National Park Service
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Natural Resource Program Center

# Vegetation Classification and Mapping Project Report, Bryce Canyon National Park

Natural Resource Technical Report NPS/NCPN/NRTR—2011/442



**ON THE COVER**
Bryce Canyon
Photograph by: Thomas O'Dell

# Vegetation Classification and Mapping Project Report, Bryce Canyon National Park

Natural Resource Technical Report NPS/NCPN/NRTR—2011/442

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# Summary

The Northern Colorado Plateau Inventory and Monitoring Network worked with the support of the U.S. Geological Survey - National Park Service Vegetation Mapping Program to describe and map vegetation at Bryce Canyon National Park (BRCA). This collaborative effort involved many project partners, particularly the Rocky Mountain Mapping Center of the U.S. Geological Survey, the Western Region office of NatureServe, engineering-environmental Management, Inc., Cogan Technology, Inc., and other cooperators.

The mapping area is approximately 23,754 hectares (58,697 acres), encompassing the entire park and an environs of adjacent public and private lands. Ecologists and photo interpreters identified plant associations for BRCA and determine how best to map them using 1:12,000-scale, true color aerial photography and digital orthophotography. The team collected vegetation and environmental data from 408 vegetation classification plots and 141 observation points between 2005 and 2006 to prepare the initial classification and preliminary vegetation map. During July 2007, team members conducted a vegetation map verification trip to test the field key to plant associations and to suggest minor adjustments to the vegetation map prior to full-scale accuracy assessment. Assessment of map accuracy entailed sampling an additional 902 data plots in the fall of 2007.

Analysis of the classification and accuracy assessment plot data revealed 126 National Vegetation Classification plant associations, alliances, or park special vegetation types within the park and environs. Twenty-three associations were documented exclusively from accuracy assessment data, the remainder from vegetation plots and observation points.

Vegetation and land use 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. Polygons representing vegetation or land use map classes were delineated on Mylar overlays on aerial photographs (where signatures were confusing) and with the heads-up digitizing technique (where signatures had high contrast), then transferred to a spatial database. The project used the national program standard minimum mapping unit of 0.5 ha with few exceptions.

Forty-nine vegetation and land-use map classes were developed for BRCA which included 6,056 total polygons. Of this total, 5,549 polygons represented 38 natural or semi-natural vegetation map classes covering 94.3% of the mapping project area. Eleven land use/land cover and geologic map classes describe 507 polygons (8% of polygons and 5.7% of the project area). Average polygon size across all map classes was 2.8 ha (7.0 acres). Lands within the Park include 14,614 ha (36,113 acres) or 61.5% of the total project area. The most common map class was the Ponderosa Pine - (Douglas-Fir) / Manzanita Woodland Complex with 490 polygons covering 21.0% of the mapping area.

Map accuracy was assessed only within the BRCA boundary. Primary analyses of the field data were presented and evaluated at an accuracy assessment meeting held from June 10-12, 2008.

Results from a thematic accuracy assessment of 36 vegetation map classes remaining after accuracy assessment analysis indicated an estimate of 84.2% overall map accuracy (Kappa statistic = 83.4 %). Seventeen 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 retention.

Products resulting from the BRCA 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 BRCA and project boundaries
- ground photography of vegetation classification plots, observation points, and accuracy assessment points in hard copy and digital formats
- all field data (classification 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 park.

# Acknowledgments

This project was completed through the effort and dedication of numerous individuals and organizations. Details of the role of each contributor mentioned here are described more fully in the Project Overview section. Angela Evenden (National Park Service), Karl Brown (NPS), Tammy Cook (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. Jim Von Loh, Dan Niosi, and Dr. Sharon Anderson ($e^2M$) prepared the project work plan in 2002 to insure tasks were completed in a timely manner.

Numerous individuals collected classification plot, observation point, and accuracy assessment field data. We appreciate the hard work of field crew members Bruce Condie, Liz Ballenger, Amy Tendick, Sarah Topp, Peter Williams, and Stephanie Shoemaker.

Gwen Kittel (NatureServe) prepared the preliminary vegetation classification and assigned final association names. Marion Reid (NatureServe) created the local association description template and Jim Von Loh ($e^2M$) wrote the draft local association descriptions. Gwen Kittel wrote the final local and global association descriptions. Jim Von Loh, Gwen Kittel, and Peter Williams wrote sections of the final report.

Dan Cogan (CTI) developed the initial map class concepts and with Jim Von Loh ($e^2M$), with assistance from Amy Tendick and Liz Ballenger (NPS), completed the photo interpretation and developed the map class attributes. Gery Wakefield and Aneth Wight (NPS) worked closely with Dan Cogan (CTI) to produce 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.

Special thanks to Kristin Legg and Bruce Fields (BRCA), who made us welcome whenever we arrived to check the map or collect field data and provided helpful advice as to the best way to access remote parts of the park.

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 |
| BPU | Biophysical Unit |
| BRCA | Bryce Canyon National Park |
| CEGL | Community Element Code |
| CNHP | Colorado Natural Heritage Program |
| CPVAC | Colorado Plateau Vegetation Advisory Committee |
| 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 |
| 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 |
| USBOR | United States Bureau of Reclamation |
| 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, Bryce Canyon National Park

The Bryce Canyon National Park (BRCA) Vegetation Mapping Project was organized and coordinated by the Northern Colorado Plateau Network (NCPN) Inventory and Monitoring (I&M) Program between 2002 and 2010, with assistance from several cooperators. The purpose of this project was to describe and map existing plant associations on 23,754 hectares (58,697 acres) within BRCA 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 project components consist of a classification and description of existing vegetation and a spatial database containing the interpretation of the vegetation into mapping units from aerial imagery and additional geospatial layers.

In 2001, the NCPN I&M Program launched a multi-year project to complete vegetation classifications and maps for 16 network park units. Funding was provided by the USGS-NPS Vegetation Mapping Program and the NCPN. The BRCA Vegetation Classification and Mapping Project was initiated by the NCPN, the Bureau of Reclamation Remote Sensing and Geographic Information Group (RSGIG), BRCA natural resources staff, NatureServe, and private contractors under a work plan prepared by $e^2$M in 2002. Project tasks wer coordinated with the USGS-NPS Vegetation Mapping Program throughout. Vegetation classification plot and observation point data collection occurred during the 2005 and 2006 field seasons and map accuracy assessment was completed in the fall of 2007.

Project methods, results, and products are documented in this report. This introductory section describes the NPS I&M Program and the USGS-NPS Vegetation Mapping Program, as well as the BRCA mapping project area. Later sections document the methods and results for each of the major project tasks: scoping, vegetation classification and description, vegetation mapping and geodatabase development, 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 existing 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 initiate dozens of new park unit vegetation classification and mapping projects, including BRCA. 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 the network 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 BRCA vegetation mapping project is the eleventh 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 2003)
- 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 works 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, which was initiated and completed prior to the revisions.

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 alliance and 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.

**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 |

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

| Level | Criteria Delineating Level | Example |
|---|---|---|
| | | 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 |

## 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.

# Project Area Description

## Location and Setting

Bryce Canyon National Park is located in southwest Utah, approximately 129 km (80 miles) east of Cedar City, Utah, with portions lying in Kane and Garfield counties (Figure 1). The nearest municipality is Tropic, Utah, approximately 25 km (16 miles) east of the park entrance. BRCA is accessible via U.S. Highway 12. Kanab is the seat of Kane County and has a population of 3,564, nearly 59% of the population of Kane County (6,046). Panguitch is the Garfield County seat and has a population of 1,623, over a third the population of Garfield County (4,735). Kane County has a low population density of 1.5 people per square mile and Garfield County has a low population density of 0.9 people per square mile. Most lands adjacent to BRCA are administered by Dixie National Forest, but some areas on the eastern edge of the park are also administered by Grand Staircase-Escalante National Monument or are in private ownership.

The park was designated to protect the Pink Cliffs, a series of steep, intricately eroded exposures of the Claron Formation along the eastern escarpment of the Paunsaugunt Plateau. The Pink Cliffs extend roughly north-south across a dozen or more amphitheater-like basins at the heads of tributary canyons to the Paria River. The largest of these amphitheaters, and the focus of most visits to the park, is at the head of Bryce Canyon. Over the past decade, an average of 1.01 million visitors annually have been recorded for BRCA (NPS 2009a). The park provides educational opportunities for visitors, students, and scholars related to natural and cultural resources research. The pristine air quality provides visitors with panoramic views of over 100 miles and the low level of human development and artificial lights provides exceptional night sky viewing opportunities (Evenden et al. 2002). Visitors to the park enjoy a variety of recreational opportunities including hiking, backpacking, horseback riding, wildlife viewing, and camping.

The BRCA project mapping area (Figure 2) includes the entire 14,614 ha (36,113 acre) park and 9,140 hectares (22,584 acres) of adjacent public and private lands in the environs for a total project area of 23,754 hectares (58,697 acres).

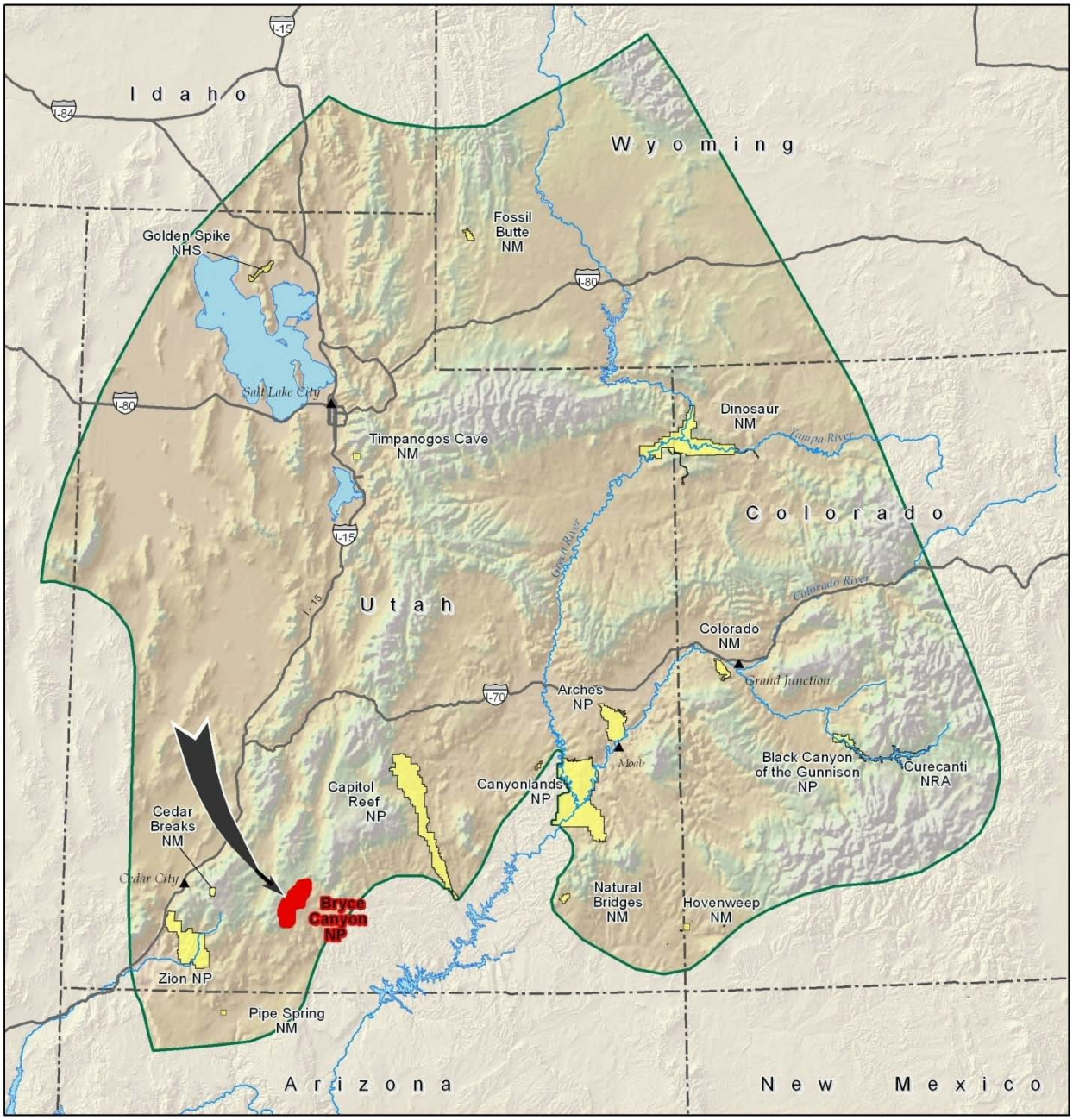



**Figure 1.** Location of BRCA on the Colorado Plateau.

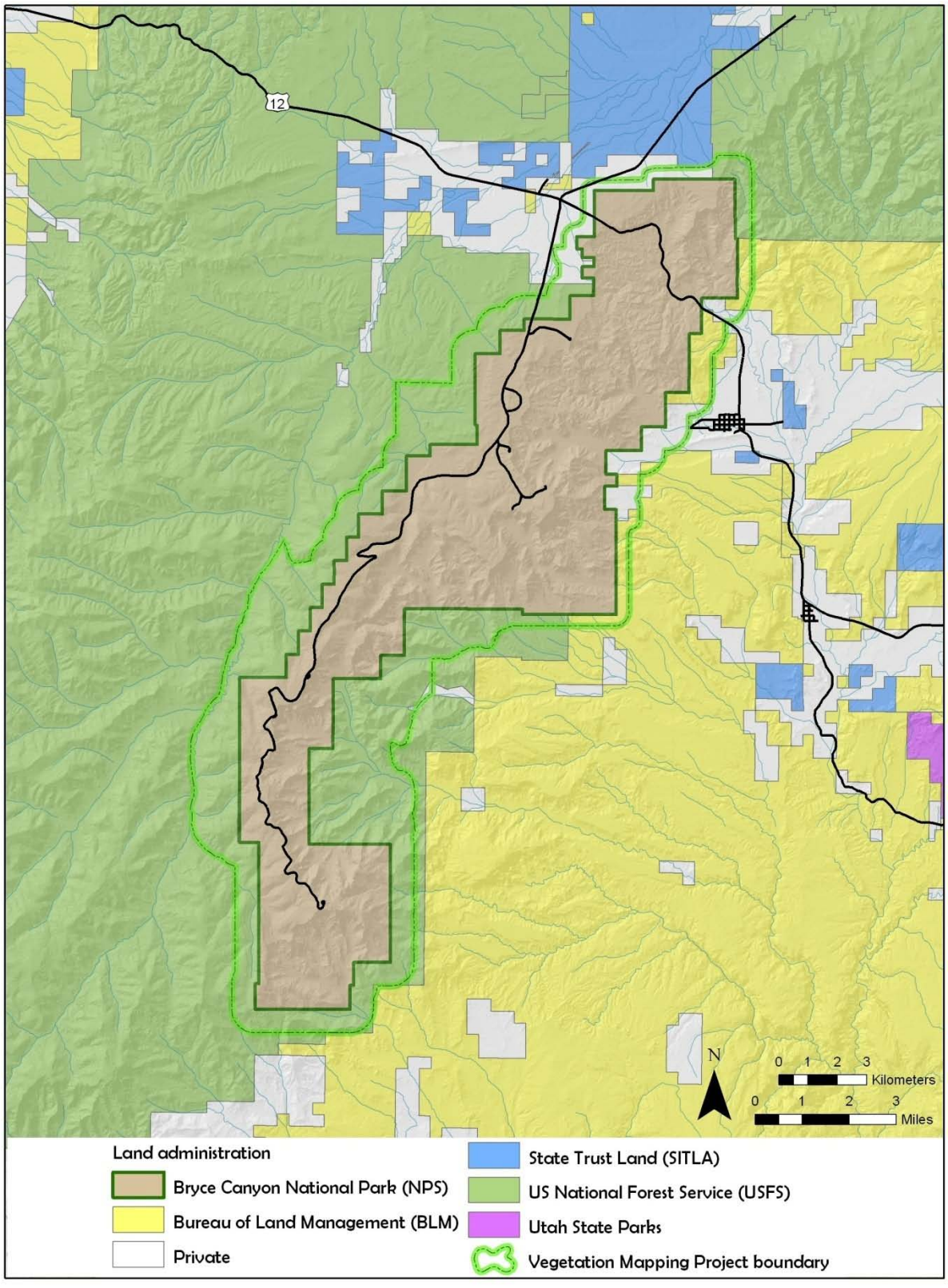



**Figure 2.** Map of the BRCA vegetation mapping project area boundary showing adjacent land ownership.

## Topography and Geologic History

BRCA sits on the eastern rim of the Paunsaugunt Plateau in the High Plateaus section of the Colorado Plateau physiographic province. The High Plateaus represent a transitional tectonic region between the Colorado Plateau proper to the east and the Basin and Range physiographic province to the west. The Paunsaugunt Plateau is a northward tilting flatland approximately 33 km (20 miles) long and 16.5 km (10 miles) wide; the highest elevation occurs at Rainbow Point, on the southern end of BRCA (Davis and Pollock 2000). The East Fork of the Sevier River flows northward across the center of the plateau, draining all of BRCA west of the rim of the Pink Cliffs. Precipitation falling on the cliffs and amphitheaters drains eastward into the Paria River. Because the Sevier River drains into the Basin and Range physiographic province and the Paria River into the Colorado River, BRCA represents a watershed divide between the Colorado Plateau and Basin and Range provinces (Wenker 2004).

Elevations in BRCA range from 2,006 m (6,580 ft) on the eastern boundary near Tropic to 2,778 m (9,115 ft) at Rainbow Point. The Pink Cliffs of BRCA represent the highest and youngest tier of the Grand Staircase, a series of large, multi-colored cliff exposures descending the geologic strata of the Colorado Plateau southeast from BRCA to the Colorado River. Along the northern boundary of BRCA the "cliffs" are short and have a mild gradient; this area is more properly termed badlands topography. In the middle portions of the park, especially in the vicinity of Bryce Canyon, the Pink Cliffs may be 90 m (295 ft) or more in height and nearly vertical. Interesting erosional features incude the hoodoos, fins, boulders, pinnacles and ridges for which BRCA is known. Cliffs and other features in the southern portions of BRCA, from the headwaters of Sheep Creek to the southern terminus of the Paunsaugunt Plateau, have been exposed by erosion for the longest time period, and tend to be the most vertical. Broad, forested benches of the Straight Cliffs Formation are exposed at the base of the Claron escarpment in these areas; this more resistant layer has slowed the rate of erosion due to drainage down-cutting and fewer hoodoos have formed (Davis and Pollock 2000)

West of the plateau rim, much of BRCA is gently sloping or relatively flat and dotted with a mosaic of open meadows separated by wooded hills and ridges. Often the hills and ridges are topped by small outcrops of the White Member of the Claron Formation.

## Climate

The Paunsaugunt Plateau lies in the rain shadow of the nearby Markagunt Plateau to the west and the Tushar Mountains to the northwest, receiving less precipitation than either of those landforms (Wenker 2004). Summer monsoon storms are often intense and can be a major hazard to visitors in BRCA, particularly at the higher elevations in the southern portion of the park. Park records demonstrate that thunderstorms can occur daily for over 50 percent of the days in July and August (NPS 2009b).

Records of climatic conditions have been maintained at BRCA headquarters (elevation 2,406 m [7,894 ft]) since 1959 (Figure 3). During the period of record, annual average precipitation was 40 cm (15.7 inches). Precipitation is lowest during the spring months (April through June) and highest during the late summer and early fall months (August through October). It is likely that data for Rainbow Point would show higher levels of precipitation than are recorded at the headquarters site. In contrast, meteorological data collected between 1893 and 1999 at nearby

Tropic, Utah, have an annual average precipitation of 30.7cm (12.1 inches), probably similar to the average at the lowest elevations of BRCA (WRCC 2009).

Temperatures and snowfall also follow a pattern of variation by elevation. Average July maximum temperatures are 26.6º C (79.8º F) and average minimum January temperatures are -12.5º C (9.5º F), as recorded at the park headquarters. Average annual snowfall at the same location is 220 cm (86.6 inches), although the average snow depth never exceeds 38 cm (15 inches) during any month of the winter. In contrast, average snow depth in Tropic never exceeds 5 cm (2 inches) during any month of the winter.

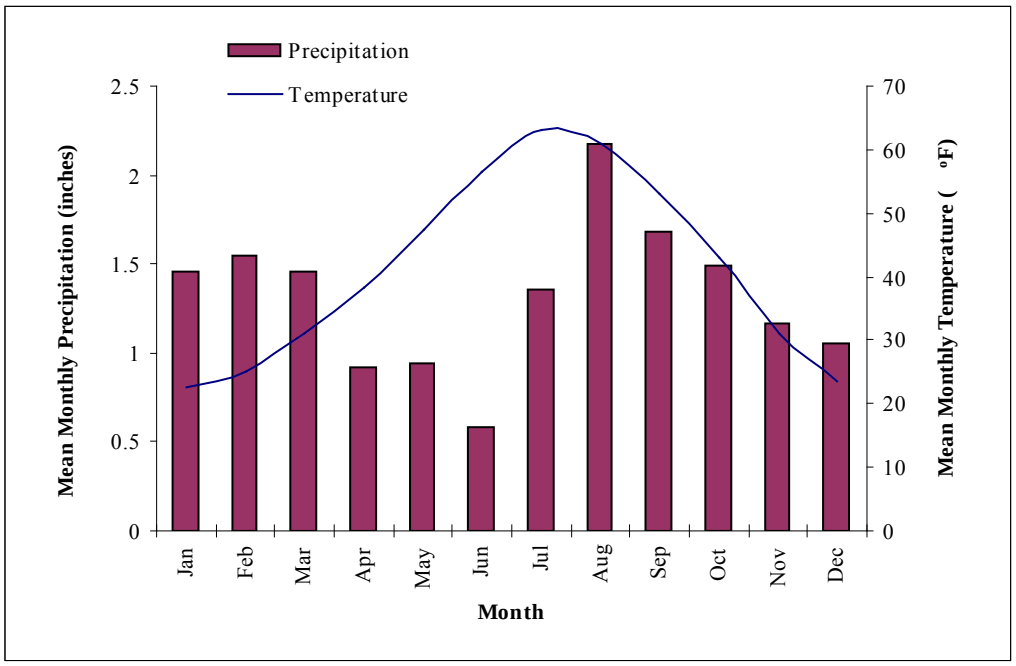



**Figure 3.** Climate data for BRCA (WRCC 2009).



USU Weeds Survey Crew

**Figure 4**. Summer thunderstorm at BRCA.

## Vegetation

Geology is often the defining element in the distribution of vegetation in many Colorado Plateau national parks. At BRCA, however, other factors including elevation, slope, aspect, fire history and soil drainage tend to drive the distribution patterns. Geology may influence the interaction of other environmental factors within BRCA, but the prevalence of the Pink member of the Claron Formation across a wide spectrum of environments and vegetation communities demonstrates that the formation is of lesser importance in determining vegetation patterns. Plant communities that have become established on the Pink Claron range from sparse bristlecone (*Pinus longaeva*) woodlands on the low elevation "Claron barrens" to dense mixed conifer forests at the highest elevations in the park. In the middle elevations, depending on slope and aspect, the Pink Claron can also support various combinations of mixed shrub, pinyon-juniper and ponderosa pine (*Pinus ponderosa*) communities.

Buchanan (1992) delineated the vegetation of BRCA into four generalized plant communities within three vegetation belts or climatic zones. The vegetation belts are, from lowest to highest elevation: pinyon-juniper woodland, submontane forest, and the montane forest belt. The submontane forest is further divided into two associated plant communities.

The harshest conditions are found in the lowest elevation zone, the pinyon-juniper woodland of the Pink Claron "breaks" (or badlands). Rapid erosion, hot summertime temperatures, and daily freeze-thaw cycles in the winter make life here difficult for even the hardiest plants. Soils poorly developed to absent, and perennial plant species experience erosional effects such as pedestaling or burial. Many endemic plants, particularly herbaceous "cushion" plants, are adapted to survive on the driest and hottest exposures of the badlands exposures or breaks (Fertig and Topp 2009). Local microclimates, formed by variable slopes and aspects, support a diversity of dominant tree

and shrub species. Buchanan (1992) associates this belt with the Bryce Canyon Breaks Community, which may be further refined by recognizing sparse bristlecone woodland communities typically found on low ridges and xeric south-facing slopes, and the two-needle pinyon pine-Utah juniper (*Pinus edulis - Juniperus osteosperma*) woodland communities of the slightly cooler, moister north-facing slopes.

Sparse bristlecone woodlands may include sparse cover of ponderosa pines; in large areas ponderosa pine cover may exceed that of bristlecone. Associated shrubs can include sparse greenleaf manzanita (*Arctostaphylos patula*) and/or antelope bitterbrush (*Purshia tridentata*). Pinyon-juniper woodland communities may include emergent ponderosa pine trees. Understory shrub species typically vary with slope and aspect, and may include a mix of mountain mahogany (*Cercocarpus montanus*), curl-leaf mountain mahogany (*Cercocarpus ledifolius*), Gambel oak (*Quercus gambelii*), greenleaf manzanita, and antelope bitterbrush among others. Pinyon-juniper woodland communities are not confined to Claron exposures, and also occur on the older Cretaceous formations exposed east of the Paunsaugunt Fault or in the lower elevation bench lands in the southern areas of the park.

The submontane forest vegetation zone includes ponderosa pine woodlands and high plateau sagebrush shrubland communities. Ponderosa pine woodlands are common on the upper slopes of the Paunsaugunt Plateau in the northern sections of BRCA, up to an approximate elevation of 2,590 m (8,500 ft) (Buchanan 1992). Smaller stands of ponderosa pine woodland also occur on alluvium in drainage systems at lower elevations. Typically these ponderosa pine woodlands become established on level to moderate slopes with some soil development. The open canopy of the woodlands allows establishment of shrubs, grasses, and forbs in the understory, especially where deeper soils have developed. Shrub understories include various combinations of greenleaf manzanita, antelope bitterbrush, and Fendler's mountain-lilac (*Ceanothus fendleri*). The short stature of these shrubs results in part from the depth of insulating snow cover in the coldest winter months (Buchanan 1992).

Winter cold is likely a limiting factor to tree recruitment in high plateau sagebrush shrubland communities. Shallow, flat-bottomed valleys on the top of the Paunsaugunt Plateau collect cold air draining downward from higher terrain, creating a significant temperature differential between the forested slopes and the sagebrush shrubland communities established in the valley meadows. Soils are also typically deeper in these valleys than in forested areas. The dominant shrub is black sagebrush (*Artemisia nova*), in association with rabbitbrush (*Chrysothamnus nauseosus*) spineless horsebrush (*Tetradymia canescens*), and other short and dwarf-shrub species. A variety of bunchgrasses, sedges and forbs also occur in the understory (Buchanan 1992; Fertig and Topp 2009) .

The montane forest zone occurs above 2,590 m (8,500 ft), and includes dense stands of mixed conifers, with occasional remnant quaking aspen *(Populus tremuloides*) groves on mesic sites. White fir (*Abies concolor*) is often the dominant species, and Douglas-fir (*Pseudotsuga menziesii*) is common. Ponderosa pine and Rocky Mountain juniper (*Juniperus scopulorum*) occur on warmer, drier slopes and blue spruce (*Picea pungens*) is typically established in moister deep ravines or on steep north-facing slopes. Montane forest understories are typically sparse, and may include shade-tolerant shrubs and forbs, including common juniper (*Juniperus*

*communis*), mountain snowberry (*Symphoricarpos oreophilus*), and mountain-lover (*Pachystima myrsinites*) (Buchanan 1992; Fertig and Topp 2009).

## Geology

The geologic history and general distribution of vegetation in relation to geologic exposures across the BRCA mapping area is described below, organized from oldest to youngest rocks. Each exposure is further illustrated with photographs acquired by field crew members during the vegetation mapping work. The following description of BRCA geology is derived from Davis and Pollock (2000), DeCourten (1994), and Foos (1999).

Dakota Formation (Upper Cretaceous,approximately 96 million years ago): The Dakota Formation in BRCA is approximately 70-100 m (200-300 ft) thick, composed mostly of sand- and siltstones with the addition of some conglomerates, and contains a variety of fossils, carbonized wood, and coal. Fossilized clams and snails from coastal environments suggest deposition occurred in a variety of near to offshore coastal plain environments which were being inundated by the advancing sea. Within BRCA, the Dakota Formation is exposed in the lower Yellow Creek drainage on the eastern park boundary, and supports sparse shrublands characterized by species of saltbush and sagebrush (*Atriplex* spp. and *Artemisia* spp., Figure 5).



**Figure 5.** *Atriplex* and *Artemisia* spp. shrublands on Dakota Formation in Yellow Creek.

Tropic Shale (Upper Cretaceous, (approximately 90 million years ago): Tropic Shale is fossil rich and approximately 250-350 m (700-1,000 ft) thick, forming the dark grey shale badlands exposed within the Tropic Valley. These badlands are exposed along the eastern park boundary near the town of Tropic, from Yellow Creek north to Cope Canyon. The easily erodable shale has formed deeply gullied, steep, smooth-sided hillslopes which support sparse shrublands of four-wing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), big sagebrush (*Artemisia tridentata*), crispleaf buckwheat (*Eriogonum corymbosum*) or siltbush (*Zuckia brandegeei*) associated with the grasses squirreltail (*Elymus elymoides*), saline wildrye (*Leymus salinus*),and/or galleta (*Pleuraphis jamesii)* and occasionally with low cover two-needle pinyon pine-Utah juniper woodlands (Figure 6).




**Figure 6.** *Zuckia brandegeei* shrublands on Tropic Shale in Death Hollow.

Straight Cliffs Formation (Upper Cretaceous, approximately 85 million years ago): The Straight Cliffs Formation represents the gradual transition from shallow marine conditions to coastal swamps, lagoons and fluvial environments. Up to 550 m (1,300-1,700 ft) thick in the BRCA region, it is composed of a series of gray and brownish shales and sandstones, interbedded with coaly or carbonaceous mudstones and significant layers of coal. The Straight Cliffs characterize most of the eastern half of the park, and generally occur as yellowish-gray steep talus slopes, ledges and bedrock outcrops. They typically support two-needle pinyon pine – Utah juniper woodlands or Gambel oak shrublands, but can support a variety of other vegetation types, including woodlands or forests of white fir, ponderosa pine, Douglas-fir, or curl-leaf mountain mahogany with a variety of understory species including greenleaf manzanita, common juniper, mountain snowberry, muttongrass (*Poa fendleriana*), squirreltail, and saline wildrye (Figure 7).




**Figure 7.** Pinyon – juniper woodlands on Straight Cliffs formation in Noon Canyon and Pasture Wash.

Wahweep Formation (Upper Cretaceous, approximately 80 million years ago): The Wahweep Formation was deposited atop the Straight Cliffs, and together with the Straight Cliffs forms the Grey Cliffs, the next geologic step down from the Pink Cliffs in the Grand Staircase. It can be a challenge to distinguish between the Straight Cliffs and the Wahweep Formation rocks. The Wahweep Formation tends to have finer-grained rocks, so there are fewer sandstones and more gray siltstones and purple-gray mudstones; slopes are generally more uniform with fewer interruptions by ledges and other bedrock outcrops. Deposited in an environment of swampy ponds, where water from a great inland sea was slowly retreating, it contains fossils of many

plants and animals, including fossils of dinosaurs. In the BRCA region the Wahweep Formation can reach 230 m (700 ft) in thickness and may appear light-brown, gray or white in color. The Wahweep Formation occurs with the Straight Cliffs Formation along the eastern half of BRCA, and supports a variety of vegetation communities including two-needle pinyon pine – Utah juniper /Gambel oak woodlands, shrublands of black sagebrush, pygmy sagebrush (*Artemisia pygmaea*), antelope bitterbrush or yellow rabbitbrush (*Chrysothamnus viscidiflorus*), grasslands of needle-and-thread (*Hesperostipa comata*) or muttongrass, and forblands of hairy goldenaster (*Heterotheca villosa,* Figure 8).




**Figure 8.** Two-needle pinyon pine – Utah juniper / Gambel oak woodlands and pygmy sagebrush dwarf-shrublands on Wahweep Formation in the north end of BRCA.

Kaiparowits Formation (Upper Cretaceous, approximately 66 million years ago): The youngest Cretaceous rocks deposited near BRCA belong to the Kaiparowits Formation, grey sandstones and mudstones that were deposited in fluvial, flood plain and lacustrine environments. Although the Kaiparowits Formation can be hundreds of feet thick, near BRCA it never exceeds 35 m (100 ft) in depth. The Kaiparowits Formation cannot be identified with certainty within BRCA and no plant communities are described within this geologic context.

Deposition of the Wahweep and Kaiparowits formations coincided with the initiation of the Laramide Orogeny approximately 70 to 35 million years ago. During this event, compressive tectonic forces squeezed up a large region of the southwestern U.S., including the modern Rocky Mountains and the Colorado Plateau. Near BRCA, the Laramide Orogeny produced the Kaibab uplift, a long monoclinal upwarp in the geologic strata of the Colorado Plateau. BRCA lies on the western edge of the Kaibab Plateau uplift region, and its proximity to the Kaibab thrust fault system has led to speculation that the Paunsaugunt Fault might have originated as a thrust fault during Larimide times (Figure 9).

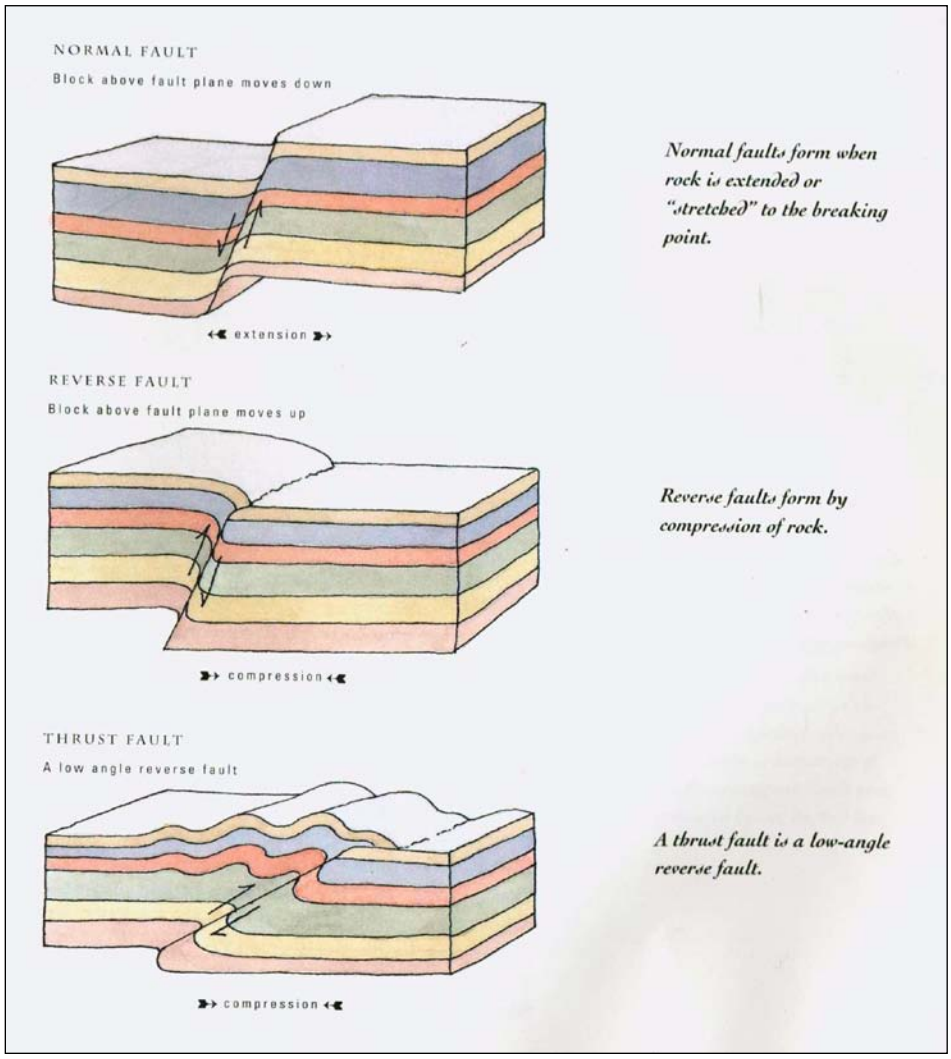



**Figure 9.** Diagram of a normal fault versus a thrust fault.

Pink Member of the Claron Formation (Eocene, approximately 50-60 million years ago): The Pink Member of the Claron Formation provides dramatic viewscapes within BRCA. It is roughly 150-250 m (500-700 ft) thick, and records a transition from fluvial environments to one of broad deltas and shallow lakes. The basal layers of the Pink Member of the Claron Formation are mostly limestones with inclusions of conglomerates and sandstones with upper layers represented by limestone and mudstone layers. Long periods between flood events have allowed for soil development and the establishment of plants. The indistinct bedding or layering of the Claron Formation has resulted from destruction of sedimentary structures by pedogenic (soil-forming) processes. Vegetation roots "churned" silt and mud particles together as they were deposited, obscuring details of the original layering and creating an oxidizing environment resulting in red and pink iron oxide hues exposed in the hoodoo landscapes within BRCA. Pedogenesis can impart a vertical internal fabric on the rocks which may be a contributing factor to the vertical erosion of the Claron Formation observed at BRCA. The Pink Member of the Claron is exposed in most of the western half of the park, and generally occurs as pink, red, tan, white or yellow steep talus slopes or "breaks", hoodoo spires, fins and variously shaped boulders

and outcrops. The breaks community includes extremely sparse woodlands of bristlecone pine, pinyon pine-Utah juniper, and/or ponderosa pine with associated shrubs including greenleaf manzanita, antelope bitterbrush, mountain mahogany, curl-leaf mountain mahogany, and Gambel oak as well as nearly homogenous shrublands of greenleaf manzanita (Figure 10).

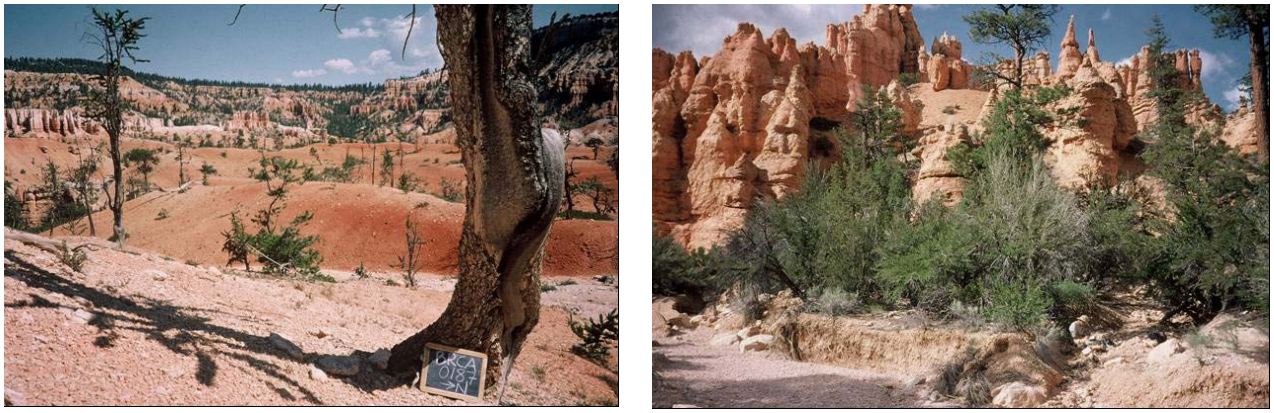


**Figure 10.** Bristlecone pine woodlands and hoodoo spires of Pink Member of the Claron Formation in BRCA.

White Member of the Claron Formation (Eocene, approximately 50-60 million years ago):
Above the Pink Member of the Claron Formation remnants of the White Member of the same formation are visible as interrupted caprock dotted across the top of the Paunsaugunt Plateau. Composed of cliff-forming limestones interbedded with thin purplish gray mudstones and siltstones, it was deposited in an environment of broad shallow lakes and contains freshwater gastropod fossils. It is more homogenous in composition and texture than the Pink Member of the Claron Formation (i.e., not as distinctly layered). Within BRCA, the White Member of the Claron Formation is visible at Bryce and Yovimpa Points. Vegetation communities on the White Claron are similar to those that occur on the Pink Claron (Figure 11).



**Figure 11.** Bristlecone and ponderosa pine woodlands on White Claron formation in BRCA.

Deposition of the Claron was complete some 50 million years ago. Approximately 25 million years ago the Marysville volcanic field, northwest of BRCA, began to spread ash over the region. After about 5 million years of activity, the southern part of the volcanic field began to collapse under its own weight. The result was the Ruby's Inn thrust, which folded and warped the Claron

Formation within BRCA. One of the dramatic results of this deformation is exposed in the northern portion of the park, where hoodoos have geologically older Straight Cliffs Formation caps atop younger Claron Formation bases.

Boat Mesa Conglomerate (Oligocene or Miocene, approximately 37 to 24 million years ago). The Boat Mesa Conglomerate, a roughly 15-30 m (50-100 ft) thick layer of fluvial deposits accumulated atop the Claron Formation. It consists of light brown, tan and gray calcareous sandstones and conglomerates, and light-gray to white limestones and conglomeratic limestones. Boat Mesa Conglomerates are exposed only on Boat Mesa within BRCA. On Boat Mesa, the vegetation community is curl-leaf mountain mahogany woodlands with a tall shrub understory of Gambel oak and mixed grasses (Figure 12).



**Figure 12.** A view of Boat Mesa and curl-leaf mountain mahogany woodlands growing on the Boat Mesa Conglomerate in BRCA.

Fifteen million years ago Basin and Range extensional faulting stretched the BRCA area in an east-west orientation. The result was the creation of the Sevier Fault, defining the western edge of the Paunsaugunt Plateau, and the creation (or the reactivation) of the Paunsaugunt Fault, located in the Tropic Valley east of the Pink Cliffs. Both faults are oriented north-to-south and the uplift on their eastern slopes defines the Paunsaugunt Plateau. The initial result of the faulting was to raise the landscape to the east of the Paunsaugunt Plateau to higher elevations than the plateau itself (Figure 13).

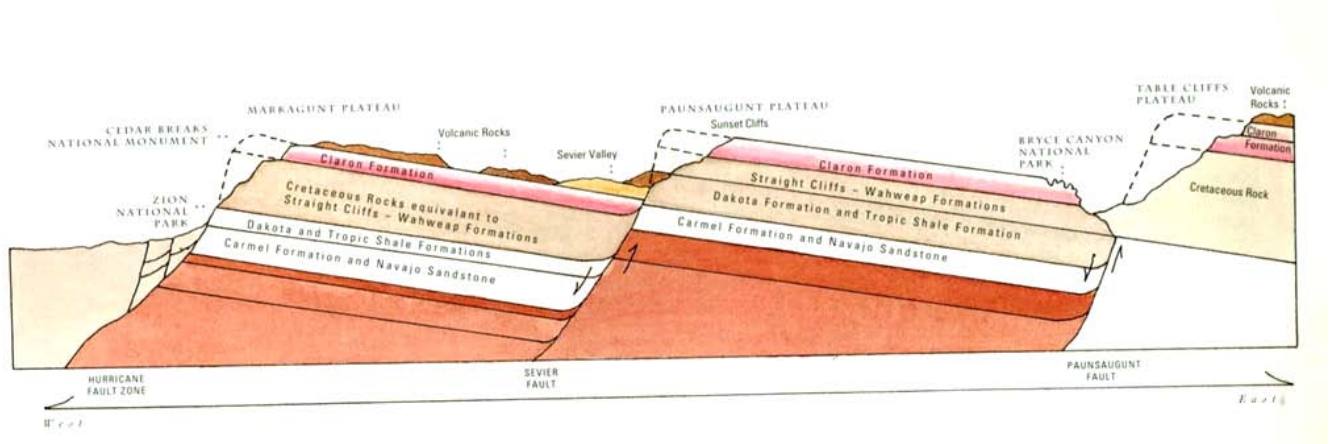



**Figure 13.** A diagram of the Paunsaugunt Plateau showing the Sevier and Paunsaugunt Faults.

The modern Colorado River system began draining the landscape approximately 5 to 10 million years ago, and rapid downcutting advanced north into the Colorado Plateau. In the BRCA area down-cutting was reflected in the headward erosion of the Paria River, which eventually removed the higher elevation geologic strata east of the Paunsaugunt Plateau and exposed the eastern flank of the Pink Cliffs (Figure 14).

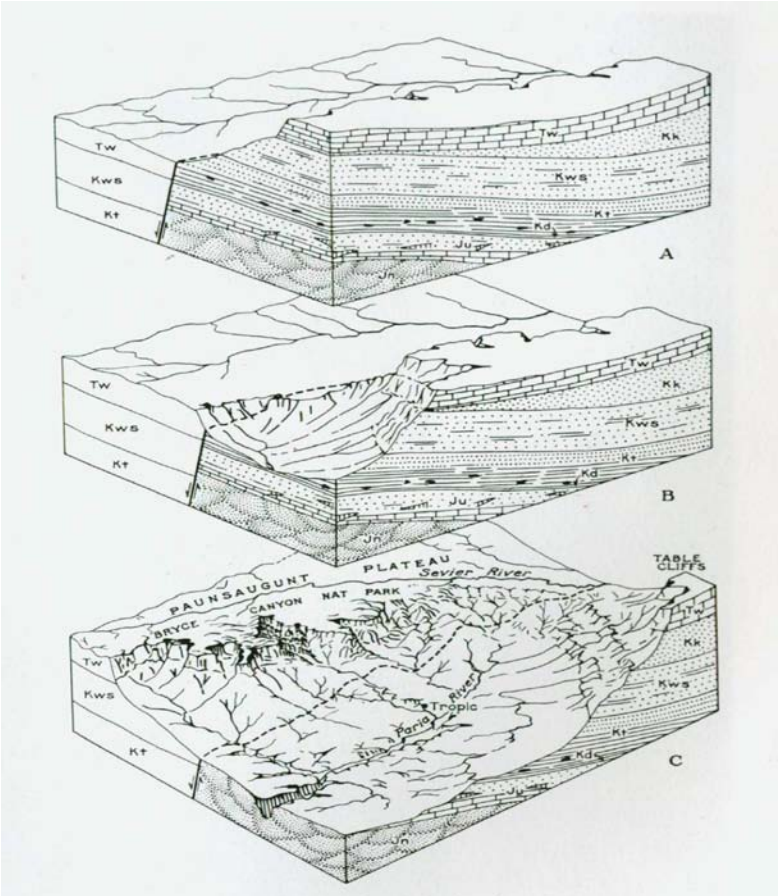



**Figure 14.** A diagram showing the downcutting of the Paunsaugunt Plateau by the Paria River.

Tributaries draining the plateau rim are steep, losing 150-460 m (500-1,500 ft) of elevation in less than 1.6 km (one mile). The steep gradient leads to rapid erosion and the removal and redistribution of large quantities of rock and sediment. Soils cannot develop and vegetation rarely becomes established on the steep slopes. It has been estimated that the Pink Cliffs currently recede at a rate of 0.3-1.2 m (1-4 ft) per century, resulting in the continuing formation of BRCA's intricate hoodoo landscapes. Moderate precipitation and an extended freeze-thaw cycle in the winter months accelerates the weathering of the exposed vertical surfaces under caprocks, while runoff from heavy rainfall during summer thunderstorms removes rocks, sediments, and debris to valley floors.

Surficial Deposits (Pleistocene and Holocene, approximately one million years ago to present): Surficial deposits are relatively common on the mesas and ridges, gentle to moderately steep slopes, and as alluvium within tributary drainages. 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, badlands/barrens, or other unvegetated map classes.

Colluvial deposits are common in BRCA and consist of several geologic strata that provide habitat for the establishment of woodlands and shrublands. Mesic colluvial sites may support blue spruce or white-fir forests and woodland and/or mesic shrublands including water birch (*Betula occidentalis*), Gambel oak, common juniper, and mountain snowberry. Dry colluvial sites typically support woodlands characterized by two-needle pinyon pine and Utah juniper or curl-leaf mountain mahogany, the shrubs greenleaf manzanita, mountain mahogany, antelope bitterbrush, black sagebrush, crispleaf buckwheat and spineless horsebrush, and the grasses muttongrass and saline wildrye (Figure 15).

Alluvial valleys above the plateau rim, as occur along East Creek and northeast of the Visitor Center, support wet meadows of Baltic rush (*Juncus balticus*), grasslands characterized by Kentucky bluegrass (*Poa pratensis*), muttongrass, and/or needle-and-thread grass, sometimes with moderate cover of spineless horsebrush, and shrublands of yellow rabbitbrush and/or Parry's rabbitbrush (*Chrysothamnus parryi*) (Figure 15).

Below the plateau rims, channel terraces, swales, and intermittent drainages support small pockets of coyote willow (*Salix exigua*) or chokecherry (*Prunus virginiana*) shrublands and woodlands of two-needle pinyon pine, Utah juniper, ponderosa pine, or white fir with mesic understories of Gambel oak or bigtooth maple (*Acer grandidentatum*). Dry gravelly washes and alluvial fans or floodplain terraces associated with the major drainages, and occurring mainly along the eastern park boundary, support shrublands characterized by basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), fourwing saltbush and rubber rabbitbrush, occasionally with grassy understories of saline wildrye, Russian wildrye *(Elymus junceus)* and/or western wheatgrass *(Pascopyrum smithii)* (Figure 15).




**Figure 15.** Blue spruce (a) and two-needle pinyon pine-Utah juniper (b) woodlands on colluvial deposits. Alluvial deposits above the rim, in East Creek, supporting Baltic rush herbaceous vegetation (c) and viscid rabbitbrush/needle-and-thread shrub herbaceous vegetation (d). Alluvial deposits in a swale below the plateau rim supporting chokecherry tall shrublands (e) and on a floodplain terrace supporting saltbush – big sagebrush mixed shrublands (f).

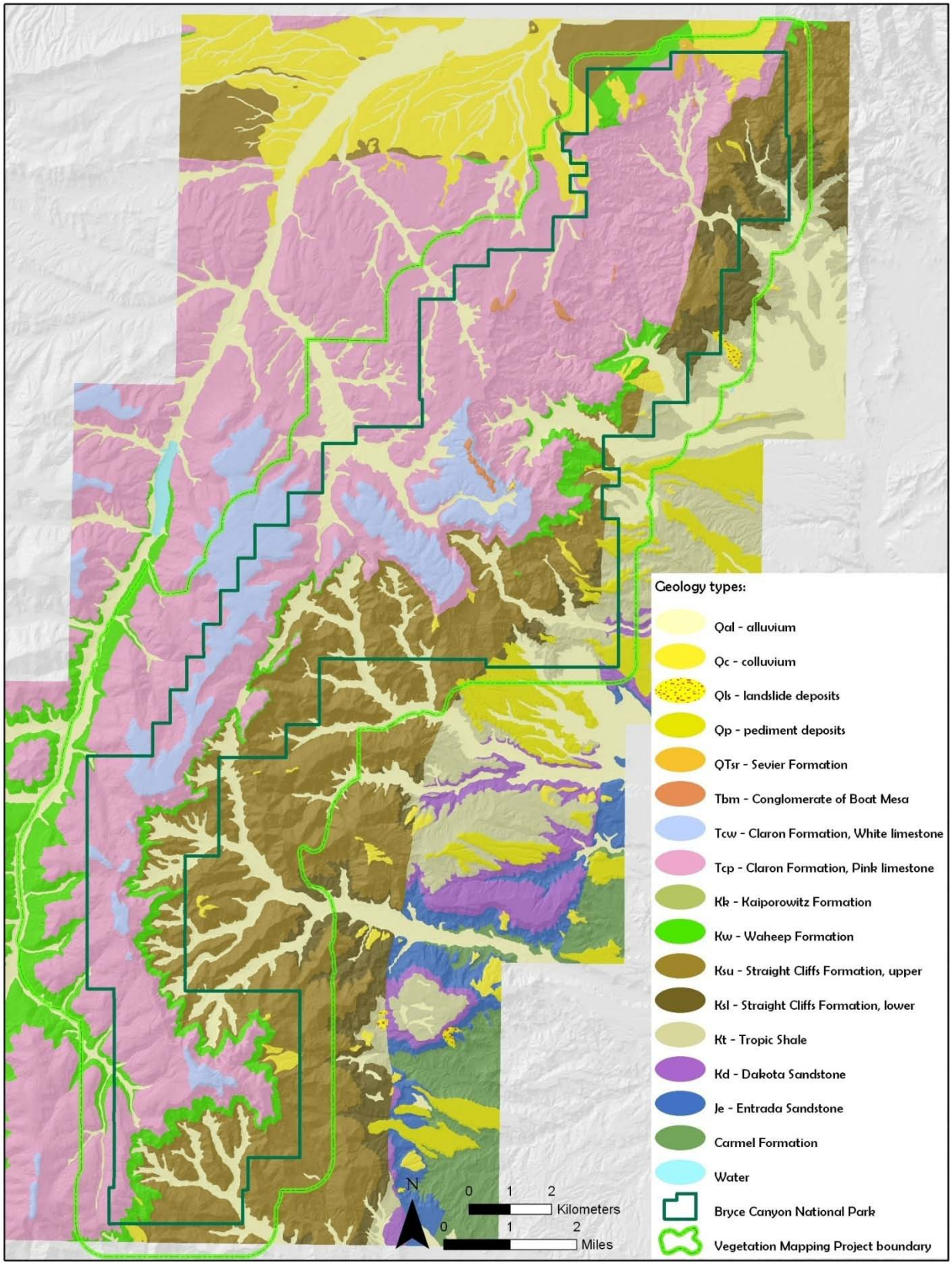



**Figure 16.** Geology map of BRCA and vicinity.

## Soils

The following information is summarized from USDA- NRCS (2009).

The most common soil mapping units within BRCA include cliff and ledge rock outcrops and rubble land areas of talus and colluviums with little soil development. The most common and widespread soil map unit in BRCA is the Badland-Rock outcrop-Paunsaugunt complex, occurring on level to moderately steep slopes and derived from calcareous sandstones and limestones. These alluvial soils are shallow and excessively drained. The secibd most common map unit is the Ruko-Podo complex, occurring on steep to very steep slopes of mountain sides. These well-drained, shallow soils are residuum weathered from shale. The third most common map unit is the Swapps gravelly loam which occurs on steep to very steep slopes on mesas and ridges in the southern portions of the Park. These are shallow to moderately deep, well-drained soils of residuum or colluvium derived from limestone. A few other common soil map units for BRCA are listed and described in Table 2. Many other soils of minor extent have formed within the park, but are not described herein.

**Table 2.** Common soil map units for the BRCA area.

| Soil Association | Description |
|---|---|
| Guben gravelly loam, dry | Deep, nearly level to moderately sloping, well-drained, gravelly loams on treed stream terraces. Alluvium derived from igneous or sedimentary rocks. Occurs mostly in the north end of the park. |
| Losee very gravelly loam | Deep, moderately sloping, well-drained, gravelly loams on mountain slopes and flanks. Alluvium derived from limestone, sandstone, and shale and/or colluvium derived from limestone, sandstone, and shale. Occurs mostly in the south end of the park. |
| Pahreah-Sheege complex | Moderately deep, level to moderately sloping, well-drained on ridges, mesas, summits and mountaintops. Colluvium or residuum derived from limestone. Occurs mostly in the central portion of the park on the mesa tops. |
| Pahreah-Swapps complex | Moderately deep, moderately sloping to steep, well-drained on mesas. Colluvium or residuum derived from limestone. Occurs mostly in the central portion of the park on the mesa tops. |
| Paunsaugunt gravelly loam | Shallow, nearly level to somewhat sloping, somewhat excessively drained, gravelly loams on hills, mesas, backslopes, and sideslopes. Alluvium derived from calcareous sandstone and/or limestone. Occurs mostly in the central and northern portions of the park. |
| Syrett-Vanet gravelly loams | Moderately deep, moderately sloping to steep, well-drained, gravelly loams on mesas. Colluvium or residuum derived from limestone. Occurs mostly in the central and northern portions of the park. |
| Ustic Torrifluvents | Deep, level, well-drained, occasionally flooded soils on alluvial fans. Alluvium derived from limestone and sandstone. Occurs mostly in the central and northern portions of the park. |
| Whiteman very cobbly, very fine sandy loam | Shallow, level, somewhat excessively drained, very cobbly, very fine sandy loams on ridges, mesas, summits, and mountaintops. Occurs mostly in the south end of the park. |
| Winetti gravelly sandy loam | Deep, level, somewhat excessively drained, gravelly sandy loams on floodplains. Mixed alluvium derived from limestone, sandstone, and shale. Occurs mostly in the far south end of the park. |

## Hydrology and Water Resources

BRCA forms a divide between waters flowing into the East Fork of the Sevier River, draining the top of the Paunsaugunt Plateau, and into the Paria River to the east of the Pink Cliffs. Typically the amphitheater areas of the northern portions of the Pink Cliffs are drained by

intermittent stream courses with steep gradients. These drainages are usually dry, but subject to extreme flash flooding, especially in the months of July and August. The notable exception is Water Canyon, which has a perennial flow fed by the East Fork of the Sevier River via the Tropic Ditch (Figure 17). In 1891 a diversion ditch was completed from the east branch of the Sevier River to Water Canyon to supplement the Paria River's flows (Scrattish 1985). The Tropic Canal crosses the northern end of BRCA and remains in operation today. There is a plan to transport flows via a pipeline for much of its length in the future, with the potential consequence that current wetland vegetation could be replaced by species adapted to drier conditions. The only other perennial stream course in the park is a short reach of the headwaters of Podunk Creek, draining the western side of Rainbow Point into the Sevier River.



**Figure 17.** Perennial flow in Water Canyon.

The park also has numerous small springs which emerge on the plateau top and along the steep slopes of the Pink Cliffs escarpment. Springs on the plateau top are generally of relatively low yield, and are typically fed by seasonally saturated alluvium. Early visitor facilities for BRCA relied on spring-fed water sources, but they soon proved inadequate. Thornberry-Ehrlich (2005) mentioned that a groundwater study was begun in 1957 after Trough and Shaker Springs (both used as park water sources at the time) dried up. Other springs in the park, especially those found below the Pink Cliffs, are fed by water moving through fractures, along bedding planes, or through permeable layers of formations such as the Wahweep or Straight Cliffs. These springs

tend to be fed by larger recharge areas than the former, and have a more perennial flow (Wenker 2004, Thornberry-Ehrlich 2005). The wetland areas found at the heads of the Paria tributaries along the southern portions of the Pink Cliffs, especially from Yellow Creek southwards, are fed by these bedrock springs.

Historically, many of these springs were sources of water for grazing allotments in the early years of BRCA. Riggs Spring, in the headwaters of Lower Podunk Creek (a different drainage than the Podunk Creek that feeds the East Fork of the Sevier River), was the scene of contention regarding the removal of cattle from the park. In 1964 Riggs Spring flows were diverted via pipeline to a trough outside of a new boundary fence line, and the era of legal cattle grazing wtihin BRCA came to an end (Scrattish 1985).

## Land Use and Settlement History

Bryce Canyon National Park was little used by prehistoric peoples; the oldest artifacts recorded from the park are two stone points tentatively associated with late Paleo-Indian or early Archaic culture, ca 9,500 B.P. (before present). Projectile points and other cultural artifacts (e.g., ceramics and storage structures) demonstrate a relatively continuous use of park lands and their environs by a succession of Native American cultures, including Archaic big game hunters, Fremont hunter/gatherers, early Puebloan agriculturalists, and protohistoric and historic Paiute tribes. Permanent occupancy within park lands has not been documented, use appears to have been confined to brief visits during food- and material-gathering forays from lower elevation areas (Wenker 2004). The Paiute Tribe, who still foraged in the area at the time of Euro-American contact, contributed an important legacy in the form of the many Numic language place names in use today.

Early Euro-American settlement in the Paunsaugant Plateau area began in the mid nineteenth century, focusing on the Sevier and Virgin river valleys to the northwest and west of BRCA. The first significant explorations across the plateau to the headwater areas of the Paria River occurred in the 1860s, principally by Mormon stockmen in search of additional rangeland (Wenker 2004). Members of the federally funded Wheeler survey visited the park region in 1872, and provided the first written account and drawing of the Pink Cliffs (Scrattish 1985: Wenker 2004). Members of the Powell and Dutton surveys also visited the area in the early 1870s, returning with exuberant descriptions of the landscapes of the BRCA area.

Settlement of the headwaters of the Paria River began in the late 1800s and by 1892 there were six Mormon communities established below the Pink Cliffs rim, three of which remain (Wenker 2004). European settlers used the Paunsaugunt Plateau uplands for grazing; the range provided summer forage for livestock. Ranchers from the west side of the plateau were running cattle in the BRCA area by 1874, and were soon joined by rancheers from the east side (Wenker 2004). The newly established Sevier National Forest began administering grazing allotments through a permit process in 1903. The early Forest Service allowed large herds to graze the allotments, and forage was severely impacted (Scrattish 1985). Livestock grazing may also have reduced the potential for natural wildfire in the northern portions of BRCA by eliminating the fine fuels (such as grasses) that carried fire through the ponderosa pine woodland and forest understory (Fields 2009).

Bryce Canyon National Monument was originally created in 1923 by proclamation of President Warren G. Harding, and included 2,946 ha (7,280 acres). The following year Congress enacted legislation that would have enabled the monument to become Utah National Park, as soon as all of the property within the park boundaries had been acquired by the federal government. Acquisitions were completed by 1928, and further legislation renamed the new park Bryce Canyon National Park (BRCA) and redrew its boundary, doubling its size from the original monument. Two further additions of land were made in 1931, bringing BRCA to its present size (Scrattish 1985).

When BRCA gained national park status in 1929, one of the provisions was that existing grazing rights would continue to be honored. However, the NPS was allowed to apply severe restrictions on the transfer of those rights, with the intent of eventually eliminating grazing from park lands. A fencing project began in 1935, with the goal of decreasing grazing within the park (Ironside, Ikeda, and Cobb 2007). The number of permittees consequently declined, and livestock grazing in BRCA ceased in 1964 (Scrattish 1985). Some trespass grazing may occur in meadows on the eastern edge of the park.

Logging occurred in the northern portions of present-day BRCA to provide lumber for towns estaplished below the plateau rim. In addition to timber cutting, several sawmills were constructed in the area, including one in the northeast corner of the park. Another sawmill, located west of the visitor center site, processed finished lumber for sale in Salt Lake City (O'Dell et al. 2005). Commercial logging and sawmill operations were eliminated from the site as soon as Bryce Canyon National Monument was established in 1923 (Wenkler 2004).

Concurrent with the commercial harvesting of timber was the practice of wildfire suppression, a policy initiated by the USFS and continued by the NPS until prescribed fire was introduced in the contemporary era. Fire suppression contributed to a significantly altered assemblage of plant species throughout BRCA (O'Dell et al. 2005). Forested areas became denser, had reduced species diversity, and deadfall and duff increased substantially in the absence of fire. Many meadow areas were encroached upon by sagebrush (Wenkler 2004). Quaking aspen, the first tree species to colonize burns in the higher elevations of the park, began to decline as stands were replaced by mixed conifers (Buchanan 1992).

The use of prescribed fire to reduce fuels and mimic natural fire effects began within BRCA in 1990; the first burns were conducted around the headquarters building. At present most of BRCA from the park entrance south to Swamp Canyon has been treated at least once, with some areas (around residences) treated up to three times. As a result of prescribed burning, these areas are now open woodlands considered resistant to high-intensity canopy fires. Prescribed fire has been used less often in the mixed conifer forests of the southern portions of BRCA, but planning is in process or has been completed for significantly more burns to be performed in the future. (Fields 2009)

Tourism-related impacts on BRCA resources have occurred for nearly 100 years, beginning with the promotional activities of Sevier National Forest Supervisor J. W. Humphrey. Starting in 1915, Humphrey publicized the scenic view from the Pink Cliffs and solicited funds for developing tourist access. During 1919 the Utah state legislature voted to request that the U.S.

Congress establish a national monument at "Bryce's Canyon," while Utah Senator Reed Smoot introduced legislation in Congress to designate the site a national park. Visitation rapidly increased, and the USFS began building access roads and trails along the rim above Bryce Amphitheater. In anticipation of the area's future park status, The Utah Parks Company, a subsidiary of the Union Pacific Railroad, began planning for construction of a large tourist facility on leased Utah state lands, conveniently located near the canyon rim. Construction of Bryce Canyon Lodge began in 1924, a year after Bryce National Monument was established. (Scrattish 1985)

In the past decade BRCA visitation has approached one million annually, with the majority of visitors remaining within the 252-acre developed area surrounding the Lodge, park campgrounds and rim trail system. Consequently, this area is severely affected by tourist activities, including social trail establishment, trampling of plant communities, and the habituation of wildlife to humans (NPS 2009b; O'Dell et al. 2005). Vehicles use roadways extending nearly the length of the park; possibly providing a vector for exotic plant introduction, both from visitor automobile tires and clothing, and from equipment used for and soil disturbance resulting from road maintenance operations.

## Previous Vegetation Studies

### *Plant Species*

Fertig and Topp (2009) include a detailed history of plant collectors working in BRCA or its immediate vicinity; the following discussion summarizes the botanical information.

The first plant collection in the BRCA vicinity (by Utah botanist Marcus E. Jones) occurred in 1894, but it was not until the late 1920s that new species were first documented from within the new national park. In 1931 Kenneth Weight established the BRCA herbarium, and initiated the first major study of the park flora. He documented 144 new species between 1931 and 1935. Mr. Weight published the first botanic checklist for the park and vicinity in 1933, listing 286 taxa. Many holotypes of Claron Formation endemic species were collected from within the park or in nearby Red Canyon during the 1930s and 1940s. The area was often a destination for taxonomists from outside of Utah, and many prominent botanists contributed to the growing list of new species.

Hayle Buchanan began floristic studies in BRCA as a graduate student in the late 1950s, and contributed 94 new species to the floristic list; he continued to conduct research in the park in the 1960s and 1970s, and co-authored a revised park plant species checklist in 1971. In the late 1970s, Buchanan and a graduate student, Robert Graybosch, conducted a new study of BRCA vegetation communities and endemic plant species, adding an additional 157 species to the floristic list. Buchanan and Graybosch published another revised checklist in 1981, which included 446 species occurring within the park. Since 1980, a variety of floristic studies have occurred, and more than 100 additional plant species have been added to the park floristic list. Forty-seven species were vouchered or reported during the fieldwork for the present NCPN vegetation classification and mapping project. A revised checklist of documented vascular flora for BRCA was developed in 2009 by Walt Fertig and Sarah Topp and includes 587 species (of which 34 remain unvouchered). None of the species documented for the park are federally listed as threatened or endangered, however, 12 plant species are currently listed as sensitive and 22

species (4.2%) are defined as locally endemic.

### *Vegetation Communities*

The following is a summary of the information presented in Ironside et al. (2008) regarding vegetation classification within BRCA. In the late 1950s Hayle Buchanan began vegetation studies at BRCA that involved the establishment of nine connecting transect lines with 266 quadrats (all permanently marked) that ran almost the entire length of the park and extended along a 400 meter elevation gradient from ponderosa pine- to white fir-dominated forests (Buchanan 1960). These transects were revisited and subsequent data were collected in 1969-1970, 1978-1980 (Buchanan and Harper 1981), 1990-1992 (McKnight and Buchanan 1998), and 2007 by the Merriam-Powell Center for Environmental Research, Northern Arizona University (Ironside et al. 2008) with the goals of recording forest succession within BRCA.

The forest succession data recorded over the past 50 years reveals a general increase in forest density, particularly of high elevation forests, mainly due to white fir regeneration and replacement of Douglas-fir, limber pine, and ponderosa pine with white fir. Increased forest density has decreased the abundance of shade intolerant species, most notably quaking aspen. The low elevation forests dominated by ponderosa pine, by comparison, showed much less change in density or species dominance. Over the past 20 years, the use of prescribed burning in these low elevation ponderosa pine forests has reduced sapling density. Understory grass cover in these forests had shown a marked decline, but has increased in the past 20 years since prescribed burning was initiated.

In 1992, David Roberts, Doug Wight, and Gregory Hallsten completed a final report and dissertation titled “Plant Community Distribution and Dynamics in Bryce Canyon National Park.” Roberts et al. (1992) summarized field data collected from 1986-1989 in an effort to produce community and habitat types for BRCA, which were then used to create a habitat type map for the park. The final habitat type map and report were delivered to BRCA in 1996.

## Exotic Plant Management

Of the 587 vascular plant species documented for BRCA, 60 species (10.2%) are non-native, and of these, seven species are on the Utah noxious weed list: musk thistle (*Carduus nutans*), spotted knapweed (*Centaurea maculosa*), Russian knapweed (*Centaurea repens*), Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvensis*), whitetop (*Cardaria draba*), and leafy spurge (*Euphorbia esula*) (Figure 18). Weed inventories conducted from 2004 through 2006 determined that the twelve targeted exotic species of concern were absent in 98.66 percent of the areas inventoried. The authors of the weed reports also note that the areas inventoried were “generally considered the sites most likely to be infested” (Dewey and Anderson 2006). Of the twelve targeted species, field crews documented the presence of six: smooth brome (*Bromus inermis*), cheatgrass (*Bromus tectorum*), musk thistle (*Carduus nutans*), bull thistle (*Cirsium vulgare*), Russian olive (*Elaeagnus angustifolia*), and salt cedar or tamarisk (*Tamarix ramosissima*). The most abundant target species found was smooth brome.

In the spring of 2010, BRCA resource managers completed a Vegetation Management Plan and Environmental Assessment (NPS 2010). Ten steps for invasive plant management were described. These include: 1) Preventing new infestations by employing prevention and early

detection techniques; 2) Educating visitors and staff about invasive plants and their management; 3) Inventorying invasive plants in Bryce Canyon National Park; 4) Monitoring effectiveness of control efforts; 5) Tracking invasive plant management efforts; 6) Prioritizing both invasive plant species and locations to be controlled; 7) Working with adjacent landowners, local, state and federal agencies, local interest groups, invasive plant cooperative networks, and others to develop and achieve common goals of invasive plant management; 8) Identifying and evaluating the most appropriate control techniques: Mechanical control, Fire, Chemical control, or Biological control; 9) Creating annual work plans to guide invasive plant management activities; and 10) Performing restoration work. The park is increasing efforts to manage exotic plant populations under the newly completed Vegetation Management Plan. Since 2006, resource management staff members have worked to eradicate/reduce invasive vegetation via mechanical and chemical methods over approximately 10 acres or more annually (NPS 2009b).



USU Weeds Survey Crew

**Figure 18**. Utah designated noxious weed species Canada thistle (*Cirsium arvense*) in BRCA.

# Project Overview

## General Approach and Timeline

The goals of this project were to inventory, describe, and map the existing vegetation and land use at Bryce Canyon National Park and its environs. The BRCA project is part of a larger effort undertaken by the NCPN to classify and map vegetation in all 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, 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 BRCA 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 Photography Field Office (APFO) and the USDI Bureau of Reclamation Remote Sensing and Geographic Information Group to acquire aerial photography for each park, including BRCA. Stereo aerial photography and orthophotography for BRCA were flown on June 27, 2002.

**Table 3.** Timeline for BRCA vegetation mapping project tasks.

| TASK DESCRIPTION | 2002 | 2003-2004 | 2005-2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| 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 were collected by NCPN and e²M ecologists at BRCA during the 2005 and 2006 summer and fall field seasons. A gradsect analysis utilizing spatial representations of the environmental variables associated with the regional vegetation diversity was developed to help determine classification plot placement. A cost surface analysis was generated to aid in the efficient sampling of ecological plots and a simulated

annealing routine, Marxan, was used to determine the final sampling design. This field sampling strategy guided by a gradsect polygon or biophysical unit coverage was prepared by Michael Schindel of NatureServe and Gery Wakefield of NPS-SEUG.

Vegetation plot data were entered into a MS Access database developed for the project and were analyzed during the fall of 2006 by NatureServe ecologists. The final assignment of 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 November 2010. An illustrated field key to BRCA 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 BRCA vegetation map was completed by the PI consultant 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 variety of photo interpretation methods were performed. Preliminary linework, performed by USGS contractors, was created by electronic segmentation methods (e-Cognition software) and used as a starting point. The primary photointerpreter highly manipulated this linework using ArcGIS editing tools by onscreen, heads-up digitizing. Additionally, interpreted polygons were drawn on Mylar overlays of 9x9-inch aerial photographs and were then transferred to a digital format using heads-up digitizing. Polygon attribution was completed by the primary photointerpreter, following standards developed by NCPN for all park mapping projects (Evenden 2004). A guide to the map classes was drafted in 2008, with final revisions made through the fall of 2010.

A draft vegetation map and associated spatial database were completed for BRCA in early summer 2007. Accuracy assessment (AA) data collection was completed by NCPN and $e^2M$ ecologists during the fall of 2007. AA data were entered into the BRCA project database and then analyzed, with results tabulated into a contingency matrix. An AA meeting for BRCA was held June 10-12, 2008 at the NatureServe office in Boulder, Colorado with project cooperators from NPS, NatureServe, Cogan Technology, Inc., and $e^2M$ to determine which map classes should be retained and which should be combined because they failed to meet the 80% accuracy standard. Final revisions were made to the vegetation classification, field keys, vegetation map, and spatial database from winter 2008 to spring 2009 and from late summer to early winter of 2010. 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 BRCA Classification and Vegetation Mapping Project. The roles of each contributor are described below.

**engineering-environmental Management, Inc.**

- *Jim Von Loh, Senior Biologist* – prepared project work plan, helped prepare agendas and compile minutes for project meetings, prepared and field tested AA field key and wrote draft association local descriptions, assisted with photointerpretation, participated in AA meeting, contributed to final report
- *Dan Niosi, Natural Resources Specialist* – prepared project work plan
- *Sharon Anderson, PhD, Botanist* – prepared project work plan

- *Stephanie Shoemaker, Consulting Ecologist* – collected plot, observation point, fuels, and AA 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, contributed to the final report, organized project meetings, managed budgets, agreements and contracts
- *Amy Tendick, Ecologist* – primary author of the final report, coordinated creation of final products, collected plot, fuels, and AA data, assisted with photointerpretation and map class development, finalized vegetation map, edited final AA field key and map class guide, participated in AA meeting
- *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* – field crew leader for plot, observation point, fuels, and AA data collection, assisted with photo interpretation and map class development, field tested and revised map class guide and AA field key
- *Bruce Condie, Sarah Topp, Biological Technicians* – collected plot, observation point, fuels, and AA data
- *Gery Wakefield, GIS Team Leader* – provided project boundary coverage, created a gradsect from various ecological datasets to develop target preliminary plots for field sampling, 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, Bryce Canyon National Park**

- *Kristin Legg, Chief of Resources* –participated in scoping meeting, provided logistical support
- *Bruce Fields, Fire Management Officer*- participated in scoping meeting, assisted with fuels training, provided logistical support, and provided fuels data to GIS specialist

**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

**Cogan Technology, Inc.**

- *Dan Cogan, Ecologist, GIS Manager* – primary photointerpreter for the project, developed initial map class concepts, generated initial accuracy assessment contingency table, participated in AA meeting, made edits to vegetation map and map classes post-AA meeting, contributed to final report, wrote draft metadata

**USGS Rocky Mountain Geographic Mapping Center**

- *Tom Owens, Former USGS Program Leader, Photography Specialist* – conducted overview meeting, analyzed aerial photography, PI training, reviewed legacy data

**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
- *Michael Schindel, TNC Oregon Ecologist* – created a gradsect from various ecological datasets to develop target preliminary plots for field sampling
- *Mary Russo, Ecology Data Manager* – entered BRCA 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., USGS Program Leader* – provided national level program oversight
- *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 park units, including BRCA.

To maximize cost savings, the NCPN planned to acquire aerial photography concurrently for several park units. In order to minimize shadow effects associated with canyon topography and maximize vegetation expression, the goal was to minimize the sun angle by flying as close as possible to noon on 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*

The NCPN contracted with Horizons, Inc. or Rapid City, South Dakota to acquire new 23 cm x 23 cm (9 in x 9 in) true color aerial photographs for BRCA. The imagery was acquired on June 27, 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 282 linear km (175.3 miles) divided among 5 flight lines and 51 individual photos (Figure 19).

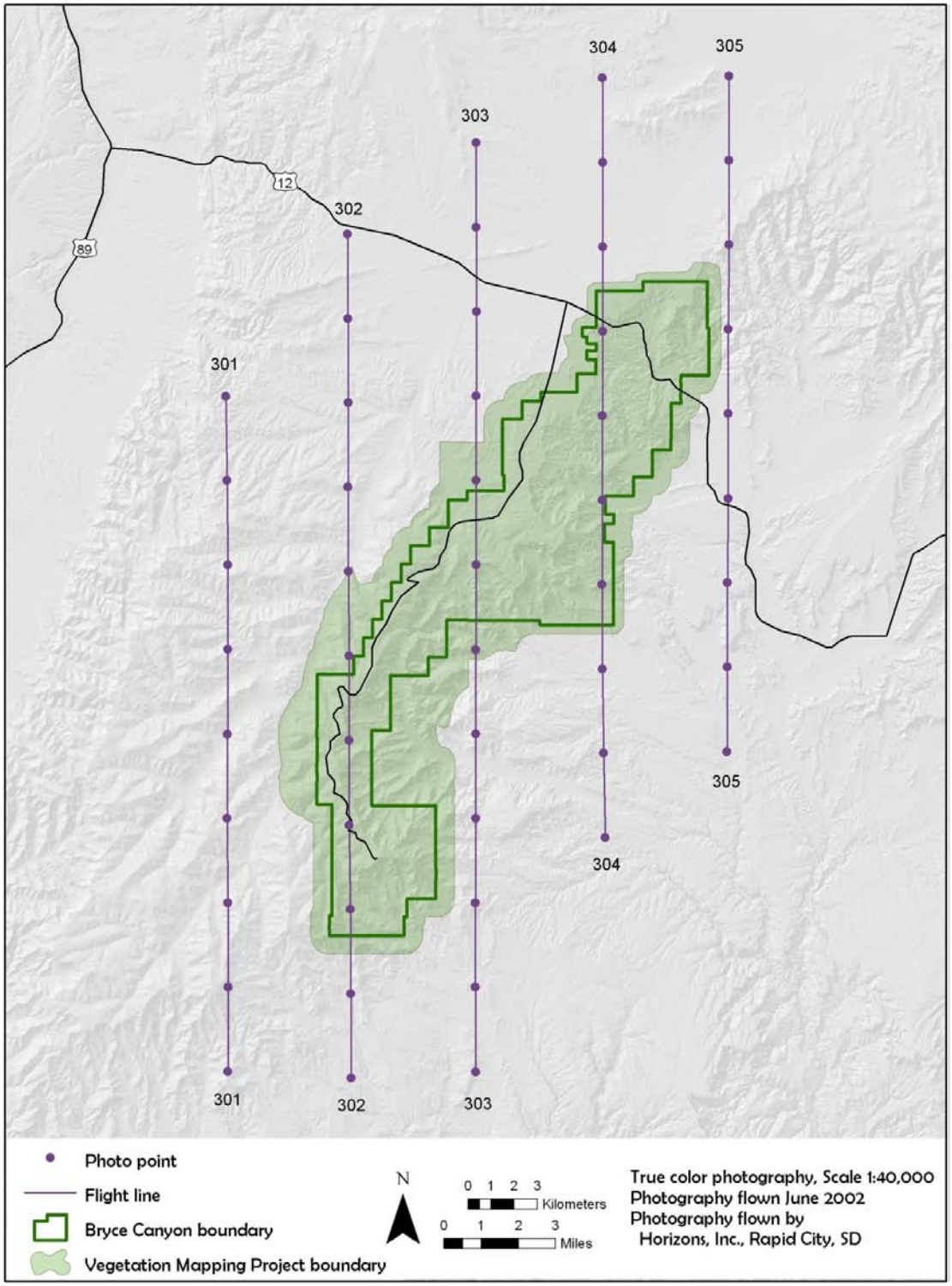



**Figure 19.** Flight lines for the 2002 stereo aerial photograph coverage of BRCA.

Figure 20 is an example of the 23 cm x 23 cm aerial stereo photographs for BRCA. These photographs were used for photo interpretation during the mapping phase of the project, as well as by field crews during plot 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 BRCA; the other is retained at the NCPN offices in Moab, Utah.




**Figure 20.** Example of a 9” x 9” stereo aerial photograph taken for the BRCA vegetation classification and mapping project.

### *Digital Orthophotos*

The USBOR Remote Sensing and Geographic Information Group in Denver, Colorado, produced 1:12,000 scale digital orthophotography for BRCA from new imagery. This work was subcontracted to Horizons Inc. of Rapid City, South Dakota. The photography was flown on June 18, 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. Aerial coverage was similar to the stereo photo imagery (Figure 20).

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 BRCA 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 strip approximately 1.6 km (1 mile) wide around the park boundary was chosen by network and BRCA staff at the July, 2001 scoping meeting (Figure 2). The total project mapping area is 23,754 hectares (58,697 acres). Of this area, 14,614 ha (36,113 acres) are within the BRCA boundary and 9,140 ha (22,584 acres) are in the environs. The environs were delineated to provide data to support management coordination on adjacent private, USFS, and BLM 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 much smaller than the standard 0.5 ha (1.24 acre) minimum mapping unit (MMU).

## Ecological System Classification

The NCPN elected to use 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 Colorado and 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 BRCA 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-seven ES units are known to occur within the BRCA vegetation mapping project area (in alphabetic order with NatureServe identifying codes):

- Colorado Plateau Mixed Low Sagebrush Shrublands (CES304.762)
- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
- Great Basin Semi-Desert Chaparral (CES304.001)
- Inter-Mountain Aspen-Mixed Conifer Forest and Woodland (CES304.776)
- Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
- Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)
- Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland (CES304.772)
- Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)
- Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
- Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
- Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
- Inter-Mountain Basins Shale Badland (CES304.789)
- Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)
- Inter-Mountain Basins Wash (CES304.781)
- Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
- Rocky Mountain Aspen Forest and Woodland (CES306.813)
- Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)
- Rocky Mountain Cliff, Canyon and Massive Bedrock (CES306.815)
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)
- Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
- Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)
- 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 Ponderosa Pine Woodland (CES306.648)

# Vegetation Classification and Description

## Pre-Field Methods

### *Preliminary Classification List*

A preliminary list of plant associations was completed for BRCA using the classification and species occurrence information provided by Roberts et al. (1992), Buchanan (1960), Buchanan and Graybosch (1981), McKnight and Buchanan (1998), and the BRCA web site for initial guidance. The process began by accessing NatureServe, and sorting associations by applicable United States Forest Service (USFS) ecoregions as described by Bailey (2001). This list was further focused, according to dominant species and by legacy data, thus eliminating those not likely to occur at BRCA. List preparation was performed by plant ecologists familiar with the vegetation of the Northern Colorado Plateau and checked by NPS regional and park ecologists who are familiar with the vegetation types present within BRCA. The final preliminary plant association list for BRCA/CEBR contained 249 plant associations for the vegetation mapping project area. The 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*

Plot data for BRCA (Roberts et al.1992) were evaluated for adequacy and/or relevance to the National Vegetation Classification and Mapping program at BRCA. The main limitations of the legacy data are the compatibility in sampling approach and methods (plot size variance in both Roberts and Buchanan data sets, and lack of strata cover data for Roberts), age of data for Roberts data and for the older data sets of Buchanan (evidence exists for the potential for change in vegetation structure in BRCA), and adequacy of geo-referencing (a topographic map exists of plot locations, with plot coordinates having been derived from digitization of the map for Roberts data, but no coordinates are available for the Buchanan data).

Buchanan's data sets from 1960, 1980, and 1993, and Roberts et al. (1992) BRCA data sets were evaluated. Legacy data sets fell within Category III, e.g., "*data can be used for vegetation classification and characterization of a vegetation type within the park, but not for mapping or analysis because the sample is not adequately geo-referenced, contains inadequate detail in the vegetation information, and/or may not represent existing vegetation at the sample location*". As such these data are considered most useful to assist with: 1) planning a sampling approach; 2) guiding further data collection; 3) providing aerial photo signature guidance and/or validation; 4) writing local plant association descriptions; and 5) preparing the final mapping project report.

### *Field Methods*

The primary purpose of classification plot data was to document the composition and structure of BRCA vegetation and the 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 and park managers. Plot forms and individual data field descriptions appear in Appendix B.

### *Field Sampling Approach*

The sampling area included the entire park as well as U.S. Forest Service and BLM lands in the environs. Private lands in the environs were not visited. Because the project area is topographically complex and access can be difficult, the areas to be sampled were selected in advance of the 2005 field season. In order to obtain a thorough sample of the range of plant communities both common/extensive and rare/unique, a method to stratify the park using a Gradsect (GRADient-directed TranSECTs) approach was employed (Austin and Heyligers 1989, Gillison and Brewer 1985). A gradsect area survey method that addresses: 1) the need for representative sampling based on environmental stratification, 2) the need for a compromise between statistical sampling, practical logistical problems and costs, and 3) the value of replicated and randomized sampling (Austin and Heyligers 1989, Gillison and Brewer 1985) was used so that field crews would visit the full spectrum of physical environments and thus most of the vegetation types.

For the BRCA modified gradsect, geology and solar insolation were chosen as the key abiotic factors (Table 4). The selection was based on gradsect biophysical units (BPUs) designed to ensure that all major environmental settings were visited and a good spatial dispersion of sample plots was achieved. The BPUs were constructed by layering geology and solar insolation (an index of sun exposure based on aspect and landscape position) information. The result was a set of polygons representing unique combinations of these environmental factors. The "cost" (distance from road or trail multiplied by a factor accounting for steep slopes) of accessing each polygon was calculated, and the polygons deemed too difficult or dangerous to access were withdrawn. A random sample of polygons representing each combination of factors became the target areas for sampling, although field crews were encouraged to use their judgment and sample areas outside the BPUs if they contained representative or unusual vegetation types.

Field crews were led by ecologists with experience sampling plant communities in national parks and other landscapes. The list of 249 potential plant associations provided a starting point for naming communities sampled in the field. The sampling goal was to collect between three and five classification plots in every vegetation association within the BRCA 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 plots across the landscape and to capture the full range of variation of each association. Field data were collected following USGS-NPS protocols during the 2005 and 2006 field seasons. Two hundred forty four plots and observation points were sampled in 2005 and 305 plots and observation points were sampled in 2006.

**Table 4.** Key abiotic factors and environmental variables used in the modified Gradsect analysis for BRCA.

| Key Abiotic Factors | Environmental variables |
|---|---|
| Solar Insolation | Dark (shade) |
| | Less dark (partial shade) |

| | |
|---|---|
| | Less bright (partial sun) |
| | Bright (full sun) |
| Geology | Quaternary Alluvium |
| | Miocene Conglomerate |
| | Eocene White Member Claron Formation |
| | Eocene Pink Member Claron Formation |
| | Upper Cretaceous Wahweep-Straight Cliffs Formation |
| | Tropic-Dakota Formations |

### *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. Highly disturbed areas were also avoided unless they covered several hectares. Plots were generally located in stands exceeding the minimum mapping unit (MMU) of 0.5 hectares. A few 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 5). 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 5.** Plot sizes used for vegetation classification sampling at BRCA.

| 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 6):

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

Location and Plot Identifiers. BRCA 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 6 and are described in detail in Appendix C. Locations were recorded on topographic maps during each field trip to avoid duplication of effort and ensure that the park was adequately sampled.

**Table 6.** 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 (1979) 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 |

Environmental Description. The physical characteristics of each 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.

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 7. Consistent and repeatable cover estimates were obtained by relating the area occupied by an individual species to the area of the entire 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 7.** Vegetation cover and height classes used in the BRCA 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 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 plot were recorded in two 35 mm color slide photographs.

### *Data Processing and Analysis*

Four hundred and eight vegetation plots were sampled within the mapping project area during the 2005 and 2006 field seasons (Figure 21). Plot data were manually entered into the BRCA Vegetation Mapping Project Database, developed by the NCPN data management staff. This 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 network vegetation mapping projects, allowing compatibility of data across network park units. Fields associated with the BRCA plots database are described in Appendix C.

Each 35 mm slide associated with the project was scanned into a digital format. The 2,139 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 141 observation points within BRCA. 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 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 park 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 plots 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 BRCA 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, 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.

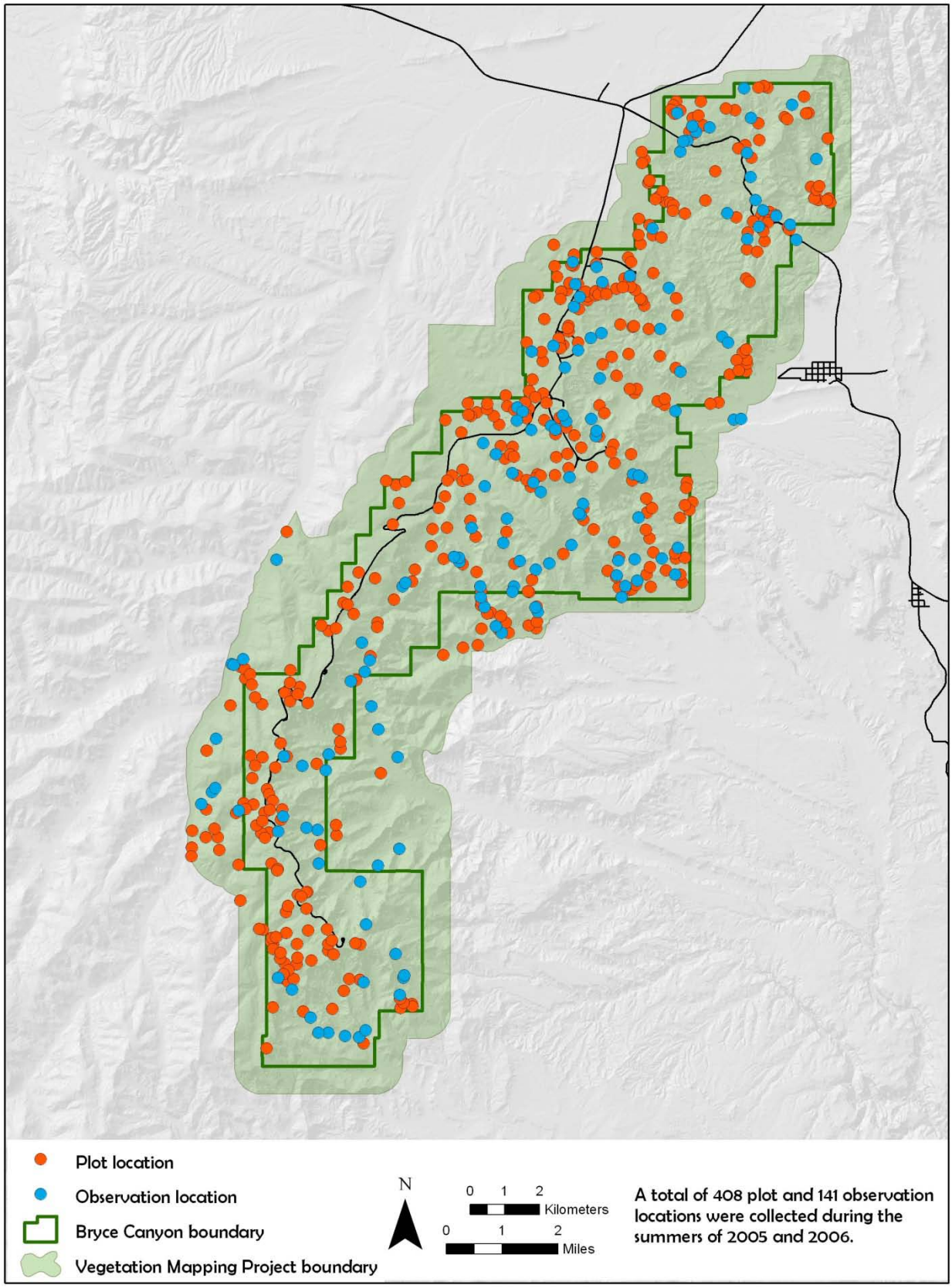



**Figure 21.** Vegetation plot and observation point locations in the BRCA mapping project area.

## 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 plots database, and then 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 BRCA and CEBR were combined into one data set for the purposes of efficiency and because ecologists thought many plant communities would be shared between the two parks. Conducting a combined analysis allowed us to test that assumption. The data set of 579 plots and 558 species was first evaluated to find outliers, which can potentially distort the matrix. Outlier analysis revealed very few outliers in BRCA and CEBR. 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, an Indicator Species Analysis (Dufrêne and Legendre 1997, as cited in McCune and Grace 2002) was performed 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). Initially ISA and Non-metric Multidimensional Scaling (NMS) ordinations were conducted on BRCA data alone to see how many groups might be present. The NMS ordinations on the BRCA data produced 15 groups after the first ordination (Figure 22):

- White Fir plots
- Quaking Aspen plots
- Manzanita plots
- Bristlecone Pine plots
- Saline Wildrye plots
- Antelope Bitterbrush plots
- Ponderosa Pine plots
- Tropic Shale Badlands/ Salt Scrub plots
- Grassland plots
- Snakeweed / Exotic Grasses plots
- Rubber Rabbitbrush plots
- Wet Meadow Herbaceous plots
- Black Sagebrush plots
- Pinyon – Juniper plots
- Gambel Oak plots

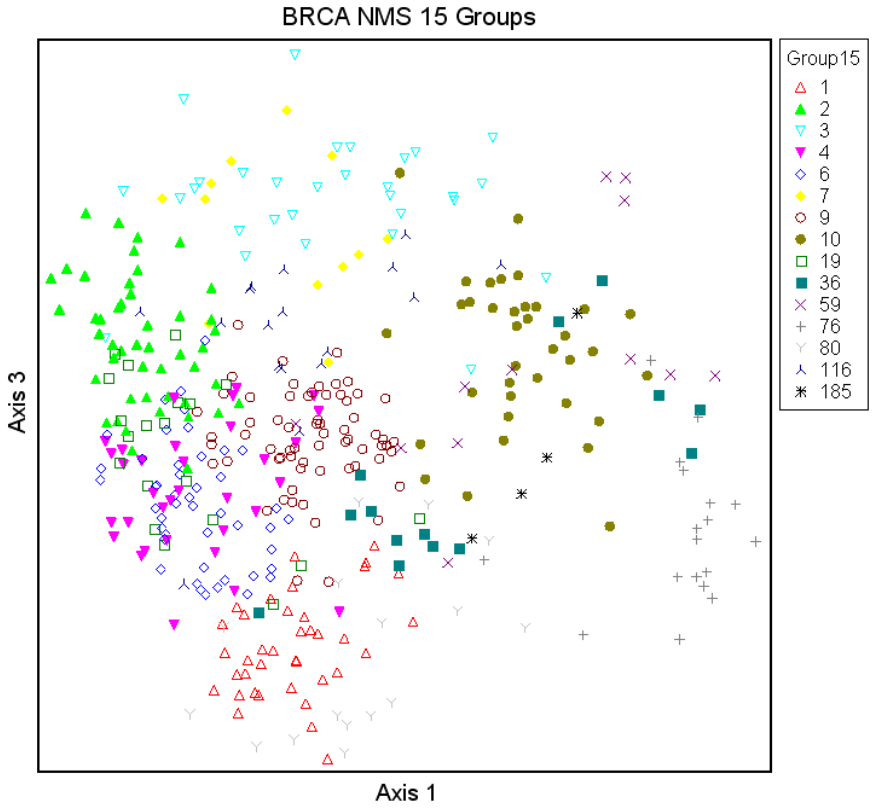



**Figure 22.** NMS ordination for BRCA showing 15 groups.

Cluster Analysis (CA) and Indicator Species Analysis (ISA) were then 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 (Figure 23). 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 ecological understanding and position in the initial cluster analysis (as per McCune and Grace 2002) and the ISA was re-run on all groups. This second Indicator Species Analysis confirmed that all groups had significant indicator species. A 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 the16 groups (Figure 24). Groups were further inspected for NVC Group, Alliance and Association level memberships.

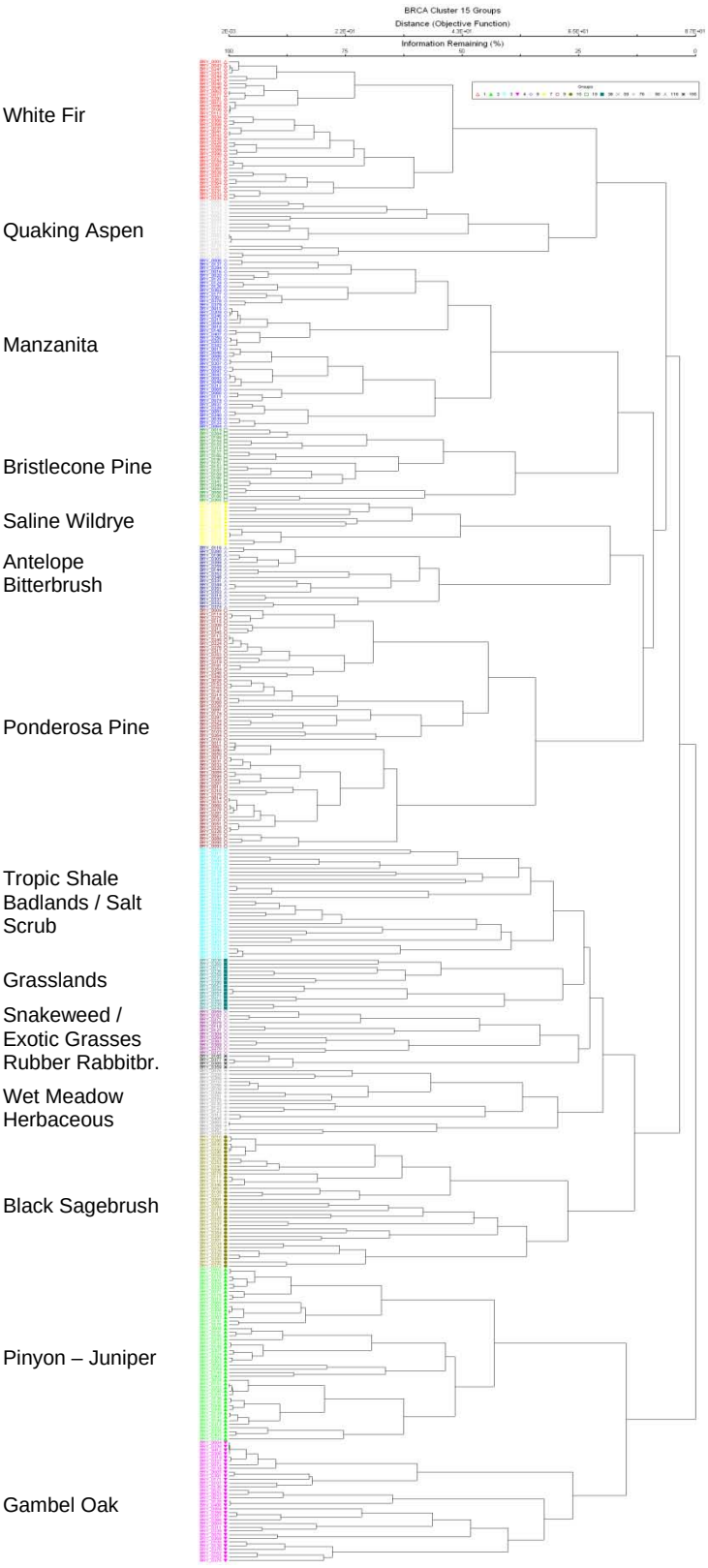



**Figure 23.** Cluster analysis dendrogram of BRCA plot data showing fifteen clusters.

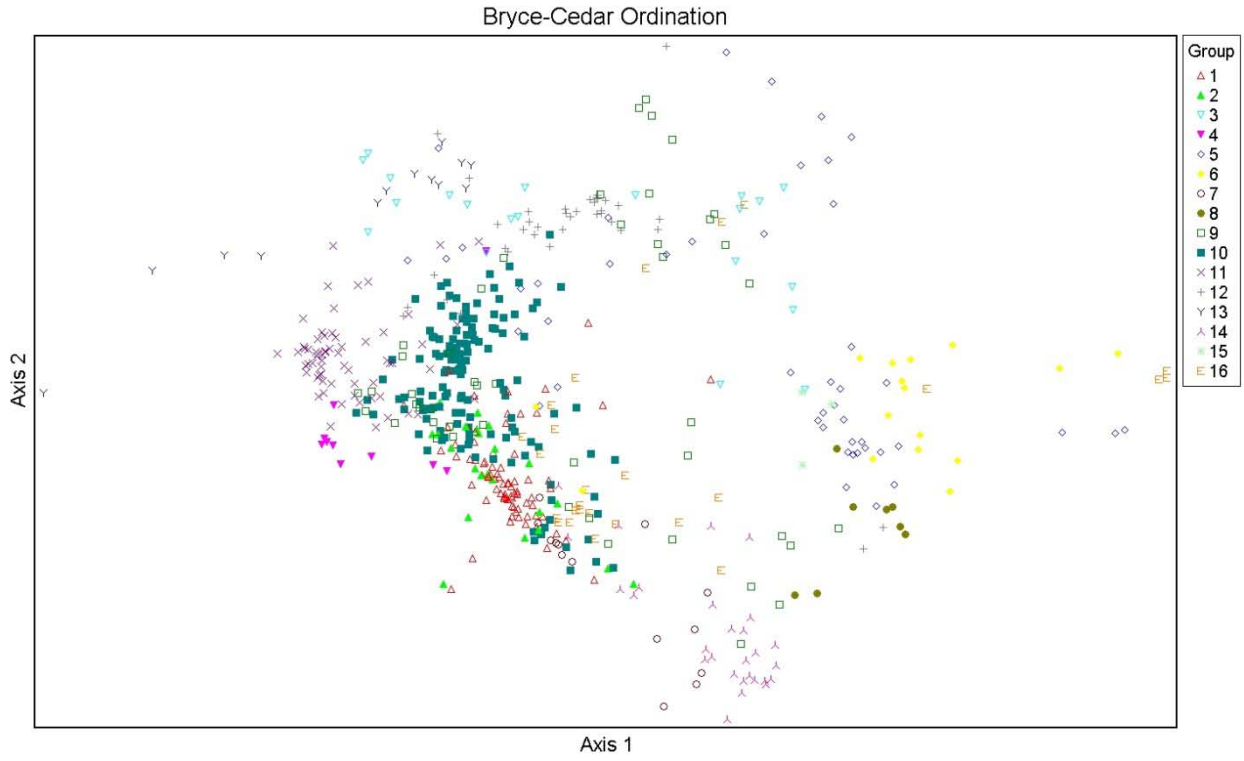



**Figure 24**. Ordination of the entire 580 plots from BRCA and CEBR.

Axis one is closely aligned with a moisture gradient, moisture increases left to right. Axis 2 corresponds to soil nutrient levels, nutrient levels increase 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 sagebrush (+), rabbit brush (open squares) and salt 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.

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. These analyses were repeated on subsets of each group until the smallest units remaining corresponded approximately to NVC associations or alliances.

Because the BRCA 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 parks. The association assignment for each 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, BRCA 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 plant associations to the NVC or assign unusual vegetation types to a "Park Special" category.

## Classification Results

The draft final classification for BRCA was issued by NatureServe in 2007, and underwent several revisions prior to release of the final classification in June 2009. Following accuracy assessment data collection in 2007, types not previously recognized from the park were analyzed for possible inclusion in the classification. Thirty-four associations discovered during accuracy assessment were added to the BRCA final classification. Revisions included amending the classification to include new associations identified during the accuracy assessment phase, amending local descriptions based on finding a rare association to be much more common during the accuracy assessment phase, and updating assignments of associations to ecological systems.

The vegetation of the BRCA mapping project area is classified into 126 community types (Table 8). Of these, 95 are described at the plant association level, two are described at the vegetation alliance level, and twenty-nine are described as 'park specials' because they are described from only one or two plots, are known only from BRCA, and have no known literature references describing the same or closely related types. Park specials are not assigned to NVC associations or alliances. Twenty-three associations are documented exclusively from data gathered during accuracy assessment (Appendix E). When comparing the vegetation between BRCA and CEBR, whose classification analyses were performed jointly, and accounting for the differences in diversity in each park, BRCA had 22% (28/126) overlap with CEBR, and CEBR had 38% overlap (28/74) with BRCA vegetation. While similar geology and close proximity gives rise to similar vegetation, BRCA covers a much larger area with a greater diversity of habitats, and CEBR includes elevations much higher than those found in BRCA.

The vegetation of the BRCA mapping project area is moderately diverse, including 56 NVC alliances and 27 ecological systems. Forty-seven of the communities are shrubland types (six riparian), 59 are forest or woodland types (five riparian), and 20 are herbaceous vegetation types (six wetland). Ponderosa pine, two-needle pinyon-Utah juniper and white fir woodlands dominate the vegetation, accounting for 15, 13 and 9 associations, respectively. Each association, alliance, or park special is represented by between at least one and as many as 67 plot samples (Appendix E). Types represented by a single plot may have been rare in BRCA, or were simply undersampled as a result of difficult access or the limitations of the biophysical unit sampling design. Some of the types that appeared to be rare after the initial sampling were found to be more common during accuracy assessment.

**Table 8.** Classified plant associations for the BRCA 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)** | | |
| Populus tremuloides – Pseudotsuga menziesii / Juniperus communis Forest | Quaking Aspen – Douglas-fir / Common Juniper Forest | CEGL000545 |
| **Rocky Mountain Aspen Forest and Woodland (CES306.813)** | | |
| Populus tremuloides / Acer grandidentatum Forest | Quaking Aspen / Bigtooth Maple Forest | Park Special |
| Populus tremuloides / Juniperus communis Forest | Quaking Aspen / Common Juniper Forest | CEGL000587 |
| Populus tremuloides / Symphoricarpos oreophilus Forest | Quaking Aspen / Mountain Snowberry Forest | CEGL000610 |
| **Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)** | | |
| Acer grandidentatum / Quercus gambelii Forest | Bigtooth Maple / Gambel Oak Forest | CEGL000559 |
| **Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)** | | |
| Abies concolor / Arctostaphylos patula Forest | White Fir / Greenleaf Manzanita Forest | CEGL000242 |
| Abies concolor / Cercocarpus ledifolius Woodland | White Fir / Curl-leaf Mountain Mahogany Woodland | CEGL000885 |
| Abies concolor / Juniperus communis Forest | White Fir / Common Juniper Forest | CEGL000249 |
| Abies concolor / Mahonia repens Forest | White Fir / Creeping Oregon-grape Forest | CEGL000251 |
| Abies concolor / Mixed Grasses Forest | White Fir / Mixed Grasses Forest | CEGL005357 |
| Abies concolor / Purshia tridentata Forest | White Fir / Bitterbrush Forest | Park Special |
| Abies concolor / Quercus gambelii Forest | White Fir / Gambel Oak Forest | CEGL000261 |
| Picea pungens / Arctostaphylos patula Forest | Blue Spruce / Greenleaf Manzanita Forest | CEGL005364 |
| Picea pungens / Arctostaphylos uva-ursi Forest | Blue Spruce / Kinnikinnick or Bearberry Forest | CEGL000385 |
| 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 / Quercus gambelii Forest | Douglas-fir / Gambel Oak Forest | CEGL000452 |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| Pseudotsuga menziesii / Symphoricarpos oreophilus Forest | Douglas-fir / Mountain Snowberry Forest | CEGL000462 |
| **Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)** | | |
| Abies concolor / Acer grandidentatum Forest | White Fir / Bigtooth Maple Forest | CEGL000241 |
| Abies concolor / Symphoricarpos oreophilus Forest | White Fir / Mountain Snowberry Forest | CEGL000263 |
| Picea pungens / Betula occidentalis Woodland | Blue Spruce / Water Birch Forest | CEGL002637 |
| Picea pungens / Juniperus communis Forest | Blue Spruce / Common Juniper Forest | CEGL000392 |
| **Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)** | | |
| Picea pungens / Bromus inermis Forest | Blue Spruce / Smooth Brome Forest | Park Special |
| **UPLAND WOODLANDS** | | |
| **Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)** | | |
| Pinus ponderosa / Arctostaphylos patula Woodland | Ponderosa Pine / Greenleaf Manzanita Woodland | CEGL000842 |
| Pinus ponderosa / Artemisia nova Woodland | Ponderosa Pine / Black Sagebrush Woodland | CEGL000846 |
| Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland | Ponderosa Pine / Curl-leaf Mountain-mahogany / Greenleaf Manzanita Woodland | Park Special |
| Pinus ponderosa / Cercocarpus montanus Woodland | Ponderosa Pine / Alderleaf Mountain-mahogany Woodland | CEGL000851 |
| Pinus ponderosa / Elymus elymoides – (Elymus spp.) Woodland | Ponderosa Pine / Squirreltail - (Wheatgrass species) Woodland | Park Special |
| Pinus ponderosa / Hesperostipa comata Colorado Plateau Woodland | Ponderosa Pine / Needle-and-Thread Colorado Plateau Woodland | Park Special |
| Pinus ponderosa / Leymus salinus Woodland | Ponderosa Pine / Saline Wildrye Woodland | CEGL005362 |
| Pinus ponderosa / Petradoria pumila Woodland | Ponderosa Pine / Rock Goldenrod Woodland | Park Special |
| Pinus ponderosa / Purshia tridentata Woodland | Ponderosa Pine / Bitterbrush Woodland | CEGL000867 |
| Pinus ponderosa / Quercus gambelii Woodland | Ponderosa Pine / Gambel Oak Woodland | CEGL000870 |
| Pinus ponderosa / Seeded Grasses Semi-natural Woodland | Ponderosa Pine / Seeded Grasses Semi-natural Woodland | Park Special |
| Pinus ponderosa / Sparse Understory Woodland [Provisional] | Ponderosa Pine / Sparse Understory Woodland | CEGL002384 |
| Pinus ponderosa / Symphoricarpos oreophilus Forest | Ponderosa Pine / Mountain Snowberry Forest | CEGL000205 |
| **Colorado Plateau Pinyon-Juniper Woodland (CES304.767)** | | |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| Pinus edulis – Juniperus osteosperma / Arctostaphylos patula Woodland | Two-needle Pinyon - Utah Juniper / Greenleaf Manzanita Woodland | CEGL002939 |
| Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland | Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland | CEGL002331 |
| Pinus edulis - Juniperus osteosperma / Atriplex spp. Woodland | Two-needle Pinyon - Utah Juniper / Saltbush species Woodland | CEGL002366 |
| Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland | Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland | CEGL002940 |
| Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii Woodland | Two-needle Pinyon - Utah Juniper / Galleta Grass Woodland | CEGL002379 |
| Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland | Two-needle Pinyon – Utah Juniper / Stansbury's Cliffrose Woodland | CEGL000782 |
| Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland | Two-needle Pinyon – Utah Juniper / Antelope Bitterbrush Woodland | CEGL000789 |
| Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia Woodland | Two-needle Pinyon - Utah Juniper / Roundleaf Buffaloberry Woodland | CEGL002335 |
| Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland | Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland | CEGL002148 |
| Pinus edulis – Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland | Two-needle Pinyon – Juniper Species / Wyoming Big Sagebrush, Mountain Big Sagebrush Woodland | CEGL000776 |
| Pinus edulis – Juniperus spp. / Cercocarpus montanus – Mixed Shrub Woodland | Two-needle Pinyon – Juniper Species / Alderleaf Mountain-mahogany Mixed Shrub Woodland | CEGL000780 |
| Pinus edulis - Juniperus spp. / Leymus salinus Woodland | Two-needle Pinyon-juniper species / Saline Wildrye Woodland | CEGL002340 |
| Pinus edulis - Juniperus spp. / Quercus gambelii Woodland | Two-needle Pinyon- Juniper Species / Gambel Oak Woodland | CEGL000791 |
| **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 / Artemisia tridentata Woodland | Curl-leaf Mountain-mahogany / Basin Big Sagebrush Woodland | CEGL000960 |
| Cercocarpus ledifolius / Quercus gambelii Woodland | Curl-leaf Mountain-mahogany / Gambel Oak Woodland | CEGL005359 |
| 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 |
| **UPLAND SHRUBLANDS** | | |
| **Great Basin Semi-Desert Chaparral (CES304.001)** | | |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| Arctostaphylos patula Shrubland | Greenleaf Manzanita Shrubland | CEGL002696 |
| **Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)** | | |
| *Artemisia nova - Purshia tridentata / Poa fendleriana* Shrubland | Black Sagebrush – Antelope Bitterbrush / Muttongrass Shrubland | CEGL002345 |
| Artemisia nova / Elymus elymoides Shrubland | Black Sagebrush / Squirreltail Shrubland | CEGL001418 |
| Artemisia nova / Hesperostipa comata Shrubland | Black Sagebrush / Needle-and-Thread Shrubland | CEGL001425 |
| Artemisia nova / Poa fendleriana Shrubland | Black Sagebrush / Muttongrass Shrubland | CEGL002698 |
| Artemisia nova Shrubland | Black Sagebrush Shrubland | CEGL001417 |
| Artemisia pygmaea Dwarf-shrubland | Pygmy Sagebrush Dwarf-shrubland | Park Special |
| **Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)** | | |
| Artemisia tridentata ssp. tridentata / Agropyron cristatum Semi-natural Shrubland | Basin Big Sagebrush / Crested Wheatgrass Semi-natural Shrubland | Park Special |
| Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus Shrubland | Wyoming Big Sagebrush / Streambank Wheatgrass Shrubland | Park Special |
| Ericameria nauseosa / Achnatherum lettermanii Shrubland | Rubber Rabbitbrush / Letterman's Needlegrass Shrubland | Park Special |
| **Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)** | | |
| Purshia tridentata / Hesperostipa comata Shrub Herbaceous Vegetation | Antelope Bitterbrush / Needle-and-Thread Shrub Herbaceous Vegetation | CEGL001498 |
| Purshia tridentata / Leymus salinus Shrubland | Antelope Bitterbrush / Saline Wildrye Shrubland | Park Special |
| **Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)** | | |
| Atriplex canescens - Artemisia tridentata Shrubland | Fourwing Saltbush – Basin Big Sagebrush Shrubland | CEGL001282 |
| Atriplex confertifolia Great Basin Shrubland | Shadscale Great Basin Shrubland | CEGL001294 |
| **Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)** | | |
| Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland | Mountain Big Sagebrush / Western Wheatgrass Shrubland | CEGL001028 |
| **Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | |
| Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland | Wyoming Big Sagebrush / Saline Wildrye Shrubland | CEGL002813 |
| Atriplex canescens / Elymus (elymoides, salinus) Shrubland | Fourwing Saltbush / Squirreltail, Saline Wildrye Shrubland | Park Special |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| Atriplex canescens / Psathyrostachys juncea Seeded Shrubland | Fourwing Saltbush / Russian Wildrye Shrubland | Park Special |
| Chrysothamnus viscidiflorus - Ericameria parryi Shrub Herbaceous Vegetation [Provisional] | Green Rabbitbrush - Parry's Rabbitbrush Shrub Herbaceous Vegetation | CEGL002781 |
| Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland | Green Rabbitbrush / Needle-and-Thread Shrubland | CEGL002799 |
| Chrysothamnus viscidiflorus / Mixed Grasses Shrubland | Green Rabbitbrush / Mixed Grasses Shrubland | Park Special |
| Ericameria nauseosa Shrubland | Rubber Rabbitbrush Shrubland | CEGL002713 |
| Gutierrezia sarothrae Wooded Dwarf-shrubland Alliance | Broom Snakeweed Wooded Dwarf-shrubland Alliance | A.2528 |
| Tetradymia canescens / Poa pratensis Shrubland | Gray Horsebrush / Kentucky Bluegrass Shrubland | Park Special |
| Tetradymia canescens Badlands Sparse Vegetation | Gray Horsebrush Badlands Sparse Vegetation | Park Special |
| Tetradymia canescens Shrubland | Gray Horsebrush Shrubland | Park Special |
| **Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)** | | |
| Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis) Shrubland | Greenleaf Manzanita - Gambel Oak - (Utah Serviceberry) Shrubland | CEGL002695 |
| Quercus gambelii - Cercocarpus montanus / (Carex geyeri) Shrubland | Gambel Oak - Alderleaf Mountain-mahogany / (Geyer's Sedge) Shrubland | CEGL001113 |
| Quercus gambelii / Sparse Understory Shrubland | Gambel Oak / Sparse Understory Shrubland | CEGL002337 |
| Quercus gambelii / Symphoricarpos oreophilus Shrubland | Gambel Oak / Mountain Snowberry Shrubland | CEGL001117 |
| Quercus gambelii Shrubland | Gambel Oak Shrubland | CEGL002477 |
| **Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)** | | |
| Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland | (Utah Serviceberry, Saskatoon Serviceberry) - Alderleaf Mountain-mahogany Shrubland | CEGL001070 |
| Artemisia nova / Leymus salinus Shrub Herbaceous Vegetation | Black Sagebrush / Saline Wildrye Shrub Herbaceous Vegetation | CEGL001421 |
| Prunus virginiana - (Prunus americana) Shrubland | Chokecherry - (American Plum) Shrubland | CEGL001108 |
| Symphoricarpos oreophilus Shrubland | Mountain Snowberry Shrubland | CEGL002951 |
| **UPLAND GRASSLANDS** | | |
| **Inter-Mountain Basins Semi-Desert Grassland (CES304.787)** | | |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| Achnatherum lettermanii Herbaceous Vegetation | Letterman's Needlegrass Herbaceous Vegetation | CEGL005354 |
| Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata) Semi-natural Herbaceous Vegetation | Crested Wheatgrass – (Western Wheatgrass, Needle-and Thread) Semi-natural Herbaceous Vegetation | CEGL005266 |
| Elymus elymoides Herbaceous Vegetation | Squirreltail Herbaceous Vegetation | Park Special |
| Hesperostipa comata Great Basin Herbaceous Vegetation | Needle-and-Thread Great Basin Herbaceous Vegetation | CEGL001705 |
| Heterotheca villosa / Mixed Grass Shrub Herbaceous Vegetation | Hairy Goldenaster / Mixed Grass Shrub Herbaceous Vegetation | Park Special |
| Leymus salinus Herbaceous Vegetation | Saline Wildrye 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 |
| Carex vallicola Herbaceous Vegetation | Valley Sedge Herbaceous Vegetation | Park Special |
| Ceanothus martinii / Elymus trachycaulus Seeded Roadcut Shrub Herbaceous Vegetation | Martin's Ceanothus / Slender Wheatgrass Seeded Roadcut Shrub Herbaceous Vegetation | Park Special |
| Elymus lanceolatus Herbaceous Vegetation | Thickspike Wheatgrass Herbaceous Vegetation | CEGL002588 |
| Elymus trachycaulus Herbaceous Vegetation | Slender Wheatgrass Herbaceous Vegetation | Park Special |
| Pascopyrum smithii Herbaceous Vegetation | Western Wheatgrass Herbaceous Vegetation | CEGL001577 |
| Poa fendleriana Herbaceous Vegetation | Muttongrass Herbaceous Vegetation | CEGL001925 |
| 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 |
| **UPLAND SPARSE VEGETATION** | | |
| **Rocky Mountain Cliff, Canyon and Massive Bedrock (CES306.815)** | | |
| Pinus ponderosa Sparse Woodland | Ponderosa pine Sparse Woodland | Park Special |
| **Inter-Mountain Basins Wash (CES304.781)** | | |
| Cercocarpus montanus Desert Wash Shrubland | Alderleaf Mountain-mahogany Desert Wash Shrubland | Park Special |
| Purshia tridentata Desert Wash Shrubland | Antelope Bitterbrush Desert Wash Shrubland | Park Special |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| **Inter-Mountain Basins Shale Badland (CES304.789)** | | |
| Eriogonum corymbosum / Leymus salinus Dwarf-shrubland | Crispleaf Wild Buckwheat / Saline Wildrye Dwarf-shrubland | CEGL001343 |
| Eriogonum corymbosum Badlands Sparse Vegetation | Crispleaf Wild Buckwheat Badlands Sparse Vegetation | CEGL002979 |
| Zuckia brandegeei Sparse Vegetation | Siltbush Sparse Vegetation | CEGL002493 |
| RIPARIAN, WETLAND AND MESIC ASSOCIATIONS | | |
| **RIPARIAN AND WETLAND WOODLANDS AND SHRUBLANDS** | | |
| **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** | | |
| Populus angustifolia – Juniperus scopulorum Woodland | Narrowleaf Cottonwood – Rocky Mountain Juniper Woodland | CEGL002640 |
| Populus angustifolia / Betula occidentalis Woodland | Narrowleaf Cottonwood / Water Birch Woodland | CEGL000648 |
| Populus angustifolia / Cornus sericea Woodland | Narrowleaf Cottonwood / Redosier Dogwood Woodland | CEGL002664 |
| Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus) Woodland | Narrowleaf Cottonwood / Snowberry species Woodland | CEGL002648 |
| Salix eriocephala / Mesic Graminoids Shrubland | Missouri Willow / Mesic Graminoids Shrubland | CEGL005363 |
| Salix exigua Temporarily Flooded Shrubland | Coyote Willow Temporarily Flooded Shrubland | CEGL001197 |
| Shepherdia argentea Shrubland | Silver Buffaloberry Shrubland | CEGL001128 |
| **Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)** | | |
| Betula occidentalis Shrubland | River Birch Shrubland | CEGL001080 |
| Cornus sericea Rocky Mountain Shrubland | Redosier Dogwood Rocky Mountain Shrubland | CEGL001165 |
| **RIPARIAN AND WETLAND HERBACEOUS COMMUNITIES** | | |
| **Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)** | | |
| Carex praegracilis Herbaceous Vegetation | Clustered Field Sedge Herbaceous Vegetation | CEGL002660 |
| Carex utriculata Herbaceous Vegetation | Northwest Territory Sedge Herbaceous Vegetation | CEGL001562 |
| Dasiphora fruticosa ssp. floribunda Shrubland | Shrubby-cinquefoil Shrubland | CEGL001105 |
| Eleocharis quinqueflora Herbaceous Vegetation | Few-flower Spikerush Herbaceous Vegetation | CEGL001836 |

**Table 8.** Classified plant associations for the BRCA vegetation mapping project area, arranged by ecological system within each physiognomic group*.

| NVCS Association | Common Name | Code |
|---|---|---|
| Juncus balticus Herbaceous Vegetation | Baltic Rush Herbaceous Vegetation | CEGL001838 |
| Mimulus guttatus - (Mimulus spp.) Herbaceous Vegetation | Seep Monkeyflower - (Monkeyflower species) Herbaceous Vegetation | CEGL005305 |
| **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 |

* 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 BRCA vegetation by physiognomic group. Appendix F provides detailed local and global descriptions of the 126 plant associations, alliances and 'park special' vegetation types found within BRCA. Local descriptions are based on plot, observation point, and accuracy assessment point data from the park and environs. Global descriptions characterize the association across its range and are based primarily on published and unpublished literature.

Most of the vegetation types at BRCA fit into existing NVC association concepts, or were considered significant enough to create new NVC associations based on the sampled data. Criteria used to determind whether to create 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 3) type is known from the literature. Twenty-nine associations were considered unique to the park; NatureServe designated these as 'Park Specials'. Two vegetation types fit into alliance concepts but lacked sufficient information to justify creating new associations.

### *Upland Forest Associations*

Upland forests dominate the southern, high elevation regions of BRCA, mostly along north and east-facing slopes and ridges, and on sheltered south and west-facing slopes. White fir forests dominate the vegetation, but stands are generally mixed, often having 2-5 conifer species in the canopy. The presence of white fir distinguishes these forests from mixed stands with ponderosa pine and Douglas-fir found further north and east in the Rocky Mountains, west in the Great Basin, and northwest in the Cascades. White fir was used as an indicator species in mixed forest stands when it was present as a mature tree, even though it was often not the dominant or most abundant tree in the upper canopy. Only a few mesic forest types were observed or sampled, generally occurring as small patches, and dominated by quaking aspen, blue spruce or Douglas-fir. The upland forest associations of BRCA include (in alphabetical order):

- *Abies concolor / Acer grandidentatum* Forest
- *Abies concolor / Arctostaphylos patula* Forest
- *Abies concolor / Juniperus communis* Forest
- *Abies concolor / Mahonia repens* Forest
- *Abies concolor /* Mixed Grasses Forest
- *Abies concolor / Purshia tridentata* Forest [Park Special]
- *Abies concolor / Quercus gambelii* Forest
- *Abies concolor / Symphoricarpos oreophilus* Forest
- *Acer grandidentatum / Quercus gambelii* Forest
- *Picea pungens / Arctostaphylos patula* Forest
- *Picea pungens / Arctostaphylos uva-ursi* Forest
- *Picea pungens / Bromus inermis* Forest [Park Special]
- *Picea pungens / Juniperus communis* Forest
- *Pinus ponderosa / Symphoricarpos oreophilus* Forest
- *Populus tremuloides - Pseudotsuga menziesii / Juniperus communis* Forest
- *Populus tremuloides / Acer grandidentatum* Forest [Park Special]
- *Populus tremuloides / Juniperus communis* Forest
- *Populus tremuloides / Symphoricarpos oreophilus* Forest
- *Pseudotsuga menziesii / Quercus gambelii* Forest

- *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest

### *Upland Woodland Associations*

BRCA is dominated by upland woodlands, and especially by woodlands of ponderosa pine and/or two-needle pinyon – juniper spp. The most commonly sampled plant association in the park was the ponderosa pine / greenleaf manzanita woodland. Ponderosa pine woodlands occur from the northernmost to the southernmost tips of the park and from the highest to the lowest elevations, occurring on a variety of substrates and with a high diversity of shrubs and grasses in the understory. They occupy nearly every available habitat, from riparian corridors and washes to rock outcrops, mesa tops, ridge tops, and on generally south or west-facing gentle to steep slopes. All stands are subject to fire.

On park barrens and steep, rocky slopes of the Claron Formation, Great Basin bristlecone pine woodlands occur; they are often a mix of conifer species (all with low cover), sometimes with every conifer known in the park in one stand. Stands are vulnerable to downslope soil movement or rock fall. The presence of mature Great Basin bristlecone pine was used as the indicator species for this community type. Also occurring on dry sites and steep, rocky slopes of the Claron Formation, generally just below a cliff band exposure, are small isolated pockets of curl-leaf mountain mahogany woodlands.

Two-needle pinyon – Juniper spp. woodlands dominate the vegetation along the eastern side of the park and mapping area. These woodlands are the most common vegetation types of the lowest elevation areas of the park and in the neighboring environs, generally occurring below the Claron Formation breaks on southeast or southwest-facing slopes of the White Cliffs formation. The upland woodland associations of BRCA include:

- *Abies concolor / Cercocarpus ledifolius* Woodland
- *Cercocarpus ledifolius / Arctostaphylos patula* Woodland
- *Cercocarpus ledifolius / Artemisia tridentata* Woodland
- *Cercocarpus ledifolius / Quercus gambelii* Woodland
- *Cercocarpus ledifolius* Woodland Alliance
- *Pinus edulis - Juniperus osteosperma / Arctostaphylos patula* Woodland
- *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland
- *Pinus edulis - Juniperus osteosperma / Atriplex* spp. Woodland
- *Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius* Woodland
- *Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii* Woodland
- *Pinus edulis - Juniperus osteosperma / Purshia stansburiana* Woodland
- *Pinus edulis- Juniperus osteosperma / Purshia tridentata* Woodland
- *Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia* Woodland
- *Pinus edulis - Juniperus osteosperma /* Sparse Understory Woodland
- *Pinus edulis - Juniperus spp. / Artemisia tridentata (*ssp. *wyomingensis,* ssp. *vaseyana)* Woodland
- *Pinus edulis - Juniperus spp. / Cercocarpus montanus* - Mixed Shrubs Woodland
- *Pinus edulis - Juniperus spp. / Leymus salinus* Woodland
- *Pinus edulis - Juniperus spp. / Quercus gambelii* Woodland
- *Pinus longaeva* Woodland
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Colorado Plateau Woodland [Park Special]
- *Pinus ponderosa / Arctostaphylos patula* Woodland
- *Pinus ponderosa / Artemisia nova* Woodland

- *Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Park Special]
- *Pinus ponderosa / Cercocarpus montanus* Woodland
- *Pinus ponderosa / Elymus elymoides - (Elymus* spp.*)* Woodland [Park Special]
- *Pinus ponderosa / Hesperostipa comata* Colorado Plateau Woodland [Park Special]
- *Pinus ponderosa / Leymus salinus* Woodland
- *Pinus ponderosa / Petradoria pumila* Woodland [Park Special]
- *Pinus ponderosa / Purshia tridentata* Woodland
- *Pinus ponderosa / Quercus gambelii* Woodland
- *Pinus ponderosa /* Seeded Grasses Semi-natural Woodland [Park Special]
- *Pinus ponderosa /* Sparse Understory Woodland [Provisional]
- *Pinus ponderosa* Sparse Woodland [Park Special]
- *Pseudotsuga menziesii / Arctostaphylos patula* Woodland

### *Upland Shrubland Associations*

Most of the shrublands in BRCA occur as small patches, often in valley swales or side slopes in the transition zone between herbaceous and forested stands, or as openings surrounded by trees. The most common shrublands encountered are greenleaf manzanita, sagebrush and rabbitbrush shrublands. One of the more unusual shrublands documented is dominated by saltbush (*Zuckia brandegeei*) and occurs only on fine-textured soils of exposed and eroded hill slopes of the Tropic Shale formation. The upland shrubland associations of BRCA include:

- *Amelanchier (utahensis, alnifolia) - Cercocarpus montanus* Shrubland
- *Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis)* Shrubland
- *Arctostaphylos patula* Shrubland
- *Artemisia nova - Purshia tridentata / Poa fendleriana* Shrubland
- *Artemisia nova / Elymus elymoides* Shrubland
- *Artemisia nova / Hesperostipa comata* Shrubland
- *Artemisia nova / Leymus salinus* Shrub Herbaceous Vegetation
- *Artemisia nova / Poa fendleriana* Shrubland
- *Artemisia nova* Shrubland
- *Artemisia pygmaea* Dwarf-shrubland [Park Special]
- *Artemisia tridentata* ssp*. tridentata / Agropyron cristatum* Semi-natural Shrubland [Park Special]
- *Artemisia tridentata* ssp. *vaseyana / Pascopyrum smithii* Shrubland
- *Artemisia tridentata* ssp*. wyomingensis / Elymus lanceolatus* Shrubland [Park Special]
- *Artemisia tridentata* ssp. *wyomingensis / Leymus salinus* Shrubland
- *Atriplex canescens - Artemisia tridentata* Shrubland
- *Atriplex canescens / Elymus (elymoides, salinus)* Shrubland [Park Special]
- *Atriplex canescens / Psathyrostachys juncea* Seeded Shrubland [Park Special]
- *Atriplex confertifolia* Great Basin Shrubland
- *Ceanothus martinii / Elymus trachycaulus* Seeded Roadcut Shrub Herbaceous Vegetation [Park Special]
- *Cercocarpus montanus* Desert Wash Shrubland [Park Special]
- *Chrysothamnus viscidiflorus - Ericameria parryi* Shrub Herbaceous Vegetation [Provisional]
- *Chrysothamnus viscidiflorus / Hesperostipa comata* Shrubland
- *Chrysothamnus viscidiflorus /* Mixed Grasses Shrubland [Park Special]
- *Ericameria nauseosa / Achnatherum lettermanii* Shrubland [Park Special]
- *Ericameria nauseosa* Shrubland
- *Eriogonum corymbosum* Badlands Sparse Vegetation
- *Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland
- *Gutierrezia sarothrae* Wooded dwarf-shrubland Alliance
- *Prunus virginiana - (Prunus americana)* Shrubland

- *Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation
- *Purshia tridentata / Leymus salinus* Shrubland [Park Special]
- *Purshia tridentata* Desert Wash Shrubland [Park Special]
- *Quercus gambelii - Cercocarpus montanus / (Carex geyeri)* Shrubland
- *Quercus gambelii /* Sparse Understory Shrubland
- *Quercus gambelii / Symphoricarpos oreophilus* Shrubland
- *Quercus gambelii* Shrubland
- *Symphoricarpos oreophilus* Shrubland
- *Tetradymia canescens / Poa pratensis* Shrubland [Park Special]
- *Tetradymia canescens* Badlands Sparse Vegetation [Park Special]
- *Tetradymia canescens* Shrubland [Park Special]
- *Zuckia brandegeei* Sparse Vegetation

### *Upland Herbaceous Associations*

Upland herbaceous communities are rare and occur only in small patches within the park. Native grasslands occur intermixed with shrublands on gentle valley floors and in and among ponderosa pine woodlands. The most unique native herbaceous and subshrub communities occur on windswept ridges and on the edges of cliffs. Introduced grasslands including smooth brome and Kentucky bluegrass occur along roadsides and in mesic sites. These and other non-native grasses were introduced historically as forage for livestock as well as 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 BRCA include:

- *Achnatherum lettermanii* Herbaceous Vegetation
- *Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation
- *Bromus inermis - (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation
- *Carex vallicola* Herbaceous Vegetation [Park Special]
- *Elymus elymoides* Herbaceous Vegetation [Park Special]
- *Elymus lanceolatus* Herbaceous Vegetation
- *Elymus trachycaulus* Herbaceous Vegetation [Park Special]
- *Hesperostipa comata* Great Basin Herbaceous Vegetation
- *Heterotheca villosa /* Mixed Grass Shrub Herbaceous Vegetation [Park Special]
- *Leymus salinus* Herbaceous Vegetation [Park Special]
- *Pascopyrum smithii* Herbaceous Vegetation
- *Poa fendleriana* Herbaceous Vegetation
- *Poa pratensis - (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation
- *Poa secunda* Herbaceous Vegetation

### *Riparian and Wetland Forest and Woodland Associations*

Wetland and riparian communities are uncommon in BRCA, and wooded riparian wetlands are rare; two sites in BRCA were classified as this riparian woodland types. The riparian and wetland forest and woodland associations of BRCA include:

- *Populus angustifolia - Juniperus scopulorum* Woodland
- *Populus angustifolia / Betula occidentalis* Woodland
- *Populus angustifolia / Cornus sericea* Woodland
- *Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus)* Woodland
- *Picea pungens / Betula occidentalis* Woodland

### *Riparian and Wetland Shrubland Associations*

Wetland and riparian shrublands are rare wtihin BRCA, with most stands occurring on springs or intermittent washes. Wet meadows and streams are more prominent on the west side of the park, with most occurring in the western environs. There are dense patches of riparian vegetation on the east side of the park near springs and along the Tropic Ditch. The riparian and wetland shrubland associations of BRCA include:

- *Betula occidentalis* Shrubland
- *Cornus sericea* Rocky Mountain Shrubland
- *Dasiphora fruticosa* ssp. *floribunda* Shrubland
- *Salix exigua* Temporarily Flooded Shrubland
- *Salix eriocephala /* Mesic graminoids Shrubland
- *Shepherdia argentea* Shrubland

### *Riparian and Wetland Herbaceous Associations*

The riparian and wetland herbaceous associations in BRCA occur almost exclusively in wet meadows and along streams on the west side of the park and environs, with a few stands occurring near springs on the eastern side of the park. The riparian and wetland herbaceous associations of BRCA include:

- *Carex praegracilis* Herbaceous Vegetation
- *Carex utriculata* Herbaceous Vegetation
- *Eleocharis quinqueflora* Herbaceous Vegetation
- *Juncus balticus* Herbaceous Vegetation
- *Mimulus guttatus - (Mimulus* spp.*)* Herbaceous Vegetation
- *Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Vegetation

## Field Key Preparation

An illustrated dichotomous field key to plant associations of the BRCA mapping area was developed for this project (Appendix G). The key is designed to assist users in identifying plant associations in the field. The key 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 identifying plant associations. To increase the utility of the key, individual plant associations are cross-referenced to map classes.

The plant 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 probably does not account for all associations occurring within the park, nor does it explain the full range of variation of all associations as they appear in the park.

The field key was tested by NatureServe using BRCA vegetation plot data prior to its use by accuracy assessment 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 accuracy assessment 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. It also contains the new associations discovered during the accuracy assessment phase of the project.

## Assessment of Global Rarity

BRCA lies in the High Plateaus region in the southwest corner of the Colorado Plateau. The High Plateaus region can be thought of as a transitional tectonic region as well as a watershed divide between the Colorado Plateau and the Basin and Range Provinces (Wenker 2004). As such, BRCA represents a unique landscape setting and contains several unique plant assemblages. Few plant associations at BRCA are considered globally imperiled (NatureServe 2008); however not enough is known about many of the associations present, especially those labeled "park specials," to evaluate global rarity. Almost all vegetation communities within BRCA are subject to change over time with the strong driving forces of drought, erosion, fire, and potentially climate change most likely representing the change agents.

The Nature Conservancy and the Natural Heritage Network assess plant communities as to their rarity and degree of imperilment by applying a global conservation status rank. The global scale for ranking ranges from 1 to 5, with a rank of "1" indicating critical imperilment due to rarity, endemism, and/or threats, and a rank of "5" indicating little or no risk of extirpation or elimination of the plant community. One plant association occurring within BRCA is considered critically imperiled (G1): *Artemisia nova / Leymus salinus* Shrub Herbaceous Vegetation. Seven associations are considered imperiled (G2): *Amelanchier (utahensis, alnifolia) - Cercocarpus montanus* Shrubland, *Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland, *Hesperostipa comata* Great Basin Herbaceous Vegetation, *Picea pungens / Betula occidentalis* Woodland, *Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus)* Woodland, and *Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation (Figure 25). Fifty-five associations are ranked vulnerable to secure (G3, G4, and G5) and the remaining 62 associations are not yet ranked or are new to the NVCS.



Photo Credit: NPS/NCPN

**Figure 25.** The globally critically imperiled *Artemisia nova / Leymus salinus* Shrub Herbaceous Vegetation association at BRCA.

# Fuels Data Collection

The following discussion is excerpted from the 2010 Bryce Canyon Vegetation Management Plan and Environmental Assessment (NPS 2010):

> "Fire has a significant impact on vegetation by influencing nutrient cycling, water availability, plant composition and diversity, and fuel accumulation. Historically, fire has played an important role in the ecological development of the landscape in and around Bryce Canyon. Naturally occurring fires on this landscape periodically and, in some vegetation types, frequently thinned vegetation. Over time, continued suppression of natural fire has altered the landscape, threatening the natural functions of healthy ecosystems.
>
> An updated BRCA Fire Management Plan was approved in 2010 (Fields 2010). The Fire Management Plan allows for the implementation of the full range of fire management activities and has been approved for BRCA through a separate environmental assessment (FONSI signed 3/14/05). Fire is currently used to manage hazardous fuels, stimulate fire dependent plant communities, restore natural ecosystems that have been modified by prolonged fire exclusion, reduce non-native plants, and restore vegetative composition. To determine if fire and resource management objectives are being met, a Wildland and Prescribed Fire Monitoring Plan has been implemented for the park (NPS 2004)."

### Fuels Data

Fire fuels data were collected as part of the BRCA 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 plot data in providing a complete picture of fire fuels for BRCA. These data were entered in the BRCA 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 plots in BRCA. Overstory trees (>5 in. DBH) were recorded throughout the entire classification plot (20 m x 20 m square) and tree saplings were recorded in a 10 m x 10 m subplot (the NW quadrangle). Trunk diameter at breast height (DBH) was recorded for every seedling/sapling within the subplot. The following measurements were 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, as well as litter and duff, was 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 26.** Brown's fuels transect training in BRCA (tallying dead and downed woody material using a go-no-go gauge).

# Vegetation Mapping

## Methods

The process of mapping vegetation and land use in the BRCA project area followed four steps:

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

Each step built upon information created during the previous stage. Field reconnaissance was intended to familiarize the photointerpreters with the park, 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 first year of vegetation plot sampling. The mapping phase applied the map class concepts in order to draw consistent, homogenous polygons on the base orthoimagery. The draft polygon set was digitized and given additional attributes (spatial database development).

### *Field Reconnaissance*

Most of the reconnaissance was conducted concurrently with the vegetation plot data collection in the summers of 2005 and 2006. The primary photointerpreters visited the park in July 2007 to assign plant communities or complexes to distinct signatures on the orthophotographs. Understanding the environmental drivers influencing vegetation patterns and identifying what information could be extracted from the project imagery were other important products of the reconnaissance. Prior to visiting the park, paper plots of the orthoimagery were created for use in the field, along with the original color stereo photograph prints mounted with Mylar overlays for recording notes. Field notes were written directly on these plots and photograph overlays and were used for guidance during the photo interpretation and polygon attribution process.

Observation point data collected by field crew members provided additional documentation of the vegetation for the photointerpreter. One hundred forty-one observation points were sampled within the BRCA vegetation mapping project area. At each point, a subset of vegetation and environmental data was collected.

### *Map Class and Polygon Attribute Development*

The goal of map class development was to identify meaningful units to represent existing vegetation and land uses for the BRCA vegetation mapping project area. Map classes specific to this project were developed to characterize vegetation types within the Park and most of the environs. Standard land-use map classes (Anderson et al. 2002) were used to map developed parts of the mapping area including Park facilities and roads. In unvegetated portions of the project area, map classes were defined by the geologic substrate or land use class. The same map classes were used within BRCA and in the environs.

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. At BRCA, 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 an NVC plant association was assigned the NatureServe common name (e.g. Ponderosa Pine / Gambel Oak Woodland). Map classes representing complexes of associations followed the convention of being named for the unifying botanic and environmental factors, e.g., Bottomland Shrubland Complex.

To facilitate tracking and management of vegetation map class information, the NCPN developed a map class coding system. Photointerpreters tend to assign a unique number to each map class as a shorthand method of labeling polygons. These numeric codes have been retained within the spatial database and map class guide (Appendix J). The NCPN 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 park 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; Table 9), land use and disturbance. All map polygons were assigned to a land cover / land use (LC/LU) 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 9.** 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 | A | Closed Tree Canopy/Continuous (> 60% cover) |
| (Applied to forest, woodland, and | B | Open Tree Canopy/Discontinuous (25- 60% cover) |
| shrub-dominated map classes) | C | Dispersed – Sparse Tree Canopy (10-25% cover) |
| | D | Dense Shrub Canopy (> 40% cover) |
| | E | Light Shrub Canopy (10 – 40% cover) |
| Vegetation Pattern | 1 | Clumped/Bunched |
| (Applied to all vegetation map classes) | 2 | Linear |
| | 3 | Gradational/Transitional |
| | 4 | Regularly Alternating |
| | 5 | Homogenous |

NCPN photointerpretation standards (Evenden 2004) defined a suite of polygon modifiers to describe altered vegetation, landforms, transportation and utilities, and other conditions. Some of these standard modifiers were used in BRCA, but the majority of modifiers were created specifically for BRCA by the primary photointerpreter and the NPS project ecologist. Table 10 is a list of the modifiers used in the BRCA project.

**Table 10.** Modifiers used to provide additional information for map polygons in the BRCA vegetation mapping project area.

| Category | Code | Name | Description |
|---|---|---|---|
| Vegetation Modifiers | a | Altered | Applies when some alteration is evident, but the type is indistinguishable |
| | b | Burn evidence | Applies to systems disturbed by burns more than one year old (as seen in photography) |
| | c | Contour-plowing | Contouring of land for erosion control |
| | d | Prairie Dog Town | Applies to systems disturbed by prairie dogs (as noted in plot or AA point comments) |
| | e | Elymus salinus | Originally mapped as Elymus salinus grasslands |
| | g | Grassy | Manzanita shrublands with considerable grass cover |
| | m | Mixed shrub understory | White fir forests that were originally mapped as having a mixed shrub understory (*Cercocarpus* spp. or *Purshia tridentata*) not an understory dominated by manzanita |
| | p | Pseudotsuga menziesii | White fir forests that were originally mapped as Douglas-fir forests; may have significant cover by Douglas-fir in the canopy |
| | t | Treed | Shrublands with notable tree cover present (wooded shrublands) |
| | w | Woodland | Gambel oak shrublands that grow in woodland form (tall, closed canopy) |

### *Park Specials*

In the scoping phase of the project, Park staff identified several natural resource features of interest that might otherwise not have been sampled or recognized for mapping. These features were photographed and noted by field crews as encountered, but may not appear in the final map:

- Prairie-dog colonies (active and abandoned)
- Cultural evidence (dendroglyphs or other historical features)

- Populations (or individuals) of noxious weed species

Information describing the condition and location of park special features was provided directly to park staff, and is searchable in the final plots database but is not otherwise included in the project final report. These features are commonly referred to as “park specials”, but should not be confused with the Park Special” designation given by NatureServe to plant associations that could not be included in the NVC.

### *Mapping*

The mapping component of the BRCA project used a combination of methods to interpret and delineate vegetation and land use polygons. The USGS applied an electronic segmentation method (e-Cognition software) to create preliminary linework on features with high-contrast photo-signatures. Using the preliminary linework as a baseline starting point, the primary photointerpreter drew polygons directly on screen through heads-up digitizing using ArcGIS editing tools. Additionally, trained photointerpreters assisting the primary photointerpreter drew polygons on Mylar overlays covering 1m resolution, 1:12,000-scale, 9 x 9-inch true-color aerial photographs. This process enabled the photointerpreters to view the landscape in stereo in order to identify finer details. The linework drawn on Mylar overlays was then transferred into digital media by heads-up digitizing using ArcGIS software. The park and environs were interpreted and mapped to the same level of detail.

### *Spatial Database Development*

Each polygon was assigned a map class number and name, Anderson land use class, and vegetation density and pattern attributes. 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 an 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 27. This format allows text and image information to be incorporated and linked to spatial coordinates. A detailed description of the geodatabase appears in Appendix C.

### *Map Classes*

The final map legend for BRCA consists of forty-nine map classes (Table 11). Of these, 38 are vegetation map classes, two are unvegetated geologic map classes, and 9 are land-use map classes. Of the 38 vegetation map classes, 8 represent single NVC plant associations and the remaining 30 vegetation map classes represent polygons delineating multiple plant associations.

Ecological systems (ES, Comer et al. 2003) are used to organize the vegetation map classes. The ES 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. 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.

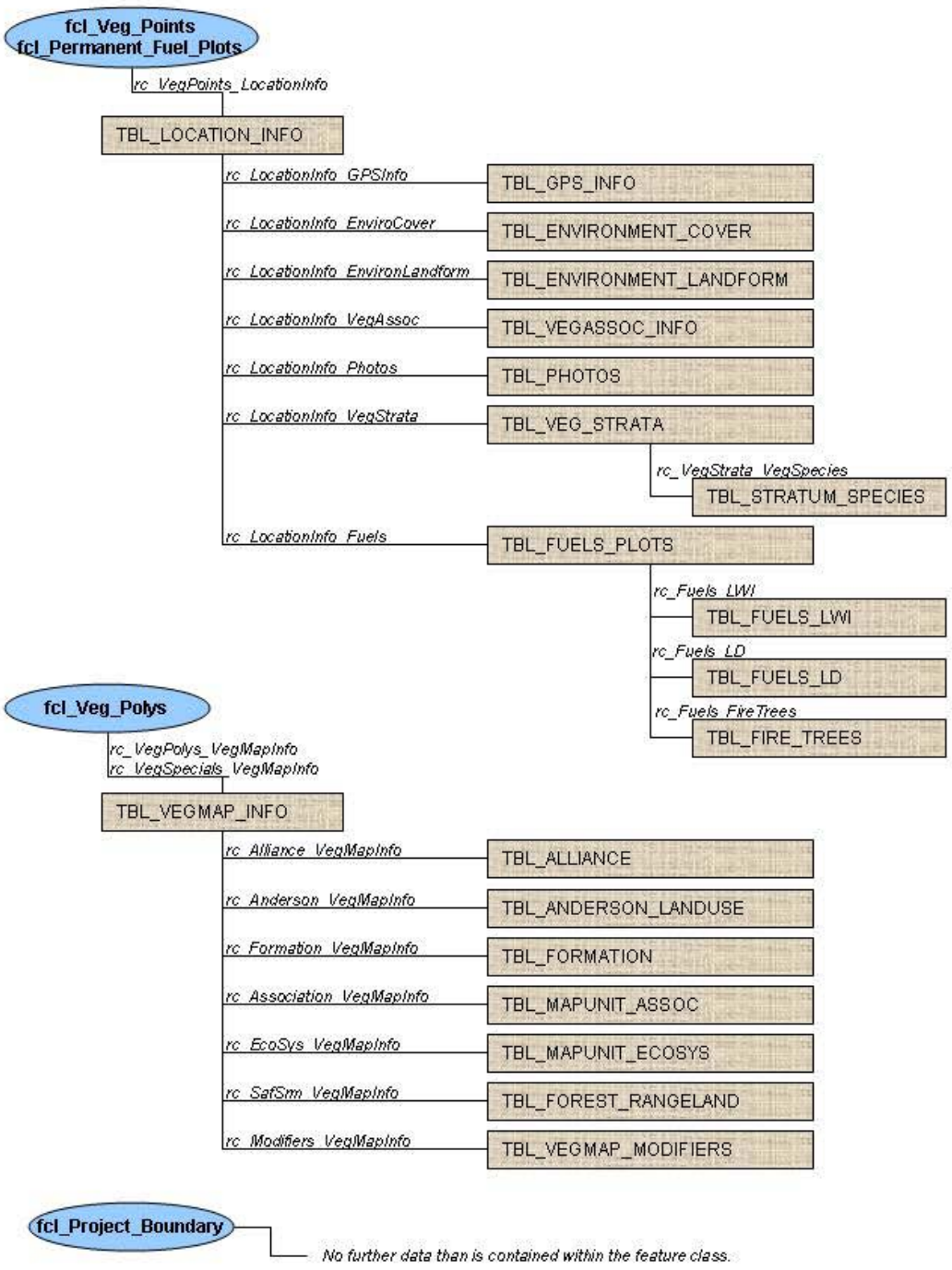



**Figure 27.** Structure of the BRCA geodatabase.

## Results

Table 11 relates vegetation map classes to ecological systems, ordered roughly by physiognomy: upland forests, upland woodlands, riparian woodlands and shrublands, upland 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 Class Descriptions*

Appendix J provides detailed descriptions of all vegetation map classes used in the final version of the BRCA 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 the park as well as 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 BRCA vegetation map consists of 6,056 polygons totaling 23,754 hectares (58,697 acres). Average polygon size is 2.8 ha (7.0 acres). Lands within the Park make up 14,614 ha (36,113 acres) or 61.5% of the total project area. Of the total, 5,549 polygons (92%) represent natural or semi-natural vegetation map classes covering 94.3% of the mapping project area. Map classes representing non-vegetated rock outcrops and developed or other land use areas account for the remaining 507 polygons (8% of polygons and 5.7% of the total project area).

The polygon count includes adjacent polygons that have the same map code but different density or pattern attributes. The most common map class is the Ponderosa Pine - (Douglas Fir) / Manzanita Woodland Complex with 490 polygons covering 21.0% of the mapping area. The Siltbush Sparse Vegetation map class has the largest average polygon size at 11.6 ha (28.6 acres) per polygon.

Figure 28 is an example of a map of the vegetation of BRCA 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 12 provides summary statistics for BRCA vegetation map polygons. Included data are map class number and name, number of polygons interpreted within BRCA and within the environs area, and the area occupied by interpreted polygons per each mapping unit.

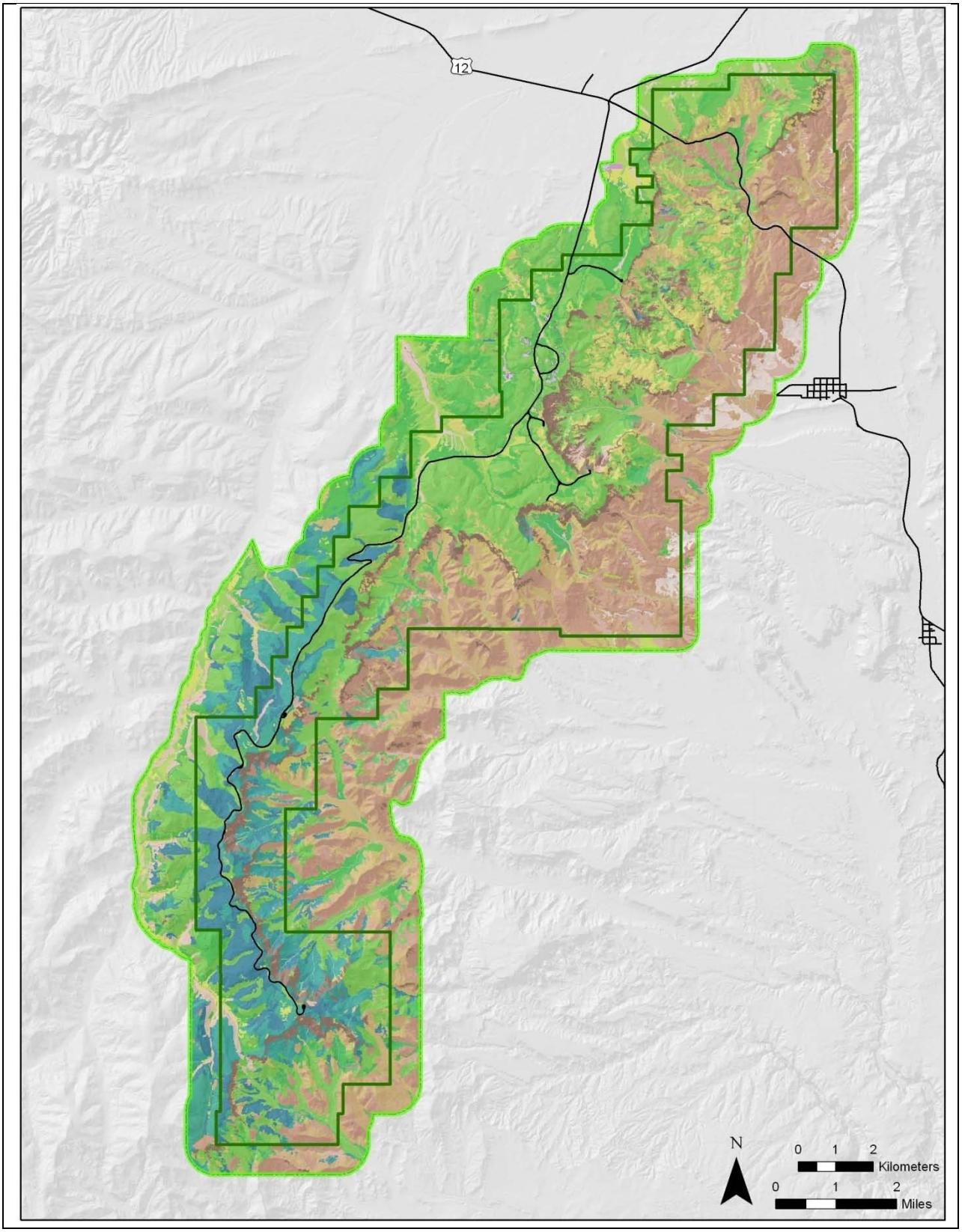



**Figure 28a.** The BRCA vegetation map.




**Figure 28b.** Legend for the BRCA vegetation map.

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| **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)** | | | | |
| 1 | F-ABIE | White Fir Forest Complex | Abies concolor / Juniperus communis Forest<br>Abies concolor / Mahonia repens Forest<br>Abies concolor / Symphoricarpos oreophilus Forest<br>Pseudotsuga menziesii / Symphoricarpos oreophilus Forest | 1 : many |
| 2 | F-WFGO | White Fir / Gambel Oak – (Bigtooth Maple) Forest | Abies concolor / Acer grandidentatum Forest<br>Abies concolor / Quercus gambelii Forest<br>Acer grandidentatum / Quercus gambelii Forest<br>Pseudotsuga menziesii / Quercus gambelii Forest | 1 : many |
| **Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)** | | | | |
| 3 | F-WFMS | White Fir / Manzanita – Mixed Shrub Forest | Abies concolor / Arctostaphylos patula Forest<br>Abies concolor / Cercocarpus ledifolius Woodland<br>Abies concolor / Purshia tridentata Forest<br>Pseudotsuga menziesii / Arctostaphylos patula Woodland | 1 : many |
| 4 | F-PSME | Douglas Fir Forest Complex | Pseudotsuga menziesii / Arctostaphylos patula Woodland<br>Pseudotsuga menziesii / Quercus gambelii Forest<br>Pseudotsuga menziesii / Symphoricarpos oreophilus Forest | 1 : many |
| 5 | F-WFMG | White Fir / Mixed Grass Forest | Abies concolor / Mixed Grasses 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) Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)** | | | | |
| 6 | F-PICE | Blue Spruce Forest Complex | Picea pungens / Arctostaphylos patula Forest<br>Picea pungens / Arctostaphylos uva-ursi Forest<br>Picea pungens / Bromus inermis Forest<br>Picea pungens / Juniperus commuis Forest | 1 : many |
| **Multiple Ecological Systems: Rocky Mountain Aspen Forest and Woodland (CES306.813) Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland (CES304.776)** | | | | |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 23 | F-ASPE | Aspen Forest Complex | Populus tremuloides / Acer grandidentatum Forest<br>Populus tremuloides / Juniperus communis Forest<br>Populus tremuloides / Symphoricarpos oreophilus Forest<br>Populus tremuloides – Pseudotsuga menziesii / Juniperus communis Forest | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)<br>Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)** | | | | |
| 13 | W-PILO | Bristlecone Pine Woodland | Pinus longaeva Woodland<br>Pinus ponderosa Sparse Woodland | 1 : many |
| **Multiple Ecological Systems:<br>Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)<br>Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)** | | | | |
| 7 | W-PPMA | Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex | Pinus ponderosa / Arctostaphylos patula Woodland<br>Pseudotsuga menziesii / Arctostaphylos patula Forest<br>Pinus ponderosa – Pseudotsuga menziesii / Arctostaphylos patula Colorado Plateau Woodland<br>Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland | 1 : many |
| **Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)** | | | | |
| 8 | W-PPMS | Ponderosa Pine / Mixed Mountain Shrub Woodland Complex | Pinus ponderosa / Artemisia nova Woodland<br>Pinus ponderosa / Cercocarpus montanus Woodland<br>Pinus ponderosa / Petradoria pumila Woodland<br>Pinus ponderosa / Purshia tridentata Woodland<br>Pinus ponderosa / Symphoricarpos oreophilus Forest | 1 : many |
| 9 | W-PPMH | Ponderosa Pine / Mixed Herbaceous Woodland Complex | Pinus ponderosa / Elymus elymoides – (Elymus spp.) Woodland<br>Pinus ponderosa / Hesperostipa comata Colorado Plateau Woodland<br>Pinus ponderosa / Leymus salinus Woodland<br>Pinus ponderosa / Seeded Grasses Semi-natural Woodland<br>Pinus ponderosa / Sparse Understory Woodland | 1 : many |
| 10 | W-PPGO | Ponderosa Pine / Gambel Oak Woodland | Pinus ponderosa / Quercus gambelii Woodland | 1 : 1 |
| **Multiple Ecological Systems:<br>Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)<br>Colorado Plateau Pinyon-Juniper Woodland (CES304.767)** | | | | |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 11 | W-PPJO | Ponderosa Pine / Pinyon Pine – Juniper spp. / Gambel Oak Woodland | Pinus ponderosa / Quercus gambelii Woodland<br>Pinus edulis – Juniperus osteosperma / Quercus gambelii Woodland | 1 : many |
| 12 | W-PPJS | Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex | Pinus ponderosa / Arctostaphylos patula Woodland<br>Pinus ponderosa / Purshia tridentata Woodland<br>Pinus edulis – Juniperus osteosperma / Arctostaphylos patula Woodland<br>Pinus edulis – Juniperus osteosperma / Cercocarpus ledifolius Woodland<br>Pinus edulis – Juniperus spp. / Cercocarpus montanus – Mixed Shrubs Woodland<br>Pinus edulis – Juniperus osteosperma / Purshia tridentata Woodland | 1 : many |
| **Colorado Plateau Pinyon-Juniper Woodland (CES304.767)** | | | | |
| 14 | W-PJSW | Pinyon Pine –Juniper spp. / Saline Wildrye Woodland | Pinus edulis – Juniperus osteosperma / Atriplex spp. Woodland<br>Pinus edulis – Juniperus spp. / Leymus salinus Woodland<br>Pinus edulis – Juniperus osteosperma / Pleuraphis jamesii Woodland | 1 : many |
| 15 | W-PJSA | Pinyon Pine –Juniper spp. / Sagebrush spp. Woodland Complex | Pinus edulis – Juniperus osteosperma / Artemisia nova Woodland<br>Pinus edulis – Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland | 1 : many |
| 16 | W-PJMS | Pinyon Pine –Juniper spp. / Mixed Mountain Shrub Woodland Complex | Pinus edulis – Juniperus osteosperma / Arctostaphylos patula Woodland<br>Pinus edulis – Juniperus spp. / Cercocarpus ledifolius Woodland<br>Pinus edulis – Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland<br>Pinus edulis – Juniperus osteosperma / Purshia stansburiana Woodland<br>Pinus edulis – Juniperus osteosperma / Purshia tridentata Woodland<br>Pinus edulis – Juniperus osteosperma / Shepherdia rotundifolia Woodland | 1 : many |
| 17 | W-PJGO | Pinyon Pine –Juniper spp. / Gambel Oak Woodland | Pinus edulis – Juniperus spp. / Quercus gambelii Woodland | 1 : 1 |
| 18 | W-PJSP | Pinyon Pine –Juniper spp. / Sparse Understory Woodland | Pinus edulis – Juniperus osteosperma / Sparse Understory Woodland | 1 : 1 |
| **Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland (CES304.772)** | | | | |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 25 | W-CLMM | Curl-leaf Mountain-mahogany Woodland Complex | Cercocarpus ledifolius / Arctostaphylos patula Woodland<br>Cercocarpus ledifolius / Artemisia tridentata Woodland<br>Cercocarpus ledifolius / Quercus gambelii Woodland<br>Cercocarpus ledifolius Woodland Alliance | 1 : many |
| **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** | | | | |
| 24 | W-COTT | Narrowleaf Cottonwood Woodland Complex | Picea pungens / Betula occidentalis Woodland<br>Populus angustifolia - Juniperus scopulorum Woodland<br>Populus angustifolia / Betula occidentalis Woodland<br>Populus angustifolia / Cornus sericea Woodland<br>Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus) Woodland | 1 : many |
| 29 | S-WILL | Willow spp. Temporarily Flooded Shrubland Complex | Cornus sericea Rocky Mountain Shrubland<br>Salix eriocephala / Mesic Graminoids Shrubland<br>Salix exigua Temporarily Flooded Shrubland<br>Shepherdia argentea Shrubland | 1 : many |
| **Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)** | | | | |
| 28 | S-BIRC | Water Birch Shrubland | Betula occidentalis Shrubland | 1 : 1 |
| **Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)** | | | | |
| 35 | S-CINQ | Shrubby-cinquefoil Shrubland | Dasiphora fruticosa ssp. floribunda Shrubland | 1 : 1 |
| **Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)** | | | | |
| 26 | S-QUER | Gambel Oak Shrubland Complex | Quercus gambelii Shrubland<br>Quercus gambelii – Cercocarpus montanus / (Carex geyeri) Shrubland<br>Quercus gambelii / Sparse Understory Shrubland<br>Quercus gambelii / Symphoricarpos oreophilus Shrubland | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)<br>Inter-Mountain Basins Wash (CES304.781)<br>Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)** | | | | |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 27 | S-MXMS | Mixed Mountain Shrubland Complex | Amelanchier (utahensis, alnifolia) – Cercocarpus montanus Shrubland<br>Cercocarpus montanus Desert Wash Shrubland<br>Prunus virginiana – (Prunus americana) Shrubland<br>Purshia tridentata Desert Wash Shrubland<br>Artemisia nova - Purshia tridentata / Poa fendleriana Shrubland<br>Purshia tridentata / Hesperostipa comata Shrub Herbaceous Vegetation<br>Purshia tridentata / Leymus salinus Shrubland<br>Symphoricarpos oreophilus Shrubland | 1 : many |
| **Multiple Ecological Systems:<br>Great Basin Semi-Desert Chaparral (CES304.001)<br>Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)** | | | | |
| 31 | S-MANZ | Manzanita Shrubland Complex | Arctostaphylos patula Shrubland<br>Arctostaphylos patula – Quercus gambelii – (Amelanchier utahensis) Shrubland | 1 : many |
| **Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)** | | | | |
| 30 | S-ARNO | Black Sagebrush Shrubland Complex | Artemisia nova Shrubland<br>Artemisia nova / Elymus elymoides Shrubland<br>Artemisia nova / Hesperostipa comata Shrubland<br>Artemisia nova / Leymus salinus Shrub Herbaceous Vegetation<br>Artemisia nova / Poa fendleriana Shrubland | 1 : many |
| 37 | S-ARPY | Pygmy Sagebrush Dwarf-shrubland | Artemisia pygmaea Dwarf-shrubland | 1 : 1 |
| **Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | | | |
| 32 | S-CHVI | Viscid Rabbitbrush Shrubland Complex | Chrysothamnus viscidiflorus – Ericameria parryi Shrub Herbaceous Vegetation<br>Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland<br>Chrysothamnus viscidiflorus / Mixed Grasses Shrubland<br>Tetradymia canescens Shrubland | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)<br>Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)<br>Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | | | |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 33 | S-BOTT | Bottomland Shrubland Complex | Atriplex canescens – Artemisia tridentata Shrubland<br>Ericameria nauseosa Shrubland<br>Ericameria nauseosa / Achnatherum lettermanii Shrubland | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)<br>Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)<br>Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | | | |
| 34 | S-ARTR | Big Sagebrush Shrubland Complex | Artemisia tridentata ssp. tridentata / Agropyron cristatum Semi-natural Shrubland<br>Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland<br>Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus Shrubland<br>Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland<br>Atriplex canescens – Artemisia tridentata Shrubland<br>Atriplex canescens / Psathyrostachys juncea Seeded Shrubland | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Semi-Desert Grassland (CES304.787)<br>Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)** | | | | |
| 40 | H-HERB | Dry Meadow Mixed Herbaceous Vegetation Mosaic | Achnatherum lettermanii Herbaceous Vegetation<br>Elymus elymoides Herbaceous Vegetation<br>Elymus lanceolatus Herbaceous Vegetation<br>Hesperostipa comata Great Basin Herbaceous Vegetation<br>Leymus salinus Herbaceous Vegetation<br>Heterotheca villosa / Mixed Grass Shrub Herbaceous Vegetation<br>Pascopyrum smithii Herbaceous Vegetation<br>Poa fendleriana Herbaceous Vegetation<br>Poa secunda Herbaceous Vegetation | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Semi-Desert Grassland (CES304.787)<br>Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)<br>Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)** | | | | |
| 41 | C-DIST | Perennial Disturbed Grassland Complex | Agropyron cristatum – (Pascopyrum smithii, Hesperostipa comata) Semi-natural Herbaceous Vegetation<br>Bromus inermis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation<br>Carex vallicola Herbaceous Vegetation<br>Poa pratensis – (Pascopyrum smithii) Semi-natural Herbaceous Vegetation<br>Tetradymia canescens / Poa pratensis Shrubland | 1 : many |
| **Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)** | | | | |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 43 | H-ROAD | Roadside Restored Herbaceous Complex | Ceanothus martinii / Elymus trachycaulus Seeded Roadcut Shrub Herbaceous Vegetation<br>Elymus trachycaulus Herbaceous Vegetation | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Semi-Desert Grassland (CES304.787)<br>Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)<br>Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** | | | | |
| 42 | H-MEAD | Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic | Carex praegracilis Herbaceous Vegetation<br>Carex utriculata Herbaceous Vegetation<br>Eleocharis quinqueflora Herbaceous Vegetation<br>Juncus balticus Herbaceous Vegetation<br>Mimulus guttatus – (Mimulus spp.) Herbaceous Vegetation<br>Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation | 1 : many |
| **Multiple Ecological Systems:<br>Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)<br>Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)<br>Inter-Mountain Basins Shale Badland (CES304.789)** | | | | |
| 45 | S-MXDE | Mixed Desert Shrubland Complex | Atriplex canescens / Elymus (elymoides, salinus) Shrubland<br>Atriplex confertifolia Great Basin Shrubland<br>Eriogonum corymbosum Badlands Sparse Vegetation<br>Eriogonum corymbosum / Leymus salinus Dwarf-shrubland<br>Gutierrezia sarothrae Wooded Dwarf-shrubland Alliance<br>Tetradymia canescens Badlands Sparse Vegetation | 1 : many |
| **Inter-Mountain Basins Shale Badland (CES304.789)** | | | | |
| 48 | S-ZUCK | Siltbush Sparse Vegetation | Zuckia brandegeei Sparse Vegetation | 1 : 1 |
| **Non-Vegetated and Anderson Land Use Map Classes:** | | | | |
| 46 | G-CLAR | Claron Formation | Geologic exposures of the Claron Formation | N/A |
| 47 | G-WASH | Barren Washes | Barren wash channels | N/A |

**Table 11.** Map classes used in the final (post-AA) BRCA vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. BRCA 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 |
|---|---|---|---|---|
| 50 | L-ROAD | Roadways | | N/A |
| 51 | L-FACI | Mixed Urban or Built-up Land | | N/A |
| 52 | L-CROP | Croplands and Pastures | | N/A |
| 54 | L-AGRI | Other Agricultural Lands | | N/A |
| 56 | L-STRE | Intermittent Streams | | N/A |
| 57 | L-RESE | Reservoirs | | N/A |
| 59 | L-POND | Stock Ponds | Small catchments along minor drainages designed to hold runoff for livestock use or groundwater amendment | N/A |
| 60 | L-MINE | Strip Mines, Quarries, and Gravel Pits | Areas disturbed by mining for gravel, uranium, or other locatable or leasable minerals | N/A |
| 61 | L-SEEP | Seeps and Springs | Linear features created for the conveyance of water from a stream to agricultural fields or orchards. Includes checkdams to control erosion | N/A |

**Table 12.** Summary statistics for polygons of each map class developed for the BRCA 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 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 Complex | 140 | 124 | 264 | 954.7 | 429.3 | 1384.1 |
| F-WFGO | White Fir / Gambel Oak – (Bigtooth Maple) Forest | 27 | 21 | 48 | 133.8 | 43.1 | 176.9 |
| | *Subtotal* | *167* | *145* | *312* | *1088.5* | *472.4* | *1561* |
| **Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)** | | | | | | | |
| F-WFMS | White Fir / Manzanita – Mixed Shrub Forest | 140 | 63 | 203 | 919.3 | 501.9 | 1421.2 |
| F-PSME | Douglas Fir Forest Complex | 6 | 1 | 7 | 20.8 | 1.9 | 22.7 |
| F-WFMG | White Fir / Mixed Grass Forest | 30 | 12 | 42 | 139.1 | 154.9 | 294.0 |
| | *Subtotal* | *176* | *76* | *252* | *1079.2* | *658.7* | *1737.9* |
| **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) Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)** | | | | | | | |
| F-PICE | Blue Spruce Forest Complex | 27 | 126 | 153 | 90.1 | 204.7 | 294.9 |
| | *Subtotal* | *27* | *126* | *153* | *90.1* | *204.7* | *294.9* |
| **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 | 36 | 30 | 66 | 17.8 | 21.0 | 38.8 |
| | *Subtotal* | *36* | *30* | *66* | *17.8* | *21.0* | *38.8* |
| **Multiple Ecological Systems: Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790) Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)** | | | | | | | |
| W-PILO | Bristlecone Pine Woodland | 186 | 12 | 198 | 746.2 | 10.6 | 756.8 |

**Table 12.** Summary statistics for polygons of each map class developed for the BRCA vegetation mapping project.

| Map Code | Map Class Common Name | Polygons | | | Area (hectares) | | |
|---|---|---|---|---|---|---|---|
| | | Park | Environs | Total Area* | Park | Environs | Total Area |
| | *Subtotal* | *186* | *12* | *198* | *746.2* | *10.6* | *756.8* |
| **Multiple Ecological Systems: Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)** | | | | | | | |
| W-PPMA | Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex | 341 | 149 | 490 | 3771.4 | 1216.0 | 4987.4 |
| | *Subtotal* | *341* | *149* | *490* | *3771.4* | *1216.0* | *4987.4* |
| **Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)** | | | | | | | |
| W-PPMS | Ponderosa Pine / Mixed Mountain Shrub Woodland Complex | 97 | 112 | 209 | 407.0 | 474.1 | 881.1 |
| W-PPMH | Ponderosa Pine / Mixed Herbaceous Woodland Complex | 190 | 178 | 368 | 669.4 | 670.4 | 1339.8 |
| W-PPGO | Ponderosa Pine / Gambel Oak Woodland | 68 | 54 | 122 | 271.5 | 138.4 | 409.9 |
| | *Subtotal* | *355* | *344* | *1149.9* | *1347.9* | *1282.9* | *2630.8* |
| **Multiple Ecological Systems: Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) Colorado Plateau Pinyon-Juniper Woodland (CES304.767)** | | | | | | | |
| W-PPJO | Ponderosa Pine / Pinyon Pine – Juniper spp. / Gambel Oak Woodland | 85 | 51 | 136 | 322.8 | 200.5 | 523.3 |
| W-PPJS | Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex | 96 | 46 | 142 | 598.3 | 222.1 | 820.3 |
| | *Subtotal* | *181* | *97* | *278* | *921.1* | *422.6* | *1343.6* |
| **Colorado Plateau Pinyon-Juniper Woodland (CES304.767)** | | | | | | | |
| W-PJSW | Pinyon Pine –Juniper spp. / Saline Wildrye Woodland | 40 | 34 | 74 | 112.7 | 130.0 | 242.7 |
| W-PJSA | Pinyon Pine –Juniper spp. / Sagebrush spp. Woodland Complex | 20 | 61 | 81 | 30.2 | 103.7 | 133.9 |
| W-PJMS | Pinyon Pine –Juniper spp. / Mixed Mountain Shrub Woodland Complex | 195 | 170 | 365 | 2304.8 | 1510.7 | 3815.4 |

**Table 12.** Summary statistics for polygons of each map class developed for the BRCA vegetation mapping project.

| Map Code | Map Class Common Name | Polygons | | | Area (hectares) | | |
|---|---|---|---|---|---|---|---|
| | | Park | Environs | Total Area* | Park | Environs | Total Area |
| W-PJGO | Pinyon Pine –Juniper spp. / Gambel Oak Woodland | 167 | 157 | 324 | 547.0 | 809.5 | 1356.5 |
| W-PJSP | Pinyon Pine –Juniper spp. / Sparse Understory Woodland | 27 | 36 | 63 | 61.0 | 54.7 | 115.7 |
| | *Subtotal* | *449* | *458* | *907* | *3055.7* | *2608.6* | *5664.2* |
| **Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland (CES304.772)** | | | | | | | |
| W-CLMM | Curl-leaf Mountain- mahogany Woodland Complex | 36 | 6 | 42 | 105.3 | 4.6 | 109.9 |
| | *Subtotal* | *36* | *6* | *42* | *105.3* | *4.6* | *109.9* |
| **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** | | | | | | | |
| W-COTT | Narrowleaf Cottonwood Woodland Complex | 2 | 0 | 2 | 3.6 | 0.0 | 3.6 |
| S-WILL | Willow spp. Temporarily Flooded Shrubland Complex | 8 | 5 | 13 | 9.1 | 0.9 | 9.9 |
| | *Subtotal* | *10* | *5* | *15* | *12.7* | *0.9* | *9.9* |
| **Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)** | | | | | | | |
| S-BIRC | Water Birch Shrubland | 2 | 0 | 2 | 0.8 | 0.0 | 0.8 |
| | *Subtotal* | *2* | *0* | *2* | *0.8* | *0.0* | *0.8* |
| **Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)** | | | | | | | |
| S-CINQ | Shrubby-cinquefoil Shrubland | 0 | 41 | 41 | 0.0 | 37.5 | 37.5 |
| | *Subtotal* | *0* | *41* | *41* | *0.0* | *37.5* | *37.5* |
| **Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)** | | | | | | | |
| S-QUER | Gambel Oak Shrubland Complex | 120 | 172 | 292 | 133.4 | 287.3 | 420.8 |
| | *Subtotal* | *120* | *172* | *292* | *133.4* | *287.3* | *420.8* |

**Table 12.** Summary statistics for polygons of each map class developed for the BRCA vegetation mapping project.

| Map Code | Map Class Common Name | Polygons | | | Area (hectares) | | |
|---|---|---|---|---|---|---|---|
| | | Park | Environs | Total Area* | Park | Environs | Total Area |
| **Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) Inter-Mountain Basins Wash (CES304.781) Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)** | | | | | | | |
| S-MXMS | Mixed Mountain Shrubland Complex | 190 | 111 | 301 | 201.8 | 161.5 | 363.3 |
| | *Subtotal* | *190* | *111* | *301* | *201.8* | *161.5* | *363.3* |
| **Multiple Ecological Systems: Great Basin Semi-Desert Chaparral (CES304.001) Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)** | | | | | | | |
| S-MANZ | Manzanita Shrubland Complex | 137 | 75 | 212 | 127.4 | 63.3 | 190.7 |
| | *Subtotal* | *137* | *75* | *212* | *127.4* | *63.3* | *190.7* |
| **Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)** | | | | | | | |
| S-ARNO | Black Sagebrush Shrubland Complex | 72 | 167 | 239 | 287.6 | 451.7 | 739.3 |
| S-ARPY | Pygmy Sagebrush Dwarf-shrubland | 12 | 41 | 53 | 6.5 | 28.4 | 34.9 |
| | *Subtotal* | *84* | *208* | *292* | *294.1* | *480.1* | *774.2* |
| **Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | | | | | | |
| S-CHVI | Viscid Rabbitbrush Shrubland Complex | 35 | 93 | 128 | 37.2 | 137.1 | 174.3 |
| | *Subtotal* | *35* | *93* | *128* | *37.2* | *137.1* | *174.3* |
| **Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | | | | | | |
| S-BOTT | Bottomland Shrubland Complex | 11 | 36 | 47 | 13.0 | 38.7 | 51.7 |

**Table 12.** Summary statistics for polygons of each map class developed for the BRCA vegetation mapping project.

| Map Code | Map Class Common Name | Polygons | | | Area (hectares) | | |
|---|---|---|---|---|---|---|---|
| | | Park | Environs | Total Area* | Park | Environs | Total Area |
| | *Subtotal* | *11* | *36* | *47* | *13.0* | *38.7* | *51.7* |
| **Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** | | | | | | | |
| S-ARTR | Big Sagebrush Shrubland Complex | 26 | 82 | 108 | 75.7 | 124.9 | 200.6 |
| | *Subtotal* | *26* | *82* | *108* | *75.7* | *124.9* | *200.6* |
| **Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)** | | | | | | | |
| H-HERB | Dry Meadow Mixed Herbaceous Vegetation Mosaic | 93 | 103 | 196 | 83.7 | 84.9 | 168.6 |
| | *Subtotal* | *93* | *103* | *196* | *83.7* | *84.9* | *168.6* |
| **Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)** | | | | | | | |
| C-DIST | Perennial Disturbed Grassland Complex | 40 | 189 | 229 | 38.8 | 241.3 | 280.1 |
| | *Subtotal* | *40* | *189* | *229* | *38.8* | *241.3* | *280.1* |
| **Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)** | | | | | | | |
| H-ROAD | Roadside Restored Herbaceous Complex | 56 | 8 | 64 | 43.6 | 2.4 | 46.0 |
| | *Subtotal* | *56* | *8* | *64* | *43.6* | *2.4* | *46.0* |
| **Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** | | | | | | | |
| H-MEAD | Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic | 22 | 55 | 77 | 42.3 | 93.7 | 136.0 |
| | *Subtotal* | *22* | *55* | *77* | *42.3* | *93.7* | *136.0* |

**Table 12.** Summary statistics for polygons of each map class developed for the BRCA vegetation mapping project.

| Map Code | Map Class Common Name | Polygons | | | Area (hectares) | | |
|---|---|---|---|---|---|---|---|
| | | Park | Environs | Total Area* | Park | Environs | Total Area |
| **Multiple Ecological Systems: Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Inter-Mountain Basins Shale Badland (CES304.789)** | | | | | | | |
| S-MXDE | Mixed Desert Shrubland Complex | 79 | 62 | 141 | 100.6 | 244.8 | 345.4 |
| | *Subtotal* | *79* | *62* | *141* | *100.6* | *244.8* | *345.4* |
| **Inter-Mountain Basins Shale Badland (CES304.789)** | | | | | | | |
| S-ZUCK | Siltbush Sparse Vegetation | 4 | 3 | 7 | 34.2 | 47.0 | 81.2 |
| | *Subtotal* | *4* | *3* | *7* | *34.2* | *47.0* | *81.2* |
| **UNVEGETATED AND ANDERSON LAND USE MAP CLASSES** | | | | | | | |
| G-CLAR | Claron Formation | 295 | 66 | 361 | 979.6 | 47.2 | 1026.8 |
| G-WASH | Barren Washes | 26 | 22 | 48 | 81.3 | 47.7 | 129.0 |
| L-ROAD | Roadways | 15 | 20 | 35 | 74.5 | 81.3 | 155.8 |
| L-FACI | Mixed Urban or Built-up Land | 33 | 12 | 45 | 14.2 | 6.0 | 20.2 |
| L-CROP | Croplands and Pastures | 0 | 1 | 1 | 0.0 | 4.3 | 4.3 |
| L-AGRI | Other Agricultural Lands | 0 | 2 | 2 | 0.0 | 0.3 | 0.3 |
| L-STRE | Intermittent Streams | 0 | 1 | 1 | 0.0 | 0.4 | 0.4 |
| L-RESE | Reservoirs | 3 | 1 | 4 | 1.2 | 0.8 | 2.0 |
| L-POND | Stock Ponds | 0 | 3 | 3 | 0.0 | 0.6 | 0.6 |
| L-MINE | Strip Mines, Quarries, and Gravel Pits | 2 | 4 | 6 | 0.9 | 3.4 | 4.3 |
| L-SEEP | Seeps and Springs | 1 | 0 | 1 | 0.2 | 0.0 | 0.2 |
| | *Subtotal* | *375* | *132* | *507* | *1151.9* | *192.0* | *1343.9* |
| | **Total All Map Classes** | **3238** | **2818** | **6056** | **14614.5** | **9139.6** | **23754.1** |

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

## Discussion

Mapping the parks of the Colorado Plateau, including BRCA, is made more challenging by the massive, sheer cliffs and steep, scree slopes that are a common feature of the Plateau. The cliffs and talus slopes 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:** Field data and local descriptions of the associations provided by project ecologists were extremely important ancillary data sources used by the cartographers to delineate map classes. Other sources of ancillary data were the long-term monitoring transects established by Hayle Buchanan and a habitat type map created for BRCA by David Roberts, Doug Wight, and Gregory Hallsten. High-quality plot and observation point data, and thorough local descriptions helped provide information for direct image interpretation and modeling. Additional data collected by the project photointerpreters on field reconnaissance trips provided a stronger basis and understanding for conducting the interpretation and mapping.

Quality base data is essential to high quality scientific work. For the vegetation mapping at BRCA, high quality orthophotography allowed for both confident manual interpretation and an accurate source for deriving physiognomic classes and tree coverage densities. The geologic data were detailed and had high horizontal spatial accuracy, both of which are important in GIS applications.

**Areas for Improvement:** One challenge in mapping the mixed conifer forests common throughout the central and southern plateau portions of BRCA was correctly identifying which conifer species was dominant and therefore, which map class was most appropriate. This problem was confounded by the classification of plot and AA point vegetation association assignments by NatureServe. For classification purposes, mixed conifer stands are often classified according to indicator species versus by dominant canopy tree species cover. In contrast, the photointerpreter is mapping what is observable on the ground using the current imagery and dominant canopy tree species are the most visible and therefore mappable. The main issue was with stands co-dominated by Douglas-fir and white fir and this problem was resolved by combining polygons of Douglas-fir forests with the most closely related white-fir map class and only retaining those polygons where a plot or accuracy assessment point verified that the stand was truly a Douglas-fir forest.

Another difficulty arose when mapping understory dominants in closed to nearly closed tree canopies. Separating forests or woodlands based on diagnostic or dominant understory species was generally accomplished by applying ancillary data layers to the map representing several different environmental variables (slope steepness, slope position, aspect, geology, etc.). These layers were especially important when photointerpretation of the understory was hampered by a lack of photo signature or by confusingly similar photo signatures. The modeling of understory dominants based on landscape and environmental characteristics did not prove as accurate as predicted and in some cases adjustments were made to the map and map classes post-AA analysis to deal with lingering accuracy issues.

# 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. Accuracy assessment results come 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 BRCA boundary; private and federal outside of the Park 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.

All but two of the original vegetated map classes were included in the accuracy assessment. One excluded map class (S-CINQ) was only interpreted in the western environs of BRCA, and because accuracy assessment is performed only for lands within the park boundary, this type was omitted from the accuracy assessment; it is documented by classification plot data alone. The other map class (H-ROAD) was not accuracy assessed because polygons were too narrow or otherwise not suited for AA point generation. This type is documented solely by classification plot data. Nine land-use map classes (L-XXXX) and two geologic classes (G-XXXX) were excluded from accuracy assessment because they are essentially unvegetated or occur exclusively outside the park boundary.

Accuracy assessment sampling points were selected for each vegetation map class using guidelines A–E. The primary set of AA evaluation sites included 902 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. 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

Accuracy assessment point data were collected at BRCA during the fall 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 5,000 $m^2$ 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, and 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 plot. In most cases, a single 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 aquired at each AA point to provide visual documentation of the site.

The field team collected data at 902 AA points (Figure 29) and the resultant data were manually entered into the plots 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 photographs.

## Data Analysis

Of the 902 AA sample points collected, 899 were used in the final AA data analysis. Two points fell on recent burns and the vegetation no longer represented the signature delineated from aerial photographs acquired in 2002 and one point was removed because it fell on the park boundary and represented a map class not present in the park (S-CINQ). However, all 902 AA plots were assessed in the initial three analyses, prior to the AA meeting. 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, Dan Cogan (CTI) 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 is 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 their corresponding map class by the total number of samples whose field call belonged to that category.

The primary photointerpreter and project ecologists met in Boulder, CO June 10-12, 2008 to analyze the map errors revealed in the preliminary contingency tables and to discuss mapping units and their refinement where necessary. Meeting results are summarized in the following section. This meeting was attended by Janet Coles (NPS-NCPN), Amy Tendick (NPS-NCPN), Marion Reid (NatureServe), Gwen Kittel (NatureServe), Dan Cogan (CTI), and Jim Von Loh ($e^2$M). 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 BRCA vegetation map was revised by Dan Cogan (CTI) to reflect the changes and decisions made at the meeting and recorded by Janet Coles (NPS-NCPN).

In February 2009, a meeting was held among the BRCA park staff and project cooperators to complete the AA process. Participants discussed the alternative solutions developed during the analysis, and decided on the best solution for the purposes of natural resource management. 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, discussed below. The final contingency table was produced by project cartographers to represent the corrected data set (Table 13). The spatial database was revised to reflect the final combinations of map classes. The original set of 100 map classes was ultimately reduced to a final set of 49 vegetation, geology, and land-use map classes. Final edits were made to the vegetation map in the fall of 2010 by

Amy Tendick (NPS-NCPN) to reflect the decisions made at the 2009 final meeting with park staff and recorded by Janet Coles (Appendix I).

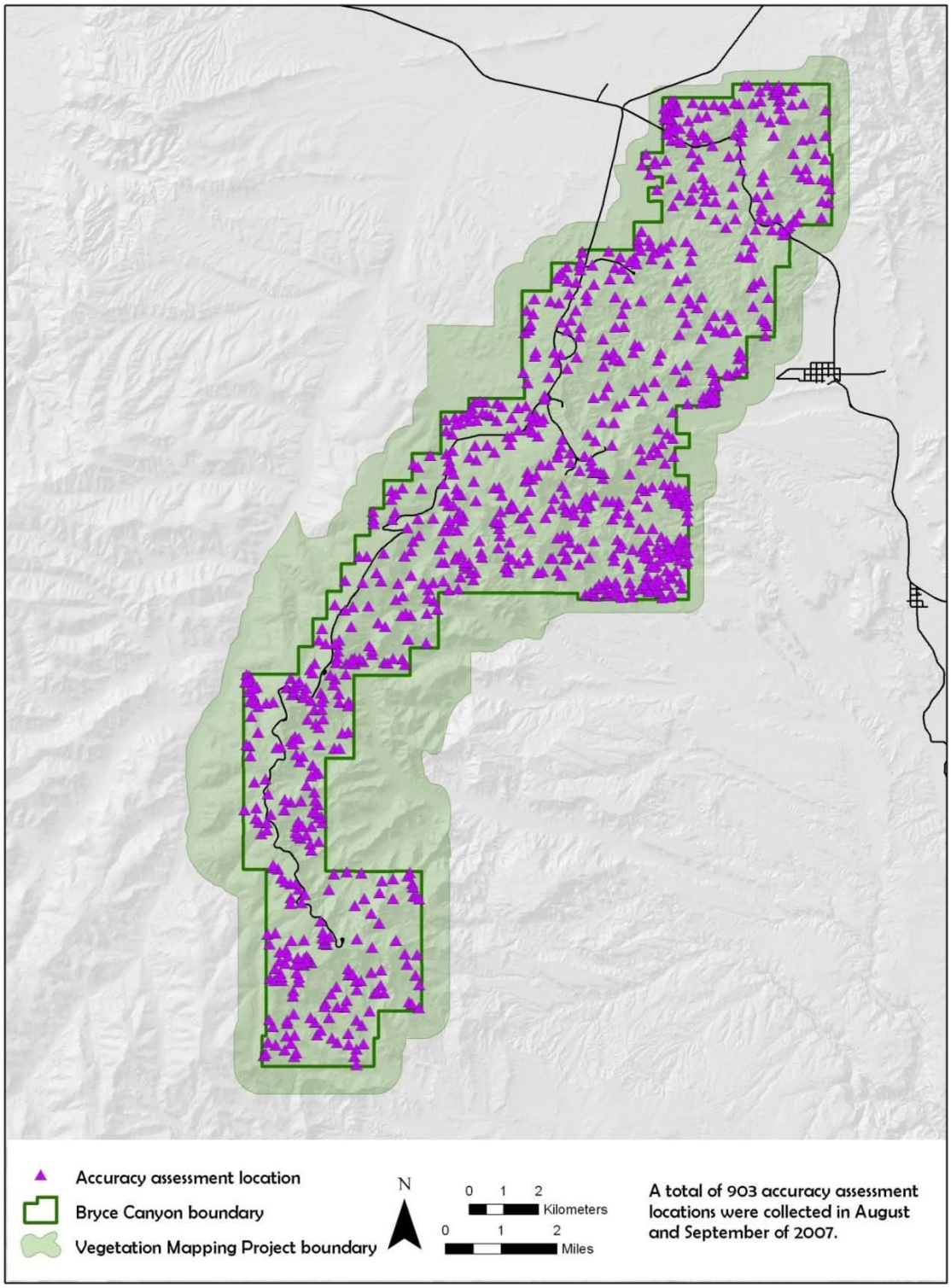



**Figure 29.** Location of accuracy assessment points sampled within BRCA. The accuracy of the map outside of the park boundary was not assessed.

**Table 13.** Final contingency table for BRCA. This table represents the 36 polygon 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 84.2% (Kappa statistic = 83.4%). User's and producer's accuracy values with 90% confidence intervals for each map class appear in Tables 14, 15, and 16.

| | | Accuracy Assessment Field Plot Data | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Commission (User's) Error | Correct | | 90% C.I. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 37 | 40 | 41 | 42 | 45 | 48 | | # | % | - | + |
| Mapped Data | 1 | 41 | 1 | 1 | | | | 1 | | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 46 | 89% | 80% | 98% |
| | 2 | 1 | 22 | 2 | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 27 | 81% | 67% | 96% |
| | 3 | 1 | 2 | 42 | | 1 | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | 49 | 86% | 76% | 95% |
| | 4 | | | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 | 100% | 90% | 110% |
| | 5 | 2 | | | | 14 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 17 | 82% | 64% | 101% |
| | 6 | | | 2 | | | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 22 | 91% | 79% | 103% |
| | 7 | 1 | | 2 | | | | 67 | 1 | 1 | | 1 | 2 | | | | 1 | | | | | | | | | | | | | | | | | | | | | 76 | 88% | 81% | 95% |
| | 8 | | | 1 | | | | 2 | 28 | 2 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | 34 | 82% | 70% | 95% |
| | 9 | | | | | 1 | | 1 | 4 | 34 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 40 | 85% | 74% | 96% |
| | 10 | | | 1 | 2 | | | 2 | 1 | | 17 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 24 | 71% | 53% | 88% |
| | 11 | | 1 | 1 | | | | 1 | 1 | | | 22 | 2 | | | | | | | | | | 1 | | | | | | | | | | | | | | | 29 | 76% | 61% | 91% |
| | 12 | | | 2 | | | 1 | | 1 | | 1 | 1 | 51 | 1 | | | | | | | | | | | | | | | | | | | | | | | | 58 | 88% | 80% | 96% |
| | 13 | | | | | | | | 1 | | | | 3 | 32 | | | | | | | | | | | | | | 2 | | | | | | | | | | 38 | 84% | 73% | 95% |
| | 14 | | | | | | | | | | | | | | 10 | | 3 | | 1 | | | | | | | | | | | | | | 1 | | | 1 | | 16 | 63% | 39% | 86% |
| | 15 | | | | | | | | | | | | 1 | | 1 | 4 | | | | | | | | | | | | | | | | | | | | | | 6 | 67% | 27% | 107% |
| | 16 | | | | | | | 1 | | | | 2 | | 1 | | | 93 | | 2 | | | | | | | | 1 | | | | | | | | | | | 100 | 93% | 88% | 98% |
| | 17 | | | | | | | | | | | | | | | | 5 | 14 | 1 | | | | 1 | | | | | | | | | | | | | | | 21 | 67% | 47% | 86% |
| | 18 | | | | | | | | | | | | 1 | | 1 | | | | 11 | | | | | | | | | | | | | | | | | | | 13 | 85% | 64% | 105% |
| | 23 | | | | | | | 1 | | | | | | | | | | | | 7 | | | | 1 | | | | | | | | | 1 | | | | | 10 | 70% | 41% | 99% |
| | 24 | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | 3 | 100% | 83% | 117% |
| | 25 | | | | | | | | 1 | 1 | | | | | | | | | | | | 10 | | | | 1 | | | | | | | | | | | | 13 | 77% | 54% | 100% |
| | 26 | | | | | | | 1 | | | | 3 | | | | | | | | | | | 23 | | | | | | | | | | | | | | | 27 | 85% | 72% | 98% |
| | 27 | | | | | | 1 | 1 | 1 | | | 1 | 1 | | | | | | | | | | | 10 | | | 1 | | | | | | | | | | 16 | 63% | 39% | 86% |
| | 28 | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | 2 | 100% | 75% | 125% |
| Omission (Producer's) Error | 29 | | | | | | | | | 1 | | | | | | | | | | | | | | | | 7 | | | | | | | | | | | 8 | 88% | 62% | 113% |
| | 30 | | | | | | | | | | | | | | | | | | | | | | | | | | 36 | | 1 | | | | | | | | 37 | 97% | 92% | 103% |
| | 31 | | | | | | | 2 | | | | 2 | 2 | 1 | | | | | | | | | | | | | | 20 | | | | | | | | | 27 | 74% | 58% | 90% |
| | 32 | | | | | | | | | 2 | | | | | | 1 | | | | | | | | | | | 1 | | 14 | | | 1 | | | | | 19 | 74% | 54% | 93% |
| | 33 | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | 8 | | | | | | | | 9 | 89% | 66% | 112% |
| | 34 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 19 | | | | | 1 | | 20 | 95% | 84% | 106% |
| | 37 | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | 3 | | | | | 5 | 60% | 14% | 106% |
| | 40 | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 2 | 1 | | 1 | | | 16 | 1 | 1 | 1 | | 24 | 67% | 49% | 85% |
| | 41 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | 12 | | | | 15 | 80% | 60% | 100% |
| | 42 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 6 | | | 7 | 86% | 57% | 115% |
| | 45 | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | | 24 | | 26 | 92% | 82% | 103% |
| | 48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10 | 10 | 100% | 95% | 105% |
| correct | # | 46 | 26 | 54 | 7 | 16 | 22 | 83 | 39 | 41 | 20 | 32 | 68 | 38 | 12 | 5 | 102 | 14 | 15 | 7 | 3 | 10 | 25 | 11 | 2 | 8 | 41 | 25 | 18 | 9 | 19 | 3 | 20 | 14 | 7 | 27 | 10 | 899 | | | |
| | % | 89% | 85% | 78% | 71% | 88% | 91% | 81% | 72% | 83% | 85% | 69% | 75% | 84% | 83% | 80% | 91% | 100% | 73% | 100% | 100% | 100% | 92% | 91% | 100% | 88% | 88% | 80% | 78% | 89% | 100% | 100% | 80% | 86% | 86% | 89% | 100% | | 84.2% | | |
| 90% C.I. | - | 80% | 71% | 68% | 36% | 71% | 79% | 73% | 59% | 72% | 69% | 54% | 66% | 73% | 61% | 41% | 86% | 96% | 51% | 93% | 83% | 95% | 81% | 72% | 75% | 62% | 78% | 65% | 59% | 66% | 97% | 83% | 63% | 67% | 57% | 77% | 95% | | | | |
| | + | 98% | 98% | 88% | 107% | 104% | 103% | 88% | 85% | 94% | 101% | 84% | 84% | 95% | 105% | 119% | 96% | 104% | 95% | 107% | 117% | 105% | 103% | 110% | 125% | 113% | 97% | 95% | 97% | 112% | 103% | 117% | 97% | 105% | 115% | 101% | 105% | | | Kappa = 83.4% | |

## Results and Discussion

The vegetation map classes presented in tables and figures in this section represent those that remained or were created following evaluation and adjustment of map classes to improve BRCA thematic accuracy. Appendix I provides the complete analysis of all map classes used in the draft map and evaluated during AA. Final overall map accuracy is 84.2% (Kappa correction = 83.4%). 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 60% to 100% (Tables 14, 15, and 16).

**Table 14**. Final BRCA 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 | 1 | White Fir Forest Complex | 89% ± 9% | 89% ± 9% |
| F-WFGO | 2 | White Fir / Gambel Oak – (Bigtooth Maple) Forest | 81% ± 15% | 85% ± 14% |
| F-WFMG | 5 | White Fir / Mixed Grass Forest | 82% ± 19% | 88% ± 16% |
| F-PICE | 6 | Blue Spruce Forest Complex | 91% ± 12% | 91% ± 12% |
| W-PPMA | 7 | Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex | 88% ± 7% | 81% ± 8% |
| W-PPMH | 9 | Ponderosa Pine / Mixed Herbaceous Woodland Complex | 85% ± 11% | 83% ± 11% |
| W-PILO | 13 | Bristlecone Pine Woodland | 84% ± 11% | 84% ± 11% |
| W-PJMS | 16 | Pinyon Pine –Juniper spp. / Mixed Mountain Shrub Woodland Complex | 93% ± 5% | 91% ± 5% |
| W-COTT | 24 | Narrowleaf Cottonwood Woodland Complex | 100% | 100% |
| S-QUER | 26 | Gambel Oak Shrubland Complex | 85% ± 13% | 92% ± 11% |
| S-BIRC | 28 | Water Birch Shrubland | 100% | 100% |
| S-WILL | 29 | Willow spp. Temporarily Flooded Shrubland Complex | 88% ± 26% | 88% ± 26% |
| S-ARNO | 30 | Black Sagebrush Shrubland Complex | 97% ± 6% | 88% ± 10% |
| S-BOTT | 33 | Bottomland Shrubland Complex | 89% ± 23% | 89% ± 23% |
| S-ARTR | 34 | Big Sagebrush Shrubland Complex | 95% ± 11% | 100% |
| C-DIST | 41 | Perennial Disturbed Grassland Complex | 80% ± 20% | 86% ± 19% |
| H-MEAD | 42 | Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic | 86% ± 29% | 86% ± 29% |
| S-MXDE | 45 | Mixed Desert Shrubland Complex | 92% ± 11% | 89% ± 12% |
| S-ZUCK | 48 | Siltbush Sparse Vegetation | 100% | 100% |

Table 15 lists fifteen vegetation map classes that were retained in the final vegetation map database for BRCA 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. 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 during the AA. In most cases, the 90% confidence interval includes 80%; park staff therefore deemed the accuracy results to be acceptable.

Five map classes were undermapped but were retained because they are ecologically significant vegetation types and the errors were confusions with closely related map classes. Ten map classes were overmapped; six of these are rare types based on a few point locations that were found to be even rarer than they were mapped. The four 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 researcher. However, they represent valuable types to park resource managers.

**Table 15.** BRCA 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-WFMS | 3 | White Fir / Manzanita – Mixed Shrub Forest | 86% ± 10% | 78% ± 10% | many |
| F-PSME | 4 | Douglas Fir Forest Complex | 100% | 71% ± 35% | 10 |
| W-PPMH | 8 | Ponderosa Pine / Mixed Mountain Shrub Woodland Complex | 82% ± 13% | 72% ± 13% | 7, 9 |
| W-PPGO | 10 | Ponderosa Pine / Gambel Oak Woodland | 71% ± 17% | 85% ± 16% | 3, 7 |
| W-PPJS | 12 | Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex | 88% ± 8% | 75% ± 9% | 7, 11, 13, 31 |
| W-PJSW | 14 | Pinyon Pine –Juniper spp. / Saline Wildrye Woodland | 63% ± 24% | 83% ± 18% | 16 |
| W-PJSA | 15 | Pinyon Pine –Juniper spp. / Sagebrush spp. Woodland Complex | 67% ± 40% | 80% ± 39% | 12, 14 |
| W-PJGO | 17 | Pinyon Pine –Juniper spp. / Gambel Oak | 67% ± 20% | 100% | 16 |
| W-PJSP | 18 | Pinyon Pine –Juniper spp. / Sparse Understory | 85% ± 21% | 73% ± 22% | 14, 16, 17 |
| F-ASPE | 23 | Aspen Forest Complex | 70% ± 29% | 100% | 7, 27, 40 |
| W-CLMM | 25 | Curl-leaf Mountain- mahogany Woodland Complex | 77% ± 23% | 100% | 8, 9, 29 |
| S-MXMS | 27 | Mixed Mountain Shrubland Complex | 63% ± 24% | 91% ± 19% | many |
| S-MANZ | 31 | Manzanita Shrubland Complex | 74% ± 16% | 80% ± 15% | 7, 11, 12, 13 |
| S-ARPY | 37 | Pygmy Sagebrush Dwarf-shrubland | 60% ± 46% | 100% | 30 |
| H-HERB | 40 | Dry Meadow Mixed Herbaceous Vegetation Mosaic | 67% ± 18% | 80% ± 17% | many |

Two vegetation map class did not achieve the 80% standard for either user's or producer's accuracy (Table 16). Map class 11 was modeled as a two-needle pinyon-Utah juniper / Gambel oak woodland with emergent ponderosa pine that occurred adjacent to drainage channels along the eastern side of the park and in the environs. The model met with mixed success and there was confusion with the canopy dominants by the PI. This map class was retained because of the ecological significance of Gambel oak in the understory (unique fire regime and wildlife value) and the unique structure and assemblage of canopy species. Map class 32 was confused with native and disturbed grasslands and with open ponderosa pine woodlands with grassy understories, but was retained because of the ecological significance of viscid rabbitbrush.

**Table 16.** BRCA 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-PPJO | 11 | Ponderosa Pine / Pinyon Pine – Juniper spp. / Gambel Oak | 76% ± 15% | 69% ± 15% | many |
| S-CHVI | 32 | Viscid Rabbitbrush Shrubland Complex | 74% ± 20% | 78% ± 19% | 9, 41 |

One map class (S-CINQ) was not accuracy assessed because it was only occurred in the western environs outside the BRCA boundary. This type is documented by classification plot data. The other map class (H-ROAD) was not accuracy assessed because polygons were too narrow or otherwise not suited for AA point generation; it too is documented by classification plot data.

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# Appendix A.
# Ecological Systems of Bryce Canyon National Park

## Introduction

This appendix contains summary descriptions of 27 terrestrial and riparian/wetland ecological system (ES) units (NatureServe 2003b, Comer et al. 2003) occurring at Bryce Canyon National Park. 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.

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This subset of the International Ecological Classification Standard covers ecological systems attributed to Bryce Canyon National Park. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC mary_russo@natureserve.org and Gwen Kittel, Regional Vegetation Ecologist, Boulder, CO gwen_kittel@natureserve.org.

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**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.

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

## UPLAND ECOLOGICAL SYSTEMS

### 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; Temperate Continental, Broad-leaved Evergreen 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 and as far east as barren sandstone highlands in the Colorado Plateau. 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, 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, with scattered occurrences in the Colorado Plateau.
**Subnations:** CA, NV, UT

### CES304.762 COLORADO PLATEAU MIXED LOW SAGEBRUSH SHRUBLAND
Division 304 (Inter-Mountain Basins); Shrubland

**Spatial Scale & Pattern:** Large patch
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Lower Montane; Lowland Foothill; Shrubland; Ridge/Summit/Upper Slope; Temperate Xeric; Aridic
**Concept Summary:** This ecological system occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats generally below 1800 m elevation. Soils are often rocky, shallow, and alkaline. This type extends across northern New Mexico into the southern Great Plains on limestone hills. It includes open shrublands and steppe dominated by *Artemisia nova* or *Artemisia bigelovii,* sometimes with *Artemisia tridentata* ssp. *wyomingensis*. Semi-arid grasses such as *Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii*, or *Poa fendleriana* are often present and may form a graminoid layer with more than 25% cover.
**Range:** Occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m.
**Subnations:** AZ, CO, NM

## CES304.765 COLORADO PLATEAU MIXED BEDROCK CANYON AND TABLELAND

Division 304 (Inter-Mountain Basins); Barren

**Spatial Scale & Pattern:** Matrix
**Required Classifiers:** Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
**Diagnostic Classifiers:** Montane, Lower Montane; Lowland, Foothill; Shrubland; Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate Xeric; Alkaline Soil; Aridic
**Concept Summary:** The distribution of this ecological system is centered on the Colorado Plateau where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland (CES304.789) may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species includes *Pinus edulis, Pinus ponderosa, Juniperus* spp., *Cercocarpus intricatus*, and other short-shrub and herbaceous species, rooted in cracks and pockets where soil accumulates.
**Comments:** Geographically restricted and distinct from the related Inter-Mountain Basins Cliff and Canyon (CES304.779). Shale areas are not extensive as in shale badlands.
**Range:** Colorado Plateau.
**Subnations:** AZ, CO, NM, UT

## 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

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**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

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**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

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**CES304.777 INTER-MOUNTAIN BASINS BIG SAGEBRUSH SHRUBLAND**
Division 304 (Inter-Mountain Basins); Shrubland

**Spatial Scale & Pattern:** Matrix
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Lowland; Shrubland; Toeslope/Valley Bottom; Deep Soil; Aridic; *Artemisia tridentata* ssp. *tridentata*
**Concept Summary:** This ecological system occurs throughout much of the western U.S., typically in basins, plains and foothills between 1500 and 2300 m elevation. Soils are typically deep, well-drained and non-saline. These shrublands are dominated by *Artemisia tridentata* ssp. *tridentata* and/or *Artemisia tridentata* ssp. *wyomingensis*. Scattered *Juniperus* spp., *Sarcobatus vermiculatus*, and *Atriplex* spp. may be present in some stands. *Ericameria nauseosa, Chrysothamnus viscidiflorus, Purshia tridentata*, or *Symphoricarpos oreophilus* may codominate disturbed stands. Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species include *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Festuca idahoensis, Hesperostipa comata, Leymus cinereus, Pleuraphis jamesii, Pascopyrum smithii, Poa secunda*, or *Pseudoroegneria spicata*.
**Range:** Occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1500-2300 m elevation.
**Subnations:** CA, CO, ID, MT, NV, OR, UT, WA, WY

**CES304.778 INTER-MOUNTAIN BASINS BIG SAGEBRUSH STEPPE**
Division 304 (Inter-Mountain Basins); Steppe/Savanna

**Spatial Scale & Pattern:** Large Patch
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Lowland [Lowland]; Deep Soil; Aridic; Xeromorphic Shrub; Bunch grasses; *Artemisia tridentata* ssp. *tridentata*
**Concept Summary:** This widespread matrix-forming ecological system occurs throughout much of the Columbia Plateau and northern Great Basin, east into the Wyoming Basins, central Montana, and north and east onto the western fringe of the Great Plains in Montana and South Dakota. It is found at slightly higher elevations farther south. Soils are typically deep and non-saline, often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. xericensis, Artemisia tridentata ssp. wyomingensis, Artemisia cana ssp. cana*, and/or *Purshia tridentata* dominating or codominating the open to moderately dense (10-40% cover) shrub layer. *Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Sarcobatus vermiculatus, Tetradymia* spp., or *Artemisia frigida* may be common especially in disturbed stands. *Bromus japonicus* and *Bromus tectorum* are indicators of disturbance. Associated graminoids can include *Achnatherum hymenoides, Calamagrostis montanensis, Elymus lanceolatus ssp. lanceolatus, Koeleria macrantha, Poa secunda, Pascopyrum smithii, Hesperostipa comata, Nassella viridula, Bouteloua gracilis*, and *Pseudoroegneria spicata*. Common forbs are *Phlox hoodii, Arenaria* spp., *Opuntia* spp., *Sphaeralcea coccinea, Dalea purpurea, Liatris punctata*, and *Astragalus* spp. Areas with deeper soils more commonly support *Artemisia tridentata ssp. tridentata* but have largely been converted for other land uses. The natural fire regime of this ecological system likely maintains a patchy distribution of shrubs, so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression. Where fire frequency has allowed for shifts to a native grassland condition, maintained without significant shrub invasion over a 50- to 70-year interval, the area would be considered Columbia Basin Foothill and Canyon Dry Grassland (CES304.993).
**Range:** This system occurs throughout much of the Columbia Plateau, the northern Great Basin, central and southeastern Montana, and Wyoming, and is found at slightly higher elevations farther south.
**Subnations:** CA, CO, ID, MT, NV, OR, UT, WA, WY

**CES304.781 INTER-MOUNTAIN BASINS WASH**
Division 304 (Inter-Mountain Basins); Barren

**Spatial Scale & Pattern:** Linear
**Required Classifiers:** Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
**Diagnostic Classifiers:** Lowland; Shrubland; Wash; Toeslope/Valley Bottom; Riverine / Alluvial; Alkaline Soil; Xeromorphic Shrub; *Sarcobatus vermiculatus*
**Concept Summary:** This barren and sparsely vegetated (generally <10% plant cover) ecological system is restricted to intermittently flooded streambeds and banks that are often lined with shrubs such as *Sarcobatus vermiculatus, Ericameria nauseosa, Fallugia paradoxa*, and/or

*Artemisia cana* ssp. *cana* (in more northern and mesic stands). *Grayia spinosa* may dominate in the Great Basin. Shrubs form a continuous or intermittent linear canopy in and along drainages but do not extend out into flats. Typically it includes patches of saltgrass meadow where water remains for the longest periods. Soils are generally less alkaline than those found in the playa system. Desert scrub species (e.g., *Acacia greggii, Prosopis* spp.), that are common in the Mojave, Sonoran and Chihuahuan desert washes, are not present. This type can occur in limited portions of the southwestern Great Plains.
**Comments:** Compare with Inter-Mountain Basins Greasewood Flat (CES304.780); should it include nonsparse shrublands? Invasive, exotic shrubs shrub as *Tamarix* spp. or *Chamaebatiaria millefolium* may be present to dominant in these washes where disturbed.
**Range:** This system occurs throughout the Intermountain U.S. into the western Great Plains.
**Subnations:** AZ, CA, CO, ID, MT, NV, OR, UT, WA, WY

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**CES304.784 INTER-MOUNTAIN BASINS MIXED SALT DESERT SCRUB**
Division 304 (Inter-Mountain Basins); Shrubland

**Spatial Scale & Pattern:** Large patch
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Lowland; Shrubland; Alluvial flat; Alkaline Soil; Saline Substrate Chemistry; Calcareous; Silt Soil Texture; Clay Soil Texture; Xeromorphic Shrub; Dwarf-Shrub; *Atriplex* spp.
**Concept Summary:** This ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes and plains across the Intermountain U.S. This type also extends in limited distribution into the southern Great Plains. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species such as *Atriplex confertifolia, Atriplex canescens, Atriplex polycarpa*, or *Atriplex spinifera*. Other shrubs present to codominant may include *Artemisia tridentata* ssp. *wyomingensis, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra nevadensis, Grayia spinosa, Krascheninnikovia lanata, Lycium* spp., *Picrothamnus desertorum*, or *Tetradymia* spp. *Sarcobatus vermiculatus* is generally absent, but if present is not dominant. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus* ssp. *lanceolatus, Pascopyrum smithii, Pleuraphis jamesii, Pleuraphis rigida, Poa secunda*, or *Sporobolus airoides*.
**Range:** Intermountain western U.S., extending into the southern Great Plains.
**Subnations:** AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

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**CES304.785 INTER-MOUNTAIN BASINS MONTANE SAGEBRUSH STEPPE**
Division 304 (Inter-Mountain Basins); Steppe/Savanna

**Spatial Scale & Pattern:** Matrix
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Upper Montane, Montane, Lower Montane; Woody-Herbaceous
**Concept Summary:** This ecological system includes sagebrush communities occurring across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern

Rockies. In British Columbia, it occurs between 450 and 1650 m in the southern Fraser Plateau and the Thompson and Okanagan basins. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. It is composed primarily of *Artemisia tidentata* ssp. *vaseyana* (mountain sagebrush) and related taxa such as *Artemisia tridentata* ssp. *spiciformis. Purshia tridentata* may codominate or even dominate some stands. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa, Peraphyllum ramosissimum, Ribes cereum,* and *Chrysothamnus viscidiflorus*. This system also includes *Artemisia tridentata* ssp. *vaseyana* shrublands. In many areas, frequent wildfires maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with a moisture providing equally high grass and forb cover. Most stands have an abundant perennial herbaceous layer (> 25% cover). Common graminoids include *Festuca arizonica, Festuca idahoensis, Hesperostipa comata, Leucopoa kingii, Poa fendleriana, Elymus trachycaulis, Bromus carinatus, Poa secunda, Deschampsia caespitosa, Calamagrostis rubescens,* and *Pseudoroegneria spicata*.
**Range:** This system occupies montane and subalpine elevations from 1000 m in eastern Oregon and Washington to more than 3000 m in the southern Rockies. In British Columbia, it occurs in the southern Fraser Plateau and the Thompson and Okanagan basins.
**Subnations:** AZ?, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

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**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 ft) 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 ft) in elevation.
**Subnations:** AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

**CES304.788 INTER-MOUNTAIN BASINS SEMI-DESERT SHRUB-STEPPE**
Division 304 (Inter-Mountain Basins); Steppe-Savanna

**Spatial Scale & Pattern:** Large Patch
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Lowland [Foothill]; Woody-Herbaceous; Temperate Xeric; Alkaline Soil; Aridic; Very Short Disturbance Interval; G-Landscape/High Intensity; Graminoid
**Concept Summary:** This ecological system occurs throughout the arid intermountain western U.S., typically at lower elevations on alluvial fans and flats with moderate to deep soils, and extends into south-central Montana between the Pryor and Beartooth ranges where a distinct rainshadow effect occurs. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub to moderately dense woody layer with a typically strong graminoid layer. The most widespread (but not always dominant) species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the northern Rockies. Other characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Distichlis spicata, Poa secunda, Poa fendleriana, Sporobolus airoides , Hesperostipa comata, Pleuraphis jamesii*, and *Leymus salinus*. The woody layer is often a mixture of shrubs and dwarf-shrubs, although it may be dominated by a single species. Characteristic species include *Atriplex canescens, Artemisia tridentata, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Ephedra* spp., *Ericameria nauseosa, Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. *Artemisia tridentata* or *Atriplex canescens* may be present but does not dominate. Annual grasses, especially the exotics *Bromus japonicus* and *Bromus tectorum*, may be present to abundant. Forbs are generally of low importance and are highly variable across the range but may be diverse in some occurrences. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layers. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some stands.
**Range:** This system occurs throughout the intermountain western U.S., typically at lower elevations, and extends into Wyoming and Montana across the Great Divide Basin. It barely gets as far north into north-central Montana (mapzone 20) but is unlikely to be mapped.
**Subnations:** AZ, CA, CO, ID, MT, NM, NV, OR, UT, 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

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**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 ft). 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

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**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

**CES306.814 ROCKY MOUNTAIN BIGTOOTH MAPLE RAVINE WOODLAND**
Division 306 (Rocky Mountain); Forest and Woodland

**Spatial Scale & Pattern:** Large patch
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Colluvial slope; Ravine; Stream terrace (Undifferentiated); Toeslope; Mineral: W/ A-Horizon <10 cm; Unconsolidated; Broad-Leaved Deciduous Tree; *Acer grandidentatum*
**Concept Summary:** This ecological system occurs in cool ravines, on toeslopes and slump benches associated with riparian areas in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico and the Trans-Pecos of Texas. Substrates are typically rocky colluvial or alluvial soils with favorable soil moisture. These woodlands are dominated by *Acer grandidentatum* but may include mixed stands codominated by *Quercus gambelii* or with scattered conifers. Some stands may include *Acer negundo* or *Populus tremuloides* as minor components. It also occurs on steeper, north-facing slopes at higher elevations, often adjacent to Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) or Rocky Mountain Aspen Forest and Woodland (CES306.813).
**Range:** Occurs in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico and the Trans-Pecos of Texas.
**Subnations:** ID, NM, TX, UT, WY?

**CES306.818 ROCKY MOUNTAIN GAMBEL OAK-MIXED MONTANE SHRUBLAND**
Division 306 (Rocky Mountain); Shrubland

**Spatial Scale & Pattern:** Large patch
**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland
**Diagnostic Classifiers:** Shrubland; Shallow Soil; Mineral w/ A-Horizon <10 cm; Loam Soil Texture; Sand Soil Texture; Ustic; Unconsolidated; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]; Broad-Leaved Deciduous Shrub
**Concept Summary:** This ecological system occurs in the mountains, plateaus, and foothills in the southern Rocky Mountains and Colorado Plateau, including the Uinta and Wasatch ranges and the Mogollon Rim. These shrublands are commonly found on dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 2000 to 2900 m in elevation, and are often situated above pinyon-juniper woodlands. Substrates include soil types

ranging from calcareous, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. The vegetation is typically dominated by *Quercus gambelii* alone or with *Amelanchier alnifolia, Amelanchier utahensis, Artemisia tridentata, Cercocarpus montanus, Prunus virginiana, Purshia stansburiana, Purshia tridentata, Robinia neomexicana, Symphoricarpos oreophilus*, or *Symphoricarpos rotundifolius*. There may be inclusions of other mesic montane shrublands with *Quercus gambelii* absent or as a minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many of the same site characteristics. Density and cover of *Quercus gambelii* and *Amelanchier* spp. often increase after fire.
**Range:** Occurs in the mountains, plateaus and foothills in the southern Rocky Mountains and Colorado Plateau including the Uinta and Wasatch ranges and the Mogollon Rim.
**Subnations:** AZ, CO, NM, UT, WY

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**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

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**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

## RIPARIAN AND WETLAND ECOLOGICAL SYSTEMS

### 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 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

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**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 ft), 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 Bryce Canyon National Park. 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

### 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 BPU's 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

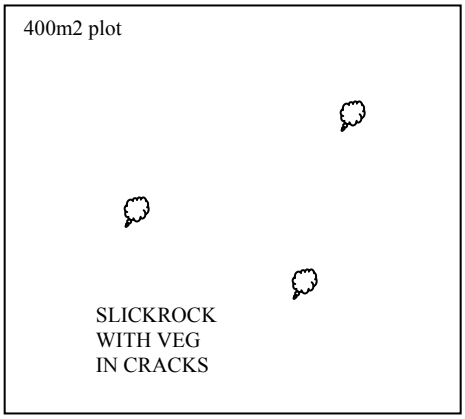
occurrences (highly invasive species that pose a big threat) and large areas of infestation may also be documented. Finally, all NCPN parks are working on documenting with specimen vouchers all vascular plants in each park. Field crews will be supplied a working vascular plant species list for each park 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

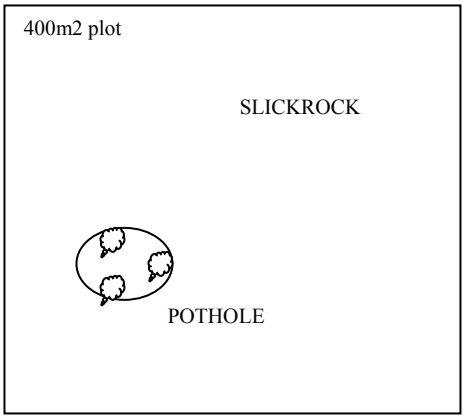
### 1. PLACEMENT OF PLOT

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.

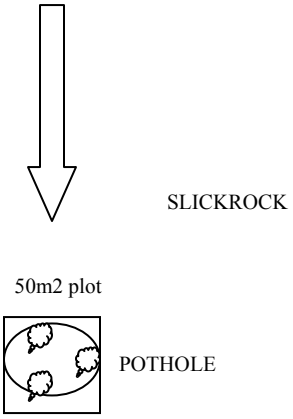
Placing a plot in slickrock/ rocky areas, where vegetation only occurs in cracks or pockets, can be particularly confusing. In these cases, there are two acceptable approaches: (1) find a pothole big enough to put a full-size plot in, or (2) use a smaller plot size and note in your comments fields that 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 $m^2$<br>20 x 20m | 400 $m^2$<br>10 x 40m<br>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 $m^2$<br>20 x 20m | 400 $m^2$<br>10 x 40m<br>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 $m^2$<br>20 x 20m | 400 $m^2$<br>10 x 40m<br>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 $m^2$<br>10 x 10m | 400 $m^2$<br>5 x 20m<br>2 x 50m, etc. |
| **Shrub Herbaceous** (i.e., forb and/or grass cover roughly equal to shrubs or dwarf shrubs). | 100 $m^2$<br>10 x 10m | 400 $m^2$<br>5 x 20m<br>2 x 50m, etc. |
| **Herbaceous** (i.e., herbs or grasses dominant, usually forming more than 25 percent cover). | 100 $m^2$<br>10 x 10m | 400 $m^2$<br>5 x 20m<br>2 x 50m, etc. |
| **Nonvascular** (i.e., lichen or moss cover dominant, usually forming more than 10% cover). | 100 $m^2$<br>10 x 10m | 25 $m^2$<br>1 x 25 m<br>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 "BRCA.0101" and their first observation point "BRCA.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?**

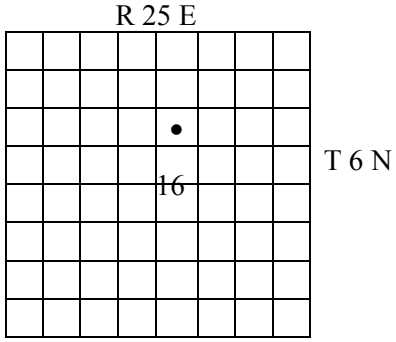
Circle Y or N accordingly. 3D differential is obtained when your GPS unit can "see" a satellite that does nothing but correct the tiny errors in the positioning or clocks of other GPS satellites. This satellite broadcasts a real-time differential correction so that your location coordinates are as accurate 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).

**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 **Bryce Canyon National Park 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**

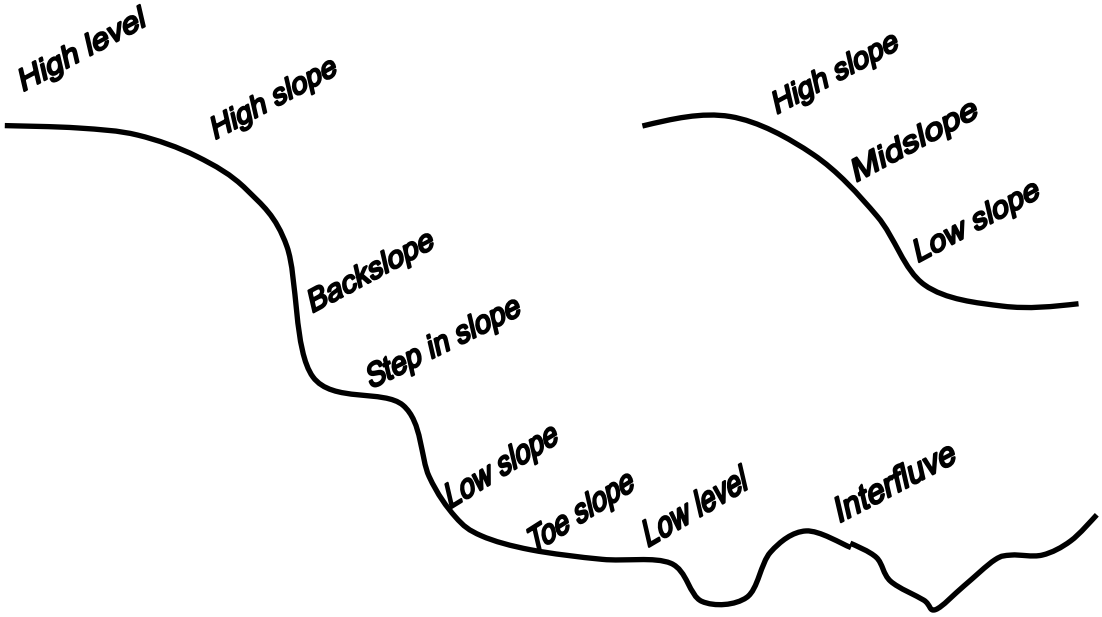
Water gullies
Mass wasting
Mountain pine beetle damage
Flash flooding
Grazing evidence
Development, historic structures
Agriculture
ORV use or Recreation
Wildlife concentration
Fire
Drought

**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.

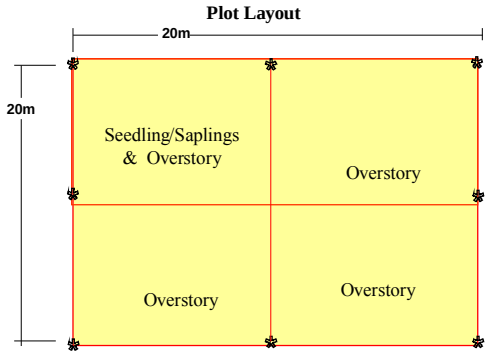
#### Aspect, Slope, and Elevation

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)**

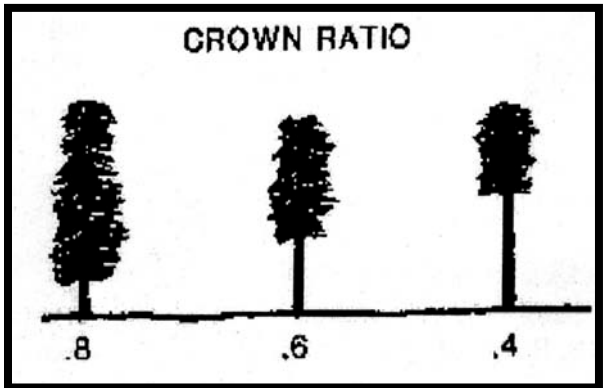
Some species such as juniper, pinyon pine, some maples and oaks commonly have multiple stems (3 or more) and are often extremely variable in form. For these species, diameter at root crown (DRC) is a more meaningful measurement than DBH (USDA Forest Service 1997). Measurement is in centimeters (cm). 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)

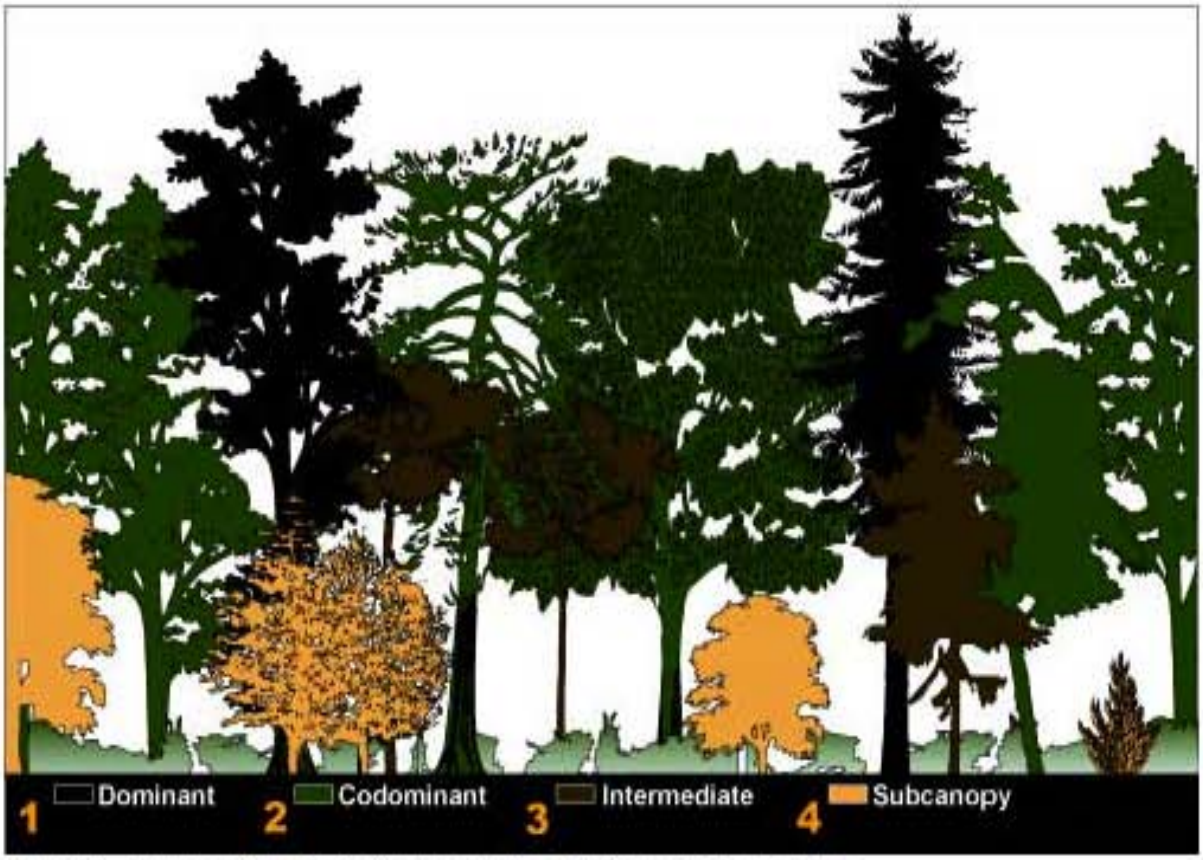



Figure 29. Crown position codes for live trees. A fifth code (5) is used for isolated trees.

**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

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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, BRCA9101)

### 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 dictionary's 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 5000m2 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/contents/part629.html#00)**

**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

**BRYCE CANYON NATIONAL PARK PLOT SURVEY FORM**
**2005 NCPN VEGETATION MAPPING PROGRAM**

SURVEY AND SITE INFORMATION

Plot Code: BRCA. 0063 Quad name: Podunk Creek BPU Code: N/A Aerial Photo #: 5037
Park Site Name Rainbow Point Location (Please Circle One): (Park) Environs
Survey Date 9/7/05 Surveyors A. Tendick, E. Ballenger

GPS file name _____ Field UTM X 389261 m E Field UTM Y 4149172 m N
☐ Coordinates from USGS NAD27 Quad Map (if checked enter coordinates under GPS comments)
Datum NAD 83 Zone: _____ GPS Unit: (Trimble XM) / Garmin Flat /Other: _____ PDOP: 3.0 3D Differential? Y / N
GPS Comments: Error: +/- _____ m (Flat Garmin only)

Directions to Plot: Drive down main park service road to just within 2 miles from the end at Rainbow Point and turn right (SW) onto a service road. Go thru locked gate and continue down road ~150 m. Plot is NW of road ~60 meters.

Square plot (20m x 20m) X | Rectangular Plot: length(m)_____ width(m)_____ | Azimuth _____

Camera Name and Model (circle one): Olympus Stylus / Canon Sureshot / (Minolta F7) Other: _____

| Roll # | Frame # | Photographer | Direction/Comments |
|---|---|---|---|
| EB15 | 35 | Ballenger | →E |
| " " | 34 | " " | →N |
| | | | |
| | | | |
| | | | |

Plot representativeness (discuss plot placement and explain non-representativeness) Plot captures mixed conifer woodland with a fairly sparse understory that seems common on the higher slopes just below the mesa top. Higher than normal representation of dead PSEMEN (still have brown needles on them). Scattered PINPON in area, but none ended up in the plot.

ENVIRONMENTAL DESCRIPTION

Elevation 2657 (m) ft From: (GPS) / Map (circle one) | Slope 10° | Aspect 158°
Topographic Position: High slope
Landform: Mesa | Geology: Obscured
Cowardin System: X Upland ___ Palustrine
Hydrology: ___ Permanently Flooded ___ Semipermanently Flooded ___ Unknown ___ Seasonally Flooded ___ Saturated ___ Temporarily Flooded ___ Intermittently Flooded

Environmental Comments (factors controlling community/plant distribution, seral stage, fire history etc): No fire evidence in the area, quite a bit of accumulated fuels. Slightly rolling microtopography, and this side of the mesa is generally SW-facing. Lots of ABICON recruitment! Understory cover sparse, with a decent amount of grass diversity. Some pockets of POPTRE and scattered PINPON common in area, but dominant canopy species are ABICON and PSEMEN.

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## BRYCE CANYON NATIONAL PARK PLOT SURVEY FORM

PLOT CODE: BRCA. 0063 DATE: 9/7/05

ENVIRONMENTAL DESCRIPTION (Continued)

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

| | | | |
|---|---|---|---|
| 1 Bare soil | 6 Live veg - litter | — Moss | — Dark cyanobacteria |
| — Bedrock | 1 Live veg – wood | — Lichen (on rocks) | — Water |
| 2 Small rocks (0.2-10cm) | 8 Wood (>1cm) | — Lichen (ground) | |
| 1 Large rocks (>10cm) | 86 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:

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

Animal Use Evidence (including scat, browse, burrows, bedding sites, etc) Some browsing evidence on Astragalus.

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) Plot is within 150 meters of the main park road and within 75 meters of a service road, but no noticeable effects from the close road proximity. Unsure of what has killed some of the PSEMEN in the area, many still have needles, could be a mistletoe or fungus since no pitching or insect holes are evident.

Other Comments. **Describe surrounding communities and how they relate to the plot.** Plot community is fairly homogenous. Downslope ~200 meters, the grass understory gets thicker, then downslope from that ARCPAT becomes the dominant understory.

VEGETATION DESCRIPTION

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

2005: JUN 15; V1.1 (Plot Form) 2

## BRYCE CANYON NATIONAL PARK PLOT SPECIES/STRATA FORM
### 2005 NCPN VEGETATION MAPPING PROGRAM

Plot Code: BRCA. 0063 Date: 9/7/05

**VEGETATION DESCRIPTION**

Provisional Community Name: Abies concolor / Mahonia repens Forest

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: 05 Strata Cover: 70 | | | | |
| Abies concolor | | 02 | 15 | |
| Pseudotsuga menziesii | | P | 3 | |
| PSEMEN dead | | Pa | 8 | |
| Pinus ponderosa | | 0 | | |
| **T3 SUBCANOPY** Strata Height: 04 Strata Cover: 25 | | | | |
| Abies concolor | | Pa | 9 | |
| Pseudotsuga menziesii | | Pa | 6 | |
| Populus tremuloides | | 0 | | |
| **S1 TALL SHRUB (2-5m)** Strata Height: ____ Strata Cover: ____ | | | | |
| **S2 SHORT SHRUB (≤2m)** Strata Height: 01 Strata Cover: P | | | | |
| Symphoricarpos oreophilus | | | T | |
| Arctostaphylos patula | | | T | |
| Rosa sp. | | | t | |
| **S3 DWARF SHRUB (≤0.5m)** Strata Height: 01 Strata Cover: P | | | | |
| Mahonia repens | | | P | 5 |
| Chrysothamnus parryi | | | t | |
| Pachistima myrsenites | | | t | |

**SPECIES/STRATA TABLE / HERBACEOUS**

| Strata / Species Scientific Name | * | Cover Class | % Cover | Spec ✓ |
|---|---|---|---|---|
| **H1 HERBACEOUS** Sum of H1, H2, H3, H4 Strata Height: 01 Strata Cover: P | | | | |
| **H1 GRAMINOIDS** Strata Height: 01 Strata Cover: P | | | | |
| Carex rossii | * | | T | |
| Elymus elymoides | | | T | |
| Poa fendleriana | | | T | |
| Bromus ciliatus | | | t | |
| Koeleria micrantha | | | t | |
| Stipa lettermanii | * | | T | |
| **H2 FORBS** Strata Height: 01 Strata Cover: T | | | | |
| ?Erigeron flagellaris | | | t | |
| Astragalus megacarpa | | | t | |
| Eriogonum racemosum | | | t | |
| Ipomopsis aggregata | | | t | |
| Senecio multilobatus | | | t | |
| ?Astragalus sp. (hairy) | | | t | |
| ?Astragalus misor | | | T | |
| **H3 FERNS & ALLIES** Strata Height: ____ Strata Cover: ____ | | | | |
| **H4 TREE SEEDLINGS** Strata Height: 02 Strata Cover: 10 | | | | |
| Abies concolor | | | P | 5 |
| Pseudotsuga menziesii | | | t | |
| Populus tremuloides | | | t | |
| **N NON-VASCULAR** Strata Height: ____ Strata Cover: ____ | | | | |

**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 | 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 |

2005: JUN 20; v1.1 (Species/Strata Form)

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## BRYCE CANYON NATIONAL PARK FUELS FORM
### 2005 NCPN VEGETATION MAPPING PROJECT

PLOT CODE: BRCA. 0063 DATE: 9/7/05

(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 | | | | | | |

N=4149174 E=389246 pdop = 7.8

**FUEL VARIABLES (English Units)**

Anderson Fuel Model Number 8 Tag#=2201

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

| Browns Transect # | Slope (%) | 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 | 0° | 91° | 11 | 4 | 0 |
| 2 | 1° | 246° | 37 | 6 | |

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 | 7.2 | R | | | | | | |
| 1 | 13.2 | S | | | | | | |
| 2 | 4.2 | 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 | 1.7 | 1.4 | 1.8 | 1.2 | 0.8 | 2.4 | 3.5 | 2.4 | 2.8 | 1.9 |
| | Duff Depth | 0.8 | 1.4 | 0.25 | 0.3 | 0.2 | 1.4 | 3.0 | 4.2 | 2.9 | 1.8 |
| Transect 2 | Litter Depth | 2.2 | 2.1 | 1.7 | 1.3 | 1.5 | 0.6 | 1.4 | 0.6 | 1.1 | 1.0 |
| | Duff Depth | 1.3 | 1.4 | 0.3 | 1.5 | 1.0 | 1.1 | 1.2 | 0.3 | 2.5 | 1.4 |

Fuels Comments: Sapling quad measured has most of saplings in plot -

2005: JUN 17; V1.1 (Fuels Form) 2

## BRYCE CANYON NATIONAL PARK FUELS FORM
### 2005 NCPN VEGETATION MAPPING PROJECT

PLOT CODE: BRCA. 0063 DATE: 9/8/05

**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 | 3.8 | ABICON | ☒ yes ☐ no | 7.6 | ABICON | ☒ yes ☐ no | 5.5 |
| | ☒ yes ☐ no | 3.1 | | ☒ yes ☐ no | 4.5 | POPTRE | ☐ yes ☒ no | 10.3 |
| | ☒ yes ☐ no | 3.2 | | ☒ yes ☐ no | 5.5 | ABICON | ☒ yes ☐ no | 1.8 |
| | ☒ yes ☐ no | 2.0 | | ☒ yes ☐ no | 1.7 | | ☒ yes ☐ no | 2.0 |
| | ☒ yes ☐ no | 1.7 | | ☒ yes ☐ no | 3.6 | | ☒ yes ☐ no | 4.7 |
| | ☒ yes ☐ no | 1.7 | | ☒ yes ☐ no | 5.8 | | ☒ yes ☐ no | 0.6 |
| | ☒ yes ☐ no | 2.4 | | ☒ yes ☐ no | 2.4 | ABICON | ☒ yes ☐ no | 2.5 |
| | ☒ yes ☐ no | 3.3 | | ☒ yes ☐ no | 1.8 | PSEMEN | ☒ yes ☐ no | 0.5 |
| | ☒ yes ☐ no | 10.0 | | ☒ yes ☐ no | 0.9 | ABICON | ☒ yes ☐ no | 5.5 |
| | ☒ yes ☐ no | 1.8 | | ☒ yes ☐ no | 0.8 | | ☐ yes ☐ no | |
| | ☒ yes ☐ no | 2.8 | | ☒ yes ☐ no | 6.1 | | ☐ yes ☐ no | |
| | ☒ yes ☐ no | 2.2 | | ☒ yes ☐ no | 4.4 | | ☐ yes ☐ no | |
| | ☒ yes ☐ no | 0.7 | | ☒ yes ☐ no | 2.5 | | ☐ yes ☐ no | |
| | ☒ yes ☐ no | 1.9 | | ☒ yes ☐ no | 5.3 | | ☐ yes ☐ no | |
| | ☒ yes ☐ no | 1.5 | | ☒ yes ☐ no | 1.7 | | ☐ yes ☐ no | |
| | ☒ yes ☐ no | 1.2 | | ☒ yes ☐ no | 6.3 | | ☐ 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 |
|---|---|---|---|---|---|---|---|---|
| PSEMEN | | ☒ yes ☐ no | 16.7 | | 5 | .4 | 3 | |
| POPTRE | | ☐ yes ☒ no | 15.7 | | | | | |
| PSEMEN | | ☒ yes ☐ no | 12.1 | | 0 | 1.0 | 3 | MISL, BROM |
| ABICON | | ☒ yes ☐ no | 32.4 | | 2 | 0.9 | 2 | |
| ABICON | ✓ | ☒ yes ☐ no | 34.9 | | 2 | 0.9 | 2 | |
| ABICON | ✓ | ☒ yes ☐ no | 15.6 | | 2 | 0.7 | 2 | |
| ABICON | ✓ | ☐ yes ☒ no | 21.2 | | | | | |
| ABICON | ✓ | ☐ yes ☒ no | 25.2 | | | | | |
| ABICON | | ☒ yes ☐ no | 30.5 | | 1 | 0.8 | 2 | |
| ABICON | | ☒ yes ☐ no | 27.0 | | 2 | 0.7 | 2 | |
| PSEMEN | | ☐ yes ☒ no | 58.5 | | | | | BROM |
| ABICON | | ☒ yes ☐ no | 55.1 | | 1.5 | 0.8 | 2 | ABGR |
| ABICON | | ☒ yes ☐ no | 17.5 | | 1.5 | 0.8 | 3 | |
| ABICON | | ☒ yes ☐ no | 33.8 | | 0 | 0.9 | 2 | |
| PSEMEN | | ☐ yes ☒ no | 70.0 | | | | | MISL, BROM |
| | | ☐ yes ☐ no | | | | | | |
| | | ☐ yes ☐ no | | | | | | |
| | | ☐ yes ☐ no | | | | | | |
| | | ☐ yes ☐ no | | | | | | |
| | | ☐ yes ☐ no | | | | | | |
| | | ☐ yes ☐ no | | | | | | |
| | | ☐ yes ☐ no | | | | | | |

2005: JUN 17; V1.1 (Fuels Form) 1

## B.4. Example of an Observation Point Data Form

**BRYCE CANYON NATIONAL PARK OBSERVATION SURVEY FORM**
**2006 NCPN VEGETATION MAPPING PROGRAM**

SURVEY AND SITE INFORMATION

Point Code: BRCA. 9 029 Quad name: Tropic BPU Code: N/A Aerial Photo #: 512-17
Type of Observation (Please Circle One): VEG/OBS SPRING/HANGING GARDEN OTHER (Specify) _____
Park Site Name Little Henderson Canyon Location (Please Circle One): (Park) Environs
Survey Date 6/18/06 Surveyors Williams, Ballenger Size of Area: 1/2 ha

GPS file name _____ Field UTM X 402096 m E Field UTM Y 4172015 m N
☐ Coordinates from USGS NAD27 Quad Map (if checked enter coordinates under GPS comments)
Datum NAD 83 Zone: _____ GPS Unit: (Trimble XM) / Garmin Flat /Other: _____ PDOP: 2.5 3D Differential? Y / N
GPS Comments: Error: +/- _____ m (Flat Garmin only)

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

| Roll # | Frame # | Photographer | Direction/Comments |
|---|---|---|---|
| AT II | 19 | Williams | => NW |
| | | | |
| | | | |

ENVIRONMENTAL DESCRIPTION

Elevation 2240 (m) / ft From: (GPS) / Map (circle one) Slope 22 Aspect Var.
Topographic Position: High slope
Landform: Ridge Geology: Claron Pink

Cowardin System: X Upland ___ Palustrine

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

Environmental Comments:
Observation point wraps over both sides of a Claron ridge. PINLON is definitely the dominant species here, though a couple PINFLE are here and doing well PINPON/ARCPAT is creeping up the lower parts of these slopes from below - and not every Claron ridge in the area is PINLON-dominated. Some have a strong component of PINPON + ARPAT. Quite a few old snags in our area.

Unvegetated Surface: *(please use cover scale below)*
01 Bare soil; ___ Bedrock; 04 Small rocks (0.2-10cm); 01 Large rocks (>10cm); ___ Sand (0.1-2mm); 01 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<br>X Evergreen<br>___ Cold-deciduous<br>___ Mixed evergreen-cold-deciduous<br><br>Herbs<br>___ Annual<br>___ Perennial | ___ Broad-leaved<br>X Needle-leaved<br>___ Microphyllous<br>___ Graminoid<br>___ Forb<br>___ Pteridophyte<br>___ Non-vascular<br>___ Mixed (describe) | ___ Forest<br>___ Woodland<br>___ Shrubland<br>___ Wooded Shrubland<br>___ Dwarf Shrubland<br>___ Shrub Herbaceous<br>___ Herbaceous<br>___ Nonvascular<br>X Sparsely Vegetated<br>___ Wooded herbaceous | 01 = 0 – 10%<br>02 = 10 – 25%<br>03 = 25 – 60%<br>04 = 60 – 100% |

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

## BRYCE CANYON NATIONAL PARK OBSERVATION SURVEY FORM

2006 NCPN VEGETATION MAPPING PROGRAM

Provisional Community Name: Pinus longaeva-Pinus flexilis / Arctostaphylos patula Sparse Veg - Plot Code: BRCA. 9029

| | Stratum Height Class | Stratum Cover Class | Dominant Species (mark Diagnostic species with *) | % Cover |
|---|---|---|---|---|
| T1 Emergent | | | | |
| T2 Canopy | 04 | 01 | Pinus longaeva<br>Pinus flexilis<br>Pinus ponderosa | 2<br>2<br>T |
| T3 Sub-canopy | | | | |
| S1 Tall shrub (> 2 m) | | | | |
| S2 Short Shrub (< 2 m) | 01 | 01 | Arctostaphylos patula<br>Cercocarpus montanus | 1<br>T |
| S3 Dwarf Shrub (< 0.5 m) | | | | |
| H Herbaceous | 01 | 01 | Oenothera howardii<br>* Elymus salinus<br>Linum kingii<br>Haplopappus armeroides<br>Eriogonum panguicense | T<br>T<br>T<br>T |
| N Non-vascular | | | | |

**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% |

## B.5. Example of an Accuracy Assessment Data Form

**2007 ACCURACY ASSESSMENT POINT FORM – BRYCE CANYON NATIONAL PARK**
**NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT**

**IDENTIFIERS/LOCATORS**

AA Point Code: BRCA_AA. 201 Quad name: _____ AA Point Shape: ☒ circle ☐ other

Park Site Name AGUA CANYON

Survey Date 8 22 07 Surveyor(s) CONDIE

GPS file name_____ Field UTM X 390084 m E Field UTM Y 4153814 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: _____ 3D Differential? ☐ yes ☐ no

Datum NAD 83 Zone: 12 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 |
|---|---|---|---|
| BC 13 | 13 | CONDIE | → E |
| | | | |
| | | | |

**PLANT ASSOCIATION INFORMATION**

| ASSOCIATIONS AT AA POINT | New? | OTHER ASSOCIATIONS WITHIN 50 M OF AA POINT |
|---|---|---|
| Primary Name ERICAMERIA NAUSEOSA SHRUBLAND | ☐ | 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)
THE ERICAMERIA ISN'T AS THICK AS THE ASSOCIATION DESCRIPTION CALLS FOR. ALSO SEVERAL TREES ARE INVADING THE SHRUBLAND.

**ENVIRONMENTAL DESCRIPTION**

Elevation 2285 m / f t From: GPS / Map (circle one) Slope 4 Aspect 77

Topographic Position: LOW LEVEL

Landform: VALLEY Geology: ALLUVIUM

Environmental Comments: THIS FLAT VALLEY BOTTOM HAS DEEP SOIL AND UNIQUE VEGETATION FOR THE AREA. A GULLY ABOUT SIX FEET DEEP RUNS THROUGH THE MEADOW AND DISPLAYS THE DEPTH OF THE FINE ALLUVIAL SOIL. A FEW COW PIES ATTEST TO THE LACK OF ADEQUATE FENCING IN THIS PART OF THE PARK.

8/6/07

## 2007 ACCURACY ASSESSMENT POINT FORM – BRYCE CANYON NATIONAL PARK

### 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 | T | Small rocks (gravel, 0.2-10 cm) | P | Bare soil |
| T | Wood ( > 1 cm) | | | — | Other:_____ |

**VEGETATION DESCRIPTION**

| Leaf phenology (dominant stratum) | Leaf Type (of dominant stratum) | Physiognomic Class | Height Class (m) | Cover Scale |
|---|---|---|---|---|
| Trees and Shrubs | X Broad-leaved | ___ Forest | 01 - <0.5 | T - <1% |
| ___ Evergreen | ___ Needle-leaved | ___ Woodland | 02 - 0.5-1 | P - 1-5% |
| X Cold-deciduous | ___ Microphyllous | ___ Shrubland | 03 - 1-2 | 1a - 6-10% |
| ___ Mixed evergreen - cold-deciduous | ___ Graminoid | ___ Dwarf- shrubland | 04 - 2-5 | 1b- 11-15% |
| Herbs | ___ Forb | X Shrub herbaceous | 05 - 5-10 | 02 - 16-25% |
| ___ Perennial | ___ Pteridophyte | ___ Wooded herbaceous | 06 - 10-15 | 03 - 26-35% |
| ___ Annual | ___ Non Vascular | ___ Wooded Shrubland | 07 - 15-20 | 04 - 36-45% |
| | ___ Mixed | ___ Herbaceous | 08 - 20-35 | 05 - 46-55% |
| | | ___ Nonvascular | 09 - 35-50 | 06 - 56-65% |
| | | ___ Sparsely vegetated | 10 - >50 | 07 - 66-75% |
| | | | | 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 | 1 |
| T2 Canopy | 05 | P | JUNIPERUS OSTEOSPERMA | 3 |
| | | | PSEUDOTSUGA MENZESII | T |
| | | | PINUS PONDEROSA | T |
| T3 Sub-canopy | ___ | ___ | | |
| S1 Tall shrub | ___ | ___ | | |
| S2 Short Shrub | 02 | 1a | CHRYSOTHAMNUS NAUSEOSUS | 5 |
| | | | CHRYSOTHAMNUS VISCIDIFLORUS | 2 |
| | | | SYMPHORICARPOS OREOPHILUS | 1 |
| S3 Dwarf-shrub | ___ | ___ | | |
| H Herbaceous | 01 | 1b | KOELERIA MACRANTHA | 3 |
| | | | ERIOGONUM RACEMOSUM | 1 |
| | | | STIPA COMATA | 3 |
| | | | ARTEMISIA DRACUNCULUS | T |
| H4 [redacted] | ___ | ___ | POA FENDLERIANA | 3 |
| 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 BRCA VegMapDB, have been used for all vegetation mapping projects conducted by NCPN. BRCA VegMapDB contains plot, observation point, and accuracy assessment data collected during project field work.

Two database files are required to use BRCA VegMapDB:

- *BRCA_PlotsAA_XP.mdb.* This "frontend" file contains all queries, forms, reports, associated modules and Visual Basic code.
- *BRCA_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 (BRCA_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.

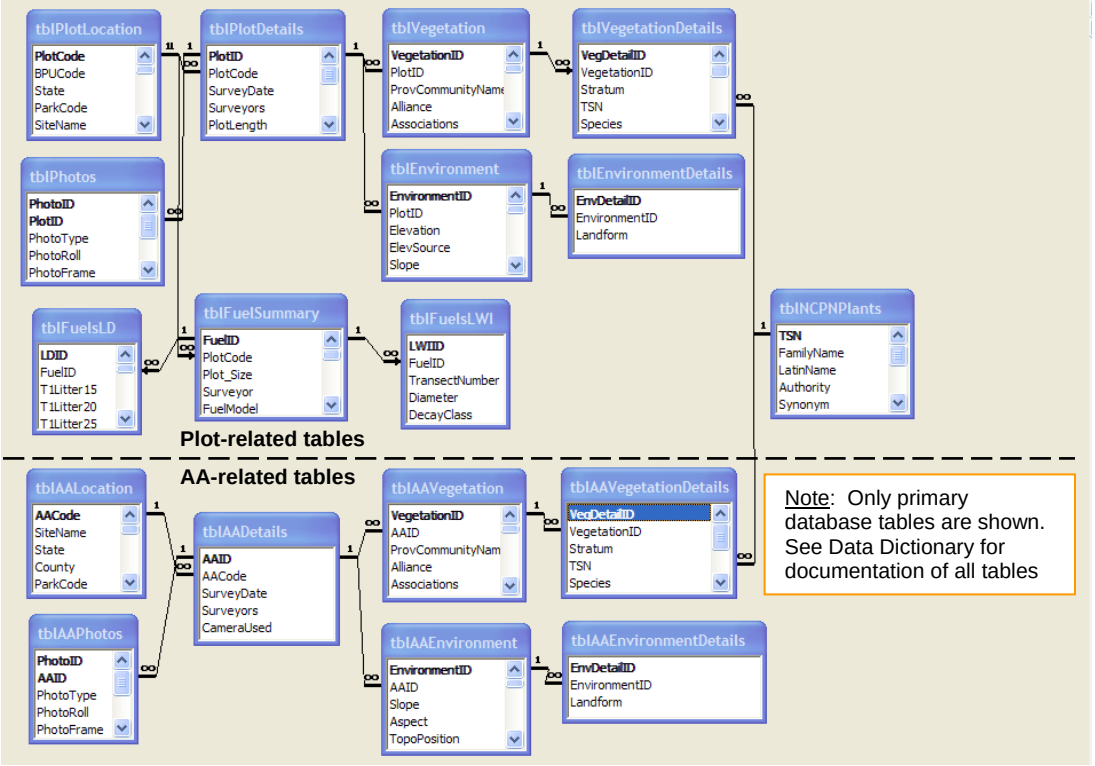



**Figure 1. Entity Relationship Diagram for BRCA VegMapDB**

**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:*** tblFinalAssociationNamesPlots
***Description:*** Table containing final Association Names (plots) assigned by NatureServe.

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| PlotCode | Identifier assigned to plot by survey crew | dbText | 255 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| ELC_Code | Unique ID assigned by NatureServe | dbText | 255 |
| Association_Name | Association Name assigned by NatureServe | dbText | 255 |

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

| 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 - moved to tblFuelSummary 2/16/2006 RD. | dbText | 10 |
| 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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:*** 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. | dbText | 50 |
| T1Azimuth | Azimuth from plot center. | dbText | 50 |
| 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. | 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 |
| 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.

| 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 | Comments field | 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 identifer | 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 BRCA.

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| NewPlotCode | Not used for BRCA | dbText | 20 |
| OldPlotCode | Not used for BRCA | 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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 are: veg/obs, spring/hanging garden, other. | dbText | 25 |
| ObservationComment | Comments for other observation type. | dbMemo | 0 |
| TagNumber | Tag number for permanent fuel plots. | dbText | 10 |
| TagUTMX | UTM easting of permanent plot. | dbDouble | 8 |
| TagUTMY | UTM northing of permanent plot. | dbDouble | 8 |

***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 |
| 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 tllkPhysiogClass) | 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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 |
| FernCovTot | Cover class of fern and fern ally stratum | dbText | 15 |
| FernCovPercent | Not used | dbText | 50 |
| SeedlHt | Height class of tree seedling stratum | dbText | 2 |
| SeedlCovTot | Cover class of tree 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 epiphyteb 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 | dbText | 240 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| | specimen label | | |
| SpecimenHabitat | Brief description of collection habitat, suitable for specimen label | dbText | 240 |
| SpecimenAssocSpecies | Brief description of associated species in collection area, suitable for specimen label | dbText | 240 |

## 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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 |
| 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 |
| 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 | dbText | 9 |
| UTMNorthing | UTM northing of point | dbText | 10 |
| 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 | dbText | 50 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| | reading from Trimble GPS unit) | | |
| 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 |
| 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 |
| USGSQuad | USGS Quad Map name | dbText | 50 |
| 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 | Was name obtained from field key? | dbBoolean | 1 |
| NewName | New classification name? | dbBoolean | 1 |
| Post_Field_Name | Post-field name? | dbBoolean | 1 |
| OtherAssocCode | Other associations within 50 m | dbText | 255 |
| VegAssocName | Association name | 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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 name | dbText | 100 |
| 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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 (tlkpCoverAA) | dbText | 50 |
| 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 |
| Diagnostic | Check if species is known to be diagnostic of the vegetation type | dbBoolean | 1 |
| Dead | Dead? | dbBoolean | 1 |

***Table Name:*** tblFinalAssociationNamesAA
***Description:*** Table containing final Association Names (AA points) assigned by NatureServe.

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| PlotCode | Identifier of AA record; assigned by field crew | dbText | 255 |
| ELC_Code | Unique ID assigned by NatureServe | dbText | 255 |
| Association_Name | Association Name assigned by NatureServe | dbText | 255 |

## 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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%, | dbText | 50 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| | 09=86-95% | | |

***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/contents/part629.html#00)

| 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 |
|---|---|---|---|

| 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 |
|---|---|---|---|

| 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:*** Look-up table for fuels structural stages

| 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 BRCA.

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| USGSQuad | Names of all 7.5 minute USGS quads for BRCA | dbText | 50 |
| USGSQuadCode | n/a for BRCA plots | dbText | 7 |

***Table Name:*** tlkpUTMZone
***Description:*** Look-up for UTM zone of BRCA

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| UTMZone | UTM zone where all BRCA 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 BRCA 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.

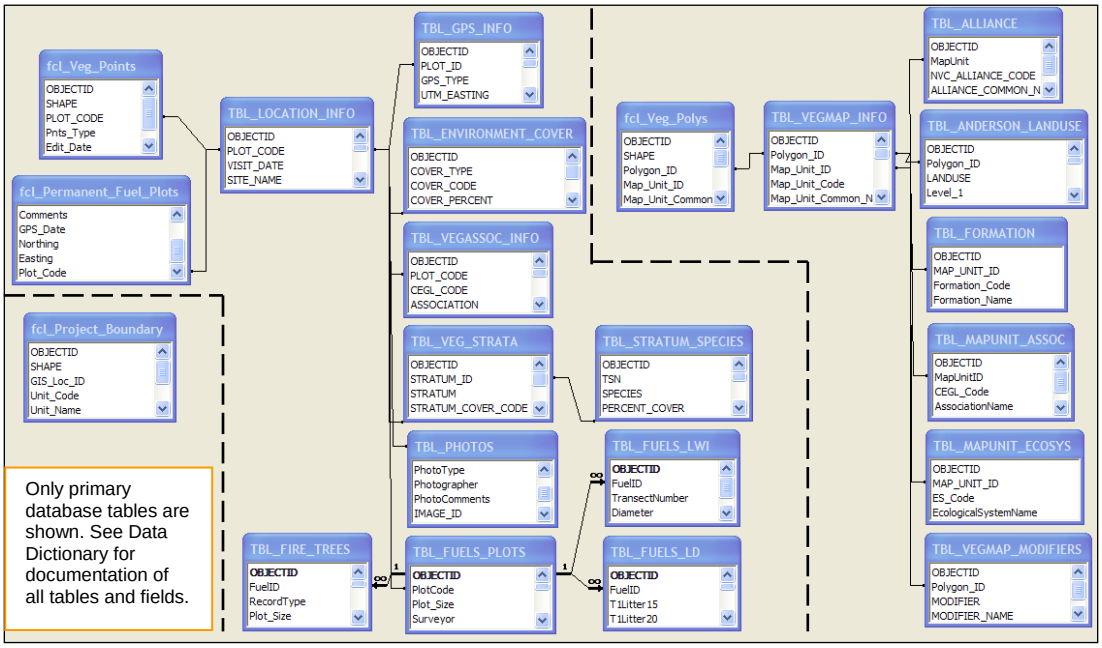



**Figure 2. Entity Relationship Diagram for BRCA Geodatabase**

### 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_Permanent_Fuel_Plots
***Description:*** The feature class containing point data associated with permanent fuels plots.

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| OBJECTID | ESRI generated autonumber | dbLong | 4 |
| SHAPE | ESRI generated | dbLongBinary | 0 |
| PointTag | Tag number for fuel plot | dbText | 10 |
| Comments | Comments about fuel plot | dbText | 255 |
| GPS_Date | Date fuel plot was visited | dbDate | 8 |
| Northing | UTM northing of fuel plot | dbDouble | 8 |
| Easting | UTM easting of fuel plot | dbDouble | 8 |
| Plot_Code | Unique Plot code, used for relating tables and feature class | dbText | 20 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| | (TBL_LOCATION_INFO) | | |

***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 (BRCA) | dbText | 10 |
| Unit_Name | Full name of national park (Bryce Canyon National Park) | dbText | 255 |
| 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 |
| 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 |
|---|---|---|---|

| 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 |
| 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 |
| 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 |
| 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 (BRCA) | 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 (Garfield or Kane 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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| 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 animals in plot area (plot and obs only) | dbText | 255 |
| 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 | dbText | 50 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| | (TBL_LOCATION_INFO) | | |
| 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 | dbText | 180 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| | name | | |
| 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 BRCA | dbText | 1 |
| COVER_PATTERN | n/a for BRCA | 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 BRCA | dbText | 1 |
| HEIGHT_CLASS | n/a for BRCA | 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:/BRCA/Vegetation/MapClassDescriptions/W-PPMS _mu8.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 |

| Field Name | Field Description | Field Type | Field Width |
|---|---|---|---|
| MODIFIER_NAME | Name/type of modifier | dbText | 50 |
| MODIFIER_DESCRIPTION | Description of modifier | dbText | 255 |

# Appendix D. Plant Species List and Crosswalk

Five hundred and five vascular plant species representing 60 families were noted during plot, observation point and accuracy assessment point data collection at Bryce Canyon National Park (BRCA). 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 BRCA 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 BRCA 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 glabrum* var. *glabrum* Torr. | *Acer glabrum var. glabrum* | Rocky Mountain maple | 28743 |
| | *Acer grandidentatum* Nutt. | *Acer grandidentatum* | bigtooth maple | 28760 |
| Agavaceae | *Yucca angustissima* Engelm. ex Trel. | *Yucca angustissima* | narrowleaf yucca | 43131 |
| | *Yucca baccata* Torr. | *Yucca baccata* | banana yucca | 43134 |
| | *Yucca harrimaniae* Trel. | *Yucca harrimaniae* | Spanish bayonet | 43144 |
| Anacardiaceae | *Rhus aromatica* Ait. | *Rhus aromatica* | fragrant sumac | 28779 |
| | *Rhus aromatica* ssp. *trilobata* (Nutt.) Gray ex. S. Wats. | *Rhus trilobata var. trilobata* | skunkbush sumac | 526551 |
| | *Rhus aromatica* var. *trilobata* (Nutt.) Gray ex. S. Wats. | *Rhus trilobata var. trilobata* | skunkbush sumac | 539586 |
| Apiaceae | *Angelica pinnata* S. Wats. | *Angelica pinnata* | smalleaf angelica | 29448 |
| | *Berula erecta* (Huds.) Coville | *Berula erecta* | cutleaf waterparsnip | 29596 |
| | *Cymopterus acaulis* (Pursh) Raf. | *Cymopterus acaulis* | plains spring parsley | 29628 |
| | *Cymopterus lemmonii* (Coult. & Rose) Dorn | *Pseudocymopterus montanus* | n/a | 511931 |
| | *Cymopterus minimus* (Mathias) Mathias | *Cymopterus minimus* | Cedar Breaks springparsley | 29646 |
| | *Cymopterus purpureus* S. Wats. | *Cymopterus purpureus* | purple springparsley | 29654 |
| | *Cymopterus* Raf. | *Cymopterus* | springparsley | 29625 |
| | *Ligusticum porteri* Coult. & Rose | *Ligusticum porteri* | Porter's licoriceroot | 29532 |
| | *Lomatium minimum* (Mathias) Mathias | *Lomatium minimum* | little desert parsley | 29723 |
| | *Lomatium parryi (S. Wats.) J.F. Macbr.* | *Lomatium parryi* | fernleaf biscuitroot | 29735 |
| Apocynaceae | *Apocynum androsaemifolium* L. | *Apocynum androsaemifolium* | spreading dogbane | 30156 |
| Asclepiadaceae | *Asclepias hallii* Gray | *Asclepias hallii* | Hall’s milkweed | 30270 |
| Asteraceae | *Achillea millefolium* L.. | *Achillea millefolium* | common yarrow | 35423 |
| | *Agoseris glauca* (Pursh) Raf. | *Agoseris glauca* | false agoseris | 36490 |
| | *Agoseris* Raf. | *Agoseris* | mountain dandelion | 36485 |
| | *Antennaria* Gaertn. | *Antennaria* | pussytoes | 36716 |
| | *Antennaria microphylla Rydb.* | *Antennaria microphylla* | littleleaf pussytoes | 185162 |
| | *Antennaria parvifolia* Nutt. | *Antennaria microphylla* | small-leaf pussytoes | 36749 |
| | *Antennaria rosulata Rydb.* | *Antennaria rosulata* | Kaibab pussytoes | 36755 |
| | *Arnica chamissonis* Less. | *Arnica chamissonis* | Chamisso arnica | 36560 |
| | *Arnica cordifolia* Hook. | *Arnica cordifolia* | heartleaf arnica | 36561 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Asteraceae | *Artemisia bigelovii* Gray | *Artemisia bigelovii* | Bigelow's sage | 35452 |
| | *Artemisia campestris* L. | *Artemisia campestris* | wormwood sagewort | 183748 |
| | *Artemisia carruthii* Wood ex Carruth. | *Artemisia carruthii* | Carruth's sagewort | 35458 |
| | *Artemisia dracunculus* L. | *Artemisia dracunculus* | wild tarragon | 35462 |
| | *Artemisia dracunculus* ssp. glauca (Pallas ex Willd.) Hall & Clements | *Artemisia dracunculus* | wild tarragon | 183731 |
| | *Artemisia frigida* Willd. | *Artemisia frigida* | fringed sagebrush | 35465 |
| | *Artemisia* L. | *Artemisia* | sagebrush | 35431 |
| | *Artemisia ludoviciana* Nutt. | *Artemisia ludoviciana* | white sagebrush | 35474 |
| | *Artemisia ludoviciana* ssp. *ludoviciana* Nutt. | *Artemisia ludoviciana ssp. ludoviciana* | Michaux's wormwood | 35475 |
| | *Artemisia ludoviciana* var. *latiloba* Nutt. | *Artemisia ludoviciana ssp. candicans* | n/a | 532352 |
| | *Artemisia nova* A. Nels. | *Artemisia nova* | black sagebrush | 500971 |
| | *Artemisia pygmaea* Gray | *Artemisia pygmaea* | pygmy sagebrush | 35490 |
| | *Artemisia tridentata* Nutt. | *Artemisia tridentata* | big sagebrush | 35498 |
| | *Artemisia tridentata* ssp. *tridentata* Nutt. | *Artemisia tridentata ssp. tridentata* | big sagebrush | 35499 |
| | *Artemisia tridentata* ssp. *vaseyana* (Rydb.) Beetle | *Artemisia tridentata ssp. vaseyana* | mountain big sagebrush | 183740 |
| | *Artemisia tridentata* ssp. *wyomingensis* Beetle & Young | *Artemisia tridentata ssp. wyomingensis* | Wyoming big sagebrush | 183741 |
| | *Artemisia tridentata* var. *vaseyana* (Rydb.) Boivin | *Artemisia tridentata ssp. vaseyana* | Mountain big sagebrush | 532368 |
| | *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 glaucodes* Blake | *Eurybia glauca* | gray aster | 35578 |
| | *Aster hesperius* Gray | *Symphyotrichum lanceolatum ssp. hesperium var. hesperium* | white panicle aster | 35586 |
| | *Aster* L. | *Aster* | aster | 35510 |
| | *Aster spathulatus* var. *spathulatus* | *Symphyotrichum spathulatum var. spathulatum* | western mountain aster | 566344 |
| | *Aster wasatchensis* var. *wasatchensis* (M.E. Jones) S.F. Blake | *Eurybia wasatchensis* | Wasatch aster | 513463 |
| | Asteraceae | *Asteraceae* | sunflowers | 35420 |
| | *Bahia* Lag. | *Bahia* | bahia | 36790 |
| | *Balsamorhiza sagittata* (Pursh) Nutt. | *Balsamorhiza sagittata* | arrowleaf balsamroot | 36818 |
| | *Brickellia oblongifolia* Nutt. | *Brickellia oblongifolia* | Mohave brickellbush | 36891 |
| | *Brickellia oblongifolia* var. *linifolia* (D.C. Eat.) B.L. Robins. | *Brickellia oblongifolia var. linifolia* | narrowleaf brickellbush | 526986 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Asteraceae | *Chaenactis douglasii* (Hook.) Hook. & Arn. | *Chaenactis douglasii* | Douglas' dustymaiden | 36987 |
| | *Chaetopappa ericoides* (Torr.) Nesom | *Chaetopappa ericoides* | rose heath | 501376 |
| | *Chrysopsis villosa* (Pursh) Nutt. ex DC | *Heterotheca villosa var. villosa* | hairy false goldenaster | 510984 |
| | *Chrysopsis villosa* var. *minor* | *Heterotheca villosa var. minor* | hairy false goldenaster | 531216 |
| | *Chrysothamnus depressus* Nutt. | *Chrysothamnus depressus* | longflower rabbitbrush | 37051 |
| | *Chrysothamnus linifolius* Greene | *Chrysothamnus linifolius* | spearleaf rabbitbrush | 37054 |
| | *Chrysothamnus nauseosus* (Pallas ex Pursh) Britt. | *Ericameria nauseosa* | rubber rabbitbrush | 507594 |
| | *Chrysothamnus nauseosus* var. *consimilis* (Greene) Hall | *Ericameria nauseosa ssp. consimilis var. oreophila* | n/a | 533550 |
| | *Chrysothamnus* Nutt. | *Chrysothamnus* | rabbitbrush | 37048 |
| | *Chrysothamnus parryi* (Gray) Greene | *Ericameria parryi* | Parry's rabbitbrush | 37071 |
| | *Chrysothamnus parryi* var. *parryi* (A. Gray) E.L. Greene | *Ericameria parryi var. parryi* | green rabbitbrush | 531201 |
| | *Chrysothamnus vaseyi* (Gray) Greene | *Chrysothamnus vaseyi* | Vasey's rabbitbrush | 37089 |
| | *Chrysothamnus viscidiflorus* (Hook.) Nutt. | *Chrysothamnus viscidiflorus* | yellow rabbitbrush | 37090 |
| | *Chrysothamnus viscidiflorus* var. *lanceolatus* (Nutt.) Greene | *Chrysothamnus viscidiflorus ssp. lanceolatus* | n/a | 533581 |
| | *Chrysothamnus viscidiflorus* var. *stenophyllus* (Gray) Hall | *Chrysothamnus viscidiflorus ssp. viscidiflorus var. stenophyllus* | n/a | 566624 |
| | *Chrysothamnus viscidiflorus* var. *viscidiflorus* (Hook.) Nutt. | *Chrysothamnus viscidiflorus ssp. viscidiflorus var. viscidiflorus* | n/a | 566625 |
| | *Cirsium calcareum* (M.E. Jones) Woot. & Standl. | *Luzula pallidula* | Cainville thistle | 39346 |
| | *Cirsium calcareum* var. *pulchellum* (Greene) Welsh | *Cirsium calcareum* | n/a | 533608 |
| | *Cirsium* P. Mill. | *Cirsium* | thistle | 36334 |
| | *Cirsium undulatum* (Nutt.) Spreng. | *Cirsium undulatum* | Wavyleaf thistle | 36423 |
| | *Cirsium wheeleri* (Gray) Petrak | *Cirsium wheeleri* | Wheeler thistle | 36429 |
| | *Crepis intermedia* Gray | *Crepis intermedia* | grayhawksbeard | 37185 |
| | *Crepis* L.. | *Crepis* | hawksbeard | 37168 |
| | *Crepis occidentalis* Nutt. | *Crepis occidentalis* | western hawksbeard | 37196 |
| | *Crepis runcinata* (James) Torr. & Gray | *Crepis runcinata* | dandelion hawksbeard | 37203 |
| | *Erigeron abajoensis* Cronq. | *Erigeron abajoensis* | Abajo fleabane | 35810 |
| | *Erigeron caespitosus* Nutt. | *Erigeron caespitosus* | tufted fleabane | 35833 |
| | *Erigeron canus* Gray | *Erigeron canus* | hoary fleabane | 35835 |
| | *Erigeron divergens* Torr. & Gray | *Erigeron divergens* | spreading fleabane | 35852 |
| | *Erigeron eatonii Gray* | *Erigeron eatonii* | Eaton's fleabane | 35853 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Asteraceae | *Erigeron flagellaris* Gray | *Erigeron flagellaris* | trailing fleabane | 35865 |
| | *Erigeron* L. | *Erigeron* | fleabane | 35803 |
| | *Erigeron pumilus* Nutt. | *Erigeron pumilus* | shaggy fleabane | 35934 |
| | *Erigeron pumilus* var. *condensatus* (D.C. Eat.) Cronq. | *Erigeron concinnus var. condensatus* | n/a | 535062 |
| | *Erigeron speciosus* (Lindl.) DC. | *Erigeron speciosus* | aspen fleabane | 35950 |
| | *Gutierrezia sarothrae* (Pursh) Britt. & Rusby | *Gutierrezia sarothrae* | broom snakeweed | 37483 |
| | *Haplopappus acaulis* (Nutt.) Gray | *Stenotus acaulis* | stemless mock goldenweed | 505369 |
| | *Haplopappus armerioides* (Nutt.) Gray | *Stenotus armerioides* | thrift mock goldenweed | 505370 |
| | *Haplopappus armeroides* var. *armeroides* | *Stenotus armerioides var. armerioides* | n/a | 530563 |
| | *Haplopappus macronema* (Nutt.) Gray | *Ericameria discoidea var. discoidea* | n/a | 514437 |
| | *Haplopappus scopulorum* (M.E. Jones) Blake | *Hesperodoria scopulorum* | n/a | 37560 |
| | *Haplopappus* Cass. | *n/a* | haplopappus | 37497 |
| | *Haplopappus zionis L.C. Anders.* | *Ericameria zionis* | n/a | 514449 |
| | *Helianthella uniflora* (Nutt.) Torr. & Gray | *Helianthella uniflora* | oneflower helianthella | 37598 |
| | *Helianthus annuus* L. | *Helianthus annuus* | annual sunflower | 36616 |
| | *Helianthus petiolaris* Nutt. | *Helianthus petiolaris* | prairie sunflower | 36671 |
| | *Heliomeris multiflora* Nutt. | *Heliomeris multiflora* | showy goldeneye | 37603 |
| | *Hymenopappus filifolius* Hook. | *Hymenopappus filifolius* | fineleaf hymenopappus | 37766 |
| | *Hymenopappus filifolius* var. *nudipes* (Maguire) B.L. Turner | *Hymenopappus filifolius var. nudipes* | n/a | 528525 |
| | *Hymenoxys* Cass. | *Hymenoxys* | rubberweed | 37778 |
| | *Hymenoxys richardsonii* (Hook.) Cockerell | *Hymenoxys richardsonii* | Colorado rubberweed | 37785 |
| | *Hymenoxys richardsonii* var. *floribunda* (Gray) Parker | *Hymenoxys richardsonii var. floribunda* | Colorado rubberweed | 528536 |
| | *Lactuca serriola* L. | *Lactuca serriola* | prickly lettuce | 36608 |
| | *Lygodesmia* D. Don | *Lygodesmia* | skeletonweed | 500397 |
| | *Lygodesmia grandiflora* (Nutt.) Torr. & Gray | *Lygodesmia grandiflora* | largeflower skeletonweed | 503622 |
| | *Lygodesmia spinosa* Nutt. | *Stephanomeria spinosa* | spiny skeletonweed | 516525 |
| | *Machaeranthera canescens* (Pursh) Gray | *Machaeranthera canescens* | hoary tansyaster | 37984 |
| | *Machaeranthera grindelioides* (Nutt.) Shinners | *Machaeranthera grindelioides* | rayless tansyaster | 37992 |
| | *Machaeranthera grindelioides* var. *grindelioides* (Nutt.) Shinners | *Machaeranthera grindelioides var. grindelioides* | n/a | 529072 |
| | *Petradoria pumila* (Nutt.) Greene | *Petradoria pumila* | grassy rockgoldenrod | 38233 |
| | *Senecio hydrophilus* Nutt. | *Senecio hydrophilus* | water groundsel | 36144 |

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|---|---|---|---|---|
| Asteraceae | *Senecio multilobatus* Torr. & Gray ex Gray | *Packera multilobata* | lobeleaf groundsel | 36161 |
| | *Senecio spartioides* Torr. & Gray | *Senecio spartioides* | broom groundsel | 36184 |
| | *Senecio spartioides* var. *spartioides* Torr. & Gray | *Senecio spartioides var. spartioides* | n/a | 531235 |
| | *Senecio werneriifolius* var. *barkleyi* S. Welsh | *Packera werneriifolia* | hoary groundsel | 518160 |
| | *Solidago* L. | *Solidago* | goldenrod | 36223 |
| | *Solidago parryi* (Gray) Greene | *Oreochrysum parryi* | Parry's goldenrod | 36287 |
| | *Solidago velutina* DC. | *Solidago velutina* | threenerve goldenrod | 505290 |
| | *Sphaeromeria capitata* Nutt. | *Sphaeromeria capitata* | Rock tansy | 38432 |
| | *Stephanomeria exigua* Nutt. | *Stephanomeria exigua* | small wirelettuce | 38445 |
| | *Stephanomeria tenuifolia* (Raf.) Hall | *Stephanomeria minor var. minor* | narrowleaf wirelettuce | 38455 |
| | *Taraxacum officinale* G.H. Weber ex Wiggers | *Taraxacum officinale* | dandelion | 36213 |
| | *Tetradymia canescens* DC. | *Tetradymia canescens* | spineless horsebrush | 38494 |
| | *Townsendia incana* Nutt. | *Townsendia incana* | hoary Townsend daisy | 38549 |
| | *Townsendia montana* var. *minima* (Eastw.) Beaman | *Townsendia alpigena var. minima* | n/a | 541337 |
| | *Tragopogon dubius* Scop. | *Tragopogon dubius* | yellow salsify | 38564 |
| | *Viguiera longifolia* var. *annua* (M.E. Jones) Welsh | *Heliomeris longifolia var. annua* | n/a | 541696 |
| | *Viguiera multiflora* (Nutt.) Blake | *Heliomeris multiflora* | n/a | 523280 |
| Berberidaceae | *Mahonia fremontii* (Torr.) Fedde | *Mahonia fremontii* | Fremont's mahonia | 195033 |
| | *Mahonia repens* (Lindl.) G. Don | *Mahonia repens* | creeping barberry | 195045 |
| Betulaceae | *Betula occidentalis* Hook. | *Betula occidentalis* | water birch | 19488 |
| Boraginaceae | *Cryptantha abata* I.M. Johnston | *Cryptantha abata* | dentnut cryptantha | 31781 |
| | *Cryptantha bakeri* (Greene) Payson | *Cryptantha bakeri* | Baker's cryptantha | 31786 |
| | *Cryptantha cinerea* (Greene) Cronq. | *Cryptantha cinerea* | brownut cryptantha | 501822 |
| | *Cryptantha cinerea var. cinerea* (Greene) Cronq. | *Cryptantha cinerea var. cinerea* | n/a | 527549 |
| | *Cryptantha confertiflora* (Greene) Payson | *Cryptantha confertiflora* | roundleaf cryptantha | 31796 |
| | *Cryptantha flava* (A. Nels.) Payson | *Cryptantha flava* | plateau yellow catseye | 31770 |
| | *Cryptantha* Lehm. ex G. Don | *Cryptantha* | cryptantha | 31765 |
| | *Cryptantha ochroleuca* Higgins | *Cryptantha ochroleuca* | yellowwhite cryptantha | 31849 |
| | Cryptantha osterhoutii (Payson) Payson | *Cryptantha osterhoutii* | Osterhout's cryptantha | 31850 |
| | *Lappula occidentalis* (S. Wats.) Greene | *Lappula occidentalis var. occidentalis* | beggar's tick | 528678 |
| | *Lappula occidentalis var. cupulata* (Gray) Higgins | *Lappula occidentalis var. cupulata* | flatspine stickseed | 528677 |
| | *Lithospermum incisum* Lehm. | *Lithospermum incisum* | narrowleaf stoneseed | 31940 |

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|---|---|---|---|---|
| Boraginaceae | *Lithospermum* L. | *Lithospermum* | stoneseed | 31937 |
| | *Lithospermum multiflorum* Torr. ex Gray | *Lithospermum multiflorum* | manyflowered stoneseed | 31951 |
| Brassicaceae | *Arabis demissa* Greene | *Arabis demissa* | nodding rockcress | 22686 |
| | *Arabis drummondii* Gray | *Arabis drummondii* | Drummond's rockcress | 22689 |
| | *Arabis holboellii* Hornem. | *Arabis holboellii* | Holboell rockcress | 22702 |
| | *Arabis* L. | *Arabis* | rockcress | 22671 |
| | *Arabis perennans* S. Wats. | *Arabis perennans* | perennial rockcress | 22720 |
| | *Arabis perennans* var. *perennans* | *Arabis perennans* | perennial rockcress | 22720 |
| | *Arabis selbyi* Rydb. | *Arabis selbyi* | Selby's rockcress | 22731 |
| | *Caulanthus crassicaulis* (Torr.) S. Wats. | *Caulanthus crassicaulis* | thickstem wild cabbage | 23080 |
| | *Descurainia pinnata* (Walt.) Britt. | *Descurainia pinnata* | western tansymustard | 22826 |
| | *Draba subalpina* Goodman & C.L. Hitchc. | *Draba subalpina* | subalpine draba | 22921 |
| | *Erysimum asperum* (Nutt.) DC. | *Erysimum capitatum var. capitatum* | western wall flower | 22931 |
| | *Erysimum inconspicuum* (S. Wats.) MacM. | *Erysimum inconspicuum* | shy wallflower | 502432 |
| | *Erysimum* L. | *Erysimum* | wallflower | 22926 |
| | *Lepidium* L. | *Lepidium* | pepperweed | 22953 |
| | *Physaria* (Nutt. ex Torr. & Gray) Gray | *Physaria* | twinpod | 23269 |
| | *Physaria chambersii* Rollins | *Physaria chambersii* | Chamber’s twinpod | 23275 |
| | *Physaria chambersii* var. *membranacea* Rollins | *Physaria lepidota var. membranacea* | n/a | 538811 |
| | *Physaria intermedia* (Maguire) O'Kane & Al-Shehbaz | *Lesquerella intermedia* | Santa Fe bladderpod | 23193 |
| | *Physaria newberryi* Gray | *Physaria newberryi* | Newberry’s twinpod | 23281 |
| | *Physaria rectipes* (Woot. & Stan.) O'Kane & Al-Shehbaz | *Lesquerella rectipes* | straight bladderpod | 23224 |
| | *Physaria rubicundula* | *Lesquerella rubicundula* | n/a | 23226 |
| | *Stanleya pinnata (Pursh) Britt.* | *Stanleya pinnata* | desert princesplume | 23329 |
| | *Streptanthella longirostris (S. Wats.) Rydb.* | *Streptanthella longirostris* | longbeak fiddle mustard | 23333 |
| | *Streptanthus cordatus* Nutt. | *Streptanthus cordatus* | heartleaf twistflower | 23348 |
| | *Thelypodiopsis sagittata (Nutt. ex Torr. & Gray) O.E. Schulz* | *Thelypodium sagittatum* | n/a | 522488 |
| | *Thelypodiopsis sagittata var. ovalifolia (Rydb.) Al-Shehbaz* | *Coronilla varia* | n/a | 521245 |
| | *Thlaspi arvense L.* | *Thlaspi arvense* | field pennycress | 23422 |
| Cactaceae | *Echinocereus triglochidiatus* Engelm. | *Echinocereus triglochidiatus* | kingcup cactus | 19815 |
| | *Opuntia erinacea* Engelm. & Bigelow ex Engelm. | *Opuntia erinacea* | grizzlybear pricklypear | 19705 |

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|---|---|---|---|---|
| Cactaceae | *Opuntia fragilis* (Nutt.) Haw. | *Opuntia fragilis* | brittle pricklypear | 19707 |
| | *Opuntia* P. Mill. | *Opuntia* | pricklypear | 19686 |
| | *Opuntia polyacantha* Haw. | *Opuntia polyacantha* | plains pricklypear | 19726 |
| | *Pediocactus simpsonii* (Engelm.) Britt. & Rose | *Pediocactus simpsonii* | Simpson's hedgehog cactus | 19776 |
| | *Sclerocactus whipplei* (Engelm. & Bigelow) Britt. & Rose | *Sclerocactus whipplei* | Whipple fishhook cactus | 19765 |
| | *Sclerocactus whipplei* var. *roseus* (Clover) L. Benson | *Sclerocactus parviflorus ssp. parviflorus* | n/a | 540500 |
| Campanulaceae | *Campanula parryi* Gray | *Campanula parryi* | Parry's bellflower | 34489 |
| Capparaceae | *Cleomella palmeriana* M.E. Jones | *Cleomella palmeriana* | Rocky Mountain stickweed | 22640 |
| Caprifoliaceae | *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 |
| | *Arenaria fendleri* var. *fendleri* Gray | *Arenaria fendleri var. fendleri* | n/a | 184229 |
| | *Arenaria fendleri* var. *glabrescens* S. Wats. | *Arenaria kingii ssp. compacta* | n/a | 532223 |
| | *Lychnis drummondii* (Hook.) S. Wats. | *Silene drummondii* | n/a | 516476 |
| | *Paronychia sessiliflora* Nutt. | *Paronychia sessiliflora* | creeping nailwort | 20346 |
| | *Silene petersonii* Maguire | *Silene petersonii* | plateau catchfly | 20104 |
| | *Stellaria jamesiana* Torr. | *Pseudostellaria jamesiana* | n/a | 521985 |
| Celastraceae | *Paxistima myrsinites* (Pursh) Raf. | *Paxistima myrsinites* | mountain lover | 504149 |
| Chenopodiaceae | *Atriplex canescens* (Pursh) Nutt. | *Atriplex canescens* | fourwing saltbush | 20518 |
| | *Atriplex confertifolia* (Torr. & Frém.) S. Wats. | *Atriplex confertifolia* | shadscale saltbush | 20519 |
| | *Atriplex powellii* S. Wats. | *Atriplex powellii* | Powell saltbush | 20561 |
| | *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 |
| | *Chenopodium leptophyllum* (Moq.) Nutt. ex S. Wats. | *Chenopodium leptophyllum* | narrowleaf goosefoot | 20616 |
| | *Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse & Smit | *Krascheninnikovia lanata* | winterfat | 503290 |
| | *Salsola tragus* L. | *Salsola tragus* | Russian thistle | 520950 |
| | *Sarcobatus vermiculatus* (Hook.) Torr. | *Sarcobatus vermiculatus* | greasewood | 20707 |
| | *Suaeda torreyana* S. Wats. | *Suaeda moquinii* | alkali seepweed | 20675 |

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|---|---|---|---|---|
| Chenopodiaceae | *Zuckia brandegeei* (Gray) Welsh & Stutz ex Welsh | *Zuckia brandegeei* | siltbush | 505810 |
| | *Zuckia brandegeei* var. *plummeri* (Stutz & Sanderson) Dorn | *Zuckia brandegeei var. plummeri* | Plummer's siltbush | 530926 |
| Cornaceae | *Cornus sericea* L. | *Cornus sericea* | redosier dogwood | 501637 |
| Cupressaceae | *Juniperus communis* L. | *Juniperus communis* | common juniper | 194820 |
| | *Juniperus* L. | *Juniperus* | juniper | 18047 |
| | *Juniperus osteosperma* (Torr.) Little | *Juniperus osteosperma* | Utah juniper | 194859 |
| | *Juniperus scopulorum* Sarg. | *Juniperus scopulorum* | Rocky Mountain juniper | 194872 |
| Cyperaceae | *Carex douglasii* Boott | *Carex douglasii* | Douglas sedge | 39578 |
| | *Carex duriuscula* C.A. Mey. | *Carex duriuscula* | needleleaf sedge | 501216 |
| | *Carex geyeri* Boott | *Carex geyeri* | elk sedge | 39613 |
| | *Carex interior* Bailey | *Carex interior* | inland sedge | 39652 |
| | *Carex* L. | *Carex* | sedge | 39369 |
| | *Carex microptera* Mackenzie | *Carex microptera* | smallwing sedge | 39699 |
| | *Carex occidentalis* Bailey | *Carex occidentalis* | western sedge | 39726 |
| | *Carex praegracilis* W. Boott | *Carex praegracilis* | slim sedge | 39767 |
| | *Carex raynoldsii* Dewey | *Carex raynoldsii* | Raynold's sedge | 39780 |
| | *Carex rossii* Boott | *Carex rossii* | Ross' sedge | 39786 |
| | *Carex simulata* Mackenzie | *Carex simulata* | shortbeak sedge | 39806 |
| | *Carex utriculata* Boott | *Carex utriculata* | Northwest Territory sedge | 501288 |
| | *Carex vallicola* Dewey | *Carex vallicola* | valley sedge | 39860 |
| | *Eleocharis palustris* (L.) Roemer & J.A. Schultes | *Eleocharis palustris* | common spikerush | 40019 |
| | *Eleocharis quinqueflora* (F.X. Hartmann) Schwarz | *Eleocharis quinqueflora* | fewflower spikerush | 502240 |
| | *Eleocharis* R. Br. | *Eleocharis* | spikerush | 40010 |
| Dennstaedtiaceae | *Pteridium aquilinum* (L.) Kuhn | *Pteridium aquilinum* | western brackenfern | 17224 |
| Elaeagnaceae | *Elaeagnus angustifolia* L. | *Elaeagnus angustifolia* | Russian olive | 27770 |
| | *Shepherdia argentea* (Pursh) Nutt. | *Shepherdia argentea* | silver buffaloberry | 27778 |
| | *Shepherdia canadensis* (L.) Nutt. | *Shepherdia canadensis* | russet buffaloberry | 27779 |
| | *Shepherdia rotundifolia* Parry | *Shepherdia rotundifolia* | roundleaf buffaloberry | 27780 |
| Ephedraceae | *Ephedra viridis* Coville | *Ephedra viridis* | green Mormon tea | 502319 |
| Equisetaceae | *Equisetum arvense* L. | *Equisetum arvense* | field horsetail | 17152 |
| | *Equisetum laevigatum* A. Braun | *Equisetum laevigatum* | smooth horsetail | 17156 |
| Ericaceae | *Arctostaphylos patula* Greene | *Arctostaphylos patula* | greenleaf manzanita | 23513 |

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|---|---|---|---|---|
| Ericaceae | *Arctostaphylos uva-ursi* (L.) Spreng | *Arctostaphylos uva-ursi* | kinnikinnick | 23530 |
| Euphorbiaceae | *Euphorbia fendleri* Torr. & Gray | *Chamaesyce fendleri* | Fendler's sandmat | 501419 |
| | *Euphorbia brachycera* Engelm. | *Euphorbia brachycera* | Horned spurge | 28049 |
| | *Euphorbia* L. | *Euphorbia* | spurge | 28032 |
| Fabaceae | *Astragalus agrestis* Dougl. ex G. Don | *Astragalus agrestis* | field milkvetch | 25405 |
| | *Astragalus amphioxys Gray* | *Astragalus amphioxys* | crescent milkvetch | 25414 |
| | *Astragalus bisulcatus* (Hook.) Gray | *Astragalus bisulcatus* | two groove milkvetch | 25438 |
| | *Astragalus convallarius Greene* | *Astragalus convallarius* | timber milkvetch | 25477 |
| | *Astragalus hallii* Gray | *Astragalus hallii* | Hall’s milkvetch | 25531 |
| | *Astragalus humistratus* Gray | *Astragalus humistratus* | groundcover milkvetch | 25540 |
| | *Astragalus kentrophyta* Gray | *Astragalus kentrophyta* | spiny milkvetch | 25553 |
| | *Astragalus kentrophyta* var. *elatus* S. Wats. | *Astragalus kentrophyta var. elatus* | tall spiny milkvetch | 526905 |
| | *Astragalus* L. | *Astragalus* | milkvetch | 25392 |
| | *Astragalus lonchocarpus* Torr. | *Astragalus lonchocarpus* | rushy milkvetch | 25567 |
| | *Astragalus megacarpus* (Nutt.) Gray | *Astragalus megacarpus* | bladdery milkvetch | 25576 |
| | *Astragalus megacarpus* var. *parryi* Gray ex S. Wats. | *Astragalus megacarpus* | bladdery milkvetch | 25576 |
| | *Astragalus miser* Dougl. | *Astragalus miser* | timber milkvetch | 25584 |
| | *Astragalus miser* var. *oblongifolius* (Rydb.) Cronq. | *Astragalus miser var. oblongifolius* | Timber milkvetch | 192623 |
| | *Astragalus tenellus* Pursh | *Astragalus tenellus* | looseflower milkvetch | 25696 |
| | *Hedysarum boreale* Nutt. | *Hedysarum boreale* | boreal sweetvetch | 26724 |
| | *Hedysarum boreale* ssp. *boreale* Nutt. | *Hedysarum boreale ssp. boreale* | boreal sweetvetch | 26725 |
| | *Lotus utahensis* Ottley | *Lotus utahensis* | Utah birdsfoot trefoil | 26410 |
| | *Lupinus argenteus* Pursh | *Lupinus argenteus* | silvery lupine | 503575 |
| | *Lupinus kingii* S. Wats. | *Lupinus kingii* | King’s lupine | 26036 |
| | *Lupinus* L. | *Lupinus* | lupine | 25916 |
| | *Lupinus sericeus* Pursh | *Lupinus sericeus* | silky lupine | 26112 |
| | *Melilotus officinalis* (L.) Lam. | *Trifolium* | yellow sweetclover | 26204 |
| | *Melilotus* P. Mill. | *Melilotus* | sweetclover | 26148 |
| | *Oxytropis oreophila* Gray | *Oxytropis oreophila* | mountain locoweed | 26178 |
| | *Pediomelum pariense* (Welsh & Atwood) J. Grimes | *Pediomelum pariense* | Paria River Indian bedroot | 504183 |
| | *Trifoium* L. | *Psoralidium lanceolatum* | clover | 504645 |
| | *Trifolium repens* L. | *Trifolium repens* | Dutch clover | 26206 |

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|---|---|---|---|---|
| Fabaceae | *Vicia americana* Muhl. ex Willd. | *Vicia americana* | American vetch | 26331 |
| Fagaceae | *Quercus gambelii* Nutt. | *Quercus gambelii* | Gambel oak | 19337 |
| | *Quercus gambelii* var. *gambelii* Nutt. | *Quercus gambelii var. gambelii* | Gambel oak | 195088 |
| Gentianaceae | *Frasera speciosa* Dougl. ex Griseb. | *Frasera speciosa* | green gentian | 502660 |
| | *Gentiana affinis* Griseb. | *Gentiana affinis* | Rocky Mountain gentian | 29964 |
| | *Gentiana affinis* var. *affinis* Grisebach | *Gentiana affinis* | pleated gentian | 29964 |
| | *Gentianella amarella* (L.) Boerner | *Gentianella amarella* | autumn dwarf gentian | 30058 |
| | *Gentianella heterosepala* (Engelm.) Holub | *Gentianella amarella ssp. heterosepala* | n/a | 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 radiata* (Kellogg) Kuntze | *Frasera speciosa* | deer ear's | 30120 |
| Geraniaceae | *Geranium caespitosum* var. *marginale* (Rydberg) S. Welsh | *Geranium atropurpureum var. atropurpureum* | Western purple cranesbill | 528228 |
| | *Geranium richardsonii* Fisch. & Trautv. | *Geranium richardsonii* | Richardson's geranium | 29118 |
| Grossulariaceae | *Ribes aureum* Pursh | *Ribes aureum* | golden currant | 24452 |
| | *Ribes cereum* Dougl. | *Ribes cereum* | wax currant | 24457 |
| | *Ribes* L. | *Ribes* | currant | 24448 |
| Hydrophyllaceae | *Phacelia crenulata* var. *corrugata* (A. Nels.) Brand | *Phacelia crenulata var. corrugata* | wild heliotrope | 529549 |
| | *Phacelia demissa* Gray | *Phacelia demissa* | Intermountain phacelia | 31483 |
| | *Phacelia* Juss. | *Phacelia* | phacelia | 31433 |
| Iridaceae | *Iris missouriensis* Nutt. | *Iris missouriensis* | wild iris | 43221 |
| Juncaceae | *Juncus arcticus* ssp. *ater* (Rydb.) Hultén | *Juncus balticus var. montanus* | mountain rush | 525993 |
| | *Juncus arcticus* Willd. | *Juncus arcticus* | arctic rush | 39222 |
| | *Juncus* L. | *Juncus* | rush | 39220 |
| | *Juncus longistylis* Torr. | *Juncus longistylis* | longstyle rush | 503256 |
| | *Juncus tenuis* Willd. | *Juncus tenuis* | field rush | 39243 |
| Lamiaceae | *Dracocephalum parviflorum* Nutt. | *Dracocephalum parviflorum* | American dragonhead | 32490 |
| | *Hedeoma drummondii* Benth. | *Hedeoma drummondii* | Drummond false pennyroyal | 32512 |
| | *Mentha arvensis* auct. non L. | *Mentha arvensis* | wild mint | 32265 |
| | *Prunella vulgaris* L. | *Prunella vulgaris* | common selfheal | 32381 |
| Liliaceae | *Calochortus nuttallii* Torr. & Gray | *Calochortus nuttallii* | sego lily | 42863 |
| | *Calochortus* Pursh | *Calochortus* | mariposa lily | 42823 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Liliaceae | *Fritillaria atropurpurea* Nutt. | *Fritillaria atropurpurea* | leopard lily | 502669 |
| | *Leucocrinum montanum* Nutt. ex Gray | *Leucocrinum montanum* | common starlily | 42957 |
| | *Leucocrinum* Nutt. ex Gray | *Leucocrinum* | starlily | 42956 |
| | *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 |
| | *Zigadenus venenosus* S. Wats. | *Zigadenus venenosus* | meadow deathcamas | 43168 |
| Linaceae | *Linum kingii* S. Wats. | *Linum kingii* | King's flax | 29213 |
| | *Linum* L. | *Linum* | flax | 29201 |
| | *Linum lewisii* Pursh | *Linum perenne* | Lewis flax | 29214 |
| | *Linum perenne L.* | *Linum perenne* | blue flax | 29217 |
| | *Linum perenne* var. *lewisii* (Pursh) Eat. & J. Wright | *Linum lewisii var. lewisii* | prairie flax | 528819 |
| Loasaceae | *Mentzelia multiflora* (Nutt.) Gray | *Mentzelia laciniata* | desert blazingstar | 503778 |
| Malvaceae | *Sphaeralcea coccinea* (Nutt.) Rydb. | *Sphaeralcea coccinea* | scarlet globemallow | 21920 |
| Nyctaginaceae | *Abronia nana* S. Wats. | *Abronia nana* | dwarf sandverbena | 19565 |
| | *Mirabilis linearis* (Pursh) Heimerl | *Mirabilis linearis* | narrowleaf four o'clock | 19651 |
| Onagraceae | *Calylophus lavandulifolius* (Torr. & Gray) Raven | *Calylophus lavandulifolius* | lavender sundrop | 501160 |
| | *Camissonia scapoidea* (Nutt. ex Torr. & Gray) Raven | *Camissonia scapoidea* | barestem eveningprimrose | 27543 |
| | *Epilobium ciliatum* Raf. | *Epilobium ciliatum* | hairy willowherb | 27293 |
| | *Gayophytum racemosum* Torr. & Gray | *Gayophytum racemosum* | blackfoot groundsmoke | 27678 |
| | *Gayophytum ramosissimum* Torr. & Gray | *Gayophytum ramosissimum* | pinyon groundsmoke | 27679 |
| | *Oenothera caespitosa* Nutt. | *Oenothera caespitosa* | tufted evening-primrose | 565328 |
| | *Oenothera coronopifolia* Torr. & Gray | *Oenothera coronopifolia* | crownleaf evening primrose | 27387 |
| | *Oenothera howardii* (A. Nels.) W.L. Wagner | *Oenothera howardii* | Howard's evening-primrose | 504002 |
| | *Oenothera pallida* Lindl. | *Oenothera pallida* | pale evening primrose | 27436 |
| Orchidaceae | *Habenaria sparsiflora* S. Wats. | *Platanthera sparsiflora* | canyon bog orchid | 514384 |
| Orobanchaceae | *Orobanche fasciculata* Nutt. | *Orobanche fasciculata* | tufted broomrape | 34290 |
| 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* L. | *Pinus* | pine | 18035 |
| | *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 | *Agropyron cristatum* (L.) Gaertn. | *Agropyron cristatum* | crested wheatgrass | 182478 |
| | *Agrostis stolonifera* L. | *Agrostis stolonifera* | creeping bentgrass | 40400 |
| | *Aristida purpurea* Nutt. | *Aristida purpurea* | purple threeawn | 41429 |
| | *Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths | *Bouteloua gracilis* | blue grama | 41493 |
| | *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 japonicus* Thunb. ex Murr. | *Bromus japonicus* | Japanese brome | 40479 |
| | *Bromus* L. | *Bromus* | brome | 40478 |
| | *Bromus tectorum* L. | *Bromus tectorum* | cheatgrass | 40524 |
| | *Calamagrostis* Adans. | *Calamagrostis* | reedgrass | 40529 |
| | *Calamagrostis scopulorum* M.E. Jones | *Calamagrostis scopulorum* | ditch reedgrass | 40566 |
| | *Calamagrostis stricta* (Timm) Koel. | *Calamagrostis stricta* | narrowspike reedgrass | 501106 |
| | *Deschampsia* Beauv. | *Deschampsia* | hairgrass | 40585 |
| | *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 hispidus* (Opiz) Melderis | *Thinopyrum intermedium* | intermediate wheatgrass | 512825 |
| | *Elymus junceus* Fisch. | *Psathyrostachys juncea* | Russian wildrye | 40702 |
| | *Elymus* L. | *Elymus* | wildrye | 40677 |
| | *Elymus lanceolatus* (Scribn. & J.G. Sm.) Gould | *Elymus lanceolatus* | streamside wild rye | 502267 |
| | *Elymus salinus* M.E. Jones | *Leymus salinus ssp. salinus* | saline wildrye | 512841 |
| | *Elymus scribneri* (Vasey) M.E. Jones | *Elymus scribneri* | Scribner's wildrye | 502277 |
| | *Elymus smithii* (Rydb.) Gould | *Pascopyrum smithii* | western wheatgrass | 512844 |
| | *Elymus spicatus* (Pursh) Gould | *Pseudoroegneria spicata* | bluebunch wheatgrass | 512845 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Poaceae | *Elymus trachycaulus* (Link) Gould ex Shinners | *Elymus trachycaulus* | slender wheatgrass | 502282 |
| | *Festuca octoflora* Walt. | *Vulpia octoflora* | sixweeks fescue | 513551 |
| | *Festuca ovina* L. | *Festuca ovina* | sheep fescue | 40804 |
| | *Hilaria jamesii* (Torr.) Benth. | *Pleuraphis jamesii* | James' galleta | 41768 |
| | *Koeleria macrantha* (Ledeb.) J.A. Schultes | *Koeleria macrantha* | Junegrass | 503284 |
| | *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 |
| | *Oryzopsis micrantha* (Trin. & Rupr.) Thurb. | *Piptatherum micranthum* | littleseed ricegrass | 41989 |
| | *Phleum pratense* L. | *Phleum pratense* | timothy grass | 41062 |
| | *Poa fendleriana* (Steud.) Vasey | *Poa fendleriana* | muttongrass | 504467 |
| | *Poa* L. | *Poa* | bluegrass | 41074 |
| | *Poa pratensis* L. | *Poa pratensis* | Kentucky bluegrass | 41088 |
| | *Poa secunda* J. Presl | *Poa secunda* | Sandberg bluegrass | 41103 |
| | *Poaceae* | *Poaceae* | grasses | 40351 |
| | *Schizachyrium scoparium* (Michx.) Nash | *Schizachyrium scoparium* | little bluestem | 42076 |
| | *Sporobolus airoides* (Torr.) Torr. | *Sporobolus airoides* | alkali sacaton | 42128 |
| | *Sporobolus cryptandrus* (Torr.) Gray | *Sporobolus cryptandrus* | sand dropseed | 42132 |
| | *Stipa comata* Trin. & Rupr. | *Hesperostipa comata ssp. comata* | needle and thread | 42172 |
| | *Stipa hymenoides* Roemer & J.A. Schultes | *Achnatherum hymenoides* | Indian ricegrass | 522063 |
| | *Stipa* L. | *n/a* | needlegrass | 42158 |
| | *Stipa lettermanii* Vasey | *Achnatherum lettermanii* | Letterman needlegrass | 522065 |
| | *Stipa nelsonii* Scribn. | *Achnatherum nelsonii ssp. nelsonii* | Nelson needlegrass | 42182 |
| | *Stipa neomexicana* (Thurb. ex Coult.) Scribn. | *Hesperostipa neomexicana* | New Mexico needlegrass | 42165 |
| | *Stipa pinetorum* M.E. Jones | *Achnatherum pinetorum* | Pine needlegrass | 42188 |
| Polemoniaceae | *Gilia* Ruiz & Pavón | *Gilia* | gilia | 31075 |
| | *Ipomopsis aggregata* (Pursh) V. Grant | *Ipomopsis aggregata* | scarlet gilia | 31192 |
| | *Leptodactylon caespitosum* Nutt. | *Leptodactylon caespitosum* | mat pricklygilia | 31239 |
| | *Leptodactylon pungens* (Torr.) Torr. ex Nutt. | *Leptodactylon pungens* | common pricklygilia | 31233 |
| | *Phlox austromontana* Coville | *Phlox austromontana* | desert phlox | 30913 |
| | *Phlox austromontana* ssp. *austromontana* Coville | *Phlox austromontana ssp. austromontana* | mountain phlox | 30914 |
| | *Phlox hoodii* Richards. | *Phlox hoodii* | spiny phlox | 30948 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Polemoniaceae | *Phlox* L. | *Phlox* | phlox | 30897 |
| | *Phlox longifolia* Nutt. | *Phlox longifolia* | longleaf phlox | 30956 |
| | *Polemonium caeruleum* L. | *Polemonium caeruleum* | charity | 31005 |
| Polygonaceae | *Eriogonum* Michx. | *Eriogonum* | buckwheat | 21054 |
| | *Eriogonum alatum* Torr. | *Eriogonum alatum* | winged buckwheat | 21057 |
| | *Eriogonum cernuum* Nutt. | *Eriogonum cernuum* | nodding buckwheat | 21090 |
| | *Eriogonum corymbosum* Benth. | *Eriogonum corymbosum* | corymbed buckwheat | 21103 |
| | *Eriogonum microthecum* Nutt. | *Eriogonum microthecum* | slender buckwheat | 21192 |
| | *Eriogonum microthecum* var. *simpsonii* (Benth.) Reveal | *Eriogonum microthecum var. simpsonii* | Simpson buckwheat | 195533 |
| | *Eriogonum panguicense* (M.E. Jones) Reveal | *Eriogonum panguicense* | Panguitch buckwheat | 21215 |
| | *Eriogonum racemosum* Nutt. | *Eriogonum racemosum* | redroot buckwheat | 21230 |
| | *Eriogonum racemosum* var. *racemosum* Nuttall | *Eriogonum racemosum* | redroot buckwheat | 531437 |
| | *Eriogonum subreniforme* S. Wats. | *Eriogonum subreniforme* | kidneyshape buckwheat | 21251 |
| | *Eriogonum umbellatum* ssp. *subaridum* (S. Stokes) Munz | *Eriogonum umbellatum var. subaridum* | sulphur-flower buckwheat | 195621 |
| | *Eriogonum umbellatum* Torr. | *Eriogonum umbellatum* | sulphur-flower buckwheat | 21266 |
| | *Eriogonum wetherillii* Eastw. | *Eriogonum wetherillii* | Wetherill's buckwheat | 21278 |
| | *Polygonum aviculare* L. | *Polygonum aviculare* | prostrate knotweed | 20876 |
| | *Polygonum douglasii* Greene | *Polygonum douglasii* | Douglas' knotweed | 20891 |
| | *Rumex crispus* L. | *Rumex crispus* | curly dock | 20937 |
| Primulaceae | *Androsace septentrionalis* L. | *Androsace septentrionalis* | pygmy rockjasmine | 23935 |
| | *Dodecatheon pulchellum* ssp. *pulchellum* (Raf.) Merr. | *Dodecatheon pulchellum ssp. pulchellum* | darkthroat shootingstar | 23946 |
| Pyrolaceae | *Pyrola asarifolia* Michx. | *Pyrola asarifolia* | alpine shinleaf | 23753 |
| | *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 |
| | *Aquilegia scopulorum* Tidestrom | *Aquilegia scopulorum* | Utah columbine | 18746 |
| | *Clematis columbiana* (Nutt.) Torr. & Gray | *Clematis columbiana* | Columbian virgin's-bower | 18693 |
| | *Clematis* L. | *Clematis* | clematis | 18685 |
| | *Clematis ligusticifolia* Nutt. | *Clematis ligusticifolia* | virgin's bower | 18702 |
| | *Delphinium andersonii* Gray | *Delphinium* | larkspur | 18457 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Ranunculaceae | *Ranunculus inamoenus* Greene | *Ranunculus inamoenus* | graceful buttercup | 18616 |
| | *Thalictrum alpinum* L. | *Thalictrum alpinum* | alpine meadowrue | 18661 |
| | *Thalictrum fendleri* Engelm. ex Gray | *Thalictrum fendleri* | Fendler's meadowrue | 18670 |
| Rhamnaceae | *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 |
| | *Cercocarpus montanus* Raf. | *Cercocarpus montanus* | alderleaf mountain mahogany | 25136 |
| | *Fragaria virginiana* Duchesne | *Fragaria virginiana* | Virginia strawberry | 24639 |
| | *Holodiscus dumosus* (Nutt. ex Hook.) Heller | *Holodiscus dumosus* | rockspirea | 25178 |
| | *Ivesia sabulosa* (M.E. Jones) Keck | *Ivesia sabulosa* | intermountain ivesia | 25234 |
| | *Peraphyllum ramosissimum Nutt.* | *Peraphyllum ramosissimum* | squawapple | 25270 |
| | *Potentilla anserina* L. | *Argentina anserina* | silverweed cinquefoil | 24687 |
| | *Potentilla concinna* Richards. | *Potentilla concinna* | elegant cinquefoil | 24700 |
| | *Potentilla concinna* var. *bicrenata* (Rydb.) Welsh & Johnston | *Potentilla concinna var. bicrenata* | red cinquefoil | 529814 |
| | *Potentilla concinna* var. *proxima* (Rydb.) Welsh & Johnson | *Potentilla concinna var. proxima* | red cinquefoil | 529817 |
| | *Potentilla crinita* Gray | *Potentilla crinita* | bearded cinquefoil | 504575 |
| | *Potentilla fruticosa* auct. non L. | *Dasiphora fruticosa ssp. floribunda* | Shrubby cinquefoil | 24710 |
| | *Potentilla gracilis* Dougl. ex Hook. | *Potentilla gracilis* | graceful cinquefoil | 24714 |
| | *Potentilla hippiana* Lehm. | *Potentilla hippiana* | horse cinquefoil | 24718 |
| | *Potentilla* L. | *Potentilla* | cinquefoil | 24666 |
| | *Potentilla pensylvanica* L. | *Potentilla pensylvanica* | Pensylvannia cinquefoil | 24736 |
| | *Prunus virginiana* L. | *Prunus virginiana* | chokecherry | 24806 |
| | *Purshia mexicana* (D. Don) Henrickson | *Purshia mexicana* | Mexican cliffrose | 195899 |
| | *Purshia mexicana* var. *stansburiana* (Torr.) Welsh | *Purshia stansburiana* | Stansbury cliffrose | 195902 |
| | *Purshia tridentata* (Pursh) DC. | *Purshia tridentata* | antelope bitterbrush | 25290 |
| | *Rosa L.* | *Rosa* | rose | 24807 |
| | *Rosa nutkana* K. Presl | *Rosa nutkana* | Nootka rose | 24835 |
| | *Rosa woodsii* Lindl. | *Rosa woodsii* | Woods' rose | 24847 |
| Rubiaceae | *Galium trifidum* L. | *Galium trifidum* | small bedstraw | 34806 |
| | *Kelloggia galioides* Torr. | *Symphyotrichum lateriflorum* | milk kellogia | 35601 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Salicaceae | *Populus angustifolia* James | *Populus angustifolia* | narrowleaf cottonwood | 22452 |
| | *Populus fremontii* S. Wats. | *Populus fremontii* | Fremont cottonwood | 22459 |
| | *Populus tremuloides* Michx. | *Populus tremuloides* | quaking aspen | 195773 |
| | *Populus x. intercurrens* S. Goodrich & S.L. Welsh | *Populus x intercurrens* | n/a | n/a |
| | *Salix bebbiana* Sarg. | *Salix bebbiana* | Bebb willow | 22507 |
| | *Salix eriocephala* (Michx.) | *Salix eriocephala* | Missouri River willow | 22528 |
| | *Salix eriocephala* var. *watsonii* (Bebb) Dorn | *Salix lutea* | Yellow willow | 540021 |
| | *Salix exigua* Nutt. | *Salix exigua* | narrowleaf willow | 22529 |
| | *Salix geyeriana* Anderss. | *Salix geyeriana* | Geyer's willow | 504965 |
| | *Salix glauca* L. | *Salix glauca* | grayleaf willow | 22482 |
| | *Salix* L. | *Salix* | willow | 22476 |
| Santalaceae | *Comandra umbellata* (L.) Nutt. | *Comandra umbellata* | bastard toadflax | 501614 |
| | *Comandra umbellata* var. *pallida* (A. DC.) M.E. Jones | *Comandra umbellata ssp. pallida* | bastard toadflax | 533741 |
| Scrophulariaceae | *Castilleja* Mutis ex L. f. | *Castilleja* | Indian paintbrush | 33049 |
| | *Castilleja chromosa* A. Nels. | *Castilleja applegatei ssp. martinii* | wavyleaf Indian paintbrush | 525154 |
| | *Castilleja linariifolia* Benth. | *Castilleja linariifolia* | Wyoming Indian paintbrush | 33138 |
| | *Castilleja parvula* var. *revealii* (N. Holmgren) Atwood | *Castilleja revealii* | Bryce Canyon Indian paintbrush | 533217 |
| | *Cordylanthus kingii* S. Wats. | *Cordylanthus kingii* | King's bird's-beak | 33542 |
| | *Cordylanthus* Nutt. ex Benth. | *Cordylanthus* | bird's beak | 33537 |
| | *Cordylanthus wrightii* Gray | *Cordylanthus wrightii* | Wright bird's-beak | 33577 |
| | *Mimulus guttatus* DC. | *Mimulus guttatus* | common monkeyflower | 33236 |
| | *Orthocarpus luteus* Nutt. | *Orthocarpus luteus* | yellow owlclover | 33437 |
| | *Orthocarpus purpureoalbus* Gray ex S. Wats. | *Orthocarpus purpureoalbus* | purple owlclover | 33456 |
| | *Pedicularis centranthera* Gray | *Pedicularis centranthera* | dwarf lousewort | 33367 |
| | *Penstemon bracteatus* Keck | *Penstemon bracteatus* | Red Canyon beardtongue | 33671 |
| | *Penstemon caespitosus* Nutt. ex Gray | *Penstemon caespitosus* | mat penstemon | 33839 |
| | Penstemon caespitosus ssp. desertipicti (A. Nels.) Keck | *Penstemon caespitosus var. desertipicti* | mat penstemon | 33841 |
| | *Penstemon comarrhenus* Gray | *Penstemon comarrhenus* | dusty penstemon | 33854 |
| | *Penstemon leiophyllus* Pennell | *Penstemon leiophyllus* | smoothleaf penstemon | 33935 |
| | *Penstemon* Schmidel | *Penstemon* | beardtongue | 33665 |
| Solanaceae | *Solanum triflorum* Nutt. | *Solanum triflorum* | cutleaf nightshade | 30461 |
| Typhaceae | *Typha latifolia* L. | *Typha latifolia* | common cattail | 42326 |

| Family | Scientific Name (Welsh et al. 2003) | Scientific Name (Kartesz 1999) | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Violaceae | *Viola adunca* Sm. | *Viola adunca* | blue violet | 22032 |
| | *Viola* L. | *Viola* | violet | 22030 |
| | *Viola nephrophylla* Greene | *Viola nephrophylla* | northern bog violet | 22117 |

## NON-VASCULAR PLANTS

| Family | Scientific Name | Scientific Name | Common Name (NatureServe) | TSN |
|---|---|---|---|---|
| Psoraceae | *Psora* Hoffm. | *Psora* | n/a | 190026 |
| Collemataceae | *Collema* Wigg. | *Collema* | n/a | 191331 |
| Verrucariaceae | *Endocarpon Hedwig* | *Endocarpon* | n/a | n/a |

# 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 95 NVC associations, two NVC alliances, and twenty-eight "Park Specials" were described for Bryce Canyon. Twenty-three 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 / Acer grandidentatum Forest | CEGL000241 | 4 | BRCA.0176, BRCA.0183, BRCA.0367, BRCA.0386 |
| Abies concolor / Arctostaphylos patula Forest | CEGL000242 | 31 | BRCA.0015, BRCA.0037, BRCA.0039, BRCA.0040, BRCA.0043, BRCA.0044, BRCA.0045. BRCA.0049, BRCA.0064, BRCA.0066, BRCA.0074, BRCA.0097, BRCA.0108. BRCA.0132, BRCA.0154, BRCA.0155, BRCA.0228, BRCA.0234, BRCA.0240, BRCA.0241, BRCA.0243, BRCA.0247, BRCA.0255, BRCA.0259, BRCA.9007, BRCA.9014, BRCA.9035, BRCA.9056, BRCA.9208, BRCA.9209, BRCA.9258 |
| Abies concolor / Cercocarpus ledifolius Woodland | CEGL000885 | 1 | BRCA_AA.0585 |
| Abies concolor / Juniperus communis Forest | CEGL000249 | 14 | BRCA.0001, BRCA.0041, BRCA.0073, BRCA.0098, BRCA.0227, BRCA.0229, BRCA.0238, BRCA.0244, BRCA.0262, BRCA.0288, BRCA.0291, BRCA.0292, BRCA.0364, BRCA.9047 |
| Abies concolor / Mahonia repens Forest | CEGL000251 | 14 | BRCA.0034, BRCA.0035, BRCA.0038, BRCA.0042, BRCA.0063, BRCA.0077, BRCA.0100, BRCA.0112, BRCA.0257, BRCA.0289, BRCA.0290, BRCA.0380, BRCA.9006, BRCA.9008 |
| Abies concolor / Mixed Grasses Forest | CEGL005357 | 7 | BRCA.0036, BRCA.0076, BRCA.0231, BRCA.0232, BRCA.0235, BRCA.0260, BRCA.0261 |
| Abies concolor / Purshia tridentata Forest [Park Special] | Park Special | 1 | BRCA_AA.0908 |
| Abies concolor / Quercus gambelii Forest | CEGL000261 | 23 | BRCA.0365, BRCA.0366, BRCA_AA.0108, BRCA_AA.0109, BRCA_AA.0257, BRCA_AA.0264, BRCA_AA.0570, BRCA_AA.0879, BRCA_AA.0882, BRCA_AA.1004, BRCA_AA.1020, BRCA_AA.1035, BRCA_AA.1043, BRCA_AA.1061, BRCA_AA.1074, BRCA_AA.1092, BRCA_AA.1097, BRCA_AA.1154, BRCA_AA.1165, BRCA_AA.1179, BRCA_AA.1189, BRCA_AA.1211, BRCA_AA.1217 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Abies concolor / Symphoricarpos oreophilus Forest | CEGL000263 | 6 | BRCA.0046, BRCA.0184, BRCA.0254, BRCA.0387, BRCA.0388, BRCA.9248 |
| Acer grandidentatum / Quercus gambelii Forest | CEGL000559 | 1 | BRCA_AA.1227 |
| Achnatherum lettermanii Herbaceous Vegetation | CEGL005354 | 3 | BRCA.0293, BRCA.0384, BRCA_AA.0772 |
| Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata) Semi-natural Herbaceous Vegetation | CEGL005266 | 3 | BRCA.0119, BRCA.0121, BRCA.9267 |
| Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland | CEGL001070 | 1 | BRCA.0070 |
| Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis) Shrubland | CEGL002695 | 3 | BRCA.0136, BRCA.0361, BRCA.0370 |
| Arctostaphylos patula Shrubland | CEGL002696 | 5 | BRCA.0016, BRCA.0215, BRCA.0283, BRCA.0294, BRCA.9250 |
| Artemisia nova / Elymus elymoides Shrubland | CEGL001418 | 1 | BRCA_AA.0323 |
| Artemisia nova / Hesperostipa comata Shrubland | CEGL001425 | 10 | BRCA.0029, BRCA.0030, BRCA.0096, BRCA.0221, BRCA.0222, BRCA.0252, BRCA.0295, BRCA.0296, BRCA.0329, BRCA.0330 |
| Artemisia nova / Leymus salinus Shrub Herbaceous Vegetation | CEGL001421 | 1 | BRCA_AA.0242 |
| Artemisia nova / Poa fendleriana Shrubland | CEGL002698 | 6 | BRCA.0078, BRCA.0117, BRCA.0118, BRCA.0245, BRCA.0346, BRCA.0347 |
| Artemisia nova Shrubland | CEGL001417 | 11 | BRCA.0010, BRCA.0053, BRCA.0058, BRCA.0085, BRCA.0106, BRCA.0286, BRCA.9017, BRCA.9046, BRCA.9053, BRCA.9217, BRCA.9247 |
| Artemisia nova – Purshia tridentata / Poa fendleriana Shrubland | CEGL002345 | 3 | BRCA.0331, BRCA.0344, BRCA.0351 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Artemisia pygmaea Dwarf-Shrubland [Park Special] | Park Special | 1 | BRCA.9214, BRCA_AA.0018, BRCA_AA.0021, BRCA_AA.0041 |
| Artemisia tridentata ssp. tridentata / Agropyron cristatum Semi-natural Shrubland [Park Special] | Park Special | 3 | BRCA.0304, BRCA.9066, BRCA.9226 |
| Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland | CEGL001028 | 5 | BRCA.0405, BRCA_AA.0859, BRCA_AA.0776, BRCA_AA.0837, BRCA_AA.0872 |
| Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus Shrubland [Park Special] | Park Special | 1 | BRCA.0317 |
| Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland | CEGL002813 | 3 | BRCA.0140, BRCA_AA.0760, BRCA_AA.0763 |
| Atriplex canescens - Artemisia tridentata Shrubland | CEGL001282 | 4 | BRCA.0323, BRCA.0325, BRCA.0396, BRCA.0398 |
| Atriplex canescens / Elymus (elymoides, salinus) Shrubland [Park Special] | Park Special | 6 | BRCA.0191, BRCA.0194, BRCA.0336, BRCA.0373, BRCA.9227, BRCA.9229 |
| Atriplex canescens / Psathyrostachys juncea Seeded Shrubland [Park Special] | Park Special | 5 | BRCA_AA.0826, BRCA_AA.0846, BRCA_AA.0856, BRCA_AA.0870, BRCA_AA.0872 |
| Atriplex confertifolia Great Basin Shrubland | CEGL001294 | 5 | BRCA.0192, BRCA.0193, BRCA.0394, BRCA.0395, BRCA.0397 |
| Betula occidentalis Shrubland | CEGL001080 | 3 | BRCA.9028, BRCA.9068, BRCA.9220 |
| Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation | CEGL005264 | 3 | BRCA.0059, BRCA.0079, BRCA.0271 |
| Carex praegracilis Herbaceous Vegetation | CEGL002660 | 5 | BRCA.0120, BRCA.0122, BRCA.0123, BRCA.0376, BRCA.9234 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Carex utriculata Herbaceous Vegetation | CEGL001562 | 4 | BRCA.0083, BRCA.0267, BRCA.0268, BRCA.9018 |
| Carex vallicola Herbaceous Vegetation [Park Special] | Park Special | 1 | BRCA_AA.0188 |
| Ceanothus martinii / Elymus trachycaulus Seeded Roadcut Shrub Herbaceous [Park Special] | Park Special | 1 | BRCA.0230 |
| Cercocarpus ledifolius / Arctostaphylos patula Woodland (Provisional) | CEGL005355 | 10 | BRCA.0128, BRCA.0406, BRCA_AA.0495, BRCA_AA.0525, BRCA_AA.0572, BRCA_AA.0589, BRCA_AA.0590, BRCA_AA.0812, BRCA_AA.0969, BRCA_AA.1190 |
| Cercocarpus ledifolius / Artemisia tridentata Woodland | CEGL000960 | 1 | BRCA.0315 |
| Cercocarpus ledifolius / Quercus gambelii Woodland (Provisional) | CEGL005359 | 7 | BRCA.0022, BRCA.0023, BRCA_AA.0268, BRCA_AA.0495, BRCA_AA.0618, BRCA_AA.0696, BRCA_AA.1190 |
| Cercocarpus ledifolius Woodland Alliance | A.586 | 2 | BRCA.9203, BRCA.9269 |
| Cercocarpus montanus Desert Wash Shrubland [Park Special] | Park Special | 1 | BRCA.0375 |
| Chrysothamnus viscidiflorus - Ericameria parryi Shrub Herbaceous Vegetation [Provisional] | CEGL002781 | 6 | BRCA_AA.0384, BRCA_AA.0691, BRCA_AA.0934, BRCA_AA.0992, BRCA_AA.1001 |
| Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland | CEGL002799 | 5 | BRCA.0299, BRCA_AA.0240, BRCA_AA.0254, BRCA_AA.0267, BRCA_AA.0436 |
| Chrysothamnus viscidiflorus / Mixed Grasses Shrubland | Park Special | 5 | BRCA.0054, BRCA.0057, BRCA.0204, BRCA.0277, BRCA.0285 |
| Cornus sericea Rocky Mountain Shrubland | CEGL001165 | 2 | BRCA_AA.0734, BRCA_AA.0746 |
| Dasiphora fruticosa ssp. floribunda Shrubland [Provisional] | CEGL001105 | 3 | BRCA.9051, BRCA_AA.0106, BRCA_AA.0296 |
| Eleocharis quinqueflora Herbaceous Vegetation | CEGL001836 | 3 | BRCA.0109, BRCA.0312, BRCA.0408 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Elymus elymoides Herbaceous Vegetation [Park Special] | Park Special | 4 | BRCA.0075, BRCA.0236, BRCA.0258, BRCA.0264 |
| Elymus lanceolatus Herbaceous Vegetation | CEGL002588 | 1 | BRCA_AA.0271 |
| Elymus trachycaulus Herbaceous Vegetation [Park Special] | Park Special | 1 | BRCA.0242 |
| Ericameria nauseosa Shrubland | CEGL002713 | 5 | BRCA_AA.0200, BRCA_AA.0201, BRCA_AA.0745, BRCA_AA.0828, BRCA_AA.1224 |
| Ericameria nauseosa / Achnatherum lettermanii Shrubland [Park Special] | Park Special | 2 | BRCA.0381, BRCA.9259 |
| Eriogonum corymbosum Badlands Sparse Vegetation | CEGL002979 | 3 | BRCA.0391, BRCA.0393, BRCA.9261 |
| Eriogonum corymbosum / Leymus salinus Dwarf-shrubland | CEGL001343 | 2 | BRCA_AA.0341, BRCA_AA.0368 |
| Gutierrezia sarothrae Wooded dwarf-shrubland Alliance | A.2528 | 5 | BRCA.0272, BRCA.0368, BRCA.0382, BRCA.0389, BRCA.0402 |
| Hesperostipa comata Great Basin Herbaceous Vegetation | CEGL001705 | 7 | BRCA.0110, BRCA.0372, BRCA_AA.0040, BRCA_AA.0045, BRCA_AA.0051, BRCA_AA.0382, BRCA_AA.0801 |
| Heterotheca villosa / Mixed Grass Shrub Herbaceous [Park Special] | Park Special | 3 | BRCA.0328, BRCA_AA.0051, BRCA_AA.0382 |
| Juncus balticus Herbaceous Vegetation | CEGL001838 | 7 | BRCA.0206, BRCA_AA.0214, BRCA_AA.0219, BRCA_AA.0224, BRCA_AA.0288, BRCA_AA.0437, BRCA_AA.0462 |
| Leymus salinus Herbaceous Vegetation [Park Special] | Park Special | 3 | BRCA.0087, BRCA.0216, BRCA.0410 |
| Mimulus guttatus - (Mimulus spp.) Herbaceous Vegetation | CEGL005305 | 1 | BRCA.0251 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Pascopyrum smithii Herbaceous Vegetation | CEGL001577 | 1 | BRCA.0321 |
| Picea pungens / Arctostaphylos patula Forest | CEGL005364 | 8 | BRCA_AA.0411, BRCA_AA.0420, BRCA_AA.0424, BRCA_AA.0607, BRCA_AA.0912, BRCA_AA.0922, BRCA_AA.0938, BRCA_AA.1177 |
| Picea pungens / Arctostaphylos uva-ursi Forest | CEGL000385 | 1 | BRCA.0180 |
| Picea pungens / Betula occidentalis Woodland | CEGL002637 | 1 | BRCA.9037, BRCA_AA.1104 |
| Picea pungens / Bromus inermis Forest [Park Special] | Park Special | 1 | BRCA.0182 |
| Picea pungens / Juniperus communis Forest | CEGL000392 | 7 | BRCA.0179, BRCA.0263, BRCA.0265, BRCA.0273, BRCA.0274, BRCA.0383, BRCA.9052 |
| Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland | CEGL002939 | 5 | BRCA.0026, BRCA.0149, BRCA.0400, BRCA.0407, BRCA.9062 |
| Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland | CEGL002331 | 2 | BRCA.0007, BRCA.9069 |
| Pinus edulis - Juniperus osteosperma / Atriplex spp. Woodland [Provisional] | CEGL002366 | 1 | BRCA_AA.1047 |
| Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland | CEGL002940 | 4 | BRCA.0021, BRCA.0024, BRCA.0362, BRCA.9032 |
| Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii Woodland | CEGL002379 | 2 | BRCA_AA.0852, BRCA_AA.0886 |
| Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland | CEGL000782 | 3 | BRCA_AA.0065, BRCA_AA.0678, BRCA_AA.0694 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland | CEGL000789 | 8 | BRCA.0084, BRCA.0202, BRCA.0302, BRCA.0305, BRCA.0335, BRCA.0348, BRCA.9012, BRCA.9216 |
| Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia Woodland | CEGL002335 | 5 | BRCA.0195, BRCA.0203, BRCA.0334, BRCA.0404, BRCA.9201 |
| Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland | CEGL002148 | 18 | BRCA_AA.0154, BRCA_AA.0156, BRCA_AA.0165, BRCA_AA.0261, BRCA_AA.0307, BRCA_AA.0317, BRCA_AA.0320, BRCA_AA.0542, BRCA_AA.0553, BRCA_AA.0661, BRCA_AA.0682, BRCA_AA.0750, BRCA_AA.0818, BRCA_AA.0836, BRCA_AA.0853, BRCA_AA.0854, BRCA_AA.1006, BRCA_AA.1258 |
| Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland | CEGL000776 | 3 | BRCA.0003, BRCA.0326, BRCA.0392 |
| Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland | CEGL000780 | 29 | BRCA.0008, BRCA.0133, BRCA.0139, BRCA.0141, BRCA.0146, BRCA.0147, BRCA.0156, BRCA.0157, BRCA.0198, BRCA.0199, BRCA.0307, BRCA.0309, BRCA.0313, BRCA.0319, BRCA.0324, BRCA.0340, BRCA.0343, BRCA.0363, BRCA.9030, BRCA.9034, BRCA.9059, BRCA.9061, BRCA.9064, BRCA.9065, BRCA.9067, BRCA.9224, BRCA.9243, BRCA.9265, BRCA.9268 |
| Pinus edulis - Juniperus spp. / Leymus salinus Woodland | CEGL002340 | 5 | BRCA.0197, BRCA.0322, BRCA.9228, BRCA.9241, BRCA.9263 |
| Pinus edulis - Juniperus spp. / Quercus gambelii Woodland | CEGL000791 | 40 | BRCA.0002, BRCA.0005, BRCA.0068, BRCA.0071, BRCA.0131, BRCA.0138, BRCA.0150, BRCA.0170, BRCA.0175, BRCA.0201, BRCA.0300, BRCA.0301, BRCA.0303, BRCA.0306, BRCA.0308, BRCA.0310, BRCA.0316, BRCA.0318, BRCA.0320, BRCA.0333, BRCA.0339, BRCA.0401, BRCA.0403, BRCA.9033, BRCA.9043, BRCA.9044, BRCA.9055, BRCA.9060, BRCA.9071, BRCA.9080, BRCA.9219, BRCA.9221, BRCA.9222, BRCA.9223, BRCA.9225, BRCA.9231, BRCA.9245, BRCA.9249, BRCA.9251, BRCA.9252 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Pinus longaeva Woodland | CEGL002380 | 20 | BRCA.0019, BRCA.0020, BRCA.0055, BRCA.0056, BRCA.0127, BRCA.0134, BRCA.0151, BRCA.0152, BRCA.0166, BRCA.0186, BRCA.0187, BRCA.0188, BRCA.0189, BRCA.0190, BRCA.0218, BRCA.0284, BRCA.0341, BRCA.0349, BRCA.9025, BRCA.9029 |
| Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula Colorado Plateau Woodland | Park Special | 9 | BRCA.0017, BRCA.0047, BRCA.0081, BRCA.0092, BRCA.0111, BRCA.0130, BRCA.0174, BRCA.0212, BRCA.0297 |
| Pinus ponderosa / Arctostaphylos patula Woodland | CEGL000842 | 67 | BRCA.0006, BRCA.0009, BRCA.0012, BRCA.0018, BRCA.0025, BRCA.0028, BRCA.0031, BRCA.0032, BRCA.0048, BRCA.0065, BRCA.0086, BRCA.0114, BRCA.0115, BRCA.0125, BRCA.0137, BRCA.0143, BRCA.0148, BRCA.0153, BRCA.0162, BRCA.0165, BRCA.0167, BRCA.0168, BRCA.0207, BRCA.0209, BRCA.0217, BRCA.0246, BRCA.0249, BRCA.0250, BRCA.0275, BRCA.0342, BRCA.0360, BRCA.0378, BRCA.0379, BRCA.9001, BRCA.9003, BRCA.9004, BRCA.9005, BRCA.9009, BRCA.9011, BRCA.9015, BRCA.9020, BRCA.9022, BRCA.9024, BRCA.9026, BRCA.9027, BRCA.9031, BRCA.9036, BRCA.9038, BRCA.9039, BRCA.9040, BRCA.9041, BRCA.9045, BRCA.9049, BRCA.9054, BRCA.9057, BRCA.9058, BRCA.9063, BRCA.9070, BRCA.9204, BRCA.9205, BRCA.9206, BRCA.9207, BRCA.9211, BRCA.9237, BRCA.9238, BRCA.9244, BRCA.9262 |
| Pinus ponderosa / Artemisia nova Woodland | CEGL000846 | 2 | BRCA.0181, BRCA.0354 |
| Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula Woodland [Park Special] | Park Special | 3 | BRCA.0124, BRCA.0126, BRCA.0177 |
| Pinus ponderosa / Cercocarpus montanus Woodland | CEGL000851 | 3 | BRCA_AA.0059, BRCA_AA.0094, BRCA_AA.0221 |
| Pinus ponderosa / Elymus elymoides - (Elymus spp.) Woodland [Park Special] | Park Special | 16 | BRCA.0051, BRCA.0060, BRCA.0062, BRCA.0067, BRCA.0101, BRCA.0103, BRCA.0113, BRCA.0219, BRCA.0224, BRCA.0225, BRCA.0226, BRCA.0248, BRCA.0270, BRCA.0276, BRCA.0281, BRCA.0298 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Pinus ponderosa / Hesperostipa comata Colorado Plateau Woodland [Park Special] | Park Special | 3 | BRCA.0080, BRCA.0169, BRCA.9212 |
| Pinus ponderosa / Leymus salinus Woodland [Provisional] | CEGL005362 | 16 | BRCA.0027, BRCA.0088, BRCA.0089, BRCA.0090, BRCA.0094, BRCA.0095, BRCA.0105, BRCA.0142, BRCA.0145, BRCA.0205, BRCA.0214, BRCA.0220, BRCA.0282, BRCA.0287, BRCA.0350, BRCA.9010 |
| Pinus ponderosa / Petradoria pumila Woodland [Park Special] | Park Special | 1 | BRCA.9233 |
| Pinus ponderosa / Purshia tridentata Woodland | CEGL000867 | 15 | BRCA.0013, BRCA.0014, BRCA.0033, BRCA.0116, BRCA.0144, BRCA.0208, BRCA.0210, BRCA.0211, BRCA.0280, BRCA.0345, BRCA.0352, BRCA.9002, BRCA.9019, BRCA.9210, BRCA.9230 |
| Pinus ponderosa / Quercus gambelii Woodland | CEGL000870 | 10 | BRCA.0072, BRCA.0093, BRCA.0163, BRCA.0164, BRCA.0178, BRCA.0311, BRCA.0356, BRCA.0357, BRCA.9215, BRCA.9260 |
| Pinus ponderosa / Seeded Grasses Semi-natural Woodland [Park Special] | Park Special | 1 | BRCA.9253 |
| Pinus ponderosa / Sparse Understory Woodland [Provisional] | CEGL002384 | 13 | BRCA.0111, BRCA.0269, BRCA_AA.0235, BRCA_AA.0237, BRCA_AA.0346, BRCA_AA.0400, BRCA_AA.0412, BRCA_AA.0455, BRCA_AA.0472, BRCA_AA.0693, BRCA_AA.0707, BRCA_AA.1174, BRCA_AA.1244 |
| Pinus ponderosa Sparse Woodland | Park Special | 10 | BRCA_AA.0088, BRCA_AA.0103, BRCA_AA.0148, BRCA_AA.0150, BRCA_AA.0166, BRCA_AA.0184, BRCA_AA.0186, BRCA_AA.0260, BRCA_AA.0272, BRCA_AA.0276 |
| Pinus ponderosa / Symphoricarpos oreophilus Forest | CEGL000205 | 4 | BRCA.0050, BRCA.0253, BRCA.0278, BRCA.0279 |
| Poa fendleriana Herbaceous Vegetation | CEGL001925 | 4 | BRCA.0213, BRCA.0233, BRCA.0237 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Poa pratensis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation | CEGL005265 | 2 | BRCA.0102, BRCA.9050 |
| Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation | CEGL003081 | 2 | BRCA.0256, BRCA.0266 |
| Poa secunda Herbaceous Vegetation | CEGL001657 | 1 | BRCA.0052 |
| Populus angustifolia - Juniperus scopulorum Woodland | CEGL002640 | 1 | BRCA_AA.0754 |
| Populus angustifolia / Betula occidentalis Woodland | CEGL000648 | 1 | BRCA_AA.0765 |
| Populus angustifolia / Cornus sericea Woodland | CEGL002664 | 1 | BRCA_AA.0417 |
| Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus) Woodland | CEGL002648 | 1 | BRCA.9236 |
| Populus tremuloides - Pseudotsuga menziesii / Juniperus communis Forest | CEGL000545 | 1 | BRCA.0173 |
| Populus tremuloides / Acer grandidentatum Forest [Park Special] | Park Special | 1 | BRCA_AA.1069 |
| Populus tremuloides / Juniperus communis Forest | CEGL000587 | 4 | BRCA.0082, BRCA.0099, BRCA.0172, BRCA.9048 |
| Populus tremuloides / Symphoricarpos oreophilus Forest | CEGL000610 | 3 | BRCA.9256, BRCA_AA.1199, BRCA_AA.1203 |
| Prunus virginiana - (Prunus americana) Shrubland | CEGL001108 | 2 | BRCA.9255, BRCA_AA.1208 |
| Pseudotsuga menziesii / Arctostaphylos patula Forest | CEGL000423 | 4 | BRCA.9016, BRCA.9021, BRCA.9042, BRCA.9213 |
| Pseudotsuga menziesii / Quercus gambelii Forest | CEGL000452 | 2 | BRCA.9013, BRCA.9266 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Pseudotsuga menziesii / Symphoricarpos oreophilus Forest | CEGL000462 | 2 | BRCA.0091, BRCA.9254 |
| Purshia tridentata / Hesperostipa comata Shrub Herbaceous Vegetation | CEGL001498 | 4 | BRCA.0104, BRCA.0239, BRCA.0353, BRCA.0355 |
| Purshia tridentata / Leymus salinus Shrubland [Park Special] | Park Special | 2 | BRCA.9023, BRCA_AA.0229 |
| Purshia tridentata Desert Wash Shrubland [Park Special] | Park Special | 5 | BRCA.0196, BRCA.0332, BRCA.0337, BRCA.0374, BRCA.0399 |
| Quercus gambelii - Cercocarpus montanus / (Carex geyeri) Shrubland | CEGL001113 | 9 | BRCA.0369, BRCA_AA.0434, BRCA_AA.0628, BRCA_AA.0835, BRCA_AA.0915, BRCA_AA.1071, BRCA_AA.1083, BRCA_AA.1200, BRCA_AA.1225 |
| Quercus gambelii / Sparse Understory Shrubland | CEGL002337 | 6 | BRCA.0004, BRCA.0314, BRCA.0327, BRCA.0338, BRCA.0412, BRCA.9240 |
| Quercus gambelii / Symphoricarpos oreophilus Shrubland | CEGL001117 | 3 | BRCA.0069, BRCA.0107, BRCA.9235 |
| Quercus gambelii Shrubland | CEGL002477 | 2 | BRCA.0135, BRCA.0171 |
| Salix eriocephala / Mesic graminoids Shrubland [Provisional] | CEGL005363 | 4 | BRCA.0358, BRCA_AA.0087, BRCA_AA.0170, BRCA_AA.0761 |
| Salix exigua Temporarily Flooded Shrubland | CEGL001197 | 5 | BRCA.9202, BRCA.9232, BRCA_AA.0082, BRCA_AA.0162, BRCA_AA.0373 |
| Shepherdia argentea Shrubland | CEGL001128 | 1 | BRCA.9246 |
| Symphoricarpos oreophilus Shrubland | CEGL002951 | 4 | BRCA.0223, BRCA.0390, BRCA.9239, BRCA.9257 |
| Tetradymia canescens / Poa pratensis Shrubland [Park Special] | Park Special | 7 | BRCA.0061, BRCA_AA.0278, BRCA_AA.0290, BRCA_AA.0293, BRCA_AA.0397, BRCA_AA.0410, BRCA_AA.0659 |

| Plant Association Scientific Name | Element Code | No. of Samples | Supporting Plot, Observation Point, and AA Point Assignments |
|---|---|---|---|
| Tetradymia canescens Badlands Sparse Vegetation [Park Special] | Park Special | 1 | BRCA.0129 |
| Tetradymia canescens Shrubland [Park Special] | Park Special | 1 | BRCA_AA.0476 |
| Zuckia brandegeei Sparse Vegetation | CEGL002493 | 5 | BRCA.0158, BRCA.0159, BRCA.0160, BRCA.0161, BRCA.9264 |

# Appendix F. Plant Association Descriptions for Bryce Canyon National Park

## NATIONAL VEGETATION CLASSIFICATION

## Vegetation Associations of Bryce Canyon National Park

18 November 2010

by

NatureServe

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This subset of the International Ecological Classification Standard covers vegetation associations attributed to Bryce Canyon National Park. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC mary_russo@natureserve.org, and/or Gwen Kittel, Regional Vegetation Ecologist, Boulder, CO gwen_kittel@natureserve.org.



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## *Pinus ponderosa / Symphoricarpos oreophilus* Forest

## Ponderosa Pine / Mountain Snowberry Forest

| | |
|---|---|
| CODE | CEGL000205 |
| 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 | Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b.) |
| ALLIANCE | *PINUS PONDEROSA* FOREST ALLIANCE (A.124)<br>Ponderosa Pine Forest Alliance |

**ECOLOGICAL SYSTEM(S):** Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030)
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This ponderosa pine forest occurs within the Seven Devils and western Boise mountains in Idaho, the Aquarius and Paunsaugunt plateaus and Abajo Mountains in Utah, and in Oregon. The association occurs in small, localized patches. In the northern portion of the range, it occurs on south-facing ridgetop and upper-slope positions at approximately 1525 m (5000 feet) elevation. In the south, the association occurs on gentle to moderate midslopes, facing all aspects, at elevations ranging from 2400-2680 m (7900-8800 feet). *Pseudotsuga menziesii* forests are adjacent on more mesic sites. Stands are characterized by an open to closed overstory dominated by *Pinus ponderosa*. *Symphoricarpos oreophilus, Purshia tridentata*, and *Amelanchier alnifolia* are common associates of the conspicuous understory shrub layer.

**DISTRIBUTION**

*Bryce Canyon National Park*

This forest has limited distribution, occurs on a variety of topographic features, and sampled on Paunsaugunt Plateau, near Yovimpa Pass, and adjacent to the main park entrance.

*Globally*

The association occurs in mountains of west-central Idaho, northeastern Oregon, and central and southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This forest is uncommon and occurs on plateaus, valleys, ridges, and hills. The sites are flat to moderately sloped (0- to 15-degree slopes), occur between 2387 and 2557 m in elevation, and are oriented to all aspects. The ground surface has sparse to low exposure of bare soil, high cover of litter, sparse to low cover of small rocks, and sparse cover of downed wood. Litter depths range from 0-1.8 cm. Soils are rapidly drained silty clay loams, loams, and sandy loams derived from the Claron Formation (White and Pink members).

*Globally*

This forest association is described for sites within the Seven Devils and western Boise mountains in Idaho, the Aquarius and Paunsaugunt plateaus and Abajo Mountains in Utah, and in Oregon. The association occurs with minor to local abundance in the two biophysical regions. In the northern portion of the range the association occurs on south-facing ridgetop and upper-slope positions at approximately 1525 m (5000 feet) elevation. In the south, the association occurs on gentle to moderate midslopes, facing all aspects, at elevations ranging from 2400-2680 m (7900-8800 feet).

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (26-79% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-15 m, has dbh ranging from 13-102 cm, and provides 16-50% cover, and the short shrub *Symphoricarpos oreophilus* that provides 1-10% cover. Other shrubs that may be present include *Purshia tridentata, Arctostaphylos patula*, and *Chrysothamnus depressus*. The herbaceous layer is highly variable, moderate to high in

floristic diversity, and contributes sparse cover. Sapling trees up to 2 m tall provide sparse cover and include *Abies concolor, Juniperus scopulorum, Pinus ponderosa*, and *Pseudotsuga menziesii*.

*Globally*
Stands are characterized by an open to closed overstory dominated by *Pinus ponderosa*. *Symphoricarpos oreophilus, Purshia tridentata*, and *Amelanchier alnifolia* are common associates of the conspicuous understory shrub layer. In southern stands, *Arctostaphylos patula* and *Chrysothamnus depressus* may also be present.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3 (28-Apr-1999). This regionally endemic plant association occurs in a few, highly dispersed and geographically separated, relatively small stands located in the Seven Devils and western Boise mountains of Idaho, the Aquarius and Paunsaugunt plateaus and Abajo Mountains in Utah, and Oregon. The association is only locally abundant. Few high-quality, representative stands of the association are known. The condition of stands is declining due to landscape-scale disruption of fire disturbance patterns and processes.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
This association may occur in Arizona or New Mexico. More investigation is needed. *Pinus ponderosa / Symphoricarpos oreophilus* is described as a habitat type by both Steele et al. (1981) and Youngblood and Mauk (1985). The plant association is considerably more productive in stands sampled by Youngblood and Mauk (1985). For this reason they propose that the southern occurrences of the association be considered unique.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Open forest with trees of all ages present; ground fire that passed through in recent years; blackened tree trunks (but with no mature tree mortality) indicate a low ground fire burned through this area at one time.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0050, BRCA.0253, BRCA.0278, BRCA.0279) and 2007 Accuracy Assessment (7 points: BRCA_AA.0104, BRCA_AA.0334, BRCA_AA.0532, BRCA_AA.0548, BRCA_AA.0613, BRCA_AA.0907, BRCA_AA.0971).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* S.K. Rust, mod. G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, Driscoll et al. 1984, Johnson and Clausnitzer 1992, Kagan et al. 2000, Madany and West 1984, Steele et al. 1981, Western Ecology Working Group n.d., Youngblood and Mauk 1985, Youngblood et al. 1985a

## *Abies concolor / Acer grandidentatum* Forest

## White Fir / Bigtooth Maple Forest

| | |
|---|---|
| CODE | CEGL000241 |
| 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)<br>White Fir Forest Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This forest association has been reported from mountains in Utah, New Mexico and Arizona along the Mogollon Rim north into the high plateaus and Wasatch Range of Utah. Elevation ranges from 1525-2590 m (5000-8500 feet). This mesic community generally occurs on steep, lower slopes and benches with northern aspects and in narrow canyons and ravines. Soils are generally deep, well-drained, coarse and fine-textured alluvium. *Abies concolor* and *Pseudotsuga menziesii* codominate the upper tree canopy with the subcanopy or tall-shrub layer dominated by *Acer grandidentatum, Quercus gambelii*, and *Acer negundo*. *Pinus strobiformis, Pinus ponderosa, Populus tremuloides*, and *Juglans major* may also be present. The short-shrub layer is variable. The herbaceous layer is moderately dense and may include *Carex siccata (= Carex foenea), Bromus ciliatus var. ciliatus, Bromus ciliatus var. richardsonii (= Bromus richardsonii), Koeleria macrantha, Thalictrum fendleri*, and *Aquilegia chrysantha*. This association transitions to *Abies concolor / Quercus gambelii* Forest (CEGL000261) in drier uplands and to riparian types adjacent to streams.

**DISTRIBUTION**

*Bryce Canyon National Park*

This mesic forest was sampled in the canyons and valleys of Corral Hollow, Ponderosa, Black Birch and Swamp canyons, Mutton Hollow and near Yovimpa Pass.

*Globally*

This forest association has been reported from mountains in New Mexico, Arizona and Utah along the Mogollon Rim north into the high plateaus and Wasatch Range of Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This mesic forest is uncommon and occurs on canyon bottoms and canyon and valley slopes. The sites are gentle to steep (4- to 30-degree slopes), occur between 2331 and 2389 m in elevation, and are oriented to all aspects. The ground surface has no to sparse exposure of bare soil, high cover of litter, sparse cover of small rocks, and sparse to low cover of downed wood. Litter depths range from 0-3.1 cm. Soils are rapidly drained loamy sands, silty clay loams, loams, and sandy loams derived from quaternary alluvium or local geologic layers.

*Globally*

This forest association has been reported from mountains in New Mexico and Arizona along the Mogollon Rim, and in Utah north into high plateaus and the Wasatch Range. Elevation ranges from 1525-2590 m (5000-8500 feet). This

mesic community generally occurs on gentle to steep (4-40 degrees) lower slopes and benches with northern aspects and in narrow canyons and ravines. Soils are generally deep, rapidly drained, coarse-textured loams, but range from loamy sands to silty clay loams. Parent materials are derived from quaternary alluvium, and bedrock and colluvium derived from local geologic layers.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (59-98% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m, have dbh ranging from 12-47 cm and provide 0-13% cover, and the tall shrub *Acer grandidentatum* that ranges in height from 2-10 m and provides 10-75% cover. Additional canopy trees provide low to moderate cover and include *Pseudotsuga menziesii, Pinus ponderosa*, and *Populus tremuloides*. The subcanopy layer is 5-10 m tall, provides low cover, and includes *Juniperus scopulorum, Pseudotsuga menziesii, Pinus ponderosa*, and *Populus tremuloides*. Additional tall shrubs are *Prunus virginiana, Betula occidentalis*, and *Quercus gambelii* that provide sparse to low cover. Short- and dwarf-shrubs present are moderate in terms of floristic diversity, provide sparse to low cover, and include *Juniperus communis, Arctostaphylos patula, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is moderate in terms of species composition, contributes sparse cover, and includes the graminoid *Carex rossii* and the forb *Maianthemum stellatum (= Smilacina stellata)*. *Pseudotsuga menziesii, Juniperus scopulorum, Populus tremuloides*, and *Abies concolor* saplings up to 2 m tall contribute sparse to low cover.

*Globally*

This mesic forest is characterized by a mixed-species tree canopy with *Abies concolor* and *Pseudotsuga menziesii* codominating the upper tree canopy and with the subcanopy or tall-shrub layer dominated by *Acer grandidentatum, Quercus gambelii*, and *Acer negundo*. *Pinus strobiformis, Pinus ponderosa, Populus tremuloides*, and *Juglans major* may also be present. The short-shrub layer is variable. Short shrub species include *Arctostaphylos patula, Juniperus communis, Mahonia repens, Paxistima myrsinites, Prunus virginiana, Quercus gambelii* (<5% cover), *Ribes cereum*, and *Symphoricarpos oreophilus*. The herbaceous layer is an open to moderately dense mixture of graminoids and forbs. Grasses commonly present include *Achnatherum hymenoides, Bromus ciliatus, Carex siccata (= Carex foenea), Koeleria macrantha, Poa fendleriana*, and *Pseudoroegneria spicata*. Scattered forbs include *Aquilegia chrysantha, Clematis ligusticifolia, Galium multiflorum, Heuchera parviflora, Maianthemum racemosum (= Smilacina racemosa), Osmorhiza occidentalis, Penstemon platyphyllus, Sedum debile*, and *Thalictrum fendleri*. Seedling trees of *Abies concolor* and *Pseudotsuga menziesii* may occur throughout. The exotic annual grass *Bromus tectorum* is present in some stands.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Acer grandidentatum* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Abies concolor* |
| Tree canopy | *Quercus gambelii* |
| Tall shrub/sapling | *Acer grandidentatum*, *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
*Abies concolor* forest; Douglas-fir forest.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Dense band of *Acer grandidentatum* along a small wash; sheltered, north-facing slope controls the community; forests occupy sites where groundwater emerges from surrounding slopes.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0176, BRCA.0183, BRCA.0367, BRCA.0386), and 2007 Accuracy Assessment (11 points: BRCA_AA.0076, BRCA_AA.0832, BRCA_AA.0913, BRCA_AA.0954, BRCA_AA.1027, BRCA_AA.1035, BRCA_AA.1043, BRCA_AA.1054, BRCA_AA.1075, BRCA_AA.1096, BRCA_AA.1181).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Alexander et al. 1984a, Alexander et al. 1987, Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, Fitzhugh et al. 1987, Moir and Ludwig 1979, Muldavin et al. 1996, Stuever and Hayden 1997b, Western Ecology Working Group n.d.

## *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 | 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)<br>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**
*Bryce Canyon National Park*

This common forest was sampled on many topographic positions where it occupies exposed slopes, near Paria View, Rainbow, Bryce, Ponderosa, and Farview points; in Cub and Oak hollows, near Yovimpa Pass, along the Yovimpa Pass Trail, along Whiteman Bench, on Paunsaugunt Plateau, adjacent to Fairyland Canyon and Aqua Connecting trails; near The Promontory, and in Bridge, Aqua, Black Birch, Ponderosa, and Water canyons.

*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**
*Bryce Canyon National Park*
This common forest association occurs on mid- to high slopes of rims, hills, ridges, mesas, canyons, valleys, colluvial slopes, and plateaus. The sites are flat to steep (0- to 35-degree slopes), occur between 2286 and 2707 m in elevation, and are oriented to all aspects. The ground surface has sparse to moderate exposure of bare soil, low to high cover of litter, sparse to high cover of small and large rocks, and sparse to low cover of downed wood. Litter depths range from 0-3.0 cm. Soils are rapidly drained loams, sandy clays, silty clay loams, silts, clay loams, sandy loams, and silty clays derived from the Claron Formation (Pink and White members), or older alluvium.

*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**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (21-78% cover) and is characterized by *Abies concolor* trees that range in height from 5-20 m, have dbh ranging from 13-74 cm, and provide <1-27% cover, and the short shrub *Arctostaphylos patula* that provides 2-45% cover. Additional canopy trees include *Pinus ponderosa, Pinus flexilis*, and *Pseudotsuga menziesii* that often have greater cover than does *Abies concolor*. The subcanopy layer ranges from 5-10 m tall, provides low to moderate cover, and includes *Pseudotsuga menziesii, Abies concolor, Pinus ponderosa, Picea pungens, Pinus edulis, Juniperus osteosperma, Cercocarpus ledifolius*, and *Juniperus scopulorum*. The tall-shrub layer provides sparse cover in some stands and includes *Cercocarpus montanus, Purshia mexicana, Quercus gambelii*, and *Acer glabrum*. The remaining short- and dwarf-shrub layers are moderate in terms of species composition, provide sparse to low cover, and include *Symphoricarpos oreophilus, Purshia tridentata, Juniperus communis, Shepherdia canadensis, Ceanothus martinii, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is moderate in terms of floristic diversity, contributes sparse cover, and includes the graminoids *Carex rossii, Achnatherum hymenoides, Leymus salinus*, and *Elymus elymoides*. *Pseudotsuga menziesii, Pinus flexilis, Pinus ponderosa*, and *Abies concolor* saplings up to 2 m tall contribute sparse to low 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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pinus ponderosa*, *Pseudotsuga menziesii* |

| | |
|---|---|
| Short shrub/sapling | *Arctostaphylos patula* |

*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**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic)

*Globally*
**Vulnerable**: *Penstemon leiophyllus* (G3)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
*Abies concolor* forest; Douglas-fir forest.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Numerous dead and downed trees; area has experienced a recent fire (5-10 years old), as evidenced by blackened bark, dead and downed trees, and charred snags and stumps; litter covers otherwise rocky soils; drier, south-facing slope with an open canopy of mixed conifers; multi-aged stand with all sizes of trees present; canyon bottom site has several drainage channels, understory composition is dependent on sun exposure; most Douglas-fir has succumbed to mistletoe, many white fir are recently dead possibly due to bark beetles; some terrace areas of stand subject to flooding; White Claron rocks abundant on several sites with steep slopes.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (24 plots: BRCA.0015, BRCA.0037, BRCA.0039, BRCA.0040, BRCA.0043, BRCA.0044, BRCA.0045, BRCA.0049, BRCA.0064, BRCA.0066, BRCA.0074, BRCA.0097, BRCA.0108, BRCA.0132, BRCA.0154, BRCA.0155, BRCA.0228, BRCA.0234, BRCA.0240, BRCA.0241, BRCA.0243, BRCA.0247, BRCA.0255, BRCA.0259; and 7 observation points: BRCA.9007, BRCA.9014, BRCA.9035, BRCA.9056, BRCA.9208, BRCA.9209, BRCA.9258); and 2007 Accuracy Assessment (58 points: BRCA_AA.0071, BRCA_AA.0172, BRCA_AA.0203, BRCA_AA.0313, BRCA_AA.0359, BRCA_AA.0365, BRCA_AA.0390, BRCA_AA.0554, BRCA_AA.0720, BRCA_AA.0803, BRCA_AA.0858, BRCA_AA.0895, BRCA_AA.0900, BRCA_AA.0928, BRCA_AA.0935, BRCA_AA.0988, BRCA_AA.1013, BRCA_AA.1014, BRCA_AA.1021, BRCA_AA.1050, BRCA_AA.1052, BRCA_AA.1055, BRCA_AA.1058, BRCA_AA.1080, BRCA_AA.1086, BRCA_AA.1106, BRCA_AA.1120, BRCA_AA.1127, BRCA_AA.1135, BRCA_AA.1144, BRCA_AA.1150, BRCA_AA.1151, BRCA_AA.1154, BRCA_AA.1169, BRCA_AA.1170, BRCA_AA.1182, BRCA_AA.0241, BRCA_AA.0360, BRCA_AA.0530, BRCA_AA.0543, BRCA_AA.0609, BRCA_AA.0654, BRCA_AA.0716, BRCA_AA.0719, BRCA_AA.0782, BRCA_AA.0855, BRCA_AA.0932, BRCA_AA.0959, BRCA_AA.0982, BRCA_AA.1018, BRCA_AA.1019, BRCA_AA.1025, BRCA_AA.1073, BRCA_AA.1082, BRCA_AA.1091, BRCA_AA.1121, BRCA_AA.1228, BRCA_AA.1250).
*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)<br>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 Markagunt, 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**

*Bryce Canyon National Park*

This common forest occurs on many topographic positions and a broad range of elevations. It was sampled in the hollows of Cub, Oak, Puma, and Long; near Rainbow Point and Ponderosa Canyon Viewpoint, west of Ponderosa Canyon, adjacent to Whiteman Trail, near Trough Spring and near Yovimpa Pass.

*Globally*

This conifer forest is found in Utah on the Markagunt, Sevier and Paunsaugunt plateaus and the Escalante and Tushar mountains and in the southern Rocky Mountains in northern New Mexico.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common forest occurs on low to high slopes of ridges, mesas, ravines, valleys, hills, plateaus, draws, and saddles. The sites are gentle to steep (2- to 24-degree slopes), occur between 2490 and 2718 m in elevation, and are oriented to all aspects. The ground surface has sparse to moderate exposure of bare soil, no to high cover of litter, sparse to moderate cover of downed wood, and sparse to high cover of small rocks. Litter depths range from 0-2.5 cm. Soils are rapidly drained clay loams, sandy clay loams, silty clay loams, silty loams, and silts derived from the Claron Formation (Pink and White members).

*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**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (25-79% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m, have dbh ranging from 13-67 cm, and provide 3-54% cover, and the short shrub *Juniperus communis* that provides 1-17% cover. Additional canopy trees provide low to moderate cover and include *Pseudotsuga menziesii, Pinus flexilis, Pinus ponderosa, Picea pungens*, and *Populus tremuloides*. The subcanopy layer provides low cover and includes 5-10 m tall *Pseudotsuga menziesii, Pinus flexilis, Pinus ponderosa*, and *Populus tremuloides*. The remaining short- and dwarf-shrub layers are moderate in terms of species composition, provide sparse to low cover, and include *Symphoricarpos oreophilus, Ribes cereum, Ceanothus martinii, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is moderate in terms of floristic diversity and contributes sparse cover. Common graminoids include *Carex rossii, Poa fendleriana*, and *Elymus elymoides*. *Pseudotsuga menziesii, Pinus flexilis, Populus tremuloides*, and *Abies concolor* saplings up to 2 m tall contribute sparse to low cover. Species of moss can provide sparse cover, up to 3% cover in some stands.

*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**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pseudotsuga menziesii* |
| Tree canopy | *Picea pungens* |
| Short shrub/sapling | *Juniperus communis* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Abies concolor*, *Pseudotsuga menziesii* |
| Shrub/sapling (tall & short) | *Juniperus communis* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium)

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G4? (23-Feb-1994).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*

*Abies concolor* forest.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Numerous dead and downed trees and limbs without evidence of fire, possibly from a strong wind event following beetle kill; continuous layer of litter seems to be inhibiting growth in the understory; several mature *Abies concolor* trees have been killed from bark beetle infestations.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (13 plots: BRCA.0001, BRCA.0041, BRCA.0073, BRCA.0098, BRCA.0227, BRCA.0229, BRCA.0238, BRCA.0244, BRCA.0262, BRCA.0288, BRCA.0291, BRCA.0292, BRCA.0364; and 1 observation point: BRCA.9047); and 2007 Accuracy Assessment (9 points: BRCA_AA.0002, BRCA_AA.0592, BRCA_AA.0924, BRCA_AA.0994, BRCA_AA.1036, BRCA_AA.1060, BRCA_AA.1084, BRCA_AA.1094, BRCA_AA.0974).
*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)<br>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**

*Bryce Canyon National Park*

This forest is common and was sampled near Rainbow Point, in Cub and Puma hollows, near Yovimpa Pass Trail, Aqua Canyon Trail, and Ponderosa Point Viewpoint, west of Ponderosa Canyon, in Aqua Canyon, and in the Podunk Creek drainage.

*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**

*Bryce Canyon National Park*

This forest occurs on midslopes of hills, ridges, mesas, ravines, valleys, and plateaus. The sites are gentle to steep (3- to 21-degree slopes), occur between 2330 and 2713 m in elevation, and are oriented to all aspects. The ground surface has no to moderate exposure of bare soil, low to high cover of litter, sparse cover of large rocks, low to moderate cover of small rocks, and sparse to moderate cover of downed wood. Litter depths range from 0-2.1 cm. Soils are rapidly drained silty clay loams, sandy clay loams, loams, and silty loams derived from the Claron Formation (Pink and White members).

*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**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (25-72% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m, have dbh ranging from 12-88 cm, and provide 7-53% cover, and the dwarf-shrub *Mahonia repens* that provides <1-10% cover. Additional canopy trees provide low to moderate cover and include *Pseudotsuga menziesii, Pinus ponderosa*, and *Populus tremuloides*. The subcanopy layer is 5-10 m tall, typically provides low cover, and includes *Abies concolor, Pseudotsuga menziesii, Pinus ponderosa*, and *Populus tremuloides*. Other shrubs present may include *Symphoricarpos oreophilus, Arctostaphylos patula, Paxistima myrsinites*, and *Juniperus communis*. The herbaceous layer is moderate in terms of floristic diversity, contributes sparse cover, and includes the graminoids *Carex rossii, Poa fendleriana*, and *Elymus elymoides*. *Pseudotsuga menziesii, Pinus flexilis, Populus tremuloides*, and *Abies concolor* saplings up to 2 m tall contribute sparse to low 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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pseudotsuga menziesii* |
| Herb (field) | *Mahonia repens* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Abies concolor*, *Pseudotsuga menziesii* |
| Shrub/sapling (tall & short) | *Mahonia repens* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Dead and downed trees and some snags; charring at the bases of most trees and partial consumption of some large logs suggests a light fire in the last 5-10 years; heavy fuel loads; continuous layer of litter seems to be inhibiting growth in the understory; several mature *Abies concolor* trees have been killed by bark beetles; deep layer of litter and duff.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (12 plots: BRCA.0034, BRCA.0035, BRCA.0038, BRCA.0042, BRCA.0063, BRCA.0077, BRCA.0100, BRCA.0112, BRCA.0257, BRCA.0289, BRCA.0290, BRCA.0380; and 2 observation points: BRCA.9006, BRCA.9008); and 2007 Accuracy Assessment (23 points: BRCA_AA.0064, BRCA_AA.0077, BRCA_AA.0509, BRCA_AA.0973, BRCA_AA.0990, BRCA_AA.0996, BRCA_AA.1024, BRCA_AA.1059, BRCA_AA.1099, BRCA_AA.1100, BRCA_AA.1116,

BRCA_AA.1201, BRCA_AA.1220, BRCA_AA.0522, BRCA_AA.0631, BRCA_AA.0929, BRCA_AA.1022, BRCA_AA.1078, BRCA_AA.1098, BRCA_AA.1197, BRCA_AA.1204, BRCA_AA.1223, BRCA_AA.1226).
*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* / Mixed Grasses Forest

### White Fir / Mixed Grasses Forest

| | |
|---|---|
| CODE | CEGL005357 |
| 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)<br>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 white fir forest occurs in southern and central Utah and likely occurs elsewhere in the southern Rocky Mountains. Elevations range from 1848-2718 m (6060-8910 feet). Stands occur on high slopes of hills, mesas, plateaus, canyon and benches. The ground surface generally has high cover of litter and sometimes rocks with sparse to moderate exposure of bedrock, bare soil, and wood. Soils are rapidly drained with variable textures ranging from gravelly loams to silty clay loams. Vegetation is characterized by an open to moderate (10-40% cover) tree canopy with an understory dominated by a mixed grasses. The tree canopy is dominated or codominated by *Abies concolor* with *Pseudotsuga menziesii, Pinus ponderosa, Populus tremuloides*, or *Juniperus scopulorum* often present in the canopy and subcanopy. The understory consists primarily of bunch grasses with low to moderately dense cover (10-55%), among which *Achnatherum lettermanii, Koeleria macrantha, Leucopoa kingii, Poa fendleriana, Poa secunda*, and *Pseudoroegneria spicata* are the most common. The non-native grasses *Bromus inermis* and *Poa pratensis* are common in some stands. Forb cover is sparse and often diverse. Scattered shrubs and dwarf-shrubs may be present but do not form a layer. The mixed perennial grass herbaceous layer and lack of a distinct shrub layer are diagnostic of this white fir forest.

**DISTRIBUTION**
*Bryce Canyon National Park*
This relatively common forest was sampled near Rainbow Point, Yovimpa Pass, Farview Point, adjacent to Yovimpa Pass Trail, and in Aqua Canyon.

*Globally*
This white fir forest occurs in southern and central Utah and likely occurs elsewhere in the southern Rocky Mountains.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This forest is relatively common and occurs on high slopes of hills, mesas, plateaus, and benches. The sites are flat to gentle (0- to 3-degree slopes), occur between 2566and 2718 m in elevation, and oriented to all aspects. The ground surface has sparse to moderate exposure of bare soil, moderate to high cover of litter, sparse cover of large

and small rocks, and sparse to low cover of downed wood. Litter depths range from 0-1.1 cm. Soils are rapidly drained silts, loams, silty loams, and silty clay loams derived from the Claron Formation (Pink and White members).

*Globally*
This forest association occurs in southern and central Utah and likely occurs elsewhere in the southern Rocky Mountains. Elevations range from 1848-2718 m (6060-8910 feet). Stands occur on high slopes of hills, mesas, plateaus, canyon and benches. The ground surface generally has high cover of litter and sometimes rocks with sparse to moderate exposure of bedrock, bare soil, and wood. Soils are rapidly drained with variable textures ranging from gravelly loams to silty clay loams.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to dense (15-94% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m, have dbh ranging from 14-48 cm, and provide 6-18% cover, and several grass species that provide 4-53% cover. Common grasses include *Poa secunda, Poa fendleriana, Achnatherum lettermanii, Koeleria macrantha*, and non-native *Poa pratensis*. Additional canopy trees provide low to moderate cover and include *Pseudotsuga menziesii, Populus tremuloides*, and *Pinus ponderosa*. The subcanopy layer provides low cover and also includes *Pseudotsuga menziesii* and *Pinus ponderosa*. The short- and dwarf-shrub layers are moderate in terms of species composition, provide sparse to low cover, and include *Arctostaphylos patula, Symphoricarpos oreophilus, Ericameria nauseosa, Chrysothamnus depressus, Ceanothus martinii, Purshia tridentata, Juniperus communis, Ribes cereum*, and *Mahonia repens*. The forb layer is diverse in terms of species composition, contributes sparse cover, and includes *Balsamorhiza sagittata, Lupinus argenteus*, and *Artemisia ludoviciana*. *Pseudotsuga menziesii, Populus tremuloides*, and *Abies concolor* saplings up to 2 m tall contribute sparse cover.

*Globally*
This associations is characterized by an open to moderate (10-40% cover) tree canopy with an understory dominated by mixed grasses. The tree canopy is dominated or codominated by *Abies concolor* with *Pseudotsuga menziesii, Pinus ponderosa, Populus tremuloides*, or *Juniperus scopulorum* often present in the canopy and subcanopy. The understory consists primarily of bunch grasses with low to moderately dense cover (10-55%), among which *Achnatherum lettermanii, Koeleria macrantha, Leucopoa kingii, Poa fendleriana, Poa secunda*, and *Pseudoroegneria spicata* are the most common. The non-native grasses *Bromus inermis* and *Poa pratensis* are common in some stands. Forb cover is sparse and often diverse. Frequent species include *Artemisia ludoviciana, Balsamorhiza sagittata, Lupinus argenteus, Penstemon eatonii, Penstemon platyphyllus*, and *Sedum debile*. Scattered shrubs and dwarf-shrubs may be present but do not form a distinct layer. Shrubs species include *Cercocarpus intricatus, Chrysothamnus depressus, Ericameria nauseosa, Mahonia repens, Quercus gambelii* (<5% cover), *Physocarpus alternans*, or *Symphoricarpos oreophilus*. *Pseudotsuga menziesii* and *Abies concolor* saplings up to 2 m tall may also be present.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pseudotsuga menziesii* |
| Herb (field) | *Achnatherum lettermanii*, *Poa fendleriana*, *Poa pratensis*, *Poa secunda* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Abies concolor*, *Pseudotsuga menziesii* |
| Tree subcanopy | *Juniperus scopulorum* |
| Herb (field) | *Achnatherum lettermanii*, *Leucopoa kingii*, *Poa fendleriana*, *Poa secunda* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
**Exotic/Invasive**: *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (6-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
*Abies concolor* forest.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Open, grassy hilltop with evidence of a patchy fire; quite a few dead trees here provide large fuel loads.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (7 plots: BRCA.0036, BRCA.0076, BRCA.0231, BRCA.0232, BRCA.0235, BRCA.0260, BRCA.0261); and 2007 Accuracy Assessment (17 points: BRCA_AA.0124, BRCA_AA.0896, BRCA_AA.0901, BRCA_AA.0931, BRCA_AA.0948, BRCA_AA.0950, BRCA_AA.0956, BRCA_AA.0961, BRCA_AA.0979, BRCA_AA.1111, BRCA_AA.1114, BRCA_AA.1115, BRCA_AA.1117, BRCA_AA.1139, BRCA_AA.1148, BRCA_AA.1161, BRCA_AA.1214).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* K.A. Schulz

**REFERENCES:** Western Ecology Working Group n.d.

## *Abies concolor / Quercus gambelii* Forest

## White Fir / Gambel Oak Forest

| | |
|---|---|
| CODE | CEGL000261 |
| 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)<br>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 New Mexico, Colorado, Utah, and in Arizona. Stands occur along the Mogollon Rim north to the Wasatch Range and east to the southern Rocky Mountains. Elevations range from 1680-2930 m (5500-9600 feet). This community is widespread and often occurs on middle and lower slopes and all aspects except south and southwestern. *Abies concolor* and *Pseudotsuga menziesii* typically codominate the upper tree canopy. *Pinus ponderosa, Pinus strobiformis*, and *Juniperus* spp. may also be present. *Quercus gambelii* dominates the subcanopy and undergrowth. Other shrub species may include *Amelanchier alnifolia, Symphoricarpos oreophilus, Robinia neomexicana*, and *Mahonia repens*. The sparse to moderately dense herbaceous layer is typically composed of *Carex rossii, Poa fendleriana, Lathyrus lanszwertii var. leucanthus (=*

*Lathyrus arizonicus), Thalictrum fendleri*, and *Achillea millefolium*. Stands transition to *Pinus ponderosa / Quercus gambelii* Woodland (CEGL000870) in drier sites.

**DISTRIBUTION**

*Bryce Canyon National Park*

This forest was sampled on the slopes of Swamp Canyon, in Agua, Bridge, Black Birch, Mud, and Ponderosa canyons, in Corral Hollow, Riggs Spring, Ponderosa Ridge, on The Promontory, and in Upper Yellow Creek.

*Globally*

This forest association has been reported from mountains and plateaus in New Mexico, Colorado, Utah, and Arizona. Stands occur along the Mogollon Rim north into the Wasatch Range, west into the southern Rocky Mountains, and on the Paunsaugunt Plateau of southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This forest occurs on the sloping ground of canyon sidewalls. The sites are moderate to steep (8- to 34-degree slopes), occur between 2248 and 2425 m in elevation, facing all aspects. The ground surface has high cover of litter and sparse to low cover of downed wood. Litter depths range from 0-2.6 cm. Soils are rapidly drained loams.

*Globally*

This forest association has been reported from mountains in New Mexico, Colorado, Utah, and in Arizona along the Mogollon Rim. Elevations range from 1717-2930 m (5630-9600 feet). This community is widespread and often occurs on middle and lower slopes of canyons and mountains and on all aspects except southern and southwestern. Slopes range from gentle to steep. Substrates are variable but are frequently rapidly drained loams. Litter cover is generally high except on steep slopes where rock cover is high. Stands transition to *Pinus ponderosa / Quercus gambelii* Woodland (CEGL000870) in drier sites.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (42-46% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m, have dbh ranging from 13-23 cm and provide 7-14% cover, and the tall shrub *Quercus gambelii* that ranges in height from 2-5 m and provides 7-13% cover. Additional canopy trees provide low to moderate cover and include *Pseudotsuga menziesii* and *Pinus ponderosa*. The subcanopy provides low cover and also includes *Pseudotsuga menziesii* and *Pinus ponderosa*. Other tall shrubs include *Amelanchier utahensis* and *Acer grandidentatum*, 2-5 m tall with sparse cover, except one stand with 25% cover of the latter species, which is equal to the cover of *Quercus gambelii* in that stand. Short and dwarf-shrubs are low in terms of species composition, provide sparse cover, and include *Symphoricarpos oreophilus, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is low in terms of floristic diversity and contributes sparse cover. *Pseudotsuga menziesii* and *Abies concolor* saplings up to 2 m tall contribute sparse cover.

*Globally*

This forest association is characterized by a moderately dense to dense tree canopy typically codominated by *Abies concolor* and *Pseudotsuga menziesii*. *Abies concolor* may not dominate all stands but is present in the tree canopy with at least 5% cover. *Pinus ponderosa, Pinus strobiformis*, and *Juniperus* spp. may also be present to codominant. *Quercus gambelii* dominates the subcanopy and undergrowth with 5-30% cover. Other shrub species may include *Acer grandidentatum, Amelanchier alnifolia, Amelanchier utahensis, Cercocarpus intricatus, Paxistima myrsinites, Prunus virginiana, Robinia neomexicana, Mahonia repens*, and *Symphoricarpos oreophilus*. The sparse to moderately dense herbaceous layer may be diverse. Characteristic species include *Achillea millefolium, Apocynum androsaemifolium, Artemisia ludoviciana, Carex rossii, Erigeron arenarioides, Eriogonum brevicaule, Eriogonum racemosum, Galium multiflorum, Lathyrus lanszwertii, Leucopoa kingii, Linaria dalmatica, Maianthemum racemosum (= Smilacina racemosa), Penstemon pachyphyllus, Penstemon platyphyllus, Petradoria pumila, Poa fendleriana, Pseudoroegneria spicata, Sedum debile, Solidago velutina*, and *Thalictrum fendleri*. Seedlings of *Abies concolor* and *Juniperus scopulorum* may also be present. *Pseudotsuga menziesii* and *Abies concolor* saplings up to 2 m tall contribute sparse cover.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Quercus gambelii* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Abies concolor*, *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
*Abies concolor* forest.

*Globally*
Note that this association typically does not include *Acer grandidentatum*.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Numerous standing dead trees; heavy fuel loading; surface is covered by litter.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (2 plots: BRCA.0365, BRCA.0366); and 2007 Accuracy Assessment (15 points: BRCA_AA.0109, BRCA_AA.0257, BRCA_AA.0264, BRCA_AA.0570, BRCA_AA.0879, BRCA_AA.0882, BRCA_AA.1004, BRCA_AA.1061, BRCA_AA.1074, BRCA_AA.0108, BRCA_AA.1020, BRCA_AA.1092, BRCA_AA.1097, BRCA_AA.1165, BRCA_AA.1179. BRCA_AA.1189, BRCA_AA.1211, BRCA_AA.1217).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* K.A. Schulz

**REFERENCES:** Alexander et al. 1984a, Alexander et al. 1987, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, DeVelice 1983, DeVelice and Ludwig 1983a, DeVelice et al. 1986, Driscoll et al. 1984, Fitzhugh et al. 1987, Johnston 1984, Johnston 1987, Larson and Moir 1987, Madany and West 1984, Moir and Ludwig 1979, Muldavin et al. 1996, 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)<br>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**

*Bryce Canyon National Park*

This forest is relatively common and was sampled on a variety of topographic features in Agua Canyon, near Whiteman Bench, and Yovimpa Pass within the park; and in Ponderosa Canyon in the surrounding environs.

*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**

*Bryce Canyon National Park*

This forest is relatively common and occurs on benches and in valleys, draws, and on ridges. The sites are gentle to steep (3- to 27-degree slopes), occur between 2306 and 2652 m in elevation, and are oriented to all aspects. The ground surface has sparse to low exposure of bare soil, high cover of litter, sparse to low cover of small and large rocks, and sparse to low cover of downed wood. Litter depths range from 0-2.6 cm. Soils are rapidly drained silty clay loams and clay loams derived from the Claron Formation (Pink and White members), or the Straight Cliffs Formation.

*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**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (35-75% cover) and is characterized by *Abies concolor* trees that range in height from 10-20 m, have dbh ranging from 13-87 cm and provide 6-45% cover, and the short shrub *Symphoricarpos oreophilus* that provides <1-15% cover. Additional canopy trees provide low to moderate cover, including *Pseudotsuga menziesii* and *Pinus ponderosa*. The subcanopy provides low cover and includes *Pseudotsuga menziesii, Pinus ponderosa*, and *Acer grandidentatum*. The remaining short and dwarf-shrubs are low in terms of species composition, provide sparse to low cover, and include *Paxistima myrsinites, Juniperus communis*, and *Mahonia repens*. The herbaceous layer is diverse in terms of species composition and contributes sparse cover. *Pseudotsuga menziesii, Populus tremuloides*, and *Abies concolor* saplings up to 2 m tall contribute sparse 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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Abies concolor*, *Pinus ponderosa*, *Pseudotsuga menziesii* |
| 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**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Pinus aristata* (G3)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
*Abies concolor* forest.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Signs of fire, but heavy fuel loads remain on the forest floor; multi-aged stand with trees of all sizes present; in one stand either *Abies concolor* or *Pinus ponderosa* could be considered the dominant tree species depending on plot placement.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (5 plots: BRCA.0046, BRCA.0184, BRCA.0254, BRCA.0387, BRCA.0388; and 1 observation point: BRCA.9248); and 2007 Accuracy Assessment (5 points: BRCA_AA.1011, BRCA_AA.1202, BRCA_AA.1206, BRCA_AA.1212, BRCA_AA.1216).
*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)<br>Blue Spruce Forest Alliance |

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**

*Globally*

This community has only been observed at Bryce Canyon National Park 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 2588 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*, and *Ceanothus martinii*. The herbaceous cover is very low to non-existent.

**DISTRIBUTION**

*Bryce Canyon National Park*

This community was only observed during Accuracy Assessment and was observed in Peekaboo Loop, Swamp Canyon Headwaters, at Bryce Point, Bridge Hollow, Yovimpa Pass and Willis Creek Headwaters.

*Globally*

This association in known only from southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

The ground is mostly open bare soil, sand or bed rock. Stands occur on steep slopes at all aspects, between 2337 and 2588 m in elevation.

*Globally*

Data are not available.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

This 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*, and *Ceanothus martinii*. The herbaceous cover is very low to non-existent.

*Globally*

Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (18-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This association was well-documented during accuracy assessment at Bryce Canyon National Park, but no data from full classification plots were collected. It is currently known only from this one park. 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**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (8 points: BRCA_AA.0411, BRCA_AA.0420, BRCA_AA.0424, BRCA_AA.0607, BRCA_AA.0912, BRCA_AA.0922, BRCA_AA.0938, BRCA_AA.1177).
*Local Description Authors:* G. Kittel
*Global Description Authors:* G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *Picea pungens / Arctostaphylos uva-ursi* Forest

## Blue Spruce / Kinnikinnick or Bearberry Forest

| | |
|---|---|
| CODE | CEGL000385 |
| 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)<br>Blue Spruce 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 is a minor forest type, occurring in small patches on warm, dry and steep south-facing slopes and ridges between 2410 and 2800 m (7000-9200 feet) elevation. It is known primarily from the San Juan Mountains of southern Colorado, northern New Mexico, and along the high plateaus of southern Utah. Stands have are a mixed canopy of *Picea pungens* with *Pseudotsuga menziesii* and *Pinus ponderosa*. In fact, the presence of *Picea pungens* is the indicator for this association, even though the combined cover of other conifers present may exceed that of blue spruce. Occasionally *Abies concolor* and *Pinus flexilis* are also present to abundant. *Populus tremuloides* may be abundant in recently disturbed stands. *Arctostaphylos uva-ursi* is characteristic in the low-shrub canopy, with other shrubs that may be present including *Symphoricarpos oreophilus, Juniperus communis*, and *Mahonia repens*. Graminoids include *Festuca arizonica* and *Carex rossii*, and forbs such as *Cirsium calcareum, Fragaria virginiana ssp. glauca (= Fragaria ovalis)*, and *Arenaria fendleri* may be present in the stand.

**DISTRIBUTION**
*Bryce Canyon National Park*
This forest has limited distribution and was sampled on a valley slope in Bridge Hollow.

*Globally*
This type is known from the San Juan Mountains of southern Colorado, northern New Mexico, and the high plateaus of southern Utah.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This forest association occurs on the sideslope of a valley. The site is moderately steep (17-degree slope), occurs at 2458 m in elevation, and is oriented to the north. The ground surface has high cover of litter and duff, low cover of small rocks, sparse cover of downed wood, and sparse exposure of bare soil. Litter depths range from 0-4.6 cm. Soils are rapidly drained silty clay loams derived from the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low (23% cover) and is characterized by the canopy tree *Picea pungens* that ranges in height from 15-20 m, has dbh ranging from 20-57 cm, and provides 9% cover, and the dwarf-shrub *Arctostaphylos uva-ursi* that provides 5% cover. *Pinus ponderosa* trees occur in the canopy with *Picea pungens* and provide 6% cover. *Pseudotsuga menziesii* trees provide sparse cover in the subcanopy and range from 2-5 m tall. The remaining short and dwarf-shrubs are low in terms of floristic diversity, provide sparse cover, and include *Symphoricarpos oreophilus* and *Mahonia repens*. The herbaceous layer is moderately diverse in terms of species composition with no species providing 1% or more cover. The graminoid *Carex rossii* and the forbs *Cirsium calcareum* and *Arenaria fendleri* are present in the stand.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Picea pungens* |
| Herb (field) | *Arctostaphylos uva-ursi* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Wooded wetlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Mixed-age stand with a few older *Pinus ponderosa* trees scattered around; evidence of fire and some accumulation of 1000-hour fuels mostly upslope of plot.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0180).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, DeVelice et al. 1986, Driscoll et al. 1984, 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)<br>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**

*Bryce Canyon National Park*

This common mesic forest occurs on low slopes of valleys, hills, and draws, and was sampled in the Podunk Creek drainage, Bridge Hollow, near Bridge Draw, southwest of Fairview Point and Yovimpa Pass within the park and in the Podunk Creek drainage, East Fork of the Sevier River, and southeast of Buck Knoll within the environs.

*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**

*Bryce Canyon National Park*

This mesic forest is common and occurs on low slopes of hills, valleys, and draws. The sites are moderately sloped to steep (4- to 28-degree slopes), occur between 2422 and 2661 m in elevation, and are oriented to all aspects. The ground surface has sparse to moderate exposure of bare soil, moderate to high cover of litter, sparse cover of small and large rocks, and low cover of downed wood. Litter depths range from 0-3.0 cm. Soils are rapidly drained loams, silty loams, and silty clay loams derived from the Kaiparowitz Formation, Claron Formation (Pink Member).

*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 alluvially deposited materials. The pH is neutral to slightly alkaline. Youngblood and Mauk (1985) suggest a preference by these forests for non-igneous parent materials. These communities often occupy sites that are protected from extreme sun and wind, within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. These forests are typically most common on north-facing slopes, which can be gentle to steep. Adjacent vegetation is usually *Pinus ponderosa - Pseudotsuga menziesii* forests at the upslope margin and herbaceous or woody riparian communities where this vegetation grades into streamside wetlands. One stand in northwestern Wyoming is surrounded by *Artemisia tridentata* on all sides.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (28-79% cover) and is characterized by *Picea pungens* trees that range in height from 10-25 m, have dbh ranging from 14-46 cm, and provide 10-24% cover, and the short shrub *Juniperus communis* that provides 1-28% cover. Additional canopy trees provide low to moderate cover and include *Pseudotsuga menziesii, Pinus ponderosa, Abies concolor*, and *Populus tremuloides*. The subcanopy layer ranges from 5-10 m in height, provides low cover, and includes *Pseudotsuga menziesii, Pinus ponderosa, Abies concolor*, and *Populus tremuloides*. The remaining short and dwarf-shrubs are low in terms of species composition, provide sparse to low cover, and include *Arctostaphylos patula, Symphoricarpos oreophilus, Ribes cereum*, and *Mahonia repens*. The herbaceous layer is floristically diverse and contributes sparse cover, with no species providing 1% or higher cover, including *Bromus inermis, Carex rossii, Elymus elymoides*, and *Poa fendleriana*. *Picea pungens, Pseudotsuga menziesii, Pinus ponderosa, Abies concolor*, and *Populus tremuloides* saplings up to 2 m tall contribute sparse to low 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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Picea pungens*, *Pseudotsuga menziesii* |
| Short shrub/sapling | *Juniperus communis* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Picea pungens* |
| Shrub/sapling (tall & short) | *Juniperus communis* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Heavy fuel loading; site is influenced by moisture from the nearby bottom of the draw; no sign of fire in this area; terraced valley slope, grasses were artificially seeded as part of a 1960s erosion control project.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (6 plots: BRCA.0179, BRCA.0263, BRCA.0265, BRCA.0273, BRCA.0274, BRCA.0383; and 1 observation point: BRCA.9052); and 2007 Accuracy Assessment (12 points: BRCA_AA.0936, BRCA_AA.0937, BRCA_AA.0945, BRCA_AA.0962, BRCA_AA.0981, BRCA_AA.1112, BRCA_AA.1125, BRCA_AA.1143, BRCA_AA.1156, BRCA_AA.1160, BRCA_AA.1164, BRCA_AA.1215).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*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

## *Pseudotsuga menziesii / Quercus gambelii* Forest

## Douglas-fir / Gambel Oak Forest

| | |
|---|---|
| CODE | CEGL000452 |
| 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)<br>Douglas-fir Forest Alliance |

**ECOLOGICAL SYSTEM(S):** 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)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This forest association occurs on mountains and plateaus from Colorado to Trans-Pecos Texas, west into New Mexico, Arizona and Utah. Elevation ranges from 1229 to 2870 m (4030-9400 feet). Stands are found along drainages, lower and middle slopes, steep upper slopes and gentle to rolling tops of mesas and ridges. Aspects are variable. This forest occurs as both a non-obligate riparian community on the outer margins of riparian areas in desert canyons and steep draws, and as an upland forest forming extensive stands on typically north-facing hillslopes (southern aspects at higher elevations). Soils vary but are often shallow and rocky, ranging from sand to clay, often derived from sandstone. The vegetation is characterized by a relatively sparse to dense evergreen tree canopy dominated by *Pseudotsuga menziesii*, sometimes with *Quercus gambelii* well-represented in the understory. Scattered large *Pinus ponderosa, Pinus strobiformis, Pinus flexilis, Pinus edulis*, or *Juniperus* spp. (especially on drier sites) may be present in the tree canopy or subcanopy. *Abies concolor* is typically not present. *Quercus gambelii* dominates both the subcanopy (tree form, if present) and the moderately dense tall-shrub layer that consists of dense clumps of oak. *Quercus gambelii* must have at least 5% cover, but there is frequently well over 25%. At higher elevations, *Quercus gambelii* are more treelike and *Symphoricarpos oreophilus* will be present with significant cover in the short-shrub layer. At lower elevations, scattered *Pinus edulis, Juniperus osteosperma*, or *Juniperus deppeana* are often present. The presence of *Chrysothamnus depressus* in some stands reflects the presence of fairly well-developed soils. The herbaceous layer is generally sparse and composed of mostly graminoids with scattered forbs, but it can be moderately dense and diverse. Many other species are associated, such as *Amelanchier* spp., *Holodiscus dumosus, Fendlera rupicola, Fraxinus anomala, Mahonia repens, Paxistima myrsinites, Quercus X pauciloba, Robinia neomexicana, Rosa woodsii, Carex* spp., *Festuca arizonica, Koeleria macrantha, Muhlenbergia virescens, Poa fendleriana, Lathyrus lanszwertii var. leucanthus, Thalictrum fendleri*, and *Vicia americana*. The shrub layer has equal or greater cover than graminoids.

**DISTRIBUTION**

*Bryce Canyon National Park*

This forest is uncommon, occurs on slopes and canyon bottoms, and was sampled at Yellow Creek and at The Promontory.

*Globally*

This *Pseudotsuga menziesii* forest association occurs in the southern Rocky Mountains and southwestern U.S. and is found on foothills, mountains and plateaus from Colorado to Trans-Pecos Texas, west to Arizona and Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This forest occurs on a hillslope and in a canyon bottom. Sites are gentle to steep (2- to 24-degree slopes), occur between 2082 and 2502 m in elevation, and are oriented to the east. The ground surface has high cover of litter and duff, low to moderate cover of rocks, sparse to low cover of downed wood, and low exposure of bare soil. One stand

has low exposure of bedrock. Soils are moderately well-drained to rapidly drained and are derived from New Alluvium and the Claron Formation (Pink Member).

*Globally*
This forest association occurs on mountains and plateaus at elevations ranging from 1229 to 2870 m (4030-9400 feet). Stands are found along drainages, gentle to moderate lower and middle slopes, steep upper slopes and gentle to rolling tops of mesas and ridges. Aspects are variable. This forest occurs as both a non-obligate riparian community on the outer margins of riparian areas in desert canyons and steep draws, and as an upland forest forming extensive stands on typically north-facing hillslopes, canyon sideslopes and mesa escarpments (southern aspects at higher elevations). Soils vary but are often shallow and rocky, ranging from sand to clay, often derived from sandstone. The surface is generally largely covered with a thin layer of litter. Parent materials are variable and include recent alluvium, fractured limestone, sandstone, metamorphic/granitic rocks, basalt, andesite, volcanic tuff, eroded Claron Formation (Pink Member), and even slickrock. Occasionally, talus to large blocks of rock and bedrock dominate the surface of sites on colluvial slopes / landslide deposits.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (48-85% cover) and is characterized by the canopy tree *Pseudotsuga menziesii* that ranges in height from 10-20 m and provides 7-43% cover, and the tall shrub *Quercus gambelii* that provides 14-18% cover. *Pinus ponderosa* canopy trees provide 6-7% cover with low cover provided by *Pinus flexilis* and *Juniperus osteosperma* in the canopy layer of one stand. The subcanopy layer provides sparse to low cover (up to 12%) and includes 2- to 5-m tall *Pseudotsuga menziesii, Abies concolor, Pinus ponderosa, Pinus edulis, Pinus flexilis*, and *Juniperus osteosperma* trees. The tall shrub *Cercocarpus montanus* provides sparse cover in one stand. Short- and dwarf-shrub species are low in terms of floristic diversity, provide sparse cover, and include *Arctostaphylos patula, Purshia tridentata, Ceanothus martinii, Rosa woodsii, Symphoricarpos oreophilus*, and *Mahonia repens*. The herbaceous layer is undocumented in the observation point sampled.

*Globally*
This forest is characterized by a relatively sparse to moderately dense evergreen tree canopy dominated by *Pseudotsuga menziesii*, with *Quercus gambelii* well-represented in the understory. Scattered large *Pinus ponderosa, Pinus strobiformis, Pinus flexilis, Pinus edulis*, or *Juniperus* spp. (especially on drier sites) may be present in the tree canopy or subcanopy. *Abies concolor* is typically not present. *Quercus gambelii* typically dominates both the subcanopy (tree form, if present) and the open to moderately dense tall-shrub layer that often consists of dense clumps of oak. *Quercus gambelii* must have at least 5% cover, but there is frequently well over 25%. At higher elevations, *Quercus gambelii* are more treelike, and *Symphoricarpos oreophilus* will be present with significant cover in the short-shrub layer. At lower elevations, scattered *Pinus edulis, Juniperus osteosperma*, or *Juniperus deppeana* are often present. The presence of *Chrysothamnus depressus* in some stands reflects the presence of fairly well-developed soils. Other common shrub species, depending on geographic location, may include *Acer glabrum, Arctostaphylos patula, Amelanchier* spp., *Brickellia longifolia, Cercocarpus montanus, Fendlera rupicola, Fraxinus anomala, Holodiscus dumosus, Mahonia repens, Paxistima myrsinites, Prunus virginiana, Purshia tridentata, Quercus X pauciloba, Rhus trilobata, Ribes cereum, Robinia neomexicana, Rosa woodsii, Shepherdia rotundifolia*, and *Yucca* spp. The generally sparse herbaceous layer is composed of mostly graminoids with scattered forbs but ranges to moderately dense and diverse. Species vary greatly by site characteristics and location. Associated graminoids may include *Achnatherum hymenoides, Bromus* spp., *Carex geyeri, Carex rossii, Elymus elymoides, Festuca arizonica, Koeleria macrantha, Muhlenbergia montana, Muhlenbergia virescens, Piptatherum micranthum*, and *Poa fendleriana*. Common forbs include *Achillea millefolium var. occidentalis, Cryptantha* sp., *Galium coloradoense, Gilia stenothyrsa, Lathyrus lanszwertii var. leucanthus, Lepidium montanum, Machaeranthera grindelioides, Maianthemum stellatum, Packera multilobata, Packera neomexicana, Physaria acutifolia, Thalictrum fendleri, Solidago* spp., and *Vicia americana*. The shrub layer generally has equal or greater cover than graminoids. Post-burn stands may have relatively low cover of *Quercus gambelii* temporarily, as these shrubs resprout and grow. This open conifer forest transitions to *Quercus gambelii* woodlands in drier sites and at lower elevations.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pseudotsuga menziesii* |

| | |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus osteosperma*, *Pinus edulis* |
| Tall shrub/sapling | *Quercus gambelii* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |
| Short shrub/sapling | *Arctostaphylos patula*, *Purshia tridentata* |
| Herb (field) | *Mahonia repens* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa*, *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Gilia stenothyrsa* (globally imperiled, G3)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This is a broadly defined association characterized by dominance or codominance of two widespread species, *Pseudotsuga menziesii* and *Quercus gambelii*. Within the literature on habitat type, there are four phases mentioned: *Festuca arizonica* phase, *Holodiscus dumosus* phase, *Muhlenbergia virescens* phase (all defined by having at least 5% cover of both *Quercus gambelii* and the nominal species), and *Quercus gambelii* (typic) phase by a undeveloped herbaceous layer (Alexander et al. 1984b, DeVelice et al. 1986, Alexander et al. 1987, Fitzhugh et al. 1987, Johnston 1987, Larson and Moir 1987, Muldavin et al. 1996, Stuever and Hayden 1997b). There are three similar *Pseudotsuga menziesii* associations in the USNVC that use these phase species as nominal species. These phases represent "intermediate" vegetation. Review of these associations is needed to clarify relationships among associations and possibly subdivide this broadly defined association into types based on herbaceous layer and habitat.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Many dead Douglas-fir trees possibly due to mistletoe parasitism, Gambel oak shrubs are low-growing; Gambel oak occupies the low slope above a high floodplain terrace.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 observation points: BRCA.9013, BRCA.9266) and 2007 Accuracy Assessment (3 points: BRCA_AA.0788, BRCA_AA.0918, BRCA_AA.1221).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Drake

**REFERENCES:** Alexander et al. 1984b, Alexander et al. 1987, Bader 1932, Blackhawk Coal Company 1981, Bourgeron and Engelking 1994, Bourgeron et al. 1993b, Bourgeron et al. 1995, CONHP unpubl. data 2003, Cogan et al. 2004, DeVelice et al. 1986, Diamond 1993, Fitzhugh et al. 1987, Freeman and Dick-Peddie 1970, Hansen et al. 2004d, Hess and Wasser 1982, Johnston 1987, Keammerer 1974b, Kittel et al. 1994, Kittel et al. 1999b, Komarkova et al. 1988a, Komarkova et al. 1988b, Larson and Moir 1987, Muldavin et al. 1996, Salas et al. 2010, Stuever and Hayden 1997b, Tiedemann and Terwilliger 1978, Western Ecology Working Group n.d., Youngblood and Mauk 1985

## *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest

## Douglas-fir / Mountain Snowberry Forest

| | |
|---|---|
| CODE | CEGL000462 |
| 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)<br>Douglas-fir Forest Alliance |

**ECOLOGICAL SYSTEM(S):** Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (CES306.959)
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This widespread forest association occurs in foothills, mountains and plateaus from southwestern Montana through Wyoming and Colorado to Trans-Pecos Texas, west to Arizona, Utah, and into eastern Oregon and Washington. Elevation ranges from 700-2900 m (2310-9500 feet). This broadly defined forest association occurs as both a non-obligate riparian community and as an upland community. In more arid regions stands occur along drainages along narrow riparian areas in ravines, canyons, and up steep draws. It continues upland on steep north-facing slopes in narrow canyons where dense shade and steepness preclude any significant shrub or herbaceous understory. Elsewhere at more northern latitudes, it occurs near lower treeline on warm, dry southern aspects with moderate to very steep mid- and upper slopes and ridges. Soils are variable and range from deep silt loam to shallow, rocky substrates. Most stands have abundant litter on the ground, and some have high rock cover. The vegetation is characterized by a relatively sparse to dense evergreen tree canopy dominated by *Pseudotsuga menziesii*, sometimes with scattered large *Pinus ponderosa, Pinus flexilis, Populus tremuloides, Juniperus scopulorum*, or *Juniperus occidentalis*, especially on drier sites. *Abies concolor* is typically not present. *Symphoricarpos oreophilus* dominates the sparse to moderately dense short-shrub layer. Shrub associates vary depending on range and habitat and may include *Acer glabrum, Amelanchier* spp., *Artemisia tridentata ssp. vaseyana, Cercocarpus montanus, Holodiscus dumosus, Juniperus communis, Mahonia repens, Paxistima myrsinites, Prunus virginiana, Quercus gambelii, Ribes cereum, Ribes inerme, Rosa woodsii*, or *Shepherdia canadensis*. The generally sparse herbaceous layer is composed of mostly graminoids with scattered forbs.

**DISTRIBUTION**

*Bryce Canyon National Park*

This forest is uncommon, occurs in narrow ravines and in valleys, and was sampled at Riggs Spring and southwest of Fairyland Point.

*Globally*

This widespread montane forest association occurs in foothills, mountains and plateaus from southwestern Montana through Wyoming and Colorado to Trans-Pecos Texas, west to Arizona, Utah, and into eastern Oregon and Washington.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This forest occurs on the sideslope of a small ravine and in a valley. Sites are gentle to moderate (4- to 13-degree slopes), occur between 2297 and 2435 m in elevation, and are oriented to the east and west. The ground surface has high cover of litter and duff, low cover of rocks, sparse to low cover of downed wood, and low exposure of bare soil. Moss provides sparse cover in one stand. Litter depths range from 0-1.2 cm. Soils are rapidly drained sandy clays derived from the Boat Mesa Conglomerate.

*Globally*
This widespread Douglas-fir forest occurs in foothills, mountains and plateaus from southwestern Montana through Wyoming and Colorado to Trans-Pecos Texas, west to Arizona, Utah, and into eastern Oregon and Washington. Elevation ranges from 700-2900 m (2310-9500 feet). This broadly defined forest association occurs as both a non-obligate riparian community and as an upland community. In more arid regions stands occur along drainages along narrow riparian areas in ravines, canyons, and up steep draws. It continues upland on steep north-facing slopes in narrow canyons where dense shade and steepness preclude any significant shrub or herbaceous understory. Elsewhere at more northern latitudes, it occurs near lower treeline on warm, dry southern aspects on moderate to very steep mid- and upper slopes and ridges. Soils are variable and range from deep loamy sands, silt loams, silty clay loams, sandy clay loams and peat to shallow, rocky substrates. Parent materials are also variable and may include colluvium or residuum derived from calcareous shale, sandstone, granite, limestone, rhyolite and basalt. Most stands have abundant litter on the ground, and some have high rock cover.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (52-63% cover) and is characterized by the canopy tree *Pseudotsuga menziesii* that ranges in height from 10-20 m, has dbh ranging from 12-35 cm, and provides 12-26% cover, and the short shrub *Symphoricarpos oreophilus* that provides 8-14% cover. *Pinus ponderosa* canopy trees provide 5-8% cover. The subcanopy layer provides low cover (up to 12%) and includes 2- to 5-m tall *Pseudotsuga menziesii, Pinus ponderosa*, and *Juniperus scopulorum* trees. The tall shrub *Quercus gambelii* provides sparse cover in one stand. Other short- and dwarf-shrub species are low in terms of floristic diversity, provide sparse cover, and include *Arctostaphylos patula, Purshia tridentata, Ceanothus martinii*, and *Chrysothamnus depressus*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover. The medium-tall bunchgrass *Leymus salinus* provides low cover. The forb layer is floristically diverse, with no species present with greater than 1% cover, and includes *Senecio spartioides* and *Cirsium calcareum*.

*Globally*
This forest is characterized by a relatively sparse to dense evergreen tree canopy dominated by *Pseudotsuga menziesii*, sometimes with scattered large *Pinus ponderosa, Pinus flexilis, Populus tremuloides, Juniperus scopulorum*, or *Juniperus occidentalis* in canopy or subcanopy, especially on drier sites. *Abies concolor* is typically not present. *Symphoricarpos oreophilus* is present and usually dominates the sparse to moderately dense short-shrub layer. Shrub associates vary depending on location and habitat and may include sparse cover of *Acer glabrum, Amelanchier* spp., *Artemisia tridentata ssp. vaseyana, Cercocarpus montanus, Holodiscus dumosus, Juniperus communis, Mahonia repens, Paxistima myrsinites, Prunus virginiana, Quercus gambelii, Ribes cereum, Ribes inerme, Rosa woodsii*, or *Shepherdia canadensis*. The generally sparse herbaceous layer is composed of mostly graminoids with scattered forbs. Associated graminoids may include *Bromus* spp., *Carex geyeri, Carex rossii, Elymus lanceolatus, Festuca idahoensis, Leucopoa kingii, Leymus cinereus, Koeleria macrantha*, and *Poa fendleriana, Poa secunda*. Common forbs include *Achillea millefolium, Arnica cordifolia, Artemisia frigida, Balsamorhiza sagittata, Thalictrum fendleri*, and *Vicia americana*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pinus ponderosa*, *Pseudotsuga menziesii* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pseudotsuga menziesii* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Douglas-fir forest. Dense forest cover, high litter cover.

*Globally*
This is a broadly defined *Pseudotsuga menziesii* association which includes a variety of stands from different environments that are tied together by a common widespread species, *Symphoricarpos oreophilus*.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Sideslope of this small ravine; both *Pinus ponderosa* and *Pseudotsuga menziesii* are regenerating, mostly saplings and a few seedlings; fire evidence noted due to charring of tree bases, area burned within the last 4 years.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (1 plot: BRCA.0091; and 1 observation point: BRCA.9254) and 2007 Accuracy Assessment (1 point: BRCA_AA.1068).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Drake, J. Coles, K.A. Schulz

**REFERENCES:** Arno 1980, Bell et al. 2009, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, Day and Wright 1985, Diamond 1993, Fischer and Bradley 1987, Hess and Wasser 1982, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1987, Jones and Ogle 2000, Kagan et al. 2000, Kittel et al. 1994, Kittel et al. 1999b, Komarkova et al. 1988b, Lillybridge et al. 1995, MTNHP 2002b, Mauk and Henderson 1984, Muldavin et al. 1996, Pfister et al. 1977, Reed 1976, Steele et al. 1981, Steele et al. 1983, Western Ecology Working Group n.d., Williams and Lillybridge 1983, Williams and Lillybridge 1985, Williams et al. 1990b, Wright et al. 1979, Youngblood and Mauk 1985

## *Acer grandidentatum / Quercus gambelii* Forest

## Bigtooth Maple / Gambel Oak Forest

| | |
|---|---|
| CODE | CEGL000559 |
| 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 | *ACER GRANDIDENTATUM* MONTANE FOREST ALLIANCE (A.265)<br>Bigtooth Maple Montane Forest Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This forest association has been reported from mountains and plateaus of Utah. Elevations range from 1220-2620 m. Sites include moderate to steep, middle and lower slopes with cool northern or eastern aspects, intermittently flooded canyon bottoms, alluvial benches, and shaded colluvial slopes. *Acer grandidentatum* and *Quercus gambelii* codominate the tree canopy. The understory is variable and may be dominated by tall or short shrubs. Species include *Prunus virginiana, Rosa woodsii, Symphoricarpos oreophilus, Physocarpus malvaceus, Mahonia repens*, and seedling trees. The herbaceous layer is generally sparse because of heavy shading. Stands transition to *Quercus gambelii* woodland in the drier uplands.

**DISTRIBUTION**
*Bryce Canyon National Park*
This association was observed at only 1 location during accuracy assessment, and therefore no descriptive information is available at this time.

*Globally*
This forest association is documented from the Wasatch and Uinta ranges in northeastern Utah and the Markagunt Plateau in southwestern Utah.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This forest association occurs in the mountains and plateaus of Utah. Elevations range from 1220-2620 m. Sites include moderate to steep, middle and lower slopes with cool northern or eastern aspects, intermittently flooded canyon bottoms, alluvial benches, and shaded colluvial slopes. These forests typically occur on these relatively mesic sites, especially at lower latitudes and elevations. However, stands have been reported on dry, open slopes in the northern part of its range in the Wasatch Mountains where fire suppression may be allowing oak-dominated stands to succeed to mixed maple-oak. Substrates are generally calcareous and rocky with soil textures ranging from sand to clay loam.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This association is characterized by a moderately dense to dense tree canopy of *Acer grandidentatum* that is typically codominated by *Quercus gambelii* with 10-50% cover. *Celtis laevigata var. reticulata, Juniperus scopulorum*, or *Juniperus osteosperma* may also be present to abundant. *Pseudotsuga menziesii* and *Abies concolor* trees may be scattered throughout the stand. The shrub layer is variable, depending on the stand age, elevation and habitat. It ranges from dense *Quercus gambelii*-dominated tall-shrub stratum to a mixed short-shrub layer that includes *Symphoricarpos oreophilus, Prunus virginiana, Amelanchier utahensis, Mahonia repens, Physocarpus malvaceus, Paxistima myrsinites, Acer glabrum, Holodiscus dumosus, Jamesia americana*, and *Rosa woodsii*. The herbaceous layer is generally sparse because of shading. Associates include graminoids such as *Achnatherum hymenoides, Carex hoodii, Elymus glaucus, Poa fendleriana*, and *Pseudoroegneria spicata*, and forbs *Galium multiflorum, Heterotheca villosa, Heuchera parviflora, Thalictrum fendleri, Vicia americana*, and species of *Lathyrus, Osmorhiza, Eriogonum*, and *Polygonum*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus scopulorum* |
| Tree canopy | *Acer grandidentatum*, *Quercus gambelii* |
| Tall shrub/sapling | *Acer grandidentatum*, *Quercus gambelii* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |
| Herb (field) | *Poa fendleriana* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus diandrus* (exotic), *Bromus tectorum* (exotic, High), *Poa pratensis* (exotic, Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
*Acer grandidentatum* and *Quercus gambelii* both are widespread western species and occur in the understory of several conifer-dominated associations. There are several similar forest associations that are dominated by *Acer grandidentatum* with one of several oak species codominant or in the understory. Both *Acer grandidentatum* and *Quercus gambelii* have shrub and tree forms which complicate the vegetation classification of this mixed type. This association is typically late seral with some large single- or few-stemmed maples and oaks that are over 5 m tall.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.1227).
*Local Description Authors:*
*Global Description Authors:* K.A. Schulz

**REFERENCES:** Allman 1952, Bourgeron and Engelking 1994, Christensen 1955, Cogan et al. 2004, Driscoll et al. 1984, FEIS 2001, Harper et al. 1985, Kunzler et al. 1981, Ream 1960, Ream 1964, Western Ecology Working Group n.d.

## *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)<br>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**

*Bryce Canyon National Park*

This forest is uncommon, occurs on mesic sheltered sites, and was sampled below Whiteman Bench, north of Puma Hollow, and in Oak Hollow within the park and in Oak Hollow in the environs.

*Globally*

This association is known from the mountains and high plateaus of Utah, Colorado, Wyoming and Montana.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This forest occurs on the low slopes of hills, valleys, and canyons and on a bench. The sites are gentle to moderately sloped (3- to 17-degree slopes), occur between 2467 and 2557 m in elevation, and are oriented to all aspects. The ground surface has sparse to low exposure of bare soil, moderate to high cover of litter, and sparse to moderate cover of downed wood. Litter depths range from 0-3.0 cm. Soils are rapidly drained loams, silt loams, and silty clay loams.

*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**

*Bryce Canyon National Park*

Total vegetation cover is dense (59-63% cover) and is characterized by the canopy tree *Populus tremuloides* that ranges in height from 10-30 m, has dbh ranging from 16-46 cm, and provides 8-45% cover in the canopy and subcanopy, and the short shrub *Juniperus communis* that provides 9-27% cover. In one stand, emergent *Pinus ponderosa* trees provide low cover (7%) and attain heights between 15 and 20 m. Additional canopy trees include *Picea pungens, Pseudotsuga menziesii*, and *Pinus ponderosa*, whose cover may exceed that of *Populus tremuloides*. The subcanopy layer is consistently present, attains 5-10 m in height, and provides sparse to low cover of *Juniperus scopulorum, Pseudotsuga menziesii, Pinus ponderosa*, and *Abies concolor*. Other shrubs present include *Arctostaphylos patula, Symphoricarpos oreophilus, Paxistima myrsinites*, 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 native bunchgrass *Poa fendleriana*. Common forbs include *Geranium richardsonii, Achillea millefolium*, and *Taraxacum officinale*. *Populus tremuloides* and *Pseudotsuga menziesii* saplings provide sparse cover.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Picea pungens*, *Pseudotsuga menziesii* |
| Tree canopy | *Populus tremuloides* |
| Short shrub/sapling | *Juniperus communis* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus tremuloides* |
| Shrub/sapling (tall & short) | *Juniperus communis* |
| Herb (field) | *Achillea millefolium*, *Thalictrum fendleri* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*
**Exotic/Invasive**: *Bromus inermis* (invasive, High/Medium), *Poa pratensis* (invasive, Medium), *Taraxacum officinale* (exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Mixed evergreen-aspen and aspen forests. Conifers present represent <25% of the quaking aspen cover.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Mature *Populus tremuloides* stand with some *Populus tremuloides* regeneration; *Picea pungens* and *Abies concolor* regeneration; deep litter layer and heavy fuel loading; stand is north-facing and thickly forested, signs of historic logging.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (3 plots: BRCA.0082, BRCA.0099, BRCA.0172; and 1 observation point: BRCA.9048) and 2007 Accuracy Assessment (4 points: BRCA_AA.0352, BRCA_AA.0889. BRCA_AA.1026. BRCA_AA.1062).
*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 / Symphoricarpos oreophilus* Forest

## Quaking Aspen / Mountain Snowberry Forest

| | |
|---|---|
| CODE | CEGL000610 |
| 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)<br>Quaking Aspen Forest Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Aspen Forest and Woodland (CES306.813)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This deciduous forest association is widespread in the Rocky Mountains and found in mountains of the interior western U.S. Stands occur at montane and subalpine elevations of 2010 to 2960 m (6600-9700 feet) on a variety of intermediately mesic sites, including lower slopes and benches, draws, sheltered slopes, and high benches that range from flat to steep slopes of any aspect. Northern to eastern aspects are common in the drier and warmer environments such as the southern portions of its range. Soils are generally well-developed, well-drained loams or sandy loams. Vegetation is characterized by a moderately dense to dense tree canopy of *Populus tremuloides* with a short-shrub layer that is dominated by *Symphoricarpos oreophilus*. Occasional conifer trees are possible in the stand but do not make up more than 25% of the tree canopy.

**DISTRIBUTION**

*Bryce Canyon National Park*

This forest was sampled once in a mesic draw at Riggs Spring, and at two Accuracy Assessment points.

*Globally*

This aspen forest association occurs throughout the Rocky Mountain region and in mountains in the interior western U.S. and possibly Trans-Pecos Texas.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This forest occurs in a draw. The site is flat and occurs at 2331 m in elevation. The ground surface has low exposure of bare soil and high cover of litter. Soils are deep and poorly drained.

*Globally*

This deciduous forest association is widespread in the Rocky Mountains and found in mountains of the interior western U.S. Stands occur at montane and subalpine elevations of 2010-2960 m (6600-9700 feet) on a variety of intermediately mesic sites, including lower slopes and benches, draws, sheltered slopes, and high plateaus that range from flat to steep slopes of any aspect. Northern to eastern aspects are common in the drier and warmer environments such as the southern portions of its range. Soils are generally deep and well-developed, well-drained loams or sandy loams.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (76% cover) and is characterized by the canopy and subcanopy trees of *Populus tremuloides* that range in height from 5-15 m and together provide 20% cover, and the short shrub *Symphoricarpos oreophilus* that provides 20% cover. The subcanopy layer also provides sparse to low cover of *Acer grandidentatum* and *Juniperus scopulorum*. The tall-shrub *Quercus gambelii* provides sparse cover. The herbaceous layer includes the non-native *Poa pratensis* that provides 16% cover. *Populus tremuloides* saplings provide sparse cover.

*Globally*

This association is characterized by a moderately dense to dense tree canopy of *Populus tremuloides* with a short-shrub layer that is dominated by *Symphoricarpos oreophilus* (usually >10% cover). Associated shrubs with lesser

cover include *Rosa woodsii, Mahonia repens, Amelanchier utahensis, Prunus virginiana, Paxistima myrsinites*, and *Amelanchier alnifolia*. The generally sparse herbaceous layer is composed primarily of graminoid species such as *Carex geyeri, Achnatherum lettermanii, Poa fendleriana, Elymus glaucus*, and *Festuca thurberi*. Associated herbaceous species include *Achillea millefolium, Thalictrum fendleri, Geranium richardsonii, Geranium caespitosum, Lupinus argenteus, Osmorhiza* spp., and *Fragaria virginiana*. Occasional conifer trees are possible in the stand, including *Juniperus scopulorum, Picea pungens*, and *Pseudotsuga menziesii*, but do not make up more than 25% of the tree canopy. Total vegetation cover is often in excess of 100%, although the tree canopy may only have 20% closure.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus tremuloides* |
| Tree subcanopy | *Juniperus scopulorum* |
| Tree subcanopy | *Acer grandidentatum* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus tremuloides* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium)

*Globally*
**Exotic/Invasive**: *Poa pratensis* (Introduced perennial cool-season grass common in many mesic environments., Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Apr-1999).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
There are many similar associations. This *Populus tremuloides* forest association is based in part on community types and habitat types that were more broadly defined and may include several of the more narrowly defined USNVC associations based on Mueggler (1988) community types. Generally, this aspen association is characterized by having a shrub layer dominated by *Symphoricarpos oreophilus* (usually >20% cover) without *Quercus gambelii* or *Amelanchier alnifolia* codominating (<5% cover). The understory is often sparse, but if not sparse will not have more than 10% cover of any of the following species: *Bromus carinatus, Calamagrostis rubescens, Carex rossii, Festuca thurberi, Thalictrum fendleri, Wyethia amplexicaulis*, or tall forbs including *Agastache urticifolia, Eucephalus engelmannii, Hackelia floribunda, Mertensia arizonica, Osmorhiza occidentalis, Senecio serra*, and *Valeriana occidentalis*.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand occurs on level site with deep soil, understory cover is continuous through stand.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 observation point: BRCA.9256 2007) and 2007 Accuracy Assessment (2 points: BRCA_AA.1199, BRCA_AA.1203).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Coles

**REFERENCES:** Baker 1982b, Bourgeron and Engelking 1994, Boyce 1977, CONHP Ecology Team 2001, Day and Wright 1985, Dorn 1969, Driscoll et al. 1984, Ferchau 1973, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnston 1987, Johnston and Hendzel 1985, Jones and Ogle 2000, Kagan et al. 2000, Keammerer and Peterson 1981, Keammerer and Stoecker 1975, Keammerer and Stoecker 1980, Komarkova et al. 1988a, Kovalchik 1987, Lewis 1975a, MTNHP 2002b, Mueggler 1988, Reed 1971, Titus et al. 1998, Western Ecology Working Group n.d., Youngblood and Mueggler 1981

## *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 | *POPULUS TREMULOIDES - PSEUDOTSUGA MENZIESII* FOREST ALLIANCE (A.426)<br>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**

*Bryce Canyon National Park*

This forest has limited distribution and was sampled only once, south of Puma Hollow.

*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**

*Bryce Canyon National Park*

This forest occurs on a valley slope. The site is steep (22-degree slope), occurs at 2527 m in elevation, and is oriented to the northwest. The ground surface has sparse exposure of bare soil, high cover of litter, and moderate cover of downed wood. Litter depths range from 0-5.6 cm. Soils are rapidly drained loams.

*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**
*Bryce Canyon National Park*
Total vegetation cover is dense (69% cover) and is characterized by the canopy trees *Populus tremuloides* and *Pseudotsuga menziesii* that range in height from 10-15 m, have dbh ranging from 16-32 cm and 19-39 cm, respectively, and provides 11% and 20% cover, respectively, and the short shrub *Juniperus communis* that provides 16% cover. The remaining canopy trees *Picea pungens* and *Pinus ponderosa* provide low cover (11%). The tall shrub *Amelanchier utahensis* provides sparse cover. The remaining short- and dwarf-shrub species are low in floristic diversity, provide sparse cover, and include *Symphoricarpos oreophilus, Rosa woodsii, Ribes cereum, Paxistima myrsinites*, and *Mahonia repens*. The herbaceous layer is floristically diverse and contributes sparse cover. Graminoids include *Carex rossii, Bromus ciliatus, Elymus elymoides*, and *Hesperostipa comata*. Forbs include *Geranium richardsonii, Achillea millefolium*, and *Vicia americana*. Tree saplings provide sparse cover and include *Populus tremuloides, Pseudotsuga menziesii, Abies concolor, Picea pungens, Pinus ponderosa*, and *Juniperus scopulorum*. Species of moss provide sparse cover (up to 1%).

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Picea pungens*, *Pseudotsuga menziesii* |
| Tree canopy | *Populus tremuloides* |
| Short shrub/sapling | *Juniperus communis* |

*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**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Douglas-fir forests.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Much of the mature *Populus tremuloides* is dead with significant *Populus tremuloides* regeneration; conifer regeneration; there is no indication of past fires, deep litter layer and heavy fuel loading; stand is north-facing and thickly forested, signs of historic logging.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0173).
*Local Description Authors:* M. Smith and J. Von Loh
*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.

## *Pinus edulis - Juniperus osteosperma / Arctostaphylos patula* Woodland

## Two-needle Pinyon - Utah Juniper / Greenleaf Manzanita Woodland

| | |
|---|---|
| CODE | CEGL002939 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This association is found on the Colorado Plateau of southern Utah on flat to gently sloping sites between 1707 and 2103 m (5600-6900 feet) elevation. Slope aspects tend toward western and southern, and parent materials are typically sandstone, although shale is possible. Soils are loamy sands, sandy loams, and clay loams and are rapidly drained. The unvegetated surface has moderate cover of bare soil and varying cover of cryptogams, litter, and small and large rocks. This woodland association has a short (2-10 m), open tree canopy (10-30% cover). *Pinus edulis* and *Juniperus osteosperma* are the most abundant tree species, each of which typically has from 5-25% cover. The shrub layer has moderate cover (5-30%) and can be fairly diverse. *Arctostaphylos patula* dominates the shrub layer with 5-30% cover. Other common shrubs include *Amelanchier utahensis, Cercocarpus intricatus, Eriogonum microthecum, Opuntia* spp., *Quercus gambelii*, and *Shepherdia rotundifolia*. The herbaceous layer has sparse to low cover and low to moderate species diversity. It may contain the graminoids *Achnatherum hymenoides, Muhlenbergia pungens*, and *Poa fendleriana* and the forbs *Comandra umbellata, Penstemon eatonii*, and *Lepidium montanum*.

**DISTRIBUTION**

*Bryce Canyon National Park*
This woodland is common and occurs on intermediate slopes in the lower elevations of the park, and was sampled near Hat Shop, southwest of Boat Mesa, south of Yellow Spring, in Pasture Canyon, and in the northeast fork of Upper Pasture Wash. Accuracy Assessment points were located above Merrill Hollow, above Swamp Canyon-upper, above the Hat Shop, Agua Canyon, Bryce Canyon, Bulldog Hollow, Campbell Canyon, east of Black Birch Canyon, Fairyland, Fairyland Trail area, Mutton Hollow, Noon Canyon Headwaters, Pasture Wash, Rim Trail / Yellow Creek, Swamp Canyon, Tropic Canyon, Upper Sheep Creek and the Water-Tropic Canyons area.

*Globally*
This association occurs in southern Utah.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This common woodland occurs on breaks, ridges, valleysides, and canyons. The sites are moderate to steep (6- to 33-degree slopes), occur between 2106 and 2448 m in elevation, and are oriented to the east or south. The ground surface has sparse to moderate exposure of bare soil, no to moderate cover of litter, sparse to low cover of large rocks, and moderate to high cover of small rocks. There is sparse cover of downed wood with one stand having high cover. Litter depths range from 0-1.4 cm. Soils are rapidly drained silty clay loams, sandy loams, and sandy clays that are derived from the Claron Formation (Pink Member) and colluvium.

*Globally*
This association occurs on flat to gently sloping sites between 1707 and 2103 m elevation. Slope aspects tend toward western and southern. Parent materials are typically sandstone, although some sites are on shale. Soils are loamy sands, sandy loams, and clay loams and are rapidly drained. The unvegetated surface has moderate cover of bare soil and varying cover of cryptogams, litter, and small and large rocks.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (15-47% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-10 m, have dbh ranging from 12-24 cm, and provide 2-11% and 3-12% cover, respectively, and the short shrub *Arctostaphylos patula* that provides 2-28% cover. Emergent *Pinus ponderosa* trees provide sparse cover and attain heights between 10 and 15 m. Other trees present include *Cercocarpus ledifolius, Juniperus scopulorum, Abies concolor, Picea pungens*, and *Pseudotsuga menziesii*. Other shrubs present include *Cercocarpus montanus, Ceanothus martinii, Mahonia fremontii, Quercus gambelii*, and *Tetradymia canescens* with low to sparse cover. The herbaceous layer is floristically diverse and provides sparse cover. Common graminoids include *Leymus salinus* and *Carex rossii*. Forbs include *Petradoria pumila* and *Stenotus armerioides (= Haplopappus armerioides)*. Tree saplings provide sparse cover and include *Pinus edulis, Pinus ponderosa*, and *Juniperus osteosperma*.

*Globally*
This woodland association typically has an open tree canopy (10-30% cover) that is 2-10 m tall, but some sparse, tree-dominated stands from extremely dry, rocky sites in the Colorado Plateau are included as a best fit. The dominant trees are *Pinus edulis* and *Juniperus osteosperma*, each of which typically has from 5-25% cover. The shrub layer has moderate cover (5-30%) and can have high species diversity. *Arctostaphylos patula* has 5-30% cover and dominates the shrub layer. Other common shrubs include *Amelanchier utahensis, Cercocarpus intricatus, Eriogonum microthecum, Opuntia* spp., *Quercus gambelii*, and *Shepherdia rotundifolia*. The herbaceous layer has sparse to low cover and low to moderate species diversity. It may contain the graminoids *Achnatherum hymenoides, Muhlenbergia pungens*, and *Poa fendleriana* and the forbs *Comandra umbellata, Penstemon eatonii*, and *Lepidium montanum*. A few stands observed on canyon rims in southeastern Utah are much sparser than average with total vegetation cover of 5-25% and total tree cover of 2-10%.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis*, *Pinus ponderosa* |
| Tall shrub/sapling | *Cercocarpus montanus* |

| | |
|---|---|
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Arctostaphylos patula* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (14-Aug-2001).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
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 *Arctostaphylos patula* 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:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Unstable/rocky slopes are mostly devoid of plants; surface is hard-packed; dieback of *Arctostaphylos patula* shrubs and stressed *Pinus edulis* trees possible indicator of drought stress; this type forms a band between ponderosa pine / greenleaf manzanita and pinyon pine - Utah juniper / mountain mahogany stands.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0026, BRCA.0149, BRCA.0400, BRCA.0407; and 1 observation point: BRCA.9062) and 2007 Accuracy Assessment (27 points: BRCA_AA.0262, BRCA_AA.0579, BRCA_AA.0673, BRCA_AA.0736, BRCA_AA.1008, BRCA_AA.1089, BRCA_AA.0089, BRCA_AA.0096, BRCA_AA.0102, BRCA_AA.0118, BRCA_AA.0143, BRCA_AA.0207, BRCA_AA.0226, BRCA_AA.0280, BRCA_AA.0349, BRCA_AA.0409, BRCA_AA.0477, BRCA_AA.0627, BRCA_AA.0630, BRCA_AA.0646, BRCA_AA.0649, BRCA_AA.0667, BRCA_AA.0671, BRCA_AA.0684, BRCA_AA.0699, BRCA_AA.0894, BRCA_AA.1184).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* J. Drake, mod. K.A. Schulz

**REFERENCES:** Cogan et al. 2004, Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland

## Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland

| | |
|---|---|
| CODE | CEGL002331 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This Colorado Plateau association occurs in western and northern Colorado, eastern Utah and northeastern Arizona on the higher areas of local topographical features such as canyon rims, mesas, hills, ridgetops, and upper slopes. Sites are nearly level to moderately steep and tend toward northern aspects, although other directions are possible. Elevation ranges from 1772 to 2518 m (5800-8260 feet). The soils are variable and range from sandy loam to silt clay loam and sandy clay soil textures. Soils are typically shallow and rapidly drained. Parent materials are often sandstones or limestones but can also be eolian deposits or shale. The unvegetated surface is composed of litter, bare soil, bedrock, and large and small rocks. Cryptogams often have moderate to high cover. This woodland association ranges from a moderately dense to a more typically open tree canopy (10-60% cover) dominated by short evergreen trees 2-10 m tall. *Pinus edulis* and *Juniperus osteosperma* dominate the tree canopy and may form a sparse subcanopy 2-5 m tall where the upper canopy is taller. In most stands, *Pinus edulis* and *Juniperus osteosperma* each have between 3 and 35% canopy cover, although in some sparsely vegetated stands, they may have less. Scattered *Pseudotsuga menziesii* may be present at higher elevations. Shrubs provide low to moderate cover. The dwarf-shrub *Artemisia nova* is the most abundant shrub, usually with less than 20% cover (rarely up to 50%). Other shrubs include *Amelanchier utahensis, Artemisia tridentata, Cercocarpus montanus, Ephedra viridis, Gutierrezia microcephala, Purshia stansburiana, Purshia tridentata*, and *Opuntia* spp. A number of herbaceous species can be found across the range of this association, but any one stand usually has low to moderate diversity and less than 10% cover in aggregate. Common herbaceous species include the graminoids *Achnatherum hymenoides, Bouteloua gracilis, Carex* spp., *Elymus elymoides, Koeleria macrantha*, and *Poa fendleriana* and forbs *Antennaria parvifolia, Arabis* spp., *Hymenoxys richardsonii, Petradoria pumila, Phlox* spp., and many others.

**DISTRIBUTION**

*Bryce Canyon National Park*

This woodland occurs on rocky exposures and was sampled on the slopes of Jolley Hollow and in Yellow Creek.

*Globally*

This association is found on the Colorado Plateau and western slope of the southern Rocky Mountains in western and northern Colorado, southern and eastern Utah and northeastern Arizona.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This unusual woodland occurs on the low slope of a hill and a ridgetop. Sites are gentle to moderate (4- to 13-degree slopes), occur between 2060 and 2193 m in elevation, and are oriented to the north and east. The ground surface has high exposure of bare soil, sparse to moderate cover of small and large rocks, low cover of litter, and sparse cover of downed wood. Litter depths range from 0-0.3 cm. Soils are rapidly drained sandy clay loams that are derived from the Straight Cliffs Formation (Upper Unit).

*Globally*

This Colorado Plateau association occurs on the higher areas of local topographical features such as canyon rims, mesas, hills, ridgetops, and upper slopes. Sites are nearly level to moderately steep and tend toward northern aspects, although other directions are possible. Elevation ranges from 1772 to 2518 m (5800-8260 feet). The soils are variable and include sandy loam, sandy clay loam, silt loam, and silt clay loam soil textures. They tend to be shallow and rapidly drained. Parent materials are often sandstones but can also be eolian deposits, limestone, or shale. The unvegetated surface is composed of litter, bare soil, bedrock, and large and small rocks. Cryptogams often have moderate to high cover.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to moderate (17-57% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-5 m, have dbh ranging from 12-21 cm, and provide 4% and 5% cover, respectively, and the short shrub *Artemisia nova* that provides 5-18% cover. *Pinus ponderosa* trees occupy the canopy layer of one stand and provide sparse cover. Other shrubs present with low to sparse cover include *Chrysothamnus viscidiflorus, Eriogonum corymbosum, Opuntia polyacantha*, and *Chrysothamnus depressus*. The

herbaceous layer is low in floristic diversity and provides sparse cover. The bunch grasses *Achnatherum hymenoides, Leymus salinus*, and *Hesperostipa comata* provide sparse cover. The forb layer includes *Sphaeralcea coccinea, Pedicularis centranthera, Astragalus* sp., and *Calochortus nuttallii*. Tree saplings provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*.

*Globally*
This woodland association ranges from a moderately dense to a more typically open tree canopy (10-60% cover) dominated by short evergreen trees 2-10 m tall. *Pