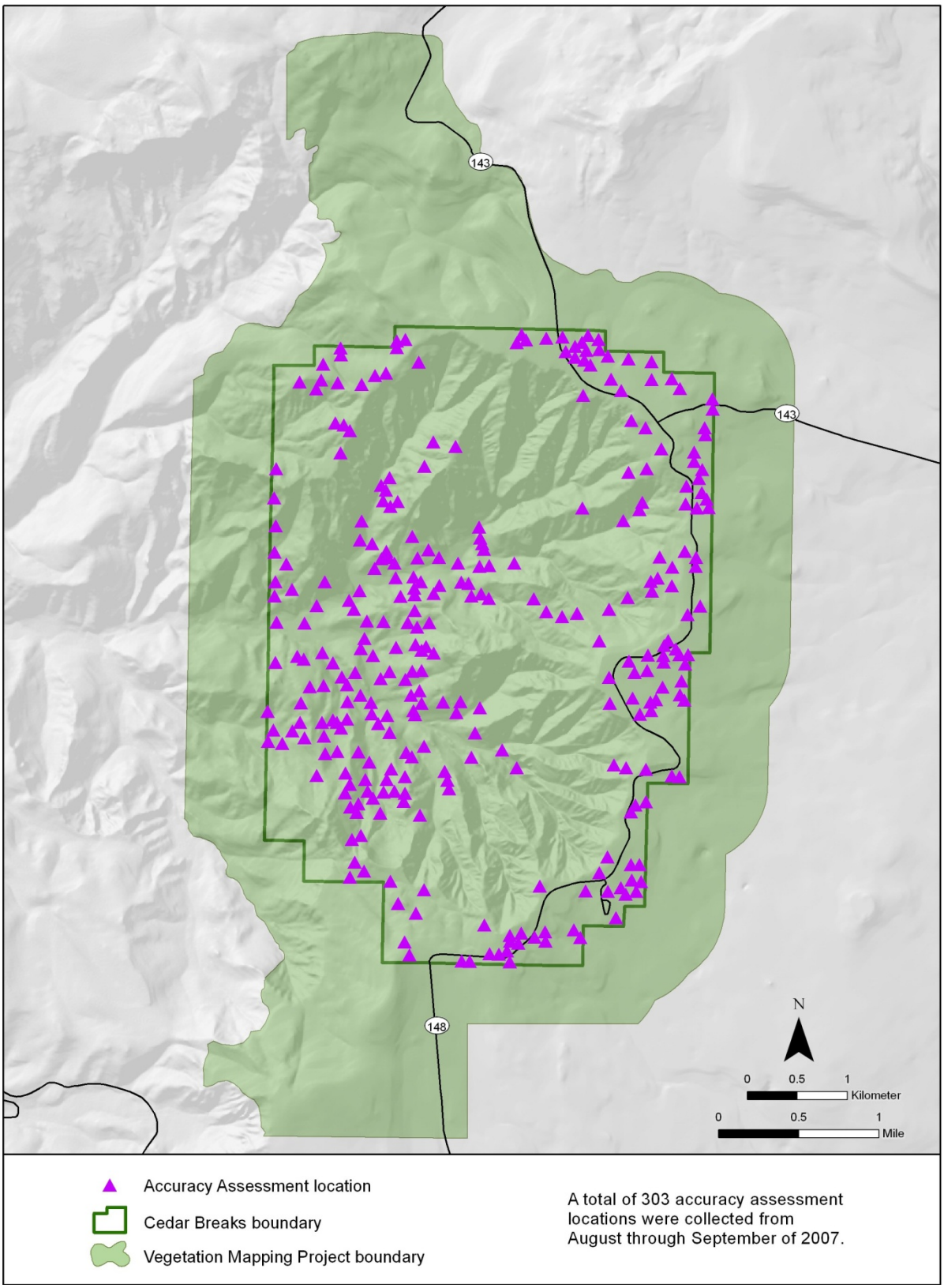

Figure 24. Location of accuracy assessment points sampled within CEBR. The accuracy of the map outside of the park boundary was not assessed.

Table 11. Final contingency table for CEBR. This table represents the 22 map classes retained following accuracy assessment and revision whose accuracy was assessed.

Shaded boxes indicate the number of AA points that agree with the assigned map class. To read the table, columns represent the map class observed in the field, while the rows represent the map class assigned by the photointerpreter. Overall accuracy is 88.1% (Kappa statistic = 87.1%). User's and producer's accuracy values with 90% confidence intervals for each map class appear in Tables 12, 13, and 14.

Map class		Accuracy Assessment Field Plot Data Commission (User's) Error																				Correct		90% C.I.	
		3	4	5	8	10	14	18	19	21	22	26	27	28	29	30	31	33	34	35	36	#	%	-	+
Mapped Data Omission (Producer's) Error	3	**13**	1		1	4																19	68%	48%	89%
	4	1	**32**																			33	97%	91%	103%
	5		1	**30**				2														33	91%	81%	101%
	8				**10**																	10	100%	95%	105%
	10	1	2	1	2	**19**		2	2													29	66%	49%	82%
	14					1	**5**															6	83%	50%	117%
	18				1			**25**														26	96%	88%	104%
	19								**26**													26	100%	98%	102%
	21						1			**8**												9	89%	66%	112%
	22										**9**								1			10	90%	69%	111%
	26					1		2				**11**										14	79%	57%	100%
	27												**1**									1	100%	50%	150%
	28													**2**								2	100%	75%	125%
	29											1			**6**				1			8	75%	44%	106%
	30															**2**			1			3	67%	5%	128%
	31																**4**		1			5	80%	41%	119%
	33																	**2**				2	100%	75%	125%
	34																		**30**	1		31	97%	90%	104%
	35			1															3	**25**		29	86%	74%	98%
	36																				**7**	7	100%	93%	107%
correct	#	15	36	32	14	25	6	31	28	8	9	12	1	2	6	2	4	2	37	26	7				
	%	87%	89%	94%	71%	76%	83%	81%	93%	100%	100%	92%	100%	100%	100%	100%	100%	100%	81%	96%	100%	**303 total points**			
90% C.I.	-	69%	79%	85%	48%	60%	50%	67%	83%	94%	94%	74%	50%	75%	92%	75%	88%	75%	69%	88%	93%	**88.1% accuracy**			
	+	104%	99%	102%	95%	92%	117%	94%	103%	106%	106%	109%	150%	125%	108%	125%	113%	125%	93%	104%	107%				

Results and Discussion

The map classes shown in tables and figures in this section represent those that remained or were created following adjustment of map classes to improve CEBR thematic accuracy. Appendix I presents the complete analysis of all map classes used in the draft map and evaluated during AA. Final overall map accuracy is 88.1% (Kappa correction = 87.1%). Individual map class producer's and user's accuracy values are given in the tables below with 90% confidence intervals. The width of each confidence interval is affected by sample size (which is determined by abundance or rarity of a map class); larger sample sizes result in narrower confidence intervals. Individual map class accuracy ranges from 66% to 100% (Tables 12, 13, and 14).

Table 12. Final CEBR vegetation map classes that met or exceeded the 80% program standard for both user's and producer's accuracy.

Map Class	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)
F-ABIE	4	White Fir Forest Alliance	97% ± 6%	89% ± 10%
F-SFES	5	Subalpine Fir – Engelmann Spruce Forest Complex	91% ± 10%	94% ± 9%
W-PIJU	14	Pinyon – Juniper Woodland Complex	83% ± 34%	83% ± 34%
W-PILO	18	Bristlecone Pine Woodland	96% ± 8%	81% ± 14%
F-ASPE	19	Aspen Forest Complex	100%	93% ± 10%
W-CLMM	21	Curl-leaf Mountain-mahogany Woodland Alliance	89% ± 23%	100%
W-COTT	22	Narrowleaf Cottonwood Temporarily Flooded Wash Complex	90% ± 21%	100%
S-ERDI	27	Whitestem Goldenbush Dwarf-shrubland	100%	100%
S-AZWI	28	Arizona Willow Temporarily Flooded Shrubland	100%	100%
S-MXMO	31	Mixed Mountain Shrubland Complex	80% ± 39%	100%
S-CINQ	33	Shrubby-cinquefoil Shrubland	100%	100%
H-HERB	34	Dry Meadow Mixed Herbaceous Vegetation Mosaic	97% ± 8%	81% ± 13%
H-DIST	35	Perennial Disturbed Grassland Complex	86% ± 12%	96% ± 8%
H-MEAD	36	Wet Meadow Herbaceous Vegetation Mosaic	100%	100%

As shown in Table 15, five map classes were retained in the final vegetation map for CEBR when either user's or producer's accuracy did not meet the 80% program standard. A high producer's accuracy but low user's accuracy can mean that a particular map class was undermapped by the PI and found to be more common by field crew members. Whereas, a high user's accuracy but low producer's accuracy can mean that a particular map class was overmapped by the PI and not found to be as common by field crew members. In all Table 15 classes, the 90% confidence interval includes 80%.

One map class (8 – Blue Spruce Forest Alliance) was undermapped but was retained because it is an ecologically significant type and because the post-AA remapping analysis improved the accuracy and distribution. Four map classes were overmapped and two of those map classes represent rare vegetation types based on a few data points that were found to be even rarer than

as mapped. The two remaining ecologically significant map classes were overmapped but were retained because errors were with closely related map classes (often a matter of a few percent cover of a diagnostic species) or because they occurred in small patches (sometimes <MMU size) that were viewed as inclusions within the larger surrounding community by the field person but were nonetheless valuable types to CEBR resource managers.

Table 13. CEBR vegetation map classes where either the user's or producer's accuracy did not meet the 80% program standard.

Map Class Code	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)	Confused with Map Class #
F-WFGM	3	White Fir / Manzanita Forest	68% ± 21%	87% ± 18%	4, 10
F-PICE	8	Blue Spruce Forest Alliance	100%	71% ± 24%	3, 10, 18
S-MANZ	26	Manzanita Shrubland	79% ± 22%	92% ± 18%	10, 18
H-MXDE	29	Mixed Desert Forb Complex	75% ± 31%	100%	26, 34
S-ARCA	30	Silver Sagebrush Bottomland Shrubland	67% ± 62%	100%	34

One map class (10 - Ponderosa Pine – (Douglas-fir) Woodland Complex did not achieve the 80% standard for either user's or producer's accuracy (Table 16). This vegetation type was confused with most other evergreen woodland types that occurs below the rim; however, the post-AA analysis remapping improved the accuracy and distribution of this type and it was deemed ecologically significant enough to retain even with a lower accuracy.

Table 14. CEBR vegetation map classes where neither the user's or producer's accuracy met the 80% program standard.

Map Class Code	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)	Confused with Map Class #
W-PODO	10	Ponderosa Pine – (Douglas-fir) Woodland Complex	66% ± 16%	76% ± 16%	3, 4, 8, 18, 19

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Appendix A.
Ecological Systems of Cedar Breaks National Monument

Introduction

This appendix contains summary descriptions of 24 terrestrial, riparian, and wetland ecological system (ES) units (NatureServe 2003b, Comer et al. 2003) occurring at Cedar Breaks National Monument. Each ecological system represents one or more National Vegetation Classification (NVC) plant associations or alliances (Table 8 within the main report). Map classes were also crosswalked to ES units (Table 11 within the main report).

The ecological systems classification was developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. One purpose of ecological systems is to provide a coarse-scale mapping unit that can be applied across management boundaries.

This subset of the International Ecological Classification Standard covers ecological systems attributed to Cedar Breaks National Monument. 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 Gwen Kittel, Regional Vegetation Ecologist, Boulder, CO gwen_kittel@natureserve.org.

Citations:

The following citation should be used in any published materials which reference ecological system and/or International Vegetation Classification (IVC hierarchy) and association data:

NatureServe. 2010. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 12 October 2010.

These data are extracted from:

NatureServe. 2010. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 12 October 2010.

CES304.001 GREAT BASIN SEMI-DESERT CHAPARRAL

Division 304 (Inter-Mountain Basins); Shrubland

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Broad-Leaved Evegreen Shrub
Concept Summary: This system includes chaparral on sideslopes transitioning from low-elevation desert landscapes up into pinyon-juniper woodlands of the western and central Great Basin. There are limited occurrences extending as far west as the inner Coast Ranges in central California. These are typically fairly open-canopy shrublands with open spaces either bare or supporting patchy grasses and forbs. Characteristic species may include *Arctostaphylos patula, Arctostaphylos pungens, Ceanothus greggii, Ceanothus velutinus, Cercocarpus montanus var. glaber, Cercocarpus intricatus, Eriogonum fasciculatum, Garrya flavescens, Quercus turbinella, Purshia stansburiana*, and *Rhus trilobata*. *Cercocarpus ledifolius* is generally absent. Typical fire regime in these systems varies with the amount of organic accumulation.
Range: Western and central Great Basin.
Subnations: CA, NV

CES304.767 COLORADO PLATEAU PINYON-JUNIPER WOODLAND

Division 304 (Inter-Mountain Basins); Forest and Woodland

Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Mesa; Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate Xeric; Aridic; *Pinus edulis, Juniperus osteosperma*
Concept Summary: This ecological system occurs in dry mountain slopes, mesas, plateaus, and ridges of the Colorado Plateau region including the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim and the northwestern corner of New Mexico. It is typically found at lower elevations (1500-2440 m). Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. In northern Arizona and northwestern New Mexico, *Juniperus monosperma* and hybrids of *Juniperus* spp. may dominate or codominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula, Artemisia tridentata, Cercocarpus intricatus, Cercocarpus montanus, Coleogyne ramosissima, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Bouteloua gracilis, Pleuraphis jamesii*, or *Poa fendleriana*. This system occurs at higher elevations than Great Basin Pinyon-Juniper Woodland (CES304.773) and Colorado Plateau shrubland systems.

Range: Occurs on dry mountains and foothills of the Colorado Plateau region from the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim. It is typically found at elevations ranging from 1500-2440 m.
Subnations: AZ, CO, NM, UT

CES304.772 INTER-MOUNTAIN BASINS CURL-LEAF MOUNTAIN MAHOGANY WOODLAND AND SHRUBLAND
Division 304 (Inter-Mountain Basins); Forest and Woodland

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Aridic; *Cercocarpus ledifolius*
Concept Summary: This ecological system occurs in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but they may be composed of small trees in steppe areas. Scattered junipers or pines may also occur. This system includes both woodlands and shrublands dominated by *Cercocarpus ledifolius*. *Artemisia tridentata* ssp. *vaseyana, Purshia tridentata*, with species of *Arctostaphylos, Ribes*, or *Symphoricarpos* are often present. Undergrowth is often very sparse and dominated by bunch grasses, usually *Pseudoroegneria spicata* and *Festuca idahoensis*. *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that generally does not resprout after burning and needs the protection from fire that rocky sites provide.
Range: This system occurs in hills and mountain ranges of the Intermountain West from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains.
Subnations: CA, CO, ID, MT, NV, OR, UT, WY

CES304.776 INTER-MOUNTAIN BASINS ASPEN-MIXED CONIFER FOREST AND WOODLAND
Division 304 (Inter-Mountain Basins); Forest and Woodland

Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Aspen – Conifer Mix
Concept Summary: This ecological system occurs on montane slopes and plateaus in Utah, western Colorado, northern Arizona, eastern Nevada, southern Idaho, western Wyoming, and in north-central Montana in the Big Snowy Mountains. Elevations range from 1700 to 2800 m. Occurrences are typically on gentle to steep slopes on any aspect but are often found on clay-rich soils in intermontane valleys. Soils are derived from alluvium, colluvium, and residuum from a variety of parent materials but most typically occur on sedimentary rocks. The tree canopy is composed of a mix of deciduous and coniferous species, codominated by *Populus tremuloides*

and conifers. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species become dominant. Common shrubs include *Amelanchier alnifolia, Prunus virginiana, Acer grandidentatum, Symphoricarpos oreophilus, Juniperus communis, Paxistima myrsinites, Rosa woodsii, Spirea betulifolia, Symphoricarpos albus,* or *Mahonia repens.* Herbaceous species include *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp., and *Achnatherum, Hesperostipa, Nassella,* and/or *Piptochaetium* spp. (=*Stipa* spp.), *Achillea millefolium, Arnica cordifolia,* Asteraceae spp., *Erigeron* spp., *Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi* (=*chilensis*), and *Thalictrum fendleri.* Most occurrences at present represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system. This is the typical meadow edge aspen-conifer setting in the Sierra Nevada where frequently, due to fire suppression, the conifers are replacing aspen.
Range: Occurs on montane slopes and plateaus in Utah, western Colorado, northern Arizona, eastern Nevada, southern Idaho, western Wyoming (in the Bighorn Mountains), and in north-central Montana in the Big Snowy Mountains. Elevations range from 1700 to 2800 m.
Subnations: AZ, CO, ID, MT, NV, UT, WY

CES304.787 INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND

Division 304 (Inter-Mountain Basins); Herbaceous

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland Foothill; Herbaceous; Temperate Xeric; Alkaline Soil; Aridic; Graminoid
Concept Summary: This widespread ecological system occurs throughout the intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesatops, plateau parks, alluvial flats, and plains, but sites are typically xeric. Substrates are often well-drained sandy or loamy-textured soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. When they occur near foothill grasslands they will be at lower elevations. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. These grasslands are typically dominated or by *Achnatherum hymenoides, Aristida* spp., *Bouteloua gracilis, Hesperostipa comata, Muhlenbergia* sp., or *Pleuraphis jamesii* and may include scattered shrubs and dwarf-shrubs of species of *Artemisia, Atriplex, Coleogyne, Ephedra, Gutierrezia*, or *Krascheninnikovia lanata*.
Range: Occurs throughout the Intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) in elevation.
Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

CES304.789 INTER-MOUNTAIN BASINS SHALE BADLAND

Division 304 (Inter-Mountain Basins); Barren

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lowland; Badlands; Alkaline Soil; Shale and Mudstone; Silt Soil Texture; Clay Soil Texture
Concept Summary: This widespread system of the intermountain western U.S. is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from marine shales but also from siltstones and mudstones (clay). Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs, e.g., *Atriplex corrugata, Atriplex gardneri, Artemisia pedatifida,* and herbaceous vegetation.
Range: This system is found in the intermountain western U.S. It is confirmed by Oregon and Washington review to not occur in either of those states.
Subnations: AZ, CA, CO, ID, MT, NM, NV, UT, WY

CES304.790 INTER-MOUNTAIN BASINS SUBALPINE LIMBER-BRISTLECONE PINE WOODLAND
Division 304 (Inter-Mountain Basins); Forest and Woodland

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Upper Montane; Forest and Woodland; Ridge; Ridge/Summit/Upper Slope; Temperate Continental; Xeric; *Pinus longaeva, Pinus flexilis*
Concept Summary: This ecological system extends from the Mojave Desert and Sierra Nevada across the central Great Basin to the central Wasatch and western Uinta mountains. These open woodlands are typically found on high-elevation ridges and rocky slopes above subalpine forests and woodlands. Sites are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone or granitic rocks. Occurrences can be found on all aspects but are more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet). Stands are strongly dominated by *Pinus flexilis* and/or *Pinus longaeva*. *Pinus monophylla* may be present in lower-elevation stands. If present, shrub and herbaceous layers are generally sparse and composed of xeric shrubs, graminoids and cushion plants. Associated species may include *Antennaria rosea*, *Arenaria kingii*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Chamaebatiaria millefolium*, *Cymopterus cinerarius*, *Erigeron pygmaeus*, *Eriogonum ovalifolium*, *Festuca brachyphylla*, *Koeleria micrantha*, *Leptodactylon pungens*, *Ribes cereum*, or *Ribes montigenum*.
Range: This system extends from the Mojave Desert and Sierra Nevada across the Great Basin to the central Wasatch and extreme western Uinta mountains.
Subnations: CA, NV, UT

CES306.648 SOUTHERN ROCKY MOUNTAIN PONDEROSA PINE WOODLAND
Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Ridge/Summit/Upper Slope; Very Shallow Soil; Mineral w/ A-Horizon <10 cm; Sand Soil Texture; Aridic; Intermediate Disturbance Interval; F-Patch/Medium Intensity; Needle-Leaved Tree; *Pinus ponderosa* with shrubby understory
Concept Summary: This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains, from the Greater Yellowstone region south. It is also found in the Colorado Plateau region, west into scattered locations of the Great Basin. Its easternmost extent in Wyoming is in the Bighorn Mountains. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in northern Wyoming to 2800 m in the New Mexico mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on soils derived from igneous, metamorphic, and sedimentary material, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030) in the eastern Cascades, Okanogan, and northern Rockies regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the central Rockies. *Pinus ponderosa* (primarily var. *scopulorum* and var. *brachyptera*) is the predominant conifer; *Pseudotsuga menziesii, Pinus edulis, Pinus contorta, Populus tremuloides*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova, Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus montanus, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Symphoricarpos* spp., *Prunus virginiana, Amelanchier alnifolia* (less so in Montana), and *Rosa* spp. common species. *Pseudoroegneria spicata, Pascopyrum smithii*, and species of *Hesperostipa, Achnatherum, Festuca, Muhlenbergia*, and *Bouteloua* are some of the common grasses. Mixed fire regimes and ground fires of variable return intervals maintain these woodlands, depending on climate, degree of soil development, and understory density.
Comments: This system intergrades with Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649). They are distinguished by the high-frequency, surface-fire regime, less steep or rocky environmental setting, and more open grassy understory structure of the savanna system. Ponderosa pine woodlands, savannas, and "escarpments" of central and eastern Montana, eastern Wyoming, the Black Hills region, western Dakotas, and Nebraska are now included in Northwestern Great Plains - Black Hills Ponderosa Pine Woodland and Savanna (CES303.650).
Range: This system is found throughout much of the Rocky Mountains, from northwestern Wyoming through the Rocky Mountains of Colorado and into New Mexico. In Arizona, it occurs on the Mogollon Rim north into the Colorado Plateau and west into the Great Basin.
Subnations: AZ, CO, ID?, NM, NV, UT, WY

CES306.813 ROCKY MOUNTAIN ASPEN FOREST AND WOODLAND

Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland; Long Disturbance Interval; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Broad-Leaved Deciduous Tree; *Populus tremuloides*

Concept Summary: This widespread ecological system is more common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S. and into Canada. In California, this system is only found in the Inyo and White mountains, while small stands occur on the Modoc Plateau. Elevations generally range from 1525 to 3050 m, but occurrences can be found at lower elevations in some regions. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand. Secondarily, it is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. In California, *Symphyotrichum spathulatum* is a common forb. Associated shrub species include *Symphoricarpos* spp., *Rubus parviflorus, Amelanchier alnifolia*, and *Arctostaphylos uva-ursi*. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease, windthrow, or cutting by man or beaver.
Range: This system is more common in the southern and central Rocky Mountains, but it does occur in the montane and subalpine zones throughout much of the western U.S. and north into Canada, as well as west into California. Elevations generally range from 1525 to 3050 m, but occurrences can be found at lower elevations in some regions.
Subnations: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

CES306.816 ROCKY MOUNTAIN ALPINE TURF

Division 306 (Rocky Mountain); Herbaceous

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Oligotrophic Soil; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Very Long Disturbance Interval; Graminoid; Alpine Slopes
Concept Summary: This widespread ecological system occurs above upper treeline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and isolated alpine sites in the northeastern Cascades. It 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. This system is characterized by a dense cover of low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Dominant species include *Artemisia arctica, Carex elynoides, Carex siccata, Carex scirpoidea, Carex nardina, Carex rupestris, Festuca brachyphylla, Festuca idahoensis, Geum rossii, Kobresia myosuroides, Phlox pulvinata*, and *Trifolium dasyphyllum*. Many other graminoids, forbs, and prostrate shrubs can also be found, including *Calamagrostis purpurascens, Deschampsia caespitosa, Dryas octopetala, Leucopoa kingii, Poa arctica, Saxifraga* spp., *Selaginella densa, Sibbaldia procumbens, Silene acaulis, Solidago* spp., and *Trifolium parryi*. Although alpine dry tundra is the matrix 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.
Range: This system occurs above upper treeline throughout the North American Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, central Wyoming, and isolated alpine sites in the northeastern Cascades.
Subnations: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY

CES306.822 ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL SHRUBLAND
Division 306 (Rocky Mountain); Shrubland

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane, Lower Montane; Lowland [Foothill]; Shrubland; Very Shallow Soil; Aridic; Intemediate Disturbance Interval [Periodicity/Polycyclic Disturbance]
Concept Summary: This ecological system is found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico north into Wyoming, and west into the Intermountain basins. These shrublands occur between 1500-2900 m elevation and are usually associated with exposed sites, rocky substrates, and dry conditions that limit tree growth. It is common where *Quercus gambelii* is absent such as the northern Colorado Front Range and in drier foothills and prairie hills. This system is generally drier than Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818), but may include mesic montane shrublands where *Quercus gambelii* does not occur. Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs including *Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata, Rhus trilobata, Ribes cereum, Symphoricarpos oreophilus,* or *Yucca glauca*. In northeastern Wyoming and adjacent Montana, *Cercocarpus ledifolius*, usually with *Artemisia tridentata*, is the common dominant shrub. Grasses include species of *Muhlenbergia, Bouteloua, Hesperostipa,* and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have severe die-back, although some species will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed or root crown sprouting. Fire suppression may allow an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth.
Range: Foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico extending north into Wyoming, and west into the Intermountain region.
Subnations: CO, MT, NE?, NM, SD, UT, WY

CES306.823 SOUTHERN ROCKY MOUNTAIN DRY-MESIC MONTANE MIXED CONIFER FOREST AND WOODLAND
Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Montane [Lower Montane]; Forest and Woodland; Aridic; Intermediate Disturbance Interval; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Needle-Leaved Tree; Montane Mesic Mixed Conifer; Moderate (100-500 yrs) Persistence
Concept Summary: This is a highly variable ecological system of the montane zone of the Rocky Mountains. It occurs throughout the southern Rockies, north and west into Utah, Nevada, western Wyoming and Idaho. These are mixed-conifer forests occurring on all aspects between 1200 and 3300 m elevation. Rainfall averages less than 75 cm per year (40-60 cm) with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence. *Pseudotsuga menziesii* and *Abies concolor* are most frequent, but *Pinus ponderosa* may be present to codominant. *Pinus flexilis* is common in Nevada. *Pseudotsuga menziesii* forests occupy drier sites, and *Pinus ponderosa* is a common codominant. *Abies concolor*-dominated forests occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. *Picea pungens* is most often found in cool, moist locations, often occurring as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub and graminoid species common, including *Arctostaphylos uva-ursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, Quercus gambelii*, and *Festuca arizonica*. This system was undoubtedly characterized by a mixed severity fire regime in its "natural condition," with a high degree of variability in intensity and return interval.
Range: Occurs throughout the southern Rockies into Utah, Nevada, Wyoming and Idaho.
Subnations: AZ, CO, ID, NV, OR, UT, WY

CES306.824 SOUTHERN ROCKY MOUNTAIN MONTANE-SUBALPINE GRASSLAND
Division 306 (Rocky Mountain); Herbaceous

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Acidic Soil; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Silt Soil Texture; Aridic; Short Disturbance Interval; Graminoid; Cool-season bunch grasses
Concept Summary: This Rocky Mountain ecological system typically occurs between 2200 and 3000 m elevation on flat to rolling plains and parks 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. An occurrence usually consists of a mosaic of two or three plant associations with one of the following dominant bunch grasses: *Danthonia intermedia, Danthonia parryi, Festuca idahoensis, Festuca arizonica, Festuca thurberi, Muhlenbergia filiculmis,* or *Pseudoroegneria spicata.* The subdominants include *Muhlenbergia montana, Bouteloua gracilis,* and *Poa secunda.* 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.

Range: This system occurs between 2200 and 3000 m elevation in the Colorado Rockies. Where it transitions in Wyoming to Northern Rocky Mountain Subalpine-Upper Montane Grassland (CES306.806) still needs to be clarified.
Subnations: AZ, CO, NM, UT, WY

CES306.825 SOUTHERN ROCKY MOUNTAIN MESIC MONTANE MIXED CONIFER FOREST AND WOODLAND
Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland; Ravine; Stream terrace (undifferentiated); Toeslope; Mesotrophic Soil; Ustic; Long Disturbance Interval; F-Patch/Low Intensity; F-Landscape/Low Intensity; Needle-Leaved Tree; Montane Dry-Mesic Mixed Conifer
Concept Summary: These are mixed conifer forests of the Rocky Mountains west into the ranges of the Great Basin, usually limited to cool ravines and north-facing slopes. Elevations range from 1200 to 3300 m. Occurrences of this system are found on cooler and more mesic sites than Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823). Sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions and cool slopes. *Pseudotsuga menziesii* and *Abies concolor* are common canopy dominants, but *Picea engelmannii, Picea pungens*, or *Pinus ponderosa* may be present. This system includes mixed conifer/aspen stands. A number of cold-deciduous shrub species can occur, including *Acer glabrum, Acer grandidentatum, Alnus incana, Betula occidentalis, Cornus sericea, Jamesia Americana, Physocarpus malvaceus, Robinia neomexicana, Vaccinium membranaceum*, and *Vaccinium myrtillus*. Herbaceous species include *Bromus ciliatus, Carex geyeri, Carex rossii, Carex siccata, Muhlenbergia virescens, Pseudoroegneria spicata, Erigeron eximius, Fragaria virginiana, Luzula parvifolia, Osmorhiza berteroi, Packera cardamine, Thalictrum occidentale,* and *Thalictrum fendleri*. Naturally occurring fires vary in their return interval; most are light, erratic, and infrequent due to the cool, moist conditions.
Comments: This system will need to be modeled to separate from similar dry-mesic system.
Range: This system is found in the Southern Rocky Mountains of Arizona and New Mexico north and west into the ranges of the Great Basin, Wyoming and southeastern Idaho, orrurring predominantly in cool ravines and on north-facing slopes.
Subnations: AZ, CO, ID, NM, NV, OR?, UT, WY

CES306.828 ROCKY MOUNTAIN SUBALPINE DRY-MESIC SPRUCE-FIR FOREST AND WOODLAND
Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Forest and Woodland (Treed); Acidic Soil; Ustic; Very Long Disturbance Interval [Seasonality/Summer Disturbance]; F-Patch/High

Intensity; F-Landscape/High Intensity; Needle-Leaved Tree; *Abies lasiocarpa – Picea engelmanii*; RM Subalpine Mesic Spruce-Fir; Long (>500 yrs) Persistance
Concept Summary: Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, and south into New Mexico and the Intermountain region. They are the matrix forests of the subalpine zone, with elevations ranging from 1275 m in its northern distribution to 3355 m in the south (4100-11,000 feet). They often represent the highest elevation forests in an area. Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pseudotsuga menziesii* may persist in occurrences of this system for long periods without regeneration. *Pinus contorta* is common in many occurrences, and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Upper elevation examples may have more woodland physiognomy, and *Pinus albicaulis* can be a seral component. What have been called "ribbon forests" or "tree islands" by some authors are included here; they can be found at upper treeline in many areas of the Rockies, including the central and northern ranges in Colorado and the Medicine Bow and Bighorn ranges of Wyoming. These are more typically islands or ribbons of trees, sometimes with a krummholz form, with open-meadow areas in a mosaic. These patterns are controlled by snow deposition and wind-blown ice. Xeric species may include *Juniperus communis, Linnaea borealis, Mahonia repens*, or *Vaccinium scoparium*. In the Bighorn Mountains, *Artemisia tridentata* is a common shrub. More northern occurrences often have taller, more mesic shrub and herbaceous species, such as *Empetrum nigrum, Rhododendron albiflorum*, and *Vaccinium membranaceum*. Disturbance includes occasional blowdown, insect outbreaks and stand-replacing fire.
Range: This system is found in the Cascades and Rocky Mountains from southern interior British Columbia east into Alberta, south into New Mexico and the Intermountain region. This type tends to be very limited in the northern Oregon Cascades.
Subnations: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY

CES306.829 ROCKY MOUNTAIN SUBALPINE-MONTANE MESIC MEADOW

Division 306 (Rocky Mountain); Herbaceous

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Herbaceous; Silt Soil Texture; Clay Soil Texture; Udic; Forb
Concept Summary: This Rocky Mountain ecological system is restricted to sites from lower montane to subalpine where finely textured soils, snow deposition, 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. It 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 Rocky Mountain Alpine-Montane Wet Meadow (CES306.812). Vegetation is typically forb-rich, with forbs often contributing more to overall herbaceous cover than graminoids. 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., Asteraceae spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Thalictrum occidentale, Valeriana sitchensis, Rudbeckia occidentalis, Balsamorhiza sagittata*, and *Wyethia* spp. Important grasses include *Deschampsia caespitosa, Koeleria macrantha*, perennial *Bromus* spp., and a number of *Carex* species. *Dasiphora fruticosa ssp. floribunda* and *Symphoricarpos* spp. are occasional but not abundant. Burrowing mammals can increase the forb diversity.
Range: This system is very widespread in the Rocky Mountain cordillera from New Mexico north into Canada. It probably occurs in the Black Hills region, as well as the "island ranges" of central Montana.
Subnations: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY

CES306.830 ROCKY MOUNTAIN SUBALPINE MESIC-WET SPRUCE-FIR FOREST AND WOODLAND
Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Forest and Woodland (Treed); Acidic Soil; Udic; Very Long Disturbance Interval [Seasonality/Summer Disturbance]; F-Patch/High Intensity; F-Landscape/Medium Intensity; *Abies lasiocarpa – Picea engelmanii*; RM Subalpine Dry-Mesic Spruce-Fir; Long (>500 yrs) Persistance
Concept Summary: This is a high-elevation system of the Rocky Mountains, dry eastern Cascades and eastern Olympic Mountains dominated by *Picea engelmannii* and *Abies lasiocarpa*. *Picea engelmannii* is generally more important in southern forests than those in the Pacific Northwest. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. Mesic understory shrubs include *Menziesia ferruginea, Vaccinium membranaceum, Rhododendron albiflorum, Amelanchier alnifolia, Rubus parviflorus, Ledum glandulosum, Phyllodoce empetriformis*, and *Salix* spp. Herbaceous species include *Actaea rubra, Maianthemum stellatum, Cornus canadensis, Erigeron eximius, Gymnocarpium dryopteris, Rubus pedatus, Saxifraga bronchialis, Tiarella* spp., *Lupinus arcticus ssp. subalpinus, Valeriana sitchensis*, and graminoids *Luzula glabrata var. hitchcockii* or *Calamagrostis canadensis*. Disturbances include occasional blowdown, insect outbreaks (30-50 years), mixed-severity fire, and stand-replacing

fire (every 150-500 years). The more summer-dry climatic areas also have occasional high-severity fires.
Range: This system is found at high elevations of the Rocky Mountains, extending west into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington, and as far east as mountain "islands" of north-central Montana.
Subnations: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY

CES306.835 SOUTHERN ROCKY MOUNTAIN PINYON-JUNIPER WOODLAND
Division 306 (Rocky Mountain); Woodland

Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Very Shallow Soil; Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Long Disturbance Interval; Needle-Leaved Tree; *Pinus edulis, Juniperus monosperma*
Concept Summary: This southern Rocky Mountain ecological system occurs on dry mountains and foothills in southern Colorado east of the Continental Divide, in mountains and plateaus of north-central New Mexico, and extends out onto limestone breaks in the southeastern Great Plains. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus monosperma* dominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus monosperma* at higher elevations. Stands with *Juniperus osteosperma* are representative the Colorado Plateau and are not included in this system. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species are more typical of southern Rocky Mountains than the Colorado Plateau and include *Artemisia bigelovii, Cercocarpus montanus, Quercus gambelii, Achnatherum scribneri, Bouteloua gracilis, Festuca arizonica*, or *Pleuraphis jamesii*.
Range: This system occurs on dry mountains and foothills in southern Colorado, in mountains and plateaus of northern New Mexico and Arizona, and extends out onto breaks in the Great Plains. It extends south to the Sacramento Mountains, especially the eastern side. The western side has Madrean elements (*Quercus grisea*) and may be classified as Madrean woodland.
Subnations: CO, NM

CES306.955 ROCKY MOUNTAIN FOOTHILL LIMBER PINE-JUNIPER WOODLAND
Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Sand Soil Texture; Aridic; Long Disturbance Interval; F-Patch/High Intensity; Needle-Leaved Tree; *Pinus flexilis, Juniperus scopulorum, J. osteosperma*

Concept Summary: This ecological system occurs in foothill and lower montane zones in the Rocky Mountains from northern Montana south to central Colorado and on escarpments across Wyoming extending out into the western Great Plains. Elevation ranges from 1000-2400 m. It occurs generally below continuous forests of *Pseudotsuga menziesii* or *Pinus ponderosa* and can occur in large stands well within the zone of continuous forests in the northeastern Rocky Mountains. It is restricted to shallow soils and fractured bedrock derived from a variety of parent material, including limestone, sandstone, dolomite, granite and colluvium. Soils have a high rock component (typically over 50% cover) and are coarse- to fine-textured, often gravelly and calcareous. Slopes are typically moderately steep to steep. At higher elevations, it is limited to the most xeric aspects on rock outcrops, and at lower elevations to the relatively mesic north aspects. Fire is infrequent and spotty because rocky substrates prevent a continuous vegetation canopy needed to spread. Vegetation is characterized by an open-tree canopy or patchy woodland that is dominated by either *Pinus flexilis, Juniperus osteosperma*, or *Juniperus scopulorum*. *Pinus edulis* is not present. A sparse to moderately dense short-shrub layer, if present, may include a variety of shrubs, such as *Arctostaphylos uva-ursi, Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus montanus, Dasiphora fruticosa ssp. floribunda, Ericameria nauseosa, Juniperus horizontalis, Purshia tridentata, Rhus trilobata, Rosa woodsii, Shepherdia canadensis* (important in Montana stands), *Symphoricarpos albus*, or *Symphoricarpos oreophilus*. Herbaceous layers are generally sparse, but range to moderately dense, and are typically dominated by perennial graminoids such as *Bouteloua gracilis, Festuca idahoensis, Festuca campestris, Danthonia intermedia, Leucopoa kingii, Hesperostipa comata, Koeleria macrantha, Piptatherum micranthum, Poa secunda*, or *Pseudoroegneria spicata*. Within this ecological system, there may be small patches of grassland or shrubland composed of some of the above species. In Wyoming, some limber pine stands are found up to 2440 m (8000 feet) elevation and are still included in this system.
Range: This system occurs in foothill and lower montane zones in the Rocky Mountains from northern Montana south to central Colorado and on escarpments across Wyoming, extending out into the western Great Plains. Elevation ranges from 1000-2400 m. This system may also occur in southeastern Idaho, though it would not be common there. It is also very likely to occur north into Canada along the Front Range of Alberta, in similar ecological settings.
Subnations: CO, MT, ND, SD, WY

RIPARIAN AND WETLAND ECOLOGICAL SYSTEMS

CES304.084 COLUMBIA PLATEAU SILVER SAGEBRUSH SEASONALLY FLOODED SHRUB-STEPPE

Division 304 (Inter-Mountain Basins); Woody Wetland

Spatial Scale & Pattern: Small Patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Lowland]; Playa; Temperate [Temperate Xeric]; Depressional; Impermeable Layer; Intermittent Flooding

Concept Summary: This ecological system includes sagebrush communities occurring at lowland and montane elevations in the Columbia Plateau-northern Great Basin region, east almost to the Great Plains. These are generally depressional wetlands or non-alkaline playas, occurring as small- or occasionally large-patch communities, in a sagebrush or montane forest matrix. Climate is generally semi-arid, although it can be cool in montane areas. This system occurs in poorly drained depressional wetlands, the largest characterized as playas, the smaller as vernal pools, or along seasonal stream channels in valley bottoms or mountain meadows. *Artemisia cana ssp. bolanderi* or *Artemisia cana ssp. viscidula* are dominant, with *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis*, or *Artemisia tridentata ssp. vaseyana* occasionally codominant; *Dasiphora fruticosa ssp. floribunda* can also be codominant. Understory graminoids and forbs are characteristic, with *Poa secunda (= Poa nevadensis), Poa cusickii, Festuca idahoensis, Muhlenbergia filiformis, Muhlenbergia richardsonis*, and *Leymus cinereus* dominant at the drier sites; *Eleocharis palustris, Deschampsia caespitosa*, and *Carex* species dominate at wetter or higher-elevation sites.
Range: This ecological system includes sagebrush communities occurring at lowland and montane elevations in the Columbia Plateau-northern Great Basin region, east almost to the Great Plains.
Subnations: CA, CO?, ID, MT, NV, OR, UT?, WA?, WY

CES306.812 ROCKY MOUNTAIN ALPINE-MONTANE WET MEADOW

Division 306 (Rocky Mountain); Herbaceous Wetland

Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AntiAldino]; Montane [Upper Montane]; Herbaceous; Seepage-Fed Sloping [Mineral]; Depressional [Lakeshore]; Depressional [Pond]; Graminoid
Concept Summary: These are high-elevation communities found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from montane to alpine (1000-3600 m). These types occur as large meadows in montane or subalpine valleys, 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 sub-irrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Calamagrostis stricta, Caltha leptosepala, Cardamine cordifolia, Carex illota, Carex microptera, Carex nigricans, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia caespitosa, Eleocharis quinqueflora, Juncus drummondii, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi*, and *Trollius laxus*. Often alpine dwarf-shrublands, especially those dominated by *Salix*, are immediately adjacent to the wet meadows. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

Range: This system is found throughout the Rocky Mountains and Intermountain West regions, ranging in elevation from montane to alpine (1000-3600 m).
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

CES306.821 ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL RIPARIAN WOODLAND AND SHRUBLAND
Division 306 (Rocky Mountain); Woody Wetland

Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Lower Montane; Riverine / Alluvial; Mineral: W/ A-Horizon <10 cm; Unconsolidated; Short (<5 yrs) Flooding Interval; Short (50-100 yrs) Persistence
Concept Summary: This system is found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 to 2800 m. This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. They can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. Dominant trees may include *Acer negundo, Populus angustifolia, Populus balsamifera, Populus deltoides, Populus fremontii, Pseudotsuga menziesii, Picea pungens, Salix amygdaloides*, or *Juniperus scopulorum*. Dominant shrubs include *Acer glabrum, Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens, Prunus virginiana, Rhus trilobata, Salix monticola, Salix drummondiana, Salix exigua, Salix irrorata, Salix lucida, Shepherdia argentea*, or *Symphoricarpos* spp. Exotic trees of *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands. Generally, the upland vegetation surrounding this riparian system is different and ranges from grasslands to forests.
Range: Found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 to 2800 m.
Subnations: AZ, CO, ID, MT, NM, NV, OR, SD, UT, WY

CES306.832 ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN SHRUBLAND
Division 306 (Rocky Mountain); Woody Wetland

Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Shrubland (Shrub-dominated); Riverine / Alluvial; Broad-Leaved Deciduous Shrub; Short (<5 yrs) Flooding Interval; RM Subalpine/Montane Riparian Woodland; Short (50-100 yrs) Persistence
Concept Summary: This system is found throughout the Rocky Mountain cordillera, from New Mexico north into Montana, and also occurs in mountainous areas of the Intermountain region and 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 it is found at higher elevations, but can be found anywhere from 1700-3475 m. 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 system are associated with beaver activity. This system often occurs as 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 dominant shrubs reflect the large elevational gradient 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 riparian systems are of either conifer or aspen forests.
Range: This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana (including the isolated island mountain ranges of central and eastern Montana), and also occurs in mountainous areas of the Intermountain West and Colorado Plateau.
Subnations: AZ, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

CES306.833 ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN WOODLAND
Division 306 (Rocky Mountain); Woddy Wetland

Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Montane, Upper Montane; Forest and Woodland; Riverine / Alluvial; Short (<5 yrs) Flooding Interval; Subalpine/Montane Riparian Shrubland
Concept Summary: This riparian woodland system is comprised of seasonally flooded forests and woodlands found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into Intermountain basins and the Colorado Plateau. It occurs throughout the interior of British Columbia and the eastern slopes of the Cascade Mountains. This system contains the conifer and aspen woodlands that line montane streams. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture in this system may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500 and 3300 m (4920-10,830 feet), farther north elevation ranges between 900 and 2000 m. This is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderate-wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Dominant tree species vary across the latitudinal range, although it usually includes *Abies lasiocarpa* and/or *Picea engelmannii*; other important species include *Pseudotsuga menziesii, Picea pungens, Populus tremuloides*, and *Juniperus scopulorum*. Non-dominant trees may include *Alnus incana, Abies concolor, Abies grandis, Pinus contorta, Populus angustifolia, Populus balsamifera* ssp. *trichocarpa*, and *Juniperus osteosperma*.
Range: This system is found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Alberta and British Columbia, and west into the Intermountain region and the Colorado Plateau.
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

Appendix B. Plot, Observation Point, Accuracy Assessment Point Instructions and Data Forms

Introduction

This appendix contains the forms and instruction manuals used in collecting field data for the Vegetation Mapping Project at Cedar Breaks National Monument. Two types of data were collected: vegetation plot (or observation point for larger, undefined plot area) and accuracy assessment point. Vegetation plots were used primarily in developing the NVC classification for the park. They were also used by photointerpreters to help recognize aerial photo signatures. Observation points were used primarily for assisting with photointerpretation, and secondarily for supporting NVC association descriptions and documenting non-standard vegetation types. Accuracy assessment data were used primarily for testing the thematic accuracy of the vegetation map and secondarily to support NVC association descriptions.

B.1. Plot and Observation Point Field Sampling Manual

FIELD SAMPLING AT BRYCE CANYON NATIONAL PARK AND CEDAR BREAKS NATIONAL MONUMENT

A Basic Guide for Field Work

This document is intended to assist you in conducting vegetation mapping and fuels data collection at Bryce Canyon National Park (BRCA) and Cedar Breaks National Monument (CEBR) during the 2005 field season. Detailed, field-by-field instructions for data collection are provided. These are abbreviated on 'cheat sheets' at the end of each section. This project is being directed by the Northern Colorado Plateau Network (NCPN) Inventory and Monitoring Program with assistance from environmental engineering management (e^2M) and Nature Serve.

NAVIGATING TO PLOT

You will navigate towards each selected Biophysical Unit (BPU) using BPU maps, park maps, topographic maps, handheld GPS receivers and aerial photos.

- BPU maps will identify the location, size and shape of the polygon.
- Topography (Topo) maps are useful in identifying the landscape through which you will be navigating, and in determining the elevation of a plot. You will find them more legible than the BPU maps in reading the names of features as well.
- GPS receivers indicate the direction and the distance (as the crow flies) to the centroid, the center of the BPU. The centroid is the center of the measured area of a given BPU, but that center does not always land in what appears to be the center of oddly shaped polygons. Regardless of where the centroid is within the polygon, it is an important navigational guide to get you within the vegetative stand you need to sample. Do not blindly navigate to BPUs with your GPS unit, not being aware of canyons or other obstacles in your way. Use the aerial photos and topo maps to plan your route! ***Note***: *In very homogenous terrain, GPS the location of your vehicle so you can find your way back! This can also help in writing the directions to your plot.*
- Aerial photos aid in navigating through the landscape, and are essential in determining where to establish a plot (this will be explained in more detail). **Please** record the vegetation, and its condition, that you walk through and sample on the photo. Feel free to write comments regarding unique features as well.

Along the way...look around. Context is everything – you will have a much better sense of how your plots represent the landscape if you are always in analysis mode. Keep in mind that the goal of this field work is to sample **all** the different vegetation types that occur at the park. If, on the way to a BPU or plot, you see an assemblage of plants that seems unique and that is not included on the list of vegetation types, **please** sample if time allows, or at least complete an observation form. At the beginning of the field season a list of potential plant associations for the parks will be provided. As the season progresses, this list will be updated and you will be better able to recognize new plant alliances and associations more easily.

Park Special Features… in the process of navigating to plots you will encounter unique features or vegetative stands too small to sample, GPS them and note them on aerial photos and maps. These GPS points will be added to the final production map as "Park Special Features" (examples include large potholes, springs, hanging gardens, a small patch of cattails, etc). In particular, field crews are requested to document locations (GPS reading) of springs, seeps and hanging gardens and record very general

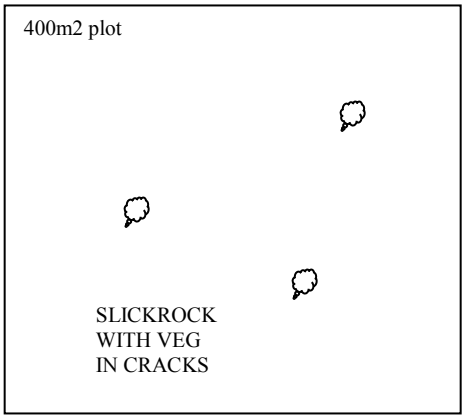
descriptive information on the Observation Point Form. General locations of significant weed occurrences (highly invasive species that pose a big threat) and large areas of infestation may also be documented. Finally, all NCPN parks are working on documenting with specimen vouchers all vascular plants in each park. Field crews will be supplied a working vascular plant species list for each park at the beginning of the field season. This list will indicate which plants are presently vouchered. Field crews are requested to collect herbarium quality specimens of park vascular plant species presently not represented in the collection. Please be careful not to collect extremely rare plants. In this case a photographic voucher would be in order.

ESTABLISHING A PLOT

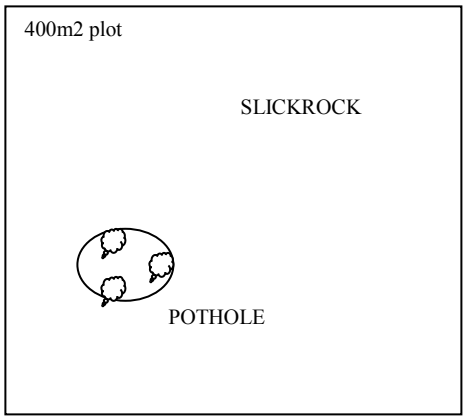
1. PLACEMENT OF PLOT

Figuring out where to place your plot is a subjective process. You'll want to place your plots in areas that seem to be both relatively **homogenous** and **representative** of the vegetation of the polygon as a whole. In other words, avoid areas where the vegetation appears to be transitioning from one type to another and areas with anomalous or heterogeneous structure or species composition. The photos will help you identify the different vegetation types available in each BPU to sample – similar color, pattern and texture usually indicate similar vegetation. Take some time and do this carefully, because some of the plots you set up may be re-sampled over time in order to determine responses to management and other useful things. Look at *all* the vegetation layers to determine if the area is structurally and floristically uniform and generally try to place your plots **at least** 30 m (100 ft) from what you see as the 'boundary' between this vegetation type and neighboring, different types. The exception to this rule is when you are sampling a unique type that is always going to occur in small patches and usually has sharp boundaries, such as a spring seep. ***Note***: In cases where a polygon is very heterogeneous, more than one plot may be needed. Again, look around; use your acquired knowledge and judgment.

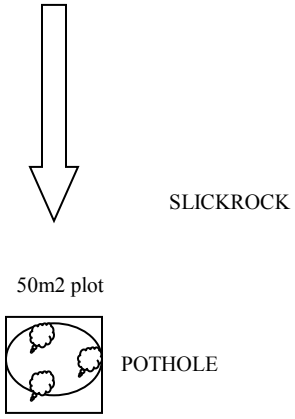
Placing a plot in slickrock/ rocky areas, where vegetation only occurs in cracks or pockets, can be particularly confusing. In these cases, there are two acceptable approaches: (1) find a pothole big enough to put a full-size plot in, or (2) use a smaller plot size and note in your comments fields that they are tiny islands in the "slickrock sea." Long, linear plots are usually a good way to handle sampling vegetation in cracks/joints. Do not place a plot which includes too much slickrock- sampling a plot that is 90% unvegetated distorts the vegetation information too much. If your plot contains less than 2% vegetative cover, it's too sparse to sample anyway and is considered a geologic type. The following diagrams will better illustrate plot placement in areas with extensive slickrock or other geology types and little vegetation:



400m2 plot OK!



400m2 plot NOT OK! Vegetation cover is hopelessly distorted by an excess of slickrock. Situation is analogous to including multiple vegetation types in a single plot.



In this case, use a small plot so as to exclude most of the unvegetated slickrock.

2. SIZE AND SHAPE OF PLOT

The chart on the next page indicates what size plot should be for each vegetation type. Because fuels data are being collected this year for BRCA/CEBR, a square 20m x 20m will be the standard employed in this project. In very limited circumstances where vegetation occurs in linear patterns, a rectangular plot may be required. For example, rectangles are ideal for ridgelines, hillsides, and riparian zones, or communities where the vegetation has a patchy or irregular distribution. Squares will be well-suited to very large, homogenous vegetative stands. Selecting the shape of the plot to fit it into a given sample area is fine, but please try not to make a plot smaller than the sizes listed below. **Make sure the type you are describing occupies an area of <u>at least</u> ½ hectare** (a circle approximately 80m in diameter!!). This is because the standard plot is about the size of a pencil point to the photo interpreter – even ½ hectare is only the size of a pea. Vegetative communities too small for a plot should be sampled as an Observation Point (instructions for points are after plots in this packet).

If you're in a ...	Square Plot, Homogenous Vegetation	Rectangular Plot, Heterogeneous Vegetation
Forest (i.e., trees have their crowns overlapping, usually 60-100% total cover)	400 m^2 20 x 20m	400 m^2 10 x 40m 5 x 80 m, etc.
Woodland (i.e., stands of trees with crowns usually not touching. Canopy tree cover is 10-60% **or** exceeds total shrub, dwarf-shrub, herb, and nonvascular cover).	400 m^2 20 x 20m	400 m^2 10 x 40m 5 x 80 m, etc.
Shrubland (i.e., shrubs greater than 0.5 m tall are dominant, usually with more than 25% cover **or** exceeding tree, dwarf-shrub, herb, and nonvascular cover).	400 m^2 20 x 20m	400 m^2 10 x 40m 5 x 80 m, etc.
Dwarf-shrubland (i.e., shrubs less than 0.5 m tall are dominant, usually with more than 25% cover OR exceeding tree, shrub, herb, and nonvascular cover).	100 m^2 10 x 10m	400 m^2 5 x 20m 2 x 50m, etc.
Shrub Herbaceous (i.e., forb and/or grass cover roughly equal to shrubs or dwarf shrubs).	100 m^2 10 x 10m	400 m^2 5 x 20m 2 x 50m, etc.
Herbaceous (i.e., herbs or grasses dominant, usually forming more than 25 percent cover).	100 m^2 10 x 10m	400 m^2 5 x 20m 2 x 50m, etc.
Nonvascular (i.e., lichen or moss cover dominant, usually forming more than 10% cover).	100 m^2 10 x 10m	25 m^2 1 x 25 m 2.5 x 10m, etc
Sparsely Vegetated (i.e. less than 10% cover). (If less than 2% cover, it's a geologic type- don't sample!)	1000 m^2	400 or 1000 m^2

VEGETATION PLOT SURVEY FORM INSTRUCTIONS - 2005

These instructions follow the 2005 version of the plot data sheet, field by field.

Please note that the Northern Colorado Plateau Network is has developed a GPS Data Dictionary for recording several fields associated with the Vegetation Plot Survey Form and Fuels Form. Please note that all data entered into the GPS unit will also be entered manually on the paper forms.

IDENTIFIERS/LOCATORS SECTION

Plot Code
This is a unique identifier you give each sample plot using the format "PARK.XXXX". Each field crew will be assigned a set of numbers to use (e.g., 0100-0299, 0300-0499, etc.). The same numbering convention will be used for observation points, except that the first digit is always "9". For example, the group using the numbers 101-199 would call their first plot "CEBR.0101" and their first observation point "CEBR.9101". **Please record the plot code on every side of every form in the provided field.**

Quad Name
Record the **full name** of the 7.5-minute quadrangle, such as "The Knoll".

BPU Code

The biophysical unit identified is the polygon identifier on the DRG map. If you have encountered a unique or new vegetative community that is not in a designated BPU, enter "None". Find the BPU number on your BPU list and write the number of the plot or observation point in the "Comments" box.

Aerial Photo Number

The photo number is in the upper right hand corner of the photo in the format FLIGHTLINE-FRAME #. Record this number on the form. Locate your plot on the photo, and mark your location with a dot in a circle and the plot number. *Again, please draw and comment on the photo regarding the vegetation of the plot and the surroundings.*

County

This field will be completed in the office as part of processing the GPS data.

State

This field will be completed in the office as part of processing the GPS data.

Site Name

This is best determined from a topo map. Select a nearby feature that is an obvious waypoint, such as the name of a canyon, road or arch (e.g. Upheaval Dome). This name does not need to be unique. If you sample a number of plots in a small area, you can use the same site name for all of them.

Location

This field identifies whether or not the plot is within the park boundary or in the environs. Circle the appropriate location.

Survey Date

Date the plot was sampled. Please use this format: Month - Day - Year.

Surveyors

List the last names of the field team members present.

GPS File Name – (only needs to be filled out if you're using a unit other than the Trimble GeoXM.) This is the name you give to the waypoint when you mark the plot location in your GPS unit. The GPS reading should be taken from the center of the plot. Please give the waypoint the same number as the plot, and the prefix "BP" for a Bryce Canyon plot (e.g., BP241 for plot #241). If doing an observation point, the file name would be "BO" and the number (e.g., BO9101 for point #101). Plot and observation points for CEBR can be labeled 'CP' and 'CO', respectively. Mark the plot location on the BPU map using the same method that you marked the aerial photo with (a dot with a circle around it and the plot number, "BP241").

Datum

ALWAYS check this on your GPS unit at the beginning of each day. It should **always** be NAD83. This information is **CRITICAL** for correctly applying your waypoints to the final vegetation map. If it is anything other than NAD83, **please, please, please** record this on the form. This step will keep your work from being wasted.

UTM Zone
This value is already entered on the datasheet as '12S', and will remain the same throughout the project area.

Field UTM X, Field UTM Y

Record the UTM easting and northing you saved as a waypoint in your GPS. Please double-check to make sure that the easting is six digits and the northing is seven digits. If recorded incorrectly, your plot will show up in Venezuela or the middle of the Caribbean.

In deep canyon country it is often difficult to get a GPS reading (your machine has to be able to see at least three or four satellites). If you are unable to get a GPS reading in the plot, or if the PDOP is greater than 8 (or EPE is greater than ±50m), first try to get a signal from a higher point outside (but still close to) the plot. If that fails, you will need to estimate the UTM coordinates from the topo map, and manually enter these UTMs into the GPS unit.

Use a map which is in NAD 83 if at all possible, since the project standard is the NAD83 datum. However, you may need to use USGS 7.5 minute maps, which use the NAD27 datum. The difference in this part of the world is that the NAD83 grid is shifted about 60m west and 200m north of NAD27. To ensure that all your plots show up in the right place, please use this procedure when estimating UTM coordinates from a NAD27 topo map:

1. Locate your plot as accurately as possible on the topo map, using triangulation or climbing to a high point.
2. Use the topo map, straightedge, pencil and a transparent overlay grid to obtain UTM coordinates in NAD27 (done carefully, you should be able to get to the nearest 10m). Write these coordinates down in the GPS Comments Field with the note "UTM coordinates derived from NAD27 topo map". DO NOT enter these in the UTM X and UTM Y fields.
3. Update the settings in your GPS unit to the NAD27 datum.
4. Create a new waypoint, give it the name of your plot, and enter the UTM coordinates you wrote down.

5. Update the settings in your GPS unit to the NAD83 datum. This will convert the NAD27 coordinates to NAD83 without screwing up the coordinates you already had in your machine (there may be rounding error). Enter the converted coordinates (now in NAD 83) into the UTM X and UTM Y fields.
6. Try to do this only once per hitch, because the more often you do it, the more likely it is that the rounding error will change the coordinates of your other (non-topo-derived) plots. You can do it in the office during datasheet cleanup and entry time.

GPS Unit

Record the name and model of the GPS unit being used to record data for the plot. If a GPS unit was not used to determine UTMs record 'none' here and be sure to complete the 'GPS Comments' field below.

GPS Error

Note the PDOP (or "Estimated Position Error" (EPE), if you're using a Garmin unit) displayed on your GPS unit. The lower the number, the more accurate your reading.

3D Differential?

Circle Y or N accordingly. 3D differential is obtained when your GPS unit can "see" a satellite that does nothing but correct the tiny errors in the positioning or clocks of other GPS satellites. This satellite broadcasts a real-time differential correction so that your location coordinates are as accurate as possible. It is in geosynchronous orbit in the southern sky, so if you can see the southern sky, you will generally be able to get 3D differential. This system is known as the Wide-Area Augmentation System, or WAAS. The Garmin and Trimble units have a field in their setup pages for turning WAAS on or off. Please make sure that WAAS is **always** on.

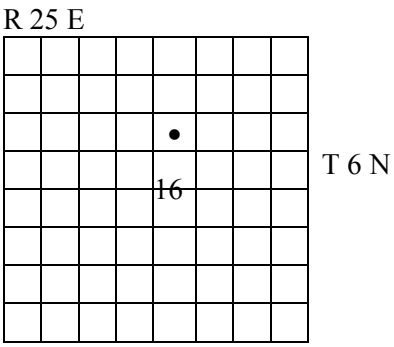
GPS Comments

VERY IMPORTANT: If you resorted to estimating the plot location UTMs on the topo map, note that in this field. If your usual GPS croaked and you had to borrow an old Magellan from a friend, note that. Also, if you left the plot to get a reading from a high point, record that here, along with the compass bearing and distance of the GPS location from the plot center (unless you used the offset function on the Trimble GeoXM- in that case, enter "point offset.")

Directions to Plot

Give precise directions to the plot beginning with a landmark (e.g., a named point on the topo map, a major highway, marked trailhead) readily locatable on a 7.5 minute topo map as the starting point. Use clear sentences that will be understandable to someone who is unfamiliar with the area and has only your directions to follow. Give distances and use compass directions. Be aware of the ambiguity of words like "above", "near", beyond", "on the back side of", "past". Again, using the GPS unit to give distances can be very helpful. If plot locations lack major landmark features as guides, use township, range and sections from the topo maps. If there are no features within a reasonable distance of your plot and writing directions is taking an inordinately long time, you can use a TRS description to the nearest quarter-quarter-quarter section. TRS directions are extremely error prone, so please have your field partner check it before you leave the plot. The TRS for the plot in the section below is "NW4SW4NE4 Sec. 16, T 6 N, R 25 E".

.



Note: Although most plots will not be permanently marked, park staff very much want to be able to relocate them for long-term vegetation monitoring purposes. Careful documentation of the stand characteristics, access route, obvious landmarks and vegetation is therefore extremely important. DO NOT use one plot to reference the location of another; TRS is preferable to this

Plot Diameter, Length, Width and Azimuth,

For square plots (20 x 20 m) please check the box. For rectangular plots record the length and width. Also record azimuth.

Photos Taken?

Circle Y or N accordingly for plot photos.

Camera Name and Model

Circle or enter the name and model of your camera

Photos: Type/Roll Number/Frame Number/Photographer/Direction and Comments

For each photo taken at the plot record the following: *Photo type* indicate whether photo is a 'plot', 'landscape' or 'biological crust' photo. *Roll number*: record roll number (Roll numbers should be a team member's initials plus a sequential number, which are written on the film before it goes into the camera.). *Frame number*: record frame number of photo. *Photographer*: record last name of person taking photograph. *Directions/Comments*: record the direction the photos were taken from and towards (e.g. SE→NW) and any other comments to clarify contents of the photo (especially landscape/scenery photos).

Taking Photographs

Take two color slides of each plot. The purpose is to get a good representation of the vegetation of the plot, not individual species. Try to include a little sky for perspective. For rectangular plots, please take the two photos from adjacent cardinal points around the plot (e.g., south and east or north and west). Photos at rectangular plots should be taken from opposite ends of the long side. Use a chalkboard to record the plot number and the direction the photo is taken. Thus, for rectangular plot 241, the board in the photo taken from the SE edge of the plot, facing NW, will read "BP241, SE→NW". Take the photograph looking across the contour if plot is on a steep slope. In addition, you will need to keep a photograph log for all photos not taken at plots.

If you are in a particularly nice, rare or representative stand, please take a third slide, without the signboard in it, from any position as long as it illustrates the community well (landscape).

CP241
SE→NW

Plot Representativeness

Representativeness of plot in stand: Does this sample represent the vegetative community within the surrounding area? If not, were additional plots taken? Note additional species occurring outside the plot but characteristic of the stand.

1. An example could be: "This stand is relatively large and very homogenous in species composition, although species density varies slightly. Pinyons are sparsely scattered throughout the stand but none are located inside the plot."
2. Another example: "The area around this plot encompasses a variety of elevations and aspects, but similar slopes. Multiple plots will be done in this stand. This plot represents a predominantly herbaceous community on a northern aspect."

Note: *Sometimes variation within an area is not large enough to sample, in which case you would describe surrounding communities in the "Other Comments" field on the back of the first data sheet.*

ENVIRONMENTAL DESCRIPTION SECTION

Elevation

Take this measurement from the GPS unit (if you are using the Trimble GeoXM), in meters. If you are using a different GPS unit, estimate the elevation from the topographic map. Specify on the data sheet whether the measurement is in feet or meters, and whether your elevation source was the GPS unit or the topo map.

Slope

Measure the slope in degrees using a clinometer. The degree scale is the left-hand scale as you look through the clinometer. If the slope varies in your plot, estimate an average. If the plot is on rolling microtopography, enter "variable." Describe these further under the Environmental Comments section.

Aspect

Measure the plot aspect in degrees using a compass (set for local magnetic declination, about 14 degrees east for Bryce Canyon). If the slope is flat, enter "n/a" for aspect. If the plot wraps around different aspects on a slope, enter "variable" and describe further under the Environmental Comments section.

Topographic Position

This is the position of the plot on its related landform. Determining this requires you to think of the landform in cross-section, which is roughly diagramed on the back of your cheat sheet. You **must** use the terms listed below:

Interfluve (crest, summit, ridge). Linear top of ridge, hill, or mountain; the elevated area between two drainages that sheds water to the drainages.
High slope (shoulder slope, upper slope, convex creep slope). The uppermost inclined surface at the top of a slope. Includes the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.
High level (mesa, summit). Level top of a plateau.
Midslope (transportational midslope). Intermediate slope position.
Backslope (dipslope). Subset of midslopes that are steep, linear, and may include cliff segments.
Step in slope (ledge, terracette). Nearly level shelf interrupting a steep slope, rock wall, or cliff face.
Lowslope (lower slope, foot slope, colluvial footslope). Inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope, and toeslope.
Toeslope (alluvial toeslope). Outermost gently inclined surface at base of a slope. In profile, usually gentle, linear and characterized by alluvial deposition.
Low level (terrace). Valley floor or shoreline representing the former position of an alluvial plain, or lake

Landform

Enter the landform(s) that describes the site where the plot was sampled. Referring to the topo map for the landscape context may help you decide what landform(s) to choose. Note that the landform choices may describe different scales, or that a landform feature can be described by more than one term. For example, your plot may be on a ledge on the rim of a canyon. A suggested list of landforms and definitions is provided in **APPENDIX 1.**

Note: *The topographic position selected above should relate to the scale of the landform chosen here.*

Surficial Geology
Note the geologic substrate where plant community occurs. The geology map should help, but if you can't tell the geology at all or you do not have the geology map with you at the plot, put a general description (e.g., coarse sandstone, green shale, aeolian sands or obscured by soils). Initial lists of BRCA and CEBR geologic strata are provided on the park-specific cheatsheets.

Cowardin System
The majority of the plots you'll be conducting will be "Uplands". Any wetland plots will be in the Palustrine category. This includes riparian, hanging garden and vernal pool wetlands. They are all fed by groundwater and support vascular plant communities.

> **Palustrine:** All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. This category also includes wetlands lacking such vegetation but with all of the following characteristics: (1) area less than 8 ha; (2) lacking an active wave-formed or bedrock boundary; (3) water depth in the deepest part of the basin less than 2 m (6.6 ft) at low water; and (4) ocean-derived salinities less than .5 parts per thousand.

Hydrology
This field will mostly be completed if you are in a wetland, however, some areas considered uplands may be subject to intermittent flooding. . Select from the following definitions (from Cowardin et al. 1979):

> **Permanently flooded.** Water covers the land surface at all times of the year in all years.
> **Semipermanently flooded.** Surface water persists throughout growing season in most years except during periods of drought. Land surface is normally saturated when water level drops below soil surface.
> **Seasonally flooded.** Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface.
> **Saturated.** Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.
> **Temporarily flooded.** Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain wetlands.
> **Intermittently flooded.** Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. This modifier was developed for use in the arid West for water regimes of playa lakes, intermittent streams, and dry washes but can be used in other parts of the U.S. where appropriate. This modifier can be applied to both wetland and non-wetland situations.
> **Unknown.** The water regime of the area is not known. The unit is labeled a non-tidal wetland.

Environmental Comments
Enter any additional noteworthy comments on the environmental setting and its effect on the vegetation. Examples include: "stunted trees due to shallow soils", "vegetation only where pockets of soil occur", or "large colluvial boulders and small rocks litter surface of soil". This field can also be used to describe site history such as fire events. This is an extremely important field for crews to document so please take the time to do a thorough job. Information from this field will be used to prepare local descriptions of the plant community and for photo interpretation.

Ground Cover
Estimate the approximate percentage of the *total* surface area covered by each category. The sum of all fields should equal 100%. A helpful hint in making ocular estimates is that in a 400 square meter plot, one

2 x 2m square is equal to 1%. The sum of the cover values should equal 100%. *Notes*: For estimating live litter and live wood, visualize cutting the vegetation off at ground level. The percent ground cover is how much space the stems take up. Estimating lichens, dark cyanobacteria and moss also take an extra step in visualization. Lichens often are growing on dark cyano mounds or on exposed bedrock, but your estimate needs to reflect the percentage of ground covered by lichens, and your estimates for dark cyano or bedrock will be for non-lichen-covered surfaces. Also note that it is possible to have bare soil and sand in a plot if sand has blown in, or to have sand on the surface of the plot but the soil test results in a texture other than sand because you are sampling below the surface. If a category is present but covers less than 1% (> 0.5%) of the ground, enter a "T" on the line next to it. If a category is present but covers a tiny bit (<0.5%) of ground, enter “t”.

Soil Texture

Use a trowel to dig a hole a few inches deep (this will vary with soil depth, of course) to expose the soil at root level, from where you will take a small handful of soil to sample. **APPENDIX 2** is a key to use when sampling soil texture, and an abbreviated version is on the cheat sheet. Check the appropriate field.

Soil Drainage

Soil drainage classes are defined in terms of (1) actual moisture content in excess of field moisture capacity and (2) the extent of the period during which excess water is present in the plant-root zone. Permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot generally be used as criteria of moisture status. Use the following definitions to determine soil drainage at your plot:

Rapidly drained. The soil moisture content seldom exceeds field capacity in any horizon except immediately after precipitation. Nearly all of the soils outside of wetlands, springs and floodplains will fall into this category. Rapidly drained soils are commonly coarse textured or soils on steep slopes located well above the water table. ***These soils are characterized by strictly upland species, including rabbitbrush.***

Well drained. The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 3 feet, but may be mottled below this depth. B horizons, if present, are reddish, brownish, or yellowish. ***Look for species that indicate periodic saturation, such as western wheatgrass, Great Basin wildrye, arctic rush or black greasewood.***

Moderately well drained. The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled (chroma < 2) in the lower B and C horizons or below a depth of 2 feet. The Ae horizon, if present, may be faintly mottled in fine-textured soils and in medium-textured soils that have a slowly permeable layer below the solum. In grassland soils the B and C horizons may be only faintly mottled and the A horizon may be relatively thick and dark. ***Soils in this category and the next three will typically support wetland plants.***

Somewhat poorly drained. The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons; the Ae horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well-drained soil on similar parent material.

Poorly drained. The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually very strongly gleyed. Except in high-chroma parent materials the B, if present, and upper C horizons usually have matrix colors of low chroma. Faint mottling may occur throughout.

Very poorly drained. Free water remains at or within 12 inches of the surface most of the year. The soils are usually very strongly gleyed. Subsurface horizons usually are of low chroma and yellowish

to bluish hues. Mottling may be present but at the depth in the profile. Very poorly drained soils usually have a mucky or peaty surface horizon.

Animal Use Evidence

Comment on any evidence of use of the plot and BPU by non-domestic animals (i.e., tracks, scat, burrows, etc.). Notes on domestic animals (grazing) should be made in the next field.

Natural and Anthropogenic Disturbance

Comment on any evidence of natural or anthropogenic disturbance and specify the source, severity and effects on the vegetation. Common disturbances in plots are water gullies, colluvial deposition of rocks on slopes, flash flooding and sometimes old tin cans from cowboys or miners. Notes on livestock grazing are included in this field. Other disturbances you may encounter in the buffer include off-road vehicle use, fire, mass-wasting.

Other Comments

Record any other comments. What is the extent of the community you sampled? Describe the landscape context of the community. Describe the adjacent plant communities and their relationship to the plot. Are there any other landscape features or processes influencing this community? Is there an important species that occurs in the stand but is not within your plot? Is there a large amount of a dead plant material in the plot?

VEGETATION DESCRIPTION SECTION

Leaf Phenology

Select the best description for the leaf phenology of the **dominant** stratum. The dominant stratum is the tallest stratum that contains at least 10% cover. Leave blank for non-vascular plots.

Evergreen. Greater than 75% of the total woody cover is never without green foliage. (Some tricky examples: most *Artemisia, Coleogyne, Ephedra* and all *Atriplex* except *canescen*s, all *Chrysothamnus* except *nauseosus* var. *junceus*).
Cold deciduous. Greater than 75% of the total woody cover sheds its foliage in connection with an unfavorable season mainly characterized by winter frost (tricky ones: *Sarcobatus vermiculatus, Tamarix*).
Mixed evergreen - cold deciduous. Evergreen and deciduous species are mixed within the type and generally contribute 25-75% of the total woody cover.

Perennial. Herbaceous vegetation composed of more than 50% perennial species.

Annual. Herbaceous vegetation composed of more than 50% annual species.

Leaf Type

Select the best description for the leaf form of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% total plot coverage. Within that dominant stratum, the species that makes up greater than 50% of cover defines the leaf type.

Broad-leaved. Woody vegetation that is primarily broad-leaved (Sagebrush, oak, mountain mahogany).
Needle-leaved. Woody vegetation that is primarily needle-leaved (Juniper, pinyon, tamarisk).

Microphyllous. Woody cover that is primarily microphyllous (*Ephedra*).

Graminoid. Herbaceous vegetation composed of more than 50 percent graminoid species (grasses, sedges, rushes, etc).
Forb (broad-leaf-herbaceous). Herbaceous vegetation composed of more than 50% broad-leaf forb species (*Phlox, Astragalus, Erigeron,* etc).
Pteridophyte. Herbaceous vegetation composed of more than 50 percent ferns or fern allies (scouring rushes).
Non-vascular. Dominated by lichens or mosses.
Mixed. As with leaf phenology, the dominant stratum may be composed approximately equally of species with several different leaf types. Describe the mix briefly or circle leaf types that apply.

Physiognomic Class

This represents what you see when you are standing in the plot looking across at the vegetation. The following definitions can be used as guidelines, but may not always apply in desert locals. For example, areas with scattered pinyon and juniper may not fit the cover classes below but they would best be described as a woodland.

Forest. Trees with their crowns overlapping (generally forming 60-100% cover).
Woodland. **Open stands of trees with crowns not usually touching (generally forming 10-60% cover). Canopy tree cover may be less than 10% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.**

Shrubland. Shrubs generally greater than 0.5 m tall with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 10% cover). Shrub cover may be less than 25% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover, respectively. Vegetation composed of woody vines is included this class.
Wooded Shrubland. Trees forming approximately equal or less cover with a shrub component.
Dwarf-Shrubland. Low-growing shrubs usually under 0.5 m tall. Individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees and tall shrubs generally less than 10% cover). Dwarf-shrub cover may be less than 25% where it exceeds tree, shrub, herb, and nonvascular cover, respectively.
Shrub Herbaceous. Low or taller shrubs forming approximately equal cover with a grass or forb component. Individuals or clumps of shrubs generally not touching and usually forming more than 25% cover; trees less than 10% cover. Spaces between shrubs are generally mostly occupied by grasses and/or forbs.
Wooded Herbaceous. Trees forming approximately equal or less cover with a grass or forb component.
Herbaceous. Perennial herbs (graminoids or forbs) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 10% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.
Nonvascular. Nonvascular cover (bryophytes, lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular perennial vegetation cover may be less than 25% , as long as it exceeds tree, shrub, dwarf-shrub, and herb cover.
Sparsely Vegetated. **Abiotic substrate features dominant. Perennial vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources. Total vegetation cover is typically less than 10% and greater than 2%. Badlands or sand dunes supporting communities of annual plants should be included in this category, regardless of cover.**

Provisional Community Name
You have been provided a list of potential plant associations, based on what has been found in surrounding parks. Find the name of the association which most closely resembles your plot. It is very likely that some of your plots won't resemble anything on the list – as many types are not yet described

and classified. If so, devise a name based on: (1) the dominant species of the dominant strata (including nonvascular) and (2) indicate the physiognomic class (this must match the physiognomic class checked on the backside of the datasheet). For example, if you are in a PJ woodland with only scattered shrubs but a really nice galleta grass layer, you would use a provisional name like "Pinus edulis – Juniperus osteosperma / Hilaria jamesii Woodland". The 'provisional community name' will be used in tallying how many of each plant community has been sampled. The provisional name is also a great help to the ecologists who will be using your work to construct a classification. Note: this field should be completed only after the entire plot is completed.

PLANT SPECIES LIST AND STRATA FORM

Plot Code
Circle the correct acronym for the park you are working in. Write the plot number on the blank line. This field is a **must** so that in the event that the two data sheets get separated, they can be paired up again. **Please record the plot code on every side of every form in the provided field.**

Species/Strata Data

A two-page dual purpose form has been developed for recording information on *species* composition and cover and *strata* cover and height. Species lists and cover estimates should be completed first (white portions of form); then cover class and height class estimates for strata should be recorded (shaded portions of form). Write out the complete species name, and use only the name in the most recent (Green) edition of "A Utah Flora" (Welsh 2003).

The main body of the table is dedicated to recording species names and associated cover estimates (white areas). To begin, the observer needs to make a complete species list for the plot and assign each species to the appropriate stratum. The next section provides a brief discussion on assigning species to the appropriate strata, followed by instructions for completing the species level information.

Stratum

Species names will be recorded within the appropriate stratum. It is important that all crew members are consistent in assignment of species to strata throughout this project. Following are some guidelines to use in determining strata. The 'working draft' plant list for each park will be used as a guide for assigning species to the appropriate stratum. Field crew members are expected to help 'improve' this list and associated categorization as the field season progresses.

Begin by assessing the strata at your plot. Trees are defined as single-stemmed woody plants, generally 5 m in height or greater at maturity and under optimal growing conditions. Shrubs are defined as multiple-stemmed woody plants generally less than 5 m in height at maturity and under optimal growing conditions. The exception is mature pinyon and juniper plants, which are considered trees regardless of their height.

T1 Emergent, T2 Canopy, T3 Subcanopy

A uniform stand of pine or cottonwood trees would be a good example of T2"canopy", but where they are absent you would begin with the shrubs, or herbaceous species if no shrubs are present. If the tree crowns in your plot are mostly touching and similar in height, but a given tree species is much taller that species would be an T1"emergent." Occasionally, you will sample an area where there may be several tall, scattered cottonwoods and then shorter scattered junipers. In this case, the cottonwoods would be your "canopy" and the junipers would be the "subcanopy". You may also have cottonwoods listed in the "subcanopy" layer, if there are a number of short saplings in addition to mature tall trees.

The remaining vegetative strata are (remember to check with plant list for consistency):
S1 Tall Shrub. >2 meters tall. For example, *Fraxinus anomala* and *Purshia mexicana.*
S2 Short Shrub. <2 meters tall. For example, *Coleogyne ramosissimum,* all *Atriplex* except *garrettii* (which is dwarf).
S3 Dwarf Shrub. <0.5 meters tall. For example, *Opuntia polyacantha.*
H1 Graminoid. All grass species, including *Juncus arcticus.*
H2 Forb. All forbs (*Typha* is a forb).
H3 Fern or Fern Ally. All ferns, including *Equisetum hyemale.*
H4 Tree Seedlings. Seedlings are trees with vertical stems less than 1.5 m tall, but that may vary by species.
N Nonvascular. This is mainly dark cyanobacteria, mosses and lichens.
V Vine/liana. All vine species.
E Epiphyte. All epiphytic species.

Height can be used to define strata, but is not how species should be placed in strata. **Species characteristically belong to one stratum or another** (e.g., pinyon and juniper are canopy (T2), Utah serviceberry is a tall shrub (S1), blackbrush is a short shrub (S2), snakeweed is a dwarf shrub (S3), etc.), **EVEN when unusual environmental circumstances dictate that the plants have an unusually tall** (e.g., 3' PLEJAM in burned areas at MEVE) **or unusually short growth form**. So even if the junipers growing in cracks are only 1.5 m tall, as long as they are mature trees, they get put in the T2 category, and get measured. About the only rule regarding height should be that the tree layer is (usually) higher than the tall shrub layer, is taller than the short shrub layer, etc.

The second thing is to avoid splitting species between strata. If a few mountain mahogany have been browsed to <1m tall, but most are 2m tall, they all get rolled into the tall shrub stratum. There are two exceptions: (1) each height class covers more than 10% of plot, or (2) there is a reproductive layer of baby shrubs or young trees.

The third thing is how to define some of the "borderline/confusing" species. What we want to avoid is some folks calling *Leptodactylon* a forb and some calling it a dwarf shrub. Ditto snakeweed. Ditto *Eriogonum microthecum*, fringed sage, *Brickellia* and any number of other species. Consult your plant lists, which you should keep updated as the crew discusses which species go in which stratum.

Species / Percent Cover Estimates

Once you have identified your strata, list all plant species in that strata and complete cover estimates per the following instructions. Be thorough in looking for plant species in your plot, but do not spend excessive amounts of time looking for new or different plants. Remember that these plot data are to be used to classify the vegetation of the Park, not to make a complete species list for it. If you had to spend much more than 20 minutes to *find* a species, it probably isn't going to be important in characterizing the vegetation type.

1. **Species Name:** Refer to the plant list you have been provided for plant names used in this area (from *Utah Flora*). Always record the full scientific name for each species – required nomenclature is Welsh et al. – Utah Flora (2003). Please note that columns on both sides of the page may be used to record species within each stratum.
2. '*' – Complete this shaded column in the strata assessment (see below).
3. **Cover Class:** Estimate the aerial / crown cover of **each** plant listed, using the cover class codes listed in the bottom of the page. These classes are as follows:
4.

t = few	1A = 5-10%	2 = 15=25%	3 = 25-35%	5A = 45-50%	6 = 55-65%	8 = 75-85%
T = 0-1%	1B = 10-15%	3 = 25-35%	4 = 35-45%	5B 50-55%	7 = 65-75 %	9 = 85 – 95%
P = 1- 5%						10 = > 95%

5. **% Cover:** Record continuous cover value used to make cover class estimates.
6. **Specimen:** Place a check mark in this column when a specimen has been collected for a given taxon. Keep complete set of notes in a field notebook with required information for processing herbarium specimens.

Unknowns. If you can't identify or easily key out the plant at the plot, assign a name to it to be recorded on your data sheet. For example, if you know what family it is in or its genus, label it "unknown Asteraceae sp." or "Unk. *Erigeron* sp.". If there are more than one unknown in a family, add a number to the name you give them. If you do not know the family, label the plant "Unknown 1", using consecutive numbers for additional unknowns. Record the cover class and other data for the unknown as you would for any other species. Then, take a sample of the species with as much of the plant as possible, especially intact sexual parts, if present. Place the sample in a plastic baggie, and either label the plant (if you are putting more than one plant in the baggie) or label the baggie with the plot code, the date and the name you gave it on the data form. Plant samples in baggies can be stored in coolers or refrigerators for short periods. If you are not able to key the plant out soon after collecting it, or you intend to keep the sample for the park collection, press the plant and with a label stating the plot or location of its collection (include UTMs if the sample is not from a plot), date, collectors name and name you assigned the plant. Also, thoroughly label any plant specimens collected as proof of plant occurrence for plants not listed on park plant list.

Strata / Height Class, Cover Class and Diagnostic Species

Once the species list and associated cover data have been completed, the observer should then complete the following fields as specified below. Data for stratum characterization are all shaded in grey on the field form.

1. Indicate the average height class of the stratum in the first column, using the Height Scale at the bottom of the form. The height scale for this project is as follows:
2.

01 = <0.5 m	03 = 1- 2 m	05 = 5 – 10 m	07 = 15-20 m	09 = 35 – 50 m
02 = 0.5 – 1 m	04 = 2-5 m	06 = 10-15 m	08 = 20-35 m	10 = > 50 m

3. Enter the average percent cover class of the whole stratum in the second column, using the Cover Scale at the bottom of the form (same cover scale as for species above).
4. '*' – This Column is used to indicate which species in the strata are particularly abundant.

ALWAYS fill in the Height Class and Cover Class for "Ht Herbaceous", which represents total cover of species in plot's ground layer (H1, H2, H3 and H4). This field is located at the top of the back page and is labeled as **'Ht Herbaceous'**. It is easy for field crews to overlook this field – so please make an extra effort to complete it for each plot.

See below for an example of the **Cedar Breaks National Monument Vegetation Mapping Cheatsheet.**

LANDFORM

alluvial fan
alluvial plain
alluvial terrace
alluvium
artificial levee
backslope
badlands
bajada
basin
bench
blowout
bluff
borrow pit
bottomland
box canyon
braided stream
break
butte
canyon
channel
cliff
climbing dune
colluvium
crest
cuesta
debris flow
deflation basin
depression
desert pavement
dike
dip
ditch
divide
dome
drainageway
draw
dune
dune field
earthflow
eolian deposit
eolian sands
ephemeral stream
escarpment
falling dune
finger ridge
flat
flood plain
foothills
gorge
gravel pit
gulch
gully
hanging valley
hill
hillslope
hogback

LANDFORM

hummock
interfluve
intermittent stream
island
knob
knoll
lakeshore
landslide
ledge
levee
meander belt
mesa
mountain
natural levee
overflow channel
oxbow
pediment
perennial stream
plain
plateau
playa
point bar
pool
quarry
ravine
reef
ridge
rise
rim
rockfall
saddle
sand ramp
sand sheet
scarp
scree slope
shoulder
side slope
slope
slope wash
stream terrace
summit
swale
talus slope
tank
terrace
toeslope
valley
valley floor
valley side
wash (dry wash)

ASPECT

Flat
Azimuth (deg.)
Variable

VEGETATIVE STRATA

T1 = emergent tree
T2 = tree canopy
T3 = tree sub-canopy.
S1 = tall shrub, > 2m
S2 = short shrub, < 2m
S3 = dwarf shrub. < 0.5m
H1 = graminoid
H2 = forb
H3 = fern or fern ally
H4 = Tree seedlings
N = nonvascular other than ferns
V = vine/liana
E = epiphyte

PARK SPECIALS (keep an eye out for)

Rare plants
Upland springs and seeps
Hanging Gardens
Invasive weeds (ignore cheatgrass, dandelions)

PHYSIOGNOMIC CLASS

Forest: Crowns touching
Woodland: Trees>10%, crowns not touching
Shrubland: Shrubs> grass, forbs or trees
Dwarf Shrubland: Shrubland <0.5 m tall
Shrub Herbaceous: Shrubs = Forbs/grasses
Herbaceous: Grass/forbs > trees or shrubs

SOIL TEXTURE

Sand: clean, no ball
Loamy sand: ball, no ribbon
Sandy loam: v. gritty weak ribbon
Silt loam: smooth weak ribbon
Loam: slightly gritty weak ribbon
Clay loam: long ribbon, no ring, slightly gritty
Sandy clay loam: long ribbon, no ring, very gritty
Silt: long ribbon, no ring, smooth
Silty clay loam: long ribbon, no ring, slightly gritty and sticky.
Clay: smooth ribbon/ring, edible
Sandy Clay; gritty ribbon & ring
Silty Clay: smooth ribbon/ring
Peat: still has plant parts
Muck: smelly black ooze

TOPOGRAPHIC POSITION

SEE THE DIAGRAM ON OTHER SIDE

SURFICIAL GEOLOGY

Obscured by soil
Aeolian sands
New Alluvium (Holocene)
Older Alluvium (pre Holocene)
Talus / Colluvium / Landslides
Sevier Formation
Conglomerate of Boat Mesa
Claron Formation, White Member
Claron Formation, Pink Member
Kaiparowitz Formation
Waheep Formation
Straight Cliffs, Upper Part
Straight Cliffs, Lower Part
Tropic Shale
Dakota Sandstone
Entrada Sandstone
Carmel Formation, Upper Member
Carmel Formation, Gypsiferous Member
Carmel Formation, Banded Member
Carmel Formation, Limestone Member

DISTURBANCE

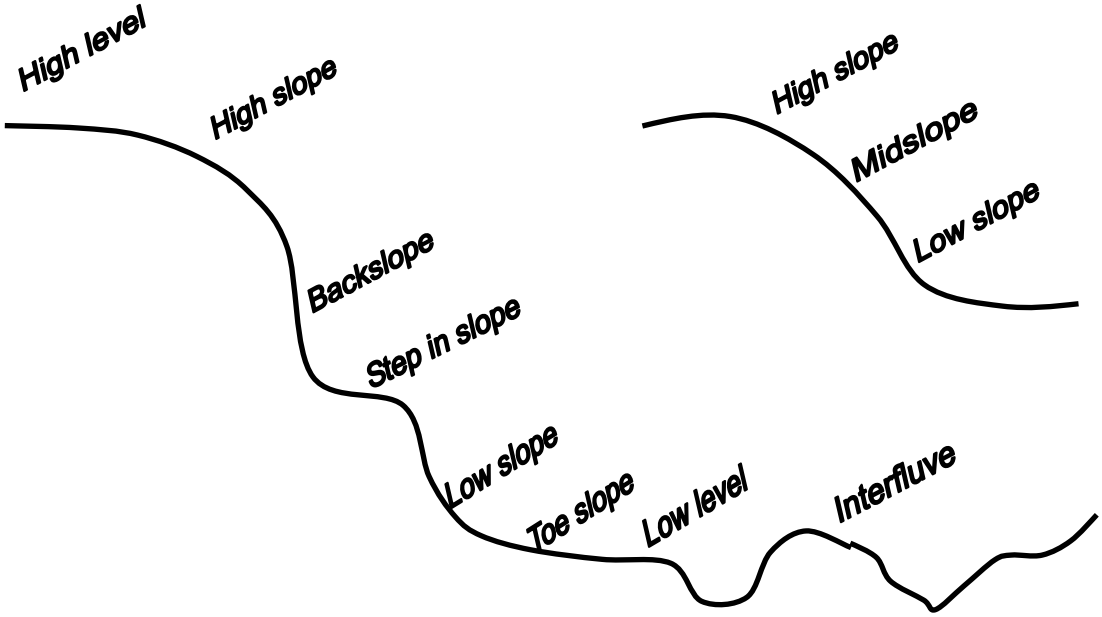
Water gullies
Mass wasting
Spruce beetle damage
Flash flooding
Grazing evidence
Development, historic structures
Agriculture
ORV use or Recreation
Wildlife concentration
Fire
Drought

PLOT SIZE

400m^2 (20x20m square): Forests, Woodlands, Shrublands
100m^2 (10x10m square): Dwarf Shrublands, Shrub-Herbaceous, Herbaceous
25m^2: Non vascular

You may adapt plot size and shape to fit the situation; but never choose a plot size **smaller** than listed here.

TOPOGRAPHIC POSITION - CHEAT SHEET



FIRE/ FUELS FORM INSTRUCTIONS- 2005

This section was prepared by Henry Bastian, Fire Ecologist, Department of Interior, Washington Office.

At each forested vegetation plot (*tree types only*) at BRCA and CEBR, the following protocols will be employed to collect fuels data. Please remember that tree types include pinyon pine and juniper. Information will be collected on all overstory trees in each 20m x 20m vegetation plot, and all sapling trees in the NW quarter (10m x 10m) of each plot. See plot layout below for data collection guidelines.

Data on dead and downed woody material, as well as litter and duff, will be collected with Browns transects. A fuels cheat sheet at the end of this section will assist you with codes for various fields on the data form.

Please note that Overstory Trees are defined as having a diameter > 12.7 cm (5 inches) measured at breast height; this is known as diameter at breast height (dbh). DBH is measured at 1.4 m (4.5 ft) from the ground). Seedling/sapling trees are defined as having a DBH of 0 - 12.6 cm (0 - 5 inches). Overstory trees need to be sampled in the entire 20 x 20 meter plot. Sapling/seedling trees need to be sampled in one quarter (10 x 10 meters) of the macro plot (see below).

Please note that both metric and English measurement standards are used in this fuels protocol. Tree measurements are all in metric where fuel loading measurements are in English.

PLOT LEVEL VARIABLES

Plot Code

Enter the plot code which was chosen for the vegetation plot you are sampling.

Survey Date

Date the AA point was sampled. Please use the format Month- Day- Year.

Location information

Global Positioning System (GPS) coordinates should be obtained for each plot. Each plot should be marked with a permanent marker such as re-bar, metal stake, or other marker which can be relocated. [The plot center marker and one corner will be installed by the vegetation crew.] GPS coordinates should be entered onto the data sheet.

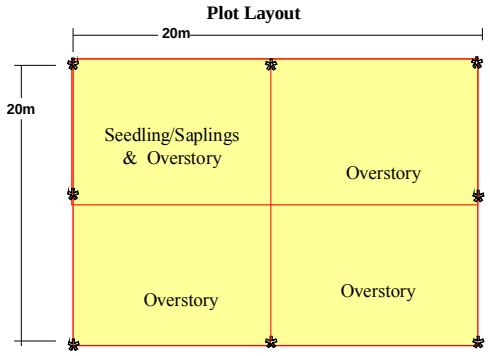
Aspect, Slope, and Elevation

These will all be recorded by vegetation crew.

Fixed Plots Area

Overstory trees (>5 inches DBH) 20 x 20 meters [See plot layout below]
Sapling/seedling trees (0-5 inches DBH). 10 x 10 meters [See plot layout below]. Seedlings will be sampled in the quadrant where the corner of the plot has been marked. The vegetation crew will be installing two markers. One marker will be placed in the center and one in a corner.

The intent of the inventory is to sample the overstory and reproduction but not spend an inordinate amount of time sampling overstory, sapling, or seedling trees.



PERMANENT PLOT VARIABLES

Permanent Plot Azimuth

Hammer in stake at NW corner of macroplot to mark a permanent fuels plot and log a GPS datum point there.

TREE LEVEL VARIABLES

Species Code

Record the six digit alphacode consisting of the first three letters of genus and first three letters of the species (e.g., JUNOST – *Juniperus osteosperma*). This variable should be recorded for all overstory, sapling and seedling trees in each plot. Please note there are separate areas of the field form for seedlings/samplings and for overstory trees.

Seedling/Sampling Tree Plot Size

Check the appropriate box to indicate the plot size used. The typical size of a seedling/sampling plot is 10m x 10 m, which is one quarter of the macroplot. In cases where seedling density is extremely high then crews could consider using sampling within one quarter equaling a 5m x 5m area.

Overstory Tree Plot Size

Measurement of overstory trees is typically conducted in the full 20m x 20 m macroplot. If there are more than about 25 trees greater than 4.5 feet tall, then divide the plot into quarters and measure the DBH (or DRC) of trees in only the southeast quarter/quadrant. **Please place a check mark** in the subplot box if DBH measurements were restricted to a quarter plot.

Tree History/status (Live or dead)

Please check on the data sheet the tree status Y=Live, N=Dead. A tree is considered living until no green branches remain on the tree. This variable should be recorded for both overstory and seedling/sapling trees.

Diameter Breast Height (DBH) - all tree species except Pinyon/Juniper

In plots containing single bole trees such as Douglas-fir, ponderosa pine, and cottonwood, record the species name and diameter in centimeters (cm) of the tree stem/trunk at breast height (4.5 ft. on uphill side of tree) using a DBH tape. Often this measurement will involve only a single tree trunk, however on some occasions there may be multiple stems. If three or more you may want to consider using a diameter at root crown or collar (DRC) measurement. Please see below for instructions. In multiple stemmed cases or situations record all diameters associated with a given individual on subsequent lines and check the 'twin' box to indicate that measurement was from a multi-stemmed tree.

Diameter Root Crown (DRC) - Pinyon/Juniper and some maples and oaks – (Use only if applicable)

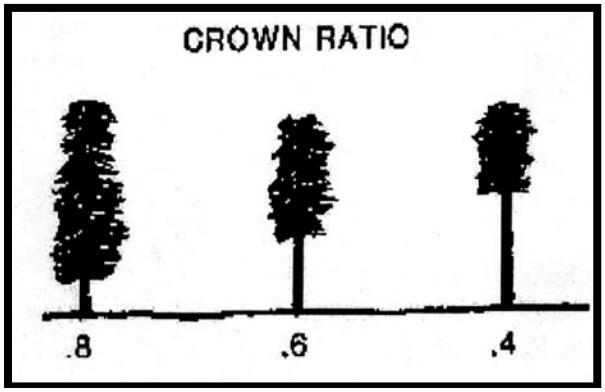
Some species such as juniper, pinyon pine, some maples and oaks commonly have multiple stems (3 or more) and are often extremely variable in form. For these species, diameter at root crown (DRC) is a more meaningful measurement than DBH (USDA Forest Service 1997). Measurement is in centimeters (cm). In plots containing pinyon and/or juniper trees or other species with multiple stems, record the species and diameter at root crown (ground level) of all stems belonging to trees taller than 4.5 feet. This measurement typically requires crawling under the low tree branches to hook the DBH/DRC measuring tape and wrap it around the trunk to read the diameter. Record this value, in centimeters on an individual line on the field form that is labeled with the appropriate tree species. In multiple stemmed cases or situations record all diameters associated with a given individual on subsequent lines and check the 'twin' box to indicate that measurement was from a multi-stemmed tree. Use caution when performing this measurement, as there may be pinyon pine pitch, sharp needles, sharp branch tips, cacti, and/or poisonous animals (spiders, scorpions, snakes, etc.) under these short-stature tree species or under the bark covering the lower portion of the tree. Always look up prior to standing to avoid collision with overhead branches. Juniper branch scratches tend to get infected, so be sure to clean them out thoroughly.

Crown Base Height (CBH)

Record the height to Live Crown Base to the closest meter for overstory trees only. For an individual tree, this is the height to the bottom of the live crown (the distance between the ground and the base of the tree crown/canopy). It is simply the lowest live branch, or the average height of the lowest branches as a whole. If your tree has an asymmetric crown, reaching the ground on one side but is 5m off the ground on the other side, take the lowest reading (i.e., zero, in this case).

Crown Height Ratio

Enter the estimated crown ratio to the closest 1/10. The ratio is crown length to total tree height. The diagram below can be used to guide the field worker in making these estimates. Crown ratio values will range from 0.1 to 1.0.



Structural Stage

Record one of the following numbers for the following codes that describe tree structural stage. This variable should be recorded only for overstory trees.

Code # =1: (DOMT) Dominant trees with crowns extending above the general level of the crown cover, receiving full light from above and partly from the side; larger than the average trees in stand.

Code # =2: (CODT) Co-dominant trees with crowns forming the general level of the crown cover, receiving full light from above, but comparatively little from the sides.

Code # =3: (INTR) Intermediate trees shorter than those in preceding classes with crowns below or extending into crown cover formed by dominant and co-dominant classes, receiving little direct light from above.

Code # =4: (SUPS) Suppressed trees with crowns below the general level of crown cover, receiving no direct light from above.

Code # =5: (OPGT) Open growth trees receiving full sunlight from above and all sides, trees widely spaced and/or isolated.

Damage Codes/comments

Record as many of the 4-letter codes that describe tree damage or condition as apply to each overstory tree. Separate each 4-letter code with a comma. These codes and their definitions are found on your cheatsheet at the back of this manual. Not a lot of time should be taken to make these assessments. If the people doing the sampling have reviewed the codes and are familiar with the definitions, this step should be fairly quick. Only record those codes that are easily visible as the tree diameters are being taken. If you feel that other comments need to be recorded about the tree or surrounding vegetation they can be included in the comments field as well.

IMPORTANT FUELS DATA VARIABLES

Note: English Measurements are used for fuels data variables.

Anderson Fuel Model selection

For each forest plot, surveyors will assign a fuel model (1-13) from Anderson's (1982) field guide. Field workers should use the Fire Behavior Fuel Model Key on Page 25 to determine the appropriate Anderson model. Anderson's guide classifies fuels into four groups: grass, shrub, timber, and slash (see cheatsheet). The differences between the four groups are related to fuel loadings and fuel size class distributions. Read through the fuel model descriptions carefully and refer to the photographs. Keep in mind the photos represent only a few possible field situations. The species depicted in the photos may be different than those present in your plots. It may be difficult at first, but when assigning a fuel model, try to visualize the vegetation in the photos and in your plot merely as different layers of fuels and choose the best fit among the 13 fuel models.

When choosing a fuel model, consider the fuel stratum that would most likely carry a fire:

- grass (models 1-3)
- shrub (models 4-7)
- timber litter (models 8-10)
- slash (models 11-13)

Browns Transects (Dead and down fuel loading)

At each forest plot, Browns transects will be sampled to measure dead and detached woody fuel as well as duff and litter depths. One or two transects will be done, depending on vegetation type. [In stands of P/J vegetation and deciduous hardwoods install one transect, in coniferous vegetation install two transects]. Transects will be 50 feet long, established in a random direction from the NW corner of the plot. Record the transect slope and azimuth. The first 15' of each transect will not be sampled but will be a buffer for reading the plot. Thus, the total length of each transect will be 65' (15' buffer, 50' sample plane).

Working along the transects, tally each particle intersected along a pre selected side of the tape, categorized by size class (see below). A go-no-go gauge with openings of (0.25, 1, and 3 in) works well for separating borderline particles into the correct class. Transect intercepts of 1-hour and 10- hour fuels will be tallied for the last six feet (59'-65') of the 50' Brown's transect. 100-hours will be tallied for the last twelve feet (53'-65'), and 1000-hr fuels will be tallied along the entire transect (15'-65'). For each 100-hour fuel, measure the diameter and assign a decay class (see below). Take depth measurements for litter and duff at 10 points along each fuel transect—that is at 15, 20, 25, 30, 35, 40, 45, 50, 55, and 60 ft.

Measurement of all particles is taken perpendicular to the point where the tape crosses the central axis of the fuel. Count intercepts of dead and down woody material along the transect plane up to 6 ft from the ground. Examples of dead and downed fuels include twigs, stems, branches, and bole wood from detached trees and shrubs from the ground (but not cones, bark, needles and leaves as these will be sampled in the litter and duff measurements). Do not count stems and branches attached to standing shrubs or trees (Brown 1974; Brown and others 1982). A particle is considered down when it has fallen to the ground or is severed from its original source of growth (Brown 1974).

Size classes for dead and down woody fuel

Fuel Class	Size	Tallied along transect
1 hour	<0.25 in (<0.6 cm)	last 6 ft of transect (59-65ft)
10 hour	0.25 – 1.0 in (0.6 – 2.5 cm)	last 6 ft of transect (59-65 ft)
100 hour	1.0-3.0 in (2.5 – 7.6 cm)	last 12 ft of transect (53-65 ft)
1000 hour	> 3.0 in (> 7.6 cm)	Entire transect (15-65 ft)

1000-hour Decay classes

Decay Class	Description
S	All bark is intact. All but the smallest twigs are present. Old needles probably still present. Hard when kicked.
	Some bark is missing, as are many of the smaller branches. No old needles still on branches. Hard when kicked.
	Most of the bark is missing and most of the branches less than 1 in. in diameter also missing. Still hard when kicked.
R	Looks like a class 3 log but the sapwood is rotten. Sounds hollow when kicked and you can probably remove wood from the outside with your boot. Pronounced sagging if suspended for even moderate distances.

	Entire log is in contact with the ground. Easy to kick apart but most of the piece is above the general level of the adjacent ground. If the central axis of the piece lies in or below the duff layer then it should not be included in the sampling as these pieces act more like duff than wood when burned.

Litter and Duff Measurements

Take depth measurements for litter and duff at 10 points along each fuel transect. At each sampling point, gently insert a trowel or knife into the ground until you hit mineral soil, then carefully pull it away exposing the litter/duff profile. Locate the boundary between the litter and duff layers. Vertically measure the litter and duff to the nearest tenth of a centimeter.

Litter includes freshly fallen dead plant parts other than wood, including cones, bracts, seeds, bark, needles, and detached leaves that are less than 50% buried in the duff layer. Refill holes created by this monitoring technique. Do not include twigs and larger stems in litter depth measurements.

Duff includes those plant parts that weathered, breaking down, and decaying. On the bottom end it includes the fermentation and humus layer. It usually lies below the litter and above mineral soil. Occasionally moss, a tree trunk, stump, log, or large rock will occur at a litter or duff depth data collection point. If moss is present, measure the duff from the base of the green portion of the moss. If a tree, stump or large rock is on the point, record the litter or duff depth as zero, even if there is litter or duff on top of the stump or rock. If a log is in the middle of the litter or duff measuring point, move the data collection point 1 ft over to the right, perpendicular to the sampling plane.

Fuels Comments

Enter any general comments regarding fuels in the plot, as well as specific comments relating to fuel model assignment, anomalies in fuels transects, litter/duff measurements, etc.

BRCA/CEBR VEGETATION MAPPING PROJECT - FIRE/ FUELS DATA CHEATSHEET 2005

STRUCTURAL STAGE should be recorded only for overstory trees (trees > 12 cm / 5 inches DBH).
1 = Dominant (trees with crowns extending above the general level of the crown cover, receiving full light from above and partly from the side; larger than the average trees in stand)
2 = Codominant (trees with crowns forming the general level of the crown cover, receiving full light from above, but comparatively little from the sides)
3 = Intermediate (trees shorter than those in preceding classes with crowns below or extending into crown cover formed by dominant and codominant classes, receiving little direct light from above)
4 = Suppressed (trees with crowns below the general level of crown cover, receiving no direct light from above
5 = Open growth (trees receiving full sunlight from above and all sides, trees widely spaced and/or isolated)

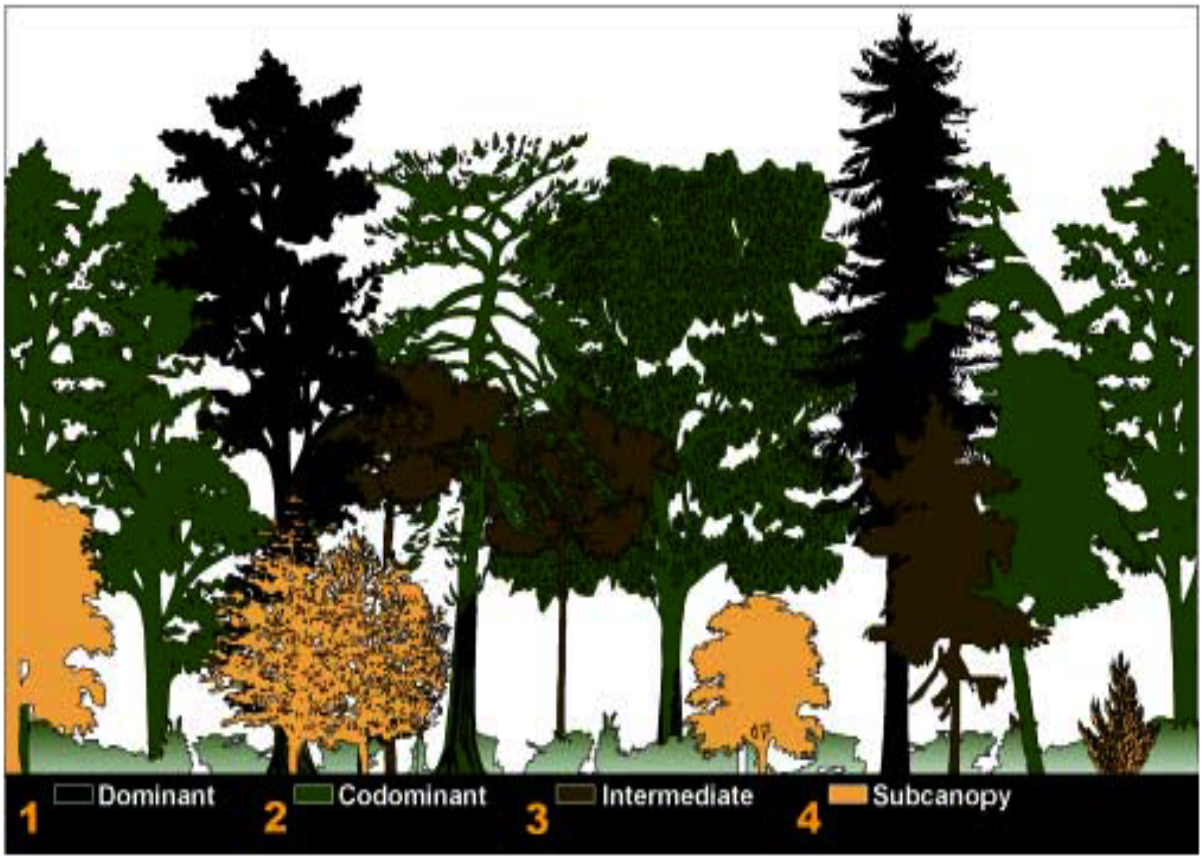


Figure 29. Crown position codes for live trees. A fifth code (5) is used for isolated trees.

DAMAGE CODES should be recorded only for overstory trees

11-ABGR = Abnormal growth pattern for the species of concern. This category would include a range of physical deformities not included in the remainder of the damage codes.
12-BIRD = Bird damage such as woodpecker or sapsucker holes.
13-BLIG = Blight is generally defined as any plant disease or injury that results in general withering and death of the plant without rotting. Blight can result from a wide variety of needle, cone, and stem rusts, as well as canker diseases, and is often species- or genus-specific. Consultation with local plant pathologists may assist in identifying specific blight conditions.
14-BROK = Broken top of the tree.
15-BROM = Witches' broom diseases are characterized by an abnormal cluster of small branches or twigs on a tree as a result of attack by fungi, viruses, dwarf mistletoes, or insects. Brooms caused by dwarf mistletoe and from yellow witches' broom disease are common in the west.
16-BURL = A hard, woody, often rounded outgrowth on a tree. This occurs naturally in some tree and shrub species, and is a sign of an infection or disease in other species.
17-CONK = The knobby fruiting body of a tree fungal infection visible on a tree bole, such as a shelf fungus.
18-CROK = Crooked or twisted bole for species in which this is uncharacteristic.
19-DTOP = Dead top.
20-EPIC = Epicormic sprouting, adventitious shoots arising from suppressed buds on the stem; often found on trees following thinning or partial girdling.
21-EPIP = Epiphytes present.
22-FIRE = Fire scar or significant cambial damage due to fire (This code is not given for black tree boles, cambial damage must be present)
23-FORK = Forked top of a tree or multiple primary leaders in a tree crown for species in which this is uncharacteristic. Forks assume vertical growth and should be distinguished from branches, which assume horizontal growth.
24-FRST = Frost crack or other frost damage.
25-GALL = Galls found on stems, leaves or roots. Galls are formed by infection of the plant by bacteria or fungi, or by an attack by certain mites, nematodes, or insects, most notably wasps.
26-HOLL = Hollowed-out trees. Repeated hot fires can burn through the bark and the tree's core may then rot out, especially in trees with tough bark, but soft heartwood, e.g., sequoia, coast redwood. These hollowed-out trees are sometimes called "goose pens" because early settlers kept poultry in them.
27-INSE = Visible insects in the tree bole or the canopy, or their sign, such as frass, pitch tubes or bark beetle galleries.
28-LEAN = Tree is leaning significantly. If on a slope, tree deviates considerably from plumb. (This code is not given to trees that may have a normal lean as part of its growth form (example Gambel Oak).
29-LICH = Lichens present.
30-LIGT = Lightning scar or other damage to the tree caused by lightning.
31-MAMM = Damage caused by mammals, such as bear claw marks, porcupine or beaver chewing's, and deer or elk rubbings.
32-MISL = Mistletoe is visible in the tree (as opposed to signs of mistletoe, such as broom, without visible mistletoe).
33-MOSS = Moss present. (Only given if there is a significant amount of moss as compared to other trees).
34-OZON = Ozone damage. Ozone injury is often seen in the form of stippling or speckling on the leaves or needles of trees. This discoloration varies among species and ranges in color from red or purple to yellow or brown. Susceptible species often drop their leaves prematurely.
35-ROOT = Large exposed roots.

36-ROTT = A rot of fungus other than a conk, often associated with a wound or crack in a tree.
37-SPAR = Unusually sparse foliage for that species and size of tree.
38-SPRT = Basal sprouting; new shoots arising from the root collar or burl.
39-TWIN = A tree that forks below breast height and has two or more boles. Use this code for tree species that typically have single boles.
40-UMAN = Human-caused damage such as axe marks, embedded nails or fence wire, or vandalism.
41-WOND = A wound to a tree that cannot be identified by one of the other damage codes, including wounds or cracks of unknown cause.

Anderson (1982) Fuel Models and Descriptions

Model type	Number	Fuel Model Name	Description/ examples
Grass/ grass-dominated	**1**	Short grass (1 foot)	Fire spread by fine, porous, and continuous herbaceous fuels. Very little shrub or timber present (usually less than 1/3 of area). Grassland and savanna, annual and perennial grasses.
	2	Timber (grass and understory)	Herbaceous material, in addition to litter and dead-down wood from open shrub or timber overstory, contributes to the fire intensity. Open shrub lands and pine stands or scrub oak, some PJ.
	3	Tall grass (2.5 feet)	Tall grass stands (avg. 3ft) dominate the area, creating an environment for intense fires with fast rate of spread.
Chaparral and shrub fields	**4**	Chaparral (6 feet)	Foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory contribute to fire intensity. California mixed chaparral, pinebarrens of NJ are examples.
	5	Brush (2 feet)	Fire carried in the surface fuels that are made up of litter cast by the shrubs and grasses or forbs in the understory. Fuel loads light, shrubs are young with little dead material. Often young, green stands such as laurel, vine maple, alder, or even chaparral, manzanita, or chamise.
	6	Dormant Brush, hardwood slash	Shrub layer is more flammable than Model 5. Shrubs are older, but not as tall as shrub types of Model 4, nor do they contain as much fuel as model 4. Intermediate stands of chamise, chaparral, oak brush, shrub tundra. PJ shrublands may be represented.
	7	Southern rough	Shrub stands 2-6ft tall, with fires burning through surface and shrub strata with equal ease. Live foliage very flammable. Palmetto-gallberry, understory-pine overstory sites.
Timber litter	**8**	Closed timber litter	Slow-burning ground fires with occasional “jackpots”. Closed canopy stands of short-needle conifers or hardwoods that have leafed out. Examples are white pine, lodgepole pine, spruce, fir and larch.
	9	Hardwood Litter	Fires run through surface litter faster than Model 8 and have longer flames. Both long-needle conifer stands and hardwood stands are typical. Closed stands of long-needled pine like ponderosa, Jeffrey, and red pines are grouped in this model.
	10	Timber (litter and understory)	Dead-down fuels include greater quantities of 1000-hr fuels. Any forest type may be considered if heavy down material is present; examples are insect- or disease-ridden stands, wind-thrown stands, and aged light thinning or partial-cut slash.
Slash	**11**	Light logging slash	Rather light fuel load, with herbaceous material intermixed with the slash. Spacing of fuel load, shading from overstory, or aging of fine fuels can limit fire potential.
	12	Medium logging slash	Visual impression is dominated by slash and not much 1000-hr fuels. Fuels seem well-distributed. Heavily-thinned conifer stands, clearcuts, and medium or heavy partial cuts represented.
	13	Heavy logging slash	Fire carried by continuous layer of slash. Large quantities of 1000-hr fuels. Clearcuts and heavy partial-cuts in mature/ overmature stands when slash load is dominated by 1000-hr fuels.

Fire Behavior Fuel Model Key (Anderson)

Use the following key to assign a fuel model pictured and described in Anderson's 1982 publication, *Aids for Determining Fuel Models for Estimating Fire Behavior* to a plot.

1. Primary carrier of fire is grass; expected rate of spread is moderate-to-high, with low to moderate fireline intensity (flame length).
    a. Grass is fine-structured, generally below knee level, cured and primarily dead. Fires are surface fires that move rapidly through the cured grass and associated material. Very little shrub or timber is present, generally less than one-third of the area..... **See Fire Behavior Model 1**
    b. Grass is coarse-structured, above knee level (averaging about 3 feet), and is difficult to walk through ..... **See Fire Behavior Model 3**
    c. Grass is usually under an open timber or brush overstory. Litter from the overstory is involved, but grass carries the fire. Expected spread rate is lower than Fuel Model 1 and intensity is less than Fuel Model 3. **See Fire Behavior Model 2**
2. Primary carrier of the fire is brush or litter beneath the brush. Expected rates of spread and fireline intensities (flame length) are moderate to high.
    a. Live fuels are absent or sparse. Brush averages 2 to 4 feet in height and requires moderate winds to carry fire ..... **Fire Behavior Model 6**
    b. Live fuel moisture can have a significant effect on fire behavior.
    i. Brush is about 2 feet with light loading of brush litter underneath. Litter may carry the fire, especially at low windspeeds ..... **See Fire Behavior Model 5**
    ii. Brush is head high (6 feet) with heavy loadings of dead woody fuel. Very intense fire with high spread rates expected .... **See Fire Behavior Model 4**
3. Primary carrier of fire is litter beneath a timber stand. Spread rates are low-to-moderate and fireline intensity (flame length) may be low-to-high.
    a. Surface fuels are mostly foliage litter. Large fuels are scattered and lie on the foliage litter and are not supported above the litter by their branches. Green fuels are scattered enough to be insignificant to fire behavior.
    i. Dead foliage is tightly compacted, short needle (2 inches or less) conifer litter or hardwood litter ..... **See Fire Behavior Model 8**
    ii. Dead foliage litter is loosely compacted long needle pine hardwood litter. ..... **See Fire Behavior Model 9**
    b. There is a significant amount of larger fuel. Larger fuel has attached branches and twigs or has rotted enough that it is splintered and broken. The larger fuels are fairly well distributed over the area. Some green fuel may be present. The overall depth of the fuel is mostly below the knees, but some fuel may be higher.
    ..... **See Fire Behavior Model 10**
4. Primary carrier of the fire is logging slash. Spread rates are low and fireline intensities (flame length) are low to very high.
    a. Slash is from hardwood litter and is cured and dried out; leaves have fallen and cured..... **See Fire Behavior Model 6**
    b. Slash is from conifers; needles have fallen and vegetation has grown in..... **See Fire Behavior Model 10**
    c. Slash is fresh (approximately 0-3 years) and not overly compacted.
    i. Slash is not continuous. Needle litter is present; live fuels are absent. ..... **See Fire Behavior Model 11**
    ii. Slash generally covers the ground (heavier loadings than Fuel Model 11);

slash depth is about 2 feet and not overly compacted. About half the needles still on branches but are not red; live fuels are absent ..... **See Fire Behavior Model 12**
iii. Slash is continuous and not overly compacted with an average depth of 3 feet. About half the needles are still on the branches and are red or all needles are still on the branches and are green. ..... **See Fire Behavior Model 13**

Notes:
Key developed as part of the LANDFIRE project (www.landfire.gov).

Reference:
LANDFIRE Handbook of Field Methods. APPENDIX G. "Fire Behavior Fuel Model Key"

FUELS REFERENCES

Anderson, H.E. 1982. Aids to determining fuel models for estimating fire behavior. USDA Forest Service, General Technical Report INT-GTR-122.

Brown, J.K. 1974. Handbook for inventorying downed woody material. Gen. Tech. Rep. INT-16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 24 p.

Brown JK, Oberhue RD, Johnston CM. 1982. Inventorying surface fuels and biomass in the Interior West. Ogden (UT): USDA Forest Service, Intermountain Forest and Range Experiment Station. Gen Tech Report INT-129. 48 p.

National Park Service. 2001. Fire Monitoring Handbook. Boise (ID): National Interagency Fire Center. 274p.

USDA Forest Service. 1997. Forest health monitoring 1997 field methods guide. Research Triangle Park (NC): USDA Forest Service, National Forest Health Monitoring Program. 353 p.

OBSERVATION POINT FORM INSTRUCTIONS – 2005

Many fields are identical to fields on the Plot Survey Forms and will not be re-defined here.

Observation Point Forms are to be used when: (1) you find a unique vegetative stand too small to conduct a plot in, (2) you are unable to access a BPU but can view it well enough to collect some data, (3) enough plots have been conducted for a given community type and the project supervisor instructs you to do Observation Points for BPUs encompassing that community, (4) you do not have time to conduct a plot and the area you are in is time consuming to access at a later date, or (5) to record information on park specials (e.g. springs, hanging gardens, etc.). You will notice that these forms are not as extensive as Plot Survey Forms. The primary role of Observation Point forms is to further aid in aerial photo interpretation; a secondary role is to help fill out plant association descriptions.

The Northern Colorado Plateau Network is in the process of developing a GPS Data Dictionary for recording several fields associated with the Observation Point Survey Form. Please note that all data entered into the GPS unit will also be entered manually on the paper forms.

IDENTIFIERS / LOCATORS SECTION

Most fields in this section are the same as the plot form. Please refer to the Plot Survey Form instructions for this section. As with the procedures for Plots, you must mark the location of the Observation Point on the corresponding topo map, aerial photo and BPU map.

Please indicate the type of observation point you are conducting (e.g. vegetation observation point, spring/seep/hanging garden point, other special feature).

You will not need to measure the area you are surveying for this form, although it is helpful to provide the size of the area described by the point. In terms of photographing this sample area, you are asked to take one photo that accurately captures the vegetative stand. Use the chalkboard as you would at a plot.

Observation Points should be assigned a code similar to Plot Survey codes to be used as a GPS file name and on the chalkboard in the photo. Observation point numbers will be assigned in the 9000 series (For example, CEBR9101).

ENVIRONMENTAL DESCRIPTION SECTION

The majority of this section is the same as the Plot Survey Form for which the instructions are stated previously. These fields are as follows: Elevation, Slope, Aspect, Topographic Position, Landform, Geology, Cowardin Wetland Classification System, and Hydrologic Regime.

Environmental Comments

This field is also on the Plot Survey Form. However, it is the only comments field on the Observation Point Form. Please use this space to record comments like you would have at plots, as well as any comments you would have made in the "Animal Use Evidence", "Natural and Anthropogenic Disturbance Comments" and "Other Comments" fields on the Plot Survey Form. Also note why an Observation Point was done instead of a Plot Survey.

Unvegetated Surface

This field is an ocular estimate of ground cover. Because there is no designated sample size for areas surveyed as Observation Points, you will have to estimate percent covers for whatever size the area is. For this estimation, you must use the cover classes listed in the bottom right hand corner of the data sheet. If an unvegetated surface category is not present in your observation point area (e.g., water is very uncommon in the sampling units), leave the corresponding line blank.

VEGETATION DESCRIPTION SECTION

These fields: Leaf Phenology, Leaf Type and Physiognomic Class, are the same as those on the Plot Survey Form. Please refer to the previously listed instructions for these fields.

Provisional Community Name

You have been provided a list of potential plant associations for BRCA and CEBR, based on what has been found in surrounding parks. Find the name of the association which most closely resembles your observation point. It is very likely that some of your points won't resemble anything on the list – as many type are not yet described and classified. If so, devise a name based on : (1) the dominant species of the dominant strata (including nonvascular) and (2) indicate the physiognomic class (this must match the physiognomic class checked on the back side of the datasheet). For example, if you are in a PJ woodland with only scattered shrubs but a really nice galleta grass layer, you would use a provisional name like "Pinus edulis – Juniperus osteosperma / Pleuraphis jamesii Woodland". The 'provisional community name' will be used in tallying how many of each plant community has been sampled. The provisional name is also a great help to the ecologists who will be using your work to construct a classification. Note: this field should be completed only after the entire plot is completed.

DOMINANT PLANT SPECIES LIST

Record information on ***dominant species only***. There are four columns that correspond to the "Stratum" column in this table. The strata have been discussed in the Plot Survey Form instructions, which you should refer to for this form. As for the blank columns:

1. **Height.** Use the number code that best describes the heights of all plant species within a given stratum. The number codes are listed in the bottom left had corner of the data sheet. These are the same height classes used for plots.
2. **Cover Class.** For this ocular estimation you are looking at the aerial cover of **all** plants within a given stratum. Use the cover class codes listed in the bottom right hand corner of the data sheet and presented below (note: these are broader cover classes than used on the plot form).

Cover Classes	
01	0 – 10%
02	10 – 25%
03	25-60%
04	60 – 100%

3. **Dominant Species (Mark species that characterize the stand with a *).** List the plant species using the full scientific name. You may find that there are not enough lines, in which case you can write in the blank area under the stratum name and number codes.
4. **% Cover.** Estimate the percent aerial cover (T-100%) for each plant species.

EXTRA CURRICULAR INSTRUCTIONS - 2005

The Northern Colorado Plateau Network Inventory and Monitoring Program is engaged is a wide suite of inventory activities designed to improve the information basis for developing a long-term natural resource monitoring program. Since field crews will be visiting most areas of each park and especially remote portions – we are requesting assistance with documenting information on the following features as they are encountered and as time allows.

Springs/Seeps/Hanging Gardens (Use Observation Point Form)

These areas are considered significant ecosystems across the Colorado Plateau and have been identified as a high priority vital sign for inclusion in the long-term monitoring program. Unfortunately very little information has been documented on the location and characteristics of these areas within the parks.

Use the 'Observation Point' (blue form) to record basic data on springs, seeps and hanging gardens and circle 'spring/hanging garden' in the Type of Observation field. It is important to take one or more photos to document the site and a GPS (or other) location reading. Please complete basic environmental and vegetation description fields as you are able. Completion of the comments field would be most appreciated.

If the spring community is sizeable enough please consider conducting a regular vegetation plot, as we need this information to characterize the full suite of vegetation types. Keep in mind that BPUs will typically overlook springs and seeps.

Invasive Plant Species (Use Invasive Plant Location Log)
Invasions of aggressive non-native species are one of the largest threats to ecosystem integrity of terrestrial and aquatic systems. Field crews are requested to document 'noteworthy' populations of invasive plants on the 'Invasive Plant Log' Form (or using the data dictionary in the Trimble GeoXM GPS unit) and take photos as feasible and appropriate. We are not requesting a comprehensive inventory of all invasive plants, as that would be another full project. However, the park would appreciate having help documenting populations of invasive plants that are of especially high concern. Early detection of species populations that are small give the park a chance for control or eradication before the problem becomes too big. For example, a small population of diffuse knapweed was found 2 years ago near Upheaval Dome in Canyonlands. This represented the first occurrence of this species in the park and control efforts were immediately implemented.

In addition to looking for established invasives in the park, field crews should take care to ensure that they are not contributing to the spread of weeds. If you are working in an infested area, please make sure that you are not carrying seeds or other propagules with you to new locations. (Wear gaiters to minimize the spread of cheatgrass, for example.) Also for field workers coming from other areas, please make sure vehicles and clothing are free of weed seed.

General Floristic Inventory
An important part of the Northern Colorado Plateau Network Program is to assist parks with the documentation of all vascular plants and vertebrate species occurring within each park. As part of the vegetation mapping project, field crews are requested to assist in the collecting of vascular plant vouchers (herbarium specimens) for parks. The park-specific plant list provided to field crews indicates whether or not a voucher has been collected for a given species. If a voucher has not been collected, field crews are to look for opportunities to make collections of these taxa. Field crews will receive training in how to collect, document and process vouchers. Specimens should contain appropriate flowering and/or fruiting

material to assure correct identification. Additionally, specimens should contain all appropriate plant parts (roots, leaves, stems, flowers etc.) and as possible show the habit of the plant. Enough material should be collected to fill a herbarium sheet.

OFFICE DATA ENTRY AND TRACKING – 2004

DATA ENTRY

NCPN has developed a park-specific vegetation mapping database application for this project. This database application houses all associated data with the project including vegetation plots, observation points, photographic documentation, and herbarium label information. Data will be entered at regular intervals as the field season progresses. Data will be entered both electronically (from the data dictionaries on the Trimble XM GPS Units) and manually from the field forms.

SPECIES LIST MANAGEMENT

As mentioned previously NCPN is working with each network park to compile vouchered vascular plant species lists. An important ancillary activity of the vegetation mapping project is to contribute to the collection of voucher specimens for currently undocumented species. To aid in this effort NCPN will provide field crews with a 'working copy' of the vascular plant species list for Canyonlands National Park. This list will include information on taxonomic number, family, genus, species, common name, life form, nativity and whether or not the taxon is documented with a specimen voucher. Field crews are requested to look for opportunities to collect vouchers where none exist. Field crews are requested to work with the NCPN Vegetation Program Manager to regularly update the 'working' species list for CANY.

TRACKING PLANT ASSOCIATIONS

At the beginning of the field season crews will be provided with a working list of 'potential' plant associations for each park. This list will represent the 'best guess' of what is present in the park and is based on recent plant association classification work at nearby parks. As the field season progresses the overall field team leader will revise this list as needed. In addition, the overall field team lead will assign each plot to preliminary plant associations and maintain a 'tracking list' throughout the field season (after each field session). This list will be used to adjust sampling priorities in the field. For example, once an adequate number of plots are collected for a certain type, it may be determined that only observation points are needed for subsequent BPUs. The list will also serve as a guide in knowing when something new is encountered and when to sample additional areas.

HERBARIUM SPECIMENS

Field crews will be instructed on how to collect voucher specimens and associated label data. Specimens will be processed at regular intervals throughout the field season. Processing includes entering all appropriate information into the vegetation mapping database in order to generate herbarium labels, identification, mounting and labeling specimens. Each field crew member is required to record all specimen documentation in a field notebook.

B.2. Accuracy Assessment Point Field Sampling Manual

The primary purpose of accuracy assessment (AA) fieldwork is to supply data that will test the accuracy of vegetation maps. It is also a continuation of the sampling of vegetation communities. The main uses of the AA data are:

- Verify accuracy of polygons drawn on the map (map units)
- Verify relationships between associations and mapping units
- Verify that field key(s) work(s) well to classify vegetation to association and/or map unit
- Check for classification completeness –undescribed associations not sampled during inventory
- Clarify concepts and augment descriptions of existing associations and possibly develop new associations

There are a number of factors that contribute to error on a vegetation map and some of these are listed below. It is important for the field investigator to be aware of these situations and to take actions to minimize error when at all possible.

- Locational error (when it is not possible to get a good GPS point, the AA point data collected may look like it is in another polygon, or if the polygons are small/narrow and the GPS isn't working well, it may be difficult to know which polygon is supposed to be sampled).
- Field key is difficult to use, leading the investigator to assign the point to the wrong association.
- Field key does not include all plant associations in the park, also leading to confusion in which association to assign to a point.
- Field data error- either by mis-identifying diagnostic species, or by not reading the key carefully, resulting in a bad field call when the map is actually accurate.
- AA point falls within an ecotone, which is impossible to classify but still has to be mapped as something
- Relationships between plant associations and map units (modeling) are flawed.
- The polygon is heterogenous, including patches of varying vegetation that are too small to map individually. The AA point may happen to fall in a part of the polygon with a different community than what the photo interpreter saw in the bigger picture.

NAVIGATING TO PLOT

The field investigator will navigate to each selected AA point using handheld GPS receivers and maps consisting of a digital orthophoto (DOQQ) base overlaid with AA point locations, mapped vegetation polygons and USGS 7.5 minute topographic quadrangle maps.

- The DOQQ maps will identify the location of the AA points, as well as the location, size and shape of the polygons.
- Topographic maps are useful in identifying the landscape when navigating to a point, and in determining the elevation of a point. They are also helpful for obtaining names of topographic features used for assigning site names.
- GPS receivers indicate the direction and the distance (as the crow flies) to the AA point. This can obviously lead to trouble if one were to navigate as the crow flies to AA points, not being aware of canyons or other obstacles in the way. Use the DOQQ and topo maps to plan the route! ***Note***: *In very homogenous terrain, GPS the location of the field vehicle so one can find their way back!*

Use the GPS unit to locate the point within 5-10 m of coordinates, but do not spend a lot of time trying to be exact. A 5000m^2 area around each point will be evaluated, which is the size of Minimum Mapping

Unit (MMU = 0.5 ha). The MMU is the smallest area that the photo interpreters are required to map to vegetation class. (However, mappers can choose to delineate smaller polygons if the map class is distinctive). Typically the AA plot will be circular in shape (40 m radius), however, in some situations the plot shape will need to be varied to accommodate the map unit being samples (e.g. a long-narrow riparian area, or point falling too close to the edge of a polygon).

At each AA point the investigator will key the vegetation to plant association within half a hectare around each point. The MMU is a relatively large area - approximately the size of a football field with endzones (50m x100m rectangle, 71m x71m square, 80m diameter circle). The shape of the MMU may need to vary depending on the shape of the mapping polygon, but for large polygons, an 80m diameter circle is easiest. If the polygon is smaller than the MMU, evaluate the whole polygon

Along the way... Identify the polygons that the target AA points are in, and if possible walk through part of the polygons on the way to the points, noting polygon boundaries. Is the map polygon uniform or variable? Is the AA point representative of the polygon? Record these observations on the AA form upon arrival at the point.

A word about safety… As with all fieldwork, navigation will occur through rough terrain, often off-trail, to reach the destination. However, particularly in AA work, there is a desire to reach as many points as possible in a day, and to get as close to each point as feasible. No AA point is worth risking one's life! Use good judgment. A list of alternate points will be provided in case an AA point cannot be reached due to difficult terrain or other reasons. If this happens, PLEASE document that the point was not reachable so that the effort is not repeated by someone else.

Occasionally the AA point will fall on the edge of two vegetation types, or at the edge of a polygon. In these instances the field crew member will need to use judgment on how to handle. If two distinct plant associations are present on a site, it may be helpful to record separate species lists for each of the communities on the field form. In addition, both types would be keyed and recorded on the field form. There will be many times where the point falls at the edge of a polygon. In selecting AA points a 12.5 m buffer from the polygon edge is used, therefore hopefully ensuring that most AA points fall cleanly with the polygon boundaries. However, in some cases the AA point will partially include some of the adjacent polygon. In this situation, the field crew member will shift the center of their AA point away from the polygon edge so that it will not fall in the adjacent polygon. The AA point will be GPSed at this new location, the checkbox "other" for plot shape will be checked, and this shifting of location will be documented by the observer at the end of the "Classification Comments" section.

IDENTIFIERS / LOCATORS SECTION

Most fields in this section, except the few fields listed below, are the same as the plot form. Please refer to the Plot Survey Form instructions for this section. As with the procedures for Plots, you must mark the location of the Accuracy Assessment Point on the corresponding topo map, aerial photo and BPU map.

AA Point code

Accuracy assessment point codes are derived from the codes assigned to points on the DOQQ photo map, with "_AA." inserted between the 4-letter park alphacode and point number. An example of an AA point at Canyonlands would be CANY_AA.0101. Please note that park specific datasheets already have the parkcode and '_AA.' delimiter listed. The field investigator will only need to record the 4-digit AA point number on the form.

AA Point Shape
Select one of the following choices to describe plot shape: circular or other. (Remember, other must be circled if the AA point center is shifted away from the coordinates you were given). In the case of other please provide comments in the classification comments field below.

Taking photographs
Take one color slide of each AA point, two if there is more than one community represented there. The purpose is to get a good representation that accurately captures the vegetative stand of the AA point. If the area is heterogeneous, please represent this in the photos. Try to include a little sky for perspective. Use a chalkboard to record the point number and the direction the photo is taken. Thus, for AA point 241, the board in the photo taken from the SE facing NW across the point will read "CANY AA 241, →NW". Take the photographs looking across the contour if point is on a steep slope. In addition, a photograph log for all photos not taken at AA points will need to be maintained. It is not anticipated that crews would routinely take additional photos, however, if a crew member finds a new vegetation type not previously described, it would be good to document this situation with an extra photograph without the signboard.

MAP UNIT/ ASSOCIATION INFORMATION SECTION

Map Unit # (primary, secondary, and tertiary)

Fill out this section last, after all the vegetation information has been collected. Using the environmental, stratum and cover data, use the map unit key to choose the best map unit for the AA point and enter the map unit number in the first row under “Map Unit”. If the situation is borderline between multiple map units, you may enter a secondary or tertiary map unit number as well. Choose carefully and write neatly, as this will be the field used in the analysis to determine the accuracy of the vegetation map! You must enter at least one map unit on the form, even your point does not fit any of the map unit concepts well. Document any problems you had in assigning a map unit under “Classification Comments.”

In addition, please make notes in the margin of the map unit key on suggestions for making the key work better, or areas of confusion in the key. This is extremely important! It will provide information for improving the key for the final report.

Primary Name, Secondary Name, Tertiary Name

Using the environmental, stratum and cover data, key the vegetation in the half-hectare area around the AA point to association. Choose carefully! Write the name of the association in the primary association field. If the situation is borderline between two associations (e.g., some sagebrush, but also some muttongrass), write another association name in the secondary association field. A tertiary name field has also been provided for the few occasions where a third call is needed. If vegetation near point does not key well, make the best effort to fit it into one or two of the associations listed in the manual, then make detailed comments in the “Classification Comments” field to justify the selection and/or reasoning.

If vegetation near the point does not fit the plant association key at all, then create a new name using the dominant species of each strata (as would be done for a plot). Provide information to characterize the new association in the comments field.

Is Primary/Secondary/Tertiary Name a New Association

If the investigator encountered a new vegetation type and applied a new name (not in the field key) then please check the 'box' to the right of the name indicating that the name is a new association. Please be sure to provide comments in the classification comments field.

Other Map Units Within 50 m

List other map units that are within 50m of the outside border of the half-hectare AA point being evaluated, as long as they are in the same polygon that you are sampling.

Representativeness of AA point

Because AA points are randomly located within a polygon, there is no guarantee that they will land in a spot that is representative of either the polygon or of the associations included within the polygon's map unit. The point could easily land in a small gully or an inclusion that is too small to map, or an ecotone where trees are invading a shrubland, for instance. Because of this, it is important that the investigator pay attention not only to the vegetation within the ½ hectare sample area, but the larger area as well. For the primary plant association call, please rank the representativeness of this AA point for the polygon (Good, Fair, Poor or Unknown). Please note in the Classification Comments field if the AA point falls in an ecotone or inclusion, or in an anomalous situation such as a gully or rock outcrop. If the polygon is extremely large and the observer is unable to make an assessment, then please use the 'unknown' field.

Fit of plant association to description in the key

The key being used does not provide a lot of descriptive information for each association, and is likely not to contain all the associations that may be encountered. Rank the representativeness of the AA point's primary association to the description in the key (Good, Fair, Poor). (If you created a new name for the association, rank the representativeness as Poor.) Please make notes in the margin of the association key on suggestions for making the key work better, or areas of confusion in the key. This is extremely important! It will provide information for improving the key for the final report.

Classification Comments

Here is your chance to describe how well your AA point fits a map unit and an association in the key, and how representative your AA point is compared to the rest of the polygon. It is especially important to make detailed comments in cases of Fair or Poor representativeness/ fit, or in cases where you think you may be encountering an association which is not in the key.

ENVIRONMENTAL DESCRIPTION SECTION

The majority of this section is the same as the Plot Survey Form for which the instructions are stated previously. These fields are as follows: Elevation, Slope, Aspect, Topographic Position, Landform, Geology, and Environmental Comments.

Unvegetated Surface

This field is an ocular estimate of ground cover for the following: bedrock; litter/duff; wood (>1cm); large rocks (cobbles, boulders >10cm); small rocks (gravel 0.1-10 cm); sand (0.1-2mm); bare soil; other (please specify). For this estimation use the cover classes listed below. If an unvegetated surface category is not present in the observation point area, leave the corresponding line blank.

T	<1%	04	36-45%
P	1-5%	05	46-55%
1a	6-10%	06	56-65%
1b	11-15%	07	64-75%
02	16-25%	08	76-85%
03	26-35%	09	86-95%

VEGETATION DESCRIPTION SECTION

These fields: Leaf Phenology, Leaf Type and Physiognomic Class, are the same as those on the Plot Survey Form. Please refer to the previously listed instructions for these fields.

DOMINANT PLANT SPECIES LIST

Record information on ***dominant species only***.
Strata. Species names will be recorded within the appropriate stratum. It is important that all crew members are consistent in assignment of species to strata throughout this project. Following are some guidelines to use in determining strata. The 'working draft' plant list for each park will be used as a guide for assigning species to the appropriate stratum. Field crew members are expected to help improve this list and associated categorization as the field season progresses.

Begin by assessing the strata at the AA point . Trees are defined as single-stemmed woody plants, generally 5 m in height or greater at maturity and under optimal growing conditions. Shrubs are defined as multiple-stemmed woody plants generally less than 5 m in height at maturity and under optimal growing conditions. The exception is mature pinyon and juniper plants, which are considered trees regardless of their height.

T1 Emergent, T2 Canopy, T3 Subcanopy. A uniform stand of pine or cottonwood trees would be a good example of T2"canopy", but where they are absent then begin with the shrub stratum, or herbaceous stratum if no shrubs are present. If the tree crowns at the AA point are mostly touching and similar in height, but a given tree species is much taller that species would be a T1"emergent." As another example, a sample area may be characterized by several tall scattered cottonwoods and then shorter scattered junipers. In this case, the cottonwoods would be the "canopy" and the junipers would be the "subcanopy". There may also be cottonwoods listed in the "subcanopy" layer, if there are a number of short saplings in addition to mature tall trees.
The remaining vegetative strata are (remember to check with plant list for consistency):

S1 Tall Shrub. >2 meters tall. For example, *Fraxinus anomala* and *Purshia mexicana.*
S2 Short Shrub. <2 meters tall. For example, *Coleogyne ramosissima,* all *Atriplex* except *garrettii, corrugata, gardneri* (which are dwarf).
S3 Dwarf Shrub. <0.5 meters tall. For example, *Opuntia polyacantha.*
H Herbaceous. All herbaceous species including graminoids, forbs, ferns and fern allies.
H4 Tree Seedlings. Seedlings are trees with vertical stems < 1.5 m tall, but that may vary by species (e.g. does not always apply to pinyon – juniper).
N Nonvascular. This is mainly dark cyanobacteria, mosses and lichens.

Height can be used to define strata, but is not how species should be placed in strata. **Species characteristically belong to one stratum or another** (e.g., pinyon and juniper are canopy (T2), Utah serviceberry is a tall shrub (S1), blackbrush is a short shrub (S2), snakeweed is a dwarf shrub (S3), etc.), **EVEN when unusual environmental circumstances dictate that the plants have an unusually tall** (e.g., response of some plants to fire) **or unusually short growth form**. *So even if the junipers growing*

in cracks are only 1.5 m tall, as long as they are not seedlings, they get put in the T2 category. About the only rule regarding height should be that the tree layer is (usually) higher than the tall shrub layer that is taller than the short shrub layer, etc.

The second thing is to avoid splitting species between strata. If a few mountain mahogany have been browsed to <1m tall, but most are 2m tall, they all get rolled into the tall shrub stratum. There are two exceptions: (1) each height class covers more than 10% of a point , or (2) there is a reproductive layer of baby shrubs or young trees.

The third issue is how to define some of the "borderline/confusing" species. What we want to avoid is having some crew members calling *Leptodactylon* a forb and some calling it a dwarf shrub. Same for snakeweed, *Eriogonum microthecum*, fringed sage, *Brickellia* and any number of other species. Consult the master plant species lists when in doubt. Crew members should keep the master plant list and strata assignments updated.

Completing the Species/Strata Table:

Dominant Species. List the dominant plant species using **full scientific name** by the strata listed below for each AA point. In some cases, due to severe drought conditions of recent years, a dominant species on the site may have experienced severe levels of mortality. In this case please record 'DEAD' in front of the scientific name and enter the cover value, independent of any live cover value for the same species. During data entry back in the office there will be a check field to use for 'DEAD'. It is also important to document these relationships in the comments field.

T1	Emergent	S3	Dwarf Shrub
T2	Canopy	H	Herbaceous
T3	Sub-canopy	H4	Tree Seedlings
S1	Tall Shrub	N	Non-vascular
S2	Short Shrub		

Diagnostic Species. Mark species that characterize the stand with a '*'.

Height Class. Use the height class code from the list below that best describes the overall height of each plant species within a given stratum.

01	<0.5 m	06	10-15 m
02	0.5-1 m	07	15-20 m
03	1-2 m	08	20-35 m
04	2-5 m	09	35-50 m
05	5-10 m	10	>50 m

Cover Class. For each plant species use the cover class codes listed below to estimate overall canopy cover for each species listed on the form.

T	<1%	04	36-45%
P	1-5%	05	46-55%
1a	6-10%	06	56-65%
1b	11-15%	07	64-75%
02	16-25%	08	76-85%
03	26-35%	09	86-95%

Percent (%) Cover. Estimate the percent aerial cover (T-100%) for each plant species recorded in the far right hand column on the form.

If the point is on the border between two types… (and both types are at least MMU-size), make two species lists, one for each type, on the back of the AA point form. These will both be entered into the database for that AA point.

AA Materials Checklist:

- Park research permit
- Topo maps
- Park and BLM maps for general navigation
- DOQQ photos of AA point locations
- Geology map
- Compass with adjustable declination
- Clinometer
- GPS unit
- Extra AA batteries for walkie-talkie
- Radio or walkie-talkie and/or cell phone
- 35 mm camera & slide film (allow at least 2 exposures per AA point)
- Baggies for temporary storage of unknown plants, and masking tape for labeling
- Plant press & paper
- Plant Keys / Flora(s)
- Pencils / sharpies
- Forms: AA point and observation point
- Clipboard/forms holder
- Pens, pencils, pencil lead, slate board, chalk, and chalkboard eraser or supply of clean rags
- Key to the plant associations of the park
- All ancillary information (cheat sheet, species list, floras, sampling priority list for zone, main sampling protocol).
- First aid kit, personal gear (food, water, rain gear, etc.)

APPENDIX 1: Landform Glossary

(http://soils.usda.gov/technical/handbook/detailedtoc.html#629)

alluvial fan - A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes, shaped like an open fan or a segment of a cone, deposited by a stream (best expressed in semiarid regions) at the place where it issues from a narrow mountain or upland valley; or where a tributary stream is near or at its junction with the main stream. It is steepest near its apex which points upstream and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

alluvial plain - (a) A large assemblage of fluvial landforms (braided streams, terraces, etc.,) that form low gradient, regional ramps along the flanks of mountains and extend great distances from their sources (e.g., High Plains of North America. SW (b) (not recommended, use flood plain.) An general, informal term for a broad flood plain or a low-gradient delta. Compare - alluvial flat.

alluvial terrace - (not preferred) refer to stream terrace.

alluvium - Unconsolidated, clastic material subaerially deposited by running water, including gravel, sand, silt, clay, and various mixtures of these. Compare - colluvium, slope alluvium.

artificial levee - An artificial embankment constructed along the bank of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel.

backslope - The hillslope profile position that forms the steepest and generally linear, middle portion of the slope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below. They may or may not include cliff segments (i.e. free faces). Backslopes are commonly erosional forms produced by mass movement, colluvial action, and running water. Compare - summit, shoulder, footslope, toeslope.

badlands - A landscape which is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes with narrow interfluves. Badlands develop on surfaces with little or no vegetative cover, overlying unconsolidated or poorly cemented materials (clays, silts, or in some cases sandstones) sometimes with soluble minerals such as gypsum or halite.

bajada - (colloquial: southwestern US.) A broad, gently inclined, alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins. Synonym - coalescent fan piedmont. Compare - colluvial apron.

basin - (a) Drainage basin; (b) A low area in the Earth's crust, of tectonic origin, in which sediments have accumulated. (c) (colloquial: western US) A general term for the nearly level to gently sloping, bottom surface of an intermontane basin (bolson). Landforms include playas, broad alluvial flats containing ephemeral drainageways, and relict alluvial and lacustrine surfaces that rarely, if ever, are subject to flooding. Where through-drainage systems are well developed, flood plains are dominant and lake plains are absent or of limited extent. Basin floors grade mountainward to distal parts of piedmont slopes.

bench - (not preferred) refer to structural bench.

blowout - A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand, loose soil, or where protective vegetation is disturbed or destroyed; the adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Commonly small, some blowouts may be large (kilometers in diameter). Compare - deflation basin.

bluff - (a) A high bank or bold headland, with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water, especially on the outside of a stream meander; ex. a river bluff. (b) (not preferred) use cliff. Any cliff with a steep, broad face.

borrow pit - An excavated area from which earthy material has been removed typically for construction purposes offsite; also called barrow pit.

bottomland - (not recommended) use flood plain. An obsolete, informal term loosely applied to varying portions of a flood plain.

box canyon - a) A narrow gorge or canyon containing an intermittent stream following a zigzag course, characterized by high, steep rock walls and typically closed upstream by a similar wall, giving the impression, as viewed from its bottom, of being surrounded or "boxed in" by almost vertical walls. b) A steep-walled canyon heading against a cliff a dead-end canyon.
braided stream - A channel or stream with multiple channels that interweave as a result of repeated bifurcation and convergence of flow around inter-channel bars, resembling (in plan view) the strands of a complex braid. Braiding is generally confined to broad, shallow streams of low sinuosity, high bedload, non-cohesive bank material, and a steep gradient. At bank-full discharge, braided streams have steeper slopes and shallower, broader, and less stable channel cross sections than meandering streams. Compare - meandering channel, flood-plain landforms.
break - (slopes) An abrupt change or inflection in a slope or profile. Compare - knickpoint, shoulder, escarpment. (geomorphology) A marked variation of topography, or a tract of land distinct from adjacent land, or an irregular or rough piece of ground. Compare - breaks.
breaks - (colloquial: western US) A landscape or large tract of steep, rough or broken land dissected by ravines and gullies and marks a sudden change in topography as from an elevated plain to lower hilly terrain, or a line of irregular cliffs at the edge of a mesa or a river (e.g., the Missouri River breaks).
butte - An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments, commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks. Compare - mesa, plateau, cuesta.
canyon - A long, deep, narrow, very steep-sided valley cut primarily in bedrock with high and precipitous walls in an area of high local relief (e.g., mountain or high plateau terrain), often with a perennial stream at the bottom; similar to but larger than a gorge. Compare - gorge, box canyon, slot canyon.
channel - (a) The hollow bed where a natural body of surface water flows or may flow. The deepest or central part of the bed of a stream, containing the main current and occupied more or less continuously by water. (b) (colloquial: western US.) The bed of a single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium. Channels may be enclosed by banks or splayed across and slightly mounded above a fan surface and include bars and mounds of cobbles and stones. (c) Small, trough-like, arcuate or sinuous channels separated by small bars or ridges, caused by fluvial processes; common to flood plains and young alluvial terraces; a constituent part of *bar and channel* topography.
cliff - Any high, very steep to perpendicular or overhanging face of rock or earth; a precipice. Compare - bluff.
climbing dune - A dune formed by the piling-up of sand by wind against a cliff or mountain slope; very common in arid regions with substantial local relief and strong winds. Compare - sand ramp.
colluvium - Unconsolidated, unsorted material being transported or deposited on sideslopes and/or at the base of slopes by mass movement (e.g. direct gravitational action) and by local, unconcentrated runoff. Compare - alluvium, slope alluvium, scree, talus, mass movement.
crest - (a) The commonly linear, narrow top of a ridge, hill, or mountain. It is appropriately applied to elevated areas where retreating backslopes are converging such that these high areas are almost exclusively composed of convex shoulders; (b) (not preferred) Sometimes used as an alternative for the hillslope component *summit*. Compare - summit (*part b*), saddle.
cuesta - An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip (commonly less than 15 percent); produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope), that roughly parallels the inclined beds, and on the other side has a relatively short and steep or cliff-like slope (scarp) that cuts through the tilted rocks. Compare - hogback, mesa, dipslope, scarp slope, cuesta valley.
debris flow - The process, associated sediments (debris flow deposit) or landform resulting from a very rapid type of *flow* dominated by a sudden downslope movement of a mass of rock, soil, and mud (more than 50% of the particles are > 2mm), and whether saturated or comparatively dry, behaves much as a viscous fluid when moving. Compare - lahar, mudflow, landslide.

deflation basin - A topographic basin excavated and maintained by wind erosion which removes unconsolidated material and commonly leaves a rim of resistant material surrounding the depression. Unlike a blowout, a deflation basin does not include adjacent deposits derived from the basin. Compare - blowout.
depression - Any relatively sunken part of the Earth's surface; especially a low-lying area surrounded by higher ground. A closed depression has no natural outlet for surface drainage (e.g. a sinkhole). An open depression has a natural outlet for surface drainage. Compare - closed depression, open depression.
desert pavement - A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments, mantling a desert surface. It is formed where wind action and sheetwash have removed all smaller particles or where coarse fragments have migrated upward through sediments to the surface. It usually protects the underlying, finer-grained material from further deflation. The coarse fragments commonly are cemented by mineral matter. Compare - erosion pavement, stone line.
dike - A tabular igneous intrusion that cuts across the bedding or foliation of the country rock. Compare – sill.
dip - A geomorphic component (characteristic piece) of flat plains (e.g., lake plain, low coastal plain, low-relief till plain) consisting of a shallow and typically closed depression that tends to be an area of focused groundwater recharge but not a permanent water body and that lies slightly lower and is wetter than the adjacent talf, and favors the accumulation of fine sediments and organic materials.
ditch - An open and usually unpaved (unlined), channel or trench excavated to convey water for drainage (removal) or irrigation (addition) to or from a landscape; smaller than a canal; some ditches are modified natural waterways.
divide - (a) The line of separation; (b) The summit area, or narrow tract of higher ground that constitutes the watershed boundary between two adjacent drainage basins; it divides the surface waters that flow naturally in one direction from those that flow in the opposite direction. Compare – interfluve.
dome - (a) An uplift or anticlinal structure, either circular or elliptical in outline, in which the rocks dip gently away in all directions. A dome may be small (e.g. a salt dome) or many kilometers in diameter. (b) A smoothly rounded landform of rock mass such as a rock-capped mountain summit, that roughly resembles the dome of a building. (e.g. the rounded granite peaks of Yosemite, CA).
drainageway - (a) A general term for a course or channel along which water moves in draining an area. (b) a term restricted to relatively small, roughly linear or arcuate depressions that move concentrated water at some time, and either lack a defined channel (e.g. head slope, swale) or have a small, defined channel (e.g. low order streams).
draw - A small, natural watercourse cut in unconsolidated materials, generally more open with a broader floor and more gently sloping sides than an arroyo, ravine or gulch, and whose present stream channel may appear inadequate to have cut the drainageway that it occupies.
dune - A low mound, ridge, bank or hill of loose, windblown, subaerially deposited granular material (generally sand), either barren and capable of movement from place to place, or covered and stabilized with vegetation, but retaining its characteristic shape. (See barchan dune, parabolic dune, parna dune, shrub-coppice dune, seif dune, transverse dune).
dune field - An assemblage of moving and/or stabilized dunes, together with sand plains, interdune areas, and the ponds, lakes, or swamps produced by the blocking of steams by the sand. See dune lake.
earthflow - The process, associated sediments (earthflow deposit) or resultant landforms characterized by slow to rapid types of flow dominated by downslope movement of soil, rock, and mud (more than 50% of the particles are < 2 mm), and whether saturated or comparatively dry, behaves as a viscous fluid when moving. Compare - debris flow (coarser, less fluid), mudflow (finer, more fluid).
eolian deposit - Sand, silt or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess. Conventionally, primary volcanic deposits (e.g. tephra) are handled separately. Compare - loess, parna, beach sands.

eolian sands - Sand-sized, clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sand sheet. Compare - beach sands.
ephemeral stream - Generally a small stream, or upper reach of a stream, that flows only in direct response to precipitation. It receives no protracted water supply from melting snow or other sources and its channel is above the water table at all times. Compare - arroyo, intermittent stream, perennial stream.
escarpment - A continuous, steep slope or cliff produced by erosion or faulting and that topographically interrupts or breaks the general continuity of more gently sloping land surfaces . The term is most commonly applied to cliffs produced by differential erosion. Synonym = scarp.
falling dune - An accumulation of sand that is formed as sand is blown off a mesa top or over a cliff face or steep slope, forming a solid wall, sloping at the angle of repose of dry sand, or a fan extending downward from a re-entrant in the mesa wall. Compare - climbing dune, sand ramp.
finger ridge - One in a group of small, tertiary spur ridges that form crudely palmate extensions of erosional remnants along the flanks or nose of larger ridges. Compare - ballena, rib.
flat - (a) (adjective) Said of an area characterized by a continuous surface or stretch of land that is smooth, even, or horizontal, or nearly so, and that lacks any significant curvature, slope, elevations, or depressions. (b) (noun) An informal, generic term for a level or nearly level surface or small area of land marked by little or no local relief. Compare - mud flat. (c) (not recommended) A nearly level region that visibly displays less relief than its surroundings.
flood plain - The nearly level plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the streams.
foothills - A steeply sloping upland composed of hills with relief of 30 up to 300 meters and fringes a mountain range or high-plateau escarpment. Compare - hill, mountain, plateau. SW &
gorge - (a) A narrow, deep valley with nearly vertical, rocky walls, smaller than a canyon, and more steep-sided than a ravine; especially a restricted, steep-walled part of a canyon. (b) A narrow defile or passage between hills or mountains.
gravel pit - A depression, ditch or pit excavated to furnish gravel for roads or other construction purposes; a type of borrow pit.
gulch - (colloquial: western US.; not preferred - refer to ravine) A small stream channel, narrow and steep-sided in cross section, and larger than a gully, cut in unconsolidated materials. General synonym - ravine. Compare - arroyo, draw, gully, wash.
gully - A small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water usually during and immediately following heavy rains or ice / snow melt. A gully generally is an obstacle to wheeled vehicles and too deep (e.g., > 0.5 m) to be obliterated by ordinary tillage; (a rill is of lesser depth and can be smoothed over by ordinary tillage). Compare - rill, ravine, arroyo, swale, draw.
hanging valley - A tributary valley whose floor at the lower end is notably higher than the floor of the main valley in the area of junction.
hill - A generic term for an elevated area of the land surface, rising at least 30 m (100 ft.) to as much as 300 meters (approx. 1000 ft.) above surrounding lowlands, usually with a nominal summit area relative to bounding slopes, a well-defined, rounded outline and slopes that generally exceed 15 percent. A hill can occur as a single, isolated mass or in a group. A hill can be further specified based on the magnitude of local relief: *low hill* (30 - 90 m) or *high hill* (90 - 300 m). Informal distinctions between a hill and a mountain are often arbitrary and dependent on local convention. Compare - hillock, plateau, mountain, foothills, hills.
hillock - A generic name for a small, low hill, generally between 3 - 30 m in height and slopes between 5 and 50% (e.g., bigger than a mound but smaller than a hill); commonly considered a microfeature. Compare - mound, hill.
hillslope - A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill. Compare - mountain slope.

hogback - A sharp-crested, symmetric (homoclinal) ridge formed by highly tilted resistant rock layers; produced by differential erosion of interlayered resistant and weak rocks with dips greater than about 25 degrees (45 percent). Compare - cuesta.
hoodoo - A bizarrely shaped column, pinnacle, or pillar of rock produced by differential weathering or erosion in a region of sporadically heavy rainfall. Formation is facilitated by joints and layers of varying hardness. Compare - earth pillar.
hummock - (a) (not preferred - see hillock). An imprecise, general term for a rounded or conical mound or other small elevation. (b) (not preferred) A slight rise of ground above a level surface.
interfluve - A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways. Compare - divide.
intermittent stream - A stream, or reach of a stream, that does not flow year-round (commonly dry for 3 or more months out of 12) and whose channel is generally below the local water table; it flows only when it receives a) base flow (i.e. solely during wet periods), or b) ground-water discharge or protracted contributions from melting snow or other erratic surface and shallow subsurface sources. Compare - ephemeral stream.
island - (a) Land completely surrounded by water; (b) An elevated area of land surrounded by swamp, or marsh, or isolated at high water or during floods. Compare - barrier island.
knob - (a) A rounded eminence, a small hill or mountain; especially a prominent or isolated hill with steep sides, commonly found in the Southern United States. (b) A peak or other projection from the top of a hill or mountain. Also, a boulder or group of boulders or an area of resistant rocks protruding from the side of a hill or mountain. Compare - stack.
knoll - A small, low, rounded hill rising above adjacent landforms.
lakeshore - The narrow strip of land in contact with or bordering a lake; especially a beach.
landslide - A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials, caused by gravitational forces and which may or may not involve saturated materials. Names of landslide types generally reflect the dominant process and/or the resultant landform. The main operational categories of mass movement are *fall* (rockfall, soil fall, topple), *slide* (rotational landslide, block glide, debris slide, lateral spread), *flow* [rock fragment flow (especially rockfall avalanche), debris avalanche, debris flow (e.g., lahar), earthflow, (creep, mudflow)], and *complex landslides*. Compare - solifluction.
ledge - (a) A narrow shelf or projection of rock, much longer than wide, formed on a rock wall or cliff face, as along a coast by differential wave action on softer rocks; erosion is by combined biological and chemical weathering. (b) A rocky outcrop; solid rock. (c) A shelf-like quarry exposure or natural rock outcrop. Compare - structural bench.
levee - An artificial or natural embankment built along the margin of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel. Compare artificial levee, natural levee.
marsh - Periodically wet or continually flooded areas with the surface not deeply submerged. Covered dominantly with sedges, cattails, rushes, or other hydrophytic plants. Compare - salt marsh, swamp, bog, fen.
meander belt - The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops. Landform components of the meander-belt surface are produced by a combination of gradual (lateral and down-valley) migration of meander loops and avulsive channel shifts causing abrupt cut-offs of loop segments. Landforms flanking the sinuous stream channel include: point bars, abandoned meanders, meander scrolls, oxbow lakes, natural levees, and flood-plain splays. Meander belts may not exhibit prominent natural levee or splay forms. Flood plains of broad valleys may contain one or more abandoned meander belts in addition to the zone flanking the active stream channel.

meander scar - (a) A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream which impinged upon and undercut the bluff; if it's no longer adjacent to the modern stream channel it indicates an abandoned route of the stream; (b) (not recommended - refer to oxbow) An abandoned meander, commonly filled in by deposition and vegetation, but still discernable.
meander scroll - (a) One of a series of long, parallel, close fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank. Compare - meander belt, point bar. (b) (not recommended; refer to oxbow lake) - A small, elongate lake on a flood plain in a well-defined part of an abandoned stream channel.
mesa - A broad, nearly flat-topped, and usually isolated landmass bounded by steep slopes or precipitous cliff and capped by layers of resistant, nearly horizontal, rocky summit width greater than the height of bounding escarpments. (Colloquial: western US; not preferred) Also used to designate broad structural benches and alluvial terraces that occupy intermediate levels in stepped sequences of platforms bordering canyons and valleys. Compare - butte, plateau, cuesta.
monocline - (a) A unit of folded strata that dips from the horizontal in one direction only, is not part of an anticline or syncline, and occurs at the earth's surface.. This structure is typically present in plateau areas where nearly flat strata locally assume steep dips caused by differential vertical movements without faulting. Compare - anticline, syncline, fold. (b) - A local steepening in an otherwise uniform gentle dip.
mountain - A generic term for an elevated area of the land surface, rising more than 300 meters above surrounding lowlands, usually with a nominal summit area relative to bounding slopes and generally with steep sides (greater than 25 percent slope) with or without considerable bare-rock exposed. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are primarily formed by tectonic activity and/or volcanic action and secondarily by differential erosion. Compare - hill, hillock, plateau, foothills, mountains.
natural levee - A long, broad low ridge or embankment of sand and coarse silt, built by a stream on its flood plain and along both sides of its channel, especially in time of flood when water overflowing the normal banks is forced to deposit the coarsest part of its load. It has a gentle slope away from the river and toward the surrounding floodplain, and its highest elevation is closest to the river bank. Compare - levee, artificial levee, meander belt.
overflow stream channel - A watercourse that is generally dry but conducts flood waters that have overflowed the banks of a river, commonly from large storms or annual meltwater.
oxbow - A closely looping stream meander having an extreme curvature such that only a neck of land is left between the two parts of the stream. (colloquial: northeastern A.) the land enclosed, or partly enclosed, within an oxbow. Compare - meander belt, oxbow lake, bayou.
pediment - A gently sloping erosional surface at the foot of a receding hill or mountain slope. The surface may be essentially bare, exposing earth material that extends beneath adjacent uplands; or it may be thinly mantled with alluvium and colluvium, ultimately in transit from upland front to basin or valley lowland. In hill-foot slope terrain the mantle is designated “pedisediment.” The term has been used in several geomorphic contexts: Pediments may be classed with respect to (a) landscape positions, for example, intermontane-basin piedmont or valley-border footslope surfaces (respectively, apron and terrace pediments); (b) type of material eroded, bedrock or regolith; or (c) combinations of the above. Compare - Piedmont slope.
perennial stream - A stream or reach of a stream that flows continuously throughout the year and whose surface is generally lower than the water table adjacent to the region adjoining the stream. Compare - Ephemeral stream, Intermittent stream.
plain - A general term referring to any flat, lowland area, large or small, at a low elevation. Specifically, any extensive region of comparatively smooth and level gently undulating land. A plain has few or no prominent hills or valleys but sometimes has considerable slope, and usually occurs at low elevation relative to surrounding areas. Where dissected, remnants of a plain can form the local uplands. A plain may be forested or bare of trees and may be formed by deposition or erosion. Compare - lowland, plateau.

plateau - A comparatively flat area of great extent and elevation; specifically an extensive land region considerably elevated (more than 100 meters) above adjacent lower-lying terrain, and is commonly limited on at least one side by an abrupt descent, has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level. Compare - hill, foothill, mountain, mesa, plain.
playa - The usually dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those occurring on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation-runoff events. Playa deposits are fine grained and may or may not have high water table and saline conditions.
point bar - One of a series of low, arcuate ridges of sand and gravel developed on the inside of a growing meander by the slow addition of individual accretions accompanying migration of the channel toward the outer bank. Compare - meander scroll.
pond - (a) A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool. (b) A small artificial body of water, used as a source of water. Compare - salt pond.
pool - A small, natural body of standing water, usually fresh; e.g. a stagnant body of water in a marsh, or a transient puddle in a depression following a rain.
quarry - Excavation areas, open to the sky, usually for the extraction of stone.
ravine - A small stream channel; narrow, steep-sided, commonly V-shaped in cross section and larger than a gully, cut in unconsolidated materials. General synonym (not preferred) - gulch. Compare - arroyo, draw, gully.
reef - (a) A ridge-like or mound-like structure, layered or massive, built by sedentary calcareous organisms, especially corals, and consisting mostly of their remains; it is wave-resistant and stands above the surrounding contemporaneously deposited sediment. Also, such a structure built in the geologic past and now enclosed in rock, commonly of differing lithology. (b) A mass or ridge of rocks, especially coral and sometimes sand, gravel, or shells, rising above the surrounding sea or lake bottom to or nearly to the surface, and dangerous to navigation; specifically such a feature at 10 fathoms (18.3 m) or less, formerly 6 fathoms (11 m).
ridge - A long, narrow elevation of the land, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief.
rill - A very small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water, usually during and immediately following moderate rains or after ice/snow melt. Generally, a rill is not an obstacle to wheeled vehicles and is shallow enough to be obliterated by ordinary tillage. Compare - gully.
rim - The border, margin, edge, or face of a landform, such as the curved brim surrounding the top part of a crater or caldera; specifically the rimrock of a plateau or canyon.
rise - (refer to lake plain) (a) A general term for a slight increase in slope and elevation of the land surface, usually with a broad summit and gently sloping sides. (b) same as (a) but the term is restricted to microfeatures in areas of very low relief such as lake plains or coastal plains.
rockfall - The process, associated sediments (rockfall deposit) or resultant landform characterized by a very rapid type of *fall* dominated by downslope movement of detached rock bodies which fall freely through the air or by leaps and bounds (lacks an underlying slip face); also spelled rock fall. Compare - debris fall, soil fall, landslide.
saddle - A low point on a ridge or interfluve, generally a divide (pass, col) between the heads of streams flowing in opposite directions. Compare - summit, crest.
sand ramp - A sand sheet blown up onto the lower slopes of a bedrock hill or mountain and forming an inclined plane, sometimes filling small mountain-side valleys and even crossing low passes. Compare - climbing dune, sand sheet.
sand sheet - A large, irregularly shaped, commonly thin, surficial mantle of eolian sand, lacking the discernible slip faces that are common on dunes.

scarp - An escarpment, cliff, or steep slope of some extent along the margin of a plateau, mesa, terrace, or structural bench. A scarp may be of any height. Compare - escarpment.
scree slope - A portion of a hillside or mountainslope mantled by scree and lacking an up-slope rockfall source (i.e. cliff). Compare - talus slope, scree, talus.
seep - (noun) An area, generally small, where water or oil percolates slowly to the land surface. For water, it may be considered as a seepage spring, but it is used by some for flows too small to be considered as springs.
shoulder - The hillslope profile position that forms the convex, erosional surface near the top of a hillslope. If present, it comprises the transition zone from summit to backslope. Compare - summit, crest, backslope, footslope, and toeslope.
side slope - A laterally planar area of a hillside, resulting in predominantly parallel overland water flow (e.g., sheet wash); contour lines generally form straight lines. Side slopes are dominated by colluvium and slope wash sediments. Slope complexity (downslope shape) can range from simple to complex. Compare - head slope, nose slope, free face, interfluve, crest, base slope. The slope bounding a drainageway and lying between the drainageway and the adjacent interfluve. It is generally linear along the slope width.
slope - (also called slope gradient or gradient) The inclination of the land surface from the horizontal. Percent slope is the vertical distance divided by the horizontal distance, then multiplied by 100.
slope wash - A collective term for non-fluvial, incipient alluvial *processes* (e.g. overland flow, minor rills) that detach, transport, and deposit sediments down hill and mountain slopes. Related sediments (*slope alluvium*) exhibit nominal sorting or rounding of particles, peds, etc., and lateral sorting downslope on long slopes; stratification is crude and intermittent and readily destroyed by pedoturbation and frost action. Also called *slope wash processes*. Compare - slope alluvium, colluvium, valley-side alluvium.
stream terrace - One or a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition (i.e., currently very rarely or never floods; inactive cut and fill and/or scour and fill processes). Erosional surfaces cut into bedrock and thinly mantled with stream deposits (alluvium) are called “strath terraces.” Remnants of constructional valley floors thickly mantled with alluvium are called alluvial terraces. Compare - alluvial terrace, flood-plain step, strath terrace, terrace.
summit - (a) The topographically highest position of a hillslope profile with a nearly level (planar or only slightly convex) surface. Compare - shoulder, backslope, footslope, and toeslope, crest. (b) A general term for the top, or highest area of a landform such as a hill, mountain, or tableland. It usually refers to a high interfluve area of relatively gentle slope that is flanked by steeper slopes, e.g., mountain fronts or tableland escarpments.
swale - (a) A shallow, open depression in unconsolidated materials which lacks a defined channel but can funnel overland or subsurface flow into a drainageway. Soils in swales tend to be more moist and thicker (cummulic) compared to surrounding soils. (b) A small, shallow, typically closed depression in an undulating ground moraine formed by uneven glacial deposition; Compare - swell-and-swale topography. (c) (not preferred; refer to interdune) A long, narrow, generally shallow, trough-like depression between two beach ridges, and aligned roughly parallel to the coastline.
talus - Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of loose broken rock formed chiefly by falling, rolling, or sliding. Compare - talus slope, colluvium, mass movement, scree.
talus slope - a portion of a hillslope or mountainslope mantled by talus and lying below a rockfall source (e.g. cliff). Compare - scree slope, scree, talus. Compare - beveled base.
tank - (colloquial: southwestern US) A natural depression or cavity in impervious rocks in which water collects and remains for the greater part of the year.
terrace - A step-like surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (tread), cut or built by stream or wave action, and the steeper slope (scarp, riser), descending to a lower

base level. Compare - stream terrace, flood-plain step. Practically, terraces are considered to be generally flat alluvial areas above the 100 yr. flood stage.
toeslope - The hillslope position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear, and are constructional surfaces forming the lower part of a hill-slope continuum that grades to valley or closed-depression floors. Compare - summit, shoulder, backslope, footslope, valley floor.
valley - An elongate, relatively large, externally drained depression of the Earth's surface that is primarily developed by stream erosion or glacial activity. Compare - basin.
valley floor - A general term for the nearly level to gently sloping, lowest surface of a valley. Landforms include axial stream channels, the flood plain, flood-plain steps, and, in some areas, low terrace surfaces. Compare - flood-plain landforms, meander, braided channel, valley side.
valley side - The sloping to very steep surfaces between the valley floor and summits of adjacent uplands. Well-defined, steep valley sides have been termed valley walls (not recommended). Note: Scale, relief, and perspective may require use of closely related terms such as hill slope or mountain slope.
wash (dry wash) - (colloquial: western US.) The broad, flat- floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium. Note: When channels reach intersect zones of ground-water discharge they are more properly classed as “intermittent stream” channels. Synonym - arroyo. Compare - gully.

APPENDIX 2: SOIL TEXTURE KEY

(Modified from Brewer and McCann 1982)

Soil primarily organic:

0a. Soil is black, is saturated with water, and often smells of rotten eggs ...……..**muck**
0b. Soil is dark brown, usually saturated, and consists of clearly identifiable plant parts …....**peat**

Soil primarily mineral:

1a. Soil does not remain in a ball when squeezed, leaves your fingers clean ..…….....**sand**
1b. Soil remains in a ball when squeezed ……..…….....2

Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger.

2a. Soil makes no ribbon but leaves your fingers dirty …….……**loamy sand**
2b. Soil makes at least a very short ribbon .....……...3

3a. Ribbon extends less than 1 inch before breaking ……..….....4
3b. Ribbon extends 1 inch or more before breaking ……..…….....5

4a. Add excess water to small amount of soil. Soil feels slightly gritty… ……..…**loam**
4b. Soil fees very gritty……..…….**sandy loam**
4c. Soil feels smooth....…….…….... **silt loam**

5a. Soil makes a ribbon that breaks when 1-2 inches long; cracks if bent into a ring 6
5b. Soil makes a ribbon 2+ inches long; does not crack when bent into a ring ……..…7

6a. Add excess water to small amount of soil; soil feels slightly gritty…… **clay loam**
6b. Soil feels very gritty and slightly sticky..……..**sandy clay loam**
6c. Soil feels very smooth but not at all sticky…..……..... **silt**
6d. Soil feels slightly gritty and slightly sticky…….……**silty clay loam**

7a. Add excess water to a small amount of soil; soil feels gritty…..…..…….... **sandy clay**
7b. Soil feels smooth and sometimes sticky……..……8

8a. Soil feels smooth but leaves a gritty taste in the mouth……..…**silty clay**
8b. Soil leaves a smooth taste in the mouth, not at all gritty…….…….....**clay**

CONSIDERATIONS FOR PLANNING

Planning for the day:

1. Safety and sustenance: Plenty of food, water, first-aid kit, raingear, sunscreen.
2. Field communications:
   a. Develop a plan with other team(s) for radio check-in time.
   b. Do you have a radio and are batteries charged? If you have a walkie-talkie, do you have extra batteries for it? Does park staff know the area in which you will be working?
3. Make sure you have the right maps and photos.
4. Check your GPS (Datum set to NAD83? WAAS on? Needs new batteries?).
5. Plan the day's mission before departing using a) USGS quads, b) aerial photos, c) BLM maps.
6. Considerations for mission planning:
   a. Plan travel based on topography, best access routes, density and complexity of vegetation (more time for forest and woodland plots, less for herbaceous and scrub).
   b. Plan data collection based on priority needs; new types get higher priority.
   c. Communicate with the other team(s) to make sure you aren't duplicating effort.

Planning for the Week (do this on the first day of the trip)

1. Do you have all appropriate maps, photos?
2. Develop a reasonable estimate of the number of plots for each team broken up by day and based on an estimate of individual team's travel logistics for the week.
3. Develop plan of attack for the week to capture all essential associations in the work area.
4. Balance points two and three above with the expected work schedule of the teams and ensure adequate time-off and reduce over-time concerns.
5. Do you have all necessary information and backups for the week's planning? E.g., blank field forms, film, plenty of batteries.

Wrapup (Do this on the last day of the trip, after you have returned to base)

1. Clean, recharge and repair equipment.
2. Hold brief meeting to discuss data collection issues, things that came up during the work week, and plan for next work hitch.
3. Edit field forms and file them systematically. File observation points separately.
4. Re-file the aerial photos and maps.
5. Send exposed rolls of film to be developed.
6. Key unknown plants.
7. Enter edited data into database.

Communicate among teams / Topics for wrap-up meetings.

1. What were your questions about the polygons visited during the week?
2. Do you have any questions about the forms or fields?
3. What was accomplished, what was not accomplished?
4. Pass on developments and questions after every trip. Don't let them build up. For example, should we sample the new types we saw? Were there problems with interpreting the aerial photos, or are there personnel issues, problems in consistency in interpreting the forms, or with park-related logistics?

B.3. Example of a Vegetation Plot Data Form

CEDAR BREAKS NATIONAL MONUMENT PLOT SURVEY FORM
2006 NCPN VEGETATION MAPPING PROGRAM

SURVEY AND SITE INFORMATION

Plot Code: CEBR 0097 Quad name: Brian Head BPU Code: —— Aerial Photo #: 112-5
Park Site Name Lower Lavendar Canyon Location (Please Circle One): (Park) Environs
Survey Date 7-27-06 Surveyors Edwards, M. Smith

GPS file name CB097 Field UTM X 336289 m E Field UTM Y 4167357 m N
☐ Coordinates from USGS NAD27 Quad Map (if checked enter coordinates under GPS comments)
Datum NAD 83 Zone: 12S GPS Unit: Trimble XM/ (Garmin) Flat /Other: etrex PDOP: ____ 3D Differential? (Y) N
GPS Comments: Error: +/- 7 m (Flat Garmin only)

Directions to Plot:
From Ashdown Creek walk up Adams creek, then up lower Lavendar Creek to plot on north facing slope.

Square plot (20m x 20m) X | Rectangular Plot: length(m)____ width(m)____ | Azimuth 354°

Camera Name and Model (circle one): Olympus Stylus / Canon Sureshot / Minolta FZ/ Other: ____

Roll #	Frame #	Photographer	Direction/Comments
KM1	11	Edwards	N
KM1	12	Edwards	W

Plot representativeness (discuss plot placement and explain non-representativeness)
Appears fairly representative for area walked through to reach plot.

ENVIRONMENTAL DESCRIPTION

Elevation 2579 (m)/ft From: (GPS) / Map (circle one) | Slope 25° Aspect 340°
Topographic Position: midslope
Landform: hill | Geology: Straight Cliffs Formation

Cowardin System: X Upland ___ Palustrine

Hydrology: ___ Unknown ___ Permanently Flooded ___ Seasonally Flooded ___ Temporarily Flooded ___ Semipermanently Flooded ___ Saturated ___ Intermittently Flooded

Environmental Comments (factors controlling community/plant distribution, seral stage, fire history etc):
Relatively north aspect loam soil contribute to vegetation growth. Steepness of slope/ winds have caused blow down, some due to bark beetle kill and slope contributes to pistol butting. Moss growth is mostly on tree stumps and/or under vegetation

2006: FEB 09; V1.2 (Plot Form) 1

CEDAR BREAKS NATIONAL MONUMENT PLOT SURVEY FORM

PLOT CODE: CEBR. 0091 DATE: 7-27-06

ENVIRONMENTAL DESCRIPTION (Continued)

Ground Cover: *(please estimate to the nearest percentage. Sum = 100%)*

16 Bare soil	1 Live veg - litter	1 Moss	= Dark cyanobacteria
— Bedrock	8 Live veg – wood	= Lichen (on rocks)	= Water
5 Small rocks (0.2-10cm)	4 Wood (>1cm)	5 Lichen (ground)	
1 Large rocks (>10cm)	70 Litter / duff		
— Sand (0.1-2mm)			

Soil Texture (see cheat sheet):

___ sand	___ loamy sand	___ sandy loam	X loam
___ silt loam	___ silt	___ clay loam	___ silty clay
___ sandy clay	___ clay	___ peat	___ muck
___ sandy clay loam	___ silty clay loam		

Soil Drainage:

___ Rapidly drained	X Well drained
___ Moderately well drained	___ Somewhat poorly drained
___ Poorly drained	___ Very poorly drained

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

Minimal use animal trail traverses through plot. Birds present. Owl scat with intestines on log and numerous flies/one wasp present. Fresh water snail shells on the plot.

Natural and Anthropogenic Disturbance Comments (see cheat sheet for examples; describe intensity and effect on the vegetation, also whether disturbance is current, chronic, episodic or historic)

Blow-down trees and minimal pistol butting seen through plot.

Other Comments. **Describe surrounding communities and how they relate to the plot.**

Forb/shrub cover may vary slightly, increased cover Populus tremuloides on flatter areas.

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class
		___ Forest
Trees and Shrubs	___ Broad-leaved	X Woodland
___ Evergreen	___ Needle-leaved	___ Shrubland
X Cold-deciduous	___ Microphyllous	___ Wooded Shrubland
X Mixed evergreen-cold-deciduous	___ Graminoid	___ Dwarf Shrubland
	___ Forb	___ Shrub Herbaceous
Herbs	___ Pteridophyte	___ Herbaceous
___ Annual	___ Non-vascular	___ Nonvascular
___ Perennial	X Mixed (describe) Broad - Needle	___ Sparsely Vegetated
		___ Wooded herbaceous

2006: FEB 09; V1.2 (Plot Form) 2

CEDAR BREAKS NATIONAL MONUMENT PLOT SPECIES/STRATA FORM
2006 NCPN VEGETATION MAPPING PROGRAM

Plot Code: CEBR. 0097 Date: 7/27/06

VEGETATION DESCRIPTION

Provisional Community Name: Abies concolor - Populus tremuloides / Mahonia repens Woodland

Supplemental Form (Please Check if Used): ☐

Species/Strata: Starting with the uppermost stratum list all species with full scientific names, cover class and % cover for each species in the stratum. For each tree species estimate seedling, sapling, total cover in appropriate stratum. Once species level information is completed, then complete height class and cover class for each strata (shaded blocks). Indicate with an asterix ('*') diagnostic species for each stratum and check whether a specimen has been collected. Trees and shrubs are on the front portion of this form. Herbaceous species and non-vascular plants are on the back of this form. **List species outside the plot at the end of the table and designate with a 0 in Cover Class Column.**

SPECIES/STRATA TABLE / TREES & SHRUBS

Strata / Species Scientific Name	*	Cover Class	% Cover	Spec ✓
T1 EMERGENT Strata Height: ____ Strata Cover: ____				
T2 CANOPY Strata Height: 07 Strata Cover: 03				
Populus tremuloides		P	6	
Abies concolor		D2	17	
Pseudotsuga menziesii (dead)		P	2	
T3 SUBCANOPY Strata Height: 04 Strata Cover: 1A				
Abies concolor		1A	6	
S1 TALL SHRUB (> 2m) Strata Height: ____ Strata Cover: ____				
S2 SHORT SHRUB (< 2m) Strata Height: 02 Strata Cover: P				
Symphoricarpos oreophilus		P	3	
Rosa woodsii		P	1	
Juniperus communis		P	1	
S3 DWARF SHRUB (< 0.5m) Strata Height: 01 Strata Cover: P				
Mahonia repens		P	3	
Pachystima myrsinites		P	1	

SPECIES/STRATA TABLE / HERBACEOUS

Strata / Species Scientific Name	*	Cover Class	% Cover	Spec ✓
H1 HERBACEOUS Sum of H1, H2, H3, H4 Strata Height: 02 Strata Cover: 1A				
H1 GRAMINOIDS Strata Height: 02 Strata Cover: T				
Bromus anomalus			T	
Elymus glaucus			T	
H2 FORBS Strata Height: 01 Strata Cover: 1A				
Mertensia arizonica		P	3	
Osmorhiza depauperata		P	1	
Arnica cordifolia		P	1	
Fragaria virginiana			T	
Aquilegia coerulea			T	
Epilobium angustifolium			T	
Xerophyllum tenax			T	
H3 FERNS & ALLIES Strata Height: 01 Strata Cover: T				
Equisetum arvense			T	
H4 TREE SEEDLINGS Strata Height: 03 Strata Cover: P				
Abies concolor		P	2	
Populus angustifolia			T	
Picea engelmannii			T	
N NON-VASCULAR Strata Height: 01 Strata Cover: T				
Moss			T	
Lichen			T	

Cover Scale for Species and Strata

t = few; T = 0-1%; P = 1-5%; 1A = 5-10%; 1B = 10-15%; 2 = 15-25%; 3 = 25-35%; 4 = 35-45%; 5A = 45-50%; 5B = 50-55%; 6 = 55-65%; 7 = 65-75%; 8 = 75-85%; 9 = 85-95%; 10 = > 95%

Height Scale for Strata

01 < 0.5 m; 02 0.5 – 1 m; 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

2006: FEB 09; v1.3 (Species/Strata Form)

3

CEDAR BREAKS NATIONAL MONUMENT FUELS FORM
2005 NCPN VEGETATION MAPPING PROJECT

PLOT CODE: CEBR. 0097 DATE: 7/27/06

(Table Continued from Previous Page)

Species Code	Twin ✓	Live ?	DBH (cm)	DRC (cm)	Crown Base Height (m)	Crown Ratio (1/10 m)	Structural Stage	Damage Codes/Comments
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						

FUEL VARIABLES (English Units)

Anderson Fuel Model Number 10

1hr/10hr/100hr fuel intercept tallies (In PJ do only one transect, In mixed conifer vegetation do two).

Browns Transect #	Slope (deg)	Azimuth	59'-65' along transect 1 hr tally (<0.25")	59'-65' along transect 10hr tally (0.25-1")	53'-65' along transect 100 hr tally (1-3")
1	30°	235°	23	2	1
2	4°	55°	23	8	4

Large Woody Intercepts (> 3 in) Decay Class: S = sound R = Rotten (15' to 65')

Transect	Diameter (in)	Decay Class	Transect	Diameter (in)	Decay Class	Transect	Diameter (in)	Decay Class
1	5.0	S						
1	3.2	S						
1	10.0	S						
1	5.5	S						
1	8.0	S						
2	3.5	S						
2	6.5	S						

Litter and Duff Measurements (to nearest 1/10 of an inch)

		Intercept									
		15 ft	20ft	25 ft	30 ft	35 ft	40 ft	45 ft	50 ft	55 ft	60 ft
Transect 1	Litter Depth	1.1	1.5	1.5	1.5	1.5	1.1	1.0	0.8	1.0	0.5
	Duff Depth	2.1	2.0	2.0	2.3	2.1	1.5	1.4	1.1	2.1	2.0
Transect 2	Litter Depth	0.7	0.8	3.0	0.4	1.3	1.7	2.7	0.3	0.9	1.1
	Duff Depth	1.2	1.0	0.0	0.9	3.4	3.4	3.9	0.0	2.6	0.0

Fuels Comments:

2006: Feb09; V1.3 (Fuels Form) 2

CEDAR BREAKS NATIONAL MONUMENT FUELS FORM
2006 NCPN VEGETATION MAPPING PROJECT

PLOT CODE: CEBR. 0097 DATE: 7/27/06

SEEDLING AND SAPLING DATA (Trees 0 to 12 cm DBH) Plot Size (check one): ☒ 10m x 10m ☐ 5m x 5m

Record DBH only if trees reach 1.4 m/4.5 ft in height)

Species Code	Live?	DBH (cm)	Species Code	Live?	DBH (cm)	Species Code	Live?	DBH (cm)
ABICON	☒ yes ☐ no	3.2		☐ yes ☐ no		"	☐ yes ☐ no	
Pic Eng	☒ yes ☐ no	1.7		☐ yes ☐ no			☐ yes ☐ no	
ABI CON	☒ yes ☐ no	2.2	"	☐ yes ☐ no			☐ yes ☐ no	
Poptre	☒ yes ☐ no	11.5		☐ yes ☐ no			☐ yes ☐ no	
Abi Con	☒ yes ☐ no	1.1		☐ yes ☐ no			☐ yes ☐ no	
	☐ yes ☐ no			☐ yes ☐ no		"	☐ yes ☐ no	
	☐ yes ☐ no			☐ yes ☐ no			☐ yes ☐ no	
	☐ yes ☐ no		"	☐ yes ☐ no			☐ yes ☐ no	
	☐ yes ☐ no			☐ yes ☐ no			☐ yes ☐ no	
"	☐ yes ☐ no			☐ yes ☐ no			☐ yes ☐ no	
	☐ yes ☐ no			☐ yes ☐ no		"	☐ yes ☐ no	
	☐ yes ☐ no			☐ yes ☐ no			☐ yes ☐ no	

OVERSTORY TREE DATA (Trees > 12 cm DBH) Plot Size (check one): ☒ 20m x 20m ☐ 10m x 10m

**Use DRC only as needed for multiple stemmed trees.*

Species Code	Twin ✓	Live?	DBH (cm)	DRC* (cm)	Crown Base Height (m)	Crown Ratio (1/10 m)	Structural Stage	Damage Codes/Comments
Poptre		☒ yes ☐ no	33.4		17	.1	2	wand
Abicon		☒ yes ☐ no	13.5		1.5	.9	3	
Abicon		☒ yes ☐ no	20.0		0.5	.9	3	
Psemen		☐ yes ☒ no	49.0					
Abicon		☒ yes ☐ no	12.2		2.0	.7	3	bliq
Abicon		☒ yes ☐ no	34.4		2.0	.8	2	
Poptre	✓	☒ yes ☐ no	17.1		12	.2	2	
Abicon		☒ yes ☐ no	13.5		2	.8	3	
Abicon		☒ yes ☐ no	31.6		3	.8	2	
Abicon		☒ yes ☐ no	22.3		.5	.9	3	
Abicon		☐ yes ☐ no	60.9		3.5	.8	2	wand
Psemen		☐ yes ☒ no	37.6					
Poptre		☒ yes ☐ no	31.9		17	.2	2	trunk, mamm
Abicon		☒ yes ☐ no	12.4		1.5	.9	3	epic
"	"	☒ yes ☐ no	13.5		.5	.9	3	
"		☒ yes ☐ no	13.6		1	.9	3	epic
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
"		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
		☐ yes ☐ no						
"		☐ yes ☐ no						
		☐ yes ☐ no						

2006: Feb09; V1.3 (Fuels Form)

B.4. Example of an Observation Point Data Form

CEDAR BREAKS NATIONAL MONUMENT OBSERVATION SURVEY FORM
2006 NCPN VEGETATION MAPPING PROGRAM

SURVEY AND SITE INFORMATION

Point Code: CEBR. 9 0 2 0 Quad name: Brian Head BPU Code: ____ Aerial Photo #: 118-10
Type of Observation (Please Circle One): (VEG/OBS) SPRING/HANGING GARDEN OTHER (Specify) ____
Park Site Name Chessmen Overlook Area Location (Please Circle One): (Park) Environs
Survey Date 7-18-06 Surveyors Edwards, B. Smith Size of Area: 30m x 120m

GPS file name CB9020 Field UTM X 338817 m E Field UTM Y 4166208 m N
☐ Coordinates from USGS NAD27 Quad Map (if checked enter coordinates under GPS comments)
Datum NAD 83 Zone: 12S GPS Unit: Trimble XM / (Garmin) Flat /Other: etrex PDOP: ____ 3D Differential? (Y) N
GPS Comments: Error: +/- 5 m (Flat Garmin only)

Camera Name and Model (circle one): (Olympus Stylus) Canon Sureshot / Minolta FZ/ Other: ____

Roll #	Frame #	Photographer	Direction/Comments
BK3	31	Edwards	N

ENVIRONMENTAL DESCRIPTION

Elevation 3186 (m)/ft From: (GPS) / Map (circle one) Slope 4° Aspect 24°
Topographic Position: midslope
Landform: drainage system. Geology: Brian Head Formation

Cowardin System: ___ Upland X Palustrine
Hydrology: ___ Permanently Flooded ___ Semipermanently Flooded ___ Seasonally Flooded ___ Saturated ___ Temporarily Flooded X Intermittently Flooded ___ Unknown

Environmental Comments:
Observation point is in a broad dry drainage that trends ~N to S into the primary drainage. To the south of the observation point in the drainage is a wooded Abies lasiocarpa-Picea engelmannii (with significant cover beetle kill snags) island. Vegetation extends east/west next to the drainage on rockier surfaces with lesser vegetation cover.

Unvegetated Surface: *(please use cover scale below)*
04 Bare soil ___ Bedrock 02 Small rocks (0.2-10cm) 01 Large rocks (>10cm) ___ Sand (0.1-2mm) ___ Wood (>1cm) 01 Litter / duff ___ Other (describe) ____

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Cover scale for strata and unvegetated surfaces:
Trees and Shrubs ___ Evergreen X Cold-deciduous ___ Mixed evergreen-cold-deciduous Herbs ___ Annual ___ Perennial	X Broad-leaved ___ Needle-leaved ___ Microphyllous ___ Graminoid ___ Forb ___ Pteridophyte ___ Non-vascular ___ Mixed (describe)	___ Forest ___ Woodland X Shrubland ___ Wooded Shrubland ___ Dwarf Shrubland ___ Shrub Herbaceous ___ Herbaceous ___ Nonvascular ___ Sparsely Vegetated ___ Wooded herbaceous	01 = 0 – 10% 02 = 10 – 25% 03 = 25 – 60% 04 = 60 – 100%

2006: FEB 09; V1.2 (Observation Form) 1

CEDAR BREAKS NATIONAL MONUMENT OBSERVATION SURVEY FORM

2006 NCPN VEGETATION MAPPING PROGRAM

Provisional Community Name: Potentilla fruticosa/Deschampsia cespitosa Shrubland Plot Code: CEBR. 9 020

	Stratum Height Class	Stratum Cover Class	Dominant Species (mark Diagnostic species with *)			% Cover
T1 Emergent						
T2 Canopy						
T3 Sub-canopy						
S1 Tall shrub (> 2 m)						
S2 Short Shrub (< 2 m)	01	03	Potentilla fruticosa			30
S3 Dwarf Shrub (< 0.5 m)						
H Herbaceous	01	02	Potentilla diversifolia	1	Polygonum bistortoides	3
			Zigadenus elegans	T	Taraxacum officinale	+
			Dodecatheon pulchellum	T	Elymus trachycaulus	+
			Deschampsia cespitosa	12	Arenaria fendleri	T
			Happlopappus clementis	T		
			Taraxacum officinale	T		
			Achillea millefolium	2		
			Hordeum brachyantherum	+		
			Phleum alpinum	+		
			Juncus drummondii	T		
			Erigeron ursinus	1		
N Non-vascular	01	01	MOSS			1

Height Scale for strata:

01 = <0.5 m	06 = 10-15m
02 = 0.5-1 m	07 = 15-20m
03 = 1-2 m	08 = 20-35 m
04 = 2-5 m	09 = 35-50 m
05 = 5-10 m	10 = >50 m

Cover scale for strata and unvegetated surfaces:

01	= 0 – 10%
02	= 10 – 25%
03	= 25 – 60%
04	= 60 – 100%

2006: FEB 09; V1.2 (Observation Form) 2

B.5. Example of an Accuracy Assessment Data Form

2007 ACCURACY ASSESSMENT POINT FORM – CEDAR BREAKS NATIONAL MONUMENT

NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT

IDENTIFIERS/LOCATORS

AA Point Code: CEBR_AA. 0294 Quad name: _____ AA Point Shape: ☒ circle ☐ other

Park Site Name Shooting Star Ridge

Survey Date 9/7/07 Surveyor(s) A Tendick

GPS file name _____ Field UTM X 335567 m E Field UTM Y 4165888 m N

☐ Coordinates from USGS NAD27 Quad Map (if checked enter coordinates under GPS comments)

GPS Unit: (circle one): Trimble XM / Garmin Flat /None/ Other: _____ PDOP: 2.8 3D Differential? ☐ yes ☐ no

Datum NAD 83 Zone: _____ Error +/-: _____ m (Flat Garmin only)

GPS Comments:

Camera Name and Model (circle one): Olympus Stylus / Canon Sureshot / Minolta FZ/ Other: _____

Roll #	Frame #	Photographer	Direction/Comments
ATIO	14	Tendick	→ E (no signboard)

PLANT ASSOCIATION INFORMATION

ASSOCIATIONS AT AA POINT	New?	OTHER ASSOCIATIONS WITHIN 50 M OF AA POINT
Primary Name POPTRE/JUNCOM Forest	☐	1.
Secondary Name	☐	2.
Tertiary Name	☐	3.

Representativeness of point within polygon: ☒ Good ☐ Fair ☐ Poor ☐ Unk .....of association to description: ☒ Good ☐ Fair ☐ Poor

Classification Comments: (complications, uncertainties, explanation of fair/poor representativeness) Good fit, easy to key except that PSEMEN is co-dominant but not mentioned in the descriptions.

ENVIRONMENTAL DESCRIPTION

Elevation 2,602 (m)/ft From: (GPS) Map (circle one) Slope 16° Aspect 58°

Topographic Position: Low slope

Landform: Canyon Geology: Obscured

Environmental Comments: This spot has very dense trees (trunks spaced 1-3 feet apart on average) but because the canopies are narrow, tree cover is much lower than it looks like it should be. Understory is sparse. Thick litter layer everywhere and lots of downed wood.

8/6/07

2007 ACCURACY ASSESSMENT POINT FORM – CEDAR BREAKS NATIONAL MONUMENT

NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT

Unvegetated Surface Cover+: *(please use the cover scale below)*

—	Bedrock	—	Large rocks (cobbles, boulders > 10 cm)	—	Sand (0.1-2 mm)
09	Litter, duff	I	Small rocks (gravel, 0.2-10 cm)	I	Bare soil
1a	Wood (> 1 cm)			P	Other: Moss

VEGETATION DESCRIPTION

Leaf phenology (dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Height Class (m)	Cover Scale
Trees and Shrubs				
___ Evergreen	X Broad-leaved	X Forest	01 - <0.5	T - <1%
X Cold-deciduous	___ Needle-leaved	___ Woodland	02 - 0.5-1	P - 1-5%
___ Mixed evergreen - cold-deciduous	___ Microphyllous	___ Shrubland	03 - 1-2	1a - 6-10%
	___ Graminoid	___ Dwarf- shrubland	04 - 2-5	1b- 11-15%
Herbs			05 - 5-10	02 - 16-25%
___ Perennial	___ Forb	___ Shrub herbaceous	06 - 10-15	03 - 26-35%
	___ Pteridophyte	___ Wooded herbaceous	07 - 15-20	04 - 36-45%
___ Annual		___ Wooded Shrubland	08 - 20-35	05 - 46-55%
	___ Non Vascular	___ Herbaceous	09 - 35-50	06 - 56-65%
	___ Mixed	___ Nonvascular	10 - >50	07 - 66-75%
		___ Sparsely vegetated		08 - 76-85%
				09 - 86-95%

Strata	Height Class	Cover Class	Dominant species (mark any known diagnostic species with a *)	% Cover
T1 Emergent	07	P	Pinus ponderosa	2
T2 Canopy	06	02	Populus tremuloides	15
			Pseudotsuga menziesii	10
			PSEMEN (dead)	3
T3 Sub-canopy				
S1 Tall shrub				
S2 Short Shrub	02	T	Juniperus communis	T
S3 Dwarf-shrub	01	P	Mahonia repens	1
H Herbaceous	01	P	Elymus glaucus	1
H4 Tree Seedlings				
N Non-vascular				

☐ Please check this box if AA point has more than one plant association (e.g. two or more species list at a point recorded on form)

8/6/07

Appendix C. Database Documentation

C.1 Plots Database Documentation

Background

This database, designed for data resulting from fieldwork related to vegetation mapping projects, was developed by the Northern Colorado Plateau Network (NCPN). The Plots Database System, developed by The Nature Conservancy, was the starting point for this database. From this starting point, NCPN normalized the data structure, added fields and lookup tables, and developed an extensive user interface. Similar versions of this database, subsequently referred to as the CEBR VegMapDB, have been used for all vegetation mapping projects conducted by NCPN. CEBR VegMapDB contains plot, observation point, and accuracy assessment data collected during project field work.

Two database files are required to use CEBR VegMapDB:

- *CEBR_PlotsAA_XP.mdb.* This "frontend" file contains all queries, forms, reports, associated modules and Visual Basic code.
- *CEBR_PlotsAA_XP_be.mdb*. This "backend" file contains the database tables.

The frontend/backend file structure allows multiple users to enter data in a network environment, and allows for easy backup and transfer of the data tables. Users typically launch the frontend file, and a utility will prompt them to establish a link to the backend file. The contents of the backend file, however, can be used independently of the frontend.

Entity Relationship Diagram

The primary tables and relationships from the backend file (CEBR_PlotsAA_XP_be.mdb) are illustrated below. The database follows the design structure of the National Park Service Natural Resource Database Template, which is based on a location record, one or more related event records, and observation data elements linked to each event.

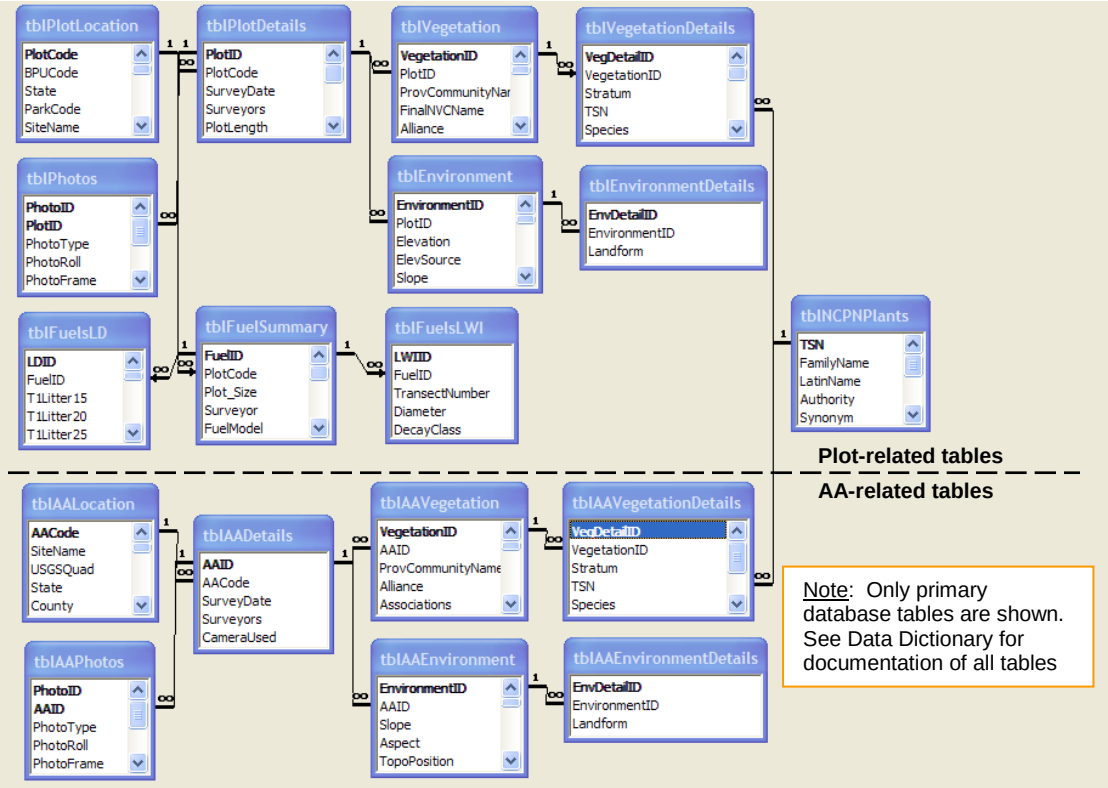


Figure 1. Entity Relationship Diagram for CEBR VegMapDB

Data Dictionary

The database consists of three types of tables: plot data, accuracy assessment data, and lookup tables that provide a standardized list of values to be used for certain data fields. Tables appear in alphabetical order within each of these three categories.

Plot-related tables

Table Name: tblBPU
Description: Location/UTMs of Biophysical Units visited during sampling effort.

Field Name	Field Description	Field Type	Field Width
BPU_record_ID	Unique record ID	dbLong	4
centroid_x	x coordinate of approximate BPU centroid	dbDouble	8
centroid_y	y coordinate of approximate BPU centroid	dbDouble	8
hectares	Number of hectares of BPU	dbDouble	8
BPU_code	ID Number for BPU	dbText	50
district	District in which BPU occurs	dbText	75
gradsect_year	Year Gradsect analysis was performed to derive the BPU	dbLong	4
BPU_comments	Comments on BPU sampling effort	dbText	250

Table Name: tblDataMgmtLog
Description: Table containing a log of data set manipulations or database object alterations.

Field Name	Field Description	Field Type	Field Width
ActionDate	The date on which the data set was massaged or manipulated.	dbDate	8
ActionMonth	If ActionDate known to month only, use this field and the ActionYear field.	dbText	50

Field Name	Field Description	Field Type	Field Width
ActionYear	If ActionDate known to year only, use this field.	dbText	50
Action	What was done with the data set. How was it altered, massaged, manipulated, etc. Include changes to data and changes to database objects or structures.	dbMemo	0
Who	The name of the person who performed the action with the data set.	dbText	50

Table Name: tblEnvironment
Description: Table containing values on environmental features and conditions of plot or observation point

Field Name	Field Description	Field Type	Field Width
EnvironmentID	Unique record identifier	dbLong	4
PlotID	Foreign key; links record to tblPlotDetails	dbLong	4
Elevation	Elevation of plot in meters as estimated from either map or GPS unit	dbLong	4
ElevSource	How elevation was derived in the field (GPS or Quad Map)	dbText	50
Slope	Slope of plot measured in degrees	dbText	50
Aspect	Aspect of plot	dbText	50
TopoPosition	Topographic position of plot; value selected from tlkpTopography	dbText	50
Landform	Landform on which plot is located, any landform could be entered by crew.	dbText	50
Geology	Geologic substrate influencing the plant community; value selected from tlkpGeology	dbText	75
CowardinSystem	If the plot is in a wetland system, select term that best describes its hydrology; value selected from tlkpCowardin	dbText	12
Hydrology	Select value that best describes hydrology of plot from tlkpHydrology	dbText	50
EnvironmentalComments	Comments on environmental setting and its effect on the vegetation; also comments on any disturbance or reproduction factors	dbMemo	0
BareSoil	Estimate to the nearest percentage of bare soil ground cover	dbText	3
Bedrock	Estimate to the nearest percentage of bedrock ground cover	dbText	3
Sand	Estimate to the nearest percentage of sand (particle size 0.1-2mm) ground cover	dbText	3
Moss	Estimate to the nearest percentage of moss ground cover	dbText	3
Other	Estimate to the nearest percentage of other type of ground cover	dbText	3
OtherPctDesc	Text field to describe the other type of ground cover.	dbText	255
Litter	Estimate to the nearest percentage of litter ground cover	dbText	3
Rocks	Estimate to the nearest percentage of rocks >10cm wide ground cover	dbText	3
Lichen	Estimate to the nearest percentage of lichen ground cover	dbText	3
Wood	Estimate to the nearest percentage of wood >1cm	dbText	3

Field Name	Field Description	Field Type	Field Width
	ground cover		
Gravel	Estimate to the nearest percentage of rocks <10cm wide ground cover	dbText	3
Water	Estimate to the nearest percentage of water ground cover	dbText	3
Cryptogam	Estimate to the nearest percentage of cryptogram ground cover	dbText	3
SoilTexture	Assessment of average soil texture from sample taken a few inches below the surface; values selected from tlkpSoilTexture	dbText	50
SoilDrainage	Soil drainage class based on actual moisture content and extent period; values selected from tlkpSoilDrainage	dbText	30
AnimalUseComments	Comments on evidence of use by non-domestic animals in plot area	dbMemo	0
DisturbanceComments	Comments on evidence of natural or anthropogenic disturbance in plot area, severity and effects on vegetation	dbMemo	0
OtherComments	Other general comments	dbMemo	0
LandscapeComments	Description of landscape context of plot, including any important landscape features influencing the community	dbMemo	0
SoilTaxonDesc	Field used for either identifying soils keyed, or to describe if large rocks or outcrops are present on the surface	dbText	255
LiveVegLitter	Estimate to the nearest percentage of live veg litter ground cover	dbText	3
LiveVegWood	Estimate to the nearest percentage of live veg wood ground cover	dbText	3
LichenRocks	Estimate to the nearest percentage of lichen covering rocks	dbText	3
LichenGround	Estimate to the nearest percentage of lichen ground cover (on the soil, associated with cryptogams)	dbText	3
DarkCyanobacteria	Estimate to the nearest percentage of dark cyanobacteria ground cover	dbText	3
TotalPct	Total percentage reported covered - calculated as QC check.	dbInteger	2

Table Name: tblEnvironmentDetails
Description: Table containing values on environmental features and conditions of plot or observation point

Field Name	Field Description	Field Type	Field Width
EnvDetailID	Unique record identifier	dbLong	4
EnvironmentID	Foreign key; links to tblEnvironment	dbLong	4
Landform	One or more landform values corresponding to plot location; any value may be entered by crew	dbText	50

Table Name: tblFireTrees
Description: Table of fuels measurements for trees.

Field Name	Field Description	Field Type	Field Width

Field Name	Field Description	Field Type	Field Width
FireTreesID	Unique record Identifier - primary key.	dbLong	4
FuelID	Foreign key to tblFuelSummary	dbLong	4
RecordType	Record type: 1=Seedling/Sapling, 2=Overstory Trees	dbInteger	2
Plot_Size	Plot size. Discontinued 3/10/2006 - moved to tblFuelSummary - RD.	dbText	20
SpeciesCode	Species code.	dbText	50
Live	Is it alive?	dbBoolean	1
DBH	DBH in centimeters.	dbSingle	4
DRC	DRC in centimeters.	dbSingle	4
Height	Height in meters.	dbSingle	4
Measured	Yes if height is measured, not estimated.	dbBoolean	1
HeightToCrown	Height to live crown in meters. Type 2 records only.	dbSingle	4
HeightMeasured	Yes if height to crown is measured, not estimated. Type 2 records only.	dbBoolean	1
StructuralStage	Structural stage. Type 2 records only.	dbInteger	2
Comments	Comments. Type 2 records only.	dbMemo	0
Twin	Is it a twin?	dbBoolean	1

Table Name: tblFuelsLD
Description: Table of Litter and Duff for fire fuels.

Field Name	Field Description	Field Type	Field Width
LDID	Unique record identifier - primary key.	dbLong	4
FuelID	Foreign key to tblFuelSummary.	dbLong	4
T1Litter15	Litter depth to nearest 1/10 of a cm, transect T1, intercept 15 ft	dbSingle	4
T1Litter20	Litter depth to nearest 1/10 of a cm, T1, 20 ft	dbSingle	4
T1Litter25	Litter depth to nearest 1/10 of a cm, T1, 25 ft	dbSingle	4
T1Litter30	Litter depth to nearest 1/10 of a cm, T1, 30 ft	dbSingle	4
T1Litter35	Litter depth to nearest 1/10 of a cm, T1, 35 ft	dbSingle	4
T1Litter40	Litter depth to nearest 1/10 of a cm, T1, 40 ft	dbSingle	4
T1Litter45	Litter depth to nearest 1/10 of a cm, T1, 45 ft	dbSingle	4
T1Litter50	Litter depth to nearest 1/10 of a cm, T1, 50 ft	dbSingle	4
T1Litter55	Litter depth to nearest 1/10 of a cm, T1, 55 ft	dbSingle	4
T1Litter60	Litter depth to nearest 1/10 of a cm, T1, 60 ft	dbSingle	4
T1Duff15	Duff depth to nearest 1/10 of a cm, transect T1, intercept 15 ft	dbSingle	4
T1Duff20	Duff depth to nearest 1/10 of a cm, T1, 20 ft	dbSingle	4
T1Duff25	Duff depth to nearest 1/10 of a cm, T1, 25 ft	dbSingle	4
T1Duff30	Duff depth to nearest 1/10 of a cm, T1, 30 ft	dbSingle	4
T1Duff35	Duff depth to nearest 1/10 of a cm, T1, 35 ft	dbSingle	4
T1Duff40	Duff depth to nearest 1/10 of a cm, T1, 40 ft	dbSingle	4
T1Duff45	Duff depth to nearest 1/10 of a cm, T1, 45 ft	dbSingle	4
T1Duff50	Duff depth to nearest 1/10 of a cm, T1, 50 ft	dbSingle	4
T1Duff55	Duff depth to nearest 1/10 of a cm, T1, 55 ft	dbSingle	4
T1Duff60	Duff depth to nearest 1/10 of a cm, T1, 60 ft	dbSingle	4
T2Litter15	Litter depth to nearest 1/10 of a cm, T2, 15 ft	dbSingle	4
T2Litter20	Litter depth to nearest 1/10 of a cm, T2, 20 ft	dbSingle	4
T2Litter25	Litter depth to nearest 1/10 of a cm, T2, 25 ft	dbSingle	4
T2Litter30	Litter depth to nearest 1/10 of a cm, T2, 30 ft	dbSingle	4
T2Litter35	Litter depth to nearest 1/10 of a cm, T2, 35 ft	dbSingle	4
T2Litter40	Litter depth to nearest 1/10 of a cm, T2, 40 ft	dbSingle	4
T2Litter45	Litter depth to nearest 1/10 of a cm, T2, 45 ft	dbSingle	4

Field Name	Field Description	Field Type	Field Width
T2Litter50	Litter depth to nearest 1/10 of a cm, T2, 50 ft	dbSingle	4
T2Litter55	Litter depth to nearest 1/10 of a cm, T2, 55 ft	dbSingle	4
T2Litter60	Litter depth to nearest 1/10 of a cm, T2, 60 ft	dbSingle	4
T2Duff15	Duff depth to nearest 1/10 of a cm, T2, 15 ft	dbSingle	4
T2Duff20	Duff depth to nearest 1/10 of a cm, T2, 20 ft	dbSingle	4
T2Duff25	Duff depth to nearest 1/10 of a cm, T2, 25 ft	dbSingle	4
T2Duff30	Duff depth to nearest 1/10 of a cm, T2, 30 ft	dbSingle	4
T2Duff35	Duff depth to nearest 1/10 of a cm, T2, 35 ft	dbSingle	4
T2Duff40	Duff depth to nearest 1/10 of a cm, T2, 40 ft	dbSingle	4
T2Duff45	Duff depth to nearest 1/10 of a cm, T2, 45 ft	dbSingle	4
T2Duff50	Duff depth to nearest 1/10 of a cm, T2, 50 ft	dbSingle	4
T2Duff55	Duff depth to nearest 1/10 of a cm, T2, 55 ft	dbSingle	4
T2Duff60	Duff depth to nearest 1/10 of a cm, T2, 60 ft	dbSingle	4

Table Name: tblFuelsLWI
Description: Table of Large Woody Intercepts for fire fuels.

Field Name	Field Description	Field Type	Field Width
LWIID	Unique record identifier - primary key.	dbLong	4
FuelID	Foreign key to tblFuelSummary.	dbLong	4
TransectNumber	Transect number - will be 1 or 2.	dbInteger	2
Diameter	Diameter in centimeters.	dbSingle	4
DecayClass	Decay class; S=sound R=Rotten.	dbText	1

Table Name: tblFuelSummary
Description: Table of fuel intercept tallies and other summary information.

Field Name	Field Description	Field Type	Field Width
FuelID	Fuel record ID - primary key.	dbLong	4
PlotCode	Foreign key to tblPlotLocation.	dbText	10
Plot_Size	Plot size.	dbText	20
Surveyor	Surveyor Name(s).	dbText	75
FuelModel	Anderson Fuel Model number.	dbInteger	2
T1Slope	Transect one slope in degrees.	dbInteger	2
T1Azimuth	Azimuth from plot center.	dbSingle	4
T1OneHrTally	One hour fuel intercept count. <.25"	dbInteger	2
T1TenHrTally	Ten hour intercept count. .25 - 1"	dbInteger	2
T1HunHrTally	Hundred hour intercept count. 1-3"	dbInteger	2
T2Slope	Transect two slope in degrees.	dbInteger	2
T2Azimuth	Azimuth from plot center.	dbSingle	4
T2OneHrTally	One hour fuel intercept count. <.25"	dbInteger	2
T2TenHrTally	Ten hour intercept count. .25 - 1"	dbInteger	2
T2HunHrTally	Hundred hour intercept count. 1-3"	dbInteger	2
Comments	Fuel comments.	dbMemo	0

Table Name: tblGeneralPhotos
Description: Information pertaining to photos not associated with plots.

Field Name	Field Description	Field Type	Field Width
GenPhotoID	Unique record identifier	dbLong	4
GenPhotoParkCode	Four-letter abbreviation of park where photo was taken (if applicable)	dbText	50
GenPhotoDate	Date photo taken	dbDate	8

Field Name	Field Description	Field Type	Field Width
GenPhotographer	Name of photographer	dbText	75
GenPhotoDesc	General description of photo contents	dbText	250
GenPhotoUTME	UTME of photo	dbLong	4
GenPhotoUTMN	UTMN of photo	dbLong	4
GenUTMZone	UTMZone of photo UTM coordinates	dbLong	4
GenPhotoRoll10	Roll number of photo	dbText	50
GenPhotoFrame	Frame number of photo	dbText	10
GenPhotoDigFile	Digital file name of photo	dbText	50
GenPhotoComments	General comments	dbText	250

Table Name: tblGeneralSpecimens
Description: Table used to enter data on specimens collected outside of plots or observation points but within the park

Field Name	Field Description	Field Type	Field Width
GenSpecimenID	Unique record ID	dbLong	4
GenSpecFamily	Family name of species collected	dbText	50
GenSpecLatinName	Latin name of species collected	dbText	120
GenSpecCollector	Name of person collecting specimen	dbText	50
GenSpecCollectNum	Reference of specimen assigned by collector	dbText	50
GenSpecAccNumber	NPS Accession Number of specimen	dbText	15
GenSpecCatNumber	NPS Catalog Number of specimen	dbText	15
GenSpecDate	Date collection made	dbDate	8
GenSpecUTMN	Northing of collection location	dbLong	4
GenSpecUTME	Easting of collection location	dbLong	4
GenSpecCounty	County of collection location	dbText	50
GenSpecElev	Elevation (ft) of collection location	dbLong	4
GenSpecLocality	Description of locality where specimen was collected	dbText	250
GenSpecHabitat	Description of habitat where specimen was collected	dbText	250
GenSpecAssocSpec	Associated species where specimen was collected	dbText	250
GenSpecComments	Specimen comments	dbText	250

Table Name: tblPhotos
Description: Details on individual photos taken of plot or observation point.

Field Name	Field Description	Field Type	Field Width
PhotoID	Unique record identifier	dbLong	4
PlotID	Foreign key, links to tblPlotDetails	dbLong	4
PhotoType	Type of photo being referenced.	dbText	16
PhotoRoll	Reference number for film roll of photo.	dbText	12
PhotoFrame	Frame number of photo within roll.	dbLong	4
PhotoOther	Other unique identifier or reference number for digital photo or name of movie file.	dbText	30
Photographer	Name of photographer.	dbText	50
PhotoComments	Brief description of photo.	dbText	80
NCPNImageFileID	Cross-reference for NCPN photo database 'ImageFileID' with 'PhotoOther'.	dbText	50

Table Name: tblPlotCodeLink
Description: Not used for CEBR.

Field Name	Field Description	Field Type	Field Width
NewPlotCode	Not used for CEBR	dbText	20

Field Name	Field Description	Field Type	Field Width
OldPlotCode	Not used for CEBR	dbText	20

Table Name: tblPlotDetails
Description: Information on a plot that is specific to a visit

Field Name	Field Description	Field Type	Field Width
PlotID	Unique identifier for record	dbLong	4
PlotCode	Foreign key, links to tblPlotLocation	dbText	10
SurveyDate	Date plot was visited and data collected	dbDate	8
Surveyors	Names of persons collecting data at plot (last names)	dbText	75
PlotLength	Length of plot, in meters	dbText	5
PlotAzimuth	Azimuth of plot; synonymous with aspect. One or the other, or both, can be used	dbText	5
PlotWidth	Width of plot, in meters	dbText	5
PlotDiam	Diameter of plot, in meters, if plot is circular	dbText	5
PlotHasPhotos	Yes if photos are taken of plot	dbBoolean	1
PlotRepresentation	Description or discussion of representativeness of plot in stand, and in comparison to associations outside the park (if known)	dbMemo	0
PlotShape	Shape of plot	dbText	15
CameraUsed	Make and model of camera used to photograph plot	dbText	50
ObsPointArea	Estimated size of observation point	dbText	50

Table Name: tblPlotLocation
Description: Basic and unchanging information on plot or observation point location

Field Name	Field Description	Field Type	Field Width
PlotCode	Identifier assigned to plot by survey crew	dbText	10
BPUCode	Biophysical unit code where plot is located.	dbText	10
State	State where plot is located	dbText	2
ParkCode	Park unit where plot is located	dbText	4
SiteName	Short, descriptive name of site where plot is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where plot is located	dbText	50
AerialPhotoNo	Aerial photo number corresponding to plot location	dbText	10
Waypoint	Garmin plot code	dbText	7
UTMEasting	UTM easting of plot	dbDouble	8
UTMNorthing	UTM northing of plot	dbDouble	8
Datum	Datum of UTM coordinates	dbText	10
UTMZone	UTM zone of coordinates	dbText	4
UTM Error	error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
PDOP	satellite Precision Dilution of Position (based on reading from Trimble GPS unit)	dbText	50
DiffCorrected	Indicate if coordinates have been differentially corrected	dbText	3
DirectionsToPlot	Precise directions to plot	dbMemo	0
County	County where plot is located.	dbText	50
GPSUnit	Manufacturer and model of GPS unit (e.g., Trimble GeoExplorer 3)	dbText	25
GPSComments	Any brief comments on GPS data collection at plot.	dbText	255
InPark	Select Yes if plot is within park boundaries.	dbBoolean	1
IsObservationPt	Yes if observation point.	dbBoolean	1
ObservationType	If observation point, type of observation. Valid entries	dbText	25

Field Name	Field Description	Field Type	Field Width
	are: veg/obs, spring/hanging garden, other.		
ObservationComment	Comments for other observation type.	dbMemo	0

Table Name: tblVegetation
Description: Overall vegetation characteristics of a plot or observation point

Field Name	Field Description	Field Type	Field Width
VegetationID	Unique record ID	dbLong	4
PlotID	Foreign key, links to tblPlotDetails	dbLong	4
ProvCommunityName	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training 04/04.	dbText	120
FinalNVCName	Final community name, provided by NatureServe.	dbText	240
Alliance	Alliance corresponding to provisional community name	dbText	100
Associations	Association corresponding to provisional community name	dbText	100
Phenology	Leaf phenology of the dominant stratum. Field is blank for non-vascular plots	dbText	35
LeafType	Leaf form of the dominant stratum.	dbText	35
LeafTypeComments	If Leaf Type is "mixed," this field describes the multiple leaf types found in the dominant stratum.	dbText	255
Physiognom	Physiognomic class of plot (from tlkpPhysiogClass)	dbText	20
EmergHt	Height class of emergent stratum (tlkpHeightClass)	dbText	2
EmergCovTot	Cover class of emergent stratum (tlkpCover)	dbText	15
EmergCovPercent	Not used	dbText	50
CanHt	Height class of canopy stratum	dbText	2
CanCovTot	Cover class of canopy stratum	dbText	15
CanCovPercent	Not used	dbText	50
SubHt	Height class of subcanopy stratum	dbText	2
SubCovTot	Cover class of subcanopy stratum	dbText	15
SubCovPercent	Not used	dbText	50
TallShHt	Height class of tall shrub stratum	dbText	2
TallShCovTot	Cover class of tall shrub stratum	dbText	15
TallShCovPercent	Not used	dbText	50
ShrubHt	Height class of shrub stratum	dbText	2
ShrubCovTot	Cover class of shrub stratum	dbText	15
ShrubCovPercent	Not used	dbText	50
DwarfHt	Height class of dwarf shrub stratum	dbText	2
DwarfCovTot	Cover class of dwarf shrub stratum	dbText	15
SwarfCovPercent	Not used	dbText	50
HerbHt	Height class of herbaceous stratum (all H layers)	dbText	2
HerbCovTot	Cover class of herbaceous stratum (all H layers)	dbText	15
HerbCovPercent	Not used	dbText	50
GramHt	Height class of graminoid stratum	dbText	2
GramCovTot	Cover class of graminoid stratum	dbText	15
GramCovPercent	Not used	dbText	50
ForbHt	Height class of forb stratum	dbText	2
ForbCovTot	Cover class of forb stratum	dbText	15
ForbCovPercent	Not used	dbText	50
FernHt	Height class of fern and fern ally stratum	dbText	2

Field Name	Field Description	Field Type	Field Width
FernCovTot	Cover class of fern and fern ally stratum	dbText	15
FernCovPercent	Not used	dbText	50
SeedlHt	Height class of seedling stratum	dbText	2
SeedlCovTot	Cover class of seedling stratum	dbText	15
SeedCovPercent	Not used	dbText	50
NonvasHt	Height class of nonvascular stratum	dbText	2
NonvasCovTot	Cover class of nonvascular stratum	dbText	15
NonvasCovPercent	Not used	dbText	50
VineHt	Height class of vine stratum	dbText	2
VineTotCov	Cover class of vine stratum	dbText	15
VineTotPercent	Not used	dbText	50
EpiHt	Height class of epiphyte stratum	dbText	2
EpiTotCov	Cover class of epiphyte stratum	dbText	15
EpiTotPercent	Not used	dbText	50
OutsidePlotHt	Height class of species occurring outside plot	dbText	50
OutsidePlotTotCov	Cover class of species occurring outside plot	dbText	50
OutsidePlotTotPercent	Not used	dbText	50
PlantSpeciesComments	Comments on plant species list, particularly for species whose ID is not 100% sure	dbMemo	0

Table Name: tblVegetationDetails
Description: Species and strata-specific data related to a plot or observation point

Field Name	Field Description	Field Type	Field Width
VegDetailID	Unique record ID	dbLong	4
VegetationID	Foreign key, links to tblVegetation	dbLong	4
Stratum	Strata class from tlkpStrata	dbText	2
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
Species	Latin names of species, from tblNCPNPlants	dbText	100
CoverClass	Cover class to describe species and strata (from tlkpCover)	dbText	5
ObsPointCoverClass	Cover class for observation points (different scale than cover classes for plots, tlkpCoverObs)	dbText	50
PercentCover	Percent (0-100) cover of each species	dbText	5
IsDead	Check yes if the species being documented was dead	dbBoolean	1
Diagnostic	Check yes if the species is known to be diagnostic of the vegetation type.	dbBoolean	1
SpecimenCollected	Check yes if a specimen of the species was collected.	dbBoolean	1
CollectedBy	Name of person collecting specimen	dbText	120
NPSAccessionNumber	Accession number corresponding to all collections made under research permit assigned by park curator	dbText	50
NPSCatalogNumber	Unique reference number for individual specimen assigned by park curator	dbText	50
SpecimenNumber	Enter the collector's reference number for the specimen collected.	dbText	20
SpecimenLocality	Brief description of collection location, suitable for specimen label	dbText	240
SpecimenHabitat	Brief description of collection habitat, suitable for specimen label	dbText	240
SpecimenAssocSpecies	Brief description of associated species in collection	dbText	240

Field Name	Field Description	Field Type	Field Width
	area, suitable for specimen label		

Accuracy assessment-related tables

Table Name: tblAADetails
Description: Information on an AA point that is specific to a visit.

Field Name	Field Description	Field Type	Field Width
AAID	Unique identifier for record	dbLong	4
AACode	Identifier of AA record; assigned by field crew	dbText	13
SurveyDate	Date AA point was visited and data was collected	dbDate	8
Surveyors	Name(s) of persons who collected data at an AA point (Last name and first initial)	dbText	75
CameraUsed	Make and model of camera used to photograph plot	dbText	50

Table Name: tblAAEnvironment
Description: Table containing values on environmental features and conditions of an AA point.

Field Name	Field Description	Field Type	Field Width
EnvironmentID	Unique record identifier	dbLong	4
AAID	Foreign key; links to tblAADetails	dbLong	4
Slope	Slope of AA point measured in degrees	dbText	50
Aspect	Aspect of AA point	dbText	50
TopoPosition	Topographic position of AA point; value selected from tlkpTopography	dbText	50
Elevation	Elevation of AA point in meters as estimated from either map or GPS unit	dbLong	4
ElevSource	How elevation was derived in the field (GPS or Quad Map)	dbText	50
EnvironmentalComments	Comments on environmental setting and its effect on the vegetation; also comments on any disturbance or reproduction factors	dbMemo	0
Geology	Geologic substrate influencing the plant community; value selected from tlkpGeology	dbText	75
BareSoil	Estimate to the nearest percentage of bare soil ground cover	dbText	3
Bedrock	Estimate to the nearest percentage of bedrock ground cover	dbText	3
Sand	Estimate to the nearest percentage of sand (particle size 0.1-2mm) ground cover	dbText	3
Moss	Estimate to the nearest percentage of moss ground cover	dbText	3
Other	Estimate to the nearest percentage of other type of ground cover	dbText	3
OtherPctDesc	Description of "other" category in previous column	dbText	255
Litter	Estimate to the nearest percentage of litter ground cover	dbText	3
Rocks	Estimate to the nearest percentage of rocks >10cm wide ground cover	dbText	3
Lichen	Estimate to the nearest percentage of lichen ground	dbText	3

Field Name	Field Description	Field Type	Field Width
	cover		
Gravel	Estimate to the nearest percentage of gravel <10cm wide ground cover	dbText	3
LiveVegLitter	Estimate to the nearest percentage of live veg litter ground cover	dbText	3
LiveVegWood	Estimate to the nearest percentage of live veg wood ground cover	dbText	3
Wood	Estimate to the nearest percentage of wood >1cm ground cover	dbText	3
LichenRocks	Estimate to the nearest percentage of lichen covering rocks	dbText	3
LichenGround	Estimate to the nearest percentage of lichen covering ground (associated with biocrust)	dbText	3
DarkCyanobacteria	Estimate to the nearest percentage of dark cyanobacteria ground cover	dbText	3
Water	Estimate to the nearest percentage of water ground cover	dbText	3

Table Name: tblAAEnvironmentDetails
Description: Table containing values on environmental features and conditions of an AA point.

Field Name	Field Description	Field Type	Field Width
EnvDetailID	Unique record identifier	dbLong	4
EnvironmentID	Foreign key; provides link to tblEnvironment	dbLong	4
Landform	One or more landform values corresponding to AA point location; any value may be entered by crew	dbText	50

Table Name: tblAALocation
Description: Basic and unchanging information on AA point location.

Field Name	Field Description	Field Type	Field Width
AACode	Identifier assigned to AA point by survey crew	dbText	13
SiteName	Short, descriptive name of site where point is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where point is located	dbText	255
State	State where point is located	dbText	2
County	County where plot is located	dbText	50
ParkCode	Park unit where point is located	dbText	4
GPSFileName	Name of corresponding GPS file	dbText	50
GPSUnit	Manufacturer and model of GPS unit (e.g., Trimble GeoExplorer 3)	dbText	25
UTMEasting	UTM easting of point	dbLong	4
UTMNorthing	UTM northing of point	dbLong	4
UTMZone	UTM zone of coordinates	dbText	4
DiffCorrected	Indicate if coordinates have been differentially corrected	dbText	3
Datum	Datum of UTM coordinates	dbText	10
PDOP	satellite Precision Dilution of Position (based on reading from Trimble GPS unit)	dbText	50
UTM Error	error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
InPark	Select Yes if plot is within park boundaries	dbBoolean	1

Field Name	Field Description	Field Type	Field Width
GPSComments	Any brief comments on GPS data collection	dbText	255
RepresentPWP	Representativeness of point within polygon	dbText	7
RepresentATD	Representativeness of association to description	dbText	4
ClassificationComments	Classification comments	dbMemo	0
PlotShape	Plot shape: Circular, Other	dbText	10
PMU	Primary Map Unit	dbText	5
SMU	Secondary Map Unit	dbText	5
TMU	Tertiary Map Unit	dbText	5

Table Name: tblAAPhotos
Description: Details on individual photos taken of an AA point.

Field Name	Field Description	Field Type	Field Width
PhotoID	Unique record identifier	dbLong	4
AAID	Foreign key; provides link to tblAADetails	dbLong	4
PhotoType	Type of photo being referenced	dbText	16
PhotoRoll	Reference number for film roll of photo	dbText	12
PhotoFrame	Frame number of photo within roll	dbText	50
PhotoOther	Other unique identifier or reference number for digital photo or name of movie file	dbText	30
Photographer	Name of photographer	dbText	50
PhotoComments	Brief description of photo	dbText	255
NCPNImageFileID	Cross-reference for NCPN Photo Database 'ImageFileID' and 'PhotoOther'	dbText	50

Table Name: tblAAVegAssociation
Description: Vegetation association at AA location

Field Name	Field Description	Field Type	Field Width
VegAssocID	Unique record identifier	dbLong	4
AAID	Foreign key; provides link to tblAADetails	dbLong	4
VegAssocCode	Identification code of vegetation association; provided by NatureServe	dbText	25
VegAssocRank	Rank of vegetation association (primary, secondary, tertiary)	dbText	15
FieldKey	Name from field key?	dbBoolean	1
NewName	New class name?	dbBoolean	1
Post_Field_Name	Post-field name?	dbBoolean	1
OtherAssocCode	Other association	dbText	255

Table Name: tblAAVegetation
Description: Overall vegetation characteristics of an AA point.

Field Name	Field Description	Field Type	Field Width
VegetationID	Unique record identifier	dbLong	4
AAID	Foreign key; provides link to tblAADetails	dbLong	4
ProvCommunityName	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training 04/04.	dbText	120
Alliance	Alliance corresponding to provisional community name	dbText	100
Associations	Association corresponding to provisional community	dbText	100

Field Name	Field Description	Field Type	Field Width
	name		
Phenology	Leaf phenology of the dominant stratum	dbText	35
LeafType	Leaf form of the dominant stratum	dbText	35
LeafTypeComments	Comments about leaf form of the dominant stratum	dbText	255
Physiognom	Physiognomic class of plot (from tlkpPhysiogClass)	dbText	20
EmergHt	Height class of emergent stratum (tlkpHeightClass)	dbText	2
EmergCovTot	Cover class of emergent stratum (tlkpCoverAA)	dbText	15
EmergCovPercent	not used	dbText	50
CanHt	Height class of canopy stratum (tlkpHeightClass)	dbText	2
CanCovTot	Cover class of canopy stratum (tlkpCoverAA)	dbText	15
CanCovPercent	not used	dbText	50
SubHt	Height class of subcanopy stratum (tlkpHeightClass)	dbText	2
SubCovTot	Cover class of subcanopy stratum (tlkpCoverAA)	dbText	15
SubCovPercent	not used	dbText	50
TallShHt	Height class of tall shrub stratum (tlkpHeightClass)	dbText	2
TallShCovTot	Cover class of tall shrub stratum (tlkpCoverAA)	dbText	15
TallShCovPercent	not used	dbText	50
ShrubHt	Height class of shrub stratum (tlkpHeightClass)	dbText	2
ShrubCovTot	Cover class of shrub stratum (tlkpCoverAA)	dbText	15
ShrubCovPercent	not used	dbText	50
DwarfHt	Height class of dwarf shrub stratum (tlkpHeightClass)	dbText	2
DwarfCovTot	Cover class of dwarf shrub stratum (tlkpCoverAA)	dbText	15
DwarfCovPercent	not used	dbText	50
HerbHt	Height class of herbaceous stratum (tlkpHeightClass)	dbText	2
HerbCovTot	Cover class of herbaceous stratum (tlkpCoverAA)	dbText	15
HerbCovPercent	not used	dbText	50
NonvasHt	Height class of nonvascular stratum (tlkpHeightClass)	dbText	2
NonvasCovTot	Cover class of nonvascular stratum (tlkpCoverAA)	dbText	15
NonvasCovPercent	not used	dbText	50
VineHt	Height class of vine stratum (tlkpHeightClass)	dbText	2
VineTotCov	Cover class of vine stratum (tlkpCoverAA)	dbText	15
VineTotPercent	not used	dbText	50
EpiHt	Height class of epiphyte stratum (tlkpHeightClass)	dbText	2
EpiTotCov	Cover class of epiphyte stratum (tlkpCoverAA)	dbText	15
EpiTotPercent	not used	dbText	50
GramHt	Height class of graminoid stratum (tlkpHeightClass)	dbText	2
GramCovTot	Cover class of graminoid stratum (tlkpCoverAA)	dbText	15
GramCovPercent	not used	dbText	50
ForbHt	Height class of forb stratum (tlkpHeightClass)	dbText	2
ForbCovTot	Cover class of forb stratum (tlkpCoverAA)	dbText	15
ForbCovPercent	not used	dbText	50
FernHt	Height class of fern stratum (tlkpHeightClass)	dbText	2
FernCovTot	Cover class of fern stratum (tlkpCoverAA)	dbText	15
FernCovPercent	not used	dbText	50
SeedlHt	Height class of tree seedling stratum (tlkpHeightClass)	dbText	2
SeedlCovTot	Cover class of tree seedling stratum (tlkpCoverAA)	dbText	15
SeedCovPercent	not used	dbText	50
OutsidePlotHt	Height class of species occurring outside plot (tlkpHeightClass)	dbText	50
OutsidePlotTotCov	Cover class of species occurring outside plot	dbText	50

Field Name	Field Description	Field Type	Field Width
	(tlkpCoverAA)		
OutsidePlotTotPercent	not used	dbText	50
PlantSpeciesComments	Comments on plant species list	dbMemo	0
MultipleAssoc	Does list represent more than one association?	dbBoolean	1

Table Name: tblAAVegetationDetails
Description: Species and strata-specific data related to an AA point.

Field Name	Field Description	Field Type	Field Width
VegDetailID	Unique record ID	dbLong	4
VegetationID	Foreign key; links to tblAAVegetation	dbLong	4
Stratum	Strata class from tlkpStrata	dbText	2
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
Species	Latin names of species, from tblNCPNPlants	dbText	100
CoverClass	Cover class to describe species and strata (from tlkpCover)	dbText	5
CoverPct	Percent cover observed for that species in the field	dbText	5
Dead	Dead?	dbBoolean	1

Lookup tables

Table Name: tblNCPNPlants
Description: Master look-up table for plant species names and taxonomic information. Derived from ITIS (Integrated Taxonomic Information System)

Field Name	Field Description	Field Type	Field Width
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
FamilyName	Family name of taxon	dbText	255
LatinName	Latin name of taxon	dbText	255
Authority	Authority of Latin name	dbText	255
Synonym	Accepted synonyms of taxon	dbText	255
CommonName	Locally accepted common name for taxon	dbText	255
Exotic	Check yes if species is exotic	dbBoolean	1
Sensitive	check yes if species is threatened, endangered, or sensitive	dbBoolean	1
GrowthHabit	Select GrowthHabit for species -- habit can vary based on region; edit as needed to reflect habit in park	dbText	255
PLANTSCode	Code for taxonomic unit assigned by USDA PLANTS	dbText	255
FullName	temporary field; concatenation of Latin name and authority	dbText	255

Table Name: tlkpAAVegAssociation
Description: Lookup of vegetation association codes (CEGL codes from NatureServe) and vegetation association name.

Field Name	Field Description	Field Type	Field Width
VegAssocCode	NVCElCode	dbText	255
VegAssocName	NVCFinalAssociationName	dbText	255

Table Name: tlkpAAVegAssocRanks
Description: Rank of vegetation association (primary, secondary, tertiary).

Field Name	Field Description	Field Type	Field Width
VegAssocRank	Indicates whether the vegetation association represents a primary, secondary, or tertiary collection by field crews	dbText	255

Table Name: tlkpAlliances
Description: Look-up of provisional community names

Field Name	Field Description	Field Type	Field Width
Alliance	Alliance name from NatureServe classification	dbText	100

Table Name: tlkpAssociations
Description: Look-up of association names

Field Name	Field Description	Field Type	Field Width
Associations	Association names from NatureServe classification	dbText	100

Table Name: tlkpCamera
Description: Lookup of Camera make/models used for plot photos.

Field Name	Field Description	Field Type	Field Width
CameraType	Model and make of camera used for photographs of plot	dbText	50
CameraComments	Additional comments on camera, including default focal length	dbText	50

Table Name: tlkpCover
Description: Look-up of cover classes assigned to species and strata in tblVegetationDetails.

Field Name	Field Description	Field Type	Field Width
CoverClass	(t)= few, T =0-1%, P =1-5%, 1a =5-10%, 1b=10-15%, 02=15-25%, 03=25-35%, 04=35-45%, 05a=45-50%, 05b=50-55%, 06=55-65%, 07=65-75%, 08=75-85%, 09=85-95%, 10=>95%	dbText	50

Table Name: tlkpCoverAA
Description: Look-up of cover classes assigned to species and strata in tblAAVegetationDetails.

Field Name	Field Description	Field Type	Field Width
CoverClass	T <1%, P =1-5%, 1a =6-10%, 1b=11-15%, 02=16-25%, 03=26-35%, 04=36-45%, 05=46-55%, 06=56-65%, 07=66-75%, 08=76-85%, 09=86-95%	dbText	50

Table Name: tlkpCoverObs
Description: Look-up of cover classes assigned to species and strata in tblVegetationDetails for observation points.

Field Name	Field Description	Field Type	Field Width
CoverClass	01= 0-10%, 02=10-25%, 03=25-60%, 04=60-100%	dbText	50

Table Name: tlkpCowardin
Description: Look-up of Cowardin system categories for Environment descriptions.

Field Name	Field Description	Field Type	Field Width
CowardinSystem	Cowardin system descriptors for environmental description of plot.	dbText	50

Table Name: tlkpDamageCodes
Description: Lookup table for damage codes.

Field Name	Field Description	Field Type	Field Width
DamageCode	Four-character damage code.	dbText	4
LMCode	Numeric damage code.	dbInteger	2
DamageDescription	A short description of damage type for combo boxes.	dbText	50
DamageDetails	Details of damage type.	dbMemo	0

Table Name: tlkpElevSource
Description: Look-up of options for source of elevation data.

Field Name	Field Description	Field Type	Field Width
ElevSource	Source of elevation data entered on field forms	dbText	50

Table Name: tlkpFireSpecies
Description: Lookup table for tblFireTrees species code.

Field Name	Field Description	Field Type	Field Width
SpeciesCode	Species code.	dbText	50

Table Name: tlkpFuelModels
Description: Lookup table for Anderson Fuel Models.

Field Name	Field Description	Field Type	Field Width
ModelNumber	Anderson Fuel Model Number.	dbInteger	2
ModelType	Model type.	dbText	30
ModelName	Fuel model name.	dbText	50
ModelDescription	Detailed description of model.	dbMemo	0

Table Name: tlkpGeology
Description: Look-up of geology types to describe substrate of plot.

Field Name	Field Description	Field Type	Field Width
Geology	Geology types used to describe substrate of plot or observation point	dbText	75

Table Name: tlkpHeightClass
Description: Look-up of height classes assigned to strata in tblVegetationDetails.

Field Name	Field Description	Field Type	Field Width
HeightClass	01<.5m 02=.5-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10>50m	dbText	2

Table Name: tlkpHydrology
Description: Look-up of hydrology types from Cowardin et al. 1979

Field Name	Field Description	Field Type	Field Width
Hydrology	Hydrology descriptors for plots that are in a wetland or upland with intermittent flooding (dry wash).	dbText	50

Table Name: tlkpLandForm
Description: Look-up of landforms in Veg Mapping Manual (from http://soils.usda.gov/technical/handbook/detailedtoc.html#629)

Field Name	Field Description	Field Type	Field Width
LandForm	landforms from appendix 1 of field manual	dbText	255

Table Name: tlkpLeafPhen

Description: Look-up of phenology types to describe dominant stratum (from VegMapping Manual 04/04.)

Field Name	Field Description	Field Type	Field Width
Phenology	Leaf phenology descriptors to describe dominant stratum	dbText	40

Table Name: tlkpLeafType
Description: Look-up of leaf form of dominant stratum (from VegMapping Manual 04/04)

Field Name	Field Description	Field Type	Field Width
LeafType	Leaf form description of the dominant stratum	dbText	35

Table Name: tlkpObservationType
Description: Lookup table for observation types.

Field Name	Field Description	Field Type	Field Width
ObservationType	Observation types for observation points.	dbText	25

Table Name: tlkpParks
Description: Look-up of parks surveyed.

Field Name	Field Description	Field Type	Field Width
ParkCode	Four-letter abbreviation for park code	dbText	4
ParkName	Full name of park where data were collected	dbText	50

Table Name: tlkpPhotoComments
Description: Lookup table of photo comments

Field Name	Field Description	Field Type	Field Width
PhotoComments	Photograph comments.	dbText	50

Table Name: tlkpPhotographer
Description: Lookup table of photographer names

Field Name	Field Description	Field Type	Field Width
Photographer	Photographer name.	dbText	50

Table Name: tlkpPhotoTypes
Description: Look-up of types of photos taken during data collection.

Field Name	Field Description	Field Type	Field Width
PhotoType	Type of photo taken, associated with plot.	dbText	50

Table Name: tlkpPhysiogClass
Description: Look-up of physiognomic types to describe each plot or observation point.

Field Name	Field Description	Field Type	Field Width
Physiognom	Physiognomic class used to describe plot	dbText	50

Table Name: tlkpPJAge
Description: Look-up of Pinyon-Juniper age classes

Field Name	Field Description	Field Type	Field Width
PJAgeClass	Pinyon- Juniper age class, if plot contains either of these two species.	dbText	15

Table Name: tlkpPlotDiameter
Description: Look-up of diameters used for circular plots.

Field Name	Field Description	Field Type	Field Width
PlotDiameter	Diameter, in meters, of circular plot	dbText	50

Table Name: tlkpPlotShapes
Description: Look-up of shapes of plots.

Field Name	Field Description	Field Type	Field Width
PlotShape	shapes of plots	dbText	15

Table Name: tlkpProvisionalCommunities
Description: Provisional names assigned by crews to each plot or observation point during data collection.

Field Name	Field Description	Field Type	Field Width
ID	Unique record ID	dbLong	4
NVC Elcode	Unique identifier for association name, assigned by NatureServe	dbText	255
NVC Association Name	Names assigned through NatureServe preliminary classification, and communities named by crews (following naming protocol in field manual)	dbText	255
CARE plots	Totals for each community type at Capitol Reef NP	dbDouble	8
COLM plots	Totals for each community type at Colorado National Monument	dbDouble	8
NABR plots	Totals for each community type at Natural Bridges NM	dbDouble	8
HOVE plots	Totals for each community type at Hovenweep NM	dbDouble	8
ARCH plots	Totals for each community type at Arches NP.	dbDouble	8

Table Name: tlkpSoilDrainage
Description: Look-up of soil drainage classes to describe plot or observation point.

Field Name	Field Description	Field Type	Field Width
SoilDrainage	Soil drainage classes used to describe soil where plot is located	dbText	30

Table Name: tlkpSoilTexture
Description: Look-up of soil textures based on Bowker 2003 field key for CANY, ARCH, and NABR.

Field Name	Field Description	Field Type	Field Width
SoilTexture	Look-up of soil textures based on Bowker 2003 field key for CANY, ARCH, and NABR.	dbText	15

Table Name: tlkpStates
Description: Look-up of all states in the USA

Field Name	Field Description	Field Type	Field Width
StateCode	Two-letter abbreviation for each state	dbText	2
StateName	Full name of each state in the USA	dbText	50

Table Name: tlkpStrata
Description: Look-up of strata classes in tblVegetationDetails (from VegMapping Manual 04/04).

Field Name	Field Description	Field Type	Field Width
Stratum	T1=Emergent T2=Canopy T3=Subcanopy S1=Tall Shrub S2=Short Shrub S3=Dwarf Shrub H1=Graminoid H2=Forb H3=Fern H4=Tree Seedl N=Nonvasc V=Vine E=Epiphyte	dbText	3

Table Name: tlkpStructuralStage
Description: Lookup table for fuels structural stages

Field Name	Field Description	Field Type	Field Width

Field Name	Field Description	Field Type	Field Width
StageCode	Structural stage code.	dbInteger	2
StageName	Name of structural stage.	dbText	15
StageDescription	Stage description.	dbMemo	0

Table Name: tlkpStructureStages
Description: Look-up table for fuels structure stages

Field Name	Field Description	Field Type	Field Width
StructureStage	Name of structure stage.	dbText	12

Table Name: tlkpSurveyors
Description: Look-up of data collection teams.

Field Name	Field Description	Field Type	Field Width
SurveyorName	Last names of crew members on data collection team.	dbText	75

Table Name: tlkpTopography
Description: Look-up of topographic positions to describe where plot or observation point is located on its related landform.

Field Name	Field Description	Field Type	Field Width
TopoPosition	Topographic positions used to describe where plot or observation point is located on its related landform.	dbText	50

Table Name: tlkpUSGS_Quad
Description: Look-up of all 7.5 minute USGS quads for CEBR.

Field Name	Field Description	Field Type	Field Width
USGSQuad	Names of all 7.5 minute USGS quads for CEBR.	dbText	50
USGSQuadCode	n/a for CEBR	dbText	7

Table Name: tlkpUTMZone
Description: Look-up for UTM zone of CEBR

Field Name	Field Description	Field Type	Field Width
UTMZone	UTM zone where all CEBR plots were collected	dbText	5

Table Name: tlu_MU_Codes
Description: Lookup table for map unit codes

Field Name	Field Description	Field Type	Field Width
MU_CODE	Map unit code	dbText	5
MU_NAME	Map unit name	dbText	255

Table Name: xrefDamageCodes
Description: Table to cross-reference Fire Trees with damage codes.

Field Name	Field Description	Field Type	Field Width
DamageID	Unique record ID - Primary key.	dbLong	4
FireTreeID	Foreign key to tblFireTrees.	dbLong	4
DamageCode	Foreign key to tlkpDamageCodes.	dbText	4

C.2 Geodatabase Documentation

Background

The geodatabase was designed to consolidate all spatial and non-spatial (i.e., tabular) data from the CEBR vegetation mapping project. In the geodatabase, feature classes were created for the spatial datasets, including plots, observation points, AA points, and polygons. These feature classes were then linked to the tables in the Plots database via relationship classes.

Entity Relationship Diagram

The primary tables and relationships for the geodatabase are illustrated below.

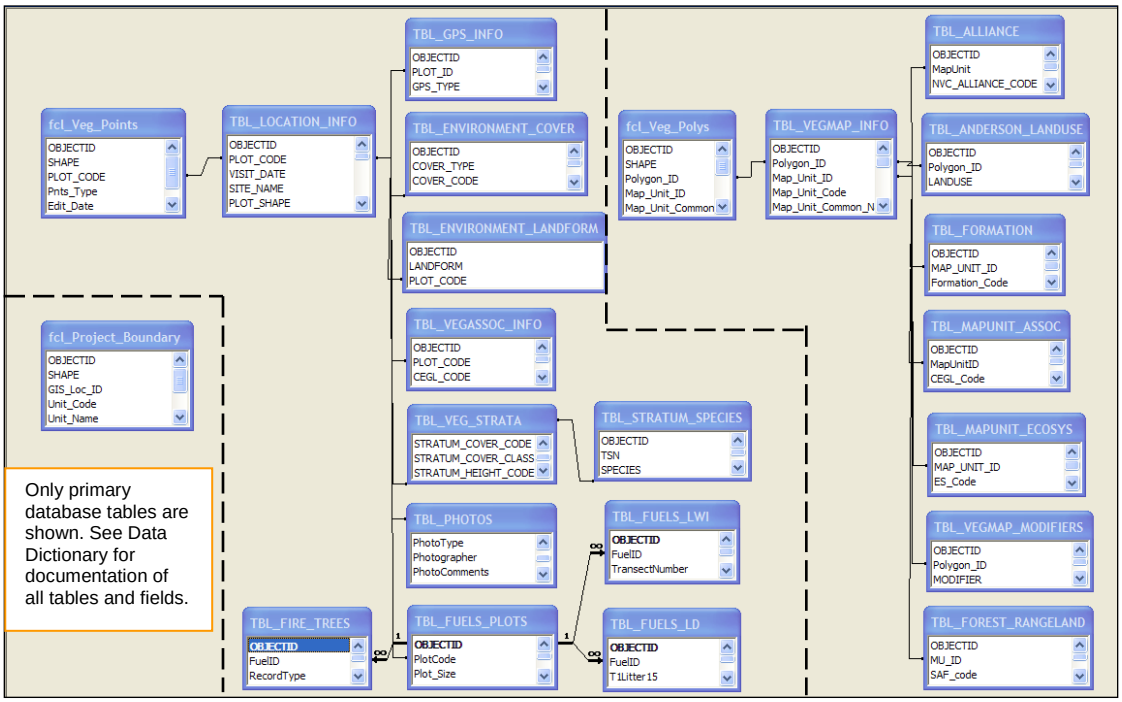


Figure 2. Entity Relationship Diagram for CEBR Geodatabase

Data Dictionary

The geodatabase consists of two types of tables: spatial (i.e., feature classes), and non-spatial tables. Tables appear in alphabetical order within these two categories.

Spatial tables

Table Name: fcl_Project_Boundary
Description: The feature class of the boundary of the vegetation mapping project area.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
GIS_Loc_ID	unique ID	dbText	128
Unit_Code	Four-letter park code (CEBR)	dbText	10
Unit_Name	Full name of national park (Cedar Breaks National	dbText	255

Field Name	Field Description	Field Type	Field Width
	Monument)		
Project_Acreage	Acreage of project area	dbLong	4
SHAPE_Length	ESRI generated	dbDouble	8
SHAPE_Area	ESRI generated	dbDouble	8

Table Name: fcl_Veg_Points
Description: The feature class containing all point data associated with the vegetation project (Plots, Observations, Fuels, AA).

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
PLOT_CODE	Unique Plot code, used for relating tables and feature class (TBL_LOCATION_INFO)	dbText	20
Pnts_Type	Type of point (fuels, plot, observation, aa, misc)	dbLong	4
Edit_Date	Date of any edits to the point or data	dbText	10
Edit_Notes	Notes regarding any edits	dbText	255

Table Name: fcl_Veg_Polys
Description: The feature class displaying the vegetation mapping units for the park.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	128
Map_Unit_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Edit_Date	Date of any edits to the polygon or its attributes	dbDate	8
Edit_Notes	Notes regarding any edits to the polygon or its attributes	dbText	250
Acres	Acres per polygon, generated using ArcMap	dbDouble	8
Hectares	Hectares per polygon, generated using ArcMap	dbDouble	8
SHAPE_Length	ESRI generated	dbDouble	8
SHAPE_Area	ESRI generated	dbDouble	8

Non-spatial tables

Table Name: TBL_ALLIANCE
Description: Contains the alliances for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MapUnit	The map unit identifier, used by the mappers (aka: grid_code or map class code, usually a number)	dbText	12
NVC_ALLIANCE_CODE	The NVC alliance code	dbText	20
ALLIANCE_COMMON_NAME	NVC alliance common name	dbText	250
ALLIANCE_NAME	NVC alliance latin name	dbText	250

Table Name: TBL_ANDERSON_LANDUSE
Description: Contains the Anderson Landuse classes for the vegetation polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	20
LANDUSE	The Anderson landuse classes of the polygon (version 1.5, January 2002)	dbDouble	8
Level_1	Anderson landuse code for level one	dbText	255
L1_Name	Anderson landuse name for level one	dbText	255
Level_2	Anderson landuse code for level two	dbText	50
L2_Name	Anderson landuse name for level two	dbText	255
Level_3	Anderson landuse code for level three	dbText	255
L3_Name	Anderson landuse name for level three	dbText	255
Level_4	Anderson landuse code for level four	dbText	255
L4_Name	Anderson landuse name for level four	dbText	255
Level_5	Anderson landuse code for level five	dbText	255
L5_Name	Anderson landuse name for level five	dbText	255
Level_6	Anderson landuse code for level six	dbText	255
L6_Name	Anderson landuse name for level six	dbText	255

Table Name: TBL_ENVIRONMENT_COVER
Description: Contains ground cover data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
COVER_TYPE	Ground cover type	dbText	30
COVER_CODE	Cover code from field sheet - AA & observation points only	dbText	5
COVER_PERCENT	Field estimate to the nearest percentage of ground cover type (plots only).	dbDouble	8
COVER_CODE_RANGE	Cover code range - for plots with non-integer percentages.	dbText	50
COVER_PERCENT_DESC	Description of cover, if "other"	dbText	255
PLOT_CODE	Unique Plot code, used for relating tables	dbText	20

Table Name: TBL_ENVIRONMENT_LANDFORM
Description: Contains landform data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
LANDFORM	Landform on which plot is located, any landform could be entered by crew.	dbText	100
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20

Table Name: TBL_FIRE_TREES
Description: Table of fuels measurements for trees.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
FuelID	Foreign key to TBL_FUELS_PLOTS	dbLong	4
RecordType	Record type: Seedling/Sapling or Overstory Trees	dbText	25

Field Name	Field Description	Field Type	Field Width
Plot_Size	Plot size	dbText	10
SpeciesCode	Species code	dbText	50
Live	1 = alive, 0 otherwise	dbSingle	4
DBH	DBH in centimeters	dbSingle	4
DRC	DRC in centimeters	dbSingle	4
Height	Height in meters	dbSingle	4
Measured	1 = height is measured, 0 otherwise	dbSingle	4
HeightToCrown	Height to live crown in meters	dbSingle	4
HeightMeasured	1 = height to crown is measured, 0 otherwise	dbSingle	4
StructuralStage	Structural stage	dbText	15
Comments	Comments	dbText	255
Twin	1 = twin, 0 otherwise	dbSingle	4

Table Name: TBL_FOREST_RANGELAND
Description: Contains the Society of American Foresters (SAF) and Society for Range Management (SRM) cover types.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MU_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code, usually a number)	dbText	10
SAF_code	Society of American Foresters (SAF) forest cover type code	dbText	50
SRM_code	Society for Range Management (SRM) cover type code	dbText	50
SAF_CovType	Society of American Foresters (SAF) forest cover type	dbText	255
SRM_CovType	Society for Range Management (SRM) cover type	dbText	255

Table Name: TBL_FORMATION
Description: Contains NVC formation level data for the vegetation polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MAP_UNIT_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Formation_Code	NVC formation level code	dbText	30
Formation_Name	NVC formation level name	dbText	255

Table Name: TBL_FUELS_LD
Description: Table of Litter and Duff for fire fuels.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
FuelID	Foreign key to TBL_FUELS_PLOTS	dbLong	4
T1Litter15	Litter depth to nearest 1/10 of a cm, transect T1, intercept 15 ft	dbSingle	4
T1Litter20	Litter depth to nearest 1/10 of a cm, T1, 20 ft	dbSingle	4
T1Litter25	Litter depth to nearest 1/10 of a cm, T1, 25 ft	dbSingle	4
T1Litter30	Litter depth to nearest 1/10 of a cm, T1, 30 ft	dbSingle	4
T1Litter35	Litter depth to nearest 1/10 of a cm, T1, 35 ft	dbSingle	4
T1Litter40	Litter depth to nearest 1/10 of a cm, T1, 40 ft	dbSingle	4
T1Litter45	Litter depth to nearest 1/10 of a cm, T1, 45 ft	dbSingle	4
T1Litter50	Litter depth to nearest 1/10 of a cm, T1, 50 ft	dbSingle	4
T1Litter55	Litter depth to nearest 1/10 of a cm, T1, 55 ft	dbSingle	4
T1Litter60	Litter depth to nearest 1/10 of a cm, T1, 60 ft	dbSingle	4
T1Duff15	Duff depth to nearest 1/10 of a cm, transect T1, intercept 15 ft	dbSingle	4

Field Name	Field Description	Field Type	Field Width
T1Duff20	Duff depth to nearest 1/10 of a cm, T1, 20 ft	dbSingle	4
T1Duff25	Duff depth to nearest 1/10 of a cm, T1, 25 ft	dbSingle	4
T1Duff30	Duff depth to nearest 1/10 of a cm, T1, 30 ft	dbSingle	4
T1Duff35	Duff depth to nearest 1/10 of a cm, T1, 35 ft	dbSingle	4
T1Duff40	Duff depth to nearest 1/10 of a cm, T1, 40 ft	dbSingle	4
T1Duff45	Duff depth to nearest 1/10 of a cm, T1, 45 ft	dbSingle	4
T1Duff50	Duff depth to nearest 1/10 of a cm, T1, 50 ft	dbSingle	4
T1Duff55	Duff depth to nearest 1/10 of a cm, T1, 55 ft	dbSingle	4
T1Duff60	Duff depth to nearest 1/10 of a cm, T1, 60 ft	dbSingle	4
T2Litter15	Litter depth to nearest 1/10 of a cm, T2, 15 ft	dbSingle	4
T2Litter20	Litter depth to nearest 1/10 of a cm, T2, 20 ft	dbSingle	4
T2Litter25	Litter depth to nearest 1/10 of a cm, T2, 25 ft	dbSingle	4
T2Litter30	Litter depth to nearest 1/10 of a cm, T2, 30 ft	dbSingle	4
T2Litter35	Litter depth to nearest 1/10 of a cm, T2, 35 ft	dbSingle	4
T2Litter40	Litter depth to nearest 1/10 of a cm, T2, 40 ft	dbSingle	4
T2Litter45	Litter depth to nearest 1/10 of a cm, T2, 45 ft	dbSingle	4
T2Litter50	Litter depth to nearest 1/10 of a cm, T2, 50 ft	dbSingle	4
T2Litter55	Litter depth to nearest 1/10 of a cm, T2, 55 ft	dbSingle	4
T2Litter60	Litter depth to nearest 1/10 of a cm, T2, 60 ft	dbSingle	4
T2Duff15	Duff depth to nearest 1/10 of a cm, T2, 15 ft	dbSingle	4
T2Duff20	Duff depth to nearest 1/10 of a cm, T2, 20 ft	dbSingle	4
T2Duff25	Duff depth to nearest 1/10 of a cm, T2, 25 ft	dbSingle	4
T2Duff30	Duff depth to nearest 1/10 of a cm, T2, 30 ft	dbSingle	4
T2Duff35	Duff depth to nearest 1/10 of a cm, T2, 35 ft	dbSingle	4
T2Duff40	Duff depth to nearest 1/10 of a cm, T2, 40 ft	dbSingle	4
T2Duff45	Duff depth to nearest 1/10 of a cm, T2, 45 ft	dbSingle	4
T2Duff50	Duff depth to nearest 1/10 of a cm, T2, 50 ft	dbSingle	4
T2Duff55	Duff depth to nearest 1/10 of a cm, T2, 55 ft	dbSingle	4
T2Duff60	Duff depth to nearest 1/10 of a cm, T2, 60 ft	dbSingle	4

Table Name: TBL_FUELS_LWI
Description: Table of Large Woody Intercepts for fire fuels.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
FuelID	Foreign key to TBL_FUELS_PLOTS	dbLong	4
TransectNumber	Transect number: 1 or 2	dbInteger	2
Diameter	Diameter in centimeters.	dbSingle	4
DecayClass	Decay class: Sound or Rotten	dbText	10

Table Name: TBL_FUELS_PLOTS
Description: Table of fuel intercept tallies and other summary information.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PlotCode	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20
Plot_Size	Plot size	dbText	20
Surveyor	Surveyor Name(s)	dbText	75
FuelModel	Anderson Fuel Model	dbText	50
T1Slope	Transect one slope in degrees	dbText	50
T1Azimuth	Azimuth from plot center	dbText	50

Field Name	Field Description	Field Type	Field Width
T1OneHrTally	One hour fuel intercept count. <.25"	dbInteger	2
T1TenHrTally	Ten hour intercept count. .25 - 1"	dbInteger	2
T1HunHrTally	Hundred hour intercept count. 1-3"	dbInteger	2
T2Slope	Transect two slope in degrees	dbText	50
T2Azimuth	Azimuth from plot center	dbText	50
T2OneHrTally	One hour fuel intercept count. <.25"	dbInteger	2
T2TenHrTally	Ten hour intercept count. .25 - 1"	dbInteger	2
T2HunHrTally	Hundred hour intercept count. 1-3"	dbInteger	2
Comments	Fuel comments	dbText	255
FuelID	Unique identifier for record	dbLong	4

Table Name: TBL_GPS_INFO
Description: Contains information about the GPS unit and accuracies of data collected for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_ID	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20
GPS_TYPE	Manufacturer / model of GPS unit (e.g., Garmin Etrex or Trimble XM)	dbText	30
UTM_EASTING	UTM easting of plot	dbDouble	8
UTM_NORTHING	UTM northing of plot	dbDouble	8
UTM_ZONE	UTM zone of coordinates	dbText	3
DATUM	Datum of UTM coordinates (NAD83)	dbText	10
GPS_ERROR	Error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
DIFF_CORRECTED	Indicates if coordinates have been differentially corrected (from Garmin screen)	dbText	3
GPS_COMMENTS	Any brief comments on GPS data collection at plot.	dbText	255
GPS_QUALITY	Indicates the quality of the GPS unit used (recreational, mapping grade)	dbText	35
PDOP	Positional Dilution Of Precision reading (from Garmin screen)	dbText	30
ERROR_RANGE	General error range, in meters, of the type of GPS unit used.	dbText	20

Table Name: TBL_LOCATION_INFO
Description: Contains data about the location of the point and general observations about the area for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables and feature class (fcl_Veg_Points)	dbText	20
VISIT_DATE	Date the location was visited	dbText	10
SITE_NAME	General Site name given by field crew	dbText	180
PLOT_SHAPE	The shape of the area observed as a point	dbText	20
PLOT_WIDTH	The width of the point (plot and obs only)	dbText	3
PLOT_LENGTH	The length of the point (plot and obs only)	dbText	3
PLOT_DIAMETER	The diameter of the point (plot and obs only)	dbText	5

Field Name	Field Description	Field Type	Field Width
PLOT_AZIMUTH	The azimuth of the point (plot and obs only)	dbText	5
ASPECT	Aspect of plot	dbText	10
ELEVATION	Elevation of plot in meters, generated by GPS unit	dbDouble	8
SLOPE	Slope of plot measured in degrees	dbText	15
TOPO_POSITION	Topographic position of plot	dbText	50
DIRECTIONS_PLOT	Directions to the location of the plot (plot and obs only)	dbText	255
REPRESENTATIVENESS	The representativeness of the vegetation (at plots and obs only)	dbText	255
OBSERVER	The names of the field crew member(s) observing the site.	dbText	50
IN_PARK	Indicates if the point was inside or outside the park boundary (only applicable to Plots and Observation points, all AA pts inside park. “1” = In Park, “0” = Not in park)	dbBoolean	1
UNIT_CODE	4 letter park code (CEBR)	dbText	10
AERIAL_PHOTO_NO	9X9 photo name on which the point most directly falls (2002 flight, plots & obs only)	dbText	30
STATE_CODE	State (UT)	dbText	2
USGS_NAME	USGS 1:24k Topo Name	dbText	75
COUNTY_NAME	County where plot is located (Iron County)	dbText	80
PHENOLOGY	Leaf phenology of the dominant stratum. Field is blank for non-vascular plots	dbText	50
PHYSIOGNOMIC_NAME	Physiognomic class of plot	dbText	80
LEAF_TYPE	Leaf form of the dominant stratum.	dbText	80
LEAF_TYPE_COMMENTS	If Leaf Type is "mixed," this field describes the multiple leaf types found in the dominant stratum.	dbText	250
PROVISIONAL_COMM_NAME	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training (plot and obs only).	dbText	220
ALLIANCE	Alliance corresponding to provisional community name (plots and obs only)	dbText	150
PLANT_SPECIES_COMMENTS	Comments about the plant species observed.	dbText	200
COWARDIN_SYSTEM	If the plot is in a wetland system, select term that best describes its hydrology (Upland, Palustrine, Riverine, Lacustrine). plot and obs only	dbText	40
HYDROLOGY	Describes hydrology of plot (plot and obs only)	dbText	40
GEOLOGY	Geologic substrate influencing the plant community (plot and obs only); Surficial geology (AA points)	dbText	60
ENV_COMMENTS	Comments on environmental setting and its effect on the vegetation; also comments on any disturbance or reproduction factors	dbText	255
LANDSCAPE_COMMENTS	Description of landscape context of plot, including any important landscape features influencing the community (plot and obs only)	dbText	255
ANIMAL_USE_COMMENTS	Comments on evidence of use by non-domestic	dbText	255

Field Name	Field Description	Field Type	Field Width
	animals in plot area (plot and obs only)		
DISTURBANCE_COMMENTS	Comments on evidence of natural or anthropogenic disturbance in plot area, severity and effects on vegetation (plot and obs only)	dbText	255
OTHER_COMMENTS	Other general comments (plot and obs only)	dbText	255
SOIL_TEXTURE	Assessment of average soil texture from sample taken a few inches below the surface (plot and obs only)	dbText	50
SOIL_DRAINAGE	Soil drainage class based on actual moisture content and extent period (plot and obs only)	dbText	30
SOIL_TAXON_DESC	Field used for either identifying soils keyed, or to describe if large rocks or outcrops are present on the surface (plot and obs only)	dbText	255

Table Name: TBL_MAPUNIT_ASSOC
Description: Contains association data for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MapUnitID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	20
CEGL_Code	NVC association code	dbText	18
AssociationName	The NVC Association name (scientific)	dbText	250
AssociationCommonName	The NVC Association Common name	dbText	250

Table Name: TBL_MAPUNIT_ECOSYS
Description: Contains ecological system data for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MAP_UNIT_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
ES_Code	Ecological System code	dbText	30
EcologicalSystemName	Ecological system name (mid-scale classification, larger than associations or alliances, smaller than ecoregions).	dbText	255

Table Name: TBL_PHOTOS
Description: Details on individual photos taken of a point.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	50
PhotoType	Type of photo being referenced.	dbText	16
Photographer	Name of photographer.	dbText	50
PhotoComments	Brief description of photo.	dbText	255
IMAGE_ID	NCPN Photo Database (unique) file name.	dbText	50
PHOTO_PATH	Hard-coded path name to photos (update this field)	dbText	200

Table Name: TBL_STRATUM_SPECIES
Description: Contains species level data by stratum.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
SPECIES	Latin names of species	dbText	255
PERCENT_COVER	Applicable to AA data only, percent cover by species	dbText	4
COVER_CODE	Cover class code to describe species and strata	dbText	5
COVER_CLASS	Cover class to describe species and strata	dbText	50
DIAGNOSTIC	Check yes if the species is known to be diagnostic of the vegetation type.	dbInteger	2
SPECIMEN_COLLECTED	"yes" (-1) if a specimen of the species was collected.	dbInteger	2
SPECIMEN_NO	The collector's reference number for the specimen collected.	dbText	10
DEAD	Percent cover of dead species seen at plot. Not completed of every species, but always done if diagnostic species.	dbInteger	2
STRATUM_ID	Unique ID, relates to TBL_VEG_STRATA	dbLong	4

Table Name: TBL_VEG_STRATA
Description: Contains stratum data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
STRATUM_ID	Links to strata	dbLong	4
STRATUM	Stratum name/type	dbText	20
STRATUM_COVER_CODE	stratum cover code	dbText	5
STRATUM_COVER_CLASS	stratum percentage cover class	dbText	50
STRATUM_HEIGHT_CODE	stratum height code	dbText	5
STRATUM_HEIGHT_CLASS	stratum height class in meters	dbText	50
PLOT_CODE	Unique Plot code, used for relating tables (TBL_STRATUM_SPECIES)	dbText	15

Table Name: TBL_VEGASSOC_INFO
Description: Contains association data for all points (plots, obs, and AA points) in the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables	dbText	35
CEGL_CODE	CEGL (association) code	dbText	10
ASSOCIATION	Association corresponding to provisional community name	dbText	180
FIELD_KEY_NAME	Yes if association name was chosen from field key	dbText	10
CREATED_NAME	Yes if no name really fits from the field key, the surveyor will create a new name.	dbText	10
POST_AA_FIELD_NAME	Yes if association name was assigned after AA field work, based on species lists and comments fields -- during AA meetings.	dbText	10
ASSOC_RANK	Rank of vegetation association (primary, secondary, tertiary)	dbText	50
OTHER_ASSOC_50M	Other associations noted in a 50 meter area beyond plot	dbText	200

Table Name: TBL_VEGMAP_INFO
Description: Contains map unit level data for each vegetation map unit polygon.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables and feature classes (fcl_Veg_polys)	dbText	30
Map_Unit_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Map_Unit_Code	NCPN code (e.g., W-PPMS)	dbText	10
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Cover_Code	n/a for CEBR	dbText	1
COVER_PATTERN	n/a for CEBR	dbText	100
Density_Code	Density value code	dbText	1
DENSITY_CLASS	Density of Forest/Woodland vegetation, and density for sagebrush communities per polygon.	dbText	100
Height_Code	n/a for CEBR	dbText	1
HEIGHT_CLASS	n/a for CEBR	dbText	100
USER_ACCURACY	User accuracy of the map unit (determined during AA meetings). N/A means the class was not accuracy assessed.	dbText	3
FUELS_TYPE	Fuels vegetation types (if applicable)	dbText	50
FUELS_VERIFICATION	Fuels verification (if applicable)	dbText	255
VEGMAP_COMMENTS	Any comments about the particular polygon or map class.	dbText	255
MAP_UNIT_PDF	File name of pdf describing map unit (class)	dbText	50
MAP_UNIT_PDF_PATH	Hard-coded link to Map Unit description PDF document - path name (e.g. C:/CEBR/Vegetation/MapClassDescriptions/F-SFES_mu5.pdf)	dbText	250

Table Name: TBL_VEGMAP_MODIFIERS
Description: Contains modifiers for the vegetation map unit polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	20
MODIFIER	Modifier code (one lower case letter)	dbText	12
MODIFIER_NAME	Name/type of modifier	dbText	50
MODIFIER_DESCRIPTION	Description of modifier	dbText	255

Appendix D. Plant Species List and Crosswalk

Three hundred and thirteen vascular plant species representing 52 families were noted during plot, observation point and accuracy assessment point data collection at Cedar Breaks National Monument (CEBR). The Northern Colorado Plateau Network uses three taxonomic authorities for vascular plants: Welsh et al. 2003 as the nomenclatural authority for Utah parks, Weber and Wittmann 2001 for Colorado parks, and Dorn and Lichvar 1984 for the single park in Wyoming; the CEBR vegetation mapping project database reflects scientific names as assigned by Welsh. These names are crosswalked to Kartesz 1999, which is the nomenclatural authority used by NatureServe for the National Vegetation Classification. Scientific and common names used by NatureServe are presented in this crosswalk; these names are used throughout the CEBR vegetation mapping report and in the individual association descriptions in Appendix F. The taxonomic serial number (TSN) assigned by the Integrated Taxonomic Information System (ITIS) is provided for each species

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VASCULAR PLANTS

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Aceraceae	*Acer glabrum* Torr.	*Acer glabrum*	Rocky Mountain maple	28742
	Acer grandidentatum Nutt.	*Acer grandidentatum*	bigtooth maple	28760
Anacardiaceae	*Rhus aromatica* var. *trilobata* (Nutt.) Gray ex. S. Wats.	*Rhus trilobata var. trilobata*	skunkbush sumac	539586
Apiaceae	*Cymopterus lemmonii* (Coult. & Rose) Dorn	*Pseudocymopterus montanus*	alpine false springparsley	511931
	Cymopterus minimus (Mathias) Mathias	*Cymopterus minimus*	Cedar Breaks springparsley	29646
	Cymopterus Raf.	*Cymopterus*	springparsley	29625
	Ligusticum filicinum S. Wats.	*Ligusticum filicinum*	fernleaf licorice-root	29530
	Ligusticum porteri Coult. & Rose	*Ligusticum porteri*	Porter's licoriceroot	29532
	Lomatium minimum (Mathias) Mathias	*Lomatium minimum*	little desert parsley	29723
	Ozmorhiza depauperata Phil.	*Osmorhiza depauperata*	bluntseed sweetroot	29790
Apocynaceae	*Apocynum androsaemifolium* L.	*Apocynum androsaemifolium*	spreading dogbane	30156
Asteraceae	*Achillea millefolium* L.	*Achillea millefolium*	common yarrow	35423
	Agoseris aurantiaca (Hook.) Greene	*Agoseris aurantiaca*	orange agoseris	36488
	Agoseris glauca (Pursh) Raf.	*Agoseris glauca*	false agoseris	36490
	Antennaria Gaertn.	*Antennaria*	pussytoes	36716
	Antennaria microphylla Rydb.	*Antennaria microphylla*	littleleaf pussytoes	185162
	Antennaria pulcherrima (Hook.) Greene	*Antennaria pulcherrima*	showy pussytoes	36751
	Antennaria rosulata Rydb.	*Antennaria rosulata*	Kaibab pussytoes	36755
	Arnica cordifolia Hook.	*Arnica cordifolia*	heartleaf arnica	36561
	Arnica mollis Hook.	*Arnica mollis*	hairy arnica	36571
	Artemisia cana Pursh.	*Artemisia cana*	silver sagebrush	35454
	Artemisia dracunculus L.	*Artemisia dracunculus*	wild tarragon	35462
	Artemisia ludoviciana Nutt.	*Artemisia ludoviciana*	white sagebrush	35474
	Aster ascendens Lindl.	*Symphyotrichum ascendens*	Chile aster	193303
	Aster eatonii (Gray) T.J. Howell	*Symphyotrichum eatonii*	Eaton’s aster	35560
	Aster foliaceus DC.	*Symphyotrichum foliaceum*	alpine leafybract aster	35572
	Aster L.	*Aster*	aster	35510
	Aster spathulatus var. *spathulatus*	*Symphyotrichum spathulatum var. spathulatum*	western mountain aster	566344
	Aster wasatchensis (M.E. Jones) Blake	*Eurybia wasatchensis*	Wasatch aster	35678
	Chaenactis douglasii (Hook.) Hook. & Arn.	*Chaenactis douglasii*	Douglas' dustymaiden	36987
	Chrysopsis villosa (Pursh) Nutt. ex DC	*Heterotheca villosa*	hairy false goldenaster	510984

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Asteraceae	*Chrysothamnus depressus* Nutt.	*Chrysothamnus depressus*	longflower rabbitbrush	37051
	Chrysothamnus nauseosus (Pallas ex Pursh) Britt.	*Ericameria nauseosa*	rubber rabbitbrush	507594
	Chrysothamnus viscidiflorus (Hook.) Nutt.	*Chrysothamnus viscidiflorus*	yellow rabbitbrush	37090
	Cirsium arizonicum (Gray) Petrak	*Cirsium arizonicum*	Arizona thistle	36341
	Cirsium calcareum (M.E. Jones) Woot. & Standl.	*Cirsium calcareum*	Cainville thistle	39346
	Cirsium P. Mill.	*Cirsium*	thistle	36334
	Cirsium wheeleri (Gray) Petrak	*Cirsium wheeleri*	Wheeler thistle	36429
	Erigeron canaani Welsh.	*Erigeron eatonii var. eatonii*	Eaton's fleabane	513023
	Erigeron compositus Pursh.	*Erigeron compositus*	cutleaf daisy	35843
	Erigeron divergens Torr. & Gray	*Erigeron divergens*	spreading fleabane	35852
	Erigeron flagellaris Gray	*Erigeron flagellaris*	trailing fleabane	35865
	Erigeron L.	*Erigeron*	fleabane	35803
	Erigeron sionis Cronq.	*Erigeron sionis*	Zion fleabane	35949
	Erigeron speciosus (Lindl.) DC.	*Erigeron speciosus*	aspen fleabane	35950
	Erigeron ursinus D.C. Eat.	*Erigeron ursinus*	Bear River fleabane	35966
	Gutierrezia sarothrae (Pursh) Britt. & Rusby	*Gutierrezia sarothrae*	broom snakeweed	37483
	Haplopappus clementis (Rydb.) Blake	*Pyrrocoma clementis var. clementis*	tranquil goldenweed	37512
	Haplopappus macronema (Nutt.) Gray	*Ericameria discoidea*	whitestem goldenbush	514437
	Haplopappus Cass.	*n/a*	haplopappus	37497
	Helenium hoopesii Gray	*Hymenoxys hoopesii*	Owl's-claws	514546
	Helianthella uniflora (Nutt.) Torr. & Gray	*Helianthella uniflora*	oneflower helianthella	37598
	Hieracium albiflorum Hook.	*Hieracium albiflorum*	White hawkweed	37693
	Hymenopappus filifolius Hook.	*Hymenopappus filifolius*	fineleaf hymenopappus	37766
	Machaeranthera canescens (Pursh) Gray	*Machaeranthera canescens*	hoary tansyaster	37984
	Senecio atratus Greene	*Senecio atratus*	tall blacktip ragwort	36101
	Senecio canus Hook.	*Packera cana*	woolly groundsel	36109
	Senecio crassulus Gray	*Senecio crassulus*	thickleaf ragwort	36116
	Senecio dimorphophyllus	*Packera dimorphophylla*	splitleaf groundsel	530304
	Senecio eremophilus Richards.	*Senecio eremophilus*	desert ragwort	36127
	Senecio integerrimus Nutt.	*Senecio integerrimus*	lambstongue ragwort	36148
	Senecio L.	*Senecio*	ragowort	36084
	Senecio multilobatus Torr. & Gray ex Gray	*Packera multilobata*	lobeleaf groundsel	36161

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Asteraceae	*Solidago* L.	*Solidago*	goldenrod	36223
	Solidago multiradiata Ait.	*Solidago multiradiata*	Rocky Mountain goldenrod	36279
	Solidago nana Nutt.	*Solidago nana*	baby goldenrod	36280
	Solidago parryi (Gray) Greene	*Oreochrysum parryi*	Parry's goldenrod	36287
	Solidago velutina DC.	*Solidago velutina*	threenerve goldenrod	505290
	Taraxacum officinale G.H. Weber ex Wiggers	*Taraxacum officinale*	dandelion	36213
	Tragopogon dubius Scop.	*Tragopogon dubius*	yellow salsify	38564
	Viguiera multiflora (Nutt.) Blake	*Heliomeris multiflora*	n/a	523280
Berberidaceae	*Mahonia repens* (Lindl.) G. Don	*Mahonia repens*	creeping barberry	195045
Betulaceae	*Alnus incana* (L.) Moench	*Alnus incana*	gray alder	181887
	Betula occidentalis Hook.	*Betula occidentalis*	water birch	19488
Boraginaceae	*Lithospermum incisum* Lehm.	*Lithospermum incisum*	narrowleaf stoneseed	31940
	Lithospermum multiflorum Torr. ex Gray	*Lithospermum multiflorum*	manyflowered stoneseed	31951
	Mertensia arizonica Greene	*Mertensia arizonica*	aspen bluebells	31666
	Mertensia ciliata (James ex Torr.) G. Don	*Mertensia ciliatia*	tall fringed bluebells	31668
Brassicaceae	*Arabis drummondii* Gray	*Arabis drummondii*	Drummond's rockcress	22689
	Arabis holboellii Hornem.	*Arabis holboellii*	Holboell rockcress	22702
	Arabis L.	*Arabis*	rockcress	22671
	Cardamine cordifolia Gray	*Cardamine cordifolia*	heartleaf bittercress	22789
	Descurainia incana (Bernh. ex Fisch. & C.A. Mey.) Dorn	*Descurainia incana*	mountain tansymustard	502003
	Draba subalpina Goodman & C.L. Hitchc.	*Draba subalpina*	subalpine draba	22921
	Erysimum asperum (Nutt.) DC.	*Erysimum capitatum var. capitatum*	western wall flower	22931
	Physaria (Nutt. ex Torr. & Gray) Gray	*Physaria*	twinpod	23269
	Thlaspi arvense L.	*Thlaspi arvense*	field pennycress	23422
	Thlaspi montanum L.	*Thlaspi montanum*	alpine pennycress	23423
	Physaria kingii	*n/a*	King bladderpod	?
	Physaria rubicundula	*Lesquerella rubicundula*	tum bladderpod	?
Caprifoliaceae	*Lonicera involucrata* Banks ex Spreng.	*Lonicera involucrata*	twinbery honeysuckle	35297
	Sambucus cerulea Raf.	*Sambucus caerulea*	blue elder	35320
	Sambucus racemosa L.	*Sambucus racemosa*	red elderberry	35326
	Symphoricarpos oreophilus Gray	*Symphoricarpos oreophilus*	mountain snowberry	35338
Caryophyllaceae	*Arenaria fendleri* Gray	*Arenaria fendleri*	Fendler's sandwort	20245

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Caryophyllaceae	*Lychnis drummondii* (Hook.) S. Wats.	*Silene drummondii*	Drummond's campion	516476
	Silene petersonii Maguire	*Silene petersonii*	plateau catchfly	20104
	Stellaria jamesiana Torr.	*Pseudostellaria jamesiana*	tuber starwort	521985
	Stellaria longipes Goldie	*Stellaria longipes*	longstalk starwort	20168
Celastraceae	*Paxistima myrsinites* (Pursh) Raf.	*Paxistima myrsinites*	mountain lover	504149
Chenopodiaceae	*Chenopodiaceae*	*Chenopodiaceae*	goosefoot	20504
	Chenopodium album L.	*Chenopodium album*	lambsquarters	20592
	Chenopodium atrovirens Rydb.	*Chenopodium atrovirens*	pinyon goosefoot	20593
	Chenopodium fremontii S. Wats.	*Chenopodium fremontii*	Fremont's goosefoot	20607
	Chenopodium L.	*Chenopodium*	goosefoot	20589
Cornaceae	*Cornus sericea* L.	*Cornus sericea*	redosier dogwood	501637
Cupressaceae	*Juniperus communis* L.	*Juniperus communis*	common juniper	194820
	Juniperus scopulorum Sarg.	*Juniperus scopulorum*	Rocky Mountain juniper	194872
Cyperaceae	*Carex aquatilis* Wahlenb.	*Carex aquatilis*	water sedge	39374
	Carex aurea Nutt.	*Carex aurea*	golden sedge	39445
	Carex dioica var. *gynocrates* Wormsk. Ex Drej.	*Carex gynocrates*	northern bog sedge	532983
	Carex egglestonii Mackenzie	*Carex egglestonii*	Eggleston's sedge	39585
	Carex L.	*Carex*	sedge	39369
	Carex pellita Muhl ex Willd.	*Carex pellita*	woolly sedge	507767
	Carex praegracilis W. Boott	*Carex praegracilis*	slim sedge	39767
	Carex rossii Boott	*Carex rossii*	Ross' sedge	39786
	Carex scirpoidea Michx.	*Carex scirpoidea*	northern singlespike sedge	39799
	Carex utriculata Boott	*Carex utriculata*	Northwest Territory sedge	501288
	Eleocharis palustris (L.) Roemer & J.A. Schultes	*Eleocharis palustris*	common spikerush	40019
	Eleocharis R. Br.	*Eleocharis*	spikerush	40010
Dryopteridaceae	*Cystopteris fragilis* (L.) Bernh.	*Cystopteris fragilis*	brittle bladderfern	17482
Elaeagnaceae	*Shepherdia canadensis* (L.) Nutt.	*Shepherdia canadensis*	russet buffaloberry	27779
Ephedraceae	*Ephedra viridis* Coville	*Ephedra viridis*	green Mormon tea	502319
Equisetaceae	*Equisetum arvense* L.	*Equisetum arvense*	field horsetail	17152
	Equisetum L.	*Equisetum*	horsetail	17148
	Equisetum laevigatum A. Braun	*Equisetum laevigatum*	smooth horsetail	17156
	Equisetum variegatum Schleich. ex F. Weber & D.M.H. Mohr	*Equisetum variegatum*	variegated scouringrush	17149

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
	Equisetum x *ferrisii* Clute, Fern Bull	*Equisetum* x *ferrisii*	n/a	?
Ericaceae	*Arctostaphylos patula* Greene	*Arctostaphylos patula*	greenleaf manzanita	23513
Euphorbiaceae	*Euphorbia brachycera* Engelm.	*Euphorbia brachycera*	Horned spurge	28049
Fabaceae	*Astragalus argophyllus* Nutt.	*Astragalus argophyllus*	silverleaf milkvetch	25421
	Astragalus argophyllus var. *panguicensis* (M.E. Jones) M.E. Jones	*Astragalus argophyllus*	silverleaf milkvetch	192355
	Astragalus kentrophyta Gray	*Astragalus kentrophyta*	spiny milkvetch	25553
	Astragalus L.	*Astragalus*	milkvetch	25392
	Astragalus limnocharis Barneby	*Astragalus limnocharis*	Cedar Breaks milkvetch	25563
	Astragalus miser Dougl.	*Astragalus miser*	timber milkvetch	25584
	Astragalus tenellus Pursh	*Astragalus tenellus*	looseflower milkvetch	25696
	Lathyrus lanszwertii Kellogg	*Lathyrus lanszwertii*	Nevada pea	25855
	Lotus utahensis Ottley	*Lotus utahensis*	Utah birdsfoot trefoil	26410
	Lupinus argenteus Pursh	*Lupinus argenteus*	silvery lupine	503575
	Oxytropis oreophila Gray	*Oxytropis oreophila*	mountain locoweed	26178
	Trifolium longipes Nutt.	*Trifolium longipes*	longstalk clover	26270
	Vicia americana Muhl. ex Willd.	*Vicia americana*	American vetch	26331
Fagaceae	*Quercus gambelii* Nutt.	*Quercus gambelii*	Gambel oak	19337
Gentianaceae	*Gentiana parryi* Engelm.	*Gentiana parryi*	Parry's gentian	29980
	Gentianella heterosepala (Engelm.) Holub	*Gentianella amarella ssp. heterosepala*	autumn dwarf gentian	513918
	Gentianella tortuosa (M.E. Jones) J. Gillett	*Gentianella tortuosa*	Cathedral Bluff gentian	30076
	Gentianopsis detonsa (Rottb.) Ma	*Gentianopsis detonsa*	western fringe gentian	30081
	Swertia L.	*Swertia*	felwort	30107
	Swertia radiata (Kellogg) Kuntze	*Frasera speciosa*	deer ear's	30120
Geraniaceae	*Geranium richardsonii* Fisch. & Trautv.	*Geranium richardsonii*	Richardson's geranium	29118
Grossulariaceae	*Ribes cereum* Dougl.	*Ribes cereum*	wax currant	24457
	Ribes L.	*Ribes*	currant	24448
	Ribes montingenum McClatchie	*Ribes montingenum*	gooseberry currant	24486
	Ribes viscosissimum Pursh	*Ribes viscosissimum*	sticky currant	24510
Hydrangeaceae	*Jamesia americana* Torr. & Gray	*Jamesia americana*	fivepetal cliffbush	24379
Juncaceae	*Juncus arcticus* Willd.	*Juncus arcticus*	arctic rush	39222
	Juncus ensifolius var. *brunnescens* (Rydb.) Cronq.	*Juncus saximontanus*	Rocky Mountain rush	536428

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Juncaceae	*Juncus ensifolius* Wikstr.	*Juncus ensifolius*	swordleaf rush	39269
	Juncus L.	*Juncus*	rush	39220
	Juncus longistylis Torr.	*Juncus longistylis*	longstyle rush	503256
	Luzula parviflora (Ehrh.) Desv.	*Luzula parviflora*	smallflowered woodrush	39347
Lamiaceae	*Monardella odoratissima Benth.*	*Monardella odoratissima*	mountain monardella	32580
	Prunella vulgaris L.	*Prunella vulgaris*	common selfheal	32381
Liliaceae	*Calochortus nuttallii* Torr. & Gray	*Calochortus nuttallii*	sego lily	42863
	Calochortus Pursh	*Calochortus*	mariposa lily	42823
	Disporum trachycarpum (S. Wats.) Benth. & Hook. f.	*Prosartes trachycarpa*	roughfruit fairybells	42923
	Fritillaria atropurpurea Nutt.	*Fritillaria atropurpurea*	leopard lily	502669
	Smilacina racemosa (L.) Desf.	*Maianthemum racemosum*	feathery false lily of the valley	43036
	Smilacina stellata (L.) Desf.	*Maianthemum stellatum*	starry false lily of the valley	43038
	Zigadenus elegans Pursh	*Zigadenus elegans*	mountain deathcamas	43158
Linaceae	*Linum kingii* S. Wats.	*Linum kingii*	King's flax	29213
	Linum lewisii Pursh	*Linum perenne*	Lewis flax	29214
	Linum perenne L.	*Linum perenne*	blue flax	29217
	Linum perenne ssp. *lewisii* (Pursh) Hulten	*Linum lewisii var. lewisii*	prairie flax	526067
Loasaceae	*Mentzelia multiflora* (Nutt.) Gray	*Mentzelia laciniata*	desert blazingstar	503778
Monotropaceae	*Pterospora andromedea* Nutt.	*Pterospora andromedea*	woodland pinedrops	23787
Onagraceae	*Epilobium angustifolium L.*	*Chamerion angustifolium*	fireweed	27284
	Epilobium ciliatum Raf.	*Epilobium ciliatum*	hairy willowherb	27293
	Epilobium hornemannii Reichenb.	*Epilobium hornemannii*	Hornemann's willowherb	27306
	Oenothera flava (A. Nels.) Garrett	*Oenothera flava*	yellow evening-primrose	27397
Orchidaceae	*Corallorrhiza maculata* (Raf.) Raf.	*Corallorrhiza maculata*	summer coralroot	43523
	Goodyera oblongifolia Raf.	*Goodyera oblongifolia*	western rattlesnake plaintain	43593
	Habenaria dilatata (Pursh) Hook.	*Platanthera dilatata*	scentbottle	43403
	Habenaria hyperborea (L.) R. Br. ex Ait. f.	*Platanthera hyperborea*	northern green orchid	514368
Pinaceae	*Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.	*Abies concolor*	white fir	181826
	Abies lasiocarpa (Hook.) Nutt.	*Abies lasiocarpa*	subalpine fir	181830
	Picea A. Dietr.	*Picea*	spruce	18033
	Picea engelmannii Parry ex Engelm.	*Picea engelmannii*	Engelmann's spruce	183291
	Picea pungens Engelm.	*Picea pungens*	blue spruce	183307

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Pinaceae	*Pinus edulis* Engelm.	*Pinus edulis*	twoneedle pinyon	183336
	Pinus flexilis James	*Pinus flexilis*	limber pine	183343
	Pinus longaeva D.K. Bailey	*Pinus longaeva*	bristlecone pine	183352
	Pinus ponderosa P. & C. Lawson	*Pinus ponderosa*	ponderosa pine	183365
	Pseudotsuga menziesii (Mirbel) Franco	*Pseudotsuga menziesii*	Douglas-fir	183424
Poaceae	*Agrostis* L.	*Agrostis*	bentgrass	40389
	Bromus anomalus Rupr. ex Fourn.	*Bromus porteri*	nodding brome	40491
	Bromus carinatus Hook. & Arn.	*Bromus carinatus*	mountain brome	40481
	Bromus ciliatus L.	*Bromus ciliatus*	fringed brome	40496
	Bromus inermis Leyss.	*Bromus inermis*	smooth brome	40502
	Bromus L.	*Bromus*	brome	40478
	Calamagrostis Adans.	*Calamagrostis*	reedgrass	40529
	Calamagrostis scopulorum M.E. Jones	*Calamagrostis scopulorum*	ditch reedgrass	40566
	Calamagrostis stricta (Timm) Koel.	*Calamagrostis stricta*	narrowspike reedgrass	501106
	Danthonia intermedia Vasey	*Danthonia intermedia*	timber oatgrass	41638
	Deschampsia caespitosa (L.) Beauv.	*Deschampsia caespitosa*	tufted hairgrass	40586
	Elymus elymoides (Raf.) Swezey	*Elymus elymoides*	squirreltail	502264
	Elymus glaucus Buckl.	*Elymus glaucus*	blue wildrye	40684
	Elymus L.	*Elymus*	wildrye	40677
	Elymus scribneri (Vasey) M.E. Jones	*Elymus scribneri*	Scribner's wildrye	502277
	Elymus spicatus (Pursh) Gould	*Pseudoroegneria spicata*	bluebunch wheatgrass	512845
	Elymus trachycaulus (Link) Gould ex Shinners	*Elymus trachycaulus*	slender wheatgrass	502282
	Festuca ovina L.	*Festuca ovina*	sheep fescue	40804
	Hordeum brachyantherum Nevski	*Hordeum brachyantherum*	meadow barley	40875
	Muhlenbergia andina (Nutt.) A.S. Hitchc.	*Muhlenbergia andina*	foxtail muhly	41884
	Muhlenbergia filiformis (Thurb. ex S. Wats.) Rydb.	*Muhlenbergia filiformis*	pullup muhly	41912
	Muhlenbergia montana (Nutt.) A.S. Hitchc.	*Muhlenbergia montana*	mountain muhly	41927
	Muhlenbergia Schreb.	*Muhlenbergia*	muhly	41883
	Phleum alpinum L.	*Phleum alpinum*	alpine timothy	41063
	Phleum pratense L.	*Phleum pratense*	timothy grass	41062
	Poa fendleriana (Steud.) Vasey	*Poa fendleriana*	muttongrass	504467
	Poa glauca Vahl	*Poa glauca*	glaucous bluegrass	41084

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Poaceae	*Poa* L.	*Poa*	bluegrass	41074
	Poa leptocoma Trin.	*Poa leptocoma*	marsh bluegrass	41141
	Poa nervosa (Hook.) Vasey	*Poa nervosa*	Wheeler bluegrass	41097
	Poa palustris L.	*Poa palustris*	fowl bluegrass	41151
	Poa pratensis L.	*Poa pratensis*	Kentucky bluegrass	41088
	Poa secunda J. Presl	*Poa secunda*	Sandberg bluegrass	41103
	Poaceae	*Poaceae*	grasses	40351
	Stipa comata Trin. & Rupr.	*Hesperostipa comata*	needle and thread	42172
	Stipa comata var. *comata* Trin. & Rupr.	*Hesperostipa comata ssp. comata*	needle and thread	530571
	Stipa hymenoides Roemer & J.A. Schultes	*Achnatherum hymenoides*	Indian ricegrass	522063
	Stipa lettermanii Vasey	*Achnatherum lettermanii*	Letterman needlegrass	522065
	Stipa nelsonii Scribn.	*Achnatherum nelsonii ssp. nelsonii*	Nelson needlegrass	42182
	Trisetum spicatum (L.) Richter	*Trisetum spicatum*	spike trisetum	41294
Polemoniaceae	*Collomia linearis* Nutt.	*Collomia linearis*	tiny trumpet	31041
	Ipomopsis aggregata (Pursh) V. Grant	*Ipomopsis aggregata*	scarlet gilia	31192
	Ipomopsis tridactyla (Rydb.) Wilken, comb. nov. ined.	*n/a*	Cedar Breaks gilia	503191
	Phlox pulvinata (Wherry) Cronq.	*Phlox pulvinata*	cushion phlox	30980
	Polemonium caeruleum L.	*Polemonium caeruleum*	charity	31005
	Polemonium pulcherrimum Hook.	*Polemonium pulcherrimum*	Jacob's-ladder	31023
Polygonaceae	*Eriogonum panguicense* (M.E. Jones) Reveal	*Eriogonum panguicense*	Panguitch buckwheat	21215
	Eriogonum umbellatum ssp. *subaridum* (S. Stokes) Munz	*Eriogonum umbellatum var. subaridum*	sulphur-flower buckwheat	195621
	Eriogonum umbellatum Torr.	*Eriogonum umbellatum*	sulphur-flower buckwheat	21266
	Polygonum bistortoides Pursh	*Polygonum bistortoides*	American bistort	20879
	Polygonum douglasii Greene	*Polygonum douglasii*	Douglas' knotweed	20891
	Polygonum L.	*Polygonum*	knotweed	20847
	Polygonum viviparum L.	*Polygonum viviparum*	alpine bistort	20864
	Rumex occidentalis S. Wats.	*Rumex aquaticus var. fenestratus*	western dock	20947
	Rumex paucifolius Nutt.	*Rumex paucifolius*	alpine sheep sorrel	20971
	Rumex salicifolius ssp. *triangulivalvis* Danser	*Rumex salicifolius var. mexicanus*	Mexican dock	526571
Portulacaceae	*Claytonia lanceolata* Pall. ex Pursh	*Claytonia lanceolata*	lanceleaf springbeauty	20390
	Lewisia pygmaea (Gray) B.L. Robins.	*Lewisia pygmaea*	alpine lewisii	20486
Primulaceae	*Androsace septentrionalis* L.	*Androsace septentrionalis*	pygmy rockjasmine	23935

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Primulaceae	*Dodecatheon alpinum* (Gray) Greene	*Dodecatheon alpinum*	alpine shootingstar	23949
	Dodecatheon pulchellum (Raf.) Merr.	*Dodecatheon pulchellum*	darkthroat shootingstar	23945
	Primula parryi Gray	*Primula parryi*	Parry's primrose	24029
Pyrolaceae	*Pyrola chlorantha* Sw.	*Pyrola chlorantha*	green shinleaf	23757
	Pyrola picta Sm.	*Pyrola picta*	whitevein shinleaf	23761
Ranunculaceae	*Aconitum columbianum* Nutt.	*Aconitum columbianum*	Columbia monkshood	18416
	Anemone multifida (Pritz.) Zamels, non Poir.	*Pulsatilla patens ssp. multifida*	Pacific anemone	18445
	Aquilegia caerulea James	*Aquilegia caerulea*	Colorado blue columbine	565004
	Caltha leptosepala DC.	*Caltha leptosepala*	white marsh marigold	18455
	Clematis columbiana (Nutt.) Torr. & Gray	*Clematis columbiana*	Columbian virgin's-bower	18693
	Delphinium barbeyi (Huth) Huth	*Delphinium barbeyi*	subalpine larkspur	18539
	Delphinium occidentale (S. Watson) S. Watson	*Delphinium* x *occidentale*	duncecap larkspur	
	Ranunculus alismifolius Geyer ex Benth.	*Ranunculus alismifolius*	plaintainleaf buttercup	18585
	Thalictrum fendleri Engelm. ex Gray	*Thalictrum fendleri*	Fendler's meadowrue	18670
Rhamnaceae	*Ceanothus fendleri* Gray	*Ceanothus fendleri*	Fendler's ceanothus	28467
	Ceanothus martinii M.E. Jones	*Ceanothus martinii*	Martin's ceanothus	28486
Rosaceae	*Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roemer	*Amelanchier alnifolia*	Saskatoon serviceberry	25109
	Amelanchier utahensis Koehne	*Amelanchier utahensis*	Utah serviceberry	25121
	Cercocarpus ledifolius Nutt.	*Cercocarpus ledifolius*	curl-leaf mountain mahongay	25134
	Fragaria virginiana Duchesne	*Fragaria virginiana*	Virginia strawberry	24639
	Geum triflorum Pursh	*Geum triflorum*	old man's whiskers	24662
	Ivesia sabulosa (M.E. Jones) Keck	*Ivesia sabulosa*	intermountain ivesia	25234
	Potentilla concinna Richards.	*Potentilla concinna*	elegant cinquefoil	24700
	Potentilla diversifolia Lehm.	*Potentilla diversifolia*	varileaf cinquefoil	24702
	Potentilla fruticosa auct. non L.	*Dasiphora fruticosa ssp. floribunda*	Shrubby cinquefoil	24710
	Potentilla glandulosa Lindl.	*Potentilla glandulosa*	sticky cinquefoil	24713
	Potentilla gracilis Dougl. ex Hook.	*Potentilla gracilis*	graceful cinquefoil	24714
	Potentilla hippiana Lehm.	*Potentilla hippiana*	horse cinquefoil	24718
	Potentilla L.	*Potentilla*	cinquefoil	24666
	Purshia mexicana (D. Don) Henrickson	*Purshia mexicana*	Mexican cliffrose	195899
	Purshia tridentata (Pursh) DC.	*Purshia tridentata*	antelope bitterbrush	25290
	Rosa L.	*Rosa*	rose	24807

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Rosaceae	*Rosa nutkana* K. Presl	*Rosa nutkana*	Nootka rose	24835
	Rosa woodsii Lindl.	*Rosa woodsii*	Woods' rose	24847
	Rubus idaeus L.	*Rubus idaeus*	American red raspberry	24947
Salicaceae	*Populus angustifolia* James	*Populus angustifolia*	narrowleaf cottonwood	22452
	Populus tremuloides Michx.	*Populus tremuloides*	quaking aspen	195773
	Salix arizonica Dorn			22501
Salicaceae	*Salix boothii* Dorn	*Salix boothii*	Booth's willow	22509
	Salix brachycarpa Nutt.	*Salix brachycarpa*	shortfruit willow	22510
	Salix exigua Nutt.	*Salix exigua*	narrowleaf willow	22529
Saxifragaceae	*Heuchera rubescens* Torr.	*Heuchera rubescens*	pink alumroot	24373
	Parnassia palustris L.	*Parnassia palustris*	marsh grass of Parnassus	24206
	Saxifraga odontoloma Piper	*Saxifraga odontoloma*	brook saxifrage	505027
Scrophulariaceae	*Castilleja linariifolia* Benth.	*Castilleja linariifolia*	Wyoming Indian paintbrush	33138
	Castilleja miniata Dougl. ex Hook.	*Castilleja linariifolia*	giant red Indian paintbrush	33069
	Pedicularis groenlandica Retz.	*Castilleja miniata*	elephanthead lousewort	33377
	Pedicularis parryi Gray	*Pedicularis groenlandica*	Parry's lousewort	33382
	Penstemon leiophyllus Pennell	*Pedicularis parryi*	smoothleaf beardtongue	33935
	Penstemon procerus Dougl. ex Graham	*Penstemon leiophyllus*	littleflower penstemon	33745
	Penstemon rydbergii A. Nels.	*Penstemon procerus*	Rydberg's penstemon	33990
	Penstemon Schmidel	*Penstemon rydbergii*	beardtongue	33665
	Penstemon whippleanus Gray	*Penstemon*	Whipple's penstemon	33793
	Veronica serpyllifolia L.	*Penstemon whippleanus*	thymeleaf speedwell	33423
Tamaricaceae	*Tamarix chinensis* Lour.	*Veronica serpyllifolia*	fivestamen tamarisk	22308
Valerianaceae	*Valeriana edulis* Nutt. ex Torr. & Gray	*Tamarix chinensis*	tobacco root	35359
	Valeriana L.	*Valeriana edulis*	valerian	35350
Violaceae	*Viola canadensis* L.	*Valeriana*	Canadian white violet	22053
	Viola nephrophylla Greene	*Viola canadensis*	northern bog violet	22117

Appendix E. Field Plot Crosswalk to NVC Associations

Plots, observation points, and accuracy assessment (AA) points are assigned to National Vegetation Classification associations based on their composition and structure as they were recorded in the field. A total of 41 NVC associations, four NVC alliances, and twenty-six "Park Specials" were described for Cedar Breaks. Sixteen associations in the table below were documented only during accuracy assessment (Plot codes in the rightmost column contain the letters "AA"). Accuracy assessment points assigned to associations already described from plots or observation points are not included in this table unless they comprise the majority of plots sampled in the type. Element codes are used by NatureServe and state Natural Heritage Programs to track nomenclature and status of rare plants, rare animals, and communities ("elements"). Nomenclature used by the NVC follows Kartesz (1999).

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point Assignments
Abies concolor - Populus tremuloides Forest Alliance	A.419	2	CEBR_AA.0005, CEBR_AA.0007
Abies concolor – Pseudotsuga menziesii / Acer glabrum Forest	CEGL000241	3	CEBR.9105, CEBR.9106, CEBR_AA.0296
Abies concolor / Arctostaphylos patula Forest	CEGL000242	16	CEBR.0099, CEBR.0118, CEBR.0135, CEBR.0157, CEBR.9040, CEBR.9043, CEBR.9068, CEBR.9069, CEBR.9070, CEBR.9074, CEBR.9076, CEBR.9086, CEBR.9088. CEBR.9091, CEBR.9102, CEBR.9104
Abies concolor / Juniperus communis Forest	CEGL000249	12	CEBR.0121, CEBR.0126, CEBR.0141, CEBR.0161, CEBR.0170, CEBR.9072, CEBR.9075, CEBR.9077, CEBR.9079, CEBR.9083, CEBR.9084, CEBR.9101
Abies concolor / Mahonia repens Forest	CEGL000251	12	CEBR.0097, CEBR.0114, CEBR.0115, CEBR.0125, CEBR.0139, CEBR.0150, CEBR.0155, CEBR.0162, CEBR.9089, CEBR.9095, CEBR.9098, CEBR.9107
Abies concolor / Symphoricarpos oreophilus Forest	CEGL000263	2	CEBR.9083, CEBR_AA.0276
Abies lasiocarpa - Picea engelmannii / Juniperus communis Woodland	CEGL000919	2	CEBR.0103, CEBR.0154
Abies lasiocarpa - Picea engelmannii / Ligusticum porteri Forest	Park Special	1	CEBR_AA.0325
Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme) Forest	CEGL000331	34	CEBR.0001, CEBR.0003, CEBR.0004, CEBR.0007, CEBR.0008, CEBR.0010, CEBR.0012, CEBR.0015, CEBR.0019, CEBR.0020, CEBR.0021, CEBR.0023, CEBR.0025, CEBR.0026, CEBR.0027, CEBR.0037, CEBR.0038, CEBR.0039, CEBR.0120, CEBR.0146, CEBR.0153, CEBR.0160, CEBR.9032, CEBR.9033, CEBR.9036, CEBR.9037, CEBR.9038, CEBR.9039, CEBR.9045, CEBR.9047, CEBR.9049, CEBR.9082, CEBR.9112, CEBR.9113

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point Assignments
Acer glabrum Colluvial Slope Shrubland [Park Special]	Park Special	4	CEBR.0111, CEBR.0136, CEBR.0137, CEBR.0173
Achnatherum lettermanii Herbaceous Vegetation	CEGL005354	5	CEBR.0050, CEBR.0070, CEBR.9011, CEBR.9025, CEBR.9044
Arctostaphylos patula Shrubland	CEGL002696	3	CEBR_AA.0265, CEBR_AA.0266, CEBR_AA.0285
Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa pratensis Semi-natural Shrubland	CEGL002988	3	CEBR.0041, CEBR.0071, CEBR.9054
Aster ascendens Herbaceous Vegetation	Park Special	6	CEBR_AA.0097, CEBR_AA.0345, CEBR_AA.0346, CEBR_AA.0348, CEBR_AA.0351, CEBR_AA.0373
Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	CEGL005264	7	CEBR.0073, CEBR.0077, CEBR.0092, CEBR.9001, CEBR.9029, CEBR.9048, CEBR.9052
Calamagrostis scopulorum Herbaceous Vegetation [Park Special]	Park Special	3	CEBR.0110, CEBR.0132, CEBR.9073
Carex aquatilis Herbaceous Vegetation	CEGL001802	8	CEBR.9013, CEBR.9016, CEBR.9062, CEBR_AA.0034, CEBR_AA.0042, CEBR_AA.0091, CEBR_AA.0200, CEBR_AA.0240
Carex egglestonii Herbaceous Vegetation [Park Special]	Park Special	2	CEBR.0061, CEBR_AA.0076
Carex scirpoidea Herbaceous Vegetation [Park Special]	Park Special	2	CEBR.0081, CEBR.0082
Cercocarpus ledifolius / Arctostaphylos patula Woodland (Provisional)	CEGL005355	8	CEBR.0094, CEBR.9042, CEBR.9099, CEBR_AA.0107, CEBR_AA.0109, CEBR_AA.0111, CEBR_AA.0135, CEBR_AA.0156
Cercocarpus ledifolius Woodland Alliance	A.586	3	CEBR.0128, CEBR.9064, CEBR.9065
Cercocarpus ledifolius / Chrysothamnus nauseosus Woodland	Park Special	1	CEBR_AA.0099
Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa Shrubland	CEGL001107	4	CEBR.9015, CEBR.9020, CEBR_AA.0229, CEBR_AA.0244

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point Assignments
Deschampsia caespitosa - Polygonum bistortoides Herbaceous Vegetation	CEGL003485	7	CEBR.0042, CEBR.0058, CEBR.0060, CEBR.9006, CEBR.9008, CEBR.9021, CEBR.9028
Elymus trachycaulus Herbaceous Vegetation [Park Special]	Park Special	6	CEBR.0002, CEBR.0045, CEBR.0056, CEBR.0078, CEBR.9007, CEBR.9009
Ericameria discoidea Dwarf-shrubland Herbaceous Sparse Vegetation [Park Special]	Park Special	5	CEBR.0040, CEBR.0087, CEBR.0088, CEBR.0151, CEBR.9022
Erigeron ursinus Herbaceous Vegetation [Park Special]	Park Special	3	CEBR.9024, CEBR.9063, CEBR_AA.0344
Eriogonum panguicense Herbaceous Vegetation [Park Special]	Park Special	6	CEBR.0055, CEBR.0084, CEBR.0085, CEBR.0086, CEBR.9023, CEBR.9027
Eriogonum umbellatum - Potentilla hippiana Herbaceous Vegetation [Park Special]	Park Special	6	CEBR.0066, CEBR.9012, CEBR_AA.0046, CEBR_AA.0055, CEBR_AA.0058, CEBR_AA.0060
Helianthella uniflora Herbaceous Vegetation [Park Special]	Park Special	2	CEBR.0067, CEBR.9004
Juniperus scopulorum / Cercocarpus ledifolius Woodland	CEGL000744	3	CEBR.0035, CEBR.0142, CEBR.0143
Ligusticum porteri Herbaceous Alliance	A.1601	6	CEBR.0054, CEBR.9002, CEBR_AA.0016, CEBR_AA.0037, CEBR_AA.0056, CEBR_AA.0326
Lomatium minimum - Arenaria fendleri Herbaceous Vegetation [Park Special]	Park Special	3	CEBR.0075, CEBR.9018, CEBR.9019
Lupinus argenteus Herbaceous Alliance	A.1605	1	CEBR.0090
Picea pungens / Acer glabrum Forest	Park Special	2	CEBR_AA.0247, CEBR_AA.0260
Picea pungens / Arctostaphylos patula Forest	CEGL005364	7	CEBR_AA.0040, CEBR_AA.0068, CEBR_AA.0071, CEBR_AA.0298, CEBR_AA.0312, CEBR_AA.0395, CEBR_AA.0404
Picea pungens / Equisetum arvense Woodland	CEGL000389	2	CEBR.0159, CEBR.9087, CEBR_AA.0286

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point Assignments
Picea pungens / Juniperus communis Forest	CEGL000392	18	CEBR.0106, CEBR.0122, CEBR_AA.0069, CEBR_AA.0128, CEBR_AA.0162, CEBR_AA.0168, CEBR_AA.0175, CEBR_AA.0176, CEBR_AA.0187, CEBR_AA.0198, CEBR_AA.0246, CEBR_AA.0254, CEBR_AA.0268, CEBR_AA.0302, CEBR_AA.0307, CEBR_AA.0308, CEBR_AA.0327, CEBR_AA.0328
Picea pungens / Mahonia repens Forest	CEGL000395	1	CEBR_AA.0332
Picea pungens / Purshia tridentata Woodland	Park Special	1	CEBR_AA.0408
Picea pungens / Salix brachycarpa Woodland [Park Special]	Park Special	2	CEBR.0109, CEBR.0172
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland	CEGL002940	1	CEBR_AA.0153
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland	CEGL000780	1	CEBR.0163
Pinus longaeva Woodland	CEGL002380	23	CEBR.0011, CEBR.0013, CEBR.0014, CEBR.0016, CEBR.0017, CEBR.0018, CEBR.0029, CEBR.0030, CEBR.0101, CEBR.0102, CEBR.0113, CEBR.0129, CEBR.0130, CEBR.0138, CEBR.0140, CEBR.0152, CEBR.9031, CEBR.9034, CEBR.9035, CEBR.9046, CEBR.9061, CEBR.9081, CEBR.9090
Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula Colorado Plateau Woodland [Park Special]	Park Special	9	CEBR.0093, CEBR_AA.0167, CEBR_AA.0180, CEBR_AA.0183, CEBR_AA.0185, CEBR_AA.0189, CEBR_AA.0204, CEBR_AA.0211, CEBR_AA.0220
Pinus ponderosa / Arctostaphylos patula Woodland	CEGL000842	13	CEBR.0033, CEBR.0034, CEBR.0095, CEBR.0098, CEBR.0108, CEBR.0119, CEBR.0134, CEBR.0141, CEBR.0168, CEBR.0171, CEBR.9085, CEBR.9092, CEBR.9096
Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland [Park Special]	Park Special	8	CEBR.0036, CEBR.0133, CEBR.9067, CEBR.9100, CEBR.9103, CEBR.9108, CEBR.9109, CEBR.9110

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point Assignments
Pinus ponderosa / Purshia tridentata Woodland	CEGL000867	2	CEBR.0032, CEBR_AA.0173
Poa pratensis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	CEGL005265	8	CEBR.0005, CEBR.0043, CEBR.0046, CEBR.0049, CEBR.0065, CEBR.0074, CEBR.0076, CEBR.0091
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	CEGL003081	3	CEBR.9003, CEBR.9010, CEBR.9011
Poa secunda Herbaceous Vegetation	CEGL001657	1	CEBR_AA.0017
Populs tremuloides / Ribes montingenum Forest	CEGL000600	1	CEBR.9051
Populus angustifolia - Picea pungens / Acer glabrum Woodland [Park Special]	Park Special	1	CEBR.0112
Populus angustifolia Temporarily Flooded Terrace Woodland	Park Special	8	CEBR.0096 CEBR.0100, CEBR.0123, CEBR.0124, CEBR.0127, CEBR.0165, CEBR.0166, CEBR.9080
Populus tremuloides - Abies concolor / Arctostaphylos patula Forest	CEGL000522	5	CEBR.0107, CEBR.0156, CEBR.0164, CEBR.9078, CEBR.9097
Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest	CEGL000523	1	CEBR_AA.0221
Populus tremuloides - Abies lasiocarpa / Tall Forbs Forest	CEGL000533	8	CEBR.0006, CEBR.0009, CEBR.0022, CEBR.0024, CEBR.0147, CEBR.0149, CEBR.0158, CEBR.9053
Populus tremuloides - Pseudotsuga menziesii / Juniperus communis Forest	CEGL000545	2	CEBR_AA.0186, CEBR_AA.0238
Populus tremuloides - Pseudotsuga menziesii / Sparse Understory Forest [Park Special]	Park Special	1	CEBR_AA.0284
Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	CEGL000546	1	CEBR_AA.0177

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point Assignments
Populus tremuloides / Juniperus communis Forest	CEGL000587	5	CEBR.0116, CEBR.0117, CEBR.0169, CEBR.9041, CEBR.9066
Populus tremuloides / Ribes montigenum Forest	CEGL000600	1	CEBR.9051
Populus tremuloides / Thalictrum fendleri Forest	CEGL000619	1	CEBR.0105
Pseudotsuga menziesii / Arctostaphylos patula Forest	CEGL000423	5	CEBR.9094, CEBR_AA.0171, CEBR_AA.0178, CEBR_AA.0181, CEBR_AA.0274
Pseudotsuga menziesii / Juniperus communis Forest	CEGL000439	3	CEBR.0028, CEBR.0104, CEBR.0167
Pseudotsuga menziesii / Ribes montigenum Forest [Park Special]	Park Special	2	CEBR.0031, CEBR_AA.0392
Ribes montingenum Shrubland	CEGL001133	11	CEBR.0044, CEBR.0051, CEBR.0063, CEBR.0068, CEBR.0072, CEBR.0145, CEBR.0148, CEBR.9017, CEBR.9050, CEBR.9055, CEBR.9056
Salix arizonica Shrubland [Park Special]	Park Special	4	CEBR.0047, CEBR.0052, CEBR.0080, CEBR.9005
Salix exigua Temporarily Flooded Shrubland	CEGL001197	1	CEBR.0131
Solidago multiradiata Herbaceous Vegetation [Park Special]	Park Special	12	CEBR.0048, CEBR.0053, CEBR.0057, CEBR.0059, CEBR.0062, CEBR.0064, CEBR.0069, CEBR.0079, CEBR.0083, CEBR.9014, CEBR.9026, CEBR.9030
Symphoricarpos oreophilus Shrubland	CEGL002951	1	CEBR.9057
Viguiera multiflora Herbaceous Vegetation [Park Special]	Park Special	2	CEBR_AA.0349, CEBR_AA.0350

Appendix F. Plant Association Descriptions for Cedar Breaks National Monument

NATIONAL VEGETATION CLASSIFICATION

Vegetation Associations of Cedar Breaks National Monument

12 June 2009

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 associations attributed to Cedar Breaks National Monument. 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 Gwen Kittel, Regional Vegetation Ecologist, Boulder, CO <gwen_kittel@natureserve.org>.

Citations:

The following citation should be used in any published materials which reference ecological system and/or International Vegetation Classification (IVC hierarchy) and association data:

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 12 June 2009.

NatureServe
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Arlington, VA 22209

These data are extracted from:

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 12 June 2009.

This document may be generally cited as follows:

NatureServe[1]. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. Vegetation Associations of Cedar Breaks National Monument. NatureServe Central Databases. Arlington, VA. Data current as of 12 June 2009.

[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:

United States
Central NatureServe Office, Arlington, VA; Eastern Regional Office, Boston, MA; Midwestern Regional Office, Minneapolis, MN; Southeastern Regional Office, Durham, NC; Western Regional Office, Boulder, CO; Alabama Natural Heritage Program, Montgomery AL; Alaska Natural Heritage Program, Anchorage, AK; Arizona Heritage Data Management Center, Phoenix AZ; Arkansas Natural Heritage Commission Little Rock, AR; Blue Ridge Parkway, Asheville, NC; California Natural Heritage Program, Sacramento, CA; Colorado Natural Heritage Program, Fort Collins, CO; Connecticut Natural Diversity Database, Hartford, CT; Delaware Natural Heritage Program, Smyrna, DE; District of Columbia Natural Heritage Program/National Capital Region Conservation Data Center, Washington DC; Florida Natural Areas Inventory, Tallahassee, FL; Georgia Natural Heritage Program, Social Circle, GA; Great Smoky Mountains National Park, Gatlinburg, TN; Gulf Islands National Seashore, Gulf Breeze, FL; Hawaii Natural Heritage Program, Honolulu, Hawaii; Idaho Conservation Data Center, Boise, ID; Illinois Natural Heritage Division/Illinois Natural Heritage Database Program, Springfield, IL; Indiana Natural Heritage Data Center, Indianapolis, IN; Iowa Natural Areas Inventory, Des Moines, IA; Kansas Natural Heritage Inventory, Lawrence, KS; Kentucky Natural Heritage Program, Frankfort, KY; Louisiana Natural Heritage Program, Baton Rouge, LA; Maine Natural Areas Program, Augusta, ME; Mammoth Cave National Park, Mammoth Cave, KY; Maryland Wildlife & Heritage Division, Annapolis, MD; Massachusetts Natural Heritage & Endangered Species Program, Westborough, MA; Michigan Natural Features Inventory, Lansing, MI; Minnesota Natural Heritage & Nongame Research and Minnesota County Biological Survey, St. Paul, MN; Mississippi Natural Heritage Program, Jackson, MI; Missouri Natural Heritage Database, Jefferson City, MO; Montana Natural Heritage Program, Helena, MT; National Forest in North Carolina, Asheville, NC; National Forests in Florida, Tallahassee, FL; National Park Service, Southeastern Regional Office, Atlanta, GA; Navajo Natural Heritage Program, Window Rock, AZ; Nebraska Natural Heritage Program, Lincoln, NE; Nevada Natural Heritage Program, Carson City, NV; New Hampshire Natural Heritage Inventory, Concord, NH; New Jersey Natural Heritage Program, Trenton, NJ; New Mexico Natural Heritage Program, Albuquerque , NM; New York Natural Heritage Program, Latham, NY; North Carolina Natural Heritage Program, Raleigh, NC; North Dakota Natural Heritage Inventory, Bismarck, ND; Ohio Natural Heritage Database, Columbus, OH; Oklahoma Natural Heritage Inventory, Norman, OK; Oregon Natural Heritage Program, Portland, OR; Pennsylvania Natural Diversity Inventory, PA; Rhode Island Natural Heritage Program, Providence, RI; South Carolina Heritage Trust, Columbia, SC; South Dakota Natural Heritage Data Base, Pierre, SD; Tennessee Division of Natural Heritage, Nashville, TN; Tennessee Valley Authority Heritage Program, Norris, TN; Texas Conservation Data Center, San Antonio, TX; Utah Natural Heritage Program, Salt Lake City, UT; Vermont Nongame & Natural Heritage Program, Waterbury, VT; Virginia Division of Natural Heritage, Richmond, VA; Washington Natural Heritage Program, Olympia, WA; West Virginia Natural Heritage Program, Elkins, WV; Wisconsin Natural Heritage Program, Madison, WI; Wyoming Natural Diversity Database, Laramie, WY

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.

NatureServe also has partnered with many International and United States Federal and State organizations, which have also contributed significantly to the development of the International Classification. Partners include the following The Nature Conservancy; Provincial Forest Ecosystem Classification Groups in Canada; Canadian Forest Service; Parks Canada; United States Forest Service; National GAP Analysis Program; United States National Park Service; United States Fish and Wildlife Service; United States Geological Survey; United States Department of Defense; Ecological Society of America; Environmental Protection Agency; Natural Resource Conservation Services; United States Department of Energy; and the Tennessee Valley Authority. Many individual state organizations and people from academic institutions have also contributed to the development of this classification.

TABLE OF CONTENTS

Abies concolor - Pseudotsuga menziesii / Acer glabrum Forest

White Fir - Douglas-fir / Rocky Mountain Maple Forest

CODE	CEGL000240
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*ABIES CONCOLOR* FOREST ALLIANCE (A.152) White Fir Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This white fir forest association ranges from southern and central Utah and southern Colorado to northern New Mexico and central Arizona and is found between 2073 and 3140 m (6800-10,300 feet) elevation. This forest shows great variety with respect to topographic characteristics. In southern Colorado and northern New Mexico, it is one of the most widespread mixed conifer forests. Though it frequently occurs on moderate to steep north- and northwest-facing slopes, other slope aspects are represented. When found on southern aspects, this forest is at higher elevations or streamside settings. Predominantly found on lower slopes, it has also been located on mid- and upper slopes. Sites can have high amounts of exposed rock (up to 50% or more cover), with abundant leaf litter and coarse woody debris. The overstory is highly complex and has high variability. *Abies concolor* dominates or codominates, if not in the overstory, then as regeneration. *Pseudotsuga menziesii* is a successional dominant and remains a codominant in late-successional stands, becoming minor in very old stands. *Picea pungens* and *Pinus flexilis* may be important, as well as *Pinus strobiformis* at lower latitudes. *Abies lasiocarpa* and *Picea engelmannii* may occur in frost pockets as regeneration or occasional mature trees, but they are minor and almost always are under severe competition from dense regeneration and canopy dominance of *Abies concolor* and *Pseudotsuga menziesii*. The open to dense tall-shrub layer dominates the undergrowth with *Acer glabrum* and often *Amelanchier alnifolia*. If present, *Quercus gambelii* has low cover (<5%). Common low-growing shrubs are *Holodiscus dumosus*, and *Jamesia americana*, which occur on cobbly substrates, along with *Mahonia repens (= Berberis repens), Paxistima myrsinites, Physocarpus monogynus*, and *Symphoricarpos oreophilus*; however, some stands have an open shrub of layer of *Acer glabrum* and little else in the understory. The herb layer species are typically low in cover value.

DISTRIBUTION

Cedar Breaks National Monument

This limited forest association was sampled in lower Lavender and Columbine canyons.

Globally

This montane forest is common in the southern portion of the southern Rocky Mountains and ranges from central and southern Utah and southern Colorado to northern New Mexico and central Arizona.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This mesic forest association is uncommon and occurs on midslopes of canyons. Sites are steep (34- to 35-degree slopes), occur between 2707 and 2725 m in elevation, and are oriented to the north. The ground surface has high cover of litter and low to sparse exposure of bare soil, small rocks, and downed wood. Soils are rapidly drained.

Globally

This montane forest shows great variety with respect to topographic characteristics where it occurs in the southern portion of the southern Rocky Mountains and high plateaus and mountains of the Colorado Plateau, extending north

into the Wasatch Range. In southern Colorado and northern New Mexico, it is one of the most widespread mixed conifer forests. It ranges between 2400 and 3140 m (7900-10,300 feet) in elevation in upland canyon and mountain slopes, down to 2100 m (6800 feet) along stream terraces and valley bottoms. In Wasatch Range in Utah stands were sampled in canyons between 1850 and 2040 m (6065-6690 feet) elevation. Though it frequently occurs on cool northeast- to northwest-facing slopes, other slope aspects are represented. When found on southern aspects, this forest occurs at higher elevations or in streamside settings (Fitzhugh et al. 1987). Predominantly found on lower slopes, it has also been located on mid- and upper slopes of mountain, ridges and canyons (DeVelice et al. 1986). Where it lies at lower elevations, sites will be locally wet and cool. Therefore, it is located along canyonsides and cool drainages, and its presence is most striking in cool drainages where the adjacent communities may be much drier. At upper elevations, this forest occurs along the tops of ridges and knolls (Alexander et al. 1984a). This association occurs on shallow, even skeletal soils as it is frequently found on steep slopes. Sites can have high amounts of exposed rock (up to 50% or more cover), with abundant leaf litter and coarse woody debris (Alexander et al. 1984a, Youngblood and Mauk 1985). Soils are moderately well-drained sandy loams, loams and clay loams derived from alluvial deposits or sideslope colluvial derived from a variety of parent materials, including Bandelier tuff, rhyolite, sandstone or andesite rocks. Common soil types are Borolls, Boralfs, and Ochrepts.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

This mesic forest association is limited and was sampled on slopes of lower canyons. Total vegetation cover is moderate (36-39% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m and provide 9-10% cover, and by the tall shrub *Acer glabrum* that provides 5-7% cover and ranges in height from 1-5 m. Other canopy trees provide low cover and include *Pseudotsuga menziesii, Pinus longaeva*, and *Pinus flexilis*. The subcanopy layer is 5-10 m tall, provides low cover, and includes *Abies concolor, Pseudotsuga menziesii*, and *Pinus flexilis*. The short- and dwarf-shrub layers are moderate in terms of species composition, provide sparse to low cover, and include *Juniperus communis, Shepherdia canadensis*, and *Mahonia repens*. The herbaceous layer is low in terms of floristic diversity, contributes sparse cover, and includes the grass *Bromus anomalus* and the forb *Pyrola chlorantha*.

Globally

The moderately open to closed overstory is highly complex and has high variability. *Abies concolor* dominates or codominates, if not in the overstory, then as regeneration. *Pseudotsuga menziesii* is a successional dominant and remains a codominant in late-successional stands, becoming minor in very old stands. *Picea pungens, Pinus longaeva, Pinus flexilis*, and *Juniperus scopulorum* may be important, as well as *Pinus strobiformis* at lower latitudes. *Abies lasiocarpa* and *Picea engelmannii* may occur in frost pockets as regeneration or occasional mature trees, but they are minor and almost always are under severe competition from dense regeneration and canopy dominance of *Abies concolor* and *Pseudotsuga menziesii* (Moir and Ludwig 1979). *Pinus ponderosa* is an accidental or minor species, since neither regeneration nor mature trees are important in late-successional stands (Moir and Ludwig 1979). Seral stands are often codominated by *Populus tremuloides* (Stuever and Hayden 1997b). The tall-shrub layer dominates the undergrowth typically dominated or codominated by *Acer glabrum* or less frequently *Amelanchier alnifolia*. *Quercus gambelii*, if present, has relatively low cover (<5%). Other short and dwarf-shrubs may be present with low cover, such as *Holodiscus dumosus* and *Jamesia americana*, which occur on cobbly substrates, along with *Acer grandidentatum, Juniperus communis, Mahonia repens (= Berberis repens), Paxistima myrsinites, Physocarpus monogynus, Rosa woodsii, Shepherdia canadensis*, and *Symphoricarpos oreophilus*; however, some stands have an open shrub of layer of *Acer glabrum* and little else. Herb layer species are typically low in cover. Common species are *Artemisia franserioides, Bromus anomalus, Bromus ciliatus, Carex* spp., *Erigeron* spp., *Lathyrus* spp., *Maianthemum racemosum, Penstemon* spp., *Pyrola chlorantha, Solidago velutina, Stellaria longifolia, Thalictrum fendleri*, and *Viola canadensis*.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies concolor*, *Pseudotsuga menziesii*
Tall shrub/sapling	*Acer glabrum*
Short shrub/sapling	*Juniperus communis*

Globally

Stratum	Species
Tree canopy	*Abies concolor*, *Pseudotsuga menziesii*
Shrub/sapling (tall & short)	*Acer glabrum*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Erigeron arenarioides, *Penstemon platyphyllus*

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Plots reassigned to CEGL000241 (GK 2-09).

Globally
On steep rocky slopes *Jamesia americana* and *Holodiscus dumosus* become more abundant and this type transitions to scree associations such as *Abies concolor - (Pseudotsuga menziesii) / Jamesia americana - Holodiscus dumosus* Scree Woodland (CEGL000890). According to Alexander et al. (1987), this type represents a transition from the *Abies concolor / Quercus gambelii* type to types representative of spruce-fir forests. This type appears to be related to the *Pseudotsuga menziesii* / *Paxistima myrsinites* habitat type of central and northern Colorado of Hoffman and Alexander (1980). The foothill ravine forest community of Rocky Mountain National Park, Colorado (Peet 1981), is weakly related to this association, as is the *Abies grandis / Acer glabrum* habitat type of central Idaho (Steele et al. 1981). The *Abies concolor / Acer glabrum / Berberis nervosa* Plant Association (Atzet and McCrimmon 1990) found in southern Oregon Cascades is not part of this association.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Captures east side of large vegetation polygon; slopes are steep; drainages occur every 60-80 m; understory is predominantly *Juniperus communis* and *Acer glabrum*.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (2 observation points: CEBR.9105, CEBR.9106; and 2 AA points: CEBR_AA.0296, CEBR_AA.0140).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: L.D. Engelking, mod. K.A. Schulz

REFERENCES: Alexander et al. 1984a, Alexander et al. 1987, Atzet and McCrimmon 1990, Atzet and Wheeler 1984, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Crane 1982, DeVelice 1983, DeVelice and Ludwig 1983a, DeVelice et al. 1986, Dieterich 1980, Driscoll et al. 1984, Fitzhugh et al. 1987, Hoffman and Alexander 1980, Larson and Moir 1987, Moir and Ludwig 1979, Muldavin et al. 1996, Muldavin et al. 2006, Peet 1981, Steele et al. 1981, Stuever and Hayden 1997b, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Abies concolor / Arctostaphylos patula Forest

White Fir / Greenleaf Manzanita Forest

CODE	CEGL000242
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP (I.A.8.N.)	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
FORMATION (I.A.8.N.c.)	Conical-crowned temperate or subpolar needle-leaved evergreen forest
ALLIANCE	*ABIES CONCOLOR* FOREST ALLIANCE (A.152) White Fir Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association has been reported from mountains and plateaus in southwestern Utah. Elevation ranges from 2390-2680 m (7840-8880 feet). Stands occur on a variety of sites including steep to gentle, middle to lower slopes and benches. Typically sites are relatively cool with northerly aspects common. Substrates are typically loamy soils derived from limestone parent materials. This association is characterized by an uneven-aged, open to moderately dense tree canopy that is dominated or codominated by *Abies concolor*. Codominants are *Pinus ponderosa* or *Pseudotsuga menziesii*. Dense patches of *Arctostaphylos patula* dominate the open to moderately dense shrub layer. Other shrub species present may include *Paxistima myrsinites, Symphoricarpos oreophilus, Mahonia repens, Ceanothus* spp., *Juniperus communis, Ribes cereum*, and *Purshia tridentata*. The herbaceous cover is sparse (<20% cover) and is primarily composed of graminoids with scattered forbs.

DISTRIBUTION

Cedar Breaks National Monument

This forest association was sampled below the breaks in Lavender Canyon, Chessmen Canyon, Cheesman Ridge, Crescent Hollow, Columbine Canyon, Ashdown Creek, Adams Canyon, Adams Creek, Arch Creek, Arch Barrier, along Shooting Star Ridge, The Quarry, and along the Bartizan Trail.

Globally

This plant association has been described only in Utah. It ranges across the southern portion of the state from the Pine Valley Mountains, Markagunt, Paunsaugunt, Aquarius plateaus east to the Abajo Mountains.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This common forest association occurs below the breaks on slopes of drainage systems, valleysides, canyonsides, and ridges. Some stands occupy terraces and one stand occurs on a landslide deposit. The sites are gentle to steep (3- to 36-degree slopes), occur between 2533 and 3647 m in elevation, and are oriented to all aspects. The ground surface has low to moderate exposure of bare soil, sparse to high cover of litter, moderate to high cover of small and large rocks, and sparse cover of downed wood. Litter depths range from 0-4.1 cm. Soils are rapidly drained silt clay loams, sandy clays, and sandy clay loams derived from the Cedar Canyon Formation.

Globally

This woodland association has been reported from mountains and plateaus in southwestern Utah. Elevation ranges from 2390-2680 m (7840-8880 feet). Stands occur on a variety of sites including steep to gentle, middle to lower slopes and benches. Sites are relatively cool, often with northerly aspects common, but warmer than sites dominated by more mesic understory species such as *Symphoricarpos oreophilus* or *Mahonia repens*. Substrates range from

sandy to silty loams that are typically derived from limestone parent materials. Bare soil averages 21% cover, but may be much higher (10-80% cover). Litter cover is generally patchy.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate (27-52% cover) and is characterized by *Abies concolor* trees that range in height from 5-30 m, have dbh ranging from 14-81 cm, and provide 2-25% cover in the canopy and subcanopy layers, and by the short shrub *Arctostaphylos patula* that provides 2-18% cover. Other canopy trees provide low cover and include *Pseudotsuga menziesii, Pinus ponderosa*, and *Juniperus scopulorum*. The remaining subcanopy layer provides low cover and includes *Juniperus scopulorum, Cercocarpus ledifolius, Pinus flexilis, Pinus longaeva, Pseudotsuga menziesii*, and *Populus tremuloides*. The remaining short- and dwarf-shrub layers are moderate in terms of species composition, provide low cover, and include *Juniperus communis* and *Mahonia repens*. The herbaceous layer has low floristic diversity, contributes sparse cover, and includes the graminoid *Carex rossii* and the forb *Packera multilobata (= Senecio multilobatus). Pseudotsuga menziesii* and *Abies concolor* seedlings also contribute sparse cover.

Globally

This association is characterized by an uneven-aged, open to moderately dense tree canopy that is dominated or codominated by *Abies concolor*. Codominants are *Pinus ponderosa* or *Pseudotsuga menziesii*. Scattered *Juniperus scopulorum* or *Pinus flexilis* trees may also be present. Dense patches of *Arctostaphylos patula* dominate the open to moderately dense shrub layer. Other shrub species present may include *Paxistima myrsinites, Symphoricarpos oreophilus, Mahonia repens, Ceanothus* spp., *Juniperus communis, Ribes cereum*, and *Purshia tridentata*. The herbaceous cover is sparse (<20% cover) and is primarily composed of graminoids with scattered forbs. Common species include *Carex rossii, Achnatherum hymenoides, Elymus elymoides, Poa fendleriana, Achillea millefolium, Astragalus miser, Packera multilobata (= Senecio multilobatus)*, and *Frasera speciosa (= Swertia radiata).*

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies concolor*, *Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Arctostaphylos patula*
Herb (field)	*Mahonia repens*

Globally

Stratum	Species
Tree canopy	*Abies concolor*, *Pinus ponderosa*, *Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Arctostaphylos patula*, *Mahonia repens*, *Paxistima myrsinites*
Herb (field)	*Carex rossii*

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument

Data are not available.

Globally

Penstemon leiophyllus

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Cedar Breaks National Monument

Abies concolor forest; Douglas-fir forest.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: History of fire observed with mature deadfall fire-scarred trees; large boulders in plots, but overall area appears relatively stable; some larger 1000-hr fuels on ground, but low litter/duff cover and fairly low fuel loading on 1-, 10-, and 100-hr fuels, many stands have heavy fuel loading; stands are often on gullied slopes, some stands are subject to rockfall; most stands have good regeneration of tree species.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (4 plots CEBR.0099, CEBR.0118, CEBR.0135, CEBR.0157, and 12 observation points: CEBR.9040, CEBR.9043, CEBR.9068, CEBR.9069, CEBR.9070, CEBR.9074, CEBR.9076, CEBR.9086, CEBR.9088, CEBR.9091, CEBR.9102, CEBR.9104), and 2007 Accuracy Assessment (16 points: CEBR_AA.0073, CEBR_AA.0093, CEBR_AA.0095, CEBR_AA.0125, CEBR_AA.0127, CEBR_AA.0132, CEBR_AA.0141, CEBR_AA.0207, CEBR_AA.0233, CEBR_AA.0287, CEBR_AA.0289, CEBR_AA.0292, CEBR_AA.0295, CEBR_AA.0297, CEBR_AA.0311, CEBR_AA.0315, CEBR_AA.0317).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, Johnston 1987, Roberts et al. 1992, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Abies concolor / Juniperus communis Forest

White Fir / Common Juniper Forest

CODE	CEGL000249
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*ABIES CONCOLOR* FOREST ALLIANCE (A.152) White Fir Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This montane forest association occurs on a wide variety of aspects, slopes and landforms and is found in southern Utah on the Markegunt, Sevier and Paunsaugunt plateaus, in the Escalante and Tushar mountains and in the southern Rocky Mountains in northern New Mexico. Sites range between 2400 and 2850 m (7900-9360 feet) in elevation. Soils are often gravelly, rapidly drained loams (sandy to silty clay loams) and silts. Litter accumulations tend to be high but may be non-uniform and patchy. The vegetation is characterized by an open to closed tree canopy (10-70% cover) that is dominated or codominated by *Abies concolor* with a sparse to moderately dense understory dominated by clumps of the short shrub *Juniperus communis*. *Pseudotsuga menziesii* is frequently a codominant with other trees such as *Picea pungens, Pinus flexilis, Pinus strobiformis* (southern latitudes), *Populus tremuloides*, and *Juniperus scopulorum*. *Abies lasiocarpa* and *Pinus ponderosa* are accidental in the tree canopy and have relatively low cover. Other shrubs include scattered *Symphoricarpos oreophilus, Shepherdia canadensis, Rosa woodsii, Ribes cereum, Paxistima myrsinites, Mahonia repens (= Berberis repens)*, or *Ceanothus martinii*. *Acer glabrum* is typically absent. The herbaceous layer is generally depauperate but can range as high as 10% cover in some stands. *Carex rossii, Carex inops ssp. heliophila, Bromus anomalus*, and *Poa fendleriana* are the most consistent species.

DISTRIBUTION

Cedar Breaks National Monument

This common forest association was sampled below the breaks in the Adams Canyon, Upper Ashdown Creek, North Fork Ashdown Creek, Adams Creek, Columbine Canyon, , Jericho Creek, Lavender Canyon, Crescent Hollow, on a ridge above Crescent Hollow, Den Hallow, Shooting Star Ridge, on the Rampart Trail, along the north park boundary, The Meadows and north of The Meadows.

Globally

This conifer forest is found in Utah on the Markegunt, Sevier and Paunsaugunt plateaus and the Escalante and Tushar mountains and in the southern Rocky Mountains in northern New Mexico.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs below the breaks on the lowslopes and midslopes of drainage systems, ridges, and canyonsides, and the high slopes of hills. The sites are gentle, and moderately sloped to steep (2-39 degrees), occur between 2542 and 3019 m in elevation, and are oriented to the west or northwest. One site is a nearly flat terrace. The ground surface has sparse to low exposure of bare soil, moderate to high cover of litter, sparse to low cover of small and large rocks, and sparse exposure of bedrock. Litter depths range from 0-2.2 cm. Soils are moderately well-drained to rapidly drained silty clays and sandy clays derived from the Cedar Canyon Formation, Straight Cliffs Formation, colluvium, or formed in older alluvium.

Globally

This montane forest association occurs on a wide variety of aspects, slopes and landforms such as low to high slopes of ridges, hills, mesas, plateaus, valleys, ravines, canyons, saddles and rolling mesatops. Sites range between 2410 and 2850 m (7900-9360 feet) in elevation. Soils are often gravelly, rapidly drained loams (sandy to silty clay loams) and silts. Litter accumulations tend to be high but may be non-uniform and patchy. Parent materials include limestone, basaltic and andesitic volcanics, rhyolite, rhyolitic tuffs, and the Pink and White members of the Claron Formation (soft limestone).

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is low to high (12-66% cover) and is characterized by *Abies concolor* that ranges in height from 5-30 m, has dbh ranging from 14-78 cm, and provides 1-20% cover in the canopy and subcanopy, and by the short shrub *Juniperus communis* that provides 1-10% cover. The canopy includes tree species that sometimes have greater cover than *Abies concolor*, including *Pseudotsuga menziesii, Picea engelmannii, Picea pungens, Pinus flexilis, Populus tremuloides*, and *Pinus ponderosa*. The subcanopy provides sparse to low cover and includes *Pseudotsuga menziesii, Populus tremuloides, Abies lasiocarpa*, and *Pinus ponderosa*. The remaining short- and dwarf-shrub layers are high in terms of species composition, provide sparse to low cover, and include *Symphoricarpos oreophilus, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer has high floristic diversity, contributes sparse cover, and includes the graminoids *Carex rossii*, *Bromus ciliatus*, and *Poa fendleriana* and the forbs *Packera multilobata (= Senecio multilobatus)* and *Solidago multiradiata*. *Pseudotsuga menziesii, Populus tremuloides, Pinus flexilis*, and *Abies concolor* seedlings contribute sparse cover.

Globally

This mixed montane forest has an open to closed tree canopy (10-70% cover). *Abies concolor* is the indicated late-seral tree and usually dominates mature stands. *Pseudotsuga menziesii, Picea pungens, Pinus flexilis, Pinus strobiformis* (southern latitudes), and *Populus tremuloides* are seral associates. *Abies lasiocarpa* and *Pinus ponderosa* are accidental in the tree canopy and have relatively low cover. Some stands may have scattered saplings of *Abies concolor, Pseudotsuga menziesii, Pinus flexilis, Populus tremuloides*, or *Juniperus scopulorum*. The undergrowth is characterized by a clumpy, typically open to moderately dense, short-shrub layer of *Juniperus communis* (5-65% cover). Other shrubs, such as *Symphoricarpos oreophilus, Shepherdia canadensis, Rosa woodsii, Ribes cereum, Paxistima myrsinites, Mahonia repens (= Berberis repens)*, or *Ceanothus martinii*, may be present with low cover. *Acer glabrum* is typically absent. The herbaceous layer is generally depauperate but can range as high as 10% cover in some stands. *Carex rossii, Carex inops ssp. heliophila, Bromus anomalus, Elymus elymoides*, and *Poa fendleriana* are the most consistent graminoids. Among forbs, mesic species such as *Fragaria vesca, Pyrola chlorantha*, and *Thalictrum fendleri* are the most frequent and abundant.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies concolor*, *Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*
Herb (field)	*Mahonia repens*

Globally

Stratum	Species
Tree canopy	*Abies concolor*, *Pseudotsuga menziesii*
Shrub/sapling (tall & short)	*Juniperus communis*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4? (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Abies concolor forest; Douglas-fir forest

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Tree trunks are pistol-butted due to slope steepness and creep; slopes are unstable and rocks fall from above dislodging plants and wounding tree boles; snags and deadfall are charred; gullying is common on some slopes; the one flat terrace site has large downed tree trunks and supports high forb and grass diversity.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (6 plots: CEBR.0121, CEBR.0126, CEBR.0144, CEBR.0161, CEBR.0167, CEBR.0170; and 7 observation points: CEBR.9072, CEBR.9075, CEBR.9077, CEBR.9079, CEBR.9084, CEBR.9093, CEBR.9101); and 2007 Accuracy Assessment (23 points: CEBR_AA.0119, CEBR_AA.0043, CEBR_AA.0118,, CEBR_AA.0119, CEBR_AA.0134, CEBR_AA.0139, CEBR_AA.0147, CEBR_AA.0148, CEBR_AA.0149, CEBR_AA.0150, CEBR_AA.0237., CEBR_AA.0245, CEBR_AA.0249, CEBR_AA.0250, CEBR_AA.0251, CEBR_AA.0252, CEBR_AA.0256, CEBR_AA.0257, CEBR_AA.0271, CEBR_AA.0291, CEBR_AA.0303, CEBR_AA.0316, CEBR_AA.0356, CEBR_AA.0365).

Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: L.D. Engelking, mod. K.A. Schulz and G. Kittel

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Fischer and Bradley 1987, Muldavin et al. 2006, Roberts et al. 1992, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Abies concolor / Mahonia repens Forest

White Fir / Creeping Oregon-grape Forest

CODE	CEGL000251
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*ABIES CONCOLOR* FOREST ALLIANCE (A.152) White Fir Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This white fir forest occurs in mountains and higher plateaus in the Colorado Plateau and southern Rocky Mountains and ranges from central Utah and southern Colorado south into New Mexico and Arizona, and possibly extends into eastern Nevada. Stands are found on a variety of generally cool and dry sites with gentle to steep slopes (3-50%). Landforms include valleys and plateaus, low and midslopes of hills, mesas, ravines, and canyonsides, and exposed ridge and mountain summits at elevations ranging from 2230 to 2930 m (7300-9600 feet). Aspect is variable, but stands often occur on cooler northerly aspects, especially at mid to lower elevations. Substrates are rapidly drained coarse- to fine-textured loam soils derived from limestone, sandstone, shale, and rhyolitic volcanics. The vegetation is characterized by a moderate to closed tree canopy (25-72% cover) that is generally dominated or codominated by *Abies concolor* or is at least present in the tree canopy and dominates understory regeneration. *Pseudotsuga menziesii* is often present to codominant in the canopy. Other trees may be present in the canopy or subcanopy with low to moderate cover, such as *Pinus ponderosa, Pinus flexilis, Populus tremuloides*, and *Picea engelmannii* (accidental). The understory is characterized by the sparse to occasionally moderately dense, low-diversity understory with 1-10% cover of the diagnostic dwarf-shrub *Mahonia repens*. If the shrub layer is moderately dense, then it is dominated by *Mahonia repens*. Other shrubs may be present and include a few scattered *Symphoricarpos oreophilus, Arctostaphylos patula, Holodiscus dumosus, Paxistima myrsinites, Rosa woodsii*, or *Juniperus communis*. The herbaceous layer is typically sparse, with low diversity, and frequently includes the graminoids *Carex rossii, Carex geophila, Carex inops ssp. heliophila, Poa fendleriana*, and the forbs *Goodyera oblongifolia, Lathyrus lanszwertii var. leucanthus (= Lathyrus arizonicus), Mertensia arizonica, Thalictrum fendleri*, and *Viola canadensis*. *Pseudotsuga menziesii* and *Abies concolor* seedlings are typically present.

DISTRIBUTION

Cedar Breaks National Monument

This common forest association was sampled below the breaks in the lower elevations of the monument, including North Fork Ashdown Creek, Arch Creek, Jericho Canyon, Crescent Hollow, Columbine Canyon, Den Hollow, North Boundary Creek, The park North Boundary, Shooting Star Ridge, The Quarry, east of The Meadows, north of Chessmen Ridge, and along Bartizan Trail.

Globally

This white fir forest association occurs in mountains and higher plateaus in the Colorado Plateau and southern Rocky Mountains and ranges from central Utah and southern Colorado south into New Mexico and Arizona, and possibly extends into eastern Nevada.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs below the breaks on the lowslopes and midslopes of hills, interfluves, ridges, and canyonsides. The sites are moderately sloped to steep (10- to 36-degree slopes), occur between 2493 and 3031 m in elevation, and are oriented to the north. The ground surface has sparse to moderate exposure of bare soil, high cover

of litter, and sparse to low cover of small and large rocks. Litter depths range from 0-4.2 cm. Soils are well-drained to rapidly drained loams, sandy clay loams, sandy loams, and silty clay loams derived from the Cedar Canyon Formation or the Straight Cliffs Formation.

Globally
This white fir forest occurs in mountains and higher plateaus in the Colorado Plateau and southern Rocky Mountains and ranges from central Utah and southern Colorado south into New Mexico and Arizona, and possibly extends into eastern Nevada. Stands are found on a variety of generally cool and dry sites with gentle to steep slopes (3-50%). Landforms include valleys and plateaus, low and midslopes of hills, mesas, ravines, and canyonsides, and exposed ridge and mountain summits at elevations ranging from 2230 to 2930 m (7300-9600 feet) (Moir and Ludwig 1979, Graybosch and Buchanan 1983, Mauk and Henderson 1984, Youngblood and Mauk 1985, Johnston 1987, Roberts et al. 1992, Muldavin et al. 1996, Stuever and Hayden 1997b). Aspect is variable, but stands often occur on cooler northerly aspects, especially at lower elevations. Soils are rapidly drained, sandy loams to silty clay loams derived from limestone, sandstones, shales, and rhyolitic volcanics (Bandelier tuff). The ground surface has low to moderate exposure of bare soil, low to high cover of litter, low to moderate cover of small rocks, sparse to low cover of large rocks, and sparse to moderate cover of downed wood. Litter depths range from 0-2.1 cm.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This common forest association was sampled below the breaks in several canyons and drainages. Total vegetation cover is moderate to high (30-58% cover) and is characterized by *Abies concolor* that ranges in height from 10-30 m, has dbh ranging from 12-53 cm, and provides 7-23% cover in the canopy and subcanopy, and by the dwarf-shrub *Mahonia repens* that provides 3-18% cover. Associated canopy trees that provide sparse to low cover include *Pseudotsuga menziesii, Pinus ponderosa*, *Pinus flexilis* and *Populus tremuloides*. The remaining subcanopy layer provides sparse to low cover and includes *Populus tremuloides, Pseudotsuga menziesii*, and *Picea engelmannii*. Other shrubs present provide sparse to low cover and include *Arctostaphylos patula , Symphoricarpos oreophilus, Paxistima myrsinites*, *Ribes montigenum* and *Juniperus communis*. The herbaceous layer is high in terms of species composition, contributes sparse cover, and includes the rhizomatous grass *Bromus anomalus* and the forbs *Goodyera oblongifolia*, *Pyrola picta, Vicia americana, Ligusticum porteri, Thalictrum fendleri, Arnica cordifolia*, and *Mertensia arizonica*. *Pseudotsuga menziesii* and *Abies concolor* seedlings contribute sparse cover.

Globally
This forest is characterized by a moderate to closed tree canopy (25-72% cover) that is generally dominated or codominated by *Abies concolor* or is at least present in the tree canopy and dominates understory regeneration. *Pseudotsuga menziesii* is often present to codominant in the canopy. Other trees may be present in the canopy or subcanopy with low to moderate cover, such as *Pinus ponderosa, Pinus flexilis, Populus tremuloides*, and *Picea engelmannii* (accidental). The understory is characterized by the sparse to occasionally moderately dense, low-diversity understory with 1-10% cover of the diagnostic dwarf-shrub *Mahonia repens*. If the shrub layer is moderately dense, then it is dominated by *Mahonia repens*. Other shrubs present in stands may include a few scattered *Symphoricarpos oreophilus, Amelanchier alnifolia, Arctostaphylos patula, Holodiscus dumosus, Paxistima myrsinites, Rosa woodsii*, or *Juniperus communis* (Moir and Ludwig 1979, Alexander et al. 1984a, Mauk and Henderson 1984, Youngblood and Mauk 1985, DeVelice et al. 1986, Muldavin et al. 1996, Stuever and Hayden 1997b). The herbaceous layer is typically sparse, with low diversity, but is occasionally moderately dense. It is frequently composed of a mixture of graminoids, including *Carex rossii, Carex geophila, Carex inops ssp. heliophila, Poa fendleriana, Bromus anomalus*, and *Elymus elymoides*, and the forbs *Geranium viscosissimum, Goodyera oblongifolia, Lathyrus lanszwertii var. leucanthus (= Lathyrus arizonicus), Mertensia arizonica, Senecio wootonii, Thalictrum fendleri*, and *Viola canadensis*. *Pseudotsuga menziesii* and *Abies concolor* seedlings are typically present.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies concolor*, *Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*
Herb (field)	*Mahonia repens*

Globally

Stratum	Species
Tree canopy	*Abies concolor*, *Pseudotsuga menziesii*
Shrub/sapling (tall & short)	*Mahonia repens*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Abies concolor forest.

Globally
This association includes some white fir / sparse understory habitat types that have *Mahonia repens* present (Alexander et al. 1984a, DeVelice et al. 1986). *Pseudotsuga menziesii / Mahonia repens* Forest (CEGL000442) is similar except it lacks *Abies concolor* and can occur outside the range of *Abies concolor* extending north into Idaho and Oregon (Pfister 1977, Steele et al. 1981, 1983, Cole 1982).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Steepness of slopes and prevailing winds have caused blowdowns; deadfall on the forest floor, rockslides, and fire-burned stumps indicate past fires; slopes are rocky and quite steep, but the soils appear to be stable; some stands of *Pseudotsuga menziesii* are affected by mistletoe.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (8 plots: CEBR.0097, CEBR.0114, CEBR.0115, CEBR.0125, CEBR.0139, CEBR.0150, CEBR.0155, CEBR.0162; and 4 observation points: CEBR.9089, CEBR.9095, CEBR.9098, CEBR.9107); and 2007 Accuracy Assessment (9 points: CEBR_AA.0005, CEBR_AA.0009, CEBR_AA.0010, CEBR_AA.0012, CEBR_AA.0130, CEBR_AA.0151, CEBR_AA.0258, CEBR_AA.0299, CEBR_AA.0360).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: K.A. Schulz

REFERENCES: Alexander et al. 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, DeVelice et al. 1986, Driscoll et al. 1984, Fitzhugh et al. 1987, Graybosch and Buchanan 1983, Heinze et al. 1962, Johnston 1984, Johnston 1987, Larson and Moir 1987, Mauk and Henderson 1984, Moir and Ludwig 1979, Muldavin et al. 1996, Muldavin et al. 2006, Pfister 1972, Roberts et al. 1992, Steele et al. 1981, Steele et al. 1983, Stuever and Hayden 1997b, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Abies concolor / Symphoricarpos oreophilus Forest

White Fir / Mountain Snowberry Forest

CODE	CEGL000263
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*ABIES CONCOLOR* FOREST ALLIANCE (A.152) White Fir Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

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.

DISTRIBUTION

Cedar Breaks National Monument

This very limited forest association was sampled only once on Shooting Star Ridge.

Globally

This coniferous forest association has been reported from mountains and high plateaus in New Mexico, Colorado, Utah, and in Arizona along the Mogollon Rim.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs on the high slope of a ridge. The site is steep (39-degree slope), occurs at 2535 m in elevation, and is oriented to the west. The ground surface has moderate exposure of bare soil, moderate cover of rocks, and sparse to low cover of litter and downed wood. Soils are rapidly drained.

Globally

This coniferous forest association has been reported from mountains in New Mexico and Arizona along the Mogollon Rim, Colorado and Utah. Elevation ranges from 1740-3200 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. Litter depth averages 2.5 cm. Bare soil averages 7% and exposed rock averages 3%.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is low (24% cover) and is characterized by *Abies concolor* trees that range in height from 10-15 m and provide 5% cover, and by the short shrub *Symphoricarpos oreophilus* that provides 2% cover. Other canopy trees provide low cover, including *Pseudotsuga menziesii* and *Pinus ponderosa*. The subcanopy provides low cover, is between 5 and 10 m tall, and includes *Abies concolor* and *Pinus ponderosa*. Other shrubs present provide sparse cover and include *Juniperus communis, Ceanothus martinii, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is diverse in terms of species composition and contributes sparse cover with no species providing 1% or more cover.

Globally

Stands have a moderately dense to dense, evergreen needleleaf tree canopy typically dominated by either *Pseudotsuga menziesii* or *Pinus ponderosa* 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, including *Pinus flexilis, Pinus aristata, Populus angustifolia*, and *Populus*

tremuloides, may also be present. The sparse to moderately dense short-shrub layer is dominated or codominated by *Symphoricarpos oreophilus* often with *Rosa woodsii, Amelanchier alnifolia*, or several other shrubs present including *Acer glabrum, Amelanchier utahensis, Jamesia americana, Juniperus communis, Mahonia repens, Physocarpus monogynus, Prunus virginiana, Quercus gambelii*, or *Ribes cereum*. The herbaceous layer is sparse. Common graminoids are *Carex rossii* and *Poa fendleriana*. Forbs are noticeably sparse, but may include *Balsamorhiza sagittata, Eriogonum racemosum, Lathyrus lanszwertii*, or *Thalictrum fendleri*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies concolor*, *Pinus ponderosa*
Short shrub/sapling	*Symphoricarpos oreophilus*

Globally

Stratum	Species
Tree canopy	*Abies concolor*, *Pinus ponderosa*, *Pseudotsuga menziesii*
Short shrub/sapling	*Amelanchier alnifolia*
Short shrub/sapling	*Rosa woodsii*, *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Pinus aristata

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
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.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Unstable and steep slope, west-facing and xeric.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (1 observation point: CEBR.9083), and 2007 Accuracy Assessment (1 point: CEBR_AA.0276).
Local Description Authors: M. Smith and J. Von Loh
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

Picea pungens / Arctostaphylos patula Forest

Blue Spruce / Greenleaf Manzanita Forest

CODE	CEGL005364
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PICEA PUNGENS* FOREST ALLIANCE (A.165) Blue Spruce Forest Alliance

ECOLOGICAL SYSTEM(S):

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This community has only been observed at Bryce Canyon and Cedar Breaks National Parks on the Paunsaugunt Plateau in southern Utah. The ground is mostly open bare soil, sand or bed rock. Stands occur on steep slopes at all aspects, between 2337 and 2900 m in elevation. It is a mixed-conifer association, with many species, where *Picea pungens* is the indicator. *Pseudotsuga menziesii, Pinus ponderosa, Abies concolor, Pinus flexilis*, and *Pinus longaeva* often all occur together with *Picea pungens*. *Juniperus scopulorum* may also be present. Total cover of the shrub layer is low, and *Arctostaphylos patula* is the most characteristic, commonly present, although rarely abundant. Other shrubs present may include *Acer glabrum, Purshia tridentata, Juniperus communis, Symphoricarpos oreophilus, Symphoricarpos rotundifolius*, *Paxistima myrsinites, Mahonia repens, Ribes cereum* and *Ceanothus martinii*. The herbaceous cover is very low to non-existent.

DISTRIBUTION

Cedar Breaks National Monument

This forest community was observed in Adams Canyon, Ash Creek, Ashdown Creeks and along the north boundary of the Park.

Globally

This association in known only from southern Utah.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest occurs on steep slopes (25-35 degrees) on talus or colluvial slopes, between 2630 and 2900 m in elevation. Aspects are south, southwest to northwest. Soils are well drained and rocky.

Globally

Data are not available.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

This is a very open canopy woodland with total tree cover about 15-20%. Several conifers are usually present and Picea pungens is the most abundant with 1-5% cover. Additional conifer species include Pinus longaeva, Abies concolor, Pinus flexilis, Pinus ponderosa, Pseudotsuga menziesii, and Juniperus scopulorum. It is typical to have mixed stands of conifers at Cedar Breaks and it is the presence of *Picea pungens* that sets this community apart. The shrub layer is id characterized by clumps of *Arctostaphylos patula*, whose cover may be low (<10%) but is the most abundant shrub present. Other shrub species present may include *Paxistima myrsinites, Mahonia repens, Ribes cereum, Juniperus communis,* and *Acer glabrum.* The herbaceous layer is very sparse with only a few scattered individual species such as *Cirsium calcareum, Eriogonum panguicense, Hymenopappus filifolius* and *Carex rossii.*.

Globally

Data are not available.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (18-Mar-2008).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This association was well-documented during accuracy assessment at Bryce Canyon and Cedar Breaks National Parks, but no full plot data for classification was collected. It is currently known only from southeastern Utah. This association may occur in Arizona or Colorado. More investigation is needed. The *Abies concolor / Arctostaphylos patula* habitat type described by Youngblood and Mauk (1985) may contain stands that would classify as this association (CEGL005364).

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: This association was observed during the AA.
Cedar Breaks National Monument Plots: The description is based on 2007 Accuracy Assessment (8 points: (CEBR_AA.0071, CEBR_AA.0068, CEBR_AA.0298, CEBR_AA.0312, CEBR_AA.0395, CEBR_AA.0040, CEBR_AA.0295, CEBR_AA.0404).
Local Description Authors: G. Kittel
Global Description Authors: G. Kittel

REFERENCES: Western Ecology Working Group n.d.

Picea pungens / Juniperus communis Forest

Blue Spruce / Common Juniper Forest

CODE	CEGL000392
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PICEA PUNGENS* FOREST ALLIANCE (A.165) Blue Spruce Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

These forests occur at middle elevations of 1800 to 3300 m (5900-10,826 feet) in the central and southern Rocky Mountains, usually in moist, concave topographic positions. These communities often occupy sites that are protected from extreme sun and wind, within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. These forests are typically most common on north-facing slopes, which can be gentle to steep. These forests are characterized by the dominance of *Picea pungens* in the forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Pseudotsuga menziesii, Abies lasiocarpa*, and *Pinus ponderosa*. *Populus tremuloides* is the only widespread hardwood associate. The shrub layer is usually of only moderate cover and dominated by ericaceous or cold-deciduous species, with the latter group increasing with soil moisture or proximity to watercourses. Common species include *Arctostaphylos uva-ursi, Juniperus communis, Mahonia repens*, and *Rubus parviflorus*. Due to favorable soil moisture, the herbaceous layer is usually a diverse mixture of forbs and graminoids, including *Packera cardamine (= Senecio cardamine), Fragaria virginiana, Linnaea borealis, Pseudoroegneria spicata, Erigeron eximius, Thalictrum fendleri, Maianthemum stellatum*, and *Achillea millefolium*. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands.

DISTRIBUTION

Cedar Breaks National Monument

This forest association was sampled in the Ashdown Creek drainage, in Adams Canyon, Cheesman Canyon, Crescent Hollow, Meadows Hill/Confluence, North Fork Ashdown Creek, North of Cheesman Ridge, on the ridge between Crescent Hollow and Ashdown Creek, on Shooting Star ridge, The Bartizan, The Meadows, The Quarry and west of Crescent Hollow. .

Globally

This association is known from the Colorado Plateau, high plateaus of southern Utah and southern Rocky Mountains in Wyoming, Utah, Colorado, and may occur in Arizona.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs gentle to very steep slopes (3-54 degrees), at bottom of steep slopes or on midslope of a colluvial slopes, or ridge tops. It occurs between at 2470 and 2980 m in elevation, facing all aspects. The ground surface has 0-20% bare soil, 0-10% cover of small and large rocks, all stands had downed wood between trace and 30% cover as well as herbaceous litter from 1-90% cover, and low exposure of bedrock (0-80%). Litter depths range from 0-1.2 cm. Soils are rapidly drained sandy clay loams formed in colluvium deposited from Claron Formation (Red Member) cliffs.

Globally

These forests occur at middle elevations of 1800 to 3300 m (5900-10,826 feet) in the central and southern Rocky Mountains, usually in moist, concave topographic positions. Precipitation averages 46-60 cm annually, with the majority falling as growing season rainfall. The temperature regime is continental and winters are moderately severe. Soils are variable. In Wyoming they are reported as silty loams and silty clay loams and are usually young and derived from glacial or alluvial deposited materials. The pH is neutral to slightly alkaline. Youngblood and Mauk (1985) suggest a preference by these forests for non-igneous parent materials. These communities often occupy sites that are protected from extreme sun and wind, within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. These forests are typically most common on north-facing slopes, which can be gentle to steep. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands. One stand in northwestern Wyoming is surrounded by *Artemisia tridentata* on all sides.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate (33% cover) and is characterized by the canopy tree *Picea pungens* that ranges in height from 10-20 m, has dbh ranging from 15-54 cm, and with 5-10% cover, and by the short shrub *Juniperus communis* that provides 1-8% cover. Several other conifer trees are often present and include *Pinus longaeva, Pinus*

flexilis, Picea pungens, Pinus ponderosa, Cercocarpus ledifolius, Juniperus scopulorum, Populus tremuloides, Pseudotsuga menziesii and *Abies concolor*. Other shrubs that may be present with low cover include *Mahonia repens, Paxistima myrsinites, Acer glabrum, Rosa woodsii, Ribes montigenum, Purshia tridentata, Symphoricarpos oreophilus, Rhus trilobata, Shepherdia canadensis, Arctostaphylos patula, Ceanothus martini, Juniperus communis,* and *Betula occidentalis.*. The herbaceous layer is low in terms of floristic diversity, contributes sparse cover, and includes the graminoid *Calamagrostis scopulorum* and the forbs *Cirsium arizonicum, Equisetum spp.* and *Eurybia wasatchensis (= Aster wasatchensis)*. *Pseudotsuga menziesii* and *Abies concolor* seedlings contribute sparse cover.

Globally
These forests are characterized by the dominance of *Picea pungens* in the forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Pseudotsuga menziesii, Abies lasiocarpa*, and *Pinus ponderosa*. *Populus tremuloides, Populus angustifolia*, or *Populus balsamifera* are common hardwood associates. The shrub layer is usually of only moderate cover and dominated by ericaceous or cold-deciduous species, with the latter group increasing with soil moisture or proximity to watercourses. Common species include *Quercus gambelii, Amelanchier alnifolia, Acer glabrum, Arctostaphylos uva-ursi, Juniperus communis, Mahonia repens, Lonicera involucrata, Shepherdia canadensis*, and *Rubus parviflorus*. Due to favorable soil moisture, the herbaceous layer is usually a diverse mixture of forbs and graminoids, including *Carex siccata (= Carex foenea), Festuca arizonica, Arnica cordifolia, Packera cardamine (= Senecio cardamine), Fragaria virginiana, Linnaea borealis, Maianthemum stellatum, Pseudoroegneria spicata, Erigeron eximius*, and *Achillea millefolium*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Picea pungens*
Tall shrub/sapling	*Acer glabrum*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Shepherdia canadensis*

Globally

Stratum	Species
Tree canopy	*Picea pungens*
Shrub/sapling (tall & short)	*Juniperus communis*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Eurybia wasatchensis

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Wooded wetlands.

Globally
This association is closely aligned with *Picea pungens / Arctostaphylos uva-ursi* Forest (CEGL000385) and *Picea pungens / Mahonia repens* Forest (CEGL000395). The presence and abundance of *Arctostaphylos uva-ursi* keys to the former, while a lack of *Juniperus communis* and presence of *Mahonia repens* keys to the later. Moir and Ludwig (1979) describe a similar *Picea pungens - Pseudotsuga menziesii* Habitat Type, *Juniperus communis* Phase that has a mature canopy codominated by the two conifer tree species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Deep drainages bisect this colluvial slope; trees and shrubs collect rock, litter, and soil on their uphill sides.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (1 plot: CEBR.0122), and 2007 Accuracy Assessment (16 points: CEBR_AA.0069, CEBR_AA.0128, CEBR_AA.0162, CEBR_AA.0168, CEBR_AA.0175, CEBR_AA.0176, CEBR_AA.0187, CEBR_AA.0198, CEBR_AA.0246, CEBR_AA.0254, CEBR_AA.0260, CEBR_AA.0268, CEBR_AA.0302, CEBR_AA.0307, CEBR_AA.0308, CEBR_AA.0327, CEBR_AA.0328).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Kerr and Henderson 1979, Moir and Ludwig 1979, Roberts et al. 1992, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Picea pungens / Mahonia repens Forest

Blue Spruce / Creeping Oregon-grape Forest

CODE	CEGL000395
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PICEA PUNGENS* FOREST ALLIANCE (A.165) Blue Spruce Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
These forests occur at middle elevations of 2380 to 2740 m (7800-9000 feet) in mountains and plateaus of the central and southern Rocky Mountains and Colorado Plateau, with low-elevation sites often associated with drainages and seeps. These forests occur on a variety of aspects, on cool, gentle to very steep slopes and benches, sometimes in relatively mesic concave areas. Substrates are colluvium, residuum and less commonly alluvium. Soils are often well-drained, gravelly, sandy to clay loams. Surface rock is often moderately high, with litter/duff cover variable. These forests are characterized by the dominance or codominance of *Picea pungens* in the open to moderately dense forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. *Pseudotsuga menziesii* is the most common associate, but others include *Abies lasiocarpa, Pinus ponderosa, Pinus flexilis, Pinus contorta* (northern stands only), and *Juniperus scopulorum*. *Populus tremuloides* is the only widespread deciduous associate. The diagnostic low-shrub layer usually has moderately dense cover and is dominated by the cold-deciduous species *Mahonia repens*, often with *Arctostaphylos uva-ursi* and *Juniperus communis* present. Other shrub species present may include *Acer glabrum, Artemisia tridentata ssp. vaseyana, Ceanothus velutinus, Chrysothamnus viscidiflorus, Paxistima myrsinites, Purshia tridentata, Quercus gambelii, Ribes cereum, Rosa woodsii, Shepherdia canadensis*, and *Symphoricarpos oreophilus*. The herbaceous layer is generally sparse, except along drainages, but is usually a diverse mixture of forbs and graminoids. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands.

DISTRIBUTION
Cedar Breaks National Monument
Data are not available.

Globally
This forest association occurs at middle elevations in mountains and plateaus of the central (Uinta Mountains) and southern Rocky Mountains and the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
These forests occur at middle elevations of 2380 to 2740 m (7800-9000 feet) in mountains and plateaus of the central and southern Rocky Mountains and the Colorado Plateau, with low-elevation sites often associated with drainages and seeps. These forests occur on a variety of aspects, on cool, gentle to very steep slopes and benches, sometimes in relatively mesic concave areas. Substrates are colluvium, residuum and less commonly alluvium. They are typically of non-igneous parent materials (Youngblood and Mauk 1985). Parent materials include limestone, dolomite, sandstone, basalt, andesite, quartzite, and other weakly calcareous to noncalcareous sedimentary rocks (Mauk and Henderson 1984, Youngblood and Mauk 1985). Soils are often well-drained, gravelly, sandy to clay loams. Surface rock is often moderately high, with litter/duff cover variable.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
These forests are characterized by the dominance or codominance of *Picea pungens* in the open to moderately dense forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. *Pseudotsuga menziesii* is the most common associate, but others include *Abies lasiocarpa, Pinus ponderosa, Pinus flexilis, Pinus contorta* (northern stands only), and *Juniperus scopulorum* (Mauk and Henderson 1984, Youngblood and Mauk 1985). *Populus tremuloides* is the only widespread deciduous associate. The diagnostic low-shrub layer usually has moderately dense cover and is dominated by the cold-deciduous species *Mahonia repens*, often with *Arctostaphylos uva-ursi* and *Juniperus communis* present. Other shrub species present may include *Acer glabrum, Artemisia tridentata ssp. vaseyana, Ceanothus velutinus, Chrysothamnus viscidiflorus, Paxistima myrsinites, Purshia tridentata, Quercus gambelii, Ribes cereum, Rosa woodsii, Shepherdia canadensis*, and *Symphoricarpos oreophilus* (Mauk and Henderson 1984, Youngblood and Mauk 1985). The herbaceous layer is generally sparse, except along drainages, but is usually a diverse mixture of forbs and graminoids, including *Achillea millefolium, Achnatherum lettermanii, Arenaria congesta, Arnica cordifolia, Astragalus miser, Bromus porteri, Carex geyeri, Carex rossii, Erigeron eximius, Festuca thurberi, Fragaria virginiana, Galium boreale, Geranium* spp., *Hesperostipa comata, Linnaea borealis, Mertensia ciliata, Poa fendleriana, Thalictrum fendleri*, and *Vicia americana*. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument Data are not available.

Globally

Stratum	Species
Tree canopy	*Picea pungens*, *Pinus ponderosa*, *Pseudotsuga menziesii*
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Artemisia tridentata ssp. vaseyana*
Herb (field)	*Mahonia repens*
Herb (field)	*Carex geyeri*, *Carex rossii*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This association is closely aligned with *Picea pungens / Arctostaphylos uva-ursi* Forest (CEGL000385) and *Picea pungens / Juniperus communis* Forest (CEGL000392). The presence and abundance of *Arctostaphylos uva-ursi* keys to the former, while presence and abundance of *Juniperus communis* and lack of *Mahonia repens* keys to the later.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: This point is high up on a steep hill slope above upper Ashdown Creek. There are some standing dead trees within this forest and many wind-thrown trees. The ground is heavy with litter and there is a band of bedrock cliff (short) exposed.
Cedar Breaks National Monument Plots: Observed during 2007 Accuracy Assessment (1 point: CEBR_AA.0332)
Local Description Authors:
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Graybosch and Buchanan 1983, Kerr and Henderson 1979, Mauk and Henderson 1984, Pfister 1972, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Pseudotsuga menziesii / Juniperus communis Forest

Douglas-fir / Common Juniper Forest

CODE	CEGL000439
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* FOREST ALLIANCE (A.157) Douglas-fir Forest Alliance
ECOLOGICAL SYSTEM(S): (CES306.959)	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This Rocky Mountain forest association occurs from northwestern Montana south into central and eastern Idaho, western Wyoming and north-central Colorado. These forests occupy gentle to steep slopes (11-100%), on dry, exposed rocky slopes and ridgetops, at lower to mid elevations of the forested zone, from 1430 to 2930 m (4690-9620 feet) in elevation. Sites are relatively dry and occur on all aspects. Substrates are typically coarse-textured soils derived from a variety of parent materials. This association includes stands dominated by the evergreen needle-leaved tree *Pseudotsuga menziesii* or a mixed montane conifer tree canopy. *Pseudotsuga menziesii* is the dominant tree species in the overstory and often in the understory as well. *Pinus ponderosa, Pinus flexilis, Pinus contorta*, or *Pinus albicaulis* are occasionally present to codominant on drier sites, *Populus tremuloides* on moister sites. The

low-shrub layer is dominated by near-continuous to large patches of *Juniperus communis*. Other shrubs include *Arctostaphylos uva-ursi, Jamesia americana, Juniperus horizontalis, Mahonia repens, Purshia tridentata, Ribes cereum, Symphoricarpos oreophilus*, or *Shepherdia canadensis*. The herbaceous cover is generally depauperate in the southern and central Rockies, with less than 10% cover of grasses or forbs. Forb species typically provide less than 5% cover and include *Achillea millefolium, Arnica cordifolia, Astragalus miser*, and *Packera streptanthifolia (= Senecio streptanthifolius).* Grass species also contribute less than 5% herbaceous canopy cover and include *Muhlenbergia montana, Danthonia parryi, Bouteloua gracilis*, or *Festuca arizonica*. However, occurrences in the northern Rockies may have relatively high herbaceous cover (30-60%), and individual stands can be diverse. Common grasses include *Pseudoroegneria spicata* and *Festuca campestris*. A number of forbs contribute to the overall diversity, although the cover for any one species is not high. *Antennaria rosea, Penstemon confertus*, and *Allium cernuum* have high constancy, and *Selaginella densa var. scopulorum* may be abundant on some sites, particularly those where rock outcrops are present.

DISTRIBUTION

Cedar Breaks National Monument

This forest has limited distribution in the monument and was sampled only in two places, along the ridge below the Chessmen Ridge Overlook and Adams Barrier.

Globally

This forested association occurs from northwestern Montana south into central and eastern Idaho, western Wyoming and northern Colorado.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forested association occurs on the midslopes of ridges. Sites are steep (20- to 34-degree slopes), occur between 2918 and 2944 m in elevation, and are oriented to the north or west. The ground surface has high cover of litter and duff, sparse cover of small and large rocks and downed wood, and sparse exposure of bare soil. Litter depths range from 0.3-2.3 cm. Soils are rapidly drained silty clay loams derived from the Claron Formation (Red Member).

Globally

These Douglas-fir forests occupy dry, exposed rocky slopes, benches and ridgetops throughout the Rocky Mountains of Montana, Wyoming and Colorado. Slopes are gentle to steep (11-100%), at the lower to mid elevations of the forested zone, from 1430 to 2930 m (4690-9620 feet) in elevation. Sites are relatively dry and occur on all aspects. Soils are typically coarse-textured, rocky, and extremely well-drained. They may be derived from a variety of parent materials, including granite, sandstone, siltstone and glacial till. The ground surface is often rocky and mostly covered by litter and duff. Bare rock can be as much as 40% of the cover, often encrusted with lichens; litter depth is usually less than 6 cm.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate (43-44% cover) and is characterized by the canopy tree *Pseudotsuga menziesii* that ranges in height from 10-20 m, has dbh ranging from 19-87 cm, and provides 15-30% cover, and by the short shrub *Juniperus communis* that provides 6% cover. Additional canopy trees provide low cover (up to 6%) and include *Pinus longaeva* and *Picea engelmannii*. The subcanopy layer provides sparse cover and includes *Pinus flexilis, Pinus longaeva*, and *Picea engelmannii*. The remaining short-shrub layer is low in terms of species composition, provides sparse cover, and includes *Ribes montigenum* and *Ribes cereum*. The herbaceous layer is low in floristic diversity, contributes sparse cover, and includes the forbs *Solidago velutina* and *Pyrola chlorantha*. *Pseudotsuga menziesii* and *Pinus flexilis* seedlings contribute sparse cover.

Globally

This association includes stands dominated by the evergreen needle-leaved tree *Pseudotsuga menziesii* or a mixed montane conifer tree canopy. Although total canopy cover may vary from sparse to dense, *Pseudotsuga menziesii* is the dominant tree species in the overstory and often in the subcanopy as well. *Populus tremuloides, Picea pungens, Pinus ponderosa, Pinus flexilis, Pinus contorta*, or *Pinus albicaulis* are occasionally present to codominant on drier sites, *Populus tremuloides* on moister sites. Total cover of the shrub and herbaceous layers tends to be negatively correlated with canopy closure. Scattered tall shrubs such as *Prunus virginiana* may be present, but they do not form a layer. The low-shrub layer is dominated by patches of *Juniperus communis*, which may vary in cover from 1% to

more than 75%. Other shrubs may include *Arctostaphylos uva-ursi, Dasiphora fruticosa ssp. floribunda, Jamesia americana, Juniperus horizontalis, Mahonia repens, Purshia tridentata, Ribes cereum, Symphoricarpos oreophilus*, and *Shepherdia canadensis*. The herbaceous cover is generally depauperate in the southern and central Rockies, with less than 10% cover of grasses or forbs. Forb species typically provide less than 5% cover and include *Achillea millefolium var. occidentalis (= Achillea lanulosa), Antennaria* spp., *Arnica cordifolia, Artemisia ludoviciana, Astragalus miser, Geranium caespitosum, Packera streptanthifolia (= Senecio streptanthifolius)*, and *Penstemon* spp. Grass species also contribute less than 5% herbaceous canopy cover and include *Muhlenbergia montana, Danthonia parryi, Bouteloua gracilis*, or *Festuca arizonica*. However, occurrences in the northern Rockies may have relatively high herbaceous cover (30-60%), and individual stands can be diverse. Common grasses include *Pseudoroegneria spicata* and *Festuca campestris*. A number of forbs contribute to the overall diversity, although the cover for any one species is not high. *Antennaria rosea, Penstemon confertus*, and *Allium cernuum* have high constancy, and *Selaginella densa var. scopulorum* may be abundant on some sites, particularly those where rock outcrops are present.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Douglas-fir forest.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Lower, north-facing slopes of this ridge are steep and have thin, rocky soils, probably reducing the amount of understory cover; localized fire charring evident on some downed wood.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (2 plots: CEBR.0028, CEBR.0104).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: G. Kittel, mod. K.A. Schulz and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Giese 1975, Johnston 1987, Jones and Ogle 2000, MTNHP 2002b, Murphy 1982, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Vories 1974, Western Ecology Working Group n.d.

Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme) Forest

Subalpine Fir - Engelmann Spruce / (Western Prickly Gooseberry, Bristly Black Currant, White-stem Gooseberry) Forest

CODE	CEGL000331
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Cylindrical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.d.)
ALLIANCE	*ABIES LASIOCARPA - PICEA ENGELMANNII* FOREST ALLIANCE (A.168) Subalpine Fir - Engelmann Spruce Forest Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This forested association occurs in southern Idaho, southern Montana, western Wyoming, central and southern Utah, and through the Colorado mountains. This association is found between 2225-3415 m (7300-11,200 feet) elevation. It occurs on plateaus, benchlands, and slopes ranging from gentle to very steep but is normally on cold northwest to northeast aspects. These forest can be large continuous stands or patch stands interspersed with open meadows. These forests are heavily shaded with a very open shrub layer of just a few individuals. *Abies lasiocarpa* and *Picea engelmannii* dominate the dense tree canopy, while any of the following four *Ribes* species may be present the shrub layer: *Ribes inerme, Ribes lacustre, Ribes montigenum*, or *Ribes wolfii*. Herbaceous layer is depauperate but rich in forbs. Common forbs include *Aquilegia caerulea, Arnica cordifolia, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Thalictrum fendleri*. A few graminoids are often present and often include *Carex rossii, Carex geyeri, Achnatherum lettermanii (= Stipa lettermanii), Bromus carinatus*, and *Festuca idahoensis*.

DISTRIBUTION

Cedar Breaks National Monument

This forest association (often expressed as a woodland in terms of cover) is common and was sampled above and below the breaks within the monument and environs. This common forest association was sampled near the Chessmen Ridge, North View, and Sunset View overlooks, in the environs north and south of the monument boundary, and north and south of Panguitch Lake Road, Shooting Star Creek, near the entrance sign and south of the Visitor Center, south of and along Rattlesnake Trail, Columbine Ridge, Mammoth Summit, in Slip Canyon, and near the Alpine Pond Trail. It was also sampled in Dixie National Forest to the north and west of the monument boundary.

Globally

This association is distributed from southern Idaho into Wyoming and south throughout Utah and Colorado.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs on plateaus, plateau rims, slopes, hillslopes, valleys, and ridge slopes. Sites are flat to steep (0- to 40-degree slopes), occur between 2779 and 3249 m in elevation, and are oriented to all aspects. The ground surface has low to high cover of litter and duff, no to sparse cover of large and small rocks, sparse to moderate cover of downed wood, and no to high exposure of bare soil. Litter depths range from 0-33.1 cm. Soils are rapidly drained silty clay loams, silty clays, sandy clays, sandy clay loams, and clay loams derived from the Claron Formation (White and Red members), Cedar Canyon Formation, Brian Head Formation, and Markagunt Megabreccia.

Globally

This association is found between 2409-3415 m (7300-11,200 feet) elevation. It occurs on plateaus, benchlands, and slopes ranging from gentle to very steep but is normally on cold northwest to northeast aspects. The forest is often broken by large meadows occupying the deeper soils of gentle basins along drainage systems. These meadows may

be fairly dry and dominated by *Artemisia*, or fairly moist and dominated by grass, forbs, and sedges (Pfister 1972). Because of its wide distribution and broad range of altitudes, this association is found on a variety of substrate types, but soils are derived primarily from calcareous parent materials (Cooper and Pfister 1985). In Colorado, this common facultative riparian forest has a wide elevational range, 2500-3700 m. Stands occur along very steep streams where the riparian area is narrow and dominated by species of the surrounding forest. Soils are weakly developed, usually with only a structural B horizon, and generally have high rock and gravel content with pH ranging from 4.8-7.2. All of the soils have low temperatures. Textures range from loamy sands to silty clays; gravel content averages 18%, and the percentage of surface rock averages about 11% (Pfister 1972).

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate to dense (26-76% cover) and is characterized by the canopy trees *Abies lasiocarpa* and *Picea engelmannii* that range in height from 10-20 m, have dbh ranging from 12-57 cm and 12-102 cm (including standing dead trees), respectively, and provide 0-15% and 0-25% cover, respectively. The understory is characterized by the short shrub *Ribes montigenum* that provides <1-12% cover. The subcanopy layer provides sparse to low cover (1-13%) and includes *Abies lasiocarpa, Picea engelmannii, Populus tremuloides*, and *Pseudotsuga menziesii* trees that range from 2-10 m tall. The remaining shrubs, if present, provide sparse cover and include *Juniperus communis, Sambucus racemosa*, and *Mahonia repens*. Herbaceous cover is variable from sparse to moderate cover (<1-24% within plots) with a high floristic diversity of forbs, including *Cardamine cordifolia, Osmorhiza depauperata, Ligusticum filicinum, Ligusticum porteri, Lupinus argenteus, Mertensia arizonica, Arnica cordifolia, Arenaria fendleri, Erigeron ursinus, Delphinium barbeyi*, *Delphinium occidentale* and *Thalictrum fendleri*. The graminoid layer provides no to sparse cover and may include *Bromus anomalus, Carex rossii*, and *Elymus trachycaulus*. Seedling *Abies lasiocarpa* and *Picea engelmannii* contribute no to low cover (up to 25%).

Globally

This type is consistently dominated by *Picea engelmannii* and *Abies lasiocarpa*. Late-successional stands may have a dominant overstory of *Picea engelmannii* possibly resulting, in part, from a reproductive advantage over *Abies* through exposure of mineral soil seedbeds by heavy grazing (Roe et al. 1970). Steele et al. (1981) note that *Pinus albicaulis* codominates with *Abies lasiocarpa*, with *Picea* becoming increasingly prevalent to the south and east. Both *Abies* and *Picea* are found layering in the understory (Cooper and Pfister 1985, Youngblood and Mauk 1985). Although an important early-seral associate, *Populus tremuloides* is usually present in mature stands only as remnant stems of poor vigor. *Pinus contorta* is a minor seral species. This association is generally above the cold limits of *Pseudotsuga*, but the species does occur at lower elevations of the type.

The shrub layer is sparse, with scattered clumps of *Ribes montigenum* usually confined to near the bases of large trees. Other shrubs, which may occur in openings or on recently disturbed areas, include *Sambucus racemosa, Symphoricarpos oreophilus*, and *Shepherdia canadensis*. The undergrowth is characteristically depauperate. Forbs with high constancies are *Aquilegia caerulea, Arnica cordifolia, Arnica latifolia, Achillea millefolium, Astragalus miser, Chamerion angustifolium (= Epilobium angustifolium), Ligusticum porteri, Lupinus argenteus, Mertensia arizonica, Thalictrum fendleri, Thalictrum occidentale, Fragaria virginiana, Polemonium pulcherrimum, Pseudocymopterus montanus, Orthilia secunda (= Pyrola secunda), Frasera speciosa, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Osmorhiza depauperata*. Graminoids are weakly represented. *Carex rossii* is the only sedge encountered with any regularity. Under disturbed conditions, or in seral stands with incomplete conifer canopies, *Lupinus argenteus, Lathyrus lanszwertii, Hymenoxys hoopesii (= Helenium hoopesii), Chamerion angustifolium, Aquilegia caerulea*, and *Achillea millefolium* are expected to increase.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies lasiocarpa*, *Picea engelmannii*
Short shrub/sapling	*Ribes montigenum*
Herb (field)	*Ligusticum porteri*, *Lupinus argenteus*, *Mertensia arizonica*, *Osmorhiza depauperata*, *Thalictrum fendleri*

Globally

Stratum	Species
Tree canopy	*Abies lasiocarpa*, *Picea engelmannii*
Short shrub/sapling	*Ribes inerme*, *Ribes lacustre*, *Ribes montigenum*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Spruce-fir forest.

Globally
In Grand Teton National Park, stands were separated into *Abies lasiocarpa - Picea engelmannii / Ribes lacustre* and *Abies lasiocarpa - Picea engelmannii / Ribes montigenum* types. While both would fit into the broader USNVC concept, only one local description can be entered under one elcode.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Beetle kill on the mature *Picea engelmannii* is 100%, but most dead are still standing; numerous, dead large trees and saplings litter the forest floor and there is significant cover of twigs and branches; several broken *Abies lasiocarpa* in area; stands have high forb cover because more sunlight reaches the ground surface; in some stands 1000-hr fuels are common and subalpine fir trees are broken approximately 10 m above ground, likely due to snow loads and wind; sites of flat plateau and steep slope have both experienced beetle kill.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (22 plots: CEBR.0001, CEBR.0003, CEBR.0004, CEBR.0007, CEBR.0008, CEBR.0010, CEBR.0012, CEBR.0015, CEBR.0019, CEBR.0020, CEBR.0021, CEBR.0023, CEBR.0025, CEBR.0026, CEBR.0027, CEBR.0037, CEBR.0038, CEBR.0039, CEBR.0120, CEBR.0146, CEBR.0153, CEBR.0160; and 11 observation points: CEBR.9032, CEBR.9033, CEBR.9036, CEBR.9037, CEBR.9038, CEBR.9039, CEBR.9045, CEBR.9049, CEBR.9082, CEBR.9112, CEBR.9113); 2007 Accuracy Assessment (22 points: CEBR_AA.0362, CEBR_AA.0082, CEBR_AA.0388, CEBR_AA.0359, CEBR_AA.0358, CEBR_AA.0083, CEBR_AA.0354, CEBR_AA.0088, CEBR_AA.0078, CEBR_AA.0032, CEBR_AA.0081, CEBR_AA.0087, CEBR_AA.0016, CEBR_AA.0084, CEBR_AA.0227, CEBR_AA.0090, CEBR_AA.0138, CEBR_AA.0050, CEBR_AA.0033, CEBR_AA.0079, CEBR_AA.0137, CEBR_AA.0143).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: L.D. Engelking, mod. G. Kittel

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Cooper and Pfister 1985, Driscoll et al. 1984, Henderson et al. 1976, Henderson et al. 1977, Johnston 1987, Jones and Ogle 2000, Kettler and McMullen 1996, Kittel et al. 1994, Kittel et al. 1999a, Kittel et al. 1999b, Langenheim 1962, MTNHP 2002b, Mauk and Henderson 1984, Peet 1975, Pfister 1972, Pfister et al. 1977, Shepherd 1975, Steele et al. 1981, Steele et al. 1983, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Populus tremuloides / Juniperus communis Forest

Quaking Aspen / Common Juniper Forest

CODE	CEGL000587
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Aspen Forest and Woodland (CES306.813)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This *Populus tremuloides* forest association is known from the mountains of Utah, Colorado, Wyoming and Montana. It occurs on gentle to steep slopes (10-100%), on nearly all exposures from 2285 to 3000 m (7500-9800 feet) in elevation. It is also documented from swales, broad benches or dry flats acting as frost pockets, or where subject to cold-air drainage. Soils are derived primarily from sandstone or granite. The tree canopy is dominated by *Populus tremuloides*. Scattered conifer trees occur, such as *Pseudotsuga menziesii, Abies lasiocarpa, Pinus contorta, Pinus ponderosa, Pinus flexilis, Picea engelmannii*, and *Picea pungens*. The shrub layer is dominated by *Juniperus communis*, although it also contains *Acer glabrum, Paxistima myrsinites, Rosa woodsii, Symphoricarpos oreophilus*, and sometimes *Artemisia tridentata*, and dwarf-shrubs *Arctostaphylos uva-ursi, Mahonia repens*, and *Vaccinium myrtillus*. The herbaceous layer is variable in expression, with graminoids dominant in some stands and forbs dominant in others. Graminoids commonly occurring include *Carex geyeri, Carex rossii, Elymus trachycaulus, Calamagrostis rubescens, Bromus ciliatus, Achnatherum occidentale (= Stipa occidentalis), Oryzopsis asperifolia, Danthonia parryi, Poa nemoralis*, or *Poa secunda (= Poa nevadensis)*. Forbs include *Achillea millefolium, Astragalus miser, Geranium viscosissimum, Lupinus argenteus*, and *Thalictrum fendleri*. Diagnostic characteristics of this association are canopy dominance by *Populus tremuloides* and a short-shrub layer with abundant *Juniperus communis*.

DISTRIBUTION

Cedar Breaks National Monument

This uncommon forest association was observed near Rattlesnake Trail, near Adams Barrier, in The Meadows, on Shooting Star Ridge, in Columbine Canyon and in the Upper Ashdown Creek, the northfork of Ashdown Creek Adams Creek, and Crescent Hollow drainages.

Globally

This association is known from the mountains and high plateaus of Utah, Colorado, Wyoming and Montana.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs on the midslopes of ridges and on the low slopes of terraces and canyonsides. The sites are gentle to steep (4- to 21-degree slopes), occur between 2515 and 3092 m in elevation, and are oriented to the southeast or west. The ground surface has sparse to low exposure of bare soil and bedrock, moderate to high cover of litter, sparse cover of small and large rocks, and sparse cover of downed wood. Litter depths range from 0-1.0 cm. Soils are rapidly drained silty clay loams and sandy clay loams derived from the Cedar Canyon Formation and Claron Formation (White and Red members).

Globally

This *Populus tremuloides* forest association is known from the mountains of Utah, Colorado, Wyoming and Montana. It occurs on gentle to steep slopes (10-100%), on nearly all exposures from 2285 to 3000 m (7500-9800 feet) in elevation. Distribution of these forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). This forest type occurs in two differing environments: (1) warm, dry

sites near the margin of bunchgrass meadows and (2) swales, broad benches or dry flats acting as frost pockets, or where subject to cold-air drainage. Soils are derived primarily from sandstone, limestone or granite parent material, and the ground surface may have a high percentage of boulders and gravel.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

This uncommon forest association was sampled above and below the breaks in sheltered areas. Total vegetation cover is moderate to high (36-61% cover) and is characterized by the canopy tree *Populus tremuloides* that ranges in height from 10-30 m, has dbh ranging from 14-81 cm, and provides 10-28% cover in the canopy and subcanopy layers, and by the short shrub *Juniperus communis* that provides 0-16% cover. The remaining subcanopy layer provides sparse to low cover and includes *Abies lasiocarpa, Pseudotsuga menziesii, Pinus ponderosa*, and *Abies concolor*. Other short- and dwarf-shrubs present are moderate in terms of species composition, provide low cover, and include *Arctostaphylos patula, Paxistima myrsinites*, *Rosa spp.* and *Mahonia repens*. The herbaceous layer is low in terms of floristic diversity, contributes sparse to low cover, and includes the non-native grass *Poa pratensis* and the rhizomatous native grass *Bromus ciliatus*. Forbs commonly include the weeds *Achillea millefolium* and *Taraxacum officinale*, but in one stand, *Thalictrum fendleri* provides moderate cover. Other native forbs present may include *Equisetum* spp., *Lithospermum incisum, Antennaria* spp., *Geranium richardsonii. Delphinium barbeyi, Cirsium calcareum* and *Mertensia arizonica.*

Globally

Stands a have a somewhat closed to closed canopy of trees 5-20 m tall that is dominated or codominated by the cold-deciduous broad-leaved tree *Populus tremuloides*. Scattered conifer trees sometimes occur, such as *Pseudotsuga menziesii, Abies lasiocarpa, Pinus contorta, Pinus ponderosa, Pinus flexilis, Picea engelmannii*, and *Picea pungens*, but at least some stands appear to be persistent aspen clones. The shrub layer is dominated by *Juniperus communis*, although it also contains *Acer glabrum, Amelanchier alnifolia, Paxistima myrsinites, Rosa woodsii, Symphoricarpos oreophilus*, and sometimes *Artemisia tridentata*, and dwarf-shrubs *Arctostaphylos uva-ursi, Mahonia repens*, and *Vaccinium myrtillus*. The herbaceous layer is variable in expression, with graminoids dominant in some stands and forbs dominant in others. Common graminoids may include *Bromus porteri, Danthonia parryi, Elymus trachycaulus, Elymus glaucus, Bromus carinatus, Calamagrostis rubescens, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii, Festuca thurberi, Poa fendleriana*, and *Hesperostipa comata*. The most common forbs present include *Thalictrum fendleri, Vicia americana, Achillea millefolium, Astragalus flexuosus, Astragalus miser, Fragaria virginiana, Pseudocymopterus montanus, Thermopsis divaricarpa, Lupinus argenteus, Campanula rotundifolia*, and *Arnica cordifolia*. Exotic species, such as *Taraxacum officinale, Poa pratensis, Bromus inermis* and *Bromus tectorum*, are often common in stands disturbed by grazing.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Juniperus communis*
Herb (field)	*Thalictrum fendleri*
Herb (field)	*Poa pratensis*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides*
Shrub/sapling (tall & short)	*Juniperus communis*
Herb (field)	*Achillea millefolium*, *Thalictrum fendleri*

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument

Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally

Bromus inermis, *Poa pratensis*, *Taraxacum officinale*

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Mixed evergreen-aspen and aspen forests.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Quaking aspen stand with conifer subcanopy has a lush understory of forbs, mainly *Thalictrum fendleri* and *Ligusticum porteri*; patch of quaking aspen that are mostly younger trees resembles a dog-haired stand, stand occupies a more mesic toeslope, stand forms a mosaic with conifer forests.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (2 plots: CEBR.0116, CEBR.0117; and 2 observation points: CEBR.9041, CEBR.9066), and 2007 Accuracy Assessment (7 points: CEBR_AA.0197, CEBR_AA.0215, CEBR_AA.0275, CEBR_AA.0161, CEBR_AA.0294, CEBR_AA.0154, CEBR_AA.0321).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: G. Kittel, mod. S.L. Neid, K.A. Schulz, J. Coles

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Curry 1962, Driscoll et al. 1984, Johnston 1987, Jones and Ogle 2000, MTNHP 2002b, Marr et al. 1973b, Mueggler 1988, Mueggler and Campbell 1986, Murphy 1982, Peet 1975, Peet 1981, Powell 1988a, Shepherd 1975, Western Ecology Working Group n.d., Youngblood and Mueggler 1981

Populus tremuloides / Thalictrum fendleri Forest

Quaking Aspen / Fendler's Meadowrue Forest

CODE	CEGL000619
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Aspen Forest and Woodland (CES306.813)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This infrequent forest association is known from Idaho, western Wyoming, Utah, Colorado, and north-central New Mexico. It occurs on sheltered sites, swales, benches and lower slopes, or on sideslopes of canyons. Soils are variable and include silty loam, silty clay loam, gravelly and loamy Mollisols, or less-developed gravelly Inceptisols derived from latite, dactite, or rhyolitic tuff. Soil depth ranges from moderately deep to deep, and moisture varies from well-drained to moist. Slopes are moderate to steep (17-45%), straight to concave, and occur on all aspects. The ground surface is characterized by scattered bunches of grasses and sedges intermixed with litter and some exposed soil and rock. Elevation ranges from 1737 to 3414 m (5700-11,200 feet). Th**e** vegetation is essentially two-layered: a tree stratum usually of only *Populus tremuloides* and a low-herb stratum. In this tall subalpine deciduous forest, tree canopies are closed (>65% cover) and dominated by *Populus tremuloides*. An occasional conifer, usually *Abies lasiocarpa* but sometimes *Pseudotsuga menziesii* or *Pinus contorta*, may be present. While seedlings and saplings of *Abies concolor* and/or *Pseudotsuga menziesii* may be common to well-represented, mature trees are

scattered. *Populus tremuloides* regeneration may also be present in the understory of these stands. Shrub occurrence in the understory is variable; shrub species may include *Mahonia repens (= Berberis repens), Physocarpus monogynus, Robinia neomexicana, Rosa woodsii*, and *Symphoricarpos oreophilus*. A diverse and moderately high herbaceous cover is characteristic. The herbaceous layer is usually abundant and rich in forbs. On mesic sites, forb species commonly include *Erigeron eximius, Fragaria vesca, Fragaria virginiana, Geranium richardsonii, Geranium viscosissimum, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Thalictrum fendleri*. Other forbs frequently present in substantial amounts include *Achillea millefolium, Fragaria vesca, Lathyrus lanszwertii var. leucanthus (= Lathyrus leucanthus), Ligusticum porteri, Lupinus argenteus*, and *Vicia americana*. Graminoids, including *Bromus anomalus, Bromus carinatus, Carex siccata*, and *Elymus glaucus*, may be common. This association is characterized by the lack of conifers and the lack of a distinct shrub layer, the absence of substantial amounts of *Carex geyeri* or *Calamagrostis rubescens*, and the prominence of *Thalictrum fendleri, Geranium viscosissimum*, or *Osmorhiza berteroi*.

DISTRIBUTION

Cedar Breaks National Monument

This forest association was sampled only once, below the breaks in a sheltered area within 15 m of the cliff base near Adams Barrier adjacent to Rattlesnake Trail.

Globally

This in an infrequent forest association known from Idaho, western Wyoming, Utah, north-central New Mexico, and Colorado, and possibly California.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs midslope. The site is gently sloped (8 degrees), occurs at 3092 m in elevation, and is oriented to the west (280 degrees). The ground surface has low exposure of bare soil, moderate cover by small rocks, moderate cover by litter, and sparse cover of downed wood. Litter and duff depths range from 0-4.0 cm. Soils are rapidly drained silty clay loams from the Claron Formation (White Member).

Globally

This forested association occurs on sheltered sites, swales, benches and lower slopes, or on sideslopes of canyons. Soils are variable and include silty loam, silty clay loam, gravelly and loamy Mollisols, or less-developed gravelly Inceptisols derived from latite, dactite, or rhyolitic tuff. Soil depth ranges from moderately deep to deep, and moisture varies from well-drained to moist. Slopes are moderate to steep (17-45%), straight to concave, and occur on all aspects. The ground surface is characterized by scattered bunches of grasses and sedges intermixed with litter and some exposed soil and rock. Elevation ranges from 1737 to 3414 m (5700-11,200 feet).

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is high (58% cover) and is characterized by the canopy tree *Populus tremuloides* that ranges in height from 20-30 m, has dbh ranging from 15-32 cm, and provides 15% cover in the canopy layer, and by the tall forb *Thalictrum fendleri* that provides 35% cover. The subcanopy layer provides sparse cover of *Abies lasiocarpa* 15-20 m tall with one tree measuring 26 cm dbh. The remaining herbaceous layer is low in terms of floristic diversity, contributes sparse to low cover, and includes the non-native grass *Poa pratensis* and the rhizomatous native grass *Bromus ciliatus*. The remaining forbs provide sparse cover and include non-natives *Achillea millefolium* and *Taraxacum officinale* and natives *Vicia americana* and *Ligusticum porteri*.

Globally

Th**e** vegetation is essentially two-layered: a tree stratum usually of only *Populus tremuloides* and a low-herb stratum. In this tall subalpine deciduous forest, tree canopies are closed (>65% cover) and dominated by *Populus tremuloides*. An occasional conifer, usually *Abies lasiocarpa* but sometimes *Pseudotsuga menziesii* or *Pinus contorta*, may be present. While seedlings and saplings of *Abies concolor* and/or *Pseudotsuga menziesii* may be common to well-represented, mature trees are scattered. *Populus tremuloides* regeneration may also be present in the understory of these stands. Shrub occurrence in the understory is variable; shrub species may include *Mahonia repens (= Berberis repens), Physocarpus monogynus, Robinia neomexicana, Rosa woodsii*, and *Symphoricarpos oreophilus*. A diverse and moderately high herbaceous cover is characteristic. The herbaceous layer is usually abundant and rich in forbs. On mesic sites, forb species commonly include *Erigeron eximius, Fragaria vesca,*

Fragaria virginiana, Geranium richardsonii, Geranium viscosissimum, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis), and *Thalictrum fendleri*. Other forbs frequently present in substantial amounts include *Achillea millefolium, Fragaria vesca, Lathyrus lanszwertii var. leucanthus (= Lathyrus leucanthus), Ligusticum porteri, Lupinus argenteus*, and *Vicia americana*. Graminoids, including *Bromus anomalus, Bromus carinatus, Carex siccata* and *Elymus glaucus*, may be common. This association is characterized by the lack of conifers and the lack of a distinct shrub layer, the absence of substantial amounts of *Carex geyeri* or *Calamagrostis rubescens*, and the prominence of *Thalictrum fendleri, Geranium viscosissimum*, or *Osmorhiza berteroi*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Herb (field)	*Thalictrum fendleri*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides*
Herb (field)	*Geranium viscosissimum*, *Thalictrum fendleri*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally
Senecio serra var. admirabilis

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Mixed evergreen-aspen and aspen forests.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Quaking aspen stand with minor conifer subcanopy has a lush understory of forbs, mainly *Thalictrum fendleri* and *Ligusticum porteri*.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (1 plot: CEBR.0105).
Local Description Authors: J. Von Loh
Global Description Authors: G. Kittel, mod. K.S. King

REFERENCES: Balice et al. 1997, Bourgeron and Engelking 1994, Boyce 1977, Bunin 1975a, Bunin 1975c, CONHP unpubl. data 2003, Crouch 1983, Driscoll et al. 1984, Hess 1981, Hess and Alexander 1986, Hibner 2009, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnston 1987, Johnston and Hendzel 1985, Jones and Ogle 2000, Keammerer and Stoecker 1980, Komarkova et al. 1988a, Langenheim 1962, Mueggler 1988, Muldavin and Tonne 2003, Muldavin et al. 2003, Muldavin et al. 2006, Powell 1988a, Western Ecology Working Group n.d.

Populus tremuloides / Ribes montigenum Forest

Quaking Aspen / Western Prickly Gooseberry Forest

CODE	CEGL000600
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
ALLIANCE	*POPULUS TREMULOIDES* TEMPORARILY FLOODED FOREST ALLIANCE (A.300) Quaking Aspen Temporarily Flooded Forest Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Aspen Forest and Woodland (CES306.813)
R ocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This minor riparian forest association is found east of the Continental Divide in a mountainous region of south-central Colorado. Stands occurs along moist streamsides, on wet toeslopes or stream bottoms, between 2900 and 3200 m elevation. Slopes are gentle and straight or concave. Soils are wet. The tree canopy is characterized by a nearly closed canopy of the broad-leaved deciduous tree *Populus tremuloides*. The understory is very lush, with a moderately dense shrub layer (55% mean cover) and a dense herbaceous layer of over 100% cover. *Ribes montigenum* dominates the shrub layer with few other shrubs. The dense herbaceous layer is dominated by a mix of perennial grasses and forbs. *Bromus ciliatus, Carex siccata (= Carex foenea)* and *Festuca thurberi* are the most important of the graminoids. Dominant forbs include *Equisetum arvense, Fragaria virginiana, Geranium richardsonii*, and *Polemonium pulcherrimum*, but many other species contribute to the high cover of the herbaceous layer. Many of these species are indicative of wet or moist site conditions. Diagnostic of this forest association is the tree canopy dominated by *Populus tremuloides* with a *Ribes montigenum*-dominated the shrub layer.

DISTRIBUTION

Cedar Breaks National Monument

This forest has limited distribution within the mapped area and was sampled on a ridgeline, in the Dixie National Forest portion of the environs.

Globally

This minor riparian forest association is found east of the Continental Divide in a mountainous region of south-central Colorado.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest was observed only once on a ridgetop. The site is moderately steep (16-degree slope), occurs at 3165 m in elevation, and is oriented to the southeast. The ground surface has sparse to low exposure of bare soil and bedrock, moderate to high cover of litter, moderate cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained.

Globally

This type is found in a mountainous region just to the east of the Continental Divide. This region includes the highest ranges in the Rocky Mountain system; many peaks are in excess of 14,000 feet elevation. Extensive Pleistocene glaciation occurred in these ranges. The climate is characterized by cool summers and cold winters. An average of 40% of the annual precipitation falls from June through August, with the remainder occurring as winter and early spring snows. Due to a rainshadow effect from the massive San Juan Mountains to the west, annual precipitation (approximately 20 inches) is less than what occurs farther south in northern New Mexico. Maximum snowfall accumulations are about 26 feet.

This association occurs along moist streamsides, on wet toeslopes or stream bottoms, between 9700 and 10,600 feet elevation. Slopes are gentle and straight or concave. Soils are wet.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is dense (67% cover) and is characterized by *Populus tremuloides* that ranges in height from 15-20 m and provides 35% cover in the canopy and subcanopy layers, and by the short shrub *Ribes montigenum* that provides 8% cover. The remaining canopy and subcanopy layers provide sparse cover by *Abies lasiocarpa*. The herbaceous layer is low in terms of species composition, contributes low to moderate cover, and includes the non-native grass *Bromus inermis* and the bunchgrass *Elymus trachycaulus*. Forbs present with sparse cover include *Achillea millefolium* and *Thalictrum fendleri*.

Globally

The broad-leaved deciduous tree *Populus tremuloides* dominates the canopy of this forest association, with over 90% cover. The understory is very lush, with the shrub layer averaging 55% cover, and the herbaceous layer having over 100% cover. Shrubs are primarily broad-leaved deciduous, with *Ribes montigenum* being the only species occurring with any abundance. The herbaceous layer is dominated by a mix of perennial grasses and forbs. *Bromus ciliatus (= Bromopsis ciliata)* and *Carex siccata (= Carex foenea)* are the most important of the graminoids, while many forbs contribute to the high cover of the herbaceous layer. Many of these species are indicative of wet or moist site conditions.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Ribes montigenum*
Herb (field)	*Achillea millefolium*, *Thalictrum fendleri*
Herb (field)	*Bromus inermis*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides*
Shrub/sapling (tall & short)	*Ribes montigenum*
Herb (field)	*Fragaria virginiana*, *Geranium richardsonii*, *Polemonium pulcherrimum*
Herb (field)	*Bromus ciliatus*, *Carex siccata*
Herb (field)	*Equisetum arvense*

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument

Achillea millefolium, *Bromus inermis*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (7-Nov-1997). This association is restricted in range of occurrence to a relatively small region of mountain ranges in the southeastern Rocky Mountains of Colorado. The type is rapidly seral to *Picea engelmannii*-dominated stands in the absence of fire (Powell 1988a), and other occurrences of *Populus tremuloides / Ribes montigenum* Forest (CEGL000600) may have been recorded as this broadly accepted habitat type found in Arizona, Colorado, New Mexico, Utah, and Wyoming. Similar aspen stands occur in canyons of the Sangre de Cristo Mountains (Sarr and Sanderson 1998), but the association has yet to be recorded there.

CLASSIFICATION COMMENTS

Cedar Breaks National Monument

Data are not available.

Globally

This association is seral to the more widespread *Picea engelmannii / Ribes montigenum* Forest (CEGL000374) of the central Rocky Mountains and may become more common if these forests are burned.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Quaking aspen stand is supported by seeps, occurs as small stand on the slope.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (1 observation point: CEBR.9051).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: M.S. Reid

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Powell 1988a, Reid et al. 1994, Sarr and Sanderson 1998, UNESCO 1973, Western Ecology Working Group n.d.

Populus tremuloides - Abies concolor / Arctostaphylos patula Forest

Quaking Aspen - White Fir / Greenleaf Manzanita Forest

CODE	CEGL000522
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C.)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
ALLIANCE	*ABIES CONCOLOR - POPULUS TREMULOIDES* FOREST ALLIANCE (A.419) White Fir - Quaking Aspen Forest Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
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.

DISTRIBUTION
Cedar Breaks National Monument
This forest association is uncommon and was sampled below the breaks along sheltered slopes and on toeslopes, near The Meadows, on Shooting Star Ridge, in Crescent Hollow, on upper Ashdown Creek and in Chessmen, Columbine and Lavender canyons.

Globally
This forest association is known from the Snake River Range in east-central Nevada and on the Markagunt Plateau in southwestern Utah.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This forest association occurs on the midslopes of hills and ridges and on toeslopes and benches. The sites are gentle to steep (3- to 27-degree slopes), occur between 2550 and 2774 m (8400-9100 feet) in elevation, and are oriented to all aspects. The ground surface has sparse to low exposure of bare soil, high cover of litter, and sparse cover of downed wood. Litter depths range from 0-1.0 cm. Soils are well-drained to rapidly drained silty clay loams derived from the Cedar Canyon and Straight Cliffs formations.

Globally
Data are not available.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate to high (38-66% cover) and is characterized by the canopy trees *Populus tremuloides* and *Abies concolor* that range in height from 5-20 m, have dbh ranging between 12-20 cm for *Populus tremuloides*, and provide 12-22% and <1-6% cover, respectively, and by *Arctostaphylos patula* short shrubs that contribute <1-20% cover. *Pseudotsuga menziesii* trees provide sparse to low cover (1-10%) in the canopy. Shrubs are low in terms of species composition, provide sparse to low cover, and include *Juniperus communis, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is low to high in terms of floristic diversity, contributes sparse cover, and includes the graminoids *Carex rossii* and *Bromus anomalus*. Forbs include *Achillea millefolium* and *Cirsium wheeleri*. *Populus tremuloides* and *Abies concolor* seedlings provide sparse cover.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Abies concolor*, *Pseudotsuga menziesii*
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Arctostaphylos patula*
Herb (field)	*Mahonia repens*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Mixed evergreen-aspen and aspen forests.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Heavy fuels scattered in plot and some standing dead; history of fire with charred deadfall and trunks present; location on toeslope provides additional moisture for this mesic stand.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (3 plots: CEBR.0107, CEBR.0156, CEBR.0164; and 2 observation points: CEBR.9078, CEBR.9097), and 2007 Accuracy Assessment (6 points: CEBR_AA.0277, CEBR_AA.0145, CEBR_AA.0155, CEBR_AA.0163, CEBR_AA.0309, CEBR_AA.0330).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Mueggler 1988, Western Ecology Working Group n.d.

Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest

Quaking Aspen - White Fir / Mountain Snowberry Forest

CODE	CEGL000523
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C.)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
ALLIANCE	*ABIES CONCOLOR - POPULUS TREMULOIDES* FOREST ALLIANCE (A.419) White Fir - Quaking Aspen Forest Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This mixed evergreen-deciduous forest is documented from the mountains and plateaus of Utah and northern Nevada at montane elevations. Stands are characterized by a moderately dense to dense tree canopy codominated by *Populus tremuloides* and *Abies concolor* with *Symphoricarpos oreophilus* dominating the short-shrub layer. Often the conifers form a subcanopy that will eventually overtake the *Populus tremuloides*. Adjacent vegetation is usually forests dominated by *Abies concolor* or *Pseudotsuga menziesii*.

DISTRIBUTION

Cedar Breaks National Monument

Data are not available.

Globally

This forest association is widespread in the mountains of Utah and northern Nevada, and likely occurs in adjacent states where *Abies concolor* and *Populus tremuloides* co-occur.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

Data are not available.

Globally

These montane, mixed evergreen-deciduous forests have been reported from mountain and plateau environments of the Great Basin and Colorado Plateau, where they occur between 2100-2800 m. Sites are gently to moderately steep slopes on all aspects. Ground cover is dominated by litter, bare ground and rock. Parent materials are sedimentary (sandstone) or volcanic. Soils are generally well-drained loams or sandy loams with substantial organic matter. Past disturbance appears to be a key factor in distribution of these forests. At drier or rocky sites these forests may be somewhat stable, but in mesic areas they are seral communities which become established following fire.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Data are not available.

Globally

This association is characterized by a moderately dense to dense, mixed evergreen-deciduous tree canopy that is codominated by *Populus tremuloides* and *Abies concolor*. *Abies lasiocarpa* is typically not present, but individuals of *Pseudotsuga menziesii, Picea engelmannii, Picea pungens*, or *Pinus ponderosa* are not uncommon. Often the conifers form a subcanopy that will eventually overtake the *Populus tremuloides* in this early seral type.

Symphoricarpos oreophilus is the characteristic species of the short-shrub layer and typically dominates. Associates include several other common species in lesser amounts such as *Amelanchier* spp., *Arctostaphylos patula, Mahonia repens, Juniperus communis, Paxistima myrsinites*, and *Rosa woodsii*. The moderately dense herbaceous layer is usually luxuriant and species-rich in comparison to adjacent conifer forests because light is able to penetrate the *Populus tremuloides* tree canopy. Herbaceous species are diverse and variable. Common graminoids are *Achnatherum occidentale, Bromus anomalus, Bromus carinatus, Carex geyeri, Carex rossii, Elymus glaucus, Elymus trachycaulus, Festuca arizonica, Poa fendleriana*, and *Poa nervosa*. Forbs may include *Achillea millefolium, Eucephalus engelmannii, Frasera speciosa, Geranium* spp., *Lathyrus* spp., *Rudbeckia occidentalis, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Thalictrum fendleri*. The introduced graminoids *Poa pratensis* and *Dactylis glomerata* are common in many stands.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument Data are not available.

Globally

Stratum	Species
Tree canopy	*Abies concolor*, *Pseudotsuga menziesii*
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Osmorhiza berteroi*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Dactylis glomerata, *Poa pratensis*

CONSERVATION STATUS RANK
Global Rank & Reasons: G4G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Data are not available.
Cedar Breaks National Monument Plots: Observed during 2007 Accuracy Assessment (1 point: CEBR_AA.0221).
Local Description Authors:
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, Mueggler 1988, Mueggler and Campbell 1986, Western Ecology Working Group n.d.

Populus tremuloides - Abies lasiocarpa / Tall Forbs Forest

Quaking Aspen - Subalpine Fir / Tall Forbs Forest

CODE	CEGL000533
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C.)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
ALLIANCE	*ABIES LASIOCARPA - POPULUS TREMULOIDES* FOREST ALLIANCE (A.422) Subalpine Fir - Quaking Aspen Forest Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This is a common aspen forest association in western Wyoming, and it also occurs in Utah and Idaho. It occurs from 2015 to 3110 m (6600-10,200 feet) in elevation. It often occurs on northerly or easterly exposures on moderately steep slopes. Soils were often derived from sandstone or limestone parent materials, but it is not restricted to those substrates. The upper canopy is dominated by *Populus tremuloides*, with a significant amount of conifers present, generally at least 10% cover, commonly *Abies lasiocarpa*, but *Pinus contorta* and *Picea engelmannii* can be present as well. There is no defined shrub layer, although shrub species are often present, such as *Amelanchier alnifolia, Symphoricarpos oreophilus*, and *Ribes montigenum*. The herbaceous layer is abundant and rich. Commonly encountered tall forbs include *Rudbeckia occidentalis, Eucephalus engelmannii (= Aster engelmannii), Valeriana occidentalis, Delphinium X occidentale, Heracleum maximum*, and *Osmorhiza occidentalis*. There are often many low-stature forbs as well, including *Thalictrum fendleri, Geranium* spp., *Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Pseudostellaria jamesiana (= Stellaria jamesiana)*. This type is distinguished from similar aspen forests by the combination of conifers with aspen in the overstory, the lack of a distinct shrub layer (tall or dwarf), and abundant tall forbs.

DISTRIBUTION

Cedar Breaks National Monument

This forest association is common and was observed mostly above the breaks within the monument with a few stands occurring below the breaks. It was sampled near the Chessmen Ridge Overlook, northern monument boundary, south of Panguitch Lake Road, near Sunset View, on Columbine Ridge, on Rattlesnake Trail, north of the campgrounds, near Sugarloaf Road, south of Alpine pond, below the breaks near Crescent Hollow, and in the environs on Dixie National Forest.

Globally

This association is known from western Wyoming, Utah and Idaho.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This forest association occurs on plateaus, slopes, hillslopes, hilltops, depressions, and ridge slopes. Sites are gentle to steep (4- to 19-degree slopes), occur between 2610 and 3221 m in elevation, and are oriented to all aspects. The ground surface has moderate to high cover of litter and duff, no to sparse cover of large and small rocks, sparse to low cover of downed wood, and sparse to moderate exposure of bare soil. Litter depths range from 0-2.5 cm. Soils are moderately well-drained to rapidly drained sandy loams, silty clays, silt clay loams, and clay loams derived from the Brian Head Formation, Claron Formation (White Member), and Markagunt Megabreccia.

Globally

It occurs from 2000 to 3100 m (6600-10,200 feet) in elevation. It often occurs on northerly or easterly exposures on moderately steep slopes. Soils were often derived from sandstone or limestone parent materials, but it is not restricted to those substrates. Soils textures are often loams.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate to dense (25-82% cover) and is characterized by the canopy trees *Populus tremuloides* and *Abies lasiocarpa* that range in height from 10-20 m, have dbh ranging from 12-51 cm and 12-42 cm (includes standing dead trees), respectively, and provide 4-45% and 5-35% cover, respectively. A variety of tall forbs provide sparse to low cover (<1-22%) and include *Achillea millefolium, Ligusticum porteri, Osmorhiza depauperata, Thalictrum fendleri, Lupinus argenteus*, and *Mertensia arizonica*. In one stand, the vine *Vicia americana* provides moderate cover. The canopy tree *Picea engelmannii* may occur with up to 15% cover. The subcanopy layer provides sparse to low cover (4-15%) and includes *Populus tremuloides, Abies lasiocarpa*, and *Picea engelmannii* trees that range from 2-10 m tall. The short- and dwarf-shrub layers are low in terms of floristic diversity, provide no to sparse cover, and include *Ribes montigenum* and *Mahonia repens*. The graminoid layer provides no to sparse cover and includes *Bromus anomalus, Carex rossii*, and *Elymus trachycaulus*. The forb layer can be diverse, is usually with 8 -25% cover and may include *Erigeron ursinus, Lupinus argenteus, Machaeranthera commixta, Potentilla hippiana, Ligusticum porteri, Osmorhiza depauperate, Agoseris glauca, Thalictrum fendleri, Mertensia arizonica, Achillea millefolium,* and *Vicia americana*. Seedling *Abies lasiocarpa, Populus tremuloides*, and *Picea engelmannii* contribute sparse to low cover (up to 28%).

Globally

The upper canopy is dominated by *Populus tremuloides*, with a significant amount of conifers present, generally at least 10% cover, commonly *Abies lasiocarpa*, but *Pinus contorta* and *Picea engelmannii* can be present as well. There is no defined shrub layer, although shrub species are often present, such as *Amelanchier alnifolia, Symphoricarpos oreophilus*, and *Ribes montigenum*. The herbaceous layer is abundant and rich. Commonly encountered tall forbs include *Rudbeckia occidentalis, Eucephalus engelmannii (= Aster engelmannii), Valeriana occidentalis, Delphinium X occidentale, Heracleum maximum*, and *Osmorhiza occidentalis*. There are often many low-stature forbs as well, including *Thalictrum fendleri, Geranium* spp., *Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Pseudostellaria jamesiana (= Stellaria jamesiana)*. Graminoids are also commonly present and abundant and include *Calamagrostis rubescens, Bromus carinatus, Elymus glaucus, Elymus trachycaulus (= Agropyron trachycaulum)*, and *Poa nervosa*. This type is distinguished from similar aspen forests by the combination of conifers with aspen in the overstory, the lack of a distinct shrub layer (tall or dwarf), and abundant tall forbs.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies lasiocarpa*
Tree (canopy & subcanopy)	*Populus tremuloides*
Herb (field)	*Delphinium barbeyi*, *Ligusticum porteri*, *Lupinus argenteus*, *Mertensia arizonica*, *Osmorhiza depauperata*

Globally

Stratum	Species
Tree canopy	*Abies lasiocarpa*
Tree canopy	*Populus tremuloides*
Herb (field)	*Heracleum maximum*

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument

Achillea millefolium, *Taraxacum officinale*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Spruce-fir forest, mixed evergreen-aspen and aspen forests.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Evidence of wind blowdown and leaning trees from wind or other falling trees; thick layer of *Abies lasiocarpa* seedlings in the understory; openings in the canopy have provided extra sunlight and moisture for forbs, allowing for greater forb cover; history of fire which may also factor into the dense cover of *Populus tremuloides*.
Cedar Breaks National Monument Plots: The description is based on 2006 field data (7 plots: CEBR.0006, CEBR.0009, CEBR.0022, CEBR.0024, CEBR.0147, CEBR.0149, CEBR.0158; and 1 observation point: CEBR.9053), and 2007 Accuracy Assessment (10 points: CEBR_AA.0277, CEBR_AA.0145, CEBR_AA.0155, CEBR_AA.0163, CEBR_AA.0309, CEBR_AA.0330).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Mueggler 1988, Mueggler and Campbell 1986, Western Ecology Working Group n.d.

Populus tremuloides - Pseudotsuga menziesii / Juniperus communis Forest

Quaking Aspen - Douglas-fir / Common Juniper Forest

CODE	CEGL000545
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C.)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
ALLIANCE (A.426)	*POPULUS TREMULOIDES - PSEUDOTSUGA MENZIESII* FOREST ALLIANCE Quaking Aspen - Douglas-fir Forest Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This minor, seral, mixed aspen-conifer forest association occurs in the Uinta Mountains and Paunsaugunt Plateau in Utah, Snake Range in eastern Nevada, and the Colorado Front Range between 2300 and 2985 m (7540-9785 feet) elevation. Stands occur on a variety of sites and substrates (sandstone, quartz and granite). Soils are often shallow and coarse-textured. The vegetation is characterized by a relatively open to dense, mixed conifer and deciduous tree canopy codominated by *Pseudotsuga menziesii* and *Populus tremuloides*. Other conifer trees may be present, such as *Abies lasiocarpa, Picea engelmannii, Pinus contorta, Pinus flexilis*, or *Pinus ponderosa*, The understory lacks a tall-shrub layer, although scattered *Amelanchier alnifolia, Prunus virginiana*, or *Salix scouleriana* may be present. *Juniperus communis* is the predominant species in the moderately dense to sparse short-shrub layer, with *Arctostaphylos uva-ursi, Mahonia repens*, and *Symphoricarpos oreophilus* as common associates. Other shrubs present may include *Artemisia tridentata, Jamesia americana, Rosa woodsii*, and *Shepherdia canadensis*. The relatively sparse herbaceous layer is a mixture of graminoids and low forbs. Common graminoids are *Achnatherum occidentale, Bromus* spp., *Carex geyeri, Carex rossii, Elymus glaucus*, and *Elymus trachycaulus*; forbs, such as *Arnica latifolia, Astragalus miser, Fragaria vesca, Lathyrus lanszwertii var. leucanthus (= Lathyrus leucanthus),*

Lupinus argenteus, Potentilla spp., *Thalictrum fendleri*, and *Thermopsis divaricarpa* may be present. The exotic species *Poa pratensis* and *Taraxacum officinale* are common in livestock-impacted stands.

DISTRIBUTION
Cedar Breaks National Monument
Data are not available.

Globally
This minor, seral, mixed aspen-conifer forest association occurs in the Uinta Mountains and Paunsaugunt Plateau in Utah, Snake Range in eastern Nevada, and the Colorado Front Range.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
This minor, seral, mixed aspen-conifer forest association occurs in the Uinta Mountains and Paunsaugunt Plateau in Utah, Snake Range in eastern Nevada, and the Colorado Front Range between 2300 and 2985 m (7540-9785 feet) elevation. Stands occur on a variety of sites and substrates (sandstone, quartz and granite) (Mueggler 1988). Soils are often shallow and coarse-textured.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
This association has an open to dense, mixed conifer and deciduous tree canopy codominated by *Pseudotsuga menziesii* and *Populus tremuloides*. Other conifer trees may be present, such as *Abies lasiocarpa, Picea engelmannii, Pinus contorta, Pinus flexilis*, or *Pinus ponderosa*. As stands age, *Populus tremuloides* cover is slowly reduced until *Pseudotsuga menziesii* becomes dominant. The understory lacks a tall-shrub layer, although scattered *Amelanchier alnifolia, Prunus virginiana*, or *Salix scouleriana* may be present. *Juniperus communis* is the predominant species in the moderately dense to sparse short-shrub layer, with *Arctostaphylos uva-ursi, Mahonia repens*, and *Symphoricarpos oreophilus* as common associates. Other shrubs present may include *Artemisia tridentata, Jamesia americana, Rosa woodsii*, and *Shepherdia canadensis*. The relatively sparse herbaceous layer is a mixture of graminoids and low forbs. Common graminoids are *Achnatherum occidentale, Bromus* spp., *Carex geyeri, Carex rossii, Elymus elymoides, Elymus glaucus*, and *Elymus trachycaulus*; forbs, such as *Achillea millefolium, Arnica latifolia, Artemisia frigida, Artemisia ludoviciana, Astragalus miser, Fragaria vesca, Lathyrus lanszwertii var. leucanthus (= Lathyrus leucanthus), Lupinus argenteus, Potentilla* spp., *Thalictrum fendleri*, and *Thermopsis divaricarpa*, may be present (Mueggler 1988). The exotic species *Poa pratensis* and *Taraxacum officinale* are common in livestock-impacted stands.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument Data are not available.

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Tree canopy	*Populus tremuloides*
Shrub/sapling (tall & short)	*Juniperus communis*
Shrub/sapling (tall & short)	*Rosa woodsii*
Herb (field)	*Arnica cordifolia*
Herb (field)	*Carex rossii*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G4 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Data are not available.
Cedar Breaks National Monument Plots: Observed at Cedar from 2 AA points in 2007 (CEBR_AA.0186, CEBR_AA.0238)
Local Description Authors:
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Mueggler 1988, Mueggler and Campbell 1986, Western Ecology Working Group n.d.

Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus Forest

Quaking Aspen - Douglas-fir / Mountain Snowberry Forest

CODE	CEGL000546
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous forest (I.C.)
PHYSIOGNOMIC GROUP	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
FORMATION	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
ALLIANCE (A.426)	*POPULUS TREMULOIDES - PSEUDOTSUGA MENZIESII* FOREST ALLIANCE Quaking Aspen - Douglas-fir Forest Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This forest association is known from throughout Utah, in the Yellowstone Plateau and southern Idaho. Most stands occur between 1800 and 2300 m (6000-7500 feet) elevation on gentle to steep slopes, on all aspects, primarily on soils derived from sedimentary parent materials. The tree layer is a mixture of *Populus tremuloides* and *Pseudotsuga menziesii*. Occasionally *Abies lasiocarpa* may be present but not abundant. The undergrowth is characterized by the low stratum of *Symphoricarpos oreophilus* and *Rosa woodsii*. The herbaceous layer is minor and includes *Elymus glaucus, Calamagrostis rubescens*, and *Carex geyeri*. Forbs present may include *Arnica cordifolia, Thalictrum fendleri, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Geranium viscosissimum*.

DISTRIBUTION
Cedar Breaks National Monument
Data are not available.

Globally
This association is known from throughout Utah, in the Yellowstone Plateau and southern Idaho.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
Most stands occur between 1800 and 2300 m (6000-7500 feet) elevation on gentle to steep slopes, on all aspects, primarily on soils derived from sedimentary parent materials.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
The tree layer is a mixture of *Populus tremuloides* and *Pseudotsuga menziesii*. Occasionally *Abies lasiocarpa* may be present but not abundant. The undergrowth is characterized by the low stratum of *Symphoricarpos oreophilus* and *Rosa woodsii*. The herbaceous layer is minor and includes *Elymus glaucus, Calamagrostis rubescens*, and *Carex geyeri*. Forbs present may include *Arnica cordifolia, Thalictrum fendleri, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Geranium viscosissimum*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument Data are not available.

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (10-Oct-2000).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Data are not available.
Cedar Breaks National Monument Plots: Observed from one AA point in 2007 (CEBR_AA.0177).
Local Description Authors:
Global Description Authors: G. Kittel

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Eddleman and Jaindl 1994, Mueggler 1988, Western Ecology Working Group n.d.

Juniperus scopulorum - Cercocarpus ledifolius Woodland

Rocky Mountain Juniper - Curl-leaf Mountain-mahogany Woodland

CODE	CEGL000744
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*JUNIPERUS SCOPULORUM* WOODLAND ALLIANCE (A.506) Rocky Mountain Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland is known from Montana and southern Utah, and may occur in similar environmental settings in between. It occurs on steep slopes, ridges and canyons, generally with southern exposures. The known elevation range is 1675 to 2610 m (5500-8560 feet) This is an open, short-statured woodland dominated by *Cercocarpus ledifolius* mixed with *Juniperus scopulorum*. Other trees present may include *Pinus edulis, Pinus ponderosa*, and *Pseudotsuga menziesii*. Other species generally have low cover and include *Quercus gambelii, Arctostaphylos patula, Symphoricarpos oreophilus*, and *Mahonia repens*. Grasses and forbs present may include *Achnatherum hymenoides* and *Poa fendleriana, Artemisia frigida*, and *Opuntia polyacantha*.

DISTRIBUTION

Cedar Breaks National Monument

This woodland association has limited distribution in the monument and was sampled, on sites in the vicinity of the Ashdown Creek and Adams Creek confluence, referred to as The Meadows and The Quarry, east of Adam's Canyon and on Chessman Ridge.

Globally

This woodland is known from Montana and southern Utah, and may occur in similar environmental settings in between.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This woodland association occurs on high and midslopes of ridges and canyons. Sites are steep (29- to 32-degree slopes), occur between 2556 and 2660 m in elevation, and are oriented to the south and southwest. The ground surface has moderate cover of litter and duff, low cover of large and small rocks, low to moderate exposure of bare soil, and sparse to low cover of downed wood. Soils are moderately well-drained to rapidly drained sandy loams, loamy sands, and sandy clays derived from the Straight Cliffs and Cedar Canyon formations.

Globally

Data are not available.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate (31-39% cover) and is characterized by the canopy trees *Juniperus scopulorum* and *Cercocarpus ledifolius* that range in height from 2-10 m and provide 12-18% cover and 4-14% cover, respectively. *Juniperus scopulorum* trees have dbh ranging between 13 and 48 cm, *Pinus edulis* dbh range from 12-38 cm, and *Pinus ponderosa* trees measure 23-35 cm dbh. One large *Juniperus scopulorum* tree has a diameter at root crown of 45 cm. Associated canopy trees include *Pinus edulis, Pinus ponderosa*, *Abies concolor, Pinus flexilis* and *Pseudotsuga menziesii* from 2-10 m tall that provide sparse cover. Subcanopy *Cercocarpus ledifolius* trees contribute sparse cover in one stand and have dbh ranging from 3-10 cm. Shrubs contribute little cover and include *Quercus gambelii* with 6% cover and 1-2 m tall in one stand, and *Arctostaphylos patula, Symphoricarpos oreophilus*, and *Mahonia repens* (up to 7%) in other stands. The herbaceous layer is low in floristic diversity and

contributes sparse cover; the bunch grasses *Achnatherum hymenoides* and *Poa fendleriana* are often present. Seedling trees provide sparse cover and include *Abies concolor, Juniperus scopulorum*, and *Pinus edulis*.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Cercocarpus ledifolius*
Tree canopy	*Juniperus scopulorum*
Tall shrub/sapling	*Quercus gambelii*
Short shrub/sapling	*Arctostaphylos patula*
Herb (field)	*Mahonia repens*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3? (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Pinyon-juniper woodlands. Change name and concept to be inclusive: P-J / CERLED.

Globally
This association is only reported from southwestern Montana, but is likely to be more extensive.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Community located on sandy soils with large blocks of Red Claron lying below a cliff band, *Cercocarpus ledifolius* distribution may be driven by runoff pattern; rocky slope with high solar exposure, trees fire-scarred from low-intensity fires.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (3 plots): (Plots: CEBR.0035, CEBR.0142, CEBR.0143), and 5 AA points (CEBR_AA.0110, CEBR_AA.0188, CEBR_AA.0114, CEBR_AA.0193, CEBR_AA.0123)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Bourgeron and Engelking 1994, DeVelice 1992, Driscoll et al. 1984, MTNHP 2002b, Western Ecology Working Group n.d.

Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland

Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland

CODE	CEGL002940
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS - (JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
Co lorado Plateau Pinyon-Juniper Woodland (CES304.767)
Co lorado Plateau Pinyon-Juniper Shrubland (CES304.766)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs on ridges, mountains and plateaus in the Colorado Plateau of eastern and southern Utah and western Colorado. Sites are moderately steep to steep. Stands in the northern part of the range tend to be on slopes with southerly aspects; in the southern part of the range, northerly aspects are more common. Elevations range from 2400 to 2770 m (7900-9100 feet) in Utah and from 2200 to 2260 m (7200-7400 feet) in Colorado. The unvegetated surface is primarily covered by large rocks, bare soil and bedrock exposures. Downed wood is common. Parent materials are sandstone or quartzite bedrock or colluvium. Soils are rapidly drained and range in texture from clay loam to loamy sand. Total vegetation cover ranges from 13 to 80%. The vegetation is characterized by an open canopy of *Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma* trees, with *Cercocarpus ledifolius* trees or shrubs that range in cover from 5 to 30%. The associated short- and dwarf-shrub layer typically provides sparse to low cover and includes *Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata ssp. vaseyana, Cercocarpus montanus, Ericameria nauseosa, Quercus gambelii*, and *Gutierrezia sarothrae*. The herbaceous layer is somewhat diverse in terms of species composition but provides less than 10% total cover. Common graminoids include *Achnatherum hymenoides, Elymus elymoides, Poa fendleriana*, and *Carex* spp. Forbs present may include *Balsamorhiza sagittata, Chenopodium album, Descurainia californica*, and *Petradoria pumila*. Seedling *Pinus edulis* and *Juniperus* spp. are often present.

DISTRIBUTION

Cedar Breaks National Monument

Data are not available.

Globally

This association has been described from high ridges in the Colorado Plateau in eastern and southern Utah and western Colorado.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

Data are not available.

Globally

This woodland association occurs on ridges, mountains and plateaus in eastern and southern Utah and western Colorado. Sites are moderately steep to steep. Stands in the northern part of the range tend to be on slopes with southerly aspects and at higher elevations (2400-2770 m); in the southern part of the range, northerly aspects and lower elevations (2200-2260 m) are more common. The unvegetated surface is primarily covered by large rocks, bare soil and bedrock exposures. Parent materials are sandstone or quartzite bedrock or colluvium, and the soils are rapidly drained clay loams and loamy sands.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Data are not available.

Globally
This woodland association is patchy and somewhat rare within the Colorado Plateau. Total vegetation cover ranges from sparse to dense (13-80%). It is characterized by an open canopy, typically 5-10 m tall, of *Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma* trees that provide up to 40% canopy closure, and *Cercocarpus ledifolius* shrubs that range in cover from 5 to 30%. *Cercocarpus ledifolius* may also occur in the tree canopy with its large trunks, wide-spreading branches and heights reaching 4 m. The associated short- and dwarf-shrub layer is low in terms of species composition, typically provides sparse to low cover and includes *Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata ssp. vaseyana, Cercocarpus montanus, Ericameria nauseosa, Quercus gambelii*, and *Gutierrezia sarothrae*. The herbaceous layer is somewhat diverse in terms of species composition but provides less than 10% total cover. Common graminoids include *Achnatherum hymenoides, Elymus elymoides, Poa fendleriana*, and *Carex* spp. Forbs present may include *Balsamorhiza sagittata, Chenopodium album, Descurainia californica*, and *Petradoria pumila*. Seedling *Pinus edulis* and *Juniperus* spp. are often present.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument Data are not available.

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Tall shrub/sapling	*Cercocarpus ledifolius*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (14-Aug-2001).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This association may be ecotonal, as it tends to occur at the upper end of the range of pinyon-juniper woodlands. However, it covers extensive areas where it does occur and may be considered a legitimate ecological type.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Data are not available.
Cedar Breaks National Monument Plots: This community was observed in 2007 during AA (CEBR_AA.0153).
Local Description Authors:
Global Description Authors: J. Coles

REFERENCES: Cogan et al. 2004, Western Ecology Working Group n.d.

Pinus edulis - *Juniperus* spp. / *Cercocarpus montanus* - Mixed Shrubs Woodland

Two-needle Pinyon - Juniper species / Alderleaf Mountain-mahogany - Mixed Shrubs Woodland

CODE	CEGL000780
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS* - *(JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
Co lorado Plateau Pinyon-Juniper Woodland (CES304.767)
Sou thern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This broadly defined woodland association is common on the Colorado Plateau, occurring on sheltered colluvial slopes, sandstone hogbacks, dry foothills and mesas from north-central New Mexico and southern Colorado west to the Mogollon Rim of Arizona, and in western Colorado and adjacent Utah. It can be found on any slope position, though lower slopes are less common. Elevations range from 1472 to 2480 m (4830-8135 feet). Stands occur on gentle to steep slopes on all aspects. The soils are variable but generally shallow, poorly developed and skeletal, ranging from clayey marl to loamy sands. The unvegetated surface is characterized by bedrock, large and small rocks, and/or bare soil with little litter. Sandstone or shale are the most common parent materials. This association is characterized by an open to moderately dense tree canopy (10-60% cover) dominated by a combination of *Pinus edulis* and *Juniperus* spp. with a shrub layer dominated by *Cercocarpus montanus*. The tree canopy averages 2-5 m tall, but some stands may be as tall as 10 m. *Pinus edulis* and *Juniperus* spp. codominate in most stands, but sometimes one may be more prevalent than the other. The species of *Juniperus* varies with geography and elevation and includes *Juniperus deppeana, Juniperus monosperma, Juniperus osteosperma*, and *Juniperus scopulorum*. The total shrub cover may range from sparse to moderate. *Cercocarpus montanus* is the dominant shrub with up to 35% cover. It typically occurs as a short shrub but can be a tall shrub on some sites. Other shrubs may be present, including *Amelanchier* spp., *Artemisia bigelovii, Artemisia tridentata, Ephedra viridis, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Fendlera rupicola, Garrya ovata, Mahonia* spp., *Nolina microcarpa, Quercus gambelii, Quercus grisea, Rhus trilobata*, or species of *Yucca* and *Opuntia*. Herbaceous cover is variable, ranging from sparse to moderately dense, and generally dominated by graminoids (>5% cover) with scattered forbs. Extremely open stands of this association, usually occurring on fractured slickrock exposures, may have as little as 5% total vegetation cover and an upper canopy only 2 m tall.

DISTRIBUTION

Cedar Breaks National Monument

This woodland has limited distribution and was sampled only once in Cheesman Canyon.

Globally

This widespread woodland association is found from southern Colorado and north-central New Mexico to the Mogollon Rim of Arizona, north across the Colorado Plateau into western Colorado and adjacent Utah.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This uncommon woodland association occurs on a steep midslope of a west-facing colluvial slope. The site is steep (38-degree slope) and occurs at 2706 in elevation. The ground surface has moderate to high exposure of bare soil, low exposure of bedrock, high cover of litter, low to high cover of small and large rocks, and sparse to low cover of downed wood. Soils data are not available.

Globally
This broadly defined woodland association is common on the Colorado Plateau, occurring on sheltered colluvial slopes, sandstone hogbacks, dry foothills and mesas. It can be found on any slope position (upper, middle, or lower), though lower slopes are the least common. Elevations range from 1472 to 2480 m (4830-8135 feet). Stands occur on gentle to steep (3- to 36-degree) slopes on all aspects. The soils are variable but generally shallow, poorly developed and skeletal, ranging from clayey marl to loamy sands. The unvegetated surface is characterized by bedrock, large and small rocks, and/or bare soil. Litter has low cover. Parent materials are often sandstone or shale, but others are possible.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is low (5-10% cover) and is characterized by the canopy trees *Pinus ponderosa, Cercocarpus ledifolius, Abies concolor* and *Picea pungens* that provide very low cover (1-3% individually, total upper canopy 7% cover) with a subcanopy of *Juniperus scopulorum, Pinus flexilis, Picea pungens*, and *Abies concolor* (1% individually, 4% total subcanopy cover). The shrub layer provides sparse to low cover and includes *Arctostaphylos patula, Ericameria nauseosa (= Chrysothamnus nauseosus), Juniperus communis*, and *Purshia tridentata*. The herbaceous layer is floristically diverse and provides sparse to low cover. Graminoids include *Carex rossii*. Forbs can include *Euphorbia brachycera*, and *Solidago velutina*. Mosses and lichens provide sparse cover in some stands.

Globally
This association is characterized by an open to moderately dense tree canopy (10-60% cover) dominated by a combination of *Pinus edulis* and *Juniperus* spp. The canopy averages 2-5 m tall, but some stands may be as tall as 10 m. *Pinus edulis* and *Juniperus* spp. codominate in most stands, but sometimes one may be more prevalent than the other. *Pinus edulis* and *Juniperus* spp. are also present as smaller individuals in the shrub and field strata. The species of *Juniperus* varies with geography and elevation. *Juniperus monosperma* is common in north-central New Mexico and southern Colorado. *Juniperus deppeana* is common in southern New Mexico, and *Juniperus osteosperma* is common from northwestern New Mexico west into Arizona and north into western Colorado and Utah. *Juniperus scopulorum* is more common in higher elevation stands. The total shrub cover may range from sparse to moderate. *Cercocarpus montanus* is the dominant shrub with 1-35% cover. It typically occurs as a short shrub <2 m tall but can be a tall shrub (2-5 m) on some sites. Other shrubs may be present, including *Amelanchier* spp., *Artemisia bigelovii, Artemisia tridentata, Ephedra viridis, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Fendlera rupicola, Fraxinus anomala, Garrya ovata, Mahonia* spp., *Nolina microcarpa, Purshia stansburiana, Quercus gambelii* (<5% cover), *Quercus grisea, Rhus trilobata, Symphoricarpos oreophilus*, or species of *Yucca* and *Opuntia*. Herbaceous cover is variable, ranging from sparse to moderately dense, and generally dominated by graminoids (>5% cover) with scattered forbs. Associated graminoids include *Achnatherum hymenoides (= Oryzopsis hymenoides), Andropogon gerardii, Aristida purpurea, Bouteloua curtipendula, Bouteloua gracilis, Bouteloua hirsuta, Carex rossii, Hesperostipa comata, Koeleria macrantha, Leymus salinus (= Elymus salinus), Muhlenbergia pauciflora, Pascopyrum smithii, Pleuraphis jamesii, Poa fendleriana, Pseudoroegneria spicata*, and *Schizachyrium scoparium*. Common forbs include species of *Chamaesyce, Cryptantha, Eriogonum, Machaeranthera, Packera, Penstemon, Petradoria, Phlox*, and *Tetraneuris*. Extremely open stands of this association occurring on exposed and fractured slickrock may have as little as 5% total vegetation cover and an upper canopy only 2 m tall. Biological soil crusts are patchy but may contribute up to 27% cover and are generally well-developed.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Juniperus scopulorum*, *Pinus flexilis*
Tree canopy	*Cercocarpus ledifolius*
Herb (field)	*Euphorbia brachycera*

Globally

Stratum	Species
Tree canopy	*Juniperus monosperma*, *Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Cercocarpus montanus*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Pinyon-juniper woodlands.

Globally
This is a widely distributed and variable association, found throughout much of the Colorado Plateau, edges of the Colorado Rockies and south into New Mexico. On dry, rocky or slickrock sites on the Colorado Plateau, this pinyon-juniper woodland association may include stands with very open tree canopies (5-10% cover) in cases where the total vegetation cover is less than 15%. These stands may be similar to open *Cercocarpus montanus* shrublands with scattered pinyon and juniper trees but is considered to be a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Colluvial slope of mostly large boulders and small pebble-sized rocks.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2005 and 2006 field data (1 plot): (Plots: CEBR.0163).
Local Description Authors: G. Kittel
Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Baker 1983b, Baker 1984a, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Bradley et al. 1992, CONHP unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, Erdman 1962, Erdman 1969, Hess and Wasser 1982, Isaacson 1967, Johnston 1987, Kennedy 1983a, Larson and Moir 1987, Marr et al. 1979, Medina 1986, Moir 1963, Moir and Carleton 1987, Moir and Ludwig 1979, Pase and Lindenmuth 1971, Stuever and Hayden 1997a, USFS 1981a, USFS 1981b, USFS 1983a, USFS 1985d, USFS 1985e, USFS 1985g, Vories 1974, Western Ecology Working Group n.d., Wright et al. 1979

Pinus longaeva Woodland

Intermountain Bristlecone Pine Woodland

CODE	CEGL002380
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS LONGAEVA* WOODLAND ALLIANCE (A.518) Intermountain Bristlecone Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

This rare woodland association is known from Capitol Reef, Bryce Canyon and Cedar Breaks National Parks in southern Utah. Small stands of this woodland occur on high slopes of scree or talus. Sites are gentle to moderately steep (1- to 21-degree slopes), occur between 2480 and 3311m elevation, and are oriented to all aspects. The unvegetated surface has moderate cover of litter, low to moderate cover of rocks and gravel, and low exposure of bare soil. Parent materials are Carmel Formation shale and the Clarion Formation shale. Soils are rapidly drained and texturally are sandy loam. Total vegetation cover ranges from 27 to 65%. The association is characterized by an open canopy, typically 10-15 m tall, of *Pinus longaeva* trees that range in cover from 15 to 25%. The associated canopy tree layer is diverse, provides sparse to low cover, and includes *Juniperus osteosperma, Juniperus scopulorum, Pinus edulis*, *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus flexilis*, and *Pseudotsuga menziesii*. The shrub layer is diverse and provides sparse to low cover with no one shrub consistently present. Shrubs that occasionally provide low cover within stands include *Acer glabrum, Amelanchier utahensis, Arctostaphylos patula, Ericameria nauseosa, Eriogonum corymbosum*, *Juniperus communis, Mahonia repens*, *Purshia tridentata and Shepherdia canadensis*. The herbaceous layer is diverse but rarely provides cover exceeding 5%. Graminoids are low in diversity and provide sparse cover, although *Leymus salinus* covers in excess of 1% in one stand. Forbs are moderate to high in diversity but provide sparse cover, typically less than 1%. The most abundant forbs are *Oxytropis oreophila* and *Tetraneuris acaulis*.

DISTRIBUTION

Cedar Breaks National Monument

This sparse woodland is common in the monument where steep breaks occur. It was sampled near the Alpine Lake Trail, Columbine Ridge, Chessmen Ridge Overlook, Chessmen Canyon, Rampart Overlook, Orange Ridge, Spectra Point, Adams Barrier, Ashdown Creek, Arch Creek, Adams Creek, Lavender Creek, Columbine Canyon, and Slip Canyon and in the environs north of the monument on Dixie National Forest.

Globally

This association is known only from Capitol Reef, Bryce Canyon and Cedar Breaks National Parks in southern Utah.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This sparse woodland occurs on plateau rims, ridge crests, badlands breaks, colluvial slopes, interfluves, and valley slopes. Sites are flat to steep (0- to 39-degree slopes), occur between 2486 and 3311 m in elevation, and are oriented to all aspects. The ground surface has sparse to high cover of litter and duff, sparse to high cover of large and small rocks, low to high exposure of bare soil, and sparse to low cover of downed wood. Litter depths range from 0-5.7 cm. Soils are moderately well-drained to rapidly drained sandy clays, sandy clay loams, silt clay loams, and clays derived from the Cedar Canyon Formation, Claron Formation (Red and White members), alluvial fan deposits, and older alluvium.

Globally

This sparse woodland occurs on plateau rims, ridge crests, hills, canyonsides, badlands breaks, colluvial slopes, interfluves, and valley slopes. Sites are flat to steep (0- to 39-degree slopes), occur between 2170 and 3311 m in elevation, and are oriented to all aspects. The ground surface has sparse to high cover of litter and duff, sparse to high cover of large and small rocks, low to high exposure of bare soil, and sparse to low cover of downed wood. Litter depths range from 0-5.7 cm. Soils are moderately well-drained to rapidly drained sandy clays, sandy clay loams, silt clay loams, and clays derived from local shale formations.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is sparse to moderate (3-41% cover) and is often a mix of conifer species, but it is always characterized by the canopy tree *Pinus longaeva* that ranges in height from 5-20 m, has dbh ranging from 12-106 cm, and provides <1-22% cover. Associated canopy trees range from 5-10 m tall and include *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus edulis, Pinus flexilis*, and *Pseudotsuga menziesii* that have a range of dbh from 12-118 cm and contribute sparse to low cover. Subcanopy *Abies concolor, Abies lasiocarpa, Betula occidentalis, Cercocarpus ledifolius, Juniperus scopulorum, Picea engelmannii, Picea pungens, Pinus flexilis, Pinus longaeva*, and *Pseudotsuga menziesii* trees from 2-15 m tall also contribute sparse to low cover. Shrubs are often absent from most stands and provide only sparse cover when present; they include *Acer glabrum,*

Amelanchier utahensis, Arctostaphylos patula, Juniperus communis, Purshia tridentata, Shepherdia canadensis, and *Mahonia repens*. The herbaceous layer is moderate to high in terms of floristic diversity and contributes sparse to low cover. Common graminoids include *Bromus anomalus, Carex rossii*, and *Elymus elymoides*. Forbs that contribute low cover include *Astragalus kentrophyta, Cirsium wheeleri*, and *Solidago velutina*. Seedling trees up to 2 m tall provide sparse to low cover and include *Abies concolor, Abies lasiocarpa, Cercocarpus ledifolius, Juniperus scopulorum, Picea engelmannii, Picea pungens, Pinus edulis, Pinus flexilis, Pinus longaeva, Pinus ponderosa, Populus angustifolia*, and *Pseudotsuga menziesii*.

Globally
Total vegetation cover is sparse to moderate and is often a mix of conifer species, but it is always characterized by the canopy tree *Pinus longaeva* that ranges in height from 5-20 m, has dbh ranging from 12-106 cm, and provides <1-22% cover. Associated canopy trees range from 5-10 m tall and include *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus edulis, Pinus flexilis*, and *Pseudotsuga menziesii* that have a range of dbh from 12-118 cm and contribute sparse to low cover. Shrubs are often absent from most stands and provide only sparse cover when present; they include *Acer glabrum, Amelanchier utahensis, Arctostaphylos patula, Cercocarpus montanus Juniperus communis, Gutierrezia sarothrae, Purshia tridentata, Shepherdia canadensis*, and *Mahonia repens*. The herbaceous layer is moderate to high in terms of floristic diversity and contributes sparse to low cover. Common graminoids include *Bromus anomalus, Carex rossii*, *Leymus salinus* and *Elymus elymoides*. Forbs that contribute low cover include *Astragalus kentrophyta, Cirsium wheeleri*, *Solidago velutina,* . *Eriogonum panguicense* and *Stenotus armerioides (= Haplopappus armerioides).*

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Pinus longaeva*
Tree subcanopy	*Pinus flexilis*
Short shrub/sapling	*Shepherdia canadensis*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Jamesia americana*, *Taraxacum officinale*

Globally
Aquilegia scopulorum, *Eriogonum holmgrenii*, *Primula nevadensis*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Pine woodlands.

Globally
This association has been described from only three southern Utah NPs

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Most sites are on steep breaks, deep erosion patterns exist, stands subject to sheet erosion, steepness and erosion preclude herbaceous vegetation establishment; some stands occur on convex slopes and in drainages; soil and rock commonly collect on upslope side of tree trunks creating a pistol-butted shape, downslope roots are often exposed; bedrock is sometimes exposed. *Cedar Breaks National Monument* Plots: Plots and Observation Points: The description is based on 2006 field data (17 plots and 7 observation points): (Plots: CEBR.0011, CEBR.0013, CEBR.0014, CEBR.0016, CEBR.0017, CEBR.0018, CEBR.0029, CEBR.0030, CEBR.0101, CEBR.0102, CEBR.0113, CEBR.0129, CEBR.0130,

CEBR.0138, CEBR.0140, CEBR.0152, CEBR.0173; Observation Points: CEBR.9031, CEBR.9034, CEBR.9035, CEBR.9046, CEBR.9061, CEBR.9081, CEBR.9090), and 25 AA points from 2007 (CEBR_AA.0038, CEBR_AA.0041, CEBR_AA.0053, CEBR_AA.0054, CEBR_AA.0067, CEBR_AA.0096, CEBR_AA.0113, CEBR_AA.0158, CEBR_AA.0159, CEBR_AA.0164, CEBR_AA.0169, CEBR_AA.0241, CEBR_AA.0243, CEBR_AA.0314, CEBR_AA.0324, CEBR_AA.0355, CEBR_AA.0363, CEBR_AA.0364, CEBR_AA.0397, CEBR_AA.0398, CEBR_AA.0399, CEBR_AA.0400, CEBR_AA.0401, CEBR_AA.0405, CEBR_AA.0406)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Pinus ponderosa / Arctostaphylos patula Woodland

Ponderosa Pine / Greenleaf Manzanita Woodland

CODE	CEGL000842
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS PONDEROSA* WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This woodland association has been reported from the mountains and plateaus in Colorado, Utah and California. Elevation ranges from 1770-2590 m (5800-8500 feet). Sites are dry, warm, mid to lower slopes, benches and ridges often with southerly aspects. Soils are typically sandy loams but vary from sand to silt loam. Parent materials are sandstone, limestone and occasionally basalt and andesite. The tree canopy is typically open (about 30% cover), but can range from 10-80% cover and is dominated by *Pinus ponderosa*. Scattered *Juniperus scopulorum* trees may also be present. *Arctostaphylos patula* dominates the moderate to sparse shrub layer. Others shrub species present may include *Amelanchier utahensis, Ceanothus* spp., *Cercocarpus montanus, Mahonia repens, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus*, and *Tetradymia canescens*. The sparse herbaceous layer (<20% cover) is primarily composed of graminoids such as *Carex rossii, Achnatherum hymenoides (= Oryzopsis hymenoides), Elymus elymoides, Leymus salinus (= Elymus salinus)*, and *Poa fendleriana*. Forbs are sparse and may include *Achillea millefolium, Balsamorhiza sagittata*, and *Eriogonum racemosum*.

DISTRIBUTION
Cedar Breaks National Monument
This woodland is relatively common in the Ashdown and Adams creek drainages and was sampled at The Quarry in the Adams Creek drainage, within the canyon of Adams Creek, in lower and middle Lavender Canyon, east of The Meadows, on Meadow Hill, on Cheesman Ridge, Den Hollow and in Crescent Hollow near Ashdown Creek.

Globally
This coniferous woodland association has been reported from the Colorado Plateau (western Colorado and southern Utah) and the eastern Sierra Nevada.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This woodland occurs midslope on drainageways, valleysides, ridges, and hills; toeslopes of interfluves; and on floodplains. Sites are gentle to steep (2- to 30-degree slopes), occur between 2503 and 2759 m in elevation, and are oriented to all aspects. The ground surface has moderate to high cover of litter and duff, sparse to low cover of large and small rocks, sparse to high exposure of bare soil, and sparse to low cover of downed wood. Litter depths range

from 0-6.3 cm. Soils are moderately well-drained to rapidly drained silty clays, silt clay loams, sandy clays, sandy loams, and sandy clay loams derived from the Straight Cliffs Formation, Cedar Canyon Formation, older alluvium, and alluvial fan deposits.

Globally
This woodland association has been reported from the Colorado Plateau and eastern Sierra Nevada, from mountains and plateaus in Colorado, Utah and California. Elevation ranges from 1770-2600 m (5800-8500 feet). Sites are dry, warm, mid- to lower slopes, benches and ridgetops often with southerly aspects. Slopes are level to moderate. Soils are typically sandy loams but vary from sand to silt loam. Parent materials are sandstone, limestone and occasionally basalt and andesite.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is low to moderate (16-54% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-20 m, has dbh ranging from 14-85 cm, and provides 1-14% cover, and by the short shrub *Arctostaphylos patula* that contributes 1-35% cover. Associated canopy trees range from 5-20 m tall and include *Abies concolor, Picea engelmannii, Pinus flexilis*, and *Pseudotsuga menziesii* that have a range of dbh from 12-62 cm and contribute sparse to low cover. Subcanopy *Abies concolor, Cercocarpus ledifolius, Juniperus scopulorum, Picea pungens, Pinus flexilis, Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii* trees from 2-10 m tall also contribute sparse to low cover. Other shrubs present contribute only low cover and may include *Amelanchier utahensis* or *Quercus gambelii* that are 1-2 m tall, and shorter shrubs such as *Ceanothus martinii, Purshia tridentata, Symphoricarpos oreophilus, Mahonia repens, Juniperus communis*, and *Paxistima myrsinites*. The herbaceous layer is moderate to high in diversity and contributes sparse to low cover. Common graminoids include *Bromus anomalus, Carex rossii, Elymus elymoides*, and *Poa fendleriana*. Forbs that contribute low cover include *Cirsium wheeleri, Lithospermum multiflorum*, and *Solidago multiradiata*. Seedling trees up to 2 m tall provide sparse cover and include *Abies concolor, Juniperus scopulorum, Picea engelmannii, Pinus ponderosa*, and *Pseudotsuga menziesii*.

Globally
This woodland association is characterized by a tree canopy dominated by *Pinus ponderosa* that is typically open (about 30% cover) but can range from 10-80% cover. Scattered *Juniperus scopulorum* trees may also be present. *Arctostaphylos patula* dominates the moderate to sparse shrub layer. Others shrub species present may include *Amelanchier utahensis, Ceanothus* spp., *Cercocarpus intricatus, Cercocarpus montanus, Fraxinus anomala, Juniperus communis, Mahonia repens, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus*, and *Tetradymia canescens*. The sparse herbaceous layer (<20% cover) is primarily composed of graminoids such as *Carex rossii, Achnatherum hymenoides (= Oryzopsis hymenoides), Elymus elymoides, Leymus salinus (= Elymus salinus)*, and *Poa fendleriana*. Forbs are sparse and may include *Achillea millefolium, Balsamorhiza sagittata, Heterotheca villosa*, and *Eriogonum racemosum*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Pinus ponderosa*
Tree subcanopy	*Juniperus scopulorum*
Short shrub/sapling	*Arctostaphylos patula*, *Purshia tridentata*
Herb (field)	*Juniperus communis*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Juniperus scopulorum*, *Pinus ponderosa*
Short shrub/sapling	*Arctostaphylos patula*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument

Achillea millefolium, *Tragopogon dubius*

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Pine woodlands.

Globally
This plant association is seral in California.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Slopes are subject to desiccation due to exposure; some stands have fire-scarred trunks and deadfall; some *Arctostaphylos patula* shrubs have up to 25% dead branches; and one stand has experienced significant blowdown of trees.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (10 plots): (Plots: CEBR0033, CEBR0034, CEBR0095, CEBR0098, CEBR0108, CEBR0119, CEBR0134, CEBR0141, CEBR0168, CEBR0171), and 11 AA points (CEBR_AA.0393, CEBR_AA.0209, CEBR_AA.0236, CEBR_AA.0235, CEBR_AA.0323, CEBR_AA.0225, CEBR_AA.0290, CEBR_AA.0267, CEBR_AA.0301, CEBR_AA.0282, CEBR_AA.0304).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, Graybosch and Buchanan 1983, Johnston 1987, Roberts et al. 1992, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Pinus ponderosa / Purshia tridentata Woodland

Ponderosa Pine / Antelope Bitterbrush Woodland

CODE	CEGL000867
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS PONDEROSA* WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Northern Rocky Mountain Foothill Conifer Wooded Steppe (CES306.958)
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This *Pinus ponderosa* woodland occurs in montane zones in the Rocky Mountains and in sheltered canyons and high plateaus in the Colorado Plateau, from Colorado to Montana west to Utah, Washington, Oregon, and California. Stands tend to occupy south-facing, moderate to somewhat steep slopes (10-49%) in the Rockies, whereas Colorado Plateau stands prefer northern and eastern slopes and benches. Elevations range from 2165 to 2760 m (7100-9040 feet). Soils are relatively deep, mesic, well-drained sandy loams or loamy sands derived from sandstone, granite, colluvium or alluvium. Ground cover of litter and duff is often significant (30-60%). This *Pinus ponderosa* woodland is strongly dominated by *Pinus ponderosa*, often in open stands (10-40% cover) 10 to 35 m tall.

Pseudotsuga menziesii, Juniperus scopulorum, Pinus edulis, and *Populus tremuloides* are common associates. The shrub layer is characterized and dominated by *Purshia tridentata*, although cover may be as low as 1% in sparsely vegetated stands. Additional species include *Quercus gambelii* (<10% cover), *Arctostaphylos uva-ursi, Artemisia bigelovii, Artemisia tridentata, Mahonia repens, Ribes cereum*, and *Juniperus communis*. In the northern states, *Amelanchier alnifolia, Prunus virginiana*, or *Symphoricarpos albus* occur. The herbaceous layer is inversely proportional to shrub cover and is dominated by graminoids, especially *Muhlenbergia montana*. Additional graminoids include *Bouteloua gracilis, Carex geyeri, Carex rossii, Danthonia parryi, Poa fendleriana, Pseudoroegneria spicata, Hesperostipa comata, Leucopoa kingii*, and *Festuca idahoensis*. Forbs are present and often diverse but have low cover. Forb composition largely depends on geographic region but often includes *Achillea millefolium var. occidentalis (= Achillea lanulosa), Antennaria* spp., *Artemisia ludoviciana, Eriogonum racemosum, Penstemon virens*, and *Sedum lanceolatum*, among many others. Bare ground and needle duff can be prevalent in some stands.

DISTRIBUTION

Cedar Breaks National Monument

This woodland was sampled on a stream terrace of Adams Creek near its confluence with Ashdown Creek.

Globally

This *Pinus ponderosa* woodland occurs in montane zones in the western United States from Colorado to Montana west to Utah and California.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This woodland occurs on a terrace of Adams Creek that is elevated 2-3 m above its streambed. The site is nearly flat (1-degree slope), occurs at 2482 m in elevation, and is oriented to the west (280 degrees). The ground surface has high cover of litter and duff and sparse cover of large and small rocks. Litter depths range from 0.1-2.1 cm. Soils are rapidly drained sandy clays derived from alluvium.

Globally

This *Pinus ponderosa* woodland occurs in montane zones in the Rocky Mountains and in sheltered canyons and high plateaus in the Colorado Plateau from Colorado to Montana west to Utah, Washington, Oregon, and California. Stands tend to occupy south-facing, moderate to somewhat steep slopes (10-49%) in the Rockies, whereas Colorado Plateau stands prefer northern and eastern slopes and benches. Elevations range from 2165 to 2760 m (7100-9040 feet). Soils are relatively deep, mesic, well-drained sandy loams or loamy sands derived from sandstone, granite, colluvium or alluvium. Ground cover of litter and duff is often significant (30-60%).

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is low (19% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 10-15 m, has dbh ranging from 45-50 cm, and provides 8% cover, and by *Purshia tridentata* short shrubs that provide 4% cover. Associated canopy trees include *Abies concolor* and *Picea pungens* (one tree with a dbh of 54 cm) that contribute sparse cover. Subcanopy *Pinus ponderosa* and *Populus angustifolia* trees from 2-5 m tall also contribute sparse cover. The other shrubs present include *Arctostaphylos patula* and *Symphoricarpos oreophilus*. The herbaceous layer is moderate to high in floristic diversity and contributes sparse cover. Seedlings up to 2 m tall provide sparse cover and include *Abies concolor, Cercocarpus ledifolius, Juniperus scopulorum, Picea pungens, Pinus ponderosa, Populus angustifolia*, and *Populus tremuloides*.

Globally

This *Pinus ponderosa* woodland is strongly dominated by *Pinus ponderosa*, often in open stands (10-40% cover) 10 to 35 m tall. *Pseudotsuga menziesii, Juniperus scopulorum, Pinus edulis*, and *Populus tremuloides* are common associates. The shrub layer is characterized and dominated by *Purshia tridentata*, although cover may be as low as 1% in sparsely vegetated stands. Additional species include *Quercus gambelii* (<10% cover), *Arctostaphylos uva-ursi, Artemisia bigelovii, Artemisia tridentata, Mahonia repens, Ribes cereum*, and *Juniperus communis*. In the northern states, *Amelanchier alnifolia, Prunus virginiana*, or *Symphoricarpos albus* occur. The herbaceous layer is inversely proportional to shrub cover and is dominated by graminoids, especially *Muhlenbergia montana*. Additional graminoids include *Bouteloua gracilis, Carex geyeri, Carex rossii, Danthonia parryi, Poa fendleriana, Pseudoroegneria spicata, Hesperostipa comata, Leucopoa kingii*, and *Festuca idahoensis*. Forbs are present and

often diverse but have low cover. Forb composition largely depends on geographic region but often includes *Achillea millefolium var. occidentalis (= Achillea lanulosa), Antennaria* spp., *Artemisia ludoviciana, Eriogonum racemosum, Penstemon virens*, and *Sedum lanceolatum*, among many others. Bare ground and needle duff can be prevalent in some stands.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Pinus ponderosa*
Short shrub/sapling	*Purshia tridentata*

Globally

Stratum	Species
Tree canopy	*Pinus ponderosa var. scopulorum*
Shrub/sapling (tall & short)	*Purshia tridentata*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Pine woodlands.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Site is on a flat stream terrace, flooding appears to be intermittent or episodic.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 plot): (Plots: CEBR.0032) and one AA point from 2007 (CEBR_AA.0173)
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: S.L. Neid, mod. J. Coles

REFERENCES: Baker 1984a, Barrows et al. 1977, Bourgeron and Engelking 1994, Brayshaw 1965, CONHP unpubl. data 2003, Clausnitzer and Zamora 1987, Daubenmire 1952, Daubenmire and Daubenmire 1968, Driscoll et al. 1984, Franklin and Dyrness 1973, Hall 1973, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hopkins 1979b, Johnson and Simon 1987, Johnston 1987, Johnston and Huckaby 2001, Larson 1974, MTNHP 2002b, Mauk and Henderson 1984, Peet 1975, Pfister et al. 1977, Roberts et al. 1992, Rowdabaugh 1978, Steele et al. 1981, Wasser and Hess 1982, Western Ecology Working Group n.d., Williams and Lillybridge 1985, Youngblood and Mauk 1985, Zlatnik 1999

Pseudotsuga menziesii / Arctostaphylos patula Woodland

Douglas-fir / Greenleaf Manzanita Woodland

CODE	CEGL000423
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.b.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This minor woodland association has been reported from the mountains and plateaus of southern Utah. Elevation ranges from 1829-2653 m (6000-8700 feet). Sites are steep mid to lower slopes, often with eastern, northern or western aspects. Soils are typically loam or sandy loam. Parent materials are usually sandstone or limestone. This association is characterized by a typically open tree canopy (about 30% cover) that is dominated or codominated by *Pseudotsuga menziesii*, usually with *Pinus ponderosa* present to codominant. Scattered *Pinus flexilis* and *Juniperus scopulorum* trees may also be present. *Arctostaphylos patula* dominates the moderate to sparse shrub layer with *Mahonia repens* a common associate. Others shrub species present may include *Acer glabrum, Amelanchier utahensis, Ceanothus* spp., *Cercocarpus ledifolius, Cercocarpus montanus, Purshia tridentata, Quercus gambelii*, and *Symphoricarpos oreophilus*. The sparse herbaceous layer (<20% cover) is primarily composed of graminoids, such as *Carex rossii, Achnatherum hymenoides (= Oryzopsis hymenoides), Elymus elymoides, Leymus salinus, Poa fendleriana*, and *Pseudoroegneria spicata*. Forbs are sparse and may include *Achillea millefolium, Astragalus miser, Clematis columbiana, Eriogonum racemosum*, and *Hymenoxys richardsonii*.

DISTRIBUTION

Cedar Breaks National Monument

This woodland association has limited distribution in the monument and was observed on Meadow Hill, Cheesman Canyon and on Cheesman Ridge.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This woodland association occurs on steep midslopes (25-36 degree slope), occurs at 2630-2700 m in elevation, and is oriented to the southwest to northwest. The ground surface has high cover of rocks, sparse to high cover of litter and duff, and low exposure of bare soil. Soils are rapidly drained.

Globally

This minor woodland association has been reported from the mountains and plateaus of southern Utah. Elevation ranges from 1829-2653 m (6000-8700 feet). Sites are steep mid to lower slopes, often with eastern, northern or western aspects. Soils are typically loam or sandy loam. Parent materials are usually sandstone or limestone.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate (51% cover) and is characterized by the canopy tree *Pseudotsuga menziesii* that ranges in height from 10-15 m and provides 4% cover, and by the short shrub *Arctostaphylos patula* that provides 32% cover. *Pinus ponderosa* provides sparse cover in the canopy layer. The subcanopy layer provides low cover and also includes *Pseudotsuga menziesii* and *Pinus ponderosa*. The remaining shrubs present include *Mahonia repens,*

Ceanothus martinii, Symphoricarpos oreophilus, Purshia tridentata, Juniperus communis, and *Amelanchier utahensis* with trace to <1% cover. The herbaceous layer is moderate in terms of floristic diversity and contributes sparse cover with no one species contributing 1% cover or higher. Species present include *Draba subalpina, Machaeranthera canescens, Solidago velutina, Packera multilobata (= Senecio multilobatus), Solidago multiradiata, Cirsium* spp., *Clematis columbiana, Heterotheca villosa (= Chrysopsis villosa), Castilleja linariifolia, Achnatherum hymenoides (= Stipa hymenoides)*, and *Poa fendleriana*.

Globally
This association is characterized by a typically open tree canopy (about 30% cover) that is dominated or codominated by *Pseudotsuga menziesii*, usually with *Pinus ponderosa* present to codominant. Scattered *Pinus flexilis* and *Juniperus scopulorum* trees may also be present. *Arctostaphylos patula* dominates the moderate to sparse shrub layer with *Mahonia repens* a common associate. Others shrub species present may include *Acer glabrum, Amelanchier utahensis, Ceanothus* spp., *Cercocarpus ledifolius, Cercocarpus montanus, Purshia tridentata, Quercus gambelii*, and *Symphoricarpos oreophilus*. The sparse herbaceous layer (<20% cover) is primarily composed of graminoids, such as *Carex rossii, Achnatherum hymenoides (= Oryzopsis hymenoides), Elymus elymoides, Leymus salinus, Poa fendleriana*, and *Pseudoroegneria spicata*. Forbs are sparse and may include *Achillea millefolium, Astragalus miser, Clematis columbiana, Eriogonum racemosum*, and *Hymenoxys richardsonii*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Pseudotsuga menziesii*
Short shrub/sapling	*Arctostaphylos patula*

Globally

Stratum	Species
Tree canopy	*Pinus ponderosa*, *Pseudotsuga menziesii*
Tall shrub/sapling	*Arctostaphylos patula*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Draba subalpina

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This *Pseudotsuga menziesii* woodland is typically codominated by *Pinus ponderosa* and occurs at the lower elevation range of *Pseudotsuga menziesii* woodlands (Youngblood and Mauk 1985). *Pinus ponderosa* and *Pseudotsuga menziesii* codominate the tree canopy, often with *Pinus ponderosa* more abundant (Youngblood and Mauk 1985). This association is very similar to the more xeric *Pinus ponderosa / Arctostaphylos patula* Woodland (CEGL000842), which may occur nearby, but this association is less xeric with *Pseudotsuga menziesii* dominating/codominating the tree canopy and the presence of mesophytic understory species such as *Acer glabrum* and *Clematis columbiana* (Graybosch and Buchanan 1983). More study is needed to clarify where to separate transition stands.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Fire history indicated by charred trunks and downed logs, slope is erosive with intermittent drainages present, vegetation grows in patches, rocks are prevalent.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 observation point): (Observation Points: CEBR.9094) 5 AA points from 2007 (CEBR_AA.0052, CEBR_AA.0274, CEBR_AA.0171, CEBR_AA.0181, CEBR_AA.0178)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Graybosch and Buchanan 1983, Roberts et al. 1992, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Abies lasiocarpa - Picea engelmannii / Juniperus communis Woodland

Subalpine Fir - Engelmann Spruce / Common Juniper Woodland

CODE	CEGL000919
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION (II.A.4.N.c.)	Cylindrical-crowned temperate or subpolar needle-leaved evergreen woodland
ALLIANCE	*ABIES LASIOCARPA* WOODLAND ALLIANCE (A.559) Subalpine Fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This spruce-fir woodland association occurs in localized areas within the subalpine to upper montane zones of the western United States. The primary elevation range for the association is between 2530 and 3200 m (8300-11,500 feet). It occurs on gentle to somewhat steep mid- to upper slopes of all aspects and on benches or at lower elevations on dry stream terraces with cold-air drainage. Soils are variable but generally rocky and well-drained with substantial areas of lichen-covered bedrock or bare soil. This association is among the driest types of *Abies lasiocarpa* forests and woodlands. The canopy is relatively open and dominated by *Abies lasiocarpa* with *Picea engelmannii* often codominant. Seral species in the tree canopy can include *Pinus contorta, Pinus flexilis, Picea pungens*, and *Populus tremuloides*, with *Pseudotsuga menziesii* occurring on relatively warmer sites. The shrub layer is often sparse but characterized by large, widely spaced patches of *Juniperus communis*. Additional shrub species occur and can include *Shepherdia canadensis, Vaccinium scoparium, Ribes montigenum, Symphoricarpos oreophilus*, and occasionally *Mahonia repens, Vaccinium myrtillus*, or *Vaccinium caespitosum*. The herbaceous layer is likewise sparse. Species occurring most frequently include *Arnica cordifolia, Lupinus argenteus, Fragaria virginiana, Chamerion angustifolium (= Epilobium angustifolium)*, and *Antennaria* spp. Diagnostic characteristics of this association include *Abies lasiocarpa* and *Picea engelmannii* in the tree canopy and *Juniperus communis* patches in the understory with greater cover than other shrub species.

DISTRIBUTION
Cedar Breaks National Monument
This uncommon woodland association was sampled on Rattlesnake Trail, Sunset Overlook, north of the campground, near the Visitor Center, in The Meadows near Ashdown Creek, near Adams Barrier, and in the environs north of the monument boundary.

Globally
This spruce-fir woodland association occurs in localized areas within the subalpine to upper montane zones of the western United States from Montana to Washington south to Arizona and New Mexico.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This woodland association occurs on plateaus, slopes, and in valleys. Sites are gentle to moderately steep (2- to 35-degree slopes), occur between 2609 and 3182m in elevation, and are oriented to the southeast and northwest. The ground surface has low to high cover of litter and duff, sparse to high cover of large and small rocks, and moderate exposure of bare soil. Litter depths range from 0-2.2 cm. Soils are rapidly drained sandy clays, sandy clay loams, and silty clay loams derived from older alluvium and the Claron Formation (White and Red members).

Globally
This spruce-fir woodland association occurs in localized areas within the subalpine to upper montane zones of the western United States. The primary elevation range for the association is between 2530 and 3200 m (8300-11,500 feet), but it occurs at lower elevations, 2600-2800 m (8700-9200 feet), on the north Kaibab Plateau. It occurs on gentle to somewhat steep mid- to upper slopes of all aspects and on benches or at lower elevations on dry stream terraces with cold-air drainage. Soils are variable but generally rocky and well-drained with substantial areas of lichen-covered bedrock or bare soil.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is low to moderate (18-52% cover) and is characterized by the canopy trees *Abies lasiocarpa* and *Picea engelmannii* that range in height from 5-20 m, have dbh for *Picea engelmannii* ranging between 17 and 38 cm, and provide 0-15% and 0-2% cover, respectively, and by *Juniperus communis* short shrubs that contribute 2-30% cover. In two stands, *Pseudotsuga menziesii* canopy trees to 20 m tall with 13-24 cm dbh contribute 2-10% cover, and in another stand *Pinus flexilis* canopy trees between 20 and 35 m tall contribute 12% cover. The subcanopy layer provides sparse cover (0-8%) and includes *Abies lasiocarpa, Picea engelmannii*, and *Pinus flexilis* that range between 2 and 10 m tall. The remaining shrubs provide sparse cover and include *Ribes cereum, Mahonia repens*, and *Paxistima myrsinites*. The herbaceous layer is moderately high in floristic diversity and contributes sparse cover. Common graminoids include *Carex rossii* and *Elymus elymoides*. Forbs commonly present include *Swertia radiata, Smilacina stellata, Mertensia arizonica, Solidago velutina Senecio multilobatus, Vicia americana, Arenaria fendleri, Thalictrum fendleri,* and *Ligusticum porteri* . Seedling *Abies lasiocarpa, Picea engelmannii*, and *Pinus flexilis* contribute sparse cover.

Globally
The canopy of this spruce-fir woodland is relatively open and dominated by *Abies lasiocarpa* with *Picea engelmannii* often codominant. Seral species in the tree canopy can include *Pinus contorta, Pinus flexilis, Picea pungens*, and *Populus tremuloides*, with *Pseudotsuga menziesii* occurring on relatively warmer sites. The shrub layer is often sparse but characterized by large, widely spaced patches of *Juniperus communis*. Additional shrub species occur and can include *Shepherdia canadensis, Vaccinium scoparium, Ribes montigenum, Symphoricarpos oreophilus*, and occasionally *Mahonia repens, Vaccinium myrtillus*, or *Vaccinium caespitosum*. The herbaceous layer is likewise sparse. Species occurring most frequently include *Arnica cordifolia, Lupinus argenteus, Fragaria virginiana, Chamerion angustifolium (= Epilobium angustifolium)*, and *Antennaria* spp.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree (canopy & subcanopy)	*Abies lasiocarpa*, *Picea engelmannii*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Arctostaphylos patula*

Globally

Stratum	Species
Tree canopy	*Abies lasiocarpa* var. *lasiocarpa*, *Picea engelmannii*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Spruce-fir forest.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Tree cover is sparse and patchy; healthy forest stand with little beetle kill in Engelmann spruce; open meadow patches of woodlands may result from lightning-caused fires; stand occupies mesic slope armored with angular gravel; stand has heavy accumulation of downed fuel.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (3 plots and 1 observation point): (Plots: CEBR.0103, CEBR.0106, CEBR.0154; Observation Points: CEBR.9047), and 3 AA points (CEBR_AA.0394, CEBR_AA.0279, CEBR_AA.0281), *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: S.L. Neid

REFERENCES: Bourgeron and Engelking 1994, Clagg 1975, Driscoll et al. 1984, Henderson et al. 1986, Henderson et al. 1989, Hoffman and Alexander 1976, Johnston 1984, Johnston 1987, Jones and Ogle 2000, Komarkova et al. 1988b, Larson and Moir 1987, MTNHP 2002b, Mauk and Henderson 1984, Moir and Ludwig 1979, Pfister et al. 1977, Roberts 1980, Steele et al. 1981, Steele et al. 1983, Tirmenstein 1999a, Western Ecology Working Group n.d., Youngblood and Mauk 1985

Picea pungens / Equisetum arvense Woodland

Blue Spruce / Field Horsetail Woodland

CODE	CEGL000389
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION (II.A.4.N.d.)	Temporarily flooded temperate or subpolar needle-leaved evergreen woodland
ALLIANCE	*PICEA PUNGENS* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.567) Blue Spruce Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
R ocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally

This association is restricted to narrow canyons and cool ravines on stream benches and streambanks in Colorado, Utah, and Wyoming. Stands occur at elevations of 2135-2745 m (7000-9000 feet) and are characterized by dominance of *Picea pungens* with a thick understory of *Equisetum arvense* and few shrubs. Other tree species possibly present include *Pseudotsuga menziesii, Pinus contorta*, and *Picea engelmannii*. Shrub cover is minor, yet diverse and may include *Betula glandulosa, Salix geyeriana, Salix monticola*, and *Rosa woodsii*. The herbaceous undergrowth typically consists of few species including *Equisetum arvense, Carex aquatilis*, and *Juncus balticus var. montanus*. Frequent flooding appears important to maintaining the species in the herbaceous layer.

DISTRIBUTION

Cedar Breaks National Monument

This uncommon wooded wetland association was sampled only along the Bartizan Trail.

Globally

This minor association is known from Colorado and Utah, and likely occurs in southwestern Wyoming and southeastern Idaho.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This wooded wetland association occurs adjacent to a wet meadow. The site is gently sloped (6 degrees), occurs at 2614 m in elevation, and is oriented to the northwest. The ground surface has moderate exposure of bare soil, moderate cover of litter, and low cover of downed wood. Soils are somewhat poorly drained and can be described as spongy.

Globally

This association occurs in cool, narrow canyons or north-facing aspects on poorly drained flats, stream terraces, gentle toeslopes, or on seeps. It occurs at elevations ranging from 878 to 2805 m (2880-9200 feet). Soils are continually saturated or moderately well-drained. The water table is within 50 cm of the surface. Textures are highly variable and range from loamy skeletal, sandy skeletal, fine loamy to silt loam and clay loam.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is dense (69% cover) and is characterized by the canopy tree *Picea pungens* that ranges in height from 15-20 m and provides 10% cover, and by the fern ally *Equisetum arvense* that provides 12% cover. The subcanopy provides sparse cover and includes *Picea pungens* and *Pseudotsuga menziesii*. Shrubs present in low cover include *Alnus incana* and *Juniperus communis*. The herbaceous layer is moderate in terms of floristic diversity, contributes moderate cover, and includes the graminoids *Carex utriculata* and *Poa palustris*. The forbs *Aconitum columbianum* and *Symphyotrichum spathulatum (= Aster spathulatus)* provide low to moderate cover. Mosses and lichens provide moderate cover (up to 19%).

Globally

These riparian stands are dominated by an overstory canopy of *Picea pungens*. Sometimes *Picea engelmannii* also occurs, as well as a few scattered *Abies lasiocarpa* individuals. *Populus tremuloides* and *Pseudotsuga menziesii* may also be present. The shrub layer is sparse, with such shrubs as *Alnus incana, Betula occidentalis, Betula glandulosa, Lonicera involucrata, Amelanchier alnifolia, Symphoricarpos oreophilus, Salix monticola*, and *Salix geyeriana*. The herbaceous layer can be monotypic with *Equisetum arvense* (sometimes *Equisetum hyemale*) the sole dominant. Other herbaceous species that may be present include *Carex aquatilis, Carex disperma, Juncus balticus, Elymus glaucus, Glyceria striata (= Glyceria elata), Geranium richardsonii, Senecio triangularis, Galium boreale, Orthilia secunda*, and *Maianthemum stellatum (= Smilacina stellata)*.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Picea pungens*
Herb (field)	*Aconitum columbianum*, *Symphyotrichum spathulatum*
Herb (field)	*Carex utriculata*, *Poa palustris*
Herb (field)	*Equisetum arvense*

Globally

Stratum	Species
Tree canopy	*Picea pungens*
Herb (field)	*Equisetum arvense*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3? (29-Dec-1999). This minor riparian association is known from Colorado, Utah, and Wyoming. Less than 100 occurrences are estimated to exist. Threats are imposed by overuse from recreation and livestock, and alteration of flood regimes from dams and diversions. Soils are often wet and easily compacted by livestock, and frequent flooding appears important to maintain the dominance of *Equisetum arvense*, at least in stands in Colorado. The question mark in the rank indicates the uncertainty of how many occurrences exist in Utah. Classification clarification of similar stands in Utah and Wyoming is needed to know the extent of this type.

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This association is known from Colorado and Utah, and western Wyoming as part of the Conifer/*Equisetum arvense* and the *Picea / Equisetum arvense* community types (Padgett et al. 1989, Youngblood et al. 1985a, respectively). These closely related forest communities have tree canopies dominated by either *Picea engelmannii* or *Picea pungens*, or codominated by both species. Hansen et al. (1995) also reported a *Picea / Equisetum arvense* community type, but in Montana these are either *Picea engelmannii* or *Picea glauca* or hybrids of the two.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Area receives drainage from surrounding slopes, soils are saturated and spongy to the step, there is some pooled water, some mature trees have died apparently from soil saturation.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 observation point): (Observation Points: CEBR.9087), and 1 AA point was observedin 2007 (CEBR_AA.0286).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: J. Thompson and J. Stevens, mod. G. Kittel

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Hansen et al. 1995, Kittel et al. 1996, Kittel et al. 1999b, Padgett et al. 1988b, Padgett et al. 1989, Western Ecology Working Group n.d., Youngblood and Mauk 1985, Youngblood et al. 1985a

Cercocarpus ledifolius / Arctostaphylos patula Woodland [Provisional]

Curl-leaf Mountain Mahogany / Greenleaf Manzanita Woodland

CODE	CEGL005355
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen woodland (II.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen woodland (II.A.5.N.)
FORMATION	Sclerophyllous extremely xeromorphic evergreen woodland (II.A.5.N.a.)
ALLIANCE	*CERCOCARPUS LEDIFOLIUS* WOODLAND ALLIANCE (A.586) Curl-leaf Mountain-mahogany Woodland Alliance

ECOLOGICAL SYSTEM(S):USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association is described only from Cedar Breaks and Bryce Canyon national parks in southwest Utah. Stands occur from 2140 to 2713 m (7000-8900 feet) in elevation, on gentle to steep slopes with southern exposure. Soils are rapidly drained sandy loams and sandy clay loams. One stand occurs as a dense thicket along a creek, on colluvium washed down a side drainage. This is an open-statured woodland characterized by a canopy of *Cercocarpus ledifolius*, which can be considered a tall shrub or a low tree. Scattered emergent conifer trees may also be present, including *Pseudotsuga menziesii, Pinus ponderosa, Juniperus scopulorum*, and/or *Pinus edulis*; these generally do not have more than a quarter to half the cover of *Cercocarpus ledifolius*. The shrub layer present is open and patchy and dominated by short-statured *Arctostaphylos patula*. A few taller shrubs may be present in low abundance, including *Amelanchier utahensis* and *Cercocarpus montanus*. Other short shrubs include *Symphoricarpos oreophilus, Ericameria nauseosa*, and *Mahonia repens*. The herbaceous layer is very sparse to absent.

DISTRIBUTION

Cedar Breaks National Monument

This uncommon woodland was sampled north of Chessmen Ridge, near Meadow Hill, Columbine Canyon, The Quarry, east of Adams Canyon and on a colluvial slope in the Adams Creek drainage near its confluence with Ashdown Creek.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This woodland association occurs on colluvial slopes, hills, and valleys, approximately midslope. Sites are steep (16- to 34-degree slopes), occur between 2580 and 2713 m in elevation, and are oriented to the south. The ground surface has moderate to high cover of litter and duff, low cover of large and small rocks, and low to moderate exposure of bare soil. Litter depths range from 0-3.4 cm. There is low cover of downed wood. Soils are well-drained sandy loams derived from the Cedar Canyon and Straight Cliffs formations.

Globally

Data are not available.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate to dense (39-67% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and provides 18-39% cover, and by the short shrub *Arctostaphylos patula* that provides 9-38% cover. Emergent *Pseudotsuga menziesii* trees between 10-15 m tall (24 cm dbh) provide sparse cover. Subcanopy *Juniperus scopulorum* and *Pseudotsuga menziesii* trees from 2-5 m tall also contribute sparse cover. The remaining short- and dwarf-shrub layers are low in terms of species composition and include *Mahonia repens*. The herbaceous layer is low in terms of floristic diversity and contributes sparse cover. Seedling trees provide sparse cover and include *Abies concolor* and *Juniperus scopulorum*.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Cercocarpus ledifolius*
Short shrub/sapling	*Arctostaphylos patula*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (3-Mar-2008).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane shrubland.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Site is steep and exposed, runoff and wind reduce litter layer; majority of *Cercocarpus ledifolius* grows on the western exposure of Meadow Hill; rock cover on one site increases moisture availability.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 plot and 2 observation points): (Plots: CEBR.0094; Observation Points: CEBR.9042, CEBR.9099) and 5 AA points (CEBR_AA.0135, CEBR_AA.0111, CEBR_AA.0109, CEBR_AA.0107, CEBR_AA.0156)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Western Ecology Working Group n.d.

Arctostaphylos patula Shrubland

Greenleaf Manzanita Shrubland

CODE	CEGL002696
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Temperate broad-leaved evergreen shrubland (III.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.)
FORMATION	Sclerophyllous temperate broad-leaved evergreen shrubland (III.A.2.N.c.)
ALLIANCE	*ARCTOSTAPHYLOS PATULA* SHRUBLAND ALLIANCE (A.788) Greenleaf Manzanita Shrubland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Semi-Desert Chaparral (CES304.001)
Mo gollon Chaparral (CES302.741)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association has been found mostly in southwestern Utah but observed in at least one stand in western Colorado. Most sites are on gentle to moderate slopes between 1770 and 2655 m (5800-8700 feet) elevation. The short-shrub canopy can have low to high cover (5-90%) but is consistently dominated by *Arctostaphylos patula*. Other shrubs may be found at low cover, including *Amelanchier utahensis, Artemisia tridentata, Ericameria nauseosa, Purshia tridentata, Quercus gambelii*, and *Tetradymia canescens*. The herbaceous stratum has sparse to low cover and is composed of species common to dry sites on the Colorado Plateau.

DISTRIBUTION
Cedar Breaks National Monument

This shrubland association was sampled in Chessman Canyon and on Shooting Star Ridge

Globally
This association has been sampled extensively from Zion National Park in southwestern Utah with additional stands observed in Cedar Breaks NP, Utah and Colorado National Monument in western Colorado.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This shrubland occurs on north and south facing aspects on moderate (8%) to steep (35%) very rocky slopes on the Claron and Wahweep Formations. Stands were observed from 2603 to 2700 m in elevation.

Globally
This association usually occurs on mesatops and plateaus between 1737 and 2700 m elevation. Slopes can have any aspect and are gentle to moderately sloping to steep (35 degrees). One lower elevation site (1558 m) was observed on a steep northeast slope. Soils are sands to sandy loams.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This shrubland forms dense clumps of *Arctostaphylos pungens* with 23-38% canopy cover. Other shrubs that may be present include *Juniperus communis, Ceanothus martini* and *Purshia tridentata*. Trees are never far away and are always present with low cover (trace to up to 4%). Several conifer species were observed with only trace cover including *Abies concolor, Pinus longaeva, Pinus ponderosa , Picea pungens,* and *Pseudotsuga menziesii*.

Globally
This shrubland association can have variable cover but is dominated by *Arctostaphylos patula* with 5-90% cover. The shrub canopy is between 1-2 m tall. Other shrubs contribute only limited cover. These associates include *Amelanchier utahensis, Artemisia tridentata, Ericameria nauseosa, Purshia tridentata, Quercus gambelii*, *Juniperus communis, Ceanothus martini* and *Tetradymia canescens*. Widely scattered trees may be found. The herbaceous stratum has sparse to low cover and is composed of species common to dry sites. These include the graminoids *Achnatherum hymenoides, Carex rossii, Hesperostipa comata, Poa fendleriana*, and *Sporobolus cryptandrus*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument
Arctostaphylos pungens
Globally

Stratum	Species
Short shrub/sapling	*Arctostaphylos patula*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument

Globally
Yucca elata var. utahensis

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (14-Aug-2001).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument

Globally
Nearly all the plots for this association are from Zion National Park with one from Colorado National Monument. The description may be skewed based on this.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Data are not available.

Cedar Breaks National Monument Plots: 4 AA points from 2007 (CEBR_AA.0189, CEBR_AA.0265, CEBR_AA.0266, CEBR_AA.0285,)
Local Description Authors: G. Kittel
Global Description Authors: J. Drake

REFERENCES: CONHP unpubl. data 2003, Cogan et al. 2004, Western Ecology Working Group n.d.

*Artemisia cana (*ssp. *bolanderi,* ssp. *viscidula) / Poa pratensis* Semi-natural Shrubland (Bolander Silver Sagebrush, Mountain Silver Sagebrush) / Kentucky Bluegrass Semi-natural Shrubland

CODE	CEGL002988
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA CANA (SSP. BOLANDERI, SSP. VISCIDULA)* SHRUBLAND ALLIANCE (A.2557) (Bolander's Silver Sagebrush, Mountain Silver Sagebrush) Shrubland Alliance

ECOLOGICAL SYSTEM(S): Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe (CES304.084)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association occurs in high mountain valleys, on broad flat, gently sloping to undulating alluvial outwash fans, first or second stream terraces, toeslopes or seeps. Elevation ranges from 1445 to 2560 m (4753-8400 feet). It generally occurs as narrow stringers along stream courses, or in meadows where the water table is near the surface seasonally. Soils are deep and finely textured, alluvial, often with mottling, indicating a fluctuating water table at depths of 60-100 cm below the soil surface. *Artemisia cana* is the major short-shrub component (10-40% canopy cover); other sagebrush species may also be present in lower abundance such as *Artemisia tridentata* or *Artemisia tridentata ssp. vaseyana*. Other shrubs include *Dasiphora fruticosa ssp. floribunda* and *Betula glandulosa*. The herbaceous cover is sparse to thick and is generally dominated by *Poa pratensis*. Other herbaceous species present include *Carex simulata, Juncus balticus, Hesperostipa* and/or *Achnatherum* spp. (= *Stipa* spp., *Achillea millefolium, Potentilla gracilis, Trifolium* spp., *Taraxacum officinale*, and *Geranium viscosissimum*. This association is considered a grazing-induced version of *Artemisia cana / Festuca idahoensis* in Idaho, Utah, western Wyoming and Montana, or *Artemisia cana / Deschampsia caespitosa* in northeastern Oregon. It can also be a grazing-induced type of *Artemisia cana / Pascopyrum smithii* and *Artemisia cana / Elymus trachycaulus*, also in Montana. Depending on the degree of disturbance, one may find traces of these native graminoid species in the undergrowth.

DISTRIBUTION
Cedar Breaks National Monument
This semi-natural short-shrub association has limited distribution within the park. It is more common at lower elevations. It was sampled near the Chessmen Ridge Overlook, south of Alpine Pond and State Highway143 within the monument and in Dixie National Forest near Brian Head.

Globally
This association is known from northeastern Oregon, Idaho, western Wyoming, southwestern Montana, Utah, and possibly Colorado.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This short-shrub association occurs on a ridge between intermittent drainages on midslope positions and in a valley bottom. The sites are gentle (2- to 6-degree slopes), occur between 2179 and 3188 m in elevation, and are oriented to

the northeast and southwest. The ground surface has sparse to high cover of large and small rocks, high exposure of bare soil, and sparse to moderate cover of downed wood and litter. Soils are well-drained to rapidly drained sandy clays and clay loams derived from the Brian Head Formation.

Globally
This association occurs in high mountain valleys, on broad flat, gently sloping to undulating alluvial outwash fans, first or second stream terraces, toeslopes or seeps. Elevation ranges from 1445 to 2560 m (4753-8400 feet). It generally occurs as narrow stringers along stream courses, or in meadows where the water table is near the surface seasonally. Soils are deep and finely textured, alluvial, and often with mottling indicating a fluctuating water table at depths of 60-100 cm below the soil surface.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This short-shrub association is limited within the monument and was sampled near the Chessmen Ridge Overlook and south of Alpine Pond. It is much more common at slightly lower elevations. Total vegetation cover is low to high (24-59% cover) and is characterized by *Artemisia cana* short shrubs that are <1 m tall and provide 12-45% cover. The herbaceous layer is diverse in terms of species composition and provides low cover. The graminoid layer is moderately diverse in terms of species composition, provides sparse to low cover, and includes *Poa pratensis, Elymus trachycaulus, Achnatherum lettermanii*, and *Muhlenbergia* sp. The forb layer is floristically diverse and provides sparse cover, predominantly by *Solidago multiradiata, Achillea millefolium, Geum triflorum, Machaeranthera bigelovii var. commixta (= Machaeranthera commixta), Penstemon leiophyllus*, *Potentilla concinna, Aster ascendens*, and *Potentilla hippiana*.

Globally
This association is a montane shrubland that occurs in mesic areas of riparian corridors, or along upper terraces of valley floors. *Artemisia cana* is the major short-shrub component (10-40% canopy cover), other sagebrush species may also be present in lower abundance such as *Artemisia tridentata* or *Artemisia tridentata ssp. vaseyana*. Other shrubs include *Dasiphora fruticosa ssp. floribunda* and *Betula glandulosa*. Herbaceous cover is sparse to thick and is generally dominated by *Poa pratensis*. Other herbaceous species present include *Carex simulata, Juncus balticus, Stipa* spp., *Achillea millefolium, Potentilla gracilis, Trifolium* spp., *Taraxacum officinale*, and *Geranium viscosissimum*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Short shrub/sapling	*Artemisia cana*
Herb (field)	*Achnatherum lettermanii*, *Poa pratensis*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia cana*
Herb (field)	*Achillea millefolium*, *Geranium viscosissimum*, *Potentilla gracilis*
Herb (field)	*Juncus balticus*, *Poa pratensis*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Machaeranthera bigelovii var. commixta*, *Penstemon leiophyllus*, *Poa pratensis*, *Taraxacum officinale*, *Thlaspi montanum*

Globally
Artemisia cana ssp. bolanderi, *Artemisia cana ssp. viscidula*, *Poa pratensis*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (invasive) (15-Apr-2002).

CLASSIFICATION COMMENTS

Cedar Breaks National Monument
Sagebrush shrubland.

Globally
This association may be dominated by *Artemisia cana ssp. bolanderi* or *Artemisia cana ssp. viscidula*. Most of the authors cited refer only to the species, *Artemisia cana*. The only known reference to *Artemisia cana ssp. bolanderi* is from another type, *Artemisia cana ssp. bolanderi / Muhlenbergia richardsonis* Habitat Type (Hironaka et al. 1983), which mentions *Poa nevadensis (= Poa secunda)* as a common understory component, but makes no reference to *Poa pratensis*. Svalberg et al. (1997) and Tart (1995) are cited for this type but were unavailable for analysis.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Minor erosion of ridge slopes occurring; additional stands of silver sagebrush occur along the road to Panguitch Reservoir.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (2 plots and 1 observation point): (Plots: CEBR.0041, CEBR.0071; Observation Points: CEBR.9054); and 3 AA points from 2007 (CEBR_AA.0226, CEBR_AA.0239, CEBR_AA.0228)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Cooper et al. 1999, Crowe and Clausnitzer 1997, Hansen et al. 1995, Hironaka et al. 1983, MTNHP 2002b, Padgett et al. 1989, Svalberg et al. 1997, Tart 1995, Tuhy and Jensen 1982, Western Ecology Working Group n.d., Youngblood et al. 1985a

Ribes montigenum Shrubland

Western Prickly Gooseberry Shrubland

CODE	CEGL001133
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temperate cold-deciduous shrubland (III.B.2.N.a.)
ALLIANCE	*RIBES MONTIGENUM* SHRUBLAND ALLIANCE (A.926) Western Prickly Gooseberry Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Alpine Turf (CES306.816)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association occurs in small patches in openings between trees in the subalpine, lower, stabilized portion of scree slopes and along small drainages near patches of krummholz (near treeline) in the upper subalpine and lower alpine of the southern Rocky Mountains. Sites are often sloping, xeric, warm, with low cover of winter snow. Slope can range from gentle to steep (1-100%), and aspect is also variable but tends to be warmer especially at higher elevation. The stands often occur in rocky drainages or on shallow benches where running water or snowmelt collects and contributes to seasonally moist soil conditions. Substrates tend to be rocky, with vegetation often growing in pockets of soil between the rocks. The soil ranges from sandy to loamy to clayey but typically has moderate to high organic content. Depending on slope position and substrate, the soil can be somewhat poorly drained to rapidly drained. Bedrock and large rock combined make up 15-35% of the plot's ground cover. Leaf litter and duff cover is often high, 10-35% of the ground surface. The vegetation is characterized by a moderately dense to dense shrub layer <1 m tall dominated by *Ribes montigenum*. Other shrubs present may include *Dasiphora fruticosa ssp. floribunda, Salix brachycarpa, Salix planifolia, Vaccinium myrtillus, Sambucus racemosa, Ribes laxiflorum*, or *Rubus idaeus*. The herbaceous layer is moderately dense and composed of a mixture of grasses such as *Carex hoodii, Elymus trachycaulus*, and forbs *Achillea millefolium, Aquilegia caerulea, Campanula rotundifolia, Erigeron*

elatior, Polemonium pulcherrimum, Penstemon whippleanus, Pseudocymopterus montanus, and *Thalictrum sparsiflorum*. Diagnostic of this shrubland association is the dominance of *Ribes montigenum*.

DISTRIBUTION

Cedar Breaks National Monument

This short-shrub association is uncommon and has patchy distribution. It was sampled above the rim of the breaks, north of the monument in the environs between the monument and Brian Head in Dixie National Forest, along the USFS road to Sugar Mountain, near the monument boundary at the northern entrance, north of Panguitch Lake Road, and near the Alpine Pond trailhead, and near the Chessmen Ridge Overlook.

Globally

This shrubland association occurs in small patches in openings between trees in the subalpine and lower alpine in the southern Rocky Mountains.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This short-shrub association occurs midslope on valleysides, hills, domes, and ridges and on high slopes of drainages. Stands also may occur on volcanic boulder talus slopes and other rock outcrops or on recent clearcuts. Sites are gentle to steep (1- to 38-degree slopes), occur between 3037 and 3302 m in elevation, and are oriented to all aspects. The ground surface has moderate to high exposure of bare soil, sparse to high cover of large and small rocks, sparse to low cover of litter, and sparse to moderate cover of downed wood. Soils are moderately well-drained to rapidly drained sandy clays, silty clays, sandy clay loams, and silty clay loams derived from the Brian Head Formation, Claron Formation (Red Member), and landslide deposits.

Globally

This association occurs in small patches in openings between trees in the subalpine, lower, stabilized portion of scree slopes and along small drainages near patches of krummholz (near treeline) in the upper subalpine and lower alpine of the southern Rocky Mountains between 3250 and 3575 m (10,650-11,725 feet) elevation. Sites are often sloping, xeric, warm, with low cover of winter snow (Komarkova 1979). Slope can range from gentle to steep (1-100%), and aspect is also variable but tends to be warmer especially at higher elevation. The stands often occur in rocky drainages or on shallow benches where running water or snowmelt collects and contributes to seasonally moist soil conditions. Substrates tend to be rocky, with vegetation often growing in pockets of soil between the rocks. The soil ranges from sandy to loamy to clayey but typically has moderate to high organic content. Depending on slope position and substrate, the soil can be somewhat poorly drained to rapidly drained. Bedrock and large rock combined make up 15-35% of the plot's ground cover. Leaf litter and duff cover is often high, 10-35% of the ground surface, and in some cases, dead wood can cover another 15%. Soils have been classified as Cryorthent and Pergelic Cryofibrist organic soil over scree (Komarkova 1979, 1986).

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is sparse to dense (4-64% cover) and is characterized by *Ribes montigenum* short shrubs that are <1 m tall and provide 4-50% cover. *Sambucus racemosa* is often present, providing sparse to low cover in addition to sparse cover by *Ribes cereum* and *Ribes viscosissimum*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover. The graminoid layer is moderately diverse floristically, provides sparse to low cover, and includes *Elymus trachycaulus, Achnatherum lettermanii, Carex rossii, Poa glauca*, and the non-native *Poa pratensis*. The forb layer is diverse in terms of species composition and provides sparse to low cover, with different species more abundant at each site. Forbs that often occur within stands include *Achillea millefolium, Ligusticum porteri, Chenopodium* sp., *Mertensia arizonica, Polemonium pulcherrimum, Potentilla gracilis*, and *Thalictrum fendleri*. Seedling trees provide sparse cover on some sites and include *Abies lasiocarpa* and *Picea engelmannii*. Rocks within this association often support low cover of lichens and mosses.

Globally

This association is characterized by a moderately dense to dense shrub layer <1 m tall dominated by *Ribes montigenum*. Other shrubs present may include *Dasiphora fruticosa ssp. floribunda, Salix brachycarpa, Salix planifolia, Vaccinium myrtillus, Sambucus racemosa, Ribes laxiflorum*, or *Rubus idaeus*. The herbaceous layer is

moderately dense and composed of a mixture of grasses such as *Carex hoodii, Elymus trachycaulus*, and forbs *Achillea millefolium, Aquilegia caerulea, Campanula rotundifolia, Erigeron elatior, Polemonium pulcherrimum, Penstemon whippleanus, Pseudocymopterus montanus*, and *Thalictrum sparsiflorum*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Short shrub/sapling	*Ribes montigenum*, *Sambucus racemosa*
Herb (field)	*Erigeron speciosus*, *Ligusticum porteri*, *Potentilla gracilis*, *Potentilla hippiana*
Herb (field)	*Achnatherum lettermanii*, *Elymus trachycaulus*, *Poa glauca*, *Poa pratensis*

Globally

Stratum	Species
Shrub/sapling (tall & short)	*Ribes montigenum*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Chenopodium album*, *Poa pratensis*, *Taraxacum officinale*

Globally
Aquilegia scopulorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GU (23-Feb-1994).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane shrubland. Shrubland pocket on a forested slope, small-patch shrubland on a slope, sparse shrubland on a talus slope of 78% rock - little room for vegetation, and highway divides stand resulting in disturbance. Successional type in clearcut area.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: *Ribes montigenum* established on convex position of slope amid woodland stands; shrubs establish around bases of rocks where more moisture is available; potential for talus slide; stand bisected by State Highway 143, habitat of large to small vesicular lava rocks; and two stands occupy formerly clearcut slopes.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (7 plots and 4 observation points): (Plots: CEBR.0044, CEBR.0051, CEBR.0063, CEBR.0068, CEBR.0072, CEBR.0145, CEBR.0148; Observation Points: CEBR.9017, CEBR.9050, CEBR.9055, CEBR.9056). And observed at one AA point from 2007 (CEBR_AA.0098).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Johnston 1987, Komarkova 1976, Komarkova 1979, Komarkova 1986, Western Ecology Working Group n.d.

Symphoricarpos oreophilus Shrubland

Mountain Snowberry Shrubland

CODE	CEGL002951
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temperate cold-deciduous shrubland (III.B.2.N.a.)
ALLIANCE	*SYMPHORICARPOS OREOPHILUS* SHRUBLAND ALLIANCE (A.2530) Mountain Snowberry Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This low-statured shrubland is known from Colorado, southern Utah, western Wyoming and central Oregon. It is a small and often overlooked yet common shrubland. It generally occurs as small patches between 2070 and 3200 m (6800-10,500 feet) elevation, and may have an even wider amplitude throughout the known range of the dominant shrub species. It occurs on a variety of sites, from gentle to steep slopes, on ridges, canyon slopes, in swales, or on landsides, with any orientation. Soils are rapidly drained sandy clay to silty clay loams or clay loams. It is overlooked as a community type because it often occupies the "transition zone" between forests and grasslands or between riparian vegetation and drier upslope communities. This shrubland is often 0.3-0.9 m (1-3 feet) tall. *Symphoricarpos oreophilus* or closely related *Symphoricarpos* species, *Symphoricarpos rotundifolius*, or *Symphoricarpos palmeri* dominate the shrub canopy. Other shrubs can be present but in much less abundance and may include *Artemisia tridentata, Chrysothamnus viscidiflorus, Amelanchier utahensis, Purshia tridentata*, and *Cercocarpus montanus*. Trees from neighboring forests may appear and range from several conifer species to aspen, but rarely have more than single digit cover. The herbaceous undergrowth is highly variable, both in abundance (total cover ranging from 1-30%) and in species composition, depending on local topographic position and geographic locale. Most often it is a rich mix of graminoids and forbs, but it can be dominated by graminoids. Typical graminoid species include *Poa pratensis* and *Carex geyeri*. Forb species include *Eriogonum umbellatum, Geranium viscosissimum, Balsamorhiza sagittata*, and *Agastache urticifolia*. *Achillea millefolium* and *Poa pratensis* are common in disturbed stands.

DISTRIBUTION

Cedar Breaks National Monument

This short shrubland association was sampled only in the project environs on Dixie National Forest.

Globally

This association is known from western Wyoming, Colorado, on the Colorado Plateau and in the high plateaus of Utah, and Oregon.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This short shrubland occurs on a ridge at midslope. The site is steep (18-degree slope), occurs at 3183 m in elevation, and is oriented to the south. The ground surface has moderate to high cover by rocks and low exposure of bare soil and cover of litter and downed wood. Soils are rapidly drained and are derived from the Claron Formation (White Member).

Globally

This low-statured shrubland is known from Colorado, southern Utah and western Wyoming. It is a small and often overlooked yet common shrubland. It has been documented to occur between 2070 and 3200 m (6800-10,500 feet) elevation, and may have an even wider amplitude throughout the known range of the dominant shrub species. It is overlooked as a community type because it often occupies the "transition zone" between forests and grasslands or between riparian vegetation and drier upslope communities. It is overlooked as a community type because it often occupies the "transition zone" between forests and grasslands (Johnson and Clausnitzer 1992) or between riparian

vegetation and drier upslope communities. It occupies steep slopes or even terrain, in depressions or gentle drainages on undulating plateaus, on canyon ridges, and mounded topography. It occurs on shallow or deeper sandy loam to clay loam soils with little surface rock. Stands generally occur on gentle to steep slopes, often facing south, but can be found on all aspects.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is low (21% cover) and is characterized by the short shrub *Symphoricarpos oreophilus* that provides 6% cover. A few scattered trees, including *Pinus flexilis* and *Pseudotsuga menziesii*, are present, provide sparse cover, and attain heights between 5 and 10 m. *Juniperus scopulorum* provides sparse cover in the subcanopy. The herbaceous layer is low in terms of species diversity and provides low cover. The graminoid layer is low in terms of species diversity, provides low cover, and includes *Poa fendleriana*. The forb layer provides low cover and includes *Helianthella uniflora* and *Achillea millefolium*.

Globally

This low-statured shrubland is often 0.3-0.9 m (1-3 feet) tall, and total vegetation cover ranges from 15 to 45%. *Symphoricarpos oreophilus* dominates the shrub canopy. Other shrubs can be present but in much less abundance. Other shrub species include *Amelanchier alnifolia, Prunus virginiana, Ribes cereum, Artemisia tridentata, Ericameria nauseosa (= Chrysothamnus nauseosus), Sambucus caerulea, Rosa woodsii, Mahonia repens*, and *Artemisia nova*. A tree canopy of less than 5% may be present with *Pinus ponderosa, Abies concolor, Picea pungens, Juniperus scopulorum, Pseudotsuga menziesii, Juniperus scopulorum*, or *Populus tremuloides*. The herbaceous undergrowth is highly variable, both in abundance (total cover ranging from 1-30%) and in species composition, depending on local topographic position and geographic locale. It can consist of a mix of graminoids and forbs but is more often dominated by graminoids. Typical graminoid species include *Poa pratensis* and *Carex geyeri*. Other graminoid species include *Achnatherum hymenoides, Festuca thurberi, Elymus trachycaulus, Elymus elymoides, Leymus cinereus, Hesperostipa comata, Calamagrostis scopulorum, Juncus balticus, Pascopyrum smithii, Pseudoroegneria spicata (= Elymus spicatus) Elymus repens, Calamagrostis rubescens, Carex geyeri, Carex hoodii, Carex rossii, Bromus ciliatus (= Bromus canadensis), Achnatherum* spp. (= *Stipa* spp.), and *Poa fendleriana*. Forbs are usually present and highly variable. In Colorado, forb species include *Geranium richardsonii, Galium boreale (= Galium septentrionale), Symphyotrichum ascendens (= Aster adscendens), Vicia americana, Heliomeris multiflora*, and *Potentilla pulcherrima*; in Wyoming, *Eriogonum umbellatum, Geranium viscosissimum, Balsamorhiza sagittata*, and *Agastache urticifolia*; and in Utah, *Artemisia dracunculus, Packera multilobata (= Senecio multilobatus), Taraxacum officinale, Cirsium calcareum, Astragalus kentrophyta, Solidago velutina, Lathyrus brachycalyx, Lupinus argenteus, Artemisia campestris, Mentha X piperita, Penstemon* spp., *Mertensia arizonica, Mertensia oblongifolia, Eriogonum racemosum*, and *Tragopogon dubius*. In central Oregon, forb species include *Eriogonum heracleoides, Potentilla glandulosa, Potentilla gracilis, Geum triflorum, Lupinus* spp., *Erigeron* spp., and *Clarkia pulchella*. *Achillea millefolium (= Achillea lanulosa*) is common to Colorado, southern Utah, as well as central Oregon stands, especially when in a degraded state.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Helianthella uniflora*

Globally

Stratum	Species
Short shrub/sapling	*Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument
Achillea millefolium

Globally
Achillea millefolium, *Elymus repens*, *Poa pratensis*, *Taraxacum officinale*, *Tragopogon dubius*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (14-Aug-2001).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This association may be dominated by *Symphoricarpos oreophilus* or closely related *Symphoricarpos* species such as *Symphoricarpos rotundifolius* or *Symphoricarpos palmeri* that ecologically function similarly and can be difficult to distinguish taxonomically at certain times of the year.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Half of the stand is herbaceous and half is shrub-herbaceous with snowberry; slope is steep but gravel-armored; grazed annually by sheep.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 observation point): (Observation Points: CEBR.9057).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: G. Kittel, mod. J. Coles

REFERENCES: Cogan et al. 2004, Johnson and Clausnitzer 1992, Johnston 1987, Komarkova 1986, Western Ecology Working Group n.d.

Dasiphora fruticosa ssp. *floribunda / Deschampsia caespitosa* Shrubland

Shrubby-cinquefoil / Tufted Hairgrass Shrubland

Shrubby-cinquefoil / Tufted Hairgrass Shrub Prairie

CODE	CEGL001107
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d.)
ALLIANCE	*DASIPHORA FRUTICOSA SSP. FLORIBUNDA* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.958) Shrubby-cinquefoil Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This montane to subalpine shrubland association is widespread in the Rocky Mountains west to eastern Oregon and Utah on stream terraces above the channel, on drier edges of wetlands, on broad gently sloping valley bottoms and floodplains, on moderately steep mesic slopes near springs, and near glacial depressions. Elevation ranges from 2500-3300 m (8300-10,700 feet) in Colorado to 860-2267 m (2820-7400 feet) in Montana. Aspect is variable. Soils are typically derived from alluvium and are deep, fine-textured, but vary from sandy loam to clay loam. Gleying and mottling are common. Sites have a high water table that fluctuates (40-100 cm) seasonally. These riparian shrublands form an open to moderately dense, low-shrub layer dominated by *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda; = Potentilla fruticosa)* with thick cover of bunch grasses. Other shrub species may include low cover of *Artemisia cana, Betula glandulosa, Salix boothii*, and *Salix planifolia*. The lush herbaceous layer is often typically diverse and usually dominated by the graminoid *Deschampsia caespitosa*, which is

consistently present as a diagnostic species at least in trace amounts. Other characteristic graminoids may include *Carex aurea, Carex aquatilis, Carex heteroneura var. chalciolepis, Carex nova, Carex pellita (= Carex lanuginosa), Carex microptera, Danthonia intermedia, Elymus trachycaulus, Festuca rubra, Festuca saximontana, Festuca brachyphylla, Phleum alpinum, Poa secunda*, and *Trisetum spicatum*. Numerous forb species may be present such as *Antennaria* spp., *Argentina anserina, Polygonum bistortoides, Caltha leptosepala, Cerastium arvense, Geum rossii, Penstemon procerus, Potentilla* spp., *Selaginella* spp., *Solidago simplex, Symphyotrichum* spp., *Stellaria longipes, Thalictrum* spp., *Trifolium longipes*, and *Valeriana edulis*. With heavy grazing *Achillea millefolium, Antennaria* spp., *Carex nebrascensis, Fragaria virginiana, Juncus balticus*, and *Potentilla gracilis* increase in cover. Exotic graminoids *Poa pratensis* and *Alopecurus pratensis* and forbs *Taraxacum officinale* and *Trifolium repens* may be common in heavily grazed/disturbed stands.

DISTRIBUTION

Cedar Breaks National Monument

This shrubland association was sampled near the Chessmen Ridge Overlook and east of State Highway 143.

Globally

This montane riparian shrubland association is widespread in the Rocky Mountain region from Colorado to Montana west into Oregon and Utah.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This short-shrub association has limited distribution in the monument and occurs in palustrine, shrub-scrub wetlands located on saturated soils of perennial drainages. The sites are gentle (1- to 4-degree slopes), occur between 3183 and 3186 m in elevation, and are oriented to the north. The ground surface has high exposure of bare soil and low cover by litter and rocks. Soils are somewhat poorly drained to poorly drained muck and peat with lower mineral layers derived from the Brian Head Formation.

Globally

This montane to subalpine shrubland association is widespread in the Rocky Mountains west to the Cascades of Oregon on stream terraces above the channel, on drier edges of wetlands, on broad gently sloping valley bottoms and floodplains, on moderately steep mesic slopes near springs, and near glacial depressions. Elevation ranges from 2500-3450 m (8300-11,320 feet) in Colorado to 860-2267 m (2820-7400 feet) in Montana. Aspect is variable. Soils are typically derived from alluvium and are deep, fine-textured, but vary from sandy loam to clay loam. Gleying and mottling are common. Sites have a high water table that fluctuates (40-100 cm) seasonally.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate (40-49% cover) and is characterized by *Dasiphora fruticosa ssp. floribunda* short shrubs that are <1 m tall and provide 30% cover, and by the bunchgrass *Deschampsia caespitosa* that provides 2-12% cover. The herbaceous layer is moderately diverse in terms of species composition and contributes low cover. The remaining graminoid layer is low in terms of species composition, provides sparse cover, and includes *Carex scirpoidea* and *Elymus trachycaulus*. The forb layer is moderately diverse floristically, provides sparse cover, and includes *Achillea millefolium, Dodecatheon pulchellum, Erigeron ursinus, Pyrrocoma clementis (= Haplopappus clementis)*, and *Zigadenus elegans*.

Globally

These riparian shrublands form an open to moderately dense, low-shrub layer dominated by *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda; = Potentilla fruticosa)* with thick cover of bunch grasses. Other shrub species may include low cover of *Artemisia cana, Betula glandulosa, Salix boothii*, and *Salix planifolia*. The lush herbaceous layer is often typically diverse and usually dominated by the graminoid *Deschampsia caespitosa*, which is consistently present as a diagnostic species in at least trace amounts. Other characteristic graminoids may include *Carex aurea, Carex aquatilis, Carex heteroneura var. chalciolepis, Carex nova, Carex pellita (= Carex lanuginosa), Carex microptera, Danthonia intermedia, Elymus trachycaulus, Festuca rubra, Festuca saximontana, Festuca brachyphylla, Phleum alpinum, Poa secunda*, and *Trisetum spicatum*. Numerous forb species may be present such as *Antennaria* spp., *Argentina anserina, Polygonum bistortoides, Caltha leptosepala, Cerastium arvense, Geum rossii, Penstemon procerus, Potentilla diversifolia, Potentilla gracilis, Potentilla hippiana, Pseudocymopterus montanus, Rhodiola rhodantha, Selaginella* spp., *Solidago simplex var. simplex,*

Symphyotrichum campestre, Stellaria longipes, Thalictrum alpinum, Thlaspi montanum, Trifolium longipes, and *Valeriana edulis*. With heavy grazing *Achillea millefolium, Antennaria* spp., *Carex nebrascensis, Fragaria virginiana, Juncus balticus*, and *Potentilla gracilis* increase in cover (Padgett et al. 1989, Hansen et al. 1995, Crowe and Clausnitzer 1997, Hall and Hansen 1997, Kittel et al. 1999b, Carsey et al. 2003b). Exotic graminoids *Poa pratensis* and *Alopecurus pratensis* and forbs *Taraxacum officinale* and *Trifolium repens* may be common in heavily grazed/disturbed stands.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Short shrub/sapling	*Dasiphora fruticosa ssp. floribunda*
Herb (field)	*Polygonum bistortoides*, *Symphyotrichum foliaceum*
Herb (field)	*Deschampsia caespitosa*

Globally

Stratum	Species
Short shrub/sapling	*Dasiphora fruticosa ssp. floribunda*
Herb (field)	*Deschampsia caespitosa*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Taraxacum officinale*

Globally
Phleum pratense, *Poa pratensis*, *Taraxacum officinale*, *Trifolium pratense*

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
Dasiphora fruticosa ssp. floribunda and *Deschampsia caespitosa* are both widespread mesic species that occur in a variety of mesic habitats. *Dasiphora fruticosa ssp. floribunda* shrublands and steppe are highly variable and need more survey and classification work to clarify diagnostic characteristics.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Shrub-scrub wetland is adapted to mesic soils of streams, occupies the first terrace; the drainage bottom supports *Deschampsia caespitosa* stands.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (2 observation points): (Observation Points: CEBR.9015, CEBR.9020). Also observed from 3 AA points in 2007 (CEBR_AA.0035, CEBR_AA.0229, CEBR_AA.0244)
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Crowe and Clausnitzer 1997, Driscoll et al. 1984, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Johnston 1987, Kagan et al. 2004, Kettler and McMullen 1996, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, MTNHP 2002b, Mutz and Graham 1982, Padgett et al. 1988b, Padgett et al. 1989, Sanderson and March 1996, Western Ecology Working Group n.d., Youngblood et al. 1985a, Youngblood et al. 1985b

Salix exigua Temporarily Flooded Shrubland

Coyote Willow Temporarily Flooded Shrubland

CODE	CEGL001197
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d.)
ALLIANCE	*SALIX (EXIGUA, INTERIOR)* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947) (Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Northwestern Great Plains Floodplain (CES303.676)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This willow shrubland is found throughout the western United States and Great Plains north into the Boreal Plains. This is a highly flood-tolerant community that occurs along rivers and streams at lower elevations, on recently flooded riparian areas, and in moist swales and ditches that are frequently disturbed. Stands occur most commonly on alluvial sand, but silt, clay or gravel may also be present. *Salix exigua* is the dominant canopy species (*Salix interior* or intermediates of the two willow species may be present in the eastern part of the range). It can form dense stands up to 4 m tall, but there are often patches where the shrub layer is absent. Seedlings and small saplings of *Populus deltoides, Populus balsamifera*, and *Salix amygdaloides* may be present. The herbaceous cover is sparse to moderate but rarely exceeds 30%. Species present may include *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima*, and *Xanthium strumarium*.

In California, the overstory shrub canopy is open to continuous and dominated by *Salix exigua*, with *Rubus discolor* often present. Trees such as *Ailanthus altissima, Fraxinus latifolia*, and *Salix laevigata* sometimes occur as scattered emergents. Other shrubs that may be present include *Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata), Quercus gambelii, Rosa woodsii, Rosa nutkana, Ericameria nauseosa, Arctostaphylos patula*, and *Dasiphora fruticosa ssp. floribunda* The herbaceous layer is typically open and often includes *Artemisia douglasiana*. The composition of this community, especially the herbaceous layer, varies from year to year with succession or renewed disturbance.

DISTRIBUTION

Cedar Breaks National Monument

This tall-shrub association has a limited distribution in the monument and was only sampled in Rattle Creek.

Globally

This willow shrubland community is found along rivers and streams at lower elevations throughout the western United States and Great Plains, ranging sporadically from Oklahoma northwest to the Dakotas and Manitoba, into the Rocky Mountains of Colorado, Wyoming, Montana and Idaho, west to Washington, and south to the Rio Grande, San Juan and Canadian River watersheds in northern New Mexico. In California, this association has been sampled along the Sacramento River, in the Central Coast Ranges, northern and central Sierra Nevada foothills, and Cascade Range foothills. Part of this type's former range in the Great Plains and eastward is actually occupied, at least in part, by *Salix interior* [see *Salix interior* Temporarily Flooded Shrubland (CEGL008562)].

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This tall-shrub association occurs in a streambed. The site is gentle (3-degree slope), occurs at 2615 m in elevation, and is oriented to the southwest (200 degrees). The ground surface has high cover of large and small rocks and moderate exposure of bare soil. Soils are rapidly drained sandy clays derived from alluvium.

Globally
This community is found on recently deposited or disturbed alluvial material. The parent material is alluvial sand, although silt, clay, or gravel may be present. Soil development is poor to absent. In New Mexico, this community occurs along wide, low-gradient streams and rivers in foothill regions and in lowland valleys and canyons at low to mid elevations of 1430 to 2266 m (4700- 7450 feet). The type is common on low alluvial bars that are subject to repeated flooding (1- to 5-year recurrence intervals). Soils are poorly stratified and generally consist of a thin layer of sandy loam at the surface overlying deep deposits of sand, gravel, or cobble. Rock fragments comprise upwards of 80% of the soil profile. These well-drained soils provide good aeration and rapid movement of water through the profile. Sites composed mostly of riverwash are moist at the surface for much of the season, while high bars may be dry on the surface, but tend to be moist at depths of 15 to 30 cm (6-12 inches) during most years.

In California, this association has been sampled along the Sacramento River, in the Central Coast Ranges, northern and central Sierra Nevada foothills, and Cascade Range foothills (Vaghti 2003, Klein et al. 2007). Stands occur along riparian corridors and stream terraces. They usually occupy slope bottoms, occasionally extending to lower slopes that were flat to somewhat steep. Stands usually occur on mixed, sandy, or silty alluvium and infrequently occur on gabbro, granitic, greenstone, sedimentary, slate, or volcanic substrates.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is sparse (4% cover) and is characterized by *Salix exigua* tall shrubs that are <1.5 m tall and provide 2% cover, and by the fern ally *Equisetum arvense* that provides sparse cover. The herbaceous layer is low in terms of species composition and provides sparse cover. The graminoid layer is low in floristic diversity, provides sparse cover, and includes *Calamagrostis scopulorum*. The forb layer is low in terms of floristic diversity and provides sparse cover, predominantly by *Castilleja linariifolia*. Seedling trees provide sparse cover and include *Abies concolor, Cercocarpus ledifolius, Picea engelmannii, Populus tremuloides*, and *Pinus ponderosa*.

Globally
This community is dominated by shrubs, generally between 2 and 4 m tall. The most common of these is *Salix exigua* (*Salix interior* or intermediates of the two willow species may be present in the eastern part of the range). *Salix irrorata, Salix lutea*, and saplings of *Populus deltoides* or *Salix amygdaloides* are also frequently found in the shrub layer in lower elevation stands. *Populus balsamifera* seedlings become more common in northern and western stands. Several other shrub species can be present (usually in much lower abundance than *Salix exigua*), such as *Purshia stansburiana (= Purshia mexicana var. stansburiana), Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata), Quercus gambelii, Rosa woodsii, Rosa nutkana, Ericameria nauseosa, Arctostaphylos patula*, and *Dasiphora fruticosa ssp. floribunda*. This stratum can have moderate to high stem density in the community as a whole. The species in the shrub layer do not form a closed canopy, allowing significant light to reach the ground layer. There are often patches where the shrub layer is absent. The herbaceous cover is sparse to moderate but rarely exceeds 30%. Older stands and places with less competition from the shrubs have greater herbaceous cover. The composition of the herbaceous layer can vary greatly. Species that are often found in this community are *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima, Xanthium strumarium, Juncus balticus, Eleocharis palustris, Elymus repens (= Elytrigia repens), Poa pratensis, Phleum pratense, Agrostis scabra, Bromus inermis, Heracleum maximum, Achillea millefolium, Solidago* sp., *Equisetum arvense*, and *Linaria vulgaris*.

In New Mexico, thickets of *Salix exigua* range from open to closed and attain heights of 1.5 to 3 m (4-9 feet). *Salix irrorata* may be common but clearly not dominant. In the densest stands, *Salix exigua* dominates to the exclusion of other species. Seedlings or young saplings of native *Populus deltoides* and/or *Populus angustifolia* are present but usually widely scattered. In some stands, exotic species such as *Tamarix ramosissima* and *Elaeagnus angustifolia* are increasing in cover. The herbaceous understory can be diverse (85 species have been recorded for the type), but cover is low. Of the 18 wetland herbaceous species recorded for the type, the most prevalent are *Eleocharis palustris, Juncus bufonius, Juncus saximontanus, Schoenoplectus pungens (= Scirpus pungens), Argentina anserina, Epilobium ciliatum, Equisetum laevigatum*, and *Mentha arvensis*.

In California, the overstory shrub canopy is open to continuous and dominated by *Salix exigua*, with *Rubus discolor* often present. Trees such as *Ailanthus altissima, Fraxinus latifolia*, and *Salix laevigata* sometimes occur as scattered emergents. The herbaceous layer is typically open and often includes *Artemisia douglasiana*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tall shrub/sapling	*Salix exigua*
Herb (field)	*Castilleja linariifolia*
Herb (field)	*Equisetum arvense*

Globally

Stratum	Species
Shrub/sapling (tall & short)	*Salix exigua*
Herb (field)	*Polygonum lapathifolium*, *Xanthium strumarium*
Herb (field)	*Cenchrus longispinus*, *Schoenoplectus americanus*, *Triglochin maritima*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Taraxacum officinale

Globally
Ailanthus altissima, *Bromus inermis*, *Elaeagnus angustifolia*, *Elymus repens*, *Juglans hindsii*, *Linaria vulgaris*, *Phleum pratense*, *Poa pratensis*, *Rubus discolor*, *Tamarix ramosissima*

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (6-May-1999). This type is widespread and common throughout its range.

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This type may be an early-successional shrubland that develops into *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203), or the two types may be essentially synonymous. This plant association occupies a wide geographic range. The range of this type was reviewed and it was split into eastern, *Salix interior* Temporarily Flooded Shrubland (CEGL008562), and western components. The western stands may all be composed of *Salix exigua* (*sensu stricto*), and Great Plains stands may contain either *Salix exigua, Salix interior*, or intermediates of the two willow species, the *Salix interior* being distributed entirely in the Great Plains and eastward (Kartesz 1999).

Because this type is subject to repeated scouring by floods, pioneering herbaceous species are often buried or removed. Woody debris and deep sandy sediments help build the sites by becoming trapped among the basal stems of the willows. These sites are also potential sites for the reproduction of native cottonwoods. As sites develop, succession is initially towards mesic types with the undergrowth dominated by *Equisetum* spp. or mesic graminoids *Scirpus* spp. and ultimately toward cottonwoods. Dense stands usually deter livestock, but open stands may be susceptible to overuse resulting in reduced vigor and loss of the willow component in the stand.

The type can occur in a matrix with cottonwood-dominated forested wetlands on higher bars and emergent vegetation dominated by sedges, cattails, and bulrushes in intermittent overflow channels or oxbows, and along banks.

This type has been previously reported in the Rocky Mountain region by Kittel (1993), Kittel and Lederer (1993), Kittel et al. (1995, 1996), and Padgett et al. (1988a).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Stream subject to flash floods.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 plot): (Plots: CEBR.0131).

Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: J.F. Drake, mod. E. Muldavin, L. Allen, G. Kittel

REFERENCES: ANHIC 2005, Bellah and Hulbert 1974, Borchert et al. 2004, Bourgeron and Engelking 1994, Donnelly et al. 2006, Driscoll et al. 1984, Evenden 1990, Foti et al. 1994, Greenall 1996, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998c, Hoagland 2000, INAI unpubl. data, Kagan et al. 2004, Kartesz 1999, Kittel 1993, Kittel and Lederer 1993, Kittel et al. 1995, Kittel et al. 1996, Klein et al. 2007, Kovalchik 1987, MTNHP 2002b, Muldavin et al. 2000a, NDNHI n.d., Padgett et al. 1988a, Phillips 1977, Steinauer 1989, Steinauer and Rolfsmeier 2000, Thompson and Hansen 2002, Vaghti 2003, Von Loh et al. 2000, WNHP unpubl. data, Western Ecology Working Group n.d., Wilson 1970

Achnatherum lettermanii Herbaceous Vegetation

Letterman's Needlegrass Herbaceous Vegetation

CODE	CEGL005354
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d.)
ALLIANCE	*ACHNATHERUM LETTERMANII* HERBACEOUS ALLIANCE (A.2524) Letterman's Needlegrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S):USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This grassland is known from Bryce Canyon and Cedar Breaks national parks in southwestern Utah, and from the Spring Mountains Recreational Area of southern Nevada. The following information is from Utah only. This grassland occurs from 2400 to 3200 m (7900-10,500 feet) elevation, on valley floors and gentle slopes along drainages. Soils are silty loam or silty clay loam on recent alluvium or volcanic ash of the Brian Head Formation. This semi-arid grassland has moderate cover (31-43%) and is characterized by the bunchgrass *Achnatherum lettermanii*. Other graminoids include *Carex praegracilis, Koeleria macrantha*, non-native *Poa pratensis, Poa fendleriana, Elymus trachycaulus*, and *Poa glauca*. Forbs may include *Achillea millefolium, Antennaria rosulata, Antennaria parvifolia, Penstemon rydbergii, Potentilla concinna*, and *Solidago multiradiata*. Shrubs are sparse to absent and may include *Chrysothamnus viscidiflorus, Ericameria parryi (= Chrysothamnus parryi)*, and *Chrysothamnus vaseyi*. A few scattered individual trees such as *Pinus ponderosa* and *Picea pungens* may be present.

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association was sampled near the Chessmen Ridge Overlook, east of the Alpine Lake pullout, near the southern boundary, near the south entrance, the east entrance, South of Alpine pond, Chessman overlook, north of the Panguitch Lake Road near State Highway 143, and in the environs on Dixie National Forest.

Globally
This association occurs in Nevada and Utah.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This graminoid association occurs on the low to midslopes of hills and along drainages. The sites are gentle (3- to 6-degree slopes), occur between 3145 and 3219 m in elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil and low cover of litter and small rocks. Soils are moderately well-drained to well-drained silty clays derived from the Brian Head Formation.

Globally
Data are not available.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This semi-arid graminoid association is uncommon in the park. Total vegetation cover is low to moderate (15-43% cover) and is characterized by the bunchgrass *Achnatherum lettermanii* that provides 5-17% cover. The remaining graminoid layer has low species diversity, provides low cover, and includes *Elymus trachycaulus, Poa pratensis* (non-native), *Poa fendleriana* and *Poa glauca*. The forb layer is diverse and provides sparse cover, predominantly by *Solidago multiradiata, Penstemon rydbergii*, *Viguiera multiflora, Aster ascendens*, and *Achillea millefolium*.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (field)	*Achillea millefolium*, *Penstemon rydbergii*, *Solidago multiradiata*
Herb (field)	*Achnatherum lettermanii*, *Elymus trachycaulus*, *Poa pratensis*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (3-Mar-2008).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
See also Nachlinger and Reese (1996).

Globally
Data from Nevada (Nachlinger and Reese 1996) do not include species composition or environmental setting. They reference Sawyer and Keeler-Wolf (1995), but this is only to the Subalpine Meadow Habitat that does not list *Acantherum lettermannii* and, in fact, lists no species in common with Nachlinger and Reese (1996) nor with Bryce Canyon and Cedar Breaks data.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Meadows are dry and some have gravelly soil; high levels of pocket gopher and other small mammal activity; grazing by sheep occurs.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (2 plots and 3 observation points): (Plots: CEBR.0050, CEBR.0070; Observation Points: CEBR.9011, CEBR.9044, CEBR.9025); and 5 AA points from 2007 (CEBR_AA.0385, CEBR_AA.0262, CEBR_AA.0222, CEBR_AA.0049, CEBR_AA.0047)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Nachlinger and Reese 1996, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d.

Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation

Smooth Brome - (Western Wheatgrass) Semi-natural Herbaceous Vegetation

Smooth Brome Semi-natural Grassland

CODE	CEGL005264
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d.)
ALLIANCE	*BROMUS INERMIS* SEMI-NATURAL HERBACEOUS ALLIANCE (A.3561) Smooth Brome Semi-natural Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Sou thern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This smooth brome grassland type occurs widely throughout the northern Great Plains, in disturbed montane meadows in the Rocky Mountains, on relatively mesic sites in the semi-arid interior western United States, and perhaps more widely in the Midwestern U.S. and Canada. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. The type is also widely planted for revegetating disturbed land, pasture and hay fields, and has escaped into a variety of habitats, including prairie, riparian grasslands, and mesic mountain meadows. The dominant grass is *Bromus inermis*, a naturalized species from Eurasia that forms moderately dense to dense stands that often develop into monocultures. Other weedy species such as *Cirsium arvense* and *Poa pratensis* may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie and montane meadow grasses, such as *Pascopyrum smithii, Deschampsia caespitosa*, and *Hesperostipa comata (= Stipa comata)*, and sparse, scattered mesic shrubs such as *Symphoricarpos* spp., as well as many others. However, the native species are not conspicuous enough to identify the native plant association that could occupy the site, or the stand would be typed as such.

DISTRIBUTION

Cedar Breaks National Monument

This semi-natural herbaceous association was sampled in the vicinity of the campground, near the employee housing, the ranger residence, along the north park boundary, near the north entrance, the Chessmen Ridge Overlook, and in proximity of State Highway 143. It was also sampled on Dixie National Forest north and west of the monument.

Globally

This type occurs widely throughout the northern Great Plains, montane meadows in the Rocky Mountains, in relatively mesic sites in Utah and Wyoming, and perhaps more widely in the Midwestern and western U.S. and Canada, as well where *Bromus inermis* has escaped from revegetation and forage plantings.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This mesic semi-natural grassland is moderately common where disturbance related to highway, campground, and overlook construction has occurred, where domestic livestock grazing occurred historically, and where continued runoff has allowed the non-native grass *Bromus inermis* to spread via rhizomes from historically seeded areas. This semi-natural mesic grassland occurs on high slopes of plateaus, in drainages, and on minor floodplains. Sites are gentle (1- to 8-degree slopes), occur between 3112 and 3200 m elevation, and are oriented to all aspects. The ground surface has moderate to high exposure of bare soil and low to moderate cover of litter and rocks. Soils are well-drained silt loams, silt clay loams, and sandy clay loams derived from the Brian Head and Claron (Red and White members) formations.

Globally
This smooth brome grassland type occurs widely throughout the northern Great Plains, on relatively mesic sites in the semi-arid interior western United States, and perhaps more widely in the Midwestern U.S. and Canada. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. The type is also widely planted for revegetating disturbed land, pasture and hay fields, and has escaped into a variety of habitats, including prairie, riparian grasslands, and mesic mountain meadows. This community is found at all elevational ranges with best examples occurring on mesic alluvial terraces. *Bromus inermis* grows best on moist, well-drained, finer-textured loam and clay loams, not heavy clays or sand, and does not tolerate prolonged flooding, however, it does persist quite well on well-drained sandy loam derived from granitic parent material. It also occurs in foothills and plains at lower elevations on relatively mesic sites. It occurs on poorly drained sites to rapidly drained sites with fine-textured alluvial soils derived from shale formations found in Utah. This community persists because it is rhizomatous, and once seeded, with enough moisture, will persist, regardless of elevation, soil or landform.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate to high, ranging from 26-69% cover, and is characterized by the rhizomatous non-native *Bromus inermis* that provides from 15-55% cover. The remaining graminoid cover is sparse to low and can include the non-native *Poa pratensis* and the native bunch grasses *Elymus trachycaulus* and *Deschampsia caespitosa*. Other graminoids present may include *Carex rossii, C. praegracilis, Poa secunda* and *Achnatherum lettermanii*. The forb layer is diverse in terms of species composition that may include *Mertensia arizonica* and *Oxytropis oreophila* providing low cover and *Achillea millefolium* and *Arenaria fendleri* providing sparse to low cover.

Globally
This association is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Bromus inermis*, a naturalized species from Eurasia that forms moderately dense to dense stands that often develop into monocultures. Other weedy species, such as *Cirsium arvense, Poa pratensis*, and other introduced forage species, may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie and montane meadow grasses, such as *Juncus balticus, Pascopyrum smithii, Deschampsia caespitosa*, and *Hesperostipa comata (= Stipa comata)*, and sparse scattered mesic shrubs, such as *Artemisia tridentata ssp. wyomingensis, Ericameria nauseosa*, and *Symphoricarpos* spp., and ruderal forbs, such as *Heterotheca villosa*, as well as many others. However, the native species are not conspicuous enough to identify the native plant association that could occupy the site, or the stand would be typed as such.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (field)	*Achillea millefolium*, *Mertensia arizonica*, *Oxytropis oreophila*
Herb (field)	*Bromus inermis*, *Elymus trachycaulus*, *Poa pratensis*

Globally

Stratum	Species
Herb (field)	*Bromus inermis*, *Pascopyrum smithii*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Bromus inermis*, *Poa pratensis*, *Taraxacum officinale*

Globally
Bromus inermis, *Cirsium arvense*, *Poa pratensis*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (invasive) (17-Jun-1999). This is a naturalized type from Europe and Asia, widely planted for cover, pasture, and hay, and has escaped into a variety of habitats.

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Grassland vegetation.

Globally
Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such. *Bromus inermis* occurs widely throughout the Midwestern and western U.S., and perhaps this association should be broadened to include almost any stand dominated almost exclusively by *Bromus inermis*.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Small convex areas and drainages contribute to increased soil moisture supporting these stands; some stands have high pocket gopher burrowing activity. Historically, this non-native grass was used as erosion control related to highway, campground, and telephone line installation, as well as for hay meadow for domestic livestock pasture.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (3 plots and 4 observation points): (Plots: CEBR.0073, CEBR.0077, CEBR.0092; Observation Points: CEBR.9001, CEBR.9029, CEBR.9048, CEBR.9052), and 4 AA points from 2007 (CEBR_AA.0371, CEBR_AA.0377, CEBR_AA.0015, CEBR_AA.0014)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: D. Faber-Langendoen, mod. K.A. Schulz and J. Coles

REFERENCES: Butler et al. 2002, Cogan et al. 2004, Cooper 2003, Cronquist et al. 1977, Hansen et al. 1995, MTNHP 2002b, Midwestern Ecology Working Group n.d., NDNHI n.d., Trammel and Butler 1995, Von Loh et al. 2000

Poa pratensis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation

Kentucky Bluegrass - (Western Wheatgrass) Semi-natural Herbaceous Vegetation

Kentucky Bluegrass Semi-natural Grassland

CODE	CEGL005265
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d.)
ALLIANCE	*POA PRATENSIS* SEMI-NATURAL HERBACEOUS ALLIANCE (A.3562) Kentucky Bluegrass Semi-natural Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This Kentucky bluegrass type is widespread throughout the Great Plains, the Midwestern United States and plains of Canada, throughout montane elevations in the Colorado Plateau and southern Rocky Mountains. Stands can occur in a wide variety of upland human-disturbed and native habitats. Stands are typically found on fine-textured, poorly drained, often alluvial or well-developed soils that are topographically situated to receive supplemental moisture, such as flat areas, swales, creek bottoms, riparian areas, moist toeslopes of upland draws and drainages. The vegetation is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Poa pratensis*, considered to be both a native and naturalized species from Eurasia. Other native species may occur as well, but they are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (= Stipa comata)*, as well as others. Where native species are conspicuous enough to identify

the native plant association that could occupy the site, the stand should be typed as such. This type includes only naturalized examples of *Poa pratensis* stands. Maintained lawns are treated as cultural types.

DISTRIBUTION

Cedar Breaks National Monument

This semi-natural mesic grassland is common where disturbance related to highway, campground, and overlook construction and grazing occurs and where continued runoff allows *Poa pratensis* to spread and persist. The association was sampled in the vicinity of the campground, the water tank, ranger residence, Chessman Overlook, near the Alpine Pond trailhead, north of Panguitch Lake Road, along the northern boundary and near the northern monument entrance, and along the southern boundary and near the southern entrance of the monument.

Globally

This Kentucky bluegrass type is potentially widespread throughout the Great Plains and into the Midwestern United States and Canada. Stands are also found on upland sites in the northwestern Great Plains and occur elsewhere in the western U.S. where *Poa pratensis* has invaded native western rangeland.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This semi-natural mesic grassland occurs on high slopes of plateaus, on plains, and in drainages. Sites are gentle (1- to 12-degree slopes), occur between 3115 and 3241 m elevation, and are oriented to all aspects. The ground surface has moderate to high exposure of bare soil and sparse to low cover of litter and rocks. Soils are moderately well-drained to rapidly drained silty clays, silt clay loams, and clay loams derived from the Brian Head Formation, Claron Formation (Red Member), and Markagunt Megabreccia.

Globally

This Kentucky bluegrass type is potentially widespread throughout the Great Plains and into the Midwestern United States and Canada, at montane elevations in the Colorado Plateau and southern Rocky Mountains, and elsewhere in the western U.S. where the introduced perennial *Poa pratensis* has invaded native western rangeland. Stands can occur in a wide variety of upland human-disturbed and native habitats. Stands in western North Dakota are found on deep, well-developed, fine-textured soils that are topographically situated to receive supplemental moisture in the form of runoff from adjacent slopes. Such conditions exist in the toeslopes of upland draws and drainages, and in shallow depressions on north- and east-facing, nearly level slopes. Stands in the semi-arid western U.S. are typically found at montane elevations (1800-3250 m) on lowland and relatively mesic upland sites, such as canyon floors and swales on high terraces with permanently saturated soils. Substrates are also typically finer-textured, poorly drained alluvial soils. The unvegetated surface has a moderate to high cover of litter.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is low to moderate, ranging from 14-43% cover, and is characterized by the rhizomatous non-native *Poa pratensis* that provides low cover (5-15%). The remaining graminoids are moderately diverse in terms of species composition, provide sparse to low cover, and include *Achnatherum lettermanii, Elymus trachycaulus*, and *Poa glauca*. The forb layer is diverse in terms of species composition, provides sparse to low cover, and includes *Achillea millefolium, Agoseris glauca, Arabis drummondii, Aster ascendens, Potentilla gracilis, Solidago multiradiata*, and *Taraxacum officinale*.

Globally

The vegetation is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Poa pratensis*, considered to be both a native and naturalized species from Eurasia (Great Plains Flora Association 1986, Gleason and Cronquist 1991). Other native species may occur as well, but they are generally less than 10% cover. Native species may include mixedgrass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (= Stipa comata)*, as well as other mesic forbs, such as *Achillea millefolium* and exotic *Taraxacum officinale*.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Herb (field)	*Senecio integerrimus*, *Solidago multiradiata*, *Symphyotrichum foliaceum*
Herb (field)	*Carex egglestonii*, *Poa pratensis*

Globally

Stratum	Species
Herb (field)	*Poa pratensis*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally
Poa pratensis, *Taraxacum officinale*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (invasive) (17-Jun-1999). This is primarily a naturalized type from Europe and Asia, widely planted for lawns and pasture, and it has escaped into a variety of habitats (Great Plains Flora Association 1986, Gleason and Cronquist 1991). Although native populations do exist and may be integral parts of some prairie and other native habitats, most stands that are thoroughly dominated by *Poa pratensis* are a result of human modifications to the habitat.

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Grassland vegetation. Degraded dry upland *Achnatherum lettermanii* type?

Globally
The debate over whether *Poa pratensis* is either native or introduced appears to be resolved in favor of it being both (Great Plains Flora Association 1986, Gleason and Cronquist 1991). The Great Plains Flora Association (1986) cites Boivin and Love (1960) as the source of this decision. Gleason and Cronquist (1991) state that in most parts of their Manual's range (Northeast and Midwest United States and adjacent Canada), the species is introduced, but that it is probably native along their northern boundary and in Canada.

This type could be narrowly restricted to mixed-grass prairie stands where *Poa pratensis* dominates to the exclusion of most other species, or it could be expanded to include almost any naturalized stand dominated by *Poa pratensis*. Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such. This type includes only naturalized examples of *Poa pratensis* stands. Maintained lawns are treated as cultural types.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Meadow soils are deeper and subject to small mammal burrowing; site covered by deep snow in winter and exposed to wind during growing season; soils are clayey with mud cracks forming; *Poa pratensis* grows in circular patches in some areas; some historic disturbance evident due to powerline installation; and grazing by livestock evident, mostly sheep.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (8 plots): (Plots: CEBR.0005, CEBR.0043, CEBR.0046, CEBR.0049, CEBR.0065, CEBR.0074, CEBR.0076, CEBR.0091). and 24 AA points from 2007 (CEBR_AA.0018, CEBR_AA.0020, CEBR_AA.0022, CEBR_AA.0023, CEBR_AA.0024, CEBR_AA.0026, CEBR_AA.0027, CEBR_AA.0028, CEBR_AA.0029, CEBR_AA.0061, CEBR_AA.0199, CEBR_AA.0201, CEBR_AA.0231, CEBR_AA.0372, CEBR_AA.0375, CEBR_AA.0378, CEBR_AA.0379, CEBR_AA.0380, CEBR_AA.0381, CEBR_AA.0382, CEBR_AA.0384, CEBR_AA.0386, CEBR_AA.0387). , *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: D. Faber-Langendoen, mod. K.A. Schulz

REFERENCES: Butler et al. 2002, Gleason and Cronquist 1991, Great Plains Flora Association 1986, MTNHP 2002b, Midwestern Ecology Working Group n.d., NDNHI n.d., Trammell 1994, USFS 1937, Von Loh et al. 2000

Carex aquatilis Herbaceous Vegetation

Aquatic Sedge Herbaceous Vegetation

CODE	CEGL001802
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*CAREX AQUATILIS* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1404) Aquatic Sedge Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Boreal Wet Meadow (CES103.873)
Western Great Plains Open Freshwater Depression Wetland (CES303.675)
Ro cky Mountain Alpine-Montane Wet Meadow (CES306.812)
Tem perate Pacific Subalpine-Montane Wet Meadow (CES200.998)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This common, widespread herbaceous vegetation occurs as large, mesic meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations throughout the western U.S. It occurs in a variety of environmental settings in the montane and subalpine zones. Some of the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. Presence of *Carex aquatilis* typically indicates wet soils with high organic matter or histic epipedons. This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (10-80% cover), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis, Deschampsia caespitosa, Juncus balticus*, and *Poa palustris*. *Eleocharis quinqueflora* can be abundant on organic substrates at high elevations. Woody species rarely occur in these sites. A clear dominance by *Carex aquatilis* and low cover of *Carex utriculata* or *Pedicularis groenlandica* set this plant association apart from closely related types.

DISTRIBUTION

Cedar Breaks National Monument

This palustrine wetland herbaceous association has limited distribution in the monument and was sampled near Sunset View, Chessmen Ridge Overlook, along the northeast park boundary, the east boundary and Alpine Pond.

Globally

This association is common and located in mountainous areas throughout the western U.S. and Canada.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This wetland graminoid association occurs as small patches in drainages and depressions and along pond margins where saturated or inundated soils are present. Sites are flat to gentle (0- to 1-degree slopes), occur between 3144 and 3231 m in elevation, and are oriented to all aspects. The ground surface has low to high exposure of bare soil and low to high cover of litter. Soils are somewhat poorly drained peat accumulated over the Brian Head Formation and Claron Formation (White Member).

Globally

This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. These palustrine wetlands have a range of hydrologic regimes, though all stands are saturated for a significant enough period during the growing season to cause a buildup of organic material in the soil. Soils are organic mucks and peats and are poorly to very poorly drained.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is high to dense (68-85% cover) and is characterized by *Carex aquatilis* that provides 30-85% cover. The remaining graminoid layer is low in terms of species diversity, provides sparse to low cover, and includes *Carex scirpoidea, Carex egglestonii*, and *Deschampsia caespitosa*. The forb layer is moderately diverse and provides sparse cover; the more common forb are *Caltha leptosepala, Machaeranthera commixta, Mertensia arizonica, Achillea millefolium , Polygonum bistortoides,* and *Aconitum columbianum*. Sparse cover of the short shrubs *Salix arizonica* and *Lonicera involucrata* occurs in this association. Species of moss provide sparse cover (up to 5%).

Globally
This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (10-80% cover), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (1-40%) or *Deschampsia caespitosa* (1-16%), *Juncus balticus*, and *Poa palustris*. *Eleocharis quinqueflora* can be abundant on organic substrates (1-49% cover) at high elevations. *Carex utriculata* (1-20% cover) may be present. When present, *Carex utriculata* is usually not more than one-third the cover of *Carex aquatilis* cover. If it is more than that, the stand may be classified as *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803) or *Carex utriculata* Herbaceous Vegetation (CEGL001562). Forbs are often present, although sometimes inconspicuous (generally <10%, but can be as high as 40%). Species include *Epilobium* spp., *Pedicularis groenlandica, Caltha leptosepala, Menyanthes trifoliata, Cardamine cordifolia*, and *Mertensia ciliata*. Shrubs and trees have been observed invading the wetland from surrounding areas, including *Betula nana, Salix maccalliana*, and *Picea engelmannii*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (field)	*Caltha leptosepala*
Herb (field)	*Carex aquatilis*

Globally

Stratum	Species
Herb (field)	*Carex aquatilis*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Salix arizonica

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
This association (CEGL001802) is distinguished from *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803) and *Carex aquatilis - Pedicularis groenlandica* Herbaceous Vegetation (CEGL001804) by the dominance of *Carex aquatilis*. If *Carex utriculata* is present, it is no more than one-third of the total cover.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Depression linked hydrologically to Sunset Spring, standing water present in depression bottom; standing and running water drive this association; stream and high groundwater table of Alpine Pond support this type.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (3 observation points): (Observation Points: CEBR.9013, CEBR.9016, CEBR.9062) and 5 AA points

(CEBR_AA.0240, CEBR_AA.0034, CEBR_AA.0091, CEBR_AA.0200, CEBR_AA.0042)., *Local Description Authors:* M. Smith and J. Von Loh
Global Description Authors: G. Kittel

REFERENCES: Achuff et al. 2002a, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bierly 1972, Bourgeron and Engelking 1994, Briggs and MacMahon 1983, Bunin 1975c, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Christy 2004, Cooper and Cottrell 1990, Cox 1933, Crowe and Clausnitzer 1997, Crowe et al. 2004, Driscoll et al. 1984, Giese 1975, Girard et al. 1997, Hall 1971, Hall 1973, Hansen et al. 1988b, Hansen et al. 1995, Hess and Wasser 1982, Hopkins 1979a, IDCDC 2005, Jankovsky-Jones et al. 1999, Johnson 1932a, Johnson 1932b, Johnson 1936, Johnson 1939, Johnson and Simon 1987, Jones 1992b, Jones and Ogle 2000, Kagan et al. 2000, Kauffman 1982, Kauffman et al. 1985, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova 1976, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Kovalchik and Elmore 1992, Lewis 1970, MTNHP 2002b, Manning and Padgett 1991, Manning and Padgett 1992, Manning and Padgett 1995, Mattson 1984, Norton et al. 1981, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley 1920, Robbins 1918, Sanderson and Kettler 1996, Stuth 1975, Terwilliger et al. 1979a, Titus and Christy 1996a, Titus and Christy 1999, Tuhy 1981, Tuhy and Jensen 1982, Volland 1976, WNHP unpubl. data, Western Ecology Working Group n.d., Wilson 1969, Young 1982, Youngblood et al. 1985a, Youngblood et al. 1985b

Deschampsia caespitosa - Polygonum bistortoides Herbaceous Vegetation

Tufted Hairgrass - American Bistort Herbaceous Vegetation

CODE	CEGL003485
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*DESCHAMPSIA CAESPITOSA* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1408) Tufted Hairgrass Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S):USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This association is known from the vicinity of Yosemite National Park, Sequoia National Park, and elsewhere in the Sierra Nevada. It occupies wet and moist meadows, streamsides, and lake margins in the montane and subalpine zone of the Sierra Nevada. This perennial bunchgrass vegetation is variable depending on the elevation. It usually forms a dense cover from 60-90% dominated by *Deschampsia caespitosa* with forbs including *Senecio scorzonella, Solidago multiradiata, Lupinus lepidus, Achillea millefolium, Oreostemma alpigenum var. alpigenum, Polygonum bistortoides, Trifolium monanthum*, and *Potentilla drummondii*. The most frequent graminoid associates include *Calamagrostis breweri, Phleum alpinum, Poa fendleriana, Carex luzulifolia, Trisetum wolfii, Eleocharis quinqueflora, Phleum alpinum, Carex scopulorum, Juncus mexicanus, Muhlenbergia richardsonis, Calamagrostis breweri*, and/or *Trisetum spicatum*. *Polygonum bistortoides* is the only species other than *Deschampsia* that occurs on all of the plots sampled at Yosemite National Park.

DISTRIBUTION
Cedar Breaks National Monument
This uncommon palustrine wetland herbaceous association was sampled near the Chessmen Ridge Overlook and Sunset View, near the northeastern and southern monument boundaries, and near State Highway 143 near the Panguitch Lake Road.

Globally
This association is known from the vicinity of Yosemite, Sequoia National Park (Benedict 1983), and elsewhere in the Sierra Nevada (Ratliff 1982, 1985).

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This wetland graminoid association is uncommon in the monument and is limited to saturated soils in drainage bottoms and depressions. The sites are gentle (1- to 3-degree slopes), occur between 3147 and 3207 m in elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil and low to moderate cover of litter. Soils are poorly drained to moderately well-drained peat deposits overlying the Brian Head Formation and the Claron Formation (White Member).

Globally

This association occupies wet and moist meadows, streamsides, and lake margins in the montane and subalpine zone of the Sierra Nevada.

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is moderate to dense (40-79% cover) and is characterized by the medium-tall bunchgrass *Deschampsia caespitosa* that provides 12-45% cover and by the mesic forb *Polygonum bistortoides* that provides 1-35% cover. The remaining graminoid layer is moderately diverse in terms of species composition, provides low to moderate cover, and includes *Carex aquatilis, Phleum alpinum, Elymus trachycaulus*, and non-native *Poa pratensis*. The remaining forb layer is diverse in terms of species composition and provides low to moderate cover, predominantly by *Symphyotrichum foliaceum (= Aster foliaceus), Ranunculus alismifolius, Erigeron ursinus*, and *Trifolium longipes*.

Globally

At Yosemite National Park, this perennial bunchgrass vegetation is variable depending on the elevation. It usually forms a dense cover from 60-90% dominated by *Deschampsia caespitosa* (26.3% cover) with forbs including *Senecio scorzonella* (3% cover), *Solidago multiradiata* (7.5%), *Lupinus lepidus* (5% cover), *Achillea millefolium* (2.5% cover), *Oreostemma alpigenum var. alpigenum* (2.5% cover), *Polygonum bistortoides* (2.5% cover), *Trifolium monanthum* (2.5% cover), and *Potentilla drummondii* (2.5% cover). The most frequent graminoid associates include *Calamagrostis breweri* (2.5% cover), *Phleum alpinum* (2.5% cover), *Poa fendleriana* (2.5% cover), *Carex luzulifolia* (15% cover), *Trisetum wolfii* (0.5% cover), *Eleocharis quinqueflora* (1% cover), *Phleum alpinum* (0.4% cover), *Carex scopulorum* (1% cover), *Juncus mexicanus* (1% cover), *Muhlenbergia richardsonis* (0.7% cover), *Calamagrostis breweri* (0.7% cover), and/or *Trisetum spicatum* (0.7% cover). *Polygonum bistortoides* is the only species other than *Deschampsia* that occurs on all of the plots sampled.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Herb (field)	*Erigeron ursinus*, *Polygonum bistortoides*, *Ranunculus alismifolius*, *Symphyotrichum foliaceum*, *Trifolium longipes*
Herb (field)	*Carex aquatilis*, *Deschampsia caespitosa*, *Phleum alpinum*, *Poa pratensis*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument

Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (1-Apr-2003). This association is likely to be widespread, but of limited extent, in the High Sierra Nevada.

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Grassland.

Globally
Potter (pers. comm. 2002) has 23 plots he characterizes as representing *Deschampsia caespitosa* alliance throughout the Sierra Nevada; these have not been split into associations. Only 13 have *Polygonum bistortoides*, suggesting further variation in this alliance occurs outside of Yosemite.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Saturated soils and flowing or standing water are characteristic.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (3 plots and 4 observation points): (Plots: CEBR.0042, CEBR.0058, CEBR.0060; Observation Points: CEBR.9006, CEBR.9008, CEBR.9021, CEBR.9028).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: T. Keeler-Wolf

REFERENCES: Benedict 1983, Ratliff 1982, Ratliff 1985, Western Ecology Working Group n.d.

Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation

Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Vegetation

CODE	CEGL003081
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*POA PRATENSIS* SEMI-NATURAL SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1382) Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This semi-natural grassland is widespread in the western U.S. and northern Great Plains where it has invaded natural meadows and riparian areas. Sites are generally flat to moderately sloping and occur on all aspects. Stands typically occur on pastures found in the plains, montane meadows, stream benches and terraces. In the semi-arid region it is restricted to relatively mesic sites. Soils are highly variable, but *Poa pratensis* grows best on moist, fertile sandy to clayey alluvium with high organic content. It does not tolerate prolonged flooding, high water tables or poor drainage well. However, it can tolerate mildly alkaline and saline soils, and some drought. The vegetation is characterized by a moderate to dense herbaceous canopy that is strongly dominated by the introduced perennial, sod-forming graminoid *Poa pratensis*. *Poa pratensis* has invaded many natural plant associations, but the diagnostic character in this association is that there is typically not enough of the native grassland left to classify it as a poor condition natural type. Associates are often those early-seral and weedy species that tolerate the historic heavy livestock grazing or other disturbance well, such as *Achillea millefolium, Cirsium arvense, Elymus repens, Equisetum* spp., *Fragaria virginiana, Hordeum* spp., *Juncus balticus, Linaria vulgaris, Potentilla gracilis, Taraxacum officinale*, and introduced forage species such as *Agrostis stolonifera, Bromus inermis*, and *Phleum pratense*. Remnant natives *Pascopyrum smithii, Deschampsia caespitosa*, and *Carex* spp. are often present in low cover. Occasional trees and shrubs may also be present.

DISTRIBUTION

Cedar Breaks National Monument

This semi-natural mesic grassland is uncommon where mesic conditions allow *Poa pratensis* to spread and persist. It was sampled east of State Highway 143, near the Rattlesnake Trailhead, and near the northern monument entrance.

Globally

This semi-natural grassland is widespread in the western U.S. and northern Great Plains.

ENVIRONMENTAL DESCRIPTION

Cedar Breaks National Monument

This semi-natural mesic grassland occurs on stable slopes of plateaus and in drainages. Sites are gentle to moderate (1- to 10-degree slopes), occur between 3185 and 3200 m elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil and sparse to low cover of litter and rocks. Soils are silt loams derived from the Brian Head Formation.

Globally

This semi-natural grassland is widespread in the western U.S. and northern Great Plains where it has invaded natural prairies, meadows and riparian areas. Elevation ranges from 1100-3200 m (3600-10,500 feet). Sites are generally flat to moderately sloping and occur on all aspects. Stands typically occur on pastures found in the plains, montane meadows, stream benches and terraces. In the semi-arid regions it is restricted to relatively mesic sites. Soils are variable, but *Poa pratensis* grows best on moist, fertile sandy to clayey alluvium with high organic content (Hansen et al. 1995). It does not tolerate prolonged flooding, high water tables or poor drainage well. However, it can tolerate mildly alkaline and saline soils, and some drought (Hansen et al. 1995, Hall and Hansen 1997, Kovalchik 1987, Manning and Padgett 1995, Padgett et al. 1989).

VEGETATION DESCRIPTION

Cedar Breaks National Monument

Total vegetation cover is low to high, ranging from 21-60% cover, and is characterized by the rhizomatous non-native *Poa pratensis* that provides low to moderate cover (10-25%). The remaining graminoids are moderately diverse in terms of species composition, provide sparse to low cover, and include *Achnatherum lettermanii, Elymus trachycaulus*, and *Trisetum spicatum*. The forb layer is diverse in terms of species composition, provides sparse to low cover, and includes *Achillea millefolium, Solidago multiradiata*, and *Penstemon rydbergii*.

Globally

This widespread, semi-natural plant association is characterized by a moderate to dense herbaceous canopy that is strongly dominated by the introduced perennial, sod-forming graminoid *Poa pratensis*. *Poa pratensis* has invaded many natural plant associations, but the diagnostic character in this association is that there is typically not enough of the native grassland left to classify it as a poor condition natural type. Associates are often those early-seral and weedy species that tolerate the historic heavy livestock grazing or other disturbance well, such as *Achillea millefolium, Cirsium arvense, Elymus repens, Equisetum* spp., *Fragaria virginiana, Hordeum* spp., *Juncus balticus, Linaria vulgaris, Potentilla gracilis, Taraxacum officinale*, and introduced forage species such as *Agrostis stolonifera, Bromus inermis*, and *Phleum pratense*. Remnant natives *Pascopyrum smithii, Deschampsia caespitosa*, and *Carex* spp. are often present in low cover. Occasional trees and shrubs may also be present.

MOST ABUNDANT SPECIES

Cedar Breaks National Monument

Stratum	Species
Herb (field)	*Penstemon rydbergii*, *Solidago multiradiata*
Herb (field)	*Elymus trachycaulus*, *Poa pratensis*

Globally

Stratum	Species
Herb (field)	*Poa pratensis*

OTHER NOTEWORTHY SPECIES

Cedar Breaks National Monument

Achillea millefolium, *Poa pratensis*, *Taraxacum officinale*, *Thlaspi montanum*

Globally
Achillea millefolium, *Agrostis stolonifera*, *Bromus inermis*, *Cirsium arvense*, *Elymus repens*, *Linaria vulgaris*, *Phleum pratense*, *Poa pratensis*, *Taraxacum officinale*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (invasive) (1-Dec-1997).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Relatively stable slope, grazing history affects vegetation cover and species composition.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (3 observation points): (Observation Points: CEBR.9003, CEBR.9010, CEBR.9111).
Local Description Authors: M. Smith and J. Von Loh
Global Description Authors: D. Faber-Langendoen, mod. K.A. Schulz and G. Kittel

REFERENCES: Cogan et al. 2004, Franklin and Dyrness 1973, Hall 1973, Hall and Hansen 1997, Hansen et al. 1995, Kauffman et al. 1983, Kauffman et al. 1985, Kovalchik 1987, MTNHP 2002b, Manning and Padgett 1995, Marriott pers. comm., Padgett et al. 1989, Sawyer and Keeler-Wolf 1995, Tuhy and Jensen 1982, Volland 1978, Volland and Dell 1981, Western Ecology Working Group n.d., Youngblood et al. 1985a

Poa secunda Herbaceous Vegetation

Curly Bluegrass Herbaceous Vegetation

CODE	CEGL001657
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*POA SECUNDA* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1410) Curly Bluegrass Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Sou thern Rocky Mountain Montane-Subalpine Grassland (CES306.824)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This widespread grassland association occurs across the intermountain western U.S. Elevation ranges from 1440 to 2722 m (4720-8925 feet). Stands occur on uplands in swales, gentle slopes and drainage bottoms, often with easterly facing aspects. Substrates are deep, well-drained loam and clay loam soils. The vegetation is characterized by a somewhat open to dense graminoid canopy dominated by the short bunchgrass *Poa secunda* (up to 50% cover). The herbaceous layer is diverse, with additional graminoids such as *Carex microptera, Eleocharis quinqueflora (= Eleocharis pauciflora), Hordeum brachyantherum ssp. californicum, Leymus simplex, Juncus* spp., and *Pascopyrum smithii* providing low to moderate cover. Forbs provide moderate cover and include *Achillea millefolium, Agoseris glauca, Iris missouriensis, Iva axillaris, Potentilla gracilis, Senecio* sp., and *Trifolium* spp. The short shrub *Artemisia tridentata ssp. wyomingensis* may be present with sparse cover. Introduced species may also be common in some stands.

DISTRIBUTION
Cedar Breaks National Monument
Data are not available.
Globally
This grassland association occurs across the intermountain western U.S. from western Colorado to California, north to Idaho and Oregon.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
This widespread grassland association occurs across the intermountain western U.S. Elevation ranges from 1440 to 2722 m (4720-8925 feet). Stands occur on uplands in swales, gentle slopes and drainage bottoms and valley floors, often with easterly facing aspects. Substrates are deep, well-drained loam, clay loam and silty clay soils derived from alluvium. Litter cover is variable but often relatively high.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Data are not available.

Globally
This herbaceous vegetation association forms a somewhat open to dense graminoid canopy strongly dominated by the short bunchgrass *Poa secunda* (up to 50% cover). The herbaceous layer may be diverse, with additional graminoids such as *Carex microptera, Eleocharis quinqueflora (= Eleocharis pauciflora), Elymus trachycaulus, Hordeum brachyantherum ssp. californicum, Leymus simplex, Koeleria macrantha, Juncus balticus, Juncus confusus, Juncus ensifolius*, and *Pascopyrum smithii* providing low to moderate cover. Forbs provide moderate cover and include *Achillea millefolium, Agoseris glauca, Elymus trachycaulus, Iris missouriensis, Potentilla gracilis, Machaeranthera canescens, Senecio* sp., *Trifolium cyathiferum, Trifolium dubium*, and *Trifolium gymnocarpon*. The short shrubs *Artemisia tridentata ssp. wyomingensis, Chrysothamnus viscidiflorus, Ericameria nauseosa, Gutierrezia sarothrae*, and *Krascheninnikovia lanata* may be present with sparse cover. Introduced species may also be common, including *Descurainia sophia, Iva axillaris, Lepidium perfoliatum, Poa pratensis, Taraxacum officinale*, and *Tragopogon dubius*.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument Data are not available.

Globally

Stratum	Species
Herb (field)	*Poa secunda*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

Globally
Descurainia sophia, *Iva axillaris*, *Lepidium perfoliatum*, *Poa pratensis*, *Taraxacum officinale*, *Tragopogon dubius*, *Trifolium dubium*

CONSERVATION STATUS RANK
Global Rank & Reasons: G4? (1-Feb-1996).

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Data are not available.
Globally
The dominant grass in this association, *Poa secunda*, was originally identified as *Poa nevadensis*, a taxon which Kartesz (1999) has subsumed into *Poa secunda*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Data are not available.
Cedar Breaks National Monument Plots: This community was observed from 1 AA point in 2007 (CEBR_AA.0017)
Local Description Authors:
Global Description Authors: K.A. Schulz

REFERENCES: Blackburn et al. 1969a, Bourgeron and Engelking 1994, Driscoll et al. 1984, IDCDC 2005, Kagan et al. 2000, Kagan et al. 2004, Manning 1988, Manning and Padgett 1995, Western Ecology Working Group n.d.

[Park Special] *Picea pungens / Salix brachycarpa* Woodland
Blue Spruce / Short-fruit Willow Woodland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This uncommon mesic woodland association was sampled on a stream terrace of Adams Creek in The Meadows near the monument boundary and in lower Lavender Canyon near its confluence with Ashdown Creek.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This wooded wetland association occurs on the creek and valley bottoms in the areas of highest ground water. The sites are gently sloped (3 degrees), occur between 2509 and 2608 m in elevation, and are oriented to the west and southwest. The ground surface has sparse to high cover of litter and duff and low to high exposure of bare soil. Litter depths range from 0-2.5 cm. Soils are somewhat poorly drained to moderately well-drained silty clays and sandy clay loams derived from older alluvium.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is dense (67-97% cover) and is characterized by the canopy tree *Picea pungens* that ranges in height from 2-20 m, has dbh ranging from 12-37 cm, and provides 5-10% cover, and by the short shrub *Salix brachycarpa* that is <1 m tall and provides 35% cover. Associated canopy trees include *Pinus ponderosa* that contributes sparse cover. Subcanopy *Betula occidentalis, Juniperus scopulorum, Picea pungens*, and *Pseudotsuga menziesii* trees from 2-5 m tall also contribute sparse to low cover. Other shrubs present include *Amelanchier utahensis, Cornus sericea*, *Juniperus communis* and *Rosa woodsii*. The herbaceous layer is high in terms of species composition and contributes low to moderate cover. Common graminoids include *Muhlenbergia andina, Juncus balticus*, and *Elymus trachycaulus*. Forbs contributing low to moderate cover include *Geranium richardsonii* and *Maianthemum stellatum*. The fern allies *Equisetum arvense* and *Equisetum laevigatum* contribute sparse cover. Seedling trees up to 1 m tall provide sparse cover and include *Abies concolor, Cercocarpus ledifolius, Betula occidentalis, Juniperus scopulorum, Picea pungens, Pinus ponderosa*, and *Pseudotsuga menziesii*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This uncommon wooded wetland occurs on gently sloped valley floors with a high groundwater table. Soils are saturated to the surface, which prevents encroachment by upland tree species to a large degree. Extended drought that lowers the groundwater table at these sites would result in a potential reduction of *Salix brachycarpa*. Flooding is rare on both sites. This stand falls under Anderson Fuel Model class 5, Chaparral and Shrub Fields.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Canopy Tree	*Picea pungens*
Short Shrub	*Salix brachycarpa, Juniperus communis*
Herbaceous (H1)	*Muhlenbergia andina, Juncus balticus*
Herbaceous (H2)	*Geranium richardsonii, Maianthemum stellatum*
Herbaceous (H4)	*Picea pungens*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Picea pungens, Salix brachycarpa, Juniperus communis

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Wooded wetlands. Type in CO called this? GMK-No

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Site is on a flat stream terrace with a high groundwater table, flooding appears to be intermittent or episodic.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (2 plots): (Plots: CEBR.0109, CEBR.0172).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 11 March 2007

[Park Special] *Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula* Woodland
Ponderosa Pine / Curl-leaf Mountain Mahogany / Greenleaf Manzanita Woodland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This woodland is uncommon to common below the breaks, and was sampled near The Quarry, north of and on Chessmen Ridge, north of The Meadows, Meadows Hill, lower Columbine Canyon, east of Adams Canyon, Lavender Canyon, and near Lavender Creek in the Ashdown Creek drainage, and north fork Ashdown Creek.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This woodland occurs on ridges, midslopes of canyons, and in floodplains. Sites are gentle to steep but mostly steep (5- to 33-degree) slopes, occur between 2507 m and 2698 m in elevation, and are oriented to the southeast and southwest. The ground surface has low to high cover of litter and duff and sparse to moderate cover of large and small rocks. Litter depths range from 0-5 cm. Soils are rapidly drained sandy loams derived from the Wahweep and Cedar Canyon Formations, Straight Cliffs Formation, and alluvial fan deposits.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate to high (26-66% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-15 m, has dbh ranging from 45-75 cm, and provides 1-8% cover; by the subcanopy tree *Cercocarpus ledifolius* that is 2-5 m tall and provides 3-18% cover; and by the short shrub *Arctostaphylos patula* that contributes 4-38% cover. Associated canopy trees include *Abies concolor* and *Pseudotsuga menziesii* that contribute sparse cover and range in dbh from 17-36 cm and 13-25 cm, respectively. Additional subcanopy trees include *Abies concolor, Juniperus scopulorum, Pinus ponderosa*, and *Pseudotsuga menziesii* that range from 2-5 m

tall and contribute sparse cover. Other shrub cover is minimal and may include *Juniperus communis, Purshia tridentata, Symphoricarpos oreophilus* and *Mahonia repens*. The herbaceous layer is low in terms of floristic diversity and contributes sparse cover. Seedling trees up to 2 m tall provide sparse cover and include *Abies concolor, Betula occidentalis, Juniperus scopulorum, Pinus edulis*, and *Pinus ponderosa*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This uncommon to common woodland occurs on moderately steep slopes that are relatively stable. One slope is subject to rockfall from cliffs. These stands are considered stable in the absence of fire. Fire could result in tree scaring, thinning, or removal and a corresponding increase to dominance by *Arctostaphylos patula* short shrubland. This stand falls under Anderson Fuel Model classes 4 and 5, Chaparral and Shrub Fields.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Canopy Tree	*Pinus ponderosa*
Subcanopy Tree	*Cercocarpus ledifolius*
Short Shrub	*Arctostaphylos patula*
Dwarf-shrub	*Mahonia repens*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Pinus ponderosa, Cercocarpus ledifolius, Arctostaphylos patula, Mahonia repens

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
N/A

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Pine woodlands.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Sites occupy moderately steep slopes but appear stable; stand occupies a ridgeline; stand occupying toeslope of hill has fire history; site occurs on a floodplain that has been active.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (3 plots and 6 observation points): (Plots: CEBR.0036, CEBR.0133,; Observation Points: CEBR.9067, CEBR.9100, CEBR.9103, CEBR.9108, CEBR.9109, CEBR.9110), and 7 AA points from 2007 (CEBR_AA.0101, CEBR_AA.0104, CEBR_AA.0121, CEBR_AA.0124, CEBR_AA.0192, CEBR_AA.0194, CEBR_AA.0232)., Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Colorado Plateau Woodland

Ponderosa Pine - Douglas-fir / Greenleaf Manzanita Woodland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This woodland association was sampled and observed near the Quarry in the Adams Creek drainage, on Shooting Star Ridge, Cheesman Ridge, Cheesman Canyon, and north of The Meadows.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This woodland association occurs on the midslope of canyons. It occurs on moderately steep to very steep slopes (15-28 degrees), and from 2534 to 2675 m in elevation that is oriented to all aspects . The unvegetated surface has high cover of litter and duff, sparse cover of large and small rocks, and low exposure of bare soil. Litter depths range from 0-1.8 cm. Soils are rapidly drained sandy loams derived from the Wahweep and Cedar Canyon Formations.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This woodland has a moderate total vegetation cover (51% cover) and is characterized by the canopy trees *Pinus ponderosa* and *Pseudotsuga menziesii* that range in height from 10-15 m, have dbhs ranging from 21-25 cm (*Pinus ponderosa*), and provide from 1-10% cover, each and by the short shrub *Arctostaphylos patula* that contributes 18-55% cover. The subcanopy layer provides low cover (up to 9%) and includes Abies concolor, *Cercocarpus ledifolius, Juniperus scopulorum, Pinus ponderosa*, and *Pseudotsuga menziesii* that range from 2-5 m tall. The remaining short- and dwarf-shrub layers are low in terms of species composition, provide sparse cover, and include Ceanothus martini, Juniperus communis, *Purshia tridentata* and *Mahonia repens*. The herbaceous layer is low in floristic diversity and contributes sparse cover.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tree canopy	*Pinus ponderosa*
Tree subcanopy	*Juniperus scopulorum*, *Pseudotsuga menziesii*
Short shrub/sapling	*Arctostaphylos patula*

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Data are not available.

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Douglas-fir forests.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Site occupies steep slope but appears stable.
Cedar Breaks National Monument Plots: Plots and Observation Points: The description is based on 2006 field data (1 plot) (Plots: CEBR.0093), and 7 AA points from 2007 (CEBR_AA.0167, CEBR_AA.0180, CEBR_AA.0183, CEBR_AA.0185, CEBR_AA.0204, CEBR_AA.0211, CEBR_AA.0220).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Populus angustifolia - Picea pungens / Acer glabrum* Woodland
Narrowleaf Cottonwood - Blue Spruce / Mountain Maple Woodland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This riparian woodland association was sampled only once time, along a stream terrace of Arch Creek in the Ashdown Creek drainage.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This riparian woodland association occurs on a terrace elevated approximately 10 m above the creek bed. The site is gentle (2^{o} slope), occurs at 2646 m in elevation, and is oriented to the southwest (214^{o}). The ground surface has high cover of large and small rocks, low cover of litter, and little exposure bare soil. Litter and duff accumulation ranges from 0-0.9 cm in depth. Soils are rapidly drained sandy clay loam derived from alluvium.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This wooded riparian association was sampled only in Arch Creek. Total vegetation cover is low to moderate (28% cover) and is characterized by the canopy tree *Populus angustifolia* that ranges in height from 15-20 m, has dbhs ranging from 17-35 cm, and provides 12% cover. Associated canopy trees include *Picea pungens, Pinus ponderosa*, and *Pseudotsuga menziesii* that contribute low cover and range in dbhs from 15-32 cm, 22 cm, and 13-23 cm, respectively. Subcanopy *Juniperus scopulorum, Populus angustifolia*, and *Pseudotsuga menziesii* trees from 5-10 m tall also contribute sparse to low cover. A sparse tall shrub layer (1-2 m tall) includes *Acer glabrum*. The short shrub layer is low in terms of species composition and provides sparse cover. The herbaceous layer is low in floristic diversity and contributes sparse cover. Seedling trees up to 1 m tall provide sparse cover and include *Picea pungens, Populus angustifolia*, and *Pseudotsuga menziesii*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This woodland association occurs on an elevated terrace and could be subject to removal during creek migration. Overbank flooding rarely occurs but could scour this site and remove the existing vegetation. Landslide off the adjacent slope could bury the existing vegetation. Fire is considered to be unlikely to occur in this stand. The Anderson Fuel Model class 2 Grass/Grass dominated defines this site.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Canopy Tree	*Populus angustifolia, Picea pungens, Pseudotsuga menziesii*
Subcanopy Tree	*Juniperus scopulorum*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Populus angustifolia

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
N/A

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Abies concolor forest.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: terrace is approximately 10 m higher than the channel bottom and is constructed of alluvium from flood events and colluvium from slopewash. Flooding rarely occurs because of its height above the creek bed.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot: CEBR.0112).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 13 March 2007

[Park Special] *Populus angustifolia* Temporarily Flooded Terrace Woodland
Narrowleaf Cottonwood Temporarily Flooded Terrace Woodland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This riparian woodland association was sampled on stream terraces of Adams Creek, Adams Canyon, in lower Lavender Canyon, Columbine Canyon, Arch Creek, Ashdown Creek, upper Ashdown Creek, and east of Meadow Hill.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This mesic woodland occurs on floodplains and terraces, in creek beds, and on the midslope of one bluff and one ridge. The sites are flat to gently sloped (1-53 degrees)the bluff and ridge plots are steep, e.g., 15- to 32-degree slopes), occur between 2450 and 2657 m in elevation, and are oriented to all aspects. The ground surface has sparse to high (one plot only) cover of litter and duff, low to high cover of large and small rocks, and low (one plot only) to high exposure of bare soil. Soils are rapidly drained loamy sands, sandy clay loams, and sandy clays derived from alluvium and the Cedar Canyon Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This wooded wetland association is uncommon and was sampled principally in the Ashdown and Adams creek drainages. The vegetation is very sparse due to the high disturbance in these drainages. The term “woodland” is used very loosely, there are trees, but they are very scattered. These are high gradient streams that scour most vegetation during storm runoff. Total vegetation cover is sparse to moderate (5-28% cover) and is characterized by the canopy tree *Populus angustifolia* that ranges in height from 2-35 m and provides <1-12% cover. Associated canopy trees include *Abies concolor, Cercocarpus ledifolius*, *Picea pungens, Pinus ponderosa, Pseudotsuga menziesii*, and *Picea engelmannii* that contribute sparse cover. Subcanopy *Abies concolor, Cercocarpus ledifolius, Picea engelmannii, Picea pungens, Pinus longaeva, Pinus ponderosa, Populus angustifolia*, Juniperus scopulorum, and *Pseudotsuga menziesii* trees from 1-15 m tall also contribute sparse to low cover. A sparse shrub layer (1-2 m tall) may occur and includes *Acer glabrum, Betula occidentalis, Salix exigua*, and the invasive exotic *Tamarix chilensis*. The short- and dwarf shrubs may also occur at sparse to low cover, and include *Mahonia repens, Juniperus communis, Purshia tridentata, Ericameria nauseosa*, and *Rosa woodsii*. The herbaceous layer is high in floristic diversity and contributes sparse to low cover. Common graminoids include *Bromus anomalus, Calamagrostis scopulorum*, and *Elymus trachycaulus*. Forbs occasionally present include *Astragalus kentrophyta, Cirsium wheeleri*, and *Packera multilobata (= Senecio multilobatus)*. The fern allies *Equisetum arvense* and *Equisetum laevigatum* are occasionally present and contribute sparse cover. Seedling trees up to 1 m tall provide sparse cover and include *Abies concolor, Juniperus scopulorum, Picea engelmannii, Picea pungens, Pinus longaeva, Pinus ponderosa, Populus angustifolia*, and *Pseudotsuga menziesii*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This riparian woodland typically occurs on gently sloped sites with a relatively high groundwater table. They occur on terraces above streams that are feed by high gradient streams that scour most vegetation during storm runoff.

Most occurrences are subject to periodic flooding that is intense enough to control the understory vegetation. Occurrences on active slopes are subject to rockfall and landslide, which prevent woody vegetation establishment.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Canopy Tree	*Populus angustifolia*
Subcanopy Tree	*Populus angustifolia, Pseudotsuga menziesii*
Short Shrub	*Purshia tridentata, Ericameria nauseosa*
Dwarf-shrub	*Mahonia repens*
Herbaceous (H1)	*Calamagrostis scopulorum*
Herbaceous (H4)	*Populus angustifolia*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Populus angustifolia

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Tamarix chilensis, Taraxacum officinale, Tragopogon dubius

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Wooded wetlands.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Intermittent flooding common, scours the substrate and prevents vegetation establishment; one site has sediment deposition from recent flood; boulders range in size to 2-3 m in diameter and are subject to redistribution in floods; and sites on slopes are subject to rockfall, soil creep, and landslide.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (9 plots and 1 observation point): (Plots: CEBR.0096, CEBR.0100, CEBR.0112, CEBR.0123, CEBR.0124, CEBR.0127, CEBR.0165, CEBR.0166, CEBR.0169; Observation Points: CEBR.9080), and 8 AA points from 2007 CEBR_AA.0066, CEBR_AA.0133, CEBR_AA.0144, CEBR_AA.0157, CEBR_AA.0170, CEBR_AA.0191, CEBR_AA.0214. CEBR_AA.0273).
Local Description Authors: M. Smith and J. Von Loh, mod by G. Kittel
Version Date: 09 July 2007

[Park Special] *Pseudotsuga menziesii / Ribes montigenum* Forest
Douglas-fir / Alpine Prickly Gooseberry Forest

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This forested association has a limited distribution and was sampled along the ridge below the Chessmen Ridge Overlook.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This forested association occurs on the midslope of a ridge. The site is steep (24-degree slope), occurs at 2913 m in elevation, and is oriented to the north. The ground surface has high cover of litter and duff, sparse cover of small and large rocks, low cover of downed wood, and sparse exposure of bare soil. Litter depths range from 0-6.3 cm. Soils are rapidly drained silty clay loams derived from the Claron Formation (Red Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is dense (61% cover) and is characterized by the canopy tree *Pseudotsuga menziesii* that ranges in height from 10-20 m, has dbh ranging from 15-56 cm, and provides 27% cover, and by the short shrub *Ribes montigenum* that provides 24% cover. Other canopy tree that provides sparse cover (up to 1%) is *Pinus longaeva*. The subcanopy layer provides sparse cover and includes *Pseudotsuga menziesii* and *Picea engelmannii*. The herbaceous layer is low in terms species composition, contributes sparse cover, and includes the forbs *Mertensia arizonica* and *Pyrola chlorantha*. *Pseudotsuga menziesii* and *Picea engelmannii* seedlings contribute sparse cover.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This forest occurs on a ridge above the breaks with stable soils. This stand is considered stable in the absence of fire. Fire could result in tree scaring, thinning or removal and a corresponding increase to potential dominance by fire-tolerant short shrubs and a variety of forbs. The dominant tree species would eventually reestablish. This stand falls under Anderson Fuel Model class 10, Timber Litter. Very heavy 1000-hr fuel is present.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Canopy Tree	*Pseudotsuga menziesii*
Subcanopy Tree	*Pseudotsuga menziesii*
Short Shrub	*Ribes montigenum*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Pseudotsuga menziesii, Ribes montigenum

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
N/A

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Douglas-fir forest.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Bark beetle infestation killed 100% of the mature *Picea engelmannii*, but stands are still shaded by *Pseudotsuga menziesii* canopy; canopy is still overlapping with not much sunlight reaching the forest floor; numerous older logs on the ground and high cover of small fuels, litter, and duff indicating that this area has not recently burned.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot): (Plots: CEBR.0031). And was observed in 2 AA points from 2007 (CEBR_AA.0332, CEBR_AA.0392).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 13 March 2007

[A.586] *Cercocarpus ledifolius* Woodland Alliance
Curl-leaf Mountain Mahogany Woodland Alliance

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This woodland alliance was sampled on colluvial slopes and in drainages and gullies in the Adams Creek drainage.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This short-stature woodland alliance occurs on steep slopes of colluvium and in erosion channels. Sites are steep (20^{o} - 43^{o} slopes), occur between 2591-2702 m in elevation, and are oriented to the north. The ground surface has moderate to high cover of large and small rocks and moderate to high amounts of bare soil. There is low cover by litter and downed wood. Soils are rapidly drained sandy clays derived from the Cedar Canyon Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This woodland alliance was only sampled in the Adams Creek drainage. Total vegetation cover is moderate (25-41% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and provides 8-18% cover. Emergent *Abies concolor, Pinus ponderosa,* and *Pseudotsuga menziesii* trees from 5-10 m tall provide sparse to low cover. The tall shrub, short shrub, and dwarf-shrub layers are low in terms of species composition and provide sparse cover. The short shrubs *Arctostaphylos patula, Ericameria nauseosa* and *Symphoricarpos oreophilus* are <1 m tall and contributes sparse cover. The graminoid layer contributes low cover, up to 11% cover, by *Achnatherum hymenoides* and *Calamagrostis scopulorum*. The forb layer is low in floristic diversity, provides sparse cover, and includes *Erysimum asperimum*. Seedling trees provide sparse cover and include *Abies concolor, Cercocarpus ledifolius,* and *Pseudotsuga menziesii*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This uncommon woodland alliance occurs midslope on colluvium and in erosion channels that are steep and therefore unstable and erosive. Fuels data could not be sampled at the plot site due to the steepness of the slope. There are many shallow rills and gullies present on the slope. Individual plants collect rock and soil upslope resulting in the formation of mounds, steps, or small terraces that partially cover smaller vegetation. Slopes are subject to continued soil creep, rockfall, and possibly landslides. Active rockfall is occurring from exposed Red Claron Formation cliffs located upslope.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Emergent Tree	*Pseudotsuga menziesii*
Canopy Tree	*Cercocarpus ledifolius*
Herb (H1)	*Calamagrostis scopulorum*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Cercocarpus ledifolius, Calamagrostis scopulorum

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
N/A

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane shrubland. Steep, active colluvial slopes.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: there is active rockfall and downslope movement of rock and soil surfaces that affect all plants growing on these slopes; the slope was too steep to collect fire fuels information; gully lies downslope of bedrock outcrop, soil is hard-pan.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot and 2 observation points: CEBR.0128 and CEBR.9064; CEBR.9065).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 04 April 2007

[Park Special] *Acer glabrum* Colluvial Slope Shrubland
Mountain Maple Colluvial Slope Shrubland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This tall-shrub association was sampled in Bristlecone Canyon near its confluence with Arch Creek and in Lower Columbine Canyon.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This open canopy tall-shrub association occurs on colluvial slopes, approximately midslope. Sites are steep (30- to 41-degree slopes), occur between 2709 and 2714 m in elevation, and are oriented to the northeast and northwest. The ground surface has high cover of large and small rocks and low to moderate exposure of bare soil. Soils are well-drained to rapidly drained sandy clays and sandy clay loams derived from colluvium and from the Cedar Canyon Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is sparse to low (8-23% cover) and is characterized by *Acer glabrum* shrubs that are <2 m tall and provide 2-6% cover. A sparse canopy of single *Juniperus scopulorum* and *Picea pungens* trees that are <2 m tall and up to 15 m tall, respectively, also occurs. Other shrubs present contribute sparse to low cover, and include *Cornus sericea* and *Shepherdia canadensis*. The herbaceous layer is low in terms of species composition and provides sparse to low cover. The graminoid layer consists only of *Calamagrostis scopulorum* and *Bromus anomalus* that provide up to 5% cover. The forb layer is moderate in terms of species diversity and provides sparse cover, predominantly by *Eurybia wasatchensis (= Aster wasatchensis)* and *Senecio atratus*. Seedling trees provide sparse cover and include *Abies concolor, Juniperus scopulorum, Picea engelmannii, Pinus longaeva*, and *Pseudotsuga menziesii*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This sparse tall-shrub association occurs midslope on colluvium that is steep and therefore unstable and erosive. There are many shallow rills and gullies present on the slope. Individual plants collect rock and soil upslope resulting in the formation of mounds, steps, or small terraces that partially cover smaller vegetation. Slopes are subject to continued soil creep, rockfall, and possibly landslides.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Tall Shrub	*Acer glabrum*
Short Shrub	*Cornus sericea*
Herb (H1)	*Calamagrostis scopulorum*
Herb (H2)	*Eurybia wasatchensis*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Acer glabrum, Cornus sericea, Calamagrostis scopulorum, Eurybia wasatchensis

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Taraxacum officinale

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane shrubland. Steep, active colluvial slopes.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: There is active downslope movement of rock and soil surfaces that affect all plants growing on these slopes.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (3 plots): (Plots: CEBR.0111, CEBR.0136, CEBR.0137).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 09 March 2007

[Park Special] *Salix arizonica* Shrubland
Arizona Willow Shrubland

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This wetland scrub-shrub association is uncommon and was sampled within meadows and drainages, mostly south and east of State Highway 143, near Sunset View, east of North View, and near the monument's northern boundary.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This shrub-scrub wetland located in perennial drainages and wet depressions. Sites are gently sloped (1-4 degrees), occur between 3153 and 3195 m in elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil and low cover by live woody stems. Soils are somewhat poorly drained to moderately well-drained muck and silt clay loams derived from the Brian Head Formation and Claron Formation (White Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is dense (65-85% cover) and is characterized by *Salix arizonica* short shrubs that are <1 m tall and provide 59-70% cover. An additional short shrub, *Dasiphora fruticosa ssp. floribunda*, is often present providing sparse cover. The herbaceous layer is diverse in terms of species composition and provides low cover. The graminoid layer is floristically diverse, provides sparse to low cover, and includes *Carex aquatilis* and *Deschampsia caespitosa*. The forb layer is diverse in terms of species composition and provides sparse cover with no one species consistently contributing more than 1% cover.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This shrub-scrub wetland occurs on soils and peat that are saturated and spongy to the touch where stands become established. The stands appear stable, although one has been negatively affected by grazing, as evidenced by the fenceline contrast.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Short Shrub	*Salix arizonica*
Herb (H1)	*Carex aquatilis, Deschampsia caespitosa*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Salix arizonica

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Achillea millefolium, Caltha leptosepala, Taraxacum officinale, Poa pratensis

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Wooded wetlands.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Shrub-scrub wetland is adapted to saturated soils of streams and depressions and areas where groundwater emerges; zones of dominant wetland vegetation form using groundwater that is near-to-surface.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (3 plots and 1 observation point): (Plots: CEBR.0047, CEBR.0052, CEBR.0080; Observation Points: CEBR.9005). And observed at one AA point from 2007 (CEBR_AA.0331).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Aster ascendens* Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Park
This meadow was observed at the Northeast Park Boundary, north of the campground, and along the southeast park Boundary.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Park
This is a dry open meadow that occurs on flat open areas of 2-6% slopes at all aspects. It was observed from 3092 to 3178 m in elevation. Soils are apparently deep with much burrowing animal activity and few rocks. 5 of the 6 locations occurred on the Brian Head Formation, one on the Claron Formation. Bare soil (from animal activity) and litter covers much of the ground surface.

VEGETATION DESCRIPTION
Cedar Breaks National Park
This is an open (low canopy coverage) meadow of mostly forbs with a few grasses. *Aster ascendens* is present in all observations with 9-12% cover. Other forbs include *Achillea millefolium, Cirsium* spp., *Ligusticum porteri, Viguiera multiflora, Solidago multiradiata, Taraxacum officinale, Trifolium longipes* and *Erigeron ursinus.* Graminoid herbaceous species with 1-8% cover include *Elymus trachycaulus, Stipa lettermanii, Carex rossii, Poa pratensis* and *Deschampsia caespitosa.*

COMMUNITY DYNAMICS
Cedar Breaks National Park

MOST ABUNDANT SPECIES
Cedar Breaks National Park

Stratum	Species
Canopy Tree	
Short Shrub	
Herb	*Aster ascendens*

CHARACTERISTIC SPECIES
Cedar Breaks National Park
Aster ascendens

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Park

CLASSIFICATION COMMENTS
Cedar Breaks National Park

ELEMENT SOURCES
Cedar Breaks National Park Inventory Notes: Individual Plot Notes:

Cedar Breaks National Park Plots and Observation Points: The description is based on 2007field data (CEBR_AA.0097, CEBR_AA.0345, CEBR_AA.0346, CEBR_AA.0348, CEBR_AA.0351, CEBR_AA.0373).
Local Description Authors: G. Kittel
Version Date: October 2010

[Park Special] *Calamagrostis scopulorum* Herbaceous Vegetation
Ditch Reedgrass Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous wetland association has limited distribution in the monument, and was observed along Ashdown Creek at the lowest monument elevations, along the north park boundary, Arch Creek, and in Crescent Hollow.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This wetland graminoid association occurs on fine soils of colluvium on canyonsides along Ashdown Creek. Sites are gentle to steep (5-40-degree slopes), occur between 2585 and 3171 m in elevation, and are oriented to all aspects. The ground surface has low to moderate exposure of bare soil, low cover of litter, and high cover of large and small rocks. Soils are well-drained to rapidly drained sandy clays derived from the recent alluvium, Wahweep and Cedar Canyon Formations.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is sparse to low (6-17% cover) and is characterized by *Calamagrostis scopulorum* that provides 3-12% cover. The remaining graminoid layer is low in terms of species composition, provides sparse cover, and includes *Bromus anomalus* and *Elymus elymoides*. The forb layer is moderately diverse in terms of species composition and provides sparse cover, predominantly by *Eurybia wasatchensis (= Aster wasatchensis)* and *Solidago velutina*. The short-shrub layer provides sparse cover on one site and includes *Purshia tridentata* and

Ericameria nauseosa. Seedling *Pseudotsuga menziesii, Abies concolor, Pinus ponderosa, Picea pungens*, *Populus tremuloides* , *P. angustifolia* and *Picea engelmannii* trees may provide sparse cover.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This wetland herbaceous vegetation occurs on gentle steep slopes that have high sun exposure, but that retain moisture following precipitation events because of the fine soils and evaporation protection provided by high cover of surface rocks.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Short Shrub	*Purshia tridentata*
Herb (H1)	*Calamagrostis scopulorum*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Calamagrostis scopulorum

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
N/A

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
This is a herbaceous community that is relatively moist but not a wetland.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Slopes active with erosion from runoff and landslide and affected by recent rockfall; community established on the erosional surface and not on colluvium.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (2 plots and 1 observation point): (Plots: CEBR.0110, CEBR.0132; Observation Points: CEBR.9073), and 3 AA points from 2007 (CEBR_AA.0115, CEBR_AA.0283, CEBR_AA.0310).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Carex scirpoidea* Seasonally Flooded Herbaceous Vegetation
Bulrush Sedge Seasonally Flooded Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This wetland herbaceous association has limited distribution and was sampled only near Sunset View in the vicinity of State Highway 143.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This palustrine wetland graminoid association occurs in drainages on low and high slopes. Sites are gently sloped (2-3 degrees), occur between 3149 and 3154 m in elevation, and are oriented to the southeast. The ground surface has high exposure of bare soil and moderate cover of litter. Soils are somewhat poorly drained to moderately well-drained peat accumulated over the Claron Formation (White Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is dense (85-95% cover) and is characterized by *Carex scirpoidea* that provides 20-30% cover. The remaining graminoid layer is moderately diverse in terms of species composition, provides moderate cover, and includes graminoids *Carex egglestonii, Carex aquatilis, Deschampsia caespitosa*, and *Juncus balticus*, and the fern ally *Equisetum laevigatum*. The forb layer is moderately diverse in terms of species composition and provides low cover, predominantly by *Caltha leptosepala* and *Polygonum bistortoides*. Sparse cover of the short shrubs *Salix arizonica* and *Dasiphora fruticosa ssp. floribunda* may also occur.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous vegetation occupies saturated soils adjacent to streambeds. The consistent hydrology results in stable plant community composition and distribution.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H1)	*Carex scirpoidea, Carex aquatilis, Carex egglestonii, Juncus balticus, Deschampsia caespitosa*
Herb (H2)	*Caltha leptosepala*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Carex scirpoidea, Juncus balticus, Deschampsia caespitosa, Caltha leptosepala

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Salix arizonica

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Herbaceous wetland.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Mesic meadow habitat.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (2 plots): (Plots: CEBR.0081, CEBR.0082).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 08 March 2007

[Park Special] *Carex egglestonii* Herbaceous Vegetation
Mount Shasta Sedge Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association has a limited distribution in the monument and was sampled only near milepost 7.0 of State Highway 143 and the monument service road at that location.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument

This graminoid association occurs on the midslope of a hill. The site is gently sloped (3 degrees), occurs at 3208 m in elevation, and is oriented to the northwest (320 degrees). The ground surface has high exposure of bare soil and low cover of litter. Soils are moderately well-drained silty clays derived from the Brian Head Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate (46% cover) and is characterized by *Carex egglestonii* that provides 25% cover. The remaining graminoid layer is moderately diverse in terms of species composition, provides low cover, and includes *Elymus trachycaulus, Poa pratensis* (non-native), and *Festuca ovina*. The forb layer is diverse in terms of species composition and provides low cover, predominantly by *Solidago multiradiata, Penstemon rydbergii*, and *Achillea millefolium*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous vegetation occurs on a mesic site that likely retains snow cover well into the spring and early summer.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H1)	*Carex egglestonii, Elymus trachycaulus, Poa pratensis*
Herb (H2)	*Solidago multiradiata, Penstemon rydbergii*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Carex egglestonii, Elymus trachycaulus, Solidago multiradiata

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium, Taraxacum officinale

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Dry sedge meadow vegetation that can occur on moist places and on rocky slopes.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: There is vole activity in this community.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot): (Plots: CEBR.0061).
1 AA point from 2007 (CEBR_AA.0076).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 08 March 2007

[Park Special] *Elymus trachycaulus* Herbaceous Vegetation
Slender Wild Rye Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This semiarid to mesic graminoid association is relatively common and was sampled throughout its distribution in the monument: near the north entrance, southern boundary, east of State Highway 143, Chessmen Ridge Overlook, south of Alpine pond and south of Panguitch Lake Road.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This graminoid association occurs on the midslopes of plains, hills, and along drainages and on plateau high slopes. The sites are gently sloped (2-5 degrees), occur between 3124 and 3219 m in elevation, and are oriented to all aspects. The ground surface has moderate to high exposure of bare soil and low to moderate cover of litter and small rocks. Soils are somewhat poorly drained to well-drained clays, clay loams, and sandy clay loams derived from the Brian Head Formation and Claron Formation (Red Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is low to moderately high (21-52% cover) and is characterized by the bunchgrass *Elymus trachycaulus* that provides 4-15% cover. The remaining graminoid layer is moderate in terms of species composition, provides low cover, and includes *Poa pratensis* (non-native), *Poa glauca, Achnatherum lettermanii*, *Elymus elymoides*, *Deschampsia caespitosa*, *Carex praegracilis* and *Trisetum spicatum*. The forb layer is diverse in terms of species composition and provides sparse to low cover, predominantly by *Achillea millefolium*. Arenaria fendleri, Aster ascendens, Erigeron ursinus, Eriogonum umbellatum, *Geum triflorum Lomatium minimum* Lupinus argenteus, *Machaeranthera bigelovii var. commixta (= Machaeranthera commixta)*Machaeranthera canescens, *Penstemon leiophyllus Penstemon rydbergii Potentilla gracilis* Potentilla hippiana, *Senecio integerrimus Solidago multiradiata* and Swertia radiata.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous vegetation occurs on semiarid to mesic sites that have high sun exposure, but that retain some moisture following snowfall and rain. Depending on soils present (Claron Formation derived), surface cracking is notable. Some vegetation stands have become established on thin soils over near-to-surface bedrock contributing to site doughtiness. Stands established on deeper soils have higher cover by *Poa pratensis*. Some grazing by sheep continues within the monument and these meadows contain preferred forage.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H1)	*Elymus trachycaulus, Poa pratensis, Poa glauca, Achnatherum lettermanii*
Herb (H2)	*Achillea millefolium, Geum triflorum, Penstemon rydbergii, Solidago multiradiata*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Elymus trachycaulus, Poa glauca, Poa pratensis

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium, Taraxacum officinale, Tragopogon dubius

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Grassland.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Continued grazing by sheep, high levels of pocket gopher activity at some sites, more mesic adjacent sites support *Poa pratensis*.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (4 plots and 2 observation points): (Plots: CEBR.0002, CEBR.0045, CEBR.0056, CEBR.0078; Observation Points: CEBR.9007, CEBR.9009), and 10 AA points from 2007 (CEBR_AA.0021, CEBR_AA.0030, CEBR_AA.0059, CEBR_AA.0092, CEBR_AA.0203, CEBR_AA.0206, CEBR_AA.0223, CEBR_AA.0263, CEBR_AA.0390, CEBR_AA.0391)., Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Ericameria discoidea* Dwarf-shrubland Herbaceous Sparse Vegetation Sharp-scaled Goldenweed Dwarf-shrubland Herbaceous Sparse Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This semiarid dwarf-shrub association occupies upper and midslopes of badlands exposures and breaks. This dwarf-shrubland association was sampled near Spectra Point, along the Rampart Overlook Trail, and on the breaks near the campground.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This dwarf-shrubland association occurs on the high slopes, midslopes, and rims of badlands break exposures. Sites are steep (16- to 35-degree slopes), occur between 3117 and 3187 m in elevation, and are oriented to the east and north. The ground surface has moderate to high exposure of bare soil and low to moderate cover of small and large rocks. Soils are moderately well-drained to rapidly drained sandy clays, sandy clay loams, and silt clay loams derived from the Claron Formation (White and Red members).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is sparse to low (5-22% cover) and is characterized by the dwarf-shrub *Ericameria discoidea* that provides 1-3% cover. The forb layer is diverse in terms of species composition, provides sparse to low cover, and includes *Eriogonum panguicense, Oxytropis oreophila, Hymenopappus filifolius, Phlox pulvinata, Arenaria fendleri*, and *Ipomopsis spicata ssp. tridactyla (= Gilia tridactyla)*. The graminoid layer is low in diversity, provides sparse cover, and is characterized by *Poa pratensis* (non-native) and *Trisetum spicatum*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This dwarf-shrub association occurs on steep badlands slopes and breaks that are highly erosive. As such this habitat is subject to rapid runoff, drought, and landslide. The plants are pedestalled on this highly erosive environment and occupy elevated areas between rills and small gullies that regularly occur. These slopes have high exposure to solar radiation, further reducing vegetation establishment.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Dwarf-shrub	*Ericameria discoidea*
Herb (H2)	*Eriogonum panguicense, Oxytropis oreophila, Pseudocymopterus montanus, Phlox pulvinata*
Herb (H1)	*Trisetum spicatum, Poa pratensis*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Ericameria discoidea, Trisetum spicatum, Eriogonum panguicense, Oxytropis oreophila

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Dwarf-shrubland. Total cover <10% on some sites and up to 20% on others.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Badlands slopes are xeric and unstable with many shallow gullies; tourist foot traffic affect some areas through compaction; higher cover on north-facing aspects.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (4 plots and 1 observation point): (Plots: CEBR.0040, CEBR.0087, CEBR.0088, CEBR.0151; Observation Points: CEBR.9022). This community was also observed during 2007 AA (CEBR_AA.0045, CEBR_AA.0242, CEBR_AA.0343).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Erigeron ursinus* Herbaceous Vegetation
Bear River Fleabane Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association has a limited distribution in the monument and was sampled only by observation points near the campground and near the Chessmen Ridge Overlook.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This mesic herbaceous association occurs on stable sites of plateau and upper drainage habitats. The sites are flat to gently sloped (0-2 degrees), occur between 3130 and 3184 m in elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil and sparse to low cover of litter and rocks. Soils are derived from the Brian Head Formation and Claron Formation (White Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate (31-46% cover) and is characterized by *Erigeron ursinus* that provides 7-10% cover. The remaining forb layer is diverse in terms of species composition, provides low to moderate cover, and includes *Achillea millefolium, Agoseris glauca, Arenaria fendleri, Haplopappus clementis*, and *Mertensia arizonica*. The graminoid layer is low in terms of species composition, provides sparse cover, and includes non-native *Poa pratensis* and native bunchgrass *Elymus trachycaulus*. Sparse cover by the short shrub *Artemisia cana* was recorded in one stand.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This mesic herbaceous association occurs on stable sites of plateau and upper drainage habitats. Historically to the present, these sites have been under heavy grazing pressure by sheep resulting in a patchy distribution of the dominant forbs.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Erigeron ursinus, Achillea millefolium, Haplopappus clementis*
Herb (H1)	*Poa pratensis, Elymus trachycaulus*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Erigeron ursinus, Achillea millefolium

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium, Taraxacum officinale

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
N/A

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: One stand has had heavy grazing pressure by sheep; association occurs within the adjacent environs.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (2 observation points): (Observation Points: CEBR.9024, CEBR.9063). This community was observed during 2007 AA (CEBR_AA.0326, CEBR_AA.0344).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Eriogonum panguicense* Herbaceous Vegetation
Panguitch Wild Buckwheat Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This semiarid forb association is rare to uncommon and was sampled on badlands exposures, some sites in areas of high visitor foot traffic. This association was sampled north of the picnic area parking lot, near State Highway 143, near the Visitor Center Overlook, the overlook near the eastern monument boundary, and near a USGS survey marker.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This forb association occurs on the high slopes and rims of badlands breaks, older talus deposits, and colluvium. Sites are gentle to steep (2- to 24-degree slopes), occur between 3152 and 3189 m in elevation, and are oriented to the south and northwest. The ground surface has high exposure of bare soil, sparse to low cover of litter, and sparse to moderate cover of rocks. Soils are moderately well-drained to rapidly drained silty clays derived from talus and colluvium and the Claron Formation (White Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is sparse to low (7-31% cover) and is characterized by the forb *Eriogonum panguicense* that provides 3-8% cover. *Oxytropis oreophila* and *Phlox pulvinata* are sometimes codominant and can provide 3-8% and 0-8% cover, respectively. The remaining forb layer is diverse in terms of species composition, provides sparse to low cover, and includes *Valeriana edulis, Hymenopappus filifolius, Achillea millefolium*, and *Ipomopsis spicata ssp. tridactyla (= Gilia tridactyla)*. The graminoid layer is low in terms of species composition, provides sparse cover, and includes *Elymus trachycaulus* and *Poa glauca*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous association occurs on erosive and steep badlands slopes, talus or colluvium, and bedrock exposed on the lower portions of drainages which is subject to rapid runoff, drought, and landslide. The plants are pedestalled on this erosive environment and occupy elevated areas between rills and small drainages that regularly occur. Soils have surface cracking due to droughtiness and the high shrink-swell ratio. The northern aspect has additional shading during the day, retention of snowfall, and less evaporation than adjacent slopes, resulting in a denser cover, while southern aspects are exposed to solar radiation reducing vegetation establishment.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Eriogonum panguicense, Oxytropis oreophila, Hymenopappus filifolius, Phlox pulvinata, Valeriana edulis*
Herb (H1)	*Poa glauca*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Eriogonum panguicense, Oxytropis oreophila, Phlox pulvinata, Hymenopappus filifolius

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Bromus inermis, Poa pratensis, Achillea millefolium, Taraxacum officinale

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Species composition between the two sampled plots is very similar. Are they auto-correlated? Dwarf-shrubland.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Cover of graminoids in drainage bottoms adjacent to colluvial slopes and on gentler slope tops is higher; steep, rocky area on the uppermost part of the breaks, sites with high wind and soil cracking, plants pedestalled from erosion; badlands slopes lie above a cliff; dry, exposed Claron Formation.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (4 plots and 2 observation points): (Plots: CEBR.055, CEBR.0084, CEBR.0085, CEBR.0086; Observation Points: CEBR.9023, CEBR.9027). This community was observed during 2007 AA (CEBR_AA.0368, CEBR_AA.0369).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 09 July 2007

[Park Special] *Eriogonum umbellatum-Potentilla hippiana* Herbaceous Vegetation
Sulphur-flower Wild Buckwheat - Horse Cinquefoil Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association has a limited distribution and was sampled near the Chessmen Ridge Overlook and northeast of State Highway 143.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This forb association occurs in a drainage on a high slope and on the upper slope of a hill. Sites are gently sloped (4-5 degrees), occur between 3195 and 3233 m in elevation, and are oriented to the south. The ground surface has high exposure of bare soil, sparse cover of litter and downed wood, and sparse to moderate cover of small and large rocks. Soils are moderately well-drained silty clays and are derived from the Brian Head Formation and the Markagunt Megabreccia.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is low to moderate (19-31% cover) and is characterized by *Eriogonum umbellatum* and *Potentilla hippiana* that provide 5-12% and 4% cover, respectively. The remaining forb layer is diverse in terms of species composition, provides sparse cover, and includes *Antennaria* sp., *Solidago multiradiata, Penstemon*

leiophyllus, Penstemon rydbergii, and *Potentilla gracilis*. The graminoid layer is moderate in terms of species composition, provides sparse to low cover, and includes *Bromus anomalus* and *Elymus trachycaulus*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous association occurs on semiarid sites including exposed slopes. They retain some moisture following snow and rain due to landscape position. Rocks create slope stability and shed water, resulting in a more mesic habitat. One site is trampled by visitors taking landscape photographs.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Eriogonum umbellatum, Potentilla hippiana, Potentilla gracilis*
Herb (H1)	*Elymus trachycaulus, Festuca ovina*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Eriogonum umbellatum, Potentilla gracilis, Elymus trachycaulus, Festuca ovina

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Taraxacum officinale, Achillea millefolium

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Herbaceous

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Continued trampling by tourists could result in death of individual plants, soil compaction, and increased erosion potential; dry, exposed, rocky slope.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot and 1 observation point): (Plots: CEBR.0066; Observation Points: CEBR.9012). This community was observed during 2007 AA (CEBR_AA.0046, CEBR_AA.0058, CEBR_AA.0060).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 09 July 2007

[Park Special] *Helianthella uniflora* Herbaceous Vegetation
Rocky Mountain Rockrose Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association has a limited distribution in the monument and was sampled only near the Chessmen Ridge Overlook and along the northern boundary.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This forb association occurs on the high and low slopes of drainages. The sites are gently sloped(4-6 degrees), occur between 3193 and 3207 m in elevation, and are oriented to the south. The ground surface has high exposure of bare soil and sparse to low cover of litter and rocks. Soils are moderately well-drained sandy clays derived from the Brian Head Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate (37-47% cover) and is characterized by *Helianthella uniflora* that provides 15% cover. The remaining forb layer is diverse in terms of species composition, provides low to moderate cover, and includes *Potentilla hippiana, Potentilla gracilis, Lupinus argenteus, Eriogonum umbellatum*, and *Penstemon rydbergii*. The graminoid layer is low in terms of species composition, provides low to moderate cover, and includes *Poa pratensis* (non-native) and *Achnatherum lettermanii*. Sparse cover by the short shrub *Ribes montigenum* was recorded in one stand.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous vegetation occurs on a stable slope and on a long, narrow, mesic site adjacent to a stand of conifers that likely retains snow cover longer during the spring and early summer. The trees also shade this site longer during the day and block desiccating wind, thus conserving moisture.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Helianthella uniflora, Potentilla hippiana, Potentilla gracilis, Lupinus argenteus*
Herb (H1)	*Poa pratensis, Achnatherum lettermanii, Elymus trachycaulus*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Helianthella uniflora, Poa pratensis

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium, Taraxacum officinale

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane meadow.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: One stand is bisected by State Highway 143, its location adjacent to a conifer stand results in more shade and snow accumulation, another stand occurs adjacent to the boundary fence and under a telephone line with single poles.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot and 1 observation point): (Plots: CEBR.0067; Observation Points: CEBR.9004).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[Park Special] *Lomatium minimum - Arenaria fendleri* Herbaceous Vegetation
Little Desert-parsley - Fendler's Sandwort Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association has limited distribution in the monument and was sampled near the campground in three locations all within close proximity to each other.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument

This forb association occurs on the mid- to lower slopes of drainages. Sites are gently sloped (1-4 degrees), occur between 3116 and 3121 m in elevation, and are oriented to the southeast. The ground surface has moderate to high exposure of bare soil and small rocks and sparse to low cover of litter and downed wood. Soils are moderately well-drained sandy clay loams derived from the Claron Formation (Red Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is sparse to low (7-22% cover) and is characterized by *Lomatium minimum* and *Arenaria fendleri* that provide 2-9% and 1-5% cover, respectively. The remaining forb layer is moderately diverse in terms of species composition, provides sparse to low cover, and includes *Castilleja miniata, Achillea millefolium, Erigeron ursinus, Penstemon leiophyllus*, and *Solidago multiradiata*. The graminoid layer is nearly absent from this association, provides sparse cover, and includes *Poa pratensis* (non-native) and *Elymus trachycaulus*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This forb association occurs on a rocky, convex slope with intermittent drainages and on the lower slopes of drainages. It is therefore more mesic than the remainder of the slope (due to rocks shedding water) and probably retains snowpack for a slightly longer time period. On some sites there is little soil development over relatively exposed Claron Formation bedrock. Historic grazing by sheep has influenced this type.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Lomatium minimum, Arenaria fendleri*
Herb (H1)	*Elymus trachycaulus, Poa pratensis*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Lomatium minimum, Arenaria fendleri, Elymus trachycaulus

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium, Taraxacum officinale

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
N/A

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Cover in drainage bottoms adjacent to this convex slope supports higher cover by *Poa pratensis*; a few small stands of *Ribes montigenum* occur on this slope; dry, exposed Claron Formation, grazing history, erosion from sheetwash.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot and 2 observation points): (Plots: CEBR.0075; Observation Points: CEBR.9018, CEBR.9019).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 04 April 2007

[A.1605] *Lupinus argenteus* Herbaceous Alliance
Silvery Lupine Herbaceous Vegetation Alliance

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous alliance has limited distribution in the monument and was sampled only on the southern monument boundary.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This mesic forb alliance occurs on the high slope of a plateau. The site is gently sloped (7 degrees), occurs at 3145 m in elevation, and is oriented to the north (6 degrees). The ground surface has high exposure of bare soil and low cover of litter and rocks. Soils are well-drained silty clay loams derived from the Brian Head Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is high (61% cover) and is characterized by *Lupinus argenteus* that provide 30% cover. Associated forbs each provide low cover and include *Heliomeris multiflora (= Viguiera multiflora), Delphinium barbeyi, Ligusticum porteri*, and *Descurainia incana*. Associated graminoids provide sparse to low cover and include *Elymus trachycaulus, Poa pratensis* (exotic), and *Carex egglestonii*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This herbaceous alliance occurs on a mesic site with random large rocks that shed moisture and reduce wind-related desiccation. This site location and rock structure likely trap additional snow and retard melt from the snowfield during the spring and early summer. This would also contribute to retaining an herbaceous structure, preventing shrubs and trees from becoming established.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Lupinus argenteus, Heliomeris multiflora, Delphinium barbeyi*
Herb (H1)	*Elymus trachycaulus*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Lupinus argenteus, Heliomeris multiflora

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Achillea millefolium

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane meadow.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: North aspect and random large rocks contribute to increased soil moisture for this stand.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot): (Plots: CEBR.0090).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 08 March 2007

[Park Special] *Solidago multiradiata* Herbaceous Vegetation
Alpine Goldenrod Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This herbaceous association is common above the rim of the breaks and was sampled near the Chessmen Ridge Overlook, near the service road at Alpine Pond Trailhead, near the Alpine Pond trailhead, near the campground, adjacent to the Panguitch Lake Road, near the southern boundary, and near the northern overlook.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This forb-dominated herbaceous association occurs on the midslopes of hills, on plains and plateaus, and in drainages. Sites are gently sloped (0-4 degrees), occur between 3116 and 3235 m in elevation, and are oriented to all aspects. The ground surface has typically high exposure of bare soil, sparse to low cover by litter, and low to moderate cover of small rocks. Soils are moderately well-drained to well-drained silty clays, silty clay loams, sandy clays, and sandy clay loams derived from the Brian Head Formation, Markagunt Megabreccia, and Claron Formation (Red Member).

VEGETATION DESCRIPTION
Cedar Breaks National Monument
Total vegetation cover is moderate to high (21-68% cover) and is characterized by the forb *Solidago multiradiata* that provides <1-20% cover. The remaining forb layer is diverse in terms of species composition, provides low to moderate cover, and includes *Potentilla hippiana, Potentilla gracilis, Eriogonum umbellatum var. subaridum, Geum triflorum*, and *Penstemon rydbergii*. The graminoid layer is low in terms of species composition, provides sparse to low cover, and includes *Achnatherum lettermanii, Elymus trachycaulus, Festuca ovina*, and the non-native *Poa pratensis*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This forb herbaceous vegetation occurs on flats and gentle slopes on the hills and plateaus above the breaks. These areas receive maximum snowfall, often occurring as snow glades, and have a rocky surface which helps to capture and distribute moisture. These areas are extensively grazed by sheep in the region.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Helianthella uniflora, Potentilla hippiana, Potentilla gracilis*
Herb (H1)	*Poa pratensis, Achnatherum lettermanii*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Solidago multiradiata, Achnatherum lettermanii, Elymus trachycaulus

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Bromus inermis, Poa pratensis, Achillea millefolium, Taraxacum officinale, Thlaspi montanum

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane meadow. Grassland. Weedy herbaceous (same as the weedy type in PINN?).

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: Individual Plot Notes: Slopes are stable; rock and bedrock contribute to surface moisture; there are many small mammal burrows; soil cracking is evident on some sites; some sites near State Highway 143 are being invaded by non-natives such as *Poa pratensis*; plants are on pedestals on some sites, indicating wind and water erosion; encroachment by seedling and sapling trees is relatively rare; and vegetation on some sites has been altered by grazing and construction activities.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (9 plots and 3 observation points): (Plots: CEBR.0048, CEBR.0053, CEBR.0057, CEBR.0059, CEBR.0062, CEBR.0064, CEBR.0069, CEBR.0079, CEBR.0083; Observation Points: CEBR.9014, CEBR.9026, CEBR.9030). And was observed from 4 AA points in 2007 (CEBR_AA.0036, CEBR_AA.0075, CEBR_AA.0165, CEBR_AA.0205).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[A.1601] *Ligusticum porteri* Herbaceous Vegetation Alliance
Porter's Lovage Herbaceous Vegetation

CONCEPT SUMMARY

DISTRIBUTION
Cedar Breaks National Monument
This rare herbaceous alliance was sampled adjacent to SH143 and near the north Monument entrance.

ENVIRONMENTAL DESCRIPTION
Cedar Breaks National Monument
This mesic forb alliance occurs on the mid-level of hills and slopes. The sites are gentle (2^o - 7^o slopes), occur between 3206-3214 m in elevation, and are oriented to the northwest and southwest. The ground surface has a high amount of bare soil and low cover of litter. Soils are well drained sandy clays derived from the Brian Head Formation.

VEGETATION DESCRIPTION
Cedar Breaks National Monument
This mesic forb alliance occurred commonly in small patches below the minimum mapping size of 0.5ha . Total vegetation cover is moderate to high (44-56% cover) and is characterized by *Ligusticum porteri* forbs that provide 20-43% cover. Associated forbs each provide sparse to moderate cover and include *Lupinus argenteus, Thalictrum fendleri, Delphinium barbeyi, Mertensia arizonica*, and *Solidago multiradiata*. The graminoid layer provides low cover and includes the exotic grass *Poa pratensis* and the native bunchgrasses *Achnatherum lettermanii* and *Elymus trachycaulus*.

COMMUNITY DYNAMICS
Cedar Breaks National Monument
This alliance occurs on a mesic site near the highway and is considered somewhat poorly drained. It is said to frequently occur along the edge of forest and woodland stands, presumably due to the more mesic conditions provided by snow accumulation and blocking desiccating wind.

MOST ABUNDANT SPECIES
Cedar Breaks National Monument

Stratum	Species
Herb (H2)	*Ligusticum porteri, Lupinus argenteus*
Herb (H1)	*Poa pratensis*

CHARACTERISTIC SPECIES
Cedar Breaks National Monument
Ligusticum porteri, Lupinus argenteus

OTHER NOTEWORTHY SPECIES
Cedar Breaks National Monument
Poa pratensis, Bromus inermis, Achillea millefolium, Taraxacum officinale, Tragopogon dubius

CLASSIFICATION COMMENTS
Cedar Breaks National Monument
Montane meadow.

ELEMENT SOURCES
Cedar Breaks National Monument Inventory Notes: this community is frequently observed along the edge of forest and woodland stands, occurs on a small site with two similar stands visible.
Cedar Breaks National Monument Plots and Observation Points: The description is based on 2006 field data (1 plot and 1 observation point: CEBR.0054 and CEBR.9002). This alliance was observed during 2007 AA (CEBR_AA.0037, CEBR_AA.0056).
Local Description Authors: M. Smith and J. Von Loh
Version Date: 03 April 2007

[A.419] ***Abies concolor - Populus tremuloides*** **Forest Alliance -** AA data only CEBR_AA.0007

[Park Special] ***Abies lasiocarpa - Picea engelmannii / Ligusticum porteri*** **Forest** - AA data only CEBR_AA.0325

[Park Special] ***Picea engelmannii*** **Breaks Woodland** - AA data only CEBR_AA.0048

[Park Special] ***Picea pungens / Purshia tridentata*** **Woodland** - AA data only CEBR_AA.0408

[Park Special] ***Cercocarpus ledifolius / Chrysothamnus nauseosus*** **Woodland** - AA data only CEBR_AA.0099

[Park Special] ***Populus tremuloides - Pseudotsuga menziesii /*** **Sparse Understory Forest** - AA data only CEBR_AA.0284

[Park Special] ***Viguiera multiflora*** **Herbaceous Vegetation** - AA data only CEBR_AA.0349, CEBR_AA.0350

[Park Special] ***Picea pungens / Acer glabrum*** **Forest** - AA data only CEBR_AA.0247, CEBR_AA.0260

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Appendix G. Illustrated Keys to the Plant Associations of Cedar Breaks National Monument

The vegetation of Cedar Breaks National Monument was characterized using field data collected in 2006 under the US Geological Survey and National Park Service's Vegetation Mapping Program. To assist in the accurate field identification of the 71 plant associations described for Cedar Breaks National Monument, this dichotomous key was developed and is illustrated with images taken during the vegetation sampling effort.

This key is structured to facilitate identification of plant associations with one or a combination of dominant or characteristic species, and in some cases, the key also relates associations to their primary habitats and range within the Monument. 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. This illustrated key also allows the user to crosswalk plant associations directly to the Cedar Breaks National Monument vegetation map so that all research may have a common focal point relative to the baseline years of aerial photography (2001-2002) and field data collection (2006).

HOW TO USE THE KEY

The key approaches plant association identification at two levels. The first level is physiognomic, allowing the user to determine which major group is being evaluated, e.g., forest, woodland, shrubland or herbaceous. The second level is based on dominant, indicator, or character species and to a lesser extent, habitat and range. As an aid to observers in the field, photographs representing typical situations as well as variation within vegetation types are shown below the association names.

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).

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 of the stand. These species include *Pinus edulis, Juniperus osteosperma,* and *Cercocarpus ledifolius*. In this key, these species are ALWAYS considered to be evergreen trees, regardless of their height or growth form.

3. 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 sampled by this project. In this instance, simply record "Unclassified pinyon-juniper (or whatever type of vegetation you have) association". Be sure to note the dominant species in each stratum as you fill out the Vegetation Description portion of the accuracy assessment form, as well as writing careful, complete notes on the environmental setting.

4. Communities that are sparsely vegetated (e.g. less than approximately 10% total vascular plant cover) may need to be run through multiple keys, because it may not be clear whether they are woodlands, shrublands, or herbaceous communities because the cover levels for each stratum are so low. In addition, some of the woodland types may have sparse cover when on the Claron Formation.

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

Special Instructions for AA Crews

1. Associations with "forest" in the name may not have 60+% canopy cover that forests usually require. Don't worry about it. Likewise, examples of associations with "woodland" in the name may occasionally have more than 60% cover.

2. Stands of mixed conifers rely on the species present rather than on abundance of any single dominant confer to get to an association. *Abies concolor* is an important indicator at Cedar Breaks. Stands mixed with *Pseudotsuga menziesii*, *Abies concolor* and usually other conifers, are called an *Abies concolor* association.

3. Tree-dominated stands on the Claron Formation also have unique rules for Cedar Breaks communities. The presence of *Pinus longaeva* is considered an indicator of this very dry and often barren habitat. Thus mixed conifer stands are named for their indicator species, in the following order of importance: *Pinus longaeva* > *Abies concolor* > *Abies lasiocarpa* > *Pseudotsuga menziesii* > *Pinus ponderosa*.

4. 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 PJ woodland on a sandstone bench with about equal cover of *Cercocarpus montanus* and *Ephedra viridis,* the community will be classified as Pinyon - Juniper / *Cercocarpus montanus*, not Pinyon – Juniper / *Ephedra viridis*

5. Not all shrub species are given equal weight, in upland situations. Low shrubs such as *Artemisia frigida*, and *Heterotheca villosa* increase with disturbance, and if they have low cover relative to herbaceous cover, are often “ignored” even though they may have 10%. In addition, *Chrysothamnus viscidiflorus* and *Purshia tridentata* can be abundant but have low relative cover compared to the herbaceous growth. *Artemisia nova*, on the other hand, is an important indicator, and decreases with disturbance, so its presence is considered an

indicator. Thus the following shrubs can be listed in order of their indicator importance value: *Artemisia nova* > *Artemisia tridentata* ssp*. vaseyana and* ssp. *wyomingensis* > *Amelanchier utahensis* > *Chrysothamnus viscidiflorus* > *Purshia tridentata* > *Artemisia frigida* > *Heterotheca villosa.*

6. Not all herbaceous species carry the same weight in upland situations. For example strong indicators are *Hesperostipa comata, Achnatherum lettermanii*, and *Leymus salinus*; medium indicators are *Achnatherum hymenoides*, and *Poa fendleriana,* while weak indicators include *Poa secunda, Elymus elymoides,* and *Bromus tectorum*. In wetland areas, wetland indicators such as *Carex aquatilis, Carex praegracilis, Carex utriculata, Eleocharis* spp., and *Mimulus* spp. are strong indicators over such species as *Bromus inermis*, *Poa pratensis*, and *Juncus balticus*.

7. Many of the shrubland and dwarf-shrubland and some of the herbaceous associations occur in harsh habitats and may have a total vegetative cover that is technically "sparse" (<10%). There is no separate key for sparse vegetation, so continue on in the shrubland or herbaceous key, but ratchet down your cover expectations for dominant species and total vegetation cover from what the key may say. Go by dominance, and relative cover rather than absolute cover measurements.

8. When in doubt, record detailed field notes. These notes and the Vegetation Description information 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.

TABLE OF CONTENTS

KEY I: A KEY TO THE MAJOR PHYSIOGNOMIC GROUPS OF CEDAR BREAKS NATIONAL MONUMENT

1a Vegetation woody or appearing woody; the tallest stratum consists primarily or entirely of trees, shrubs or subshrubs; total vegetation cover may range from sparse to dense (2).

1b Vegetation non-woody; consisting predominantly of grasses, graminoids and/or broad-leaf herbs (forbs), which may be tall and coarse. Woody shrubs or trees may be present, but woody plant cover does not exceed approximately 10%. Characteristic genera include *Achnatherum, Bromus, Calamagrostis, Carex, Deschampsia, Elymus, Erigeron, Ligusticum, Lomatium, Poa, Pascopyrum,* or *Solidago* **(Key IV)**

2a Vegetation of forest (predominantly interlocking tree canopies) or woodland (predominantly open, tree canopies) stands; tree cover except in sparse vegetation is usually greater than 10%; characteristic genera include *Abies, Cercocarpus (ledifolius), Juniperus, Pinus, Picea, Populus* or *Pseudotsuga* **(Key II)**

2b Vegetation of tall shrubs, short shrubs or dwarf-shrubs; canopies may interlock, but more commonly are less dense; characteristic genera include *Acer, Artemisia, Dasiphora, Ericameria, Ribes, Salix, Sambucus,* or *Symphoricarpos* **(Key III)**

KEY II: A KEY TO THE FOREST AND WOODLAND ASSOCIATIONS OF CEDAR BREAKS NATIONAL MONUMENT

1a Deciduous forests or woodlands occupying a variety of habitats, including stream banks, floodplains and riparian areas or mesic high elevation slopes; includes mixed deciduous-evergreen woodlands in cold north-facing sites. Canopy dominants include *Populus,* sometimes with *Picea pungens, Pseudotsuga menziesii, Abies concolor,* or *Abies lasiocarpa* as a co-dominant **(2)**

1b Evergreen forests or woodlands occupying a variety of upland habitats; canopy dominants include *Abies, Picea*, *Pinus, Pseudotsuga, Juniperus* and/or *Cercocarpus ledifolius.* If deciduous trees are present they provide less than 25% of the total cover (relative cover) **(12)**

Deciduous Forest and Woodlands

2a (1) Forests or woodlands characterized by *Populus tremuloides,* often occupying mesic north-facing slopes. In xeric or post-fire situations, the trees may be dwarfed to little more than tall shrub stature **(3)**

2b Forests or woodlands characterized by *Populus angustifolia;* occurring within drainage bottoms or on alluvial deposits **(11)**

3a (2) Forests or woodlands characterized by *Populus tremuloides,* if conifers are present they provide less than 25% of the total canopy cover; typical understory may include shrubs or forbs **(4)**

3b Forests or woodlands characterized by *Populus tremuloides;* conifers share co-dominance (>25% relative cover) with the aspen **(6)**

4a (3) Aspen forests with shrubs providing no more than 1% cover, and where *Thalictrum fendleri* is the dominant forb, with >25% cover - ***Populus tremuloides / Thalictrum fendleri*** **Forest [Map Unit 19 -- Aspen Forest Complex]**


4b Aspen forests with a shrub layer in the understory; may be scattered and only 3-5% cover, but a shrub component is present and otherwise is not like above **(5)**

5a (4) Aspen forests or woodlands with a shrub understory characterized by *Juniperus communis*, even if only a few scattered individuals are present. If *Arctostaphylos patula* or *Symphoricarpos oreophilus* are present, the cover of *Juniperus communis* is always greater - ***Populus tremuloides / Juniperus communis*** **Forest [Map Unit 19 -- Aspen Forest Complex]**


5b Aspen forests or woodlands with a tall shrub understory characterized by *Ribes montigenum.* If *Juniperus communis* is present, the cover is much less than *Ribes.* Other shrubs such as *Acer grandidentatum* or *Quercus gambelii* may be present. The understory may contain a diversity of grasses and forbs, but *Ribes montigenum* is the dominant component - ***Populus tremuloides / Ribes montigenum*** **Forest [Map Unit 19 -- Aspen Forest Complex]**

6a (3) Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Abies lasiocarpa or Abies concolor* are co-dominant with *Populus tremuloides* **(7)**

6b Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Pseudotsuga menziesii* is co-dominant with *Populus tremuloides* **(9)**

7a (6) Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Abies lasiocarpa* is co-dominant with *Populus tremuloides*. *Picea engelmannii* can also be present. Shrub species such as *Paxistima myrsinites, Juniperus communis* and *Mahonia repens* may be present, but do not form a layer. Herbaceous species cover is >15%, and may include *Vicia americana, Thalictrum fendleri, Ligusticum porteri, Osmorhiza depauperata, Carex rossii, Lupinus argenteus, Polemonium pulcherrimum,* and *Achillea millefolium* - ***Populus tremuloides – Abies lasiocarpa* / Tall Forbs Forest [Map Unit 19 -- Aspen Forest Complex]**

7b Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Abies concolor* is co-dominant with *Populus tremuloides* **(8)**

8a (7) Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Abies concolor* is co-dominant with *Populus tremuloides*. *Pseudotsuga menziesii* may be present, but is not the dominant conifer. Shrubs form a moderate to dense layer; *Arctostaphylos patula* and *Juniperus communis* dominate the shrub layer. Other shrubs present may include *Symphoricarpos oreophilus, Rosa woodsii*, *Paxistima myrsinites,* and *Mahonia repens* - ***Populus tremuloides – Abies concolor / Arctostaphylos patula*** **Forest [Map Unit 19 -- Aspen Forest Complex]**

8b Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Abies concolor* is co-dominant with *Populus tremuloides*. *Pseudotsuga menziesii* may be present, but is not the dominant conifer. *Symphoricarpos oreophilus* dominates the shrub layer. Other shrubs present may include *Amelanchier* spp., *Arctostaphylos patula, Rosa woodsii*, *Paxistima myrsinites,* and *Mahonia repens*. A variety of forbs and grasses are also common in the understory - ***Populus tremuloides – Abies concolor / Symphoricarpos oreophilus*** **Forest [Map Unit 19 -- Aspen Forest Complex]**

9a (6) Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Pseudotsuga menziesii* is co-dominant with *Populus tremuloides*. The

understory is sparse with no one species typically dominant - ***Populus tremuloides – Pseudotsuga menziesii* / Sparse Understory Forest [Map Unit 19 -- Aspen Forest Complex]**

9b Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Pseudotsuga menziesii* is co-dominant with *Populus tremuloides*. The understory is dominated by either *Juniperus communis* or *Symphoricarpos oreophilus* **(10)**

10a (11)Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Pseudotsuga menziesii* is co-dominant with *Populus tremuloides*. A variety of other evergreen tree species may also be present in the canopy and subcanopy layers. *Juniperus communis* is the predominant species in the moderately dense to sparse short-shrub layer, with *Arctostaphylos uva-ursi, Mahonia repens*, and *Symphoricarpos oreophilus* as common associates - ***Populus tremuloides – Pseudotsuga menziesii / Juniperus communis* Forest [Map Unit 19 -- Aspen Forest Complex]**

10b Mixed aspen – conifer forests or woodlands, where aspen comprises at least 25% of the total canopy. *Pseudotsuga menziesii* is co-dominant with *Populus tremuloides*. The understory is characterized by the low shrubs *Symphoricarpos oreophilus* and *Rosa woodsii* - ***Populus tremuloides – Pseudotsuga menziesii / Symphoricarpos oreophilus*** **Forest [Map Unit 19 -- Aspen Forest Complex]**

11a (2) Open narrowleaf cottonwood woodlands in the active floodplain or on nearby terraces. Other tree species may be present, but overall canopy cover is low. *Populus angustifolia* is the most abundant tree with 5-25% cover. *Abies concolor, Pseudotsuga menziesii, Pinus ponderosa, Cercocarpus ledifolius, Picea engelmannii,* or *Pinus longaeva* may also be present. Scattered shrubs may be present, and the herbaceous layer varies depending on depth to the water table and the degree to which the stand has been disturbed by recent flood scour, grazing or camping - ***Populus angustifolia*** **Temporarily Flooded Terrace Woodland [Map Unit 22 -- Narrowleaf Cottonwood Temporarily Flooded Wash Complex]**

11b Lanceleaf or narrowleaf cottonwood-dominated woodlands in the active floodplain or on alluvial terraces. Trees are older and tree cover is significantly higher than the previous type. Mature *Picea pungens*, *Pseudotsuga menziesii*, *Pinus ponderosa* and *Juniperus scopulorum* are usually present. Shrub cover is sparse, with *Acer glabrum, Shepherdia canadensis*, and *Juniperus communis* most commonly present. This and the previous type are very similar in species composition; it is the age of the trees and higher canopy cover separates them - ***Populus angustifolia – Picea pungens / Acer glabrum*** **Woodland [Map Unit 22 -- Narrowleaf Cottonwood Temporarily Flooded Wash Complex]**

Evergreen Forests and Woodlands

12a (1) Evergreen woodlands occupying upland habitats, canopy dominant is the tree-like tall shrub *Cercocarpus ledifolius*. Individuals of *Pseudotsuga menziesii, Pinus edulis, Juniperus scopulorum, Juniperus osteosperma* or *Pinus ponderosa* may be present, but if any of these species provides more than 10% canopy cover, go to **12b (13)**

12b Evergreen forests or woodlands, including "sparse or barren" forests, occupying upland habitats, such as flats, slopes, ravines, and ridge tops. Canopy dominants include *Abies, Picea, Pinus, Pseudotsuga,* or *Juniperus*. If *Cercocarpus ledifolius* is present, it is clearly an understory or subcanopy species with *Pinus ponderosa, Pseudotsuga menziesii*, *Pinus edulis,* and/or *Juniperus osteosperma* **(15)**

Cercocarpus ledifolius Woodlands

13a (12) Curl-leaf mountain mahogany woodlands with an understory dominated by a variety of shrubs or grasses, or with a sparse understory - ***Cercocarpus ledifolius*** **Woodland Alliance [Map Unit 21 – Curl-leaf Mountain Mahogany Woodland Alliance]**

13b *Cercocarpus ledifolius* woodlands with a shrub layer dominated by *Arctostaphylos patula* or *Chrysothamnus nauseosus* **(14)**

14a (13)Curl-leaf mountain mahogany woodlands with an understory dominated by *Arctostaphylos patula;* other shrubs and trees may be present, but these generally have less than 10% cover - ***Cercocarpus ledifolius / Arctostaphylos patula*** **Woodland [Map Unit 21 – Curl-leaf Mountain Mahogany Woodland Alliance]**

14b Curl-leaf mountain mahogany woodlands with a sparse understory dominated by *Chrysothamnus nauseosus* occurring on steep, colluvial slopes - ***Cercocarpus ledifolius / Chrysothamnus nauseosus*** **Woodland [Map Unit 21 – Curl-leaf Mountain Mahogany Woodland Alliance]**

Conifer Forests and Woodlands

15a (12) Evergreen forests and woodlands of cool slopes or sheltered canyons. Pure or mixed stands of many tree species, such as *Abies lasiocarpa* and *Picea engelmannii*, or *Abies concolor, Picea pungens, Pinus ponderosa*, *Pinus flexilis*, *Pinus ponderosa* and/or *Pseudotsuga menziesii*. If *Abies concolor* is present with *Pinus ponderosa* or *Pseudotsuga menziesii, Abies concolor* is the indicator species. If *Abies concolor* is present where *Picea pungens* is the most abundant conifer, *Picea pungens* is the indicator species. If *Abies concolor* occurs in pinyon-juniper woodlands, go to **15b**. *Pinus longaeva*, if present in mixed stands and the stands are on barren or sparsely vegetated Claron Formation, key as a *Pinus longaeva* type (**15b**), EXCEPT when stands are dominated by *Abies lasiocarpa* and/or *Picea engelmannii,* with *Pinus longaeva* present, key as and ABILAS-PICENG type. Otherwise mixed conifer stands rely on dominance. For example, if Douglas-fir is dominant, key as a *Pseudotsuga menziesii* type **(16)**

15b Evergreen forests and woodlands of a variety of habitats, including Claron Formation "barrens", and other steep, exposed slopes. Total tree canopy cover on barrens can be low (<10%) but is still considered a tree layer. Forests are dominated by a single (rare) or a mix of (more typical) tree species such as *Pinus edulis, Pinus flexilis, Pinus longaeva, Pinus ponderosa, Juniperus scopulorum* and/or *Juniperus osteosperma.* Claron barrens often have mixed stands of several conifers, of which *Pinus longaeva* is the indicator species. When *Pinus edulis - Juniperus* spp. are the dominants, other conifers such as *Pinus ponderosa* and/or *Pseudotsuga menziesii* may be present with less than 50% relative cover *(*and *Abies concolor* may rarely be present). Understories can be sparse or contain dense shrub and herb layers **(36)**

16a (15) Evergreen woodlands, usually on moderate to steep or very steep slopes, where trees are mature (and at least 4 feet tall) and where species of *Abies* or *Picea* are the most abundant conifers **(17)**

16b Evergreen woodlands on level, moderate to steep slopes with a canopy dominated by *Pseudotsuga menziesii* and/or *Pinus ponderosa.* Mature *Abies concolor* trees not present or are exceptionally rare. *Picea pungens* may be present. *Pinus edulis* and/or *Juniperus* spp. may form a subcanopy **(30)**

17a (16) Stands dominated by *Abies lasiocarpa. Picea engelmannii* is often present to co-dominant. Other conifers and even *Populus tremuloides* may be present **(39)**

17b Stands not dominated by *Abies lasiocarpa* **(18)**

18a (17) North-facing, moist slopes or wet toe slopes where *Picea pungens* or *Picea engelmannii* is the most abundant tree in the stand. Other conifers are often present such as *Pseudotsuga menziesii, Pinus ponderosa, Pinus longaeva, Pinus flexilis*, and *Abies concolor*. *Populus tremuloides* may also be present. A shrub layer may or may not be present, consisting of *Betula, Arctostaphylos,* or *Juniperus communis* **(24)**

18b *Abies concolor* present (as mature trees) to dominant, often with several other conifer species present in the mixed stand **(19)**

Abies concolor Forests

19a (18) Evergreen forests where *Abies concolor* is co-dominant with *Populus tremuloides* or *Pseudotsuga menziesii* **(23)**

19b Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species present in the canopy or subcanopy but not sharing co-dominance with *Abies concolor*. Understory dominated by *Arctostaphylos patula, Juniperus communis, Mahonia repens*, and/or *Symphoricarpos oreophilus.* Tall shrub species may be present, but are not abundant **(20)**

20a (19) Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species. *Symphoricarpos oreophilus* is the dominant shrub. Other shrubs may be present, but generally with less than 1% cover, or if >1% then their cover is less than half that of *Symphoricarpos*. If other shrubs such as *Mahonia repens* are co-dominant, *Symphoricarpos* is the indicator species - ***Abies concolor / Symphoricarpos oreophilus*** **Forest** [**Map Unit 4 – White Fir Forest Alliance]**

20b Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species. The shrub layer is dominated by *Arctostaphylos patula, Mahonia repens, or Juniperus communis*, or the understory is dominated by herbaceous species **(21)**

21a (20) Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species. The shrub layer is dominated by *Arctostaphylos patula. Juniperus communis,* and *Mahonia repens* may be present but with far less cover than greenleaf manzanita - ***Abies concolor / Arctostaphylos patula*** **Forest**. [**Map Unit 3 – White Fir / Greenleaf Manzanita Forest]**

21b Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species. *Juniperus communis* or *Mahonia repens* are the dominant understory shrubs. Other shrubs may be present, but generally with less than 1% cover, or if more than 1%, then less than half that of the dominant shrub **(22)**

22a (21) Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species. *Juniperus communis* is the dominant shrub in the understory. Other shrubs may be present, but generally with less than 1% cover, or if more, then less than half that of *Juniperus communis*. *Juniperus communis* cover ranges from 1 to 20% - ***Abies concolor / Juniperus communis*** **Forest** [**Map Unit 4 – White Fir Forest Alliance]**

22b Evergreen forests where *Abies concolor* is present to dominant, often with other conifer species. *Mahonia repens* is the dominant shrub in the understory. Other shrubs may be present, but generally with less than 1%; if >1%, then less than half that of *Mahonia* - ***Abies concolor / Mahonia repens*** **Forest** [**Map Unit 4 – White Fir Forest Alliance]**

23a (19)Evergreen forests where *Abies concolor* dominates or codominates, and *Pseudotsuga menziesii* is a successional dominant and remains codominant in late-successional stands, becoming minor in very old stands. The tall shrub *Acer glabrum* is dominant in the understory. The short- and dwarf-shrub layers are moderate in terms of species composition, provide sparse to low cover, and include *Juniperus communis, Shepherdia canadensis*, and *Mahonia repens* – ***Abies concolor – Pseudotsuga menziesii / Acer glabrum*** **Forest** [**Map Unit 4 – White Fir Forest Alliance]**


23b These forests are characterized by *Abies concolor* and *Populus tremuloides* as canopy codominants. Common tree associates include *Pseudotsuga menziesii* and *Picea pungens*. An evergreen or cold-deciduous shrub layer is often present, including *Acer glabrum, Arctostaphylos patula, Rosa woodsii, Symphoricarpos oreophilus, Mahonia repens*, or *Juniperus communis*. The herbaceous ground layer is usually luxuriant and species-rich in comparison to adjacent conifer forests – ***Abies concolor – Populus tremuloides* Forest Alliance [Map Unit 19 -- Aspen Forest Complex]**


Picea pungens Forests

24a (18)*Picea pungens* woodlands in relatively wet sites, with an understory dominated by *Equisetum arvense* or *Salix brachycarpa* **(25)**

24b *Picea pungens* forests or woodlands with a shrub layer dominated by *Acer glabrum, Arctostaphylos patula, Juniperus communis, Mahonia repens,* or *Purshia tridentata* **(26)**

25a (24)*Picea pungens* is the dominant conifer. *Pseudotsuga menziesii, Juniperus scopulorum,* and *Pinus ponderosa* may be present. *Salix brachycarpa* is the most abundant shrub; other shrubs present may include *Betula occidentalis, Lonicera involucrata,* and *Cornus sericea* - ***Picea pungens / Salix brachycarpa*** **Woodland [Map Unit 8 -- Blue Spruce Forest Alliance]**

25b Sites are very moist to wet, in valley bottoms or on seeping toe slopes. *Picea pungens* is the most abundant conifer. *Equisetum arvense* and/or *Equisetum laevigatum* dominate the understory. Other mesic herbs present may include *Aconitum columbianum, Habenaria dilatata,* and *Carex utriculata* - ***Picea pungens / Equisetum arvense*** **Woodland [Map Unit 8 -- Blue Spruce Forest Alliance]**

26a (24)Sites are cool and moist or are on sheltered, steep Claron slopes and *Picea pungens* is the most abundant conifer. Shrub layer is dominated by *Juniperus communis* - ***Picea pungens / Juniperus communis*** **Forest [Map Unit 8 -- Blue Spruce Forest Alliance]**


26b *Picea pungens* forests or woodlands with a shrub layer dominated by *Acer glabrum, Arctostaphylos patula, Mahonia repens,* or *Purshia tridentata* **(27)**

27a (26)Open canopy *Picea pungens* woodlands on steep, rocky slopes of the Claron Formation. Additional conifer species present may include *Pinus longaeva, Abies concolor, Pinus flexilis, Pinus ponderosa, Pseudotsuga menziesii,* and *Juniperus scopulorum.* The shrub layer is characterized by clumps of *Arctostaphylos patula*. Other shrub species present may include *Paxistima myrsinites, Mahonia repens, Ribes cereum, Juniperus communis,* and *Acer glabrum* – ***Picea pungens / Arctostaphylos patula*** **Forest [Map Unit 8 -- Blue Spruce Forest Alliance]**


27b *Picea pungens* forests or woodlands with a shrub layer dominated by *Acer glabrum, Mahonia repens,* or *Purshia tridentata* **(28)**

28a (27)Open to moderately dense *Picea pungens* forests. The diagnostic low-shrub layer usually has moderately dense cover and is dominated by the cold-deciduous species *Mahonia repens*, often with *Arctostaphylos uva-ursi* and *Juniperus communis* present **–** ***Picea pungens / Mahonia repens*** **Forest [Map Unit 8 -- Blue Spruce Forest Alliance]**

28b *Picea pungens* forests or woodlands with a shrub layer dominated by *Acer glabrum* or *Purshia tridentata* **(29)**

29a (28)*Picea pungens* forests on steep, colluvial slopes or steep-sided ravines with a tall shrub understory dominated by *Acer glabrum*. Other shrub species present may include *Paxistima myrsinites, Mahonia repens, Juniperus communis,* and *Symphoricarpos oreophilus* – ***Picea pungens / Acer glabrum*** **Forest [Map Unit 8 -- Blue Spruce Forest Alliance]**

29b Open *Picea pungens* woodlands documented on stream terraces of Ashdown Creek where the only shrub species with notable cover in the understory was *Purshia tridentata* **– *Picea pungens / Purshia tridentata* Woodland [Map Unit 8 -- Blue Spruce Forest Alliance]**

30a (16) Forests and woodlands dominated by *Pseudotsuga menziesii*, or codominated by several conifer species, of which *Pseudotsuga menziesii* has the highest cover. If mature *Abies concolor* trees are present, go to **19**. If *Pinus ponderosa* is present, its cover is not more than half that of *Pseudotsuga menziesii*. *Pinus longaeva* is often present with low cover. Stands occur on rich sites, where *Pseudotsuga menziesii* has the greatest individual tree cover **(31)**

30b Forests and woodlands where *Pinus ponderosa* is dominant or co-dominant. *Pseudotsuga menziesii, Picea pungens, Pinus edulis, Juniperus* spp., and *Pinus flexilis* may also be present **(33)**

Pseudotsuga menziesii Forests

31a (30) *Pseudotsuga menziesii* woodlands with a shrub understory dominated by *Arctostaphylos patula* (35% cover) - ***Pseudotsuga menziesii / Arctostaphylos patula* Woodland [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**

31b Woodlands and forests dominated by *Pseudotsuga menziesii* with a shrub understory dominated by *Juniperus communis* or *Ribes montigenum* **(33)**

32a (31)Woodlands and forests dominated by *Pseudotsuga menziesii* with a shrub understory dominated by *Juniperus communis* - ***Pseudotsuga menziesii / Juniperus communis*** **Forest [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**

32b Woodlands and forests dominated by *Pseudotsuga menziesii* with a shrub understory dominated by *Ribes montigenum* (24%) - ***Pseudotsuga menziesii / Ribes montigenum*** **Forest [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**

Pinus ponderosa Forest and Woodlands

33a (30) *Pinus ponderosa* forests and woodlands (with or without other conifers) with *Arctostaphylos patula* dominating the understory. Other shrubs or herbaceous species may be present, abundant, or absent **(34)**

33b Open *Pinus ponderosa* woodlands with a shrub layer dominated by *Purshia tridentata*. The other shrubs present include *Arctostaphylos patula* and *Symphoricarpos oreophilus*. The herbaceous layer is moderate to high in floristic diversity and contributes sparse cover – ***Pinus ponderosa / Purshia tridentata*** **Woodland [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**

34a (33) *Pinus ponderosa* co-dominant with *Pseudotsuga menziesii* (cover of canopy and subcanopy combined); the understory shrub layer dominated by *Arctostaphylos patula* - ***Pinus ponderosa – Pseudotsuga menziesii / Arctostaphylos patula*** **Colorado Plateau Woodland [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**


34b *Pinus ponderosa* the dominant conifer; if *Pseudotsuga menziesii* is present, it has less than half the cover of *Pinus ponderosa* (i.e., it is clearly not co-dominant). The shrub understory is dominated by *Arctostaphylos patula* **(35)**

35a (34) *Pinus ponderosa* is the dominant conifer, *Cercocarpus ledifolius* is present and creates a subcanopy layer, and the shrub layer is dominated by *Arctostaphylos patula* - ***Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula*** **Woodland [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**


35b *Cercocarpus ledifolius* absent or if present then not abundant. *Pinus ponderosa* is the dominant conifer and the shrub layer is dominated by *Arctostaphylos patula* - ***Pinus ponderosa / Arctostaphylos patula*** **Woodland [Map Unit 10 -- Ponderosa Pine – (Douglas Fir) Woodland Complex]**

Pinus longaeva Woodlands

36a (15) Mixed evergreen conifer woodlands and forests; canopy cover ranges from 10% (or slightly less) to 25% cover. *Pinus longaeva* always present to abundant. Some stands may have every species of conifer known from the park. These stands occur almost exclusively on Claron Formation barrens, and have very little shrub or herbaceous cover - ***Pinus longaeva* Woodland [Map Unit 18 – Bristlecone Pine Woodland]**

36b Evergreen conifer woodlands and forests lacking *Pinus longaeva*. *Pinus edulis* and/or *Juniperus osteosperma* or *J. scopulorum* are the dominant tree species. *Pinus ponderosa* or *Pseudotsuga menziesii* may be present with up to 10% relative cover, but these are "incidentals" to the otherwise PJ dominated woodland. *Abies concolor* may be present in a very few stands **(37)**

Pinyon-Juniper Woodlands

37a (36) *Juniperus scopulorum* co-dominant with *Cercocarpus ledifolius*. *Pseudotsuga menziesii* or *Pinus ponderosa* may also be present but not co-dominant. Shrubs with as much as 6% cover may include *Mahonia repens, Symphoricarpos oreophilus, Purshia tridentata,*

Arctostaphylos patula, or *Quercus gambelii* - ***Juniperus scopulorum – Cercocarpus ledifolius*** **Woodland [Map Unit 14 – Pinyon - Juniper Woodland Complex]**

37b *Pinus edulis* mixed with either *Juniperus osteosperma* or *J. scopulorum*, or both. The shrub layer is dominated by *Cercocarpus* spp. **(38)**

38a (37) *Pinus edulis* woodlands mixed with either *Juniperus osteosperma* or *J. scopulorum*, or both. The shrub layer is dense and usually diverse. *Cercocarpus montanus* is the most abundant (7-33% cover) shrub; other species (1-23%) may include *Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata ssp. wyomingensis, Ericameria nauseosa, Chrysothamnus viscidiflorus, Ephedra viridis, Eriogonum corymbosum, Gutierrezia sarothrae, Juniperus communis, Mahonia fremontii, Mahonia repens, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Rhus trilobata, Shepherdia rotundifolia, Symphoricarpos oreophilus*, and/or *Tetradymia canescens* - ***Pinus edulis – Juniperus spp. / Cercocarpus montanus*** **– Mixed Shrubs Woodland [Map Unit 14 – Pinyon - Juniper Woodland Complex]**

38b Open *Pinus edulis* woodlands mixed with *Juniperus osteosperma*. The vegetation is characterized by a subcanopy layer dominated by *Cercocarpus ledifolius* trees or shrubs that range in cover from 5 to 30%. The associated short- and dwarf-shrub layer typically

provides sparse to low cover and includes *Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata ssp. vaseyana, Cercocarpus montanus, Ericameria nauseosa, Quercus gambelii*, and *Gutierrezia sarothrae* **– *Pinus edulis – Juniperus osteosperma / Cercocarpus ledifolius* Woodland [Map Unit 14 – Pinyon - Juniper Woodland Complex]**

Abies lasiocarpa – Picea engelmannii Forests

39a (17) Spruce-fir forests with a fairly diverse herbaceous understory dominated by the forb, *Ligusticum porteri* **– *Abies lasiocarpa – Picea engelmannii / Ligusticum porteri* Forest [Map Unit 5 – Subalpine Fir – Engelmann Spruce Forest Complex]**

39b Spruce-fir forests with a shrub layer dominated by *Juniperus communis* or *Ribes montigenum* **(40)**

40a (39) Spruce-fir forests with a shrub layer dominated by *Juniperus communis*. Other shrubs such as *Paxistima myrsinites, Arctostaphylos patula, Mahonia repens, Rosa woodsii,*

Symphoricarpos oreophilus, and *Ribes cereum* may be present, but never with as much cover as *Juniperus communis.* Herbaceous cover is typically low: trace to 15% - ***Abies lasiocarpa – Picea engelmannii / Juniperus communis*** **Woodland [Map Unit 5 – Subalpine Fir – Engelmann Spruce Forest Complex]**

40b Spruce-fir forests with sparse, often patchy shrubs, characterized by *Ribes montigenum*. Other shrubs include *Sambucus racemosa* with up to 17% cover, *Symphoricarpos oreophilus,* and *Ribes cereum. Juniperus communis* may be present with very low cover. Herbaceous cover is typically 10-50%. *Mertensia arizonica, Osmorhiza depauperata, Thalictrum fendleri*, and *Ligusticum porteri* can have high cover (10-40%), and are the most consistently present species in a long list of forbs present in any stand - ***Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme)*** **Forest [Map Unit 5 – Subalpine Fir – Engelmann Spruce Forest Complex]**

KEY III: A KEY TO THE SHRUBLAND ASSOCIATIONS OF CEDAR BREAKS NATIONAL MONUMENT

1a Shrublands occupying wetlands, riparian areas, floodplains, canyon floors, alcoves, or other habitats that are either wet or periodically flooded, including the dry streambeds of arroyos. Characteristic genera include *Salix* and young *Populus angustifolia* **(2)**

1b Shrublands occupying upland habitats, gentle to steep slopes, or upper alluvial terraces. Characteristic genera include *Acer, Arctostaphylos, Artemisia*, *Dasiphora, Ericameria, Ribes,* or *Symphoricarpos* **(3)**

Wetland Shrublands

2a (1) Tall or short shrublands in sandy washes. *Salix exigua* is the dominant species. It can occur in highly disturbed washes with very low cover (2%). Other riparian species present may include *Salix eriocephala* and/or *Betula occidentalis,* but these are rare - ***Salix exigua*** **Temporarily Flooded Shrubland [Map Unit 22 -- Narrowleaf Cottonwood Temporarily Flooded Wash Complex]**

2b Tall or short shrublands in valley bottom wetlands and riparian areas. *Salix arizonica* forms homogenous thickets with 30-70% cover - ***Salix arizonica*** **Shrubland [Map Unit 28 – Arizona Willow Temporarily Flooded Shrubland Complex]**


Upland Shrublands

3a (1) Small shrublands on logged slopes, rocky areas, colluvial slopes and/or steep eroding slopes of the Claron Formation **(4)**

3b Larger (or small) patches on gentle slopes or valley bottoms **(8)**

4a (3) Small patches that can be in openings surrounded by *Populus tremuloides* or *Abies lasiocarpa* forests, or on open hillsides logged some time ago, or on naturally small rocky outcrops. Stands are dominated by *Ribes montigenum* or *Sambucus racemosa*. Other *Ribes* spp. may be present. The distribution may be clumps of *Sambucus* separate from clumps of *Ribes*, or they may be mixed together - ***Ribes montigenum*** **Shrubland [Map Unit 31 -- Mixed Mountain Shrubland Complex]**


4b Shrublands characterized by *Arctostaphylos patula, Symphoricarpos oreophilus, Ericameria discoidea,* or *Acer glabrum* **(5)**

5a (4) Gravelly, exposed slopes; stands dominated by *Symphoricarpos oreophilus* (6%). The only sample from CEBR is on the edge of woodland with trace cover of *Pseudotsuga*

menziesii, Pinus flexilis, *Juniperus scopulorum*, and *Populus tremuloides* - ***Symphoricarpos oreophilus*** **Shrubland [Map Unit 31 -- Mixed Mountain Shrubland Complex]**

5b Shrublands characterized by *Arctostaphylos patula, Ericameria discoidea,* or *Acer glabrum* **(6)**

6a (5) Steep colluvial slopes of the Claron Formation supporting dense clumps of *Arctostaphylos pungens* with 23-38% canopy cover. Other shrubs that may be present include *Juniperus communis, Ceanothus martini* and *Purshia tridentata*. Trees are never far away and are always present with low cover (trace to 4%) **– *Arctostaphylos patula* Shrubland [Map Unit 26 – Greenleaf Manzanita Shrublands]**

6b Shrublands characterized by *Ericameria discoidea* or *Acer glabrum* **(7)**

7a (6) Steep eroding slopes of the Claron Formation supporting an open, sparsely vegetated dwarf shrubland characterized by *Ericameria discoidea* (=*Haplopappus macronema*) with 1-5% cover. Other species present include *Oxytropis oreophila, Ipomopsis*

tridactyla, Hymenopappus filifolius, Cymopterus lemmonii, Phlox pulvinata, Solidago multiradiata, and *Eriogonum panguicense,* each with <5% cover - ***Ericameria discoidea*** **Dwarf-Shrubland Herbaceous Sparse Vegetation [Map Unit 27 -- Whitestem Goldenbush Shrubland]**


7b Rocky colluvial slopes with a very sparse community of shrubs and small trees characterized by *Acer glabrum*. Other shrubs present may include *Cornus sericea* and *Shepherdia canadensis*. A few stands had scattered *Juniperus scopulorum* or *Picea pungens* trees - ***Acer glabrum*** **Colluvial Slope Shrubland [Map Unit 26 – Greenleaf Manzanita Shrublands]**


8a (3) Shrublands on flat valley bottoms or gentle slopes, dominated by *Artemisia cana.* Herbaceous cover is relatively high; the most abundant graminoid is *Poa pratensis*, with *Elymus trachycaulus, Muhlenbergia spp., Achnatherum lettermanii,* and *Poa glauca* often accompanying it. Forbs include *Geum triflorum, Potentilla hippiana, Machaeranthera commixta, Solidago multiradiata, Achillea millefolium, Penstemon leiophyllus, Trisetum spicatum, Potentilla gracilis, Erigeron flagellaris,* and *Trifolium longipes* - ***Artemisia cana (spp. bolanderi, spp. viscidula) / Poa pratensis*** **Semi-natural Shrubland [Map Unit 30 -- Silver Sagebrush Bottomland Shrublands]**

8b Shrublands on flat valley bottoms or gentle slopes dominated by *Dasiphora fruticosa.* Often occurs on disturbed sites with *Poa pratensis*, *Juncus balticus* and *Iris missouriensis.* On less disturbed sites, *Deschampsia caespitosa* is the indicator understory species and is often the dominant graminoid **- *Dasiphora fruticosa ssp. floribunda* / *Deschampsia caespitosa* Shrubland [Map Unit 33 – Shrubby Cinquefoil Shrubland]**

KEY IV: A KEY TO THE HERBACEOUS ASSOCIATIONS OF CEDAR BREAKS NATIONAL MONUMENT

1a Herbaceous vegetation in mesic sites, including wetlands, perennial drainages, floodplains, seeps, and springs. Dominant species include *Bromus*, *Calamagrostis, Carex, Deschampsia, Juncus,* and *Poa* **(2)**

1b Herbaceous vegetation in xeric and upland sites, including dry drainages, terraces, and benches; community not controlled by water table or subsurface flow of water. Dominant grass species include *Achnatherum, Bromus, Carex, Elymus, Pseudoroegneria, Poa and Pascopyrum.* Common forbs include *Lomatium, Solidago, Eriogonum, Oxytropis,* and *Erigeron* **(7)**

Wetland and Mesic Herbaceous Communities

2a (1) Wet or mesic sites dominated by *Carex;* other graminoids are usually present but not as abundant as the *Carex* **(3)**

2b Wet or mesic sites dominated by graminoids other than *Carex*, such as *Poa pratensis, Bromus inermis, Calamagrostis, or Deschampsia. Carex* may be present, but not characteristic or dominant **(4)**

3a (2) Freshwater seeps and streams dominated by *Carex aquatilis*. Other graminoid and forb species may be present, including *Deschampsia caespitosa*, *Carex scirpoidea*, and *Carex egglestonii* . Forbs are often present with low cover, including *Caltha leptosepala, Habenaria hyperborea*, and *Pedicularis groenlandica.* A few woody species may be present such as *Dasiphora fruticosa* and *Salix arizonica* - ***Carex aquatilis*** **Herbaceous Vegetation [Map Unit 36 -- Sedge spp. – Rush spp. Wet Meadow Herbaceous Vegetation Mosaic]**

3b Low lying wet areas characterized by *Carex scirpoidea*. Other *Carex* species may be present to codominant, such as *Carex aquatilis, Carex aurea*, and *Carex egglestonii* along the drier margins. Typical forbs include *Dodecatheon alpinum, Caltha leptosepala, Polygonum bistortoides,* and *Pedicularis groenlandica.* A few woody species may also be present, including *Dasiphora fruticosa* and *Salix arizonica* - ***Carex scirpoidea*** **Seasonally Flooded Herbaceous Vegetation [Map Unit 36 -- Sedge spp. – Rush spp. Wet Meadow Herbaceous Vegetation Mosaic]**

4a (2) Grasslands and meadows with high graminoid cover occupying low-gradient drainages, slopes, and valley bottoms. *Deschampsia caespitosa* is the most abundant grass, although many forbs and other graminoids are usually present. *Polygonum bistortoides* is always present; other herbaceous species may include *Poa pratensis, Ranunculus alismifolius, Phleum alpinum, Carex aquatilis, Carex* spp. *Elymus trachycaulus, Achillea millefolium, Trifolium longipes*, and *Erigeron ursinus* - ***Deschampsia caespitosa – Polygonum bistortoides*** **Herbaceous Vegetation [Map Unit 36 -- Sedge spp. – Rush spp. Wet Meadow Herbaceous Vegetation Mosaic]**


4b Grasslands and meadows dominated by *Poa pratensis* and/or *Bromus inermis.* Other species may be present, but *Poa pratensis* and/or *Bromus inermis* clearly dominate **(5)**

5a (4) Grasslands and meadows dominated by *Bromus inermis,* usually in old seeded pastures near barns and corrals and often spreading into adjacent native mesic meadows. In the latter case, *Bouteloua gracilis, Carex egglestonii, Eleocharis* spp., *Elymus hispidus, Elymus trachycaulus, Hordeum brachyantherum, Juncus balticus, Koeleria macrantha, Phleum pratense, Poa glauca, Poa pratensis, Achnatherum lettermanii, A. pinetorum,* and/or *Trisetum spicatum,* may have trace to 5% cover - ***Bromus inermis – (Pascopyrum smithii)*** **Semi-Natural Herbaceous Vegetation [Map Unit 35 -- Perennial Disturbed Grassland Complex]**


5b Grasslands and meadows dominated by *Poa pratensis***(6)**

6a (6) Wet to mesic sites in drainages with sub irrigation or ephemeral flooding, dominated by *Poa pratensis* - ***Poa pratensis*** **Semi-natural Seasonally Flooded Herbaceous Vegetation [Map Unit 36 -- Sedge spp. – Rush spp. Wet Meadow Herbaceous Vegetation Mosaic]**

6b Mesic sites in swales or wet areas that are now drier for a variety of reasons; not as wet as the previous association. *Poa pratensis* is the dominant species. If native graminoids are present, none are indicator species nor as abundant as *Poa pratensis.* It may be impossible to tell what the original native grassland community might have been - ***Poa pratensis – (Pascopyrum smithii)*** **Semi-natural Herbaceous Vegetation [Map Unit 35 -- Perennial Disturbed Grassland Complex]**

Upland and Dry Herbaceous Communities

7a (1) Dry to slightly mesic meadows and grasslands dominated by introduced or seeded grass species such as *Poa pratensis* and/ or *Bromus inermis*. *Poa secunda* may be co-dominant in some stands otherwise characterized by *Poa pratensis* **(8)**

7b Dry to slightly mesic meadows and grasslands dominated by native species such as *Achnatherum lettermanii, Aster ascendens, Calamagrostis, Carex, Deschampsia, Elymus, Eriogonum corymbosum, Solidago multiradiata,* and/or *Viguiera multiflora* **(10)**

8a (8) Grasslands and meadows dominated by *Bromus inermis*, usually in old seeded pastures near barns and corrals and often spreading into adjacent native upland meadows. *Bouteloua gracilis, Carex egglestonii, Eleocharis, Elymus hispidus, Elymus trachycaulus, Hordeum brachyantherum, Juncus balticus, Koeleria macrantha, Phleum pratense, Poa glauca, Poa pratensis, Achnatherum lettermanii, A. pinetorum, and/ or Trisetum spicatum* each may have up to 5% cover - ***Bromus inermis – (Pascopyrum smithii)*** **Semi-Natural Herbaceous Vegetation [Map Unit 35 -- Perennial Disturbed Grassland Complex]**

8b Mesic or dry, windswept meadows that are dominated by *Poa* spp. **(9)**

9a Mesic sites in swales or wet areas that are now drier for a variety of reasons. *Poa pratensis* is dominant. If native graminoids are present, none are indicator species nor as abundant as *Poa pratensis.* It may be impossible to tell what the original native grassland community might have been - ***Poa pratensis – (Pascopyrum smithii)*** **Semi-natural Herbaceous Vegetation [Map Unit 35 -- Perennial Disturbed Grassland Complex]**

[See photo from couplet **6b]**

9b Dry, windswept meadows with rocky soils that support a mixed grassland of *Poa pratensis* and *Poa secunda*, along with a few other forb and grass species – **Poa secunda Herbaceous Vegetation [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

10a (7) Grasslands with some forb cover, but most of the biomass is from graminoids. Dominant species include *Achnatherum lettermanii, Calamagrostis, Carex, Deschampsia,* or *Elymus* **(11)**

10b Forb (or subshrub)-dominated stands; abundant species may include *Aster, Eriogonum*, *Helianthella, Lomatium, Penstemon, Solidago, Ligusticum, Oxytropis, Viguiera,* and/or *Erigeron* **(14)**

11a (10) Dry grasslands where *Achnatherum lettermanii* or *Elymus* spp. are dominant or characteristic **(12)**

11b Dry to mesic grasslands, meadows, or steep slopes with sparse cover of the following graminoids *Calamagrostis scopulorum*, *Carex egglestonii,* or *Deschampsia caespitosa* **(13)**

12a (11) *Achnatherum lettermanii* is the dominant and characteristic grass species. Shrubs such as *Chrysothamnus vaseyi*, *C. depressus, or Ericameria parryi* may be present with trace to 6% cover. Other graminoids present with up to 8% cover may include *Carex egglestonii, Carex praegracilis, Elymus elymoides, Pseudoroegneria spicata, Elymus trachycaulus, Koeleria macrantha, Poa glauca, Achnatherum hymenoides,* and *Trisetum spicatum.* Forbs are abundant, although few have more than 2% cover, except for *Potentilla concinna*, which can have up to 20% cover - ***Achnatherum lettermanii*** **Herbaceous Vegetation [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

12b Grasslands dominated by *Elymus trachycaulus* (4-25% cover). Other herbaceous species present with up to 7% cover may include *Poa glauca, Poa pratensis,* and *Achnatherum lettermanii*. Forb species having >1% cover may include *Solidago multiradiata, Penstemon leiophyllus, Geum triflorum, Arenaria fendleri, Achillea millefolium*, and *Lomatium minimum***.** Scattered shrubs may be present with less than 5% total cover - ***Elymus trachycaulus* Herbaceous Vegetation [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

13a (11) Meadows in drainages cutting very steep slopes. Many small trees and shrubs are present with <5% cover. Springs or runoff keeps the site moist, and there is much evidence of soil and rock movement. *Calamagrostis scopulorum* is the most abundant graminoid (3-12%). Common species include *Abies concolor, Picea pungens, Pinus ponderosa, Pinus longaeva*, *Pseudotsuga menziesii, Acer glabrum* and *Shepherdia canadensis*. Other herbaceous species present include *Carex aurea*, *Juncus* spp., *Aster wasatchensis, Senecio atratus*, and *Monardella odoratissima* - ***Calamagrostis scopulorum* Herbaceous Vegetation [Park Special] [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

13b Moderate slopes with some exposed soil. *Carex egglestonii* is the most abundant graminoid, along with *Elymus trachycaulus, Solidago multiradiata, Poa pratensis, Festuca ovina*, and *Penstemon rydbergii* - ***Carex egglestonii*** **Herbaceous Vegetation [Park Special] [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

Forb-Dominated Herbaceous Vegetation

14a (10) Dry eroding slopes of the Claron Formation. *Eriogonum panguicense* is present; overall vegetative cover is sparse to >10%. Other species present include *Oxytropis oreophila, Hymenopappus filifolius, Trisetum spicatum, Erigeron compositus, Elymus scribneri*, *Monardella odoratissima,* and *Phlox pulvinata.* These species may have greater combined cover than *E. panguicense,* but for this calcareous habitat, *Eriogonum panguicense* is the indicator species - ***Eriogonum panguicense*** **Herbaceous Vegetation [Park Special] [Map Unit 29 -- Mixed Desert Forb Complex]**

14b Dry to lush meadows that may have significant bare soil or gravel exposure, but not occurring on eroding slopes of the Claron Formation instead occurring on gentle slopes and valley bottoms or in openings among forested patches. Vegetation can be less than 0.5 m or >1 m tall **(15)**

15a (14) Forbs are generally less than 0.5 m tall; dry sites or sites with high bare ground or gravel cover. Dominant species include *Erigeron ursinus, Eriogonum umbellatum, Solidago multiradiata*, or *Lomatium minimum* **(16)**

15b Forbs are 0.5 to 1m tall, generally on more mesic sites where vegetation is lush. Bare ground may have high cover. Dominant species include *Aster ascendens, Helianthella uniflora, Ligusticum porteri, Lupinus argenteus,* and *Viguiera multiflora* **(19)**

Short-Stature Forb-Dominated Meadows

16a (15) Dry meadows dominated by *Lomatium minimum*. Other species present may include *Arenaria fendleri, Poa pratensis, Castilleja miniata, Solidago multiradiata*, and *Penstemon leiophyllus* - ***Lomatium minimum – Arenaria fendleri*** **Herbaceous Vegetation [Park Special] [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

16b Dry meadows dominated by *Erigeron ursinus, Eriogonum umbellatum*, *Potentilla hippiana* or *Solidago multiradiata* **(17)**

17a (16) Dry open meadows on gentle slopes, valley bottoms, or along stream drainages with high cover of exposed soil (15-85%) and gravel (3-68%). Total vegetative cover is >30%. *Solidago multiradiata* typically dominates or codominates. Other important species include *Geum triflorum, Penstemon rydbergii, Potentilla gracilis, Potentilla hippiana, Achnatherum lettermanii* and *Elymus trachycaulus* - ***Solidago multiradiata*** **Herbaceous Vegetation [Park Special] [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

17b Dry open meadows on gentle slopes that are not characterized by *Erigeron ursinus, Eriogonum umbellatum*, or *Potentilla hippiana* **(18)**

18a (17) Dry open meadows on gentle slopes and valley bottoms. Usually much exposed soil (40%) from voles and pocket gopher disturbance and/or past grazing. Total vegetative cover is about 30%. Dominant species are *Erigeron ursinus, Achillea millefolium, Haplopappus clementis,* and *Elymus trachycaulus* - ***Erigeron ursinus*** **Herbaceous Vegetation [Park Special] [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**


18b Dry open meadows on gentle slopes, with much exposed soil (30-90%); often trampled by visitors taking photographs, possibly disturbed by past grazing as well. Dominant species include *Festuca ovina, Eriogonum umbellatum, Potentilla hippiana, Penstemon leiophyllus, Antennaria* spp., and *Elymus trachycaulus* - ***Eriogonum umbellatum – Potentilla hippiana*** **Herbaceous Vegetation [Park Special] [Map Unit 29 -- Mixed Desert Forb Complex]**


Tall-Stature Forb Dominated Meadows

19a (15) Mesic and lush or dry meadows on gentle open slopes dominated by *Helianthella uniflora* (15%). Other species present may include *Ribes montigenum*, *Eriogonum umbellatum, Lupinus argenteus, Mertensia arizonica, Penstemon rydbergii, Potentilla hippiana, Potentilla gracilis, Solidago multiradiata, Thalictrum fendleri, Achnatherum lettermanii, Poa pratensis, and Elymus trachycaulus* (each with 1-10% cover) - ***Helianthella uniflora*** **Herbaceous Vegetation [Park Special] [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**


19b Tall stature forb-dominated meadows that are characterized by *Aster ascendens, Ligusticum porteri, Lupinus argenteus,* and/or *Viguiera multiflora* **(20)**

20a (19) Mesic lush meadows near forest edges dominated by *Ligusticum porteri* (20-43%). Additional tall forbs such as *Aconitum columbianum, Thalictrum fendleri, Delphinium barbeyi, Helenium hoopesii*, and *Lupinus argenteus* are often present to co-dominant. A few graminoids may be present and include *Poa pratensis, Poa glauca*, and *Elymus trachycaulus* - ***Ligusticum porteri*** **Herbaceous Alliance [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**


20b Lush meadows on gentle slopes dominated by *Aster ascendens, Viguiera multiflora* and/or *Lupinus argenteus* **(21)**

21a (20) Lush mesic meadows near forest stands dominated by *Lupinus argenteus* (30%). Only one stand documented at CEBR near some old cement structures, which may be a disturbed version of the *Ligusticum porteri* type (above). Other species present with 1-8% cover include *Delphinium barbeyi, Descurainia incana, Elymus trachycaulus, Ligusticum porteri, Poa pratensis*, and *Thalictrum fendleri* - ***Lupinus argenteus*** **Herbaceous Alliance [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**


21b Lush meadows on gentle slopes dominated by *Aster ascendens, Viguiera multiflora* and/or *Lupinus argenteus* **(22)**

22a (21) Dry, open meadows dominated by *Aster ascendens* (9-12%). Other forb species present include *Achillea millefolium, Cirsium spp., Ligusticum porteri, Viguiera multiflora, Solidago multiradiata, Taraxacum officinale, Trifolium longipes* and *Erigeron ursinus.* Graminoid species present with 1-8% cover include *Elymus trachycaulus, Stipa lettermanii, Carex rossii, Poa pratensis,* and *Deschampsia caespitosa* **– *Aster ascendens* Herbaceous Vegetation [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**


22b Dry, open meadows dominated by *Viguiera multiflora* (10-16%), often accompanied by low cover of the shrub species *Ribes montigenum.* Other forb species present with more than trace cover include *Aster ascendens, Erigeron ursinus, Achillea millefolium,* and *Taraxacum officinale.* Graminoid species present include *Poa pratensis* and *Elymus trachycaulus* **– *Viguiera multiflora* Herbaceous Vegetation [Map Unit 34 -- Dry Meadow Mixed Herbaceous Vegetation Mosaic]**

Index of the Vegetation Associations of Cedar Breaks National Monument

Appendix H. Modified Anderson Land Use/Land Cover Classification

This classification was used as the primary attribute for areas of developed land within and around Bryce Canyon National Park. Every polygon was assigned an Anderson Land Use or Land Cover code in addition to its vegetation attributes.

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
1.0 Water	1.1 Open Water	1.11 Stream/river			
		1.12 Canal/ditch	1.121 Lined canal/ditch		
			1.122 Unlined canal/ditch		
		1.13 Lake/pond			
		1.14 Reservoir			
		1.15 Bay/estuary			
		1.16 Sea/ocean			
	1.2 Perennial Ice/Snow	1.21 Snowfield			
		1.22 Glacier			
2.0 Developed	2.1 Residential	2.11 Single-family residential			
		2.12 Multi-family residential			
	2.2 Non-residential Developed	2.21 Commercial/Light Industry	2.211 Major Retail		
			2.212 Mixed/Minor Retail and Services		
			2.213 Office		
			2.214 Light industry		
		2.22 Heavy Industry	2.221 Petro-chemical Refinery		
		2.23 Communications and Utilities			
		2.24 Institutional	2.241 Schools		
			2.242 Cemeteries		
		2.25 Agricultural Business	2.251 Aquiculture		
			2.252 Confined feeding		
		2.26 Transportation	2.261 Airport		
		2.27 Entertainment/ Recreation	2.271 Golf Course		
			2.272 Urban Parks		
	2.3 Mixed Urban				
3.0 Bare	3.1 Transitional				
	3.2 Quarries/Strip mines/Gravel pits				
	3.3 Bare Rock/Sand				

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	3.4 Flats				
	3.5 Disposal				
4.0 Vegetated	4.1 Woody	4.11 Forested	4.111 Deciduous		
			4.112 Evergreen		
			4.113 Mixed		
		4.12 Shrub land	4.121 Deciduous		
			4.122 Evergreen		
			4.123 Mixed		
			4.124 Desert scrub		
		4.13 Orchards/vineyards/ groves	4.131 Irrigated Orchard/ vineyards/groves		
			4.132 Citrus		
			4.133 Non-managed Citrus		
		4.14 Mixed Forest/Shrub			
	4.2 Herbaceous	4.21 Natural Herbaceous	4.211 Natural Grassland		
		4.22 Planted/cultivated	4.221 Fallow/Bare Fields		
			4.222 Small Grains	4.2221 Irrigated small grains	
			4.223 Row Crops	4.2231 Irrigated row crops	
				4.2232 Sugar Cane	
			4.224 Planted grasses	4.2241 Pasture/ hay	4.22411 Irrigated Pasture/hay
				4.2242 Other grass	4.22421 Irrigated Other grass
			4.225 Irrigated Planted/ cultivated		
	4.3 Wetlands	4.31 Woody wetlands			
		4.32 Emergent wetlands			

Classification Definitions

1.0 WATER - area covered by water, snow, or ice with less than 25% vegetated or developed cover, unless specifically included in another category.

1.1 Open Water - all areas of open water with less than 25% vegetative or developed cover

1.11 Stream/river - a natural body of flowing water. Includes streams and rivers that

have been channelized in order to control flooding or erosion or to maintain flow for navigation.

1.12 Canal/ditch - a man-made open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft. Collection should include the right of ways and associated dikes and levees.

1.121 Lined canal/ditch - a canal or ditch lined with concrete or other impervious material preventing passage of water into underlying strata.

1.122 Unlined canal/ditch - a canal or ditch constructed with dirt or other porous material allowing water to drain.

1.13 Lake/pond - a non-flowing, naturally-existing, body of water. Includes water impounded by natural occurrences and artificially regulated natural lakes. The delineation of a lake is based on the areal extent of water at the time the imagery was acquired.

1.14 Reservoir - any artificial body of water, unless specifically included in another category. It can lie in a natural basin or a man-constructed basin. The delineation of a reservoir is based on the areal extent of water at the time the imagery was acquired. (The water control structures are classified as Communications/Utilities).

2.0 DEVELOPED - Areas of the earth that have been improved by man. Includes all "built-up" and urban areas of the landscape. Does NOT include mining lands, croplands, or waste-disposal areas (dumps). This land use category takes precedence over a land cover category when the criteria for more than one category are met.

2.1 Residential - lands containing structures used for human habitation

2.11 Single-family Residential - Lands used for housing residents in single-family dwelling units. Includes trailer parks, mobile home parks, and entire "farmsteads" when there is a home in the complex. (If no home is in the complex, it should be classified as Agricultural Business.) Single-family residential buildings located within another category, such as military family housing, should be identified in this category.

2.12 Multi-family Residential - All lands devoted to housing more than one family on a permanent or semi-permanent basis, group living situations, and their associated grounds. Includes apartments, apartment complexes, duplexes, triplexes, attached row houses, condominiums, retirement homes, nursing homes, and residential hotels. Residential buildings located within another category, such as barracks and dormitories, should be identified in this category when possible, (except residential buildings within convents and monasteries - include these with Institutional).

2.2 Non-residential Developed - Any "developed" area or feature that is used for a purpose other than habitation.

2.21 Commercial/Light Industry - structures and associated grounds used for the sale of products and services, for business, or for light industrial activities. Includes all retail and wholesale operations. Include "industrial parks" and other features that cannot be clearly classified as either a retail service or light industry, such as heavy equipment yards, machinery repair, and junkyards.

2.211 Major Retail - This category includes shopping malls, retail "outlet centers," and "superstores" that draw clientele from a regional area. Major retail centers consist of extremely large single buildings or a complex of large buildings and their

parking lots. Malls usually house one or two major department stores and numerous small retail stores. Includes outlet centers, "superstores", multi-plex movie theaters, and huge warehouse-type stores. The structures themselves are often several acres in size and have extensive parking lots.

2.212 Mixed/Minor Retail and Services - Includes individual stores and services of various sizes and associated grounds and parking. Includes neighborhood strip malls and shopping centers, veterinarian services, small movie theaters, gas stations and auto repair shops, garden centers, motels, small auto dealerships, public parking lots, lumber yards, art galleries, farm supply stores, flea-markets, bars and restaurants, grocery stores, and commercial "truck stops". Many small office buildings will have no features to distinguish them from retail stores and will fall in this category.

2.213 Office - structures and their associated grounds and parking, that provide financial, professional, administrative, and informational type services. Includes administrative government offices (e.g., IRS and State Motor Vehicles offices) trade schools, professional medical office complexes, research facilities/centers, and banks. Usually only office buildings in office complexes or in downtown areas will be distinguishable as offices. Small, single-story office buildings may blend in with minor retail.

2.214 Light industry - structures and their associated grounds and facilities that are used primarily to produce or process some finished product; or as a wholesale distribution center. Activities include design, assembly, finishing, packaging, warehousing or shipping of products rather than processing raw materials. The materials used in light industry have generally been processed at least once. They are generally "clean" industries that do not produce lots of waste materials. Use this category as a default for those facilities with semi-truck and trailer activity around loading docks, but that cannot be classified as either retail services or heavy industry. Includes electronic firms, clothing and furniture manufacture, grain elevators, printing plants, commercial bakeries, shipping and distribution centers, sand/gravel sorting facilities, secondary buildings associated with a mining or quarrying site, and generic warehouses.

2.22 Heavy Industry - structures and their associated grounds used for heavy fabrication, manufacturing and assembling parts that are, in themselves, large and heavy; or for processing raw materials such as iron ore, timber, and animal products. Accumulated raw materials are subject to treatment by mechanical, chemical, or heat processing to render them suitable for further processing, or to produce materials from that finished products are created. Heavy industries generally require large amounts of energy and raw materials and produce a significant amount of waste products. Indicators of heavy industry may be stockpiles of raw materials, energy producing sources and fuels, waste disposal areas and ponds, transportation facilities capable of handling heavy materials, smokestacks, furnaces, tanks, and extremely large buildings that are complex in outline and roof structure. Include associated waste piles and waste ponds. Heavy industry is usually located away from residential areas. Includes steel mills, paper mills, lumber mills, cotton gins, chemical plants, cement and brick plants, smelters, rock crushing machinery, and ore-processing facilities associated with mining.

2.23 Communications and Utilities - structures or facilities and associated grounds

used for the generation of power and communications, the treatment or storage of drinking water, waste management, flood control, or the distribution and storage of gas and oil not associated with a unique feature. Includes pumping stations (oil, gas, or water), tank farms, power plants, electric substations, sewage treatment facilities and ponds, garbage collection facilities (not the final dumping ground - these are included in Bare), dams, levees, and spillways of appropriate dimensions, filtration plants, and heavy concentrations of antennas or satellite dishes; along with the related operational buildings.

2.24 Institutional - specialized government or private features that meet the educational, religious, medical, governmental, protective, and correctional needs of the public. Parking lots and associated grounds are included with these features. Includes public and private schools (not day care), state capitols, city halls, courthouses, libraries, churches, convents, monasteries, hospitals and training hospitals, post offices, police and fire departments, prisons, and military bases. Only the military-business areas of a military base are classified here; residential, airport, athletic fields, and vegetated areas are classified in the appropriate category.

2.241 Schools/Universities - public and private schools, seminaries, university campuses, and associated lands. Include the entire "core campus" area, along with athletic fields and vegetated areas. This category does not include day care centers or commercial trade schools, both of that are commercial uses.

2.242 Cemeteries - structures and lands devoted to burial of the dead. Includes mausoleums, service areas, and parking lots.

2.25 Agricultural Business - structures and all associated grounds used for raising plants or animals for food or fiber. Includes fish farms and hatcheries, feedlots, poultry farms, dairy farms, temporary shipping and holding pens, animal breeding or training facilities, and greenhouses. (Farmsteads including a dwelling are classified as residential, not agricultural business.)

2.251 Aquiculture site - a set of pools of water and related structures used for producing fish, shellfish, or aquatic plants.

2.252 Confined feeding operation - structures and associated pens, storage facilities, waste areas, and ponds that are used for raising meat and dairy cattle, hogs, poultry, or other animals. These features must have a relatively permanent and high animal population density. Temporary holding pens and thoroughbred horse farms usually do not qualify.

2.26 Transportation - Roads, railroads, airports, port facilities, and their associated lands. Roads and railroads include the right-of-way, interchanges, and median strips. Category includes railroad stations, railroad yards, bus stations, highway maintenance yards, school bus parking and service yards, and park-and-ride lots. Port facilities include loading and unloading facilities, docks, locks and, temporary storage areas. Associated warehousing and transfer stations for truck or rail are included only if they appear to be an integral part of the airport or port facility. Nearby but separate warehouses will be classified as light industry.

2.27 Entertainment and Recreational - areas and structures used predominantly for athletic or artistic events, or for leisure activities, and all associated lands and developed parking areas. Includes outdoor amphitheaters, drive-in theaters, campgrounds, zoos, sports arenas (including indoor arenas), developed parks and playgrounds, community

recreation centers, museums, amusement parks, public swimming pools, fairgrounds, and ski complexes (not the ski slopes). Marinas with over 25% of water surface covered by docks and boats are included here.

2.271 Golf Course - structures, associated grounds, driving ranges, and interspersed natural areas used for the game of golf.

2.272 Urban Parks - designated open space in urban settings used for outdoor recreation. Include grass fields and associated structures, parking lots, and facilities. Includes city parks, "green-belt" urban parks, and athletic fields not associated with a school. Does not include undeveloped "open space" on the periphery of urban areas or undeveloped regional, state, or national park areas.

2.3 Mixed Urban - developed areas that have such a mixture of residential and non-residential features where no single feature meets the minimum mapping unit specification. This category is used when more than one-third of the features in an area do not fit into a single category. Often applicable in the central, urban-core area of cities.

3.0 BARE - undeveloped areas of the earth not covered by water that exhibit less than 25% vegetative cover or less than 5% vegetative cover if in an arid area. The earth's surface may be composed of bare soil, rock, sand, gravel, salt deposits, or mud.

3.1 Transitional Bare - areas dynamically changing from one land cover/land use to another, often because of land use activities. Includes all construction areas, areas transitioning between forest and agricultural land, and urban renewal areas that are in a state of transition.

3.2 Quarries/Strip Mines/Gravel Pits - areas of extractive mining activities with significant surface disturbance. Vegetative cover and overburden are removed for the extraction of deposits such as coal, iron ore, limestone, copper, sand and gravel, or building and decorative stone. Current mining activity does not need to be identifiable. Inactive or unreclaimed mines and pits are included in this category until another land cover or land use has been established. Includes strip mines, open-pit mines, quarries, borrow pits, oil and gas drilling sites, and gravel pits with their associated structures, waste dumps, and stockpiles.

3.3 Bare Rock/Sand - includes bare bedrock, natural sand beaches, sand bars, deserts, desert pavement, scarps, talus, slides, lava, and glacial debris.

3.4 Flats - A level landform composed of unconsolidated sediments of mud, sand, gravel, or salt deposits. Includes coastal tidal flats and interior desert basin flats and playas.

3.5 Disposal - designated areas where refuse is dumped or exists, such as landfills, trash dumps, or hazardous-waste disposal sites. Reclaimed disposal areas or those covered with vegetation do not qualify.

4.0 VEGETATED - areas having generally 25% or more of the land or water with vegetation. Arid or semi-arid areas may have as little as 5% vegetation cover.

4.1 Woody Vegetation - land with at least 25% tree and (or) shrub canopy cover.

4.11 Forested - land where trees form at least 25% of the canopy cover.

4.111 Deciduous Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees that loose all their leaves for a specific season of the year.

4.112 Evergreen Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees that maintain their leaves all year.

4.113 Mixed Forest - areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the canopy cover.

4.12 Shrub land - areas where trees have less than 25% canopy cover and the existing vegetation is dominated by plants that have persistent woody stems, a relatively low growth habit, and that generally produce several basal shoots instead of a single shoot. Includes true shrubs, trees that are small or stunted because of environmental conditions, desert scrub, and chaparral. In the eastern US, include former cropland or pasture lands that are now covered by brush to the extent that they are no longer identifiable or usable as cropland or pasture. Clear-cut areas will exhibit a stage of shrub cover during the regrowth cycle. Some common species that would be classified as shrub land are mountain mahogany, sagebrush, and scrub oaks.

4.121 Deciduous Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that lose all their leaves for a specific season of the year.

4.122 Evergreen Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that keep their leaves year round.

4.123 Mixed Shrub land - areas dominated by shrubs where neither deciduous nor evergreen species represent more than 75% of the land cover.

4.124 Desert Scrub - land areas predominantly in arid and semi-arid portions of the southwestern U.S. Existing vegetation is sparse and often covers only 5-25% of the land. Example species include sagebrush, creosotebush, saltbush, black greasewood, and cactus.

4.13 Planted/Cultivated Woody (Orchards/Vineyards/Groves) - areas containing plantings of evenly spaced trees, shrubs, bushes, or other cultivated climbing plants usually supported and arranged evenly in rows. Includes orchards, groves, vineyards, cranberry bogs, berry vines, and hops. Includes tree plantations planted for the production of fruit, nuts, Christmas tree farms, and commercial tree nurseries. Exclude pine plantations and other lumber or pulp wood plantings that will be classified as Forest.

4.131 Irrigated Planted/Cultivated Woody - orchards, groves, or vineyards where a visible irrigation system is in place to supply water.

4.14 Mixed Forest/Shrub – areas dominated by forest and shrub where neither species represent more than 75% of the canopy cover.

4.2 Herbaceous Vegetation - areas dominated by non-woody plants such as grasses, forbs, ferns and weeds, either native, naturalized, or planted. Trees must account for less than 25% canopy cover while herbaceous plants dominate all existing vegetation.

4.21 Natural Herbaceous - areas dominated by native or naturalized grasses, forbs, ferns and weeds. It can be managed, maintained, or improved for ecological purposes such as weed/brush control or soil erosion. Includes vegetated vacant lots and areas where it cannot be determined whether the vegetation was planted or cultivated such as in areas of dispersed grazing by feral or domesticated animals. Includes landscapes dominated by grass-like plants such as bunch grasses, Palouse grass, palmetto prairie areas, and tundra vegetation, as well as true prairie grasses.

4.211 Natural Grasslands - natural areas dominated by true grasses. Includes undisturbed tall-grass and short-grass prairie in the Great Plains of the U.S.

4.22 Planted/Cultivated Herbaceous - areas of herbaceous vegetation planted and/or cultivated by humans for agronomic purposes in developed settings. The majority of

vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, pasture, or seed. Temporarily flooded are included in this category. Do not include harvested areas of naturally occurring plants such as wild rice and cattails.

4.221 Fallow/Bare Fields - areas within planted or cultivated regions that have been tilled or plowed and do not exhibit any visible vegetation cover.

4.222 Small Grains - areas used for the production of grain crops such as wheat, oats, barley, graham, and rice. Category is difficult to distinguish from cultivated grasses grown for hay and pasture. Indicators of small grains may be a less than 10% slope, annual plowing and seeding, distinctive field patterns and sizes, different timing of green-up and harvest, different harvesting practices, a very "even" texture and tone, or regional variations discovered during field checks.

4.223 Row Crops - areas used for the production of crops or plants such as corn, soybeans, vegetables, tobacco, flowers and cotton. Fields that exhibit characteristics similar to row crops, but that do not have any other distinguishing features for a more specific category may be included.

4.2231 Irrigated Row Crops - areas used for the production of row crops where a visible irrigation system is in place to supply water.

4.224 Cultivated grasses - areas of herbaceous vegetation, including perennial grasses, legumes, or grass-legume mixtures that are planted by humans and used for erosion control, for seed or hay crops, for grazing animals, or for landscaping purposes.

4.2241 Pasture/Hay - areas of cultivated perennial grasses and/or legumes (e.g., alfalfa) used for grazing livestock or for seed or hay crops. Pasturelands can have a wide range of cultivation levels. It can be managed by seeding, fertilizing, application of herbicides, plowing, mowing, or baling. Pastureland has often been cleared of trees and shrubs, is generally on steeper slopes than cropland, is intended to graze animals at a higher density than open rangeland, and is often fenced and divided into smaller parcels than rangeland or cropland. Hay fields may be more mottled than small grain fields as they are not plowed annually and may be harvested and baled two or three times a year in some locations.

4.22411 Irrigated Pasture/Hay - areas used as pasture or hay fields where a visible irrigation system is in place to supply water.

4.2242 Other planted grasses - areas of other cultivated grass such as turf and sod farms.

4.22421 Irrigated other grasses - areas of other cultivated grasses where a visible irrigation system is in place to supply water.

4.225 Irrigated Planted Herbaceous - land that is growing some indistinguishable crop or grass, but is obviously irrigated.

4.3 Vegetated Wetland - areas where the water table is at, near, or above the land surface for a significant part of most years and vegetation indicative of this covers more than 25% of the land surface. Wetlands can include marshes, swamps situated on the shallow margins of bays, lakes, ponds, streams, or reservoirs; wet meadows or perched bogs in high mountain valleys, or seasonally wet or flooded low spots or basins. Do not include agricultural land that is flooded for cultivation purposes.

4.31 Woody Wetland - areas dominated by woody vegetation. Includes seasonally

flooded bottomland, mangrove swamps, shrub swamps, and wooded swamps including those around bogs. Wooded swamps and southern flood plains contain primarily cypress, tupelo, oaks, and red maple. Central and northern flood plains are dominated by cottonwoods, ash, alder, and willow. Flood plains of the Southwest may be dominated by mesquite, saltcedar, seepwillow, and arrowweed. Northern bogs typically contain tamarack or larch, black spruce, and heath shrubs. Shrub swamp vegetation includes alder, willow, and buttonbush.

4.32 Emergent Herbaceous Wetlands - areas dominated by wetland herbaceous vegetation that is present for most of the growing season. Includes fresh-water, brackish-water, and salt-water marshes, tidal marshes, mountain meadows, wet prairies, and bogs.

Appendix I. Accuracy Assessment Analysis Results

Introduction

This index contains the results of the analysis of accuracy assessment field data. Each of the 303 accuracy assessment field plots sampled at CEBR was compared with the polygon in which it occurred. If the field data matched the polygon label, the plot was deemed correct. If it did not, it was marked incorrect and underwent further analysis as to the type and pattern of error, and the best way to resolve the error.

We approached the error analysis with the idea that error can enter a map and into a data set from many sources, most of which are out of the photointerpreter's control. These sources of error include:

- Label transcription error by the technician who created the digital mapping database
- Locational error in the field (e.g. canyons or dense forests where GPS doesn't work, OR small or narrow polygons, so sample is taken in a different polygon than was intended)
- Transcription error by persons entering AA data into the relational database
- Transcription error by persons creating the AA contingency table
- Field key is difficult to use (fault may lie with key or with classification)
- Field key does not include all plant associations present within the park
- Field crew error, either by mis-identifying diagnostic species in the field, or by not reading the key carefully, thus resulting in a bad call when the map is actually good
- Point falls within an ecotone, which is impossible to classify but which still has to get mapped as something
- The polygon includes patches of varying vegetation that are too small to map individually; the mapper had to choose the visually dominant type to name the polygon
- The photos were flown and/or the plot data collected in a year or season either much drier or much wetter than the year/season in which AA is done

These types of error may affect the accuracy of a map even when the map concepts are good. We therefore felt justified in making adjustments to the map class definitions, association-map class crosswalk, field key, and in a few cases, the map polygon labels to account for what we considered to be "false" (i.e., not in control of the mapper) errors.

The initial (uncorrected) accuracy of the CEBR vegetation map was 75%. We therefore inspected the original AA plot data, plot photographs, and aerial imagery for approximately 303 plots of accuracy assessment field data to create the table that follows. The final step in the process was to present the table in February, 2008 to CEBR natural resources staff and ask for their input for solutions we would apply to the final map. In some cases, their preference was different than our recommendation; in every case, we implemented the park's suggestion.

Map Class	Final Map Class	Map Class Name	Final Map Class Name	Error Source	Potential Resolution	Instructions for GIS Coordinator	Park Decision 02/2008
2	**4**	White Fir / Bigtooth Maple Forest Alliance	White Fir Forest Alliance	Based on two observation points that were misclassified as Abicon/Acer grand. Too rare to map as its own map class.	Move to White Fir Forest Alliance (map class 4)	Relabel polygons of this map class to map class 4	Accept proposed solution
3	**3**	*Abies concolor / Arctostaphylos patula* Forest	White Fir / Greenleaf Manzanita Forest	User's accuracy 87%, producer's accuracy 65%; confused with MU10 & MU8.	Leave as is.	N/A	Accept with lower user's accuracy in order to retain detail
4	**4**	White Fir / Mahonia / Juniper Forest	White Fir Forest Alliance	Meets standards for both user's and producer's accuracy	Leave as is.	N/A	OK
5	**5**	Abies lasiocarpa – Picea engelmannii Forest Complex	Subalpine Fir - Engelmann Spruce Forest Complex	Meets standards for both user's and producer's accuracy	Leave as is.	N/A	OK
6	**8**	Engelmann Spruce / Field Horsetail Forest	Blue Spruce Forest Alliance	Only one MU6 polygon and one AA point (0% accuracy). Polygon based on one plot where wrong species of spruce was recorded (should have been blus spruce).	Delete MU6? Move to Blue Spruce Forest Alliance (map class 8).	Relabel polygon of this map class to map class 8	Delete MU6. Reassign plot to Picea pungens / Equisetum arvense and relabel polygon to map class 8.
7	**10**	Douglas-fir Forest	Ponderosa Pine – (Douglas Fir) Woodland Complex	Confused with MU10 and MU11.	Combine MU7, MU10, and MU11 into one ponderosa pine – douglas fir woodland type.	Relabel polygons of this map class to map class 10	Accept proposed solution, retain linework with modifier to hold on to the detail

Map Class	Final Map Class	Map Class Name	Final Map Class Name	Error Source	Potential Resolution	Instructions for GIS Coordinator	Park Decision 02/2008
8	**8**	*Picea pungens* Forest Alliance	Blue Spruce Forest Alliance	Undermapped. Poor accuracy. Confused with MU3, MU4, MU5, and MU18	Located on mesic, north slopes and drainages that should be broken out from mixed ABICON stands and remapped as PICPUN. Or lump with ABICON?	Add polygons on mesic slopes and along drainages using AA points as guidance.	Added polygons where instructed, though this type is often an inclusion in the breaks and in gullies and swales. Still likely undermapped, but accuracy much improved after the remapping.
10	**10**	Ponderosa Pine – (Douglas Fir) Woodland Complex	Ponderosa Pine – (Douglas Fir) Woodland Complex	Confused with MU7 and MU11	Combine MU7, MU10, and MU11 into one ponderosa pine – douglas fir woodland type.	Relabel polgyons of map classes 7 and 11 to this map class	Accept proposed solution
11	**10**	Ponderosa Pine / Mixed Mountain Shrubs	Ponderosa Pine – (Douglas Fir) Woodland Complex	Confused with MU7 and MU10	Combine MU7, MU10, and MU11 into one ponderosa pine – douglas fir woodland type.	Relabel polygons of this map class to map class 10	Accept proposed solution, retain linework with modifier to hold on to the detail
14	**14**	Pinyon Pine – Juniper spp. Woodland Complex	Pinyon – Juniper Woodland Complex	Rare type. 4 of 6 correct.	Leave as is.	N/A	Accept as is; at least one point has PJ elements, and so is not really wrong.
18	**18**	Bristlecone Pine Woodland	Bristlecone Pine Woodland	Meets standards for both user's and producer's accuracy	Leave as is.	N/A	OK
19	**19**	*Populus tremuloides* Forest Complex	Aspen Forest Complex	Meets standards for both user's and producer's accuracy	Leave as is.	N/A	OK
21	**21**	Curl-leaf Mountain Mahogany Woodland Alliance	Curl-leaf Mountain-mahogany Woodland Alliance	Undermapped and confused with MU10 and MU26. Computer-generated error; clear CERLED signature visible but not differentiated well from map classes 10 or 26.	Combine with MU26? Or remap using AA points as guidance.	Add polygons on dry rocky slopes where canopy height differentiates this type from low manzanita shrublands using AA points as guidance.	Added polygons where instructed; accuracy improved by this remapping.

Map Class	Final Map Class	Map Class Name	Final Map Class Name	Error Source	Potential Resolution	Instructions for GIS Coordinator	Park Decision 02/2008
22	**22**	Narrowleaf Cottonwood Woodland	Narrowleaf Cottonwood Temporarily Flooded Wash Complex	Sparsely vegetated areas creating confusion; most of error with MU28	Create mosaic wash class that includes Ericameria nauseosa and Salix exigua shrublands; pull out dry wash channel separately as MU41	Pull out sparsely vegetated terraces from the rest of the unvegetated wash channel	Accept proposed solution - mosaic of wash types, ERINAU, SALEXI, POPANG in debris flow channels and on minor terraces below rim.
26	**26**	Greenleaf Manzanita Shrubland Alliance	Greenleaf Manzanita Shrubland	Overmapped and confused with MU10, MU14, MU18, and MU21. Some of the error may be due to errors with the key (no Manzanita Shrubland choice in the key).	Add Manzanita Shrubland to the field key. Perform some remapping of polygons where tree cover is too high to call it a shrubland or where canopy height can differentiate true manzanita shrublands from similar-looking CERLED woodlands.	Perform remapping as recommended in potential resolution.	Add Manzanita Shrubland to the key, where ARCPAT is the dominant layer. May have scattered trees of many species present with low cover. Remapping improved the accuracy of this map class.
27	**27**	Rabbitbrush spp. Shrubland Complex	Whitestem Goldenbush Shrubland	Very rare type. Ericameria nauseosa shrublands confused in wash areas with other sparse vegetation types of MU22.	Small class. Leave as is.	Fold polys of ERINAU into map class 22; retain 27 for Ericameria discoidea only.	Accept proposed solution
28	**28**	Willow Shrubland	Arizona Willow Temporarily Flooded Shrubland	Overmapped and confused with MU5, MU22, and MU36.	Create wash class to include sparse shrublands of Salix exigua and retain this class for Arizona willow shrublands only	N/A	Retain this map class for SALARI. Share ground data with park rare plant inventory, correct boundaries based on park SALARI data. Will be 100% correct once park data incorporated.
29	**29**	Mixed Desert Shrubland Complex	Mixed Desert Forb Complex	Meets standards for both user's and producer's accuracy	Leave as is.	N/A	OK

Map Class	Final Map Class	Map Class Name	Final Map Class Name	Error Source	Potential Resolution	Instructions for GIS Coordinator	Park Decision 02/2008
30	**30**	Bottomland Shrubland Complex	Silver Sagebrush Bottomland Shrubland	Overmapped and confused with MU34.	Combine with 34?	N/A	Retain map class, but rename two small, wrong polys to map class 34. Retain largest polygon, is correct.
31	**31**	Mixed Mountain Shrubland Complex	Mixed Mountain Shrubland Complex	Overmapped and confused with MU34.	Add RIBMON as second choice to plot AA.0016. Leave as is.	Some remapping to map class 34 needed where no shrub signature evident.	OK. Accuracy improved enough after some remapping.
33	**33**	Cinquefoil Shrubland	Shrubby Cinquefoil Shrubland	Very rare class. One plot mapped as MU 36 was found to be this type.	Small class. Leave as is.	N/A	OK
34	**34**	Dry Meadow Mixed Herbaceous Vegetation Mosaic	Dry Meadow Mixed Herbaceous Vegetation Mosaic	Slightly undermapped. Some minor confusion with map classes 30, 31, 35 and 36.	Leave as is.	N/A	OK
35	**35**	Perennial Disturbed Grassland Complex	Perennial Disturbed Grassland Complex	Meets standards for both user's and producer's accuracy	Leave as is.	N/A	OK
36	**36**	Wet Meadows	Wet Meadow Herbaceous Vegetation Mosaic	Slightly undermapped. Some confusion with map classes 28 and 34.	Leave as is.	N/A	OK
37	**37**	Red Claron	Red Claron	Not accuracy assessed.	N/A	N/A	N/A
38	**38**	White Claron	White Claron	Not accuracy assessed.	N/A	N/A	N/A
39	**39**	Unvegetated scree slopes	Unvegetated scree slopes	Not accuracy assessed.	N/A	N/A	N/A
40	**226**	Roads	Roads	Not accuracy assessed.	N/A	N/A	N/A
41	**41**	Temporarily Flooded Wash Complex	Barren Wash Channels	Not accuracy assessed.	N/A	N/A	N/A
45	**113**	Ponds	Lake/pond	Not accuracy assessed.	N/A	N/A	N/A

Appendix J. Map Class Descriptions for Cedar Breaks National Monument

Introduction

This document provides a visual guide and description of the vegetation map classes for the Cedar Breaks National Monument Vegetation Mapping Project. Twenty map classes are described in this guide. Four land use classes and two geologic map classes are not included.

Each of the map classes included in this guide is documented by:

- ground photographs (if available)
- a list of component NVC associations
- common plant species
- examples of each map class photo signature taken from the ortho imagery with delineated polygons
- descriptions of the photo signature interpretation
- a description of the ecology and distribution of the map class within the mapping area
- a graphic showing distribution of the map class throughout the mapping area
- polygon statistics report (polygon number, size, and area)
- accuracy assessment results

This guide does not attempt to show all variations within each vegetation map class; only the most common or significant representations are included. These should be sufficient to give the user an understanding of the relationships among the vegetation classification, the imagery, and the mapping concepts.

VEGETATED MAP CLASSES OF CEDAR BREAKS NATIONAL MONUMENT

Upland Forest and Woodland

Map Class 3
White Fir / Greenleaf Manzanita Forest (F-WFGM)

Photo credits: NPS

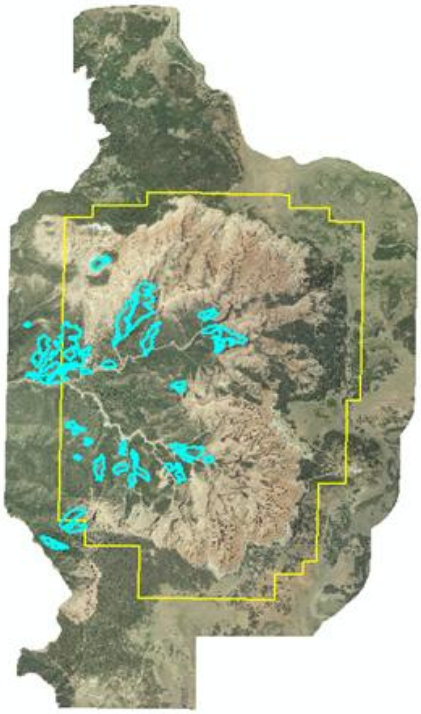
Associations
Abies concolor / Arctostaphylos patula Forest

Common species
- *Abies concolor*
- *Arctostaphylos patula*
- *Juniperus communis*
- *Pseudotsuga menziesii*
- *Mahonia repens*
- *Pinus ponderosa*

F-WFGM Map Class Statistics

Type:	Complex
Frequency:	39 total polygons
	30 total polygons in CEBR
	9 total polygons in the environs
Total project area:	107 hectares / 266 acres (2.2 %)
	84 hectares / 208 acres in CEBR
	23 hectares / 58 acres in the environs
Average Polygon Size:	5.2 hectares / 13 acres
Producer's accuracy:	68% ± 21%
User's accuracy:	87% ± 18%

Distribution in Mapping Area

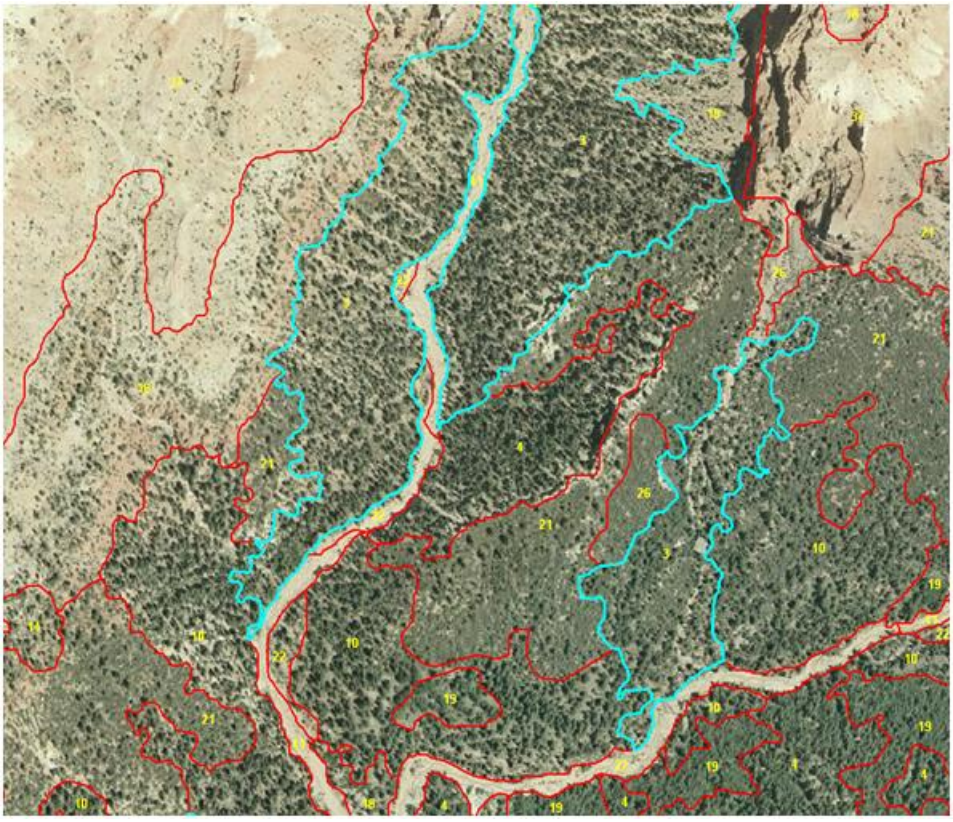


Distribution/Ecology/Composition

Stands occur primarily on moderately steep to steep southwest-to-southeast-facing slopes, often along ravines, below the rim. White fir is dominant, but Douglas-fir, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or subcanopy layers. The stands are somewhat xeric. The short shrub layer is dominated by greenleaf manzanita, which may be accompanied by the short shrubs common juniper and Oregon-grape, often with only sparse to low cover. The herbaceous layer is sparse and sometimes includes the graminoid Ross sedge and the forb lobeleaf groundsel.

Interpretation

This uncommon map class appears as small to large irregular polygons on steep mid- to low slopes along ravines or canyon sides leading to tributaries of Ashdown Creek, and is only found below the rim and mostly below the breaks. Found in silt clay loams, sandy clays, and sandy clay loams derived from the Wahweap / Grand Castle Formation or Straight Cliffs Formation. Only minor confusion was noted between this and the other two Abies map units, undoubtedly due to the distinctive freckled signature of *Arctostaphylos patula* in the understory. The color is dark gray-green, with tree crowns providing a rough and pebbled texture and shadows producing black spots. Common neighbors include polygons of white fir forests with mixed shrub understories (map class 4), ponderosa pine – Douglas fir woodlands (map class 10), pinyon-juniper woodlands (map class 14), aspen woodlands (map class 19), curl-leaf mountain-mahogany woodlands (map class 21), and greenleaf manzanita shrublands (map class 26).



Example of photo signature for map class F-WFGM (#3).

Map Class 4
White Fir Forest Alliance (F-ABIE)

Photo credits: NPS

Associations

Abies concolor / Juniperus communis Forest
Abies concolor / Mahonia repens Forest
Abies concolor / Symphoricarpos oreophilus Forest
Abies concolor - Pseudotsuga menziesii /Acer glabrum Forest

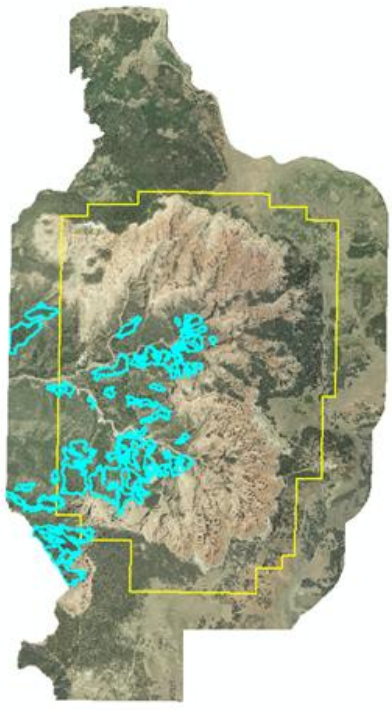
Common species

- *Abies concolor*
- *Symphoricarpos oreophilus*
- *Juniperus communis*
- *Pseudotsuga menziesii*
- *Mahonia repens*
- *Acer glabrum*

F-ABIE Map Class Statistics

Type:	Complex
Frequency:	52 total polygons 41 total polygons in CEBR 11 total polygons in the environs
Total project area:	214 hectares / 529 acres (4.4 %) 148 hectares / 365 acres in CEBR 66 hectares / 164 acres in the environs
Average Polygon Size:	3.4 hectares / 8.3 acres
Producer's accuracy:	97% ± 6%
User's accuracy:	89% ± 10%

Distribution in Mapping Area

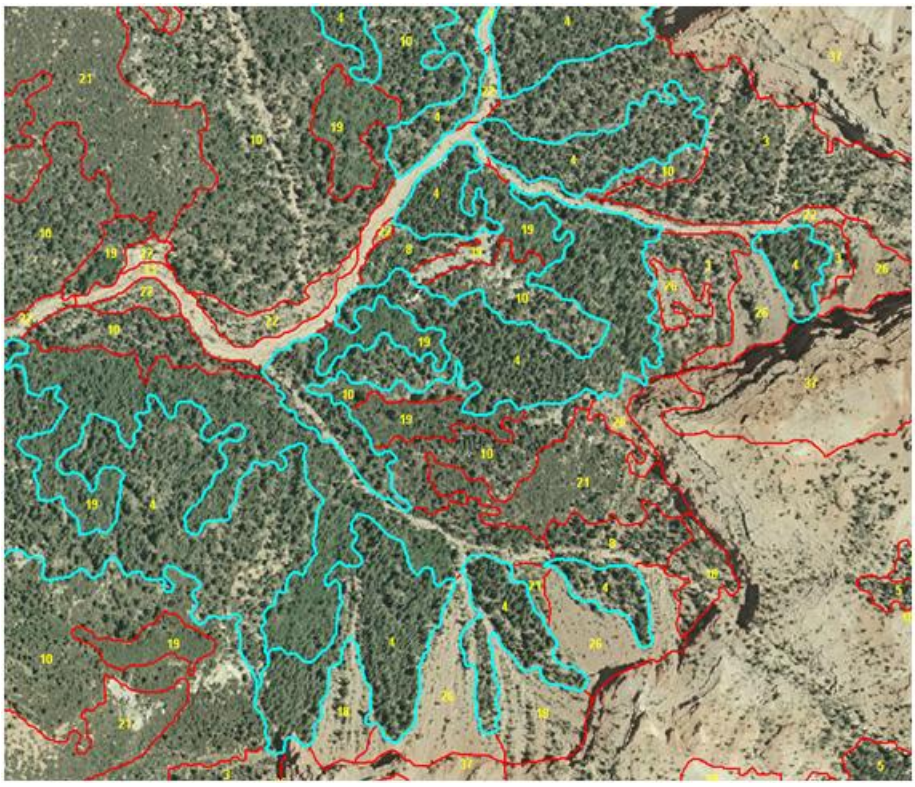


Distribution/Ecology/Composition

Stands occur primarily on moderately steep to steep north-facing slopes below the breaks of the Claron Formation. White fir is generally dominant, but Douglas-fir, blue spruce, quaking aspen, ponderosa pine, limber pine, bristlecone pine, and Rocky Mountain juniper may be present in the canopy or subcanopy layers. The stands have mesic, tall and short shrub understories of Rocky Mountain maple, common juniper, western snowberry, and/or Oregon grape. The herbaceous layer is generally high in terms of floristic diversity but low in cover.

Interpretation

This somewhat common map class appears as small to large irregular polygons on sheltered slopes in central and western portions of the Monument, occurring exclusively below the Claron breaks, along Ashdown drainage, Crescent, Dan, and Blowhard Hollows. This map class generally reflects a longer shadow than map class 3 and does not have the characteristic understory of *Arctostaphylos patula*. The *Abies concolor - Pseudotsuga menziesii / Acer glabrum* Forest association was moved from a separate map class to this forest alliance based on a NatureServe recommendation. This class incorporates rare types, such as the *Abies concolor / Symphoricarpos oreophilus* found on steep, xeric, exposed, and erosive sites as well as common associations, such as *Abies concolor / Mahonia repens* which occurs below the breaks on low to mid slopes of hills, interfluves, ridges, and canyon sides. The color is dark green, with tree crowns providing a rough and pebbled texture and shadows producing black spots. Common neighbors include



Example of photo signature for map class F-ABIE (#4).

Map Class 5
Subalpine Fir – Engelmann Spruce Forest Complex (F-SFES)

Photo credits: NPS

Associations

Abies lasiocarpa - Picea engelmannii / Juniperus communis Woodland
Abies lasiocarpa - Picea engelmannii / Ligusticum porteri Woodland [Park Special]
Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme) Forest

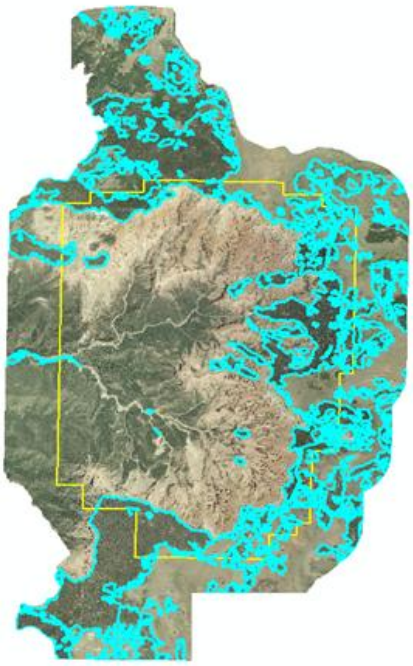
Common species

- *Abies lasiocarpa*
- *Juniperus communis*
- *Ribes montigenum*
- *Picea engelmannii*
- *Mertensia arizonica*
- *Ligusticum porteri*

F-SFES Map Class Statistics

Type:	Association
Frequency:	240 total polygons 95 total polygons in CEBR 145 total polygons in the environs
Total project area:	1,239 hectares / 3,063 acres (25.6 %) 445 hectares / 1100 acres in CEBR 794 hectares / 1,963 acres in the environs
Average Polygon Size:	3.8 hectares / 9.5 acres
Producer's accuracy:	89% ± 10%
User's accuracy:	94% ± 9%

Distribution in Mapping Area

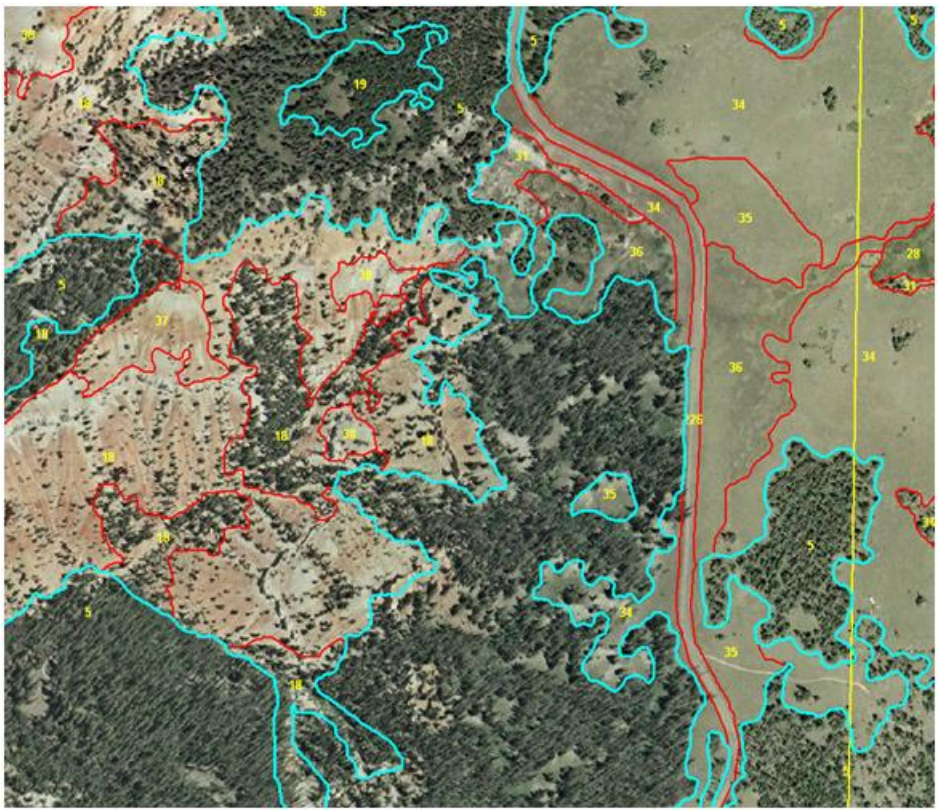


Distribution/Ecology/Composition

Stands occur primarily on flats and gentle slopes of all aspects above the rim. Documented at Chessmen, North, and Sunset Overlooks, in the environs north of the Monument boundary and north of Panguitch Lake Road, Shooting Star Creek, near the entry sign and south of the Visitor Center, south of and along Rattlesnake Trail, Columbine Ridge, and near the Alpine Lake Trail. The canopy would normally be co-dominated by subalpine fir and Engelmann spruce. However, due to extensive spruce beetle kills over the past 10-20 years, the canopy is now often dominated by only subalpine fir. Standing dead Engelmann spruce trees and many downed dead spruce trees are signs of this former co-dominant forest canopy species. Douglas-fir, quaking aspen, and limber pine may also be present in the canopy or subcanopy layers. Shrubs provide low cover and include mountain gooseberry, Oregon-grape, common juniper, and red elderberry. The herbaceous layer is generally high in terms of floristic diversity but low in cover.

Interpretation

This very common map class appears as small to very large regular polygons on plateaus, hillslopes, valleys, and ridge slopes, and on all aspects of the Claron Formation (White and Red Members) dominating portions of the Monument above the rim. Cover is moderate to dense (26% - 76%). Dying Engelmann spruce trees (attacked by the spruce beetle) are visible in some areas of the imagery, but much more of the forest has been affected since the imagery was acquired (in 2002). The color is moderately dark gray-green, with tree crowns providing a rough and pebbled texture and shadows producing black spots. Grassy openings within the stands are typically light to medium gray-green in color and have a smooth texture. Common neighbors include polygons of all the upland and mesic herbaceous map classes (34, 35 and 36), mixed mountain shrublands (map class 31), bristlecone pine woodlands (map class 18), and aspen forests (map class 19).



Example of photo signature for map class F-SFES (#5).

Map Class 8
Blue Spruce Forest Alliance (F-PICE)

Photo credits: NPS

Associations

Picea pungens / Acer glabrum Forest [Park Special]
Picea pungens / Arctostaphylos patula Forest
Picea pungens / Equisetum arvense Woodland
Picea pungens / Juniperus communis Forest
Picea pungens / Mahonia repens Forest
Picea pungens / Purshia tridentata Woodland [Park Special]
Picea pungens / Salix brachycarpa Woodland [Park Special]

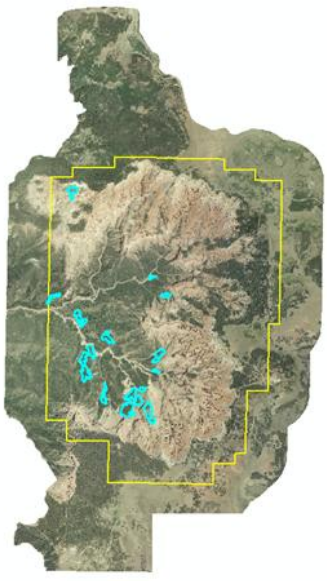
Common species

- *Picea pungens*
- *Arctostaphylos patula*
- *Equisetum arvense*
- *Salix brachycarpa*
- *Acer glabrum*
- *Juniperus communis*
- *Mahonia repens*
- *Purshia tridentata*

F-PICE Map Class Statistics

Type:	Alliance
Frequency:	16 total polygons
	15 total polygons in CEBR
	1 total polygons in the environs
Total project area:	37 hectares / 92 acres (0.8 %)
	37 hectares / 92 acres in CEBR
	hectares / acres in the environs
Average Polygon Size:	5.8 hectares / 14.3 acres
Producer's accuracy:	100%
User's accuracy:	71% ± 24%

Distribution in Mapping Area

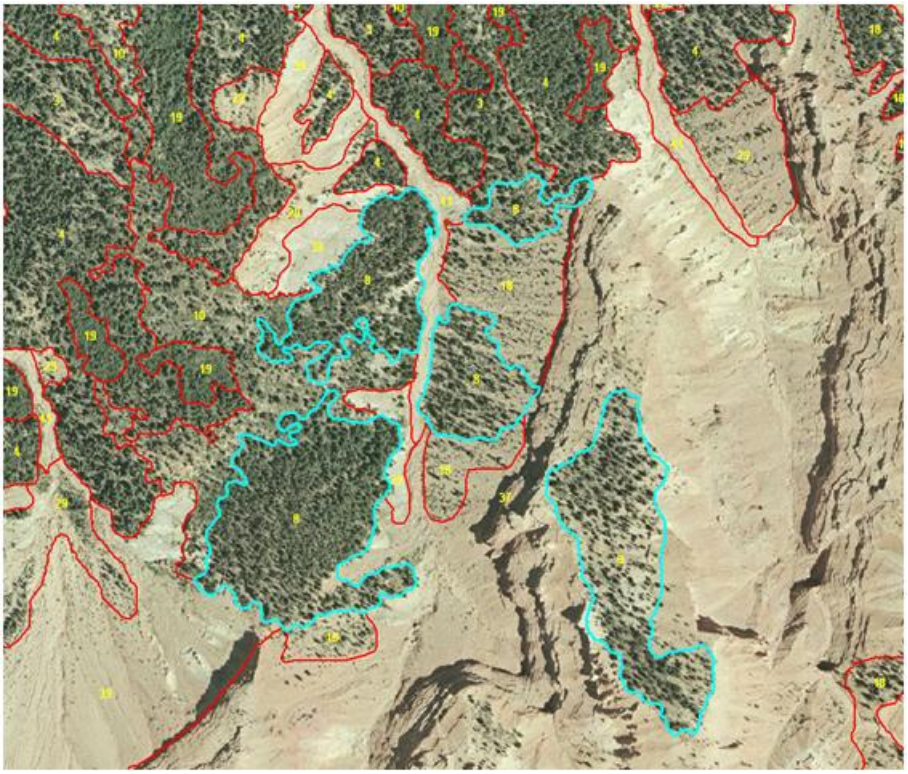


Distribution/Ecology/Composition

Stands occur primarily on moderately steep to steep, east to northwest-facing, low to mid slopes along ravines leading to tributaries of Ashdown Creek, and rarely in small pockets on the breaks of the Claron Formation. Blue spruce is dominant, but Douglas-fir, white fir, bristlecone pine, limber pine, quaking aspen, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or subcanopy layers. The stands are mesic and short shrubs including common juniper, shortfruit willow, Rocky Mountain maple, antelope bitterbrush, field horsetail, manzanita, and Oregon-grape dominate the understory in many stands.

Interpretation

This rare map class appears as small to large regular polygons on steep slopes adjacent to drainages or on steep north-facing ravines or slopes. It occurs on or below the Claron Formation breaks. The color is medium gray-green with tree crowns providing a rough and pebbled texture and shadows producing black spots. The original mapping was based on two rare occurrences documented from field data. During accuracy assessment, however, this map unit was determined to be more widespread than previously sampled. Mixed *Abies concolor* stands that were mapped on mesic, north-facing slopes and drainages below the breaks were broken out and remapped as *Picea pungens*. Common neighbors include polygons of white fir forests with greenleaf manzanita understories (map class 3) or mixed shrub understories (map class 4), ponderosa pine – Douglas fir woodlands (map class 10), bristlecone pine woodlands (map class 18), and aspen woodlands (map class 19).



Example of photo signature for map class F-PICE (#8).

Map Class 10
Ponderosa Pine – (Douglas Fir) Woodland Complex (W-PODO)

Photo credits: NPS

Associations

Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula Woodland
Pinus ponderosa / Arctostaphylos patula Woodland
Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland [Park Special]
Pinus ponderosa / Purshia tridentata Woodland
Pseudotsuga menziesii / Arctostaphylos patula Forest
Pseudotsuga menziesii / Juniperus communis Forest
Pseudotsuga menziesii / Ribes montigenum Forest [Park Special]

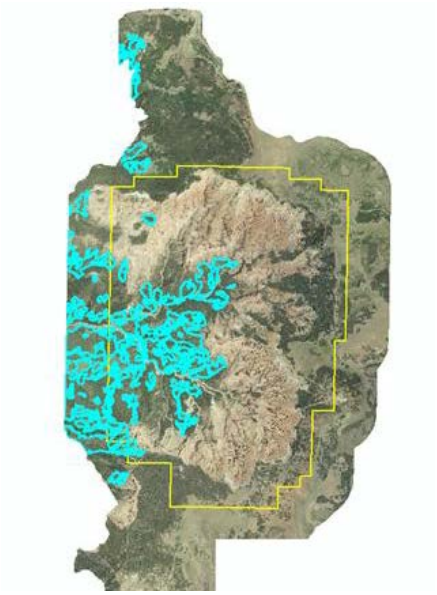
Common species

- *Pinus ponderosa*
- *Arctostaphylos patula*
- *Purshia tridentata*
- *Ribes montigenum*
- *Pseudotsuga menziesii*
- *Cercocarpus ledifolius*
- *Leymus salinus*
- *Juniperus communis*

W-PODO Map Class Statistics

Type:	Complex
Frequency:	82 total polygons 48 total polygons in CEBR 34 total polygons in the environs
Total project area:	409 hectares / 1,011 acres (8.5 %) 212 hectares / 523 acres in CEBR 198 hectares / 488 acres in the environs
Average Polygon Size:	3.8 hectares / 9.4 acres
Producer's accuracy:	66% ± 16%
User's accuracy:	76% ± 16%

Distribution in Mapping Area

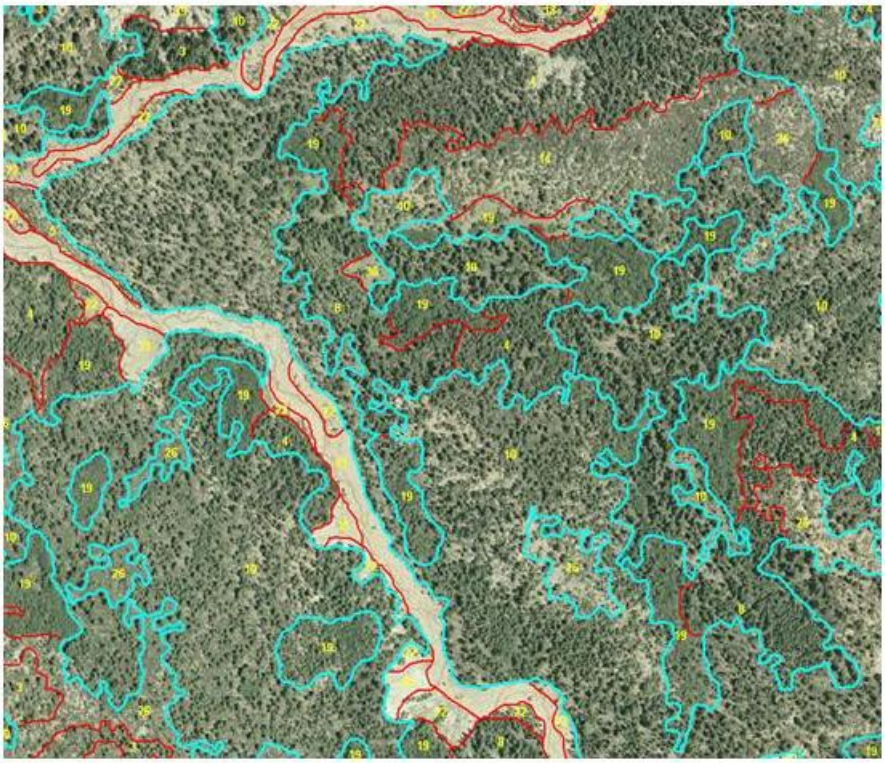


Distribution/Ecology/Composition

Stands occur on gentle to steep slopes of all aspects, above the rim and mostly below the rim, on valley sides, ridges, hills, level floodplains, and on midslopes of drainages. Ponderosa pine is dominant on drier sites and shares dominance with Douglas-fir and curlleaf mountain mahogany on more mesic exposures. The short shrub greenleaf manzanita is dominant in the understory as small to moderate size patches between trees. Additional shrub cover may include bitterbrush or Rocky Mountain juniper. Common herbaceous species include Salina wildrye and Ross sedge. The stands are mesic to xeric.

Interpretation

This very abundant map class appears as small to very large, regular to irregular polygons on gentle to steep slopes throughout the western half of the Monument. Douglas-fir and ponderosa pine map classes were combined into this map class after the accuracy assessment showed confusion between these classes. These two forest species grade from one into another and occupy similar habitats. Polygons originally mapped as Douglas-fir forests retain a map class 7 minor code. Rare *Pinus ponderosa / Purshia tridentata* woodlands, found in riparian areas, have a minor code of map class 11 to differentiate them from the larger, more xeric map class 10 types. The color is moderately dark gray green with white to gray inclusions where rock and bare ground are exposed. The tall tree crowns provide a rough and pebbled texture and shadows produce black spots. Manzanita shrubs in the understory have a unique speckled, dark gray signature seen between tree canopies. Because this map class is so widespread and occurs throughout the Monument, neighboring polygons include most all of the other woodland and forest map classes and some of the shrub and herbaceous classes as well.



Example of photo signature for map class W-PODO (#10).

Map Class 14
Pinyon - Juniper Woodland Complex (W-PIJU)


Photo credits: NPS

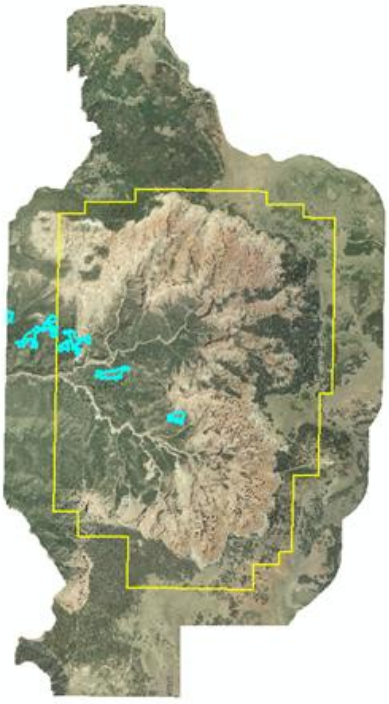
Associations
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland
Juniperus scopulorum / Cercocarpus ledifolius Woodland

Common species
- *Pinus edulis*
- *Juniperus scopulorum*
- *Cercocarpus montanus*
- *Arctostaphylos patula*
- *Juniperus osteosperma*
- *Juniperus communis*
- *Cercocarpus ledifolius*
- *Purshia tridentata*

W-PIJU Map Class Statistics

Type:	Alliance
Frequency:	8 total polygons
	5 total polygons in CEBR
	3 total polygons in the environs
Total project area:	21 hectares / 52 acres (0.4 %)
	13 hectares / 32 acres in CEBR
	8 hectares / 21 acres in the environs
Average Polygon Size:	3.3 hectares / 8.1 acres
Producer's accuracy:	83% ± 34%
User's accuracy:	83% ± 34%

Distribution in Mapping Area

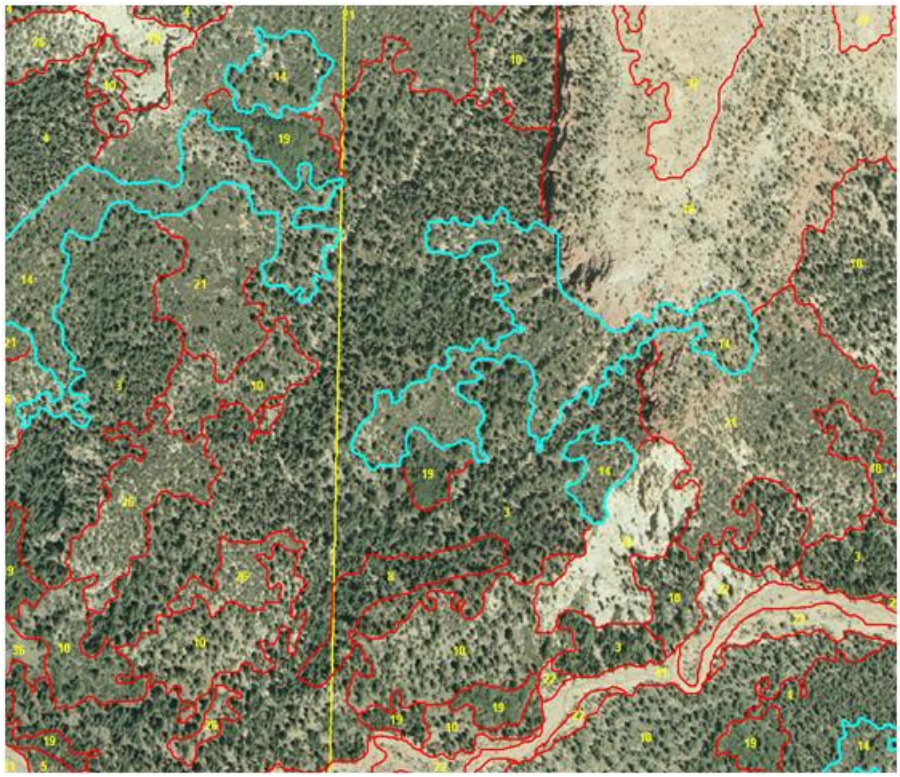


Distribution/Ecology/Composition

Stands occur primarily on gentle to moderately steep south to southwest-facing rocky slopes, low ridges and hills. The dominant trees are pinyon pine, Rocky Mountain juniper, and Utah juniper. The dominant understory shrubs are curl-leaf mountain-mahogany, alderleaf mountain-mahogany, littleleaf manzanita, and common juniper. Forb and grass diversity can be high but cover is low. The stands are xeric.

Interpretation

This very rare map class appears as small to medium, regular to irregular polygons on gentle to moderately steep slopes below the breaks in the eastern-most portions of the Monument. It was mapped below the breaks and guided by plot and observation data. It occurs primarily on rocky slopes of ridges and canyons oriented to the south and southwest. The signature is a smooth or mottled medium gray green representing the shrub cover (dominantly curl-leaf mountain-mahogany) with white to gray inclusions where rock and bare ground are exposed. The low tree crowns are widely spaced and provide a moderately dark green, rough and pebbled texture and shadows produce black spots. Common neighbors include white fir / Manzanita or mixed shrub understory forests (map classes 3 and 4), ponderosa pine – (Douglas-fir) woodlands, aspen forests (map class 19), and curl-leaf mountain mahogany woodlands (map class 21).



Example of photo signature for map class W-PIJU (#14).

Map Class 18
Bristlecone Pine Woodland (W-PILO)

Photo credits: NPS

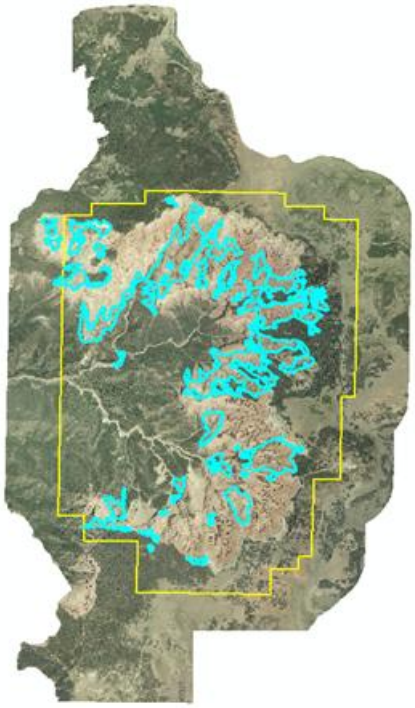
Associations
Pinus longaeva Woodland

Common species
- *Pinus longaeva*
- *Shepherdia Canadensis*
- *Arctostaphylos patula*
- *Pinus flexilis*
- *Purshia tridentata*

W-PILO Map Class Statistics

Type:	Association
Frequency:	65 total polygons 60 total polygons in CEBR 5 total polygons in the environs
Total project area:	356 hectares / 881 acres (7.4 %) 350 hectares / 865 acres in CEBR 6 hectares / 16 acres in the environs
Average Polygon Size:	1.7 hectares / 4.1 acres
Producer's accuracy:	96% ± 8%
User's accuracy:	81% ± 14%

Distribution in Mapping Area



Distribution/Ecology/Composition

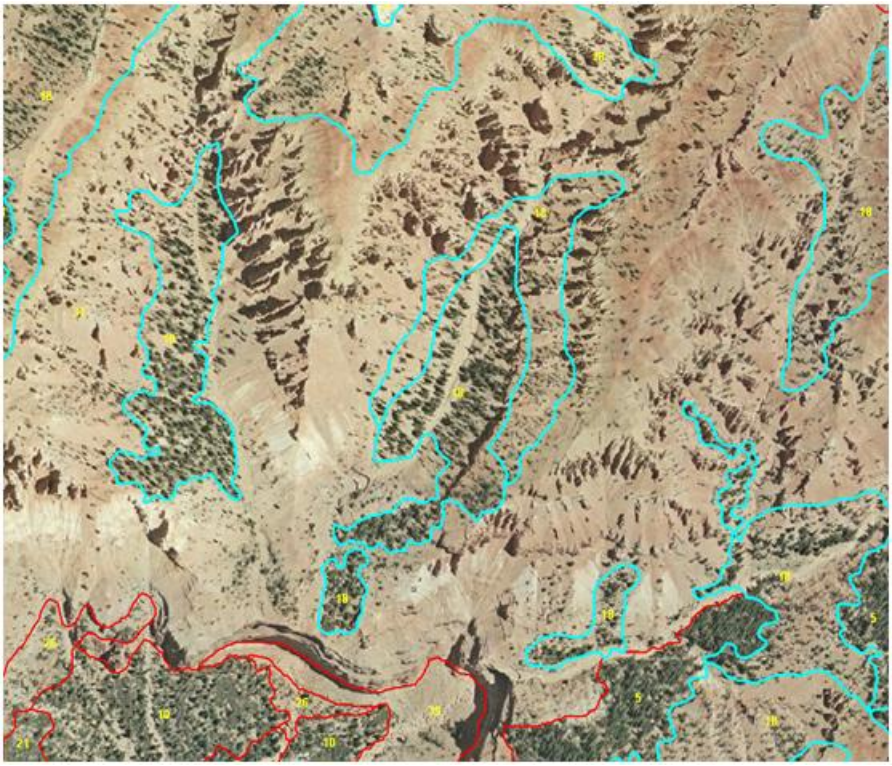
This common sparse woodland association was sampled near the Alpine Lake Trail, Columbine Ridge, Chessmen Overlook and Canyon, Rampart Overlook, Spectra Point, Adams Barrier, Arch Creek, Adams Creek, Lavender Creek, Lower Columbine Canyon, and Slip Canyon and in the environs north of the Monument on Dixie National Forest.

Stands occur primarily on moderately steep to steep east to south-facing slopes of Claron formation ridges that have formed below the rims of the main Bryce canyon and its major tributaries. The Great Basin bristlecone pine is dominant and can be present in sparse to moderate cover. Trees that may occasionally occur in these stands include ponderosa pine, limber pine, pinyon pine, and Utah juniper. Sparse to low shrub cover is sometimes present and species include greenleaf manzanita, bitterbrush, and snakeweed. The stands are xeric.

Interpretation

Most of the sparse conifers on moderately steep to steep slopes in the upper areas of the Claron breaks were mapped as Bristlecone pine. Plot and observation data also guided the interpretation.

This common map class appears as medium to large regular polygons on gentle to steep slopes and ridges in the northern and northeastern portion of the Park on the Pink Cliffs formation from the north park boundary south to Bryce Canyon. The color is patchy ranging from white to orange-brown to grayish pink, with generally widely-spaced tree crowns providing a rough and pebbled texture and shadows producing black spots. Common neighbors include polygons ponderosa pine – Douglas fir / Manzanita woodlands (map class 7) and exposures of the Claron geologic formation (map class 46).



Example of photo signature for map class W-PILO (#18).

Map Class 19
Aspen Forest Complex (F-ASPE)

Photo credits: NPS

Associations

Populus tremuloides / Juniperus communis Forest
Populus tremuloides / Ribes montigenum Forest
Populus tremuloides / Thalictrum fendleri Forest
Populus tremuloides - Abies concolor / Arctostaphylos patula Forest
Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest
Populus tremuloides - Abies lasiocarpa / Tall Forbs Forest
Populus tremuloides - Pseudotsuga menziesii / Juniperus communis Forest
Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus Forest
Populus tremuloides - Pseudotsuga menziesii / Sparse Understory Forest [Park Special]
Abies concolor – Populus tremuloides Forest Alliance

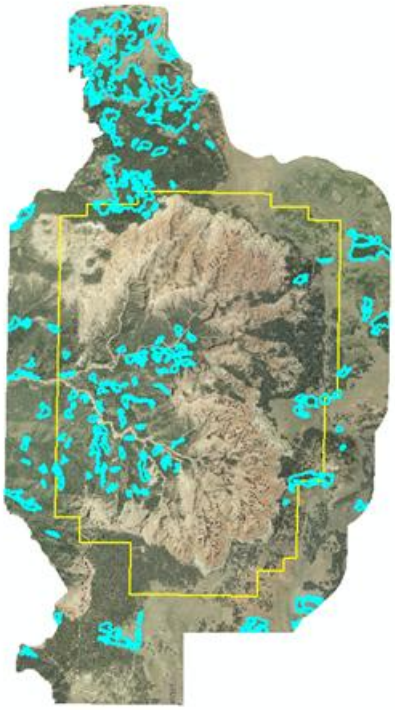
Common species

- *Populus tremuloides*
- *Abies concolor*
- *Ribes montigenum*
- *Symphoricarpos oreophilus*
- *Thalictrum fendleri*
- *Mertensia arizonica*
- *Pseudotsuga menziesii*
- *Abies lasiocarpa*
- *Juniperus communis*
- *Arctostaphylos patula*
- *Ligusticum porteri*
- *Lupinus argenteus*

F-ASPE Map Class Statistics

Type:	Alliance
Frequency:	147 total polygons 69 total polygons in CEBR 78 total polygons in the environs
Total project area:	306 hectares / 757 acres (6.3 %) 78 hectares / 192 acres in CEBR 229 hectares / 565 acres in the environs
Average Polygon Size:	10.5 hectares / 25.8 acres
Producer's accuracy:	100%
User's accuracy:	93% ± 10%

Distribution in Mapping Area

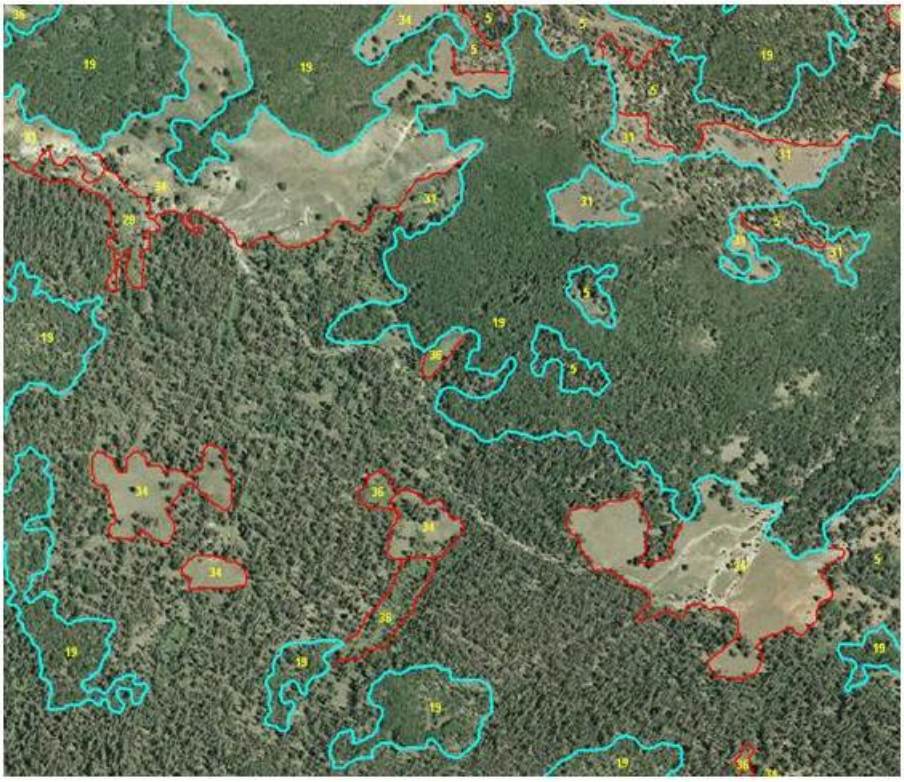


Distribution/Ecology/Composition

This forest association occurs on gentle to moderately steep, sheltered (mostly north-facing) slopes that may receive extra moisture from ground water emerging from the slope, on ridges, low hills, and in swales or flats. Significant cover by the evergreen tree species *Abies concolor, Abies lasiocarpa,* or *Pseudotsuga menziesii* in the canopy or subcanopy indicates that these stands are transitioning to conifer forests. The stands are mesic and short shrubs including common juniper, western snowberry, and gooseberry currant dominate the understory in many stands. Herbaceous vegetation is dominated by forbs and often includes Fendler's meadow rue, Porter's licoriceroot, aspen bluebells, silvery lupine, and bluntseed sweetroot.

Interpretation

This common map class appears as small to very large, regular to irregular polygons on moderately steep slopes and flats both above and below the rim. The distinctive green, smooth signature of quaking aspen guided the identification of this map class. Common neighbors include all of the forest and woodland map classes, with the exception of bristlecone pine woodlands (map class 18).



Example of photo signature for map class F-ASPE (#19).

Map Class 21
Curl-leaf Mountain-mahogany Woodland Alliance (W-CLMM)

Photo credits: NPS

Associations

Cercocarpus ledifolius / Arctostaphylos patula Woodland
Cercocarpus ledifolius / Chrysothamnus nauseosus Woodland
Cercocarpus ledifolius Woodland Alliance

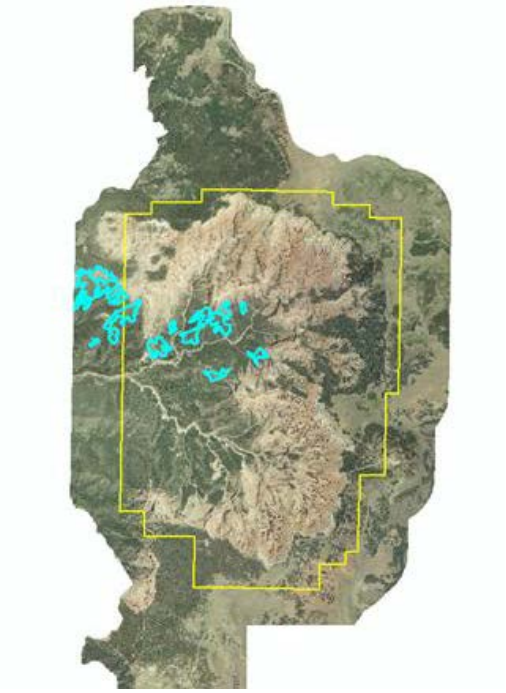
Common species

- *Cercocarpus ledifolius*
- *Juniperus scopulorum*
- *Chrysothamnus nauseosus*
- *Symphoricarpos oreophilus*
- *Achnatherum hymenoides*
- *Arctostaphylos patula*
- *Pseudotsuga menziesii*
- *Mahonia repens*
- *Calamagrostis scopulorum*

W-CLMM Map Class Statistics

Type:	Alliance
Frequency:	19 total polygons
	12 total polygons in CEBR
	7 total polygons in the environs
Total project area:	71 hectares / 174 acres (1.5 %)
	37 hectares / 91 acres in CEBR
	34 hectares / 83 acres in the environs
Average Polygon Size:	4.2 hectares / 10.3 acres
Producer's accuracy:	89% ± 23%
User's accuracy:	100%

Distribution in Mapping Area

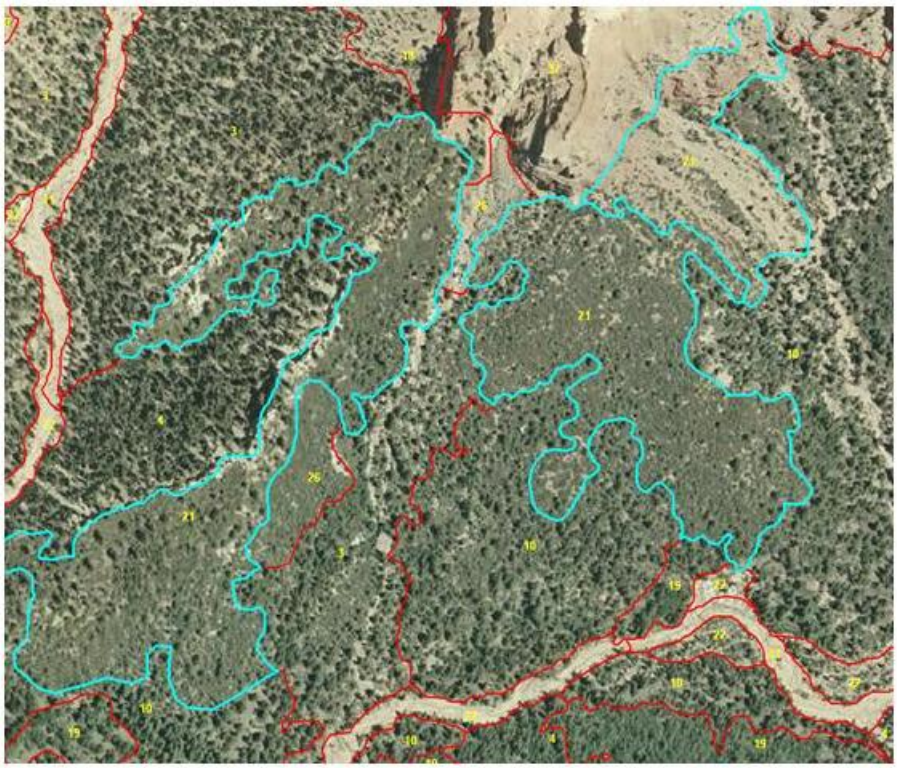


Distribution/Ecology/Composition

Stands dominated by curl-leaf mountain-mahogany trees occur on steep to very steep, south-facing, rocky slopes of the Wahweap/Grand Castle Formation. Emergent trees with low cover may include Rocky Mountain juniper, white fir, or Douglas-fir. Associated shrubs may include mountain snowberry, rubber rabbitbrush, and/or Oregon grape. Grass cover can sparse to moderate and is dominated by ricegrass and ditch reedgrass.

Interpretation

This rare map class occurs as small to large, irregular polygons on steep talus slopes at the base of the Pink Cliffs. The color is medium-gray to gray-green, with scattered tree crowns providing dark green to black dots of several sizes. The texture is roughened and it occurs primarily on thin soils of rockfalls. The most common neighbors include white fir / manzanita forests (map class 3), white fir / mixed shrub forests (map class 4), and ponderosa pine – (Douglas-fir) woodlands (map class 10).



Example of photo signature for map class W-CLMM (#21).

Upland Shrublands

Map Class 26
Manzanita Shrubland (S-MANZ)

Photo credits: NPS

Associations

Arctostaphylos patula Shrubland

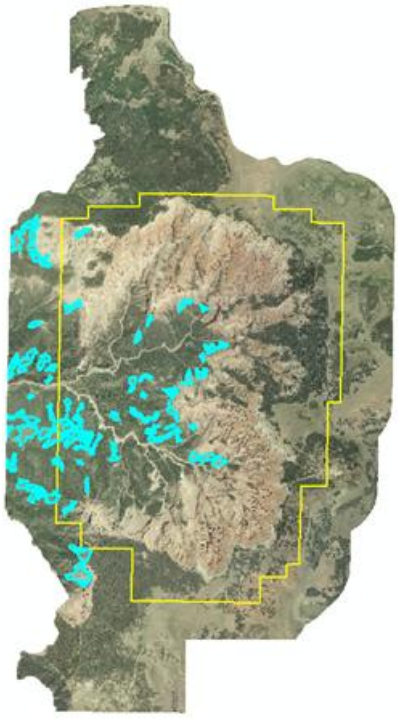
Common species

- *Pinus ponderosa*
- *Arctostaphylos patula*
- *Purshia tridentata*
- *Pseudotsuga menziesii*
- *Ceanothus martinii*
- *Cercocarpus ledifolius*

S-MANZ Map Class Statistics

Type:	Association
Frequency:	60 total polygons 44 total polygons in CEBR 16 total polygons in the environs
Total project area:	105 hectares / 259 acres (2.2 %) 47 hectares / 116 acres in CEBR 58 hectares / 143 acres in the environs
Average Polygon Size:	3.7 hectares / 9.1 acres
Producer's accuracy:	79% ± 22%
User's accuracy:	92% ± 18%

Distribution in Mapping Area

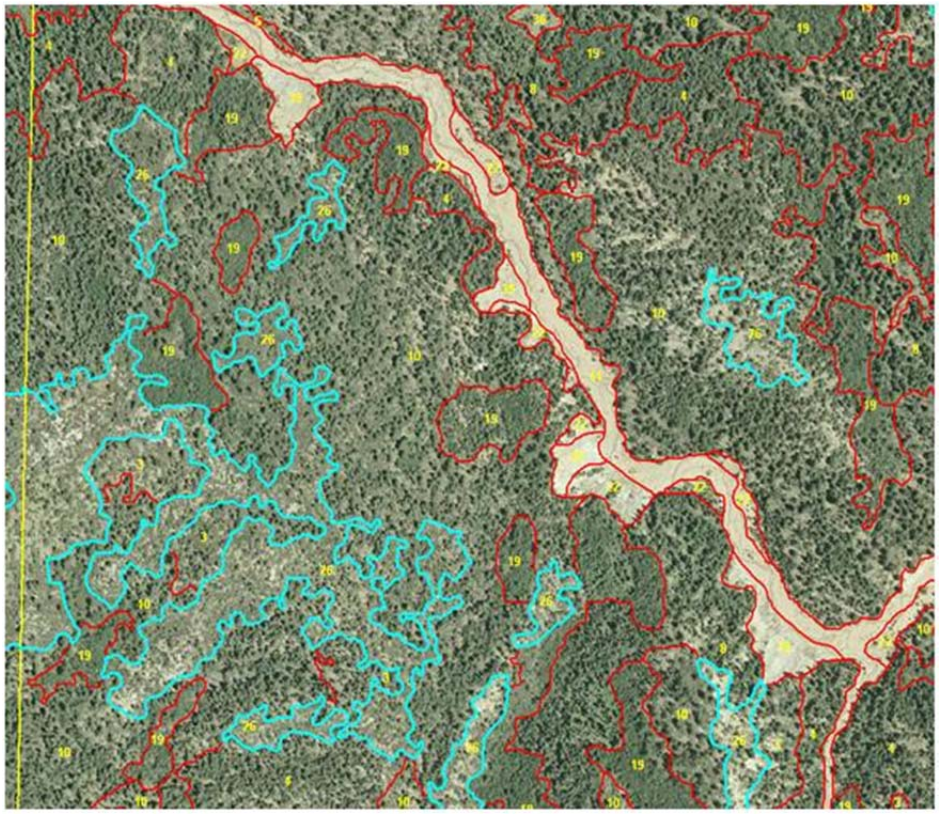


Distribution/Ecology/Composition

Stands occur on moderately steep to steep, mostly south-facing, rocky slopes and on ridges with shallow, gravelly soils. Greenleaf manzanita is always dominant, but may be accompanied by a few other shrub species, all with low cover. Scattered white fir, Douglas-fir or ponderosa pine generally occurs as scattered individuals mosaicked throughout these shrub-dominated stands, giving them a wooded shrubland appearance. The stands are xeric.

Interpretation

This somewhat common map class was the most common shrubland association found at Cedar Breaks and appears as small to very large, irregular polygons on steep slopes and ridges. The density of manzanita cover ranged widely, but the distinctive signature of olive-green color and pattern of circular clones with scattered tree crowns providing black dots of several sizes helped identify this map class. Scattered trees of many species were often present, and if dense enough were mapped as a woodland or forest map class. Because these shrublands most commonly occur as openings in woodlands or forests, they are surrounded by woodlands or forests with a manzanita understory and a canopy layer dominated by ponderosa pine – Douglas fir (map class 10), white fir (map class 3), pinyon – juniper (map class 14), or curl-leaf mountain-mahogany (map class 21).



Example of photo signature for map class S-MANZ (#26).

Map Class 30
Silver Sagebrush Bottomland Shrubland (S-ARCA)

Photo credits: NPS

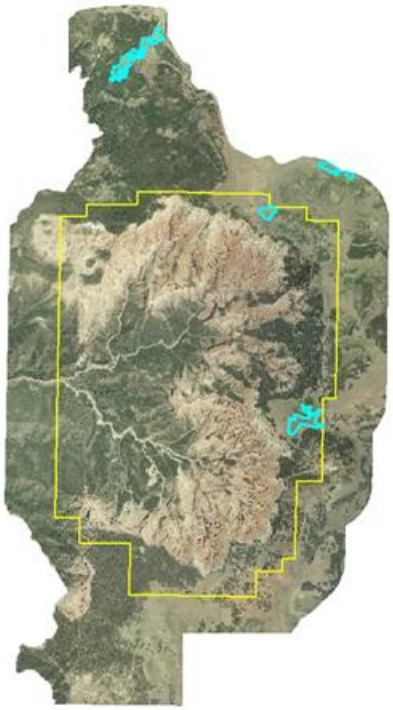
Associations
*Artemisia cana (*ssp. *bolanderi,* ssp. *viscidula) / Poa pratensis* Semi-natural Shrubland

Common species
- *Artemisia cana*
- *Achnatherum lettermanii*
- *Poa pratensis*

S-ARCA Map Class Statistics

Type:	Complex
Frequency:	13 total polygons
	2 total polygons in CEBR
	11 total polygons in the environs
Total project area:	30 hectares / 74 acres (0.6 %)
	13 hectares / 33 acres in CEBR
	17 hectares / 41 acres in the environs
Average Polygon Size:	1.4 hectares / 3.6 acres
Producer's accuracy:	67% ± 62%
User's accuracy:	100%

Distribution in Mapping Area

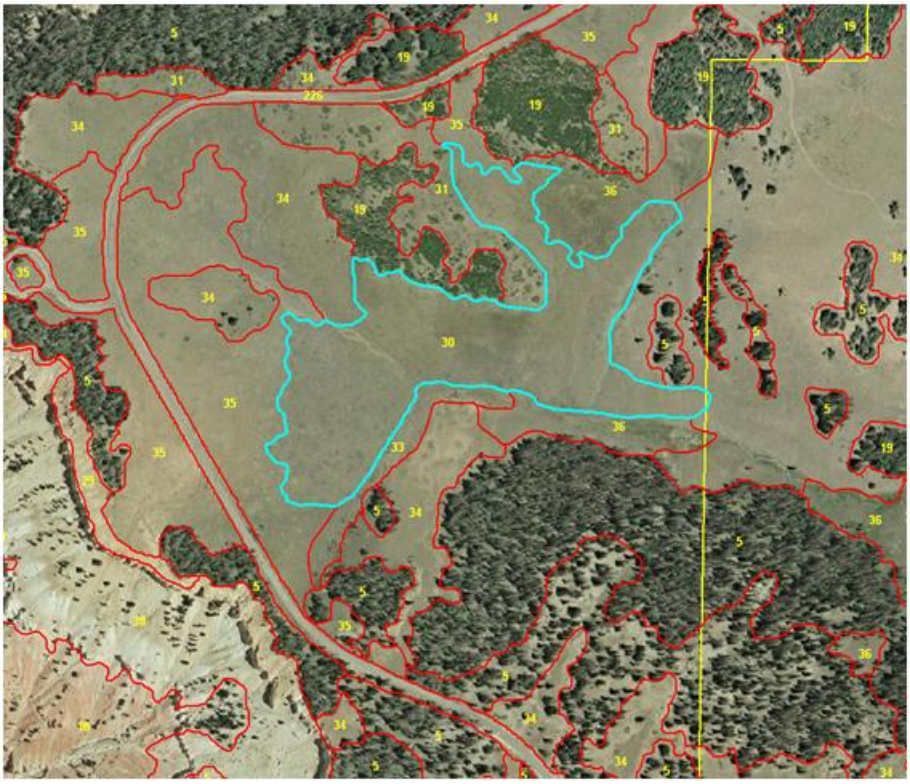


Distribution/Ecology/Composition

Stands occur above the rim on flats, in swales or in valley bottoms where the water table is near the surface seasonally. Silver sagebrush is the dominant shrub and *Poa pratensis* is dominant in the understory, with equal or greater cover than that of the sagebrush. The herbaceous layer is diverse. Other common graminoid species include *Achnatherum lettermanii* and *Elymus trachycaulus*. Dominant forb species include *Aster ascendens, Achillea millefolium*, and *Solidago multiradiata*.

Interpretation

This very rare map class appears as medium to large regular polygons in swales or valley bottoms. The color is light to medium-gray to gray-green and smooth-textured. Field data were used to guide the interpretation of this map class. Scattered *Artemisia cana* shrubs were found in flat areas with graminoids and forbs. Common neighbors include aspen woodlands (map class 19), Arizona willow shrublands (map class 28), mixed mountain shrublands (map class 31), dry meadows (map class 34), disturbed meadows (map class 35), and wet meadows (map class 36).



Example of photo signature for map class S-ARCA (#30).

Map Class 31
Mixed Mountain Shrubland Complex (S-MXMO)

Photo credits: NPS

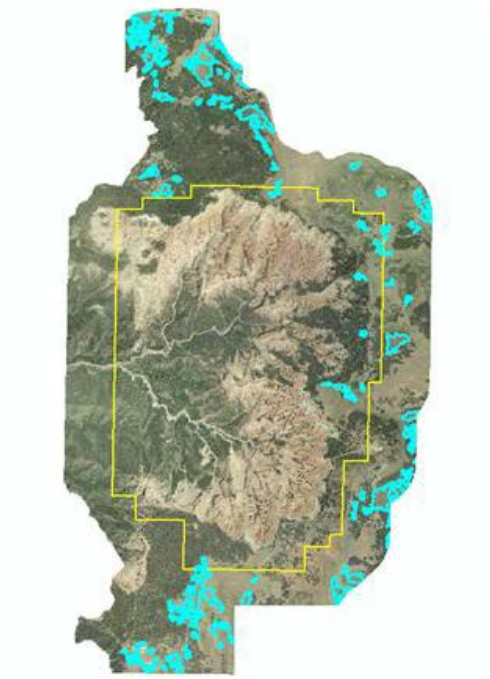
Associations
Ribes montigenum Shrubland
Symphoricarpos oreophilus Shrubland
Acer glabrum Colluvial Slope Shrubland [Park Special]

Common species
- *Ribes montigenum*
- *Purshia tridentata*
- *Acer glabrum*
- *Helianthella uniflora*
- *Calamagrostis scopulorum*
- *Sambucus racemosum*
- *Symphoricarpos oreophilus*
- *Elymus trachycaulus*
- *Cornus sericea*
- *Aster wasatchensis*

S-MXMO Map Class Statistics

Type:	Complex
Frequency:	108 total polygons 16 total polygons in CEBR 92 total polygons in the environs
Total project area:	177 hectares / 437 acres (3.7 %) 15 hectares / 37 acres in CEBR 162 hectares / 400 acres in the environs
Average Polygon Size:	1.2 hectares / 3 acres
Producer's accuracy:	80% ± 39%
User's accuracy:	100%

Distribution in Mapping Area

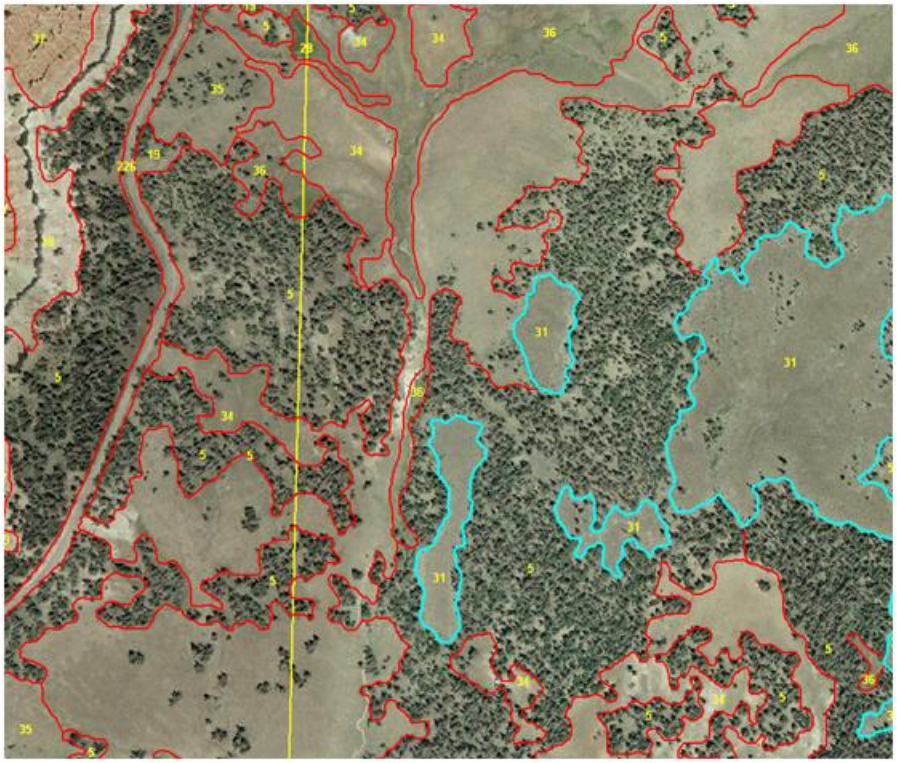


Distribution/Ecology/Composition

Stands occur above the rim and primarily on gentle slopes to flats or in valley bottoms that have deep soils. This complex is comprised of a mix of unique and common shrub associations. The general habitat is moderately mesic. Several *Sambucus racemosa* stands were mapped in areas of clear-cuts outside the monument boundary. The herbaceous layer has low to moderate cover and is low to high in terms of species diversity.

Interpretation

This somewhat common map class appears as small to large regular polygons on gentle slopes, flats and occasionally ridgetops or hillsides. The signature is highly variable due to the mixture of shrub associations assigned to this map class and varies from light gray to gray-brown with a slightly speckled textured to a smooth light green background representing grasses with bright green clumps of *Ribes* shrubs scattered around. Common neighbors include polygons of subalpine fir – Engelmann spruce forests (map class 5), aspen woodlands (map class 19), silver sagebrush shrublands (map class 30), dry meadows (map class 34), and disturbed meadows (map class 35).



Example of photo signature for map class S-MXMO (#31).

Upland Herbaceous Communities

Map Class 34

Dry Meadow Mixed Herbaceous Vegetation Mosaic (H-HERB)

Photo credits: NPS

Associations

Achnatherum lettermanii Herbaceous Alliance
Aster ascendens Herbaceous Vegetation [Park Special]
Calamagrostis scopulorum Herbaceous Vegetation [Park Special]
Carex egglestonii Herbaceous Vegetation [Park Special]
Erigeron ursinus Herbaceous Vegetation [Park Special]
Elymus trachycaulus Herbaceous Vegetation [Park Special]
Helianthella uniflora Herbaceous Vegetation [Park Special]
Ligusticum porteri Herbaceous Alliance
Lomatium minimum - Arenaria fendleri Herbaceous Vegetation [Park Special]
Lupinus argenteus Herbaceous Alliance
Poa secunda Herbaceous Vegetation
Solidago multiradiata Herbaceous Vegetation [Park Special]
Viguiera multiflora Herbaceous Vegetation [Park Special]

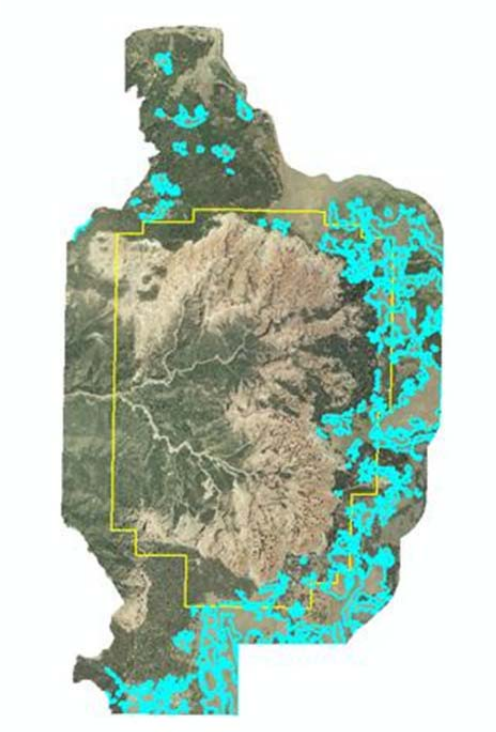
Common species

- *Achnatherum lettermanii*
- *Erigeron ursinus*
- *Festuca idahoensis*
- *Ligusticum porter*
- *Arenaria fendleri*
- *Poa secunda*
- *Aster ascendens*
- *Achillea millefolium*
- *Lupinus argenteus*
- *Calamagrostis scopulorum*
- *Elymus trachycaulus*
- *Helianthella uniflora*
- *Lomatium minimum*
- *Solidago multiradiata*
- *Poa fendleriana*
- *Elymus elymoides*
- *Viguiera multiflora*

H-HERB Map Class Statistics

Type:	Complex
Frequency:	145 total polygons 65 total polygons in CEBR 80 total polygons in the environs
Total project area:	532 hectares / 1,314 acres (11 %) 97 hectares / 240 acres in CEBR 435 hectares / 1,074 acres in the environs
Average Polygon Size:	0.8 hectares / 1.9 acres
Producer's accuracy:	97% ± 8%
User's accuracy:	81% ± 13%

Distribution in Mapping Area

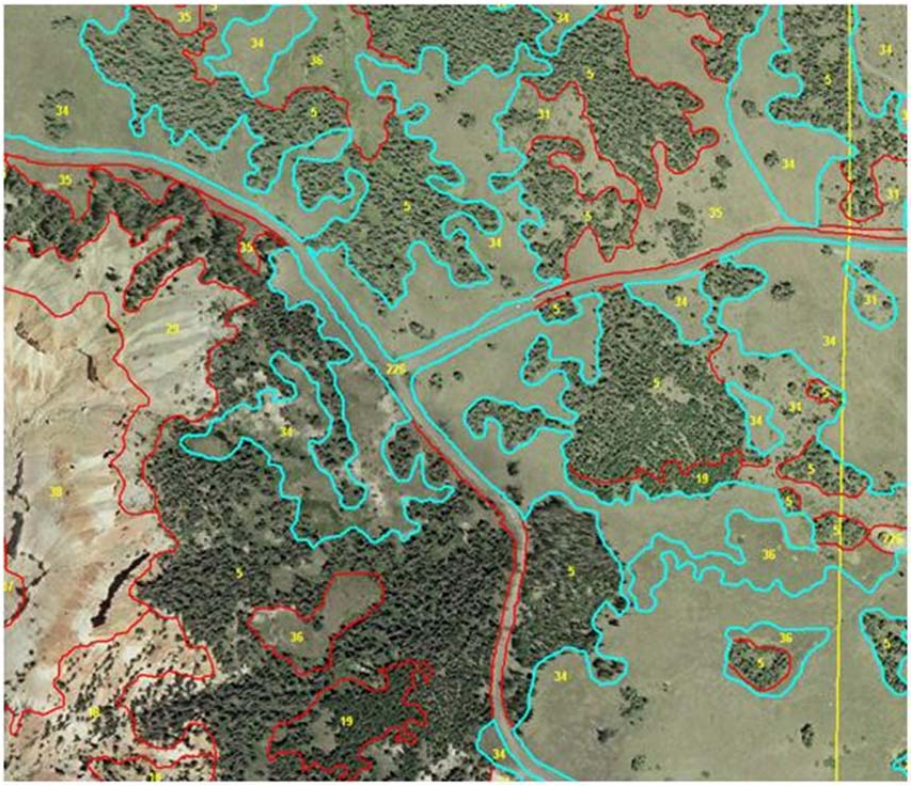


Distribution/Ecology/Composition

Stands occur primarily on gentle slopes and flats bordering forested sites above the canyon rims. Species of grasses including Letterman needlegrass, ditch reedgrass, Sandberg bluegrass, Fendler bluegrass, Idaho fescue, and slender wheatgrass are common to dominant and yarrow, bear daisy, oneflower helianthella, Porter's licoriceroot, little desertparsley, Fendler's sandwort, Rocky Mountain goldenrod, Chile aster, and showy goldeneye are common forbs. Shrubs are present with sparse to low cover, including antelope bitterbrush, rubber rabbitbrush, silver sagebrush, and gooseberry currant. The stands are xeric.

Interpretation

This very common map class appears as small to very large, regular to irregular polygons on gentle slopes and flats above the rim. It includes different associations of graminoids and forbs with a varying photo signature ranging from browns to greys, depending on the dryness of the area and the color of the substrate. There was slight confusion with MU 35 (Perennial Disturbed Grassland Complex), due to the similar habitat of both map units, but the plethora of field observations provided guidance for identifying this mosaic. Common neighbors include polygons of subalpine fir – Engelmann spruce forests (map class 5), aspen woodlands (map class 19), mixed mountain shrublands (map class 31), disturbed meadows (map class 35), and wet meadows (map class 36).



Example of photo signature for map class H-HERB (#34).

Map Class 35
Perennial Disturbed Grassland Complex (H-DIST)

Photo credits: NPS

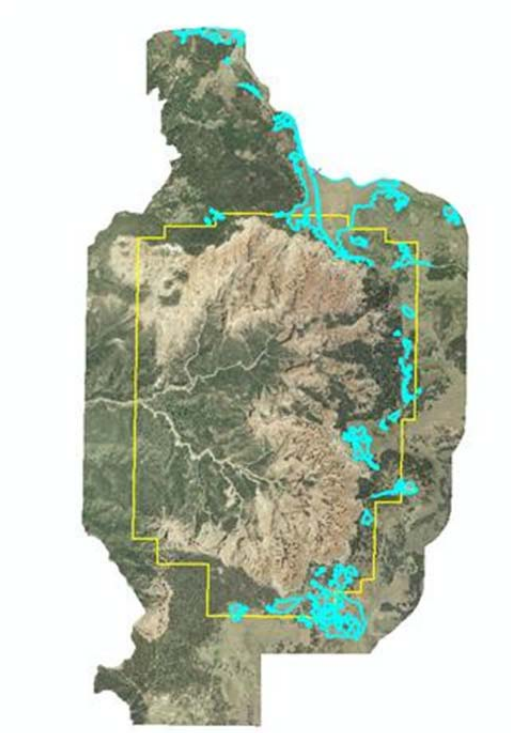
Associations
Bromus inermis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation
Poa pratensis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation

Common species
- *Pascopyrum smithii*
- *Bromus inermis*
- *Elymus trachycaulus*
- *Achnatherum lettermanii*
- *Poa pratensis*
- *Deschampsia caespitosa*

H-DIST Map Class Statistics

Type:	Complex
Frequency:	74 total polygons 42 total polygons in CEBR 32 total polygons in the environs
Total project area:	210 hectares / 518 acres (4.3 %) 78 hectares / 193 acres in CEBR 131 hectares / 325 acres in the environs
Average Polygon Size:	7 hectares / 17.3 acres
Producer's accuracy:	86% ± 12%
User's accuracy:	96% ± 8%

Distribution in Mapping Area

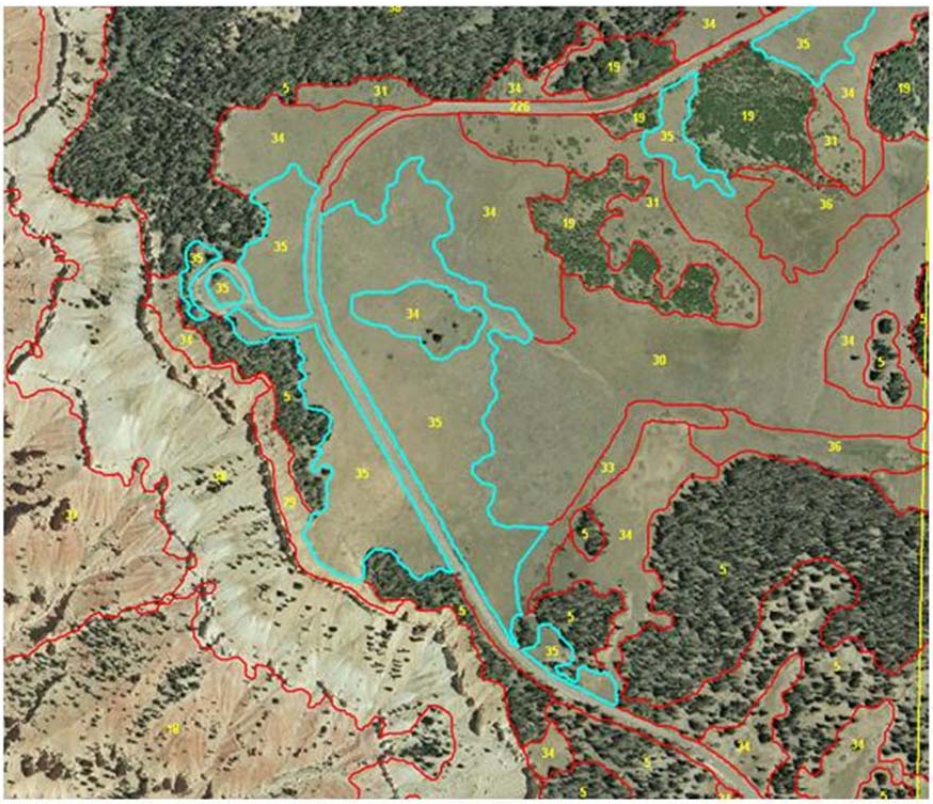


Distribution/Ecology/Composition

Stands occur on flats above the rim, generally in areas bordering roadways. These are disturbed grasslands, mostly outside the Monument boundary, that are dominated by the non-native species smooth brome, western wheatgrass, and Kentucky bluegrass. The stands are xeric to mesic.

Interpretation

This class was mapped on the eastern portion of the study area above the Claron breaks. This map class appears as small to large, regular polygons typically found along road-sides and in other disturbed areas. The photo signature varied from brighter greens to greys and browns, depending on the relative abundance of annual forbs, moisture, and growth stage. Common neighbors include polygons of subalpine fir – Engelmann spruce forests (map class 5), aspen woodlands (map class 19), silver sagebrush shrublands (map class 30), dry meadows (map class 34), and wet meadows (map class 36).



Example of photo signature for map class H-DIST (#35).

Sparse Vegetation & Talus Slope Communities

Map Class 27
Whitestem Goldenbush Dwarf-shrubland (S-ERDI)

Photo credits: NPS

Associations

Ericameria discoidea Dwarf-shrubland Herbaceous Sparse Vegetation [Park Special]

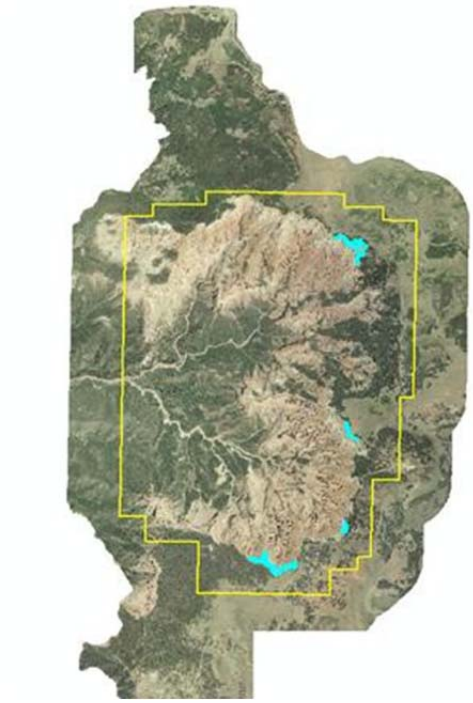
Common species

- *Ericameria discoidea*
- *Eriogonum panguicense*
- *Poa pratensis*
- *Trisetum spicatum*
- *Oxytropis oreophila*
- *Phlox pulvinata*

S-ERDI Map Class Statistics

Type:	Association
Frequency:	4 total polygons
	4 total polygons in CEBR
	total polygons in the environs
Total project area:	11 hectares / 26 acres (0.2 %)
	11 hectares / 26 acres in CEBR
	hectares / acres in the environs
Average Polygon Size:	0.6 hectares / 1.5 acres
Producer's accuracy:	100%
User's accuracy:	100%

Distribution in Mapping Area

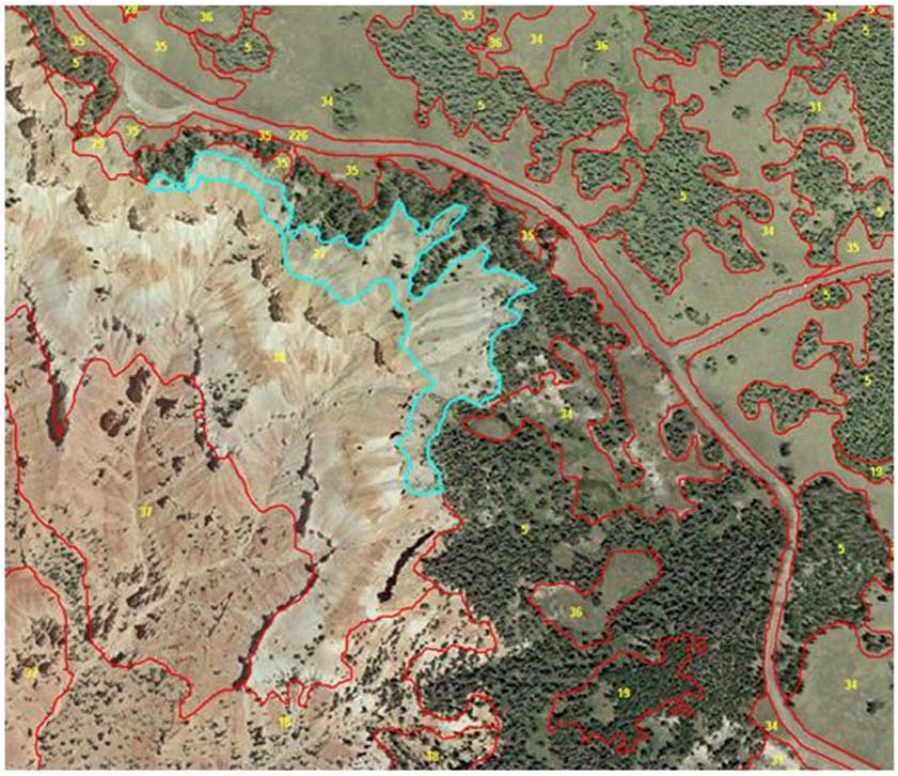


Distribution/Ecology/Composition

This dwarf-shrubland association occurs on the ridgeline slopes and rims of badlands break exposures in the White Claron formation. Sites are steep (16- to 35-degree slopes) and oriented to the west and north. The ground surface has moderate to high exposure of bare soil and low to moderate cover of small and large rocks. Whitestem goldenbush is the diagnostic species characterizing this association and map class, even though its cover is sparse. There is a lot of overlap with map class 29, both in environmental setting and dominant species. Whitestem goldenbush may have less than or equal cover to some of the dominant forb species present (often there is a high diversity of forbs in these communities), including *Eriogonum panguicense, Oxytropis oreophila,* and *Phlox pulvinata.*

Interpretation

This very rare map class consists of just one association that was mapped only where documented from plots, observation points, and/or AA points and appears as medium to large irregular, often linear polygons. This is a dwarf-shrubland / cushion plant community with unvegetated badlands located on exposed slopes just below the rim on the White Claron formation. The photo signature is medium gray-brown and smooth. Common neighbors include polygons of subalpine fir – Engelmann spruce forests (map class 5), mixed desert forblands (map class 29), disturbed meadows (map class 35), and unvegetated badlands and breaks of the White Claron formation (map class 38).



Example of photo signature for map class S-ERDI (#27).

Map Class 29
Mixed Desert Forb Complex (H-MXDE)

Photo credits: NPS

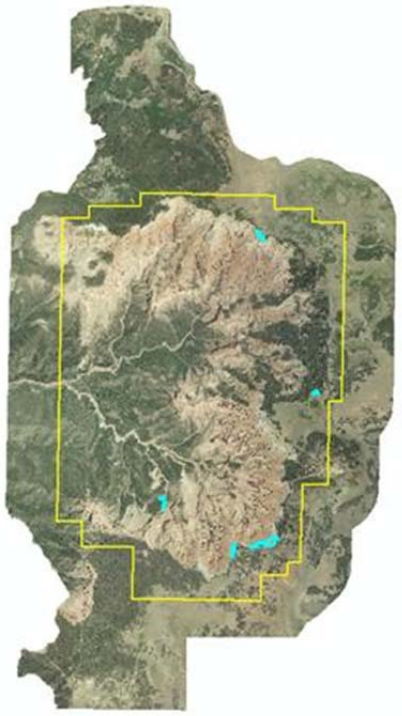
Associations
Eriogonum panguicense Herbaceous Vegetation [Park Special]
Eriogonum umbellatum - Potentilla hippiana Herbaceous Vegetation [Park Special]

Common species
- *Eriogonum panguicense*
- *Potentilla hippiana*
- *Phlox pulvinata*
- *Eriogonum umbellatum*
- *Oxytropis oreophila*
- *Hymenopappus filifolius*

H-MXDE Map Class Statistics

Type:	Association
Frequency:	5 total polygons 5 total polygons in CEBR total polygons in the environs
Total project area:	5 hectares / 11 acres (0.1 %) 5 hectares / 11 acres in CEBR 0hectares / 0 acres in the environs
Average Polygon Size:	2.6 hectares / 6.5 acres
Producer's accuracy:	75% ± 31%
User's accuracy:	100%

Distribution in Mapping Area

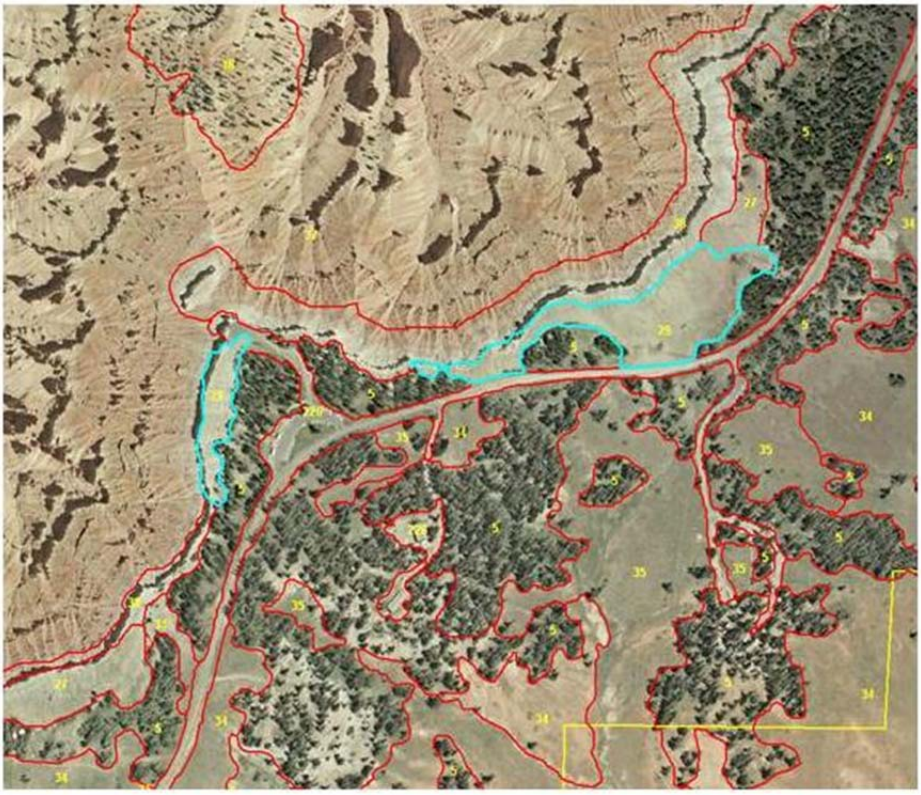


Distribution/Ecology/Composition

This forb association occurs on the high slopes and rims of badlands breaks and ravines, and on older talus deposits and colluvium. Sites are gentle to steep (2- to 24-degree slopes) and are oriented to the south and northwest. The ground surface has high exposure of bare soil and sparse to moderate cover of rocks. Total vegetation cover is sparse to moderate (7-31% cover) and is characterized by the forbs *Eriogonum panguicense* (3-8% cover), *Eriogonum umbellatum* (5-12%), and/or *Potentilla hippiana* (4% cover). *Oxytropis oreophila* (3-8%) and *Phlox pulvinata* (0-8%) are sometimes codominant. The remaining forb layer is diverse in terms of species composition, provides sparse to low cover, and includes *Valeriana edulis, Hymenopappus filifolius, Antennaria* sp., *Solidago multiradiata, Penstemon leiophyllus, Penstemon rydbergii*, *Potentilla gracilis, Achillea millefolium*, and *Ipomopsis spicata ssp. tridactyla (= Gilia tridactyla)*. The graminoid layer is low in terms of species composition, provides sparse cover, and includes *Bromus anomalus, Elymus trachycaulus,* and *Poa glauca*.

Interpretation

This very rare map class was found primarily on the exposed slopes of the first cliffs of the White Claron breaks and appears as small to medium, regular polygons. The interpretation was guided by field sampling points along the sparsely vegetated and light- to medium gray colored cliffs. The most common neighboring communities include polygons of subalpine fir – Engelmann spruce forests (map class 5), whitestem goldenbush dwarf-shrublands (map class 27), and unvegetated badlands and breaks of the Red Claron formation (map class 37) and White Claron formation (map class 38).



Example of photo signature for map class H-MXDE (#29).

Riparian / Wetland Woodlands and Shrublands

Map Class 22
Narrowleaf Cottonwood Temporarily Flooded Wash Complex (W-COTT)


Photo credits: NPS

Associations

Populus angustifolia - Picea pungens / Acer glabrum Woodland [Park Special]
Populus angustifolia Temporarily Flooded Terrace Woodland [Park Special]
Salix exigua Temporarily Flooded Shrubland

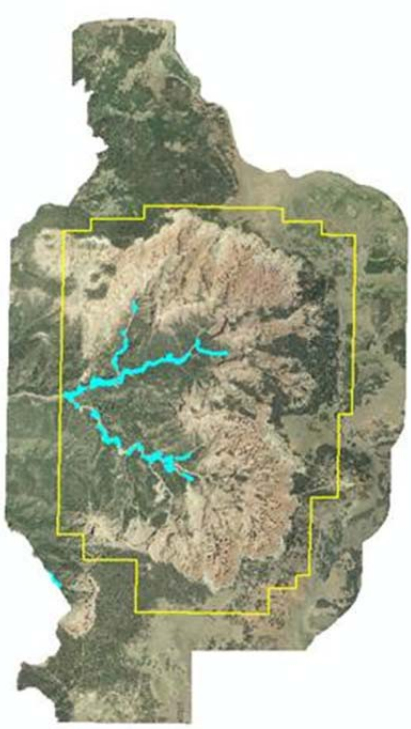
Common species

- *Populus angustifolia*
- *Pinus ponderosa*
- *Purshia tridentata*
- *Ericameria nauseosa*
- *Equisetum arvense*
- *Juncus arcticus*
- *Picea pungens*
- *Juniperus scopulorum*
- *Acer glabrum*
- *Salix exigua*
- *Cercocarpus ledifolius*
- *Arctostaphylos patula*

W-COTT Map Class Statistics

Type:	Complex
Frequency:	37 total polygons 36 total polygons in CEBR 1 total polygons in the environs
Total project area:	14 hectares / 35 acres (0.3 %) 14 hectares / 34 acres in CEBR 1 hectares / 2 acres in the environs
Average Polygon Size:	1.8 hectares / 4.5 acres
Producer's accuracy:	90% ± 21%
User's accuracy:	100%

Distribution in Mapping Area

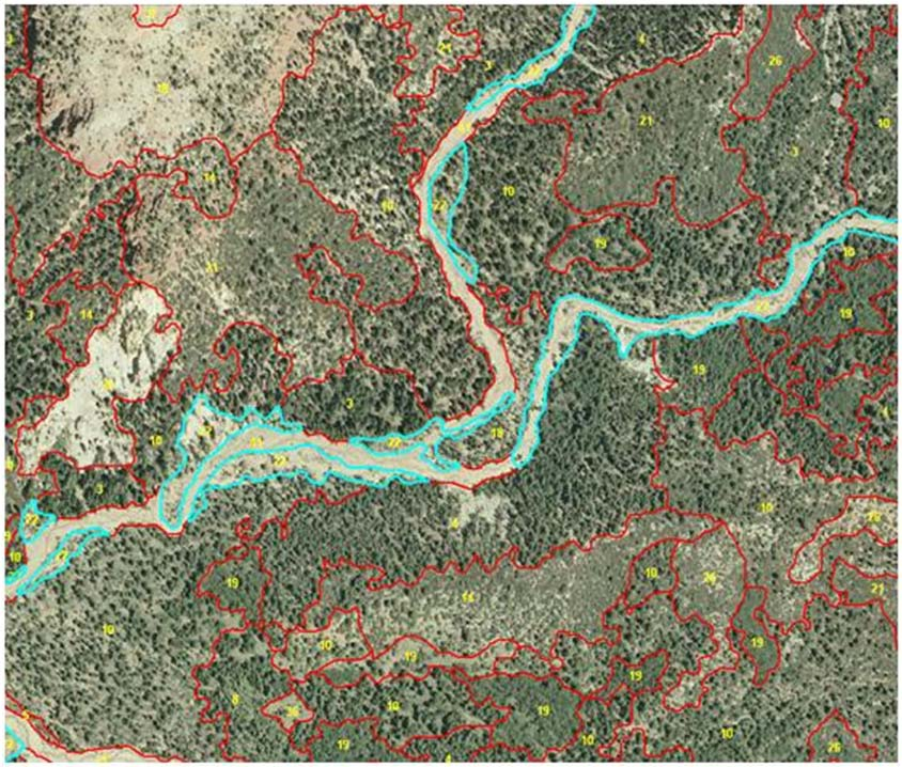


Distribution/Ecology/Composition

Stands occur on low terraces and along the main Ashdown Creek drainage and its tributaries where near-to-surface groundwater occurs and in the active floodplain where run-off events scour the area regularly. Narrowleaf cottonwood is generally dominant, but Douglas-fir, blue spruce, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or subcanopy layers. The stands are mesic and also support the tall shrub Rocky Mountain maple and coyote willow.

Interpretation

This rare map class appears as small to large, narrow, linear polygons found along wash areas in the Adams and Ashdown Creek drainages. The photo signature is a mottled gray-green with the light-brown of the substrate showing through in many places. A variety of communities bordering Ashdown Creek and its tributaries are neighbors with this map class, with none being particularly more common than another.



Example of photo signature for map class W-COTT (#22).

Map Class 28
Arizona Willow Temporarily Flooded Shrubland (S-AZWI)

Photo credits: NPS

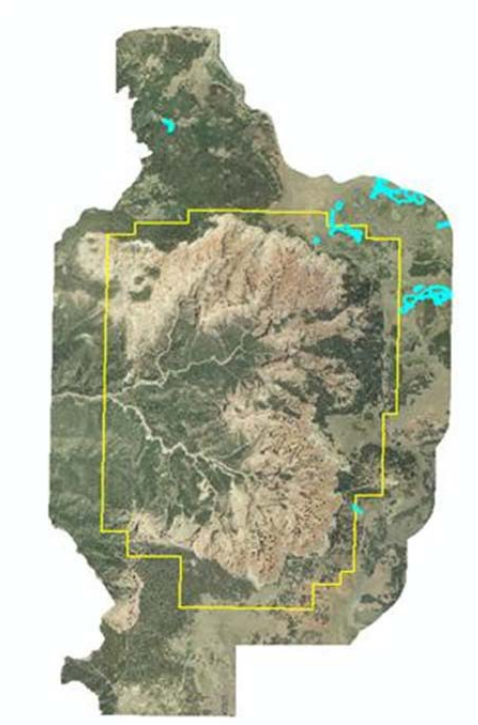
Associations
Salix arizonica Shrubland [Park Special]

Common species
- *Salix arizonica*
- *Equisetum arvense*
- *Deschampsia caespitosa*
- *Salix exigua*
- *Carex aquatilis*

S-AZWI Map Class Statistics

Type:	Association
Frequency:	14 total polygons
	3 total polygons in CEBR
	11 total polygons in the environs
Total project area:	22 hectares / 54 acres (0.5 %)
	3 hectares / 6 acres in CEBR
	19 hectares / 48 acres in the environs
Average Polygon Size:	1.8 hectares / 4.4 acres
Producer's accuracy:	100%
User's accuracy:	100%

Distribution in Mapping Area

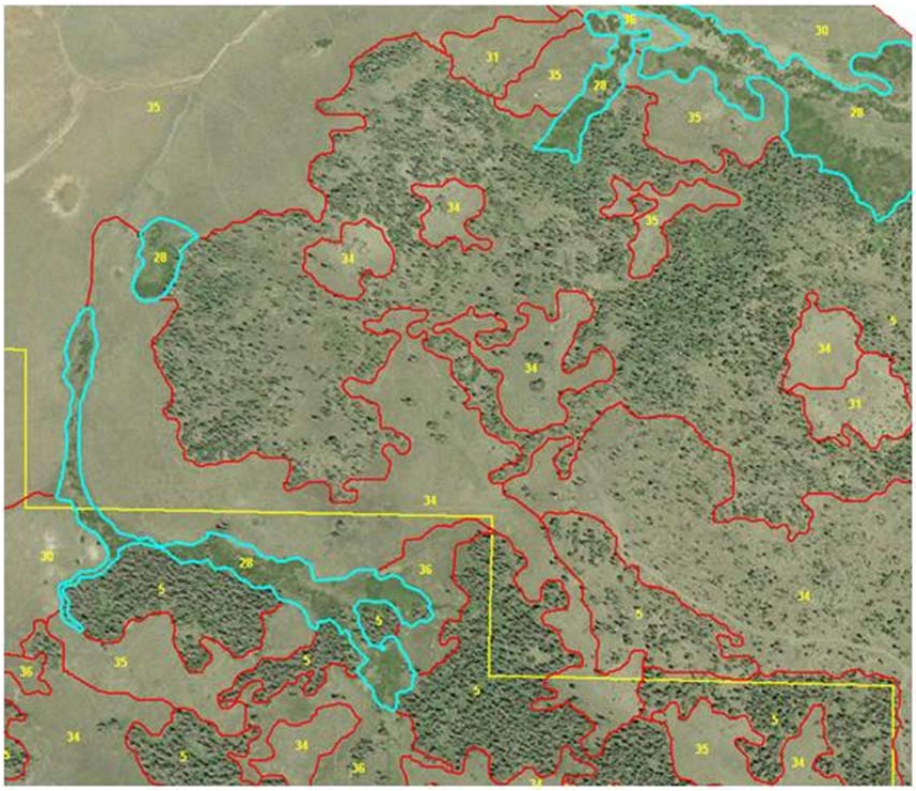


Distribution/Ecology/Composition

Stands occur in wet swales or depressions in valley bottoms above the rim, most commonly following the courses of perennial drainage channels, and on soils and peat that are saturated and spongy to the touch. Total vegetation cover is dense (65-85% cover) and is characterized by *Salix arizonica* short shrubs that are <1 m tall and provide 59-70% cover. The graminoid layer is floristically diverse, provides sparse to low cover, and includes *Carex aquatilis* and *Deschampsia caespitosa*. The forb layer is diverse in terms of species composition and provides sparse cover with no one species consistently contributing more than 1% cover. Stands are mesic.

Interpretation

The very rare map class appears as small to large, irregular polygons and was interpreted primarily from field data and mapped along perennial drainages in wet swales above the rim. The photo signature is a distinct bright green color with a clumped pattern and linear distribution following drainage courses. Common neighbors include polygons of subalpine fir – Engelmann spruce forests (map class 5), silver sagebrush shrublands (map class 30), dry meadows (map class 34), disturbed meadows (map class 35), and wet meadows (map class 36).



Example of photo signature for map class S-AZWI (#28).

Map Class 33
Shrubby-cinquefoil Shrubland (S-CINQ)

Photo credits: NPS

Associations
Dasiphora fruticosa ssp. *floribunda / Deschampsia caespitosa* Shrubland

Common species
- *Dasiphora fruticosa* ssp. *floribunda*
- *Carex scirpoidea*
- *Deschampsia caespitosa*
- *Elymus trachycaulus*

S-CINQ Map Class Statistics

Type:	Association
Frequency:	1 total polygons
	1 total polygons in CEBR
	total polygons in the environs
Total project area:	1 hectares / 2 acres (0 %)
	1 hectares / 2 acres in CEBR
	0 hectares / 0 acres in the environs
Average Polygon Size:	0.4 hectares / 0.9 acres
Producer's accuracy:	100%
User's accuracy:	100%

Distribution in Mapping Area

Distribution/Ecology/Composition

The one mapped stand of this vegetation association occurred along a perennial drainage on saturated soils. Total vegetation cover is moderate (40-50%) and shrubby cinquefoil is the dominant shrub (30% cover) and saltgrass is the dominant understory species (2-12% cover). The remaining graminoid layer is low in terms of species composition, provides sparse cover, and includes *Carex scirpoidea* and *Elymus trachycaulus*. The forb layer is moderately diverse floristically and provides sparse cover. Stands are mesic.

Interpretation

This very rare map class was interpreted using observation point and AA field data and the only mapped occurrence was drawn along and perpendicular to a broad drainage at the edge of a meadow near Chessman Overlook. Neighboring polygons included subalpine fir – Engelmann spruce forests (map class 5), silver sagebrush shrublands (map class 30), dry meadows (map class 34), disturbed meadows (map class 35), and wet meadows (map class 36).

Example of photo signature for map class S-CINQ (#33).

Riparian / Wetland Herbaceous Communities

Map Class 36
Wet Meadow Herbaceous Vegetation Mosaic (H-MEAD)


Photo credits: NPS

Associations

Carex aquatilis Herbaceous Vegetation
Carex scirpoidea Seasonally Flooded Herbaceous Vegetation [Park Special]
Deschampsia caespitosa - Polygonum bistortoides Herbaceous Vegetation
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation [Placeholder]

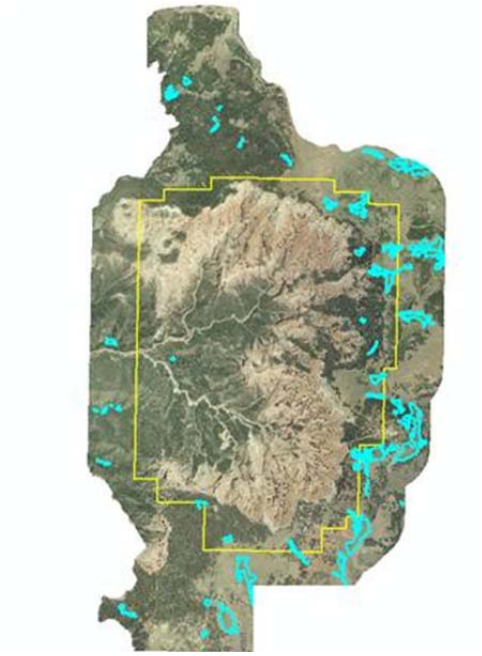
Common species

- *Carex aquatilis*
- *Carex scirpoidea*
- *Polygonum bistortoides*
- *Carex egglestonii*
- *Poa pratensis*
- *Juncus balticus*
- *Deschampsia caespitosa*
- *Elymus trachycaulus*

H-MEAD Map Class Statistics

Type:	Complex
Frequency:	66 total polygons 20 total polygons in CEBR 46 total polygons in the environs
Total project area:	106 hectares / 263 acres (2.2 %) 19 hectares / 47 acres in CEBR 87 hectares / 216 acres in the environs
Average Polygon Size:	3.1 hectares / 7.6 acres
Producer's accuracy:	100%
User's accuracy:	100%

Distribution in Mapping Area

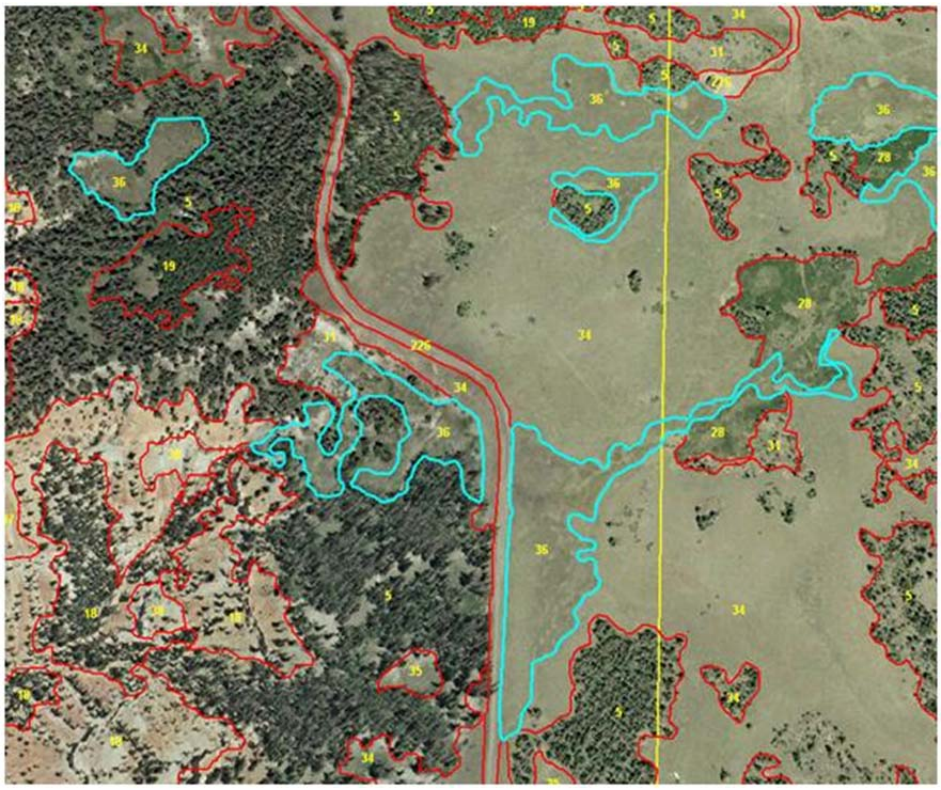


Distribution/Ecology/Composition

This wetland map class occurs as small patches in drainages and depressions and along pond margins where saturated or inundated soils are present. Total vegetation cover is moderate to dense (21-95% cover) and is characterized by *Carex aquatilis* (30-85% cover), *Deschampsia caespitosa* (12-45% cover), *Polygonum bistortoides* (1-35% cover), *Poa pratensis* (10-25% cover), and/or *Carex scirpoidea* (20-30% cover). The remaining graminoid layer is moderately diverse in terms of species composition, provides sparse to moderate cover, and includes *Carex egglestonii, Phleum alpinum, Elymus trachycaulus, Achnatherum lettermanii, Trisetum spicatum, Juncus balticus*, and the fern ally *Equisetum laevigatum*. The forb layer is moderately diverse and provides sparse to moderate cover. Sparse cover of the short shrubs *Salix arizonica, Dasiphora fruticosa* ssp. *floribunda* and *Lonicera involucrata* may also occur.

Interpretation

This wet meadow mosaic contains a mixture of mesic graminoids and forb species and appears as small to large, regular polygons. Typically this map class has a smooth texture and brownish to greenish color, depending on the amount of moisture present, with narrow drainages lacing through the site. Common neighbors include polygons include subalpine fir – Engelmann spruce forests (map class 5), Arizona willow shrublands (map class 28), silver sagebrush shrublands (map class 30), dry meadows (map class 34), and disturbed meadows (map class 35).



Example of photo signature for map class H-MEAD (#36).

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NPS 154/108321, July 2011

National Park Service
U.S. Department of the Interior

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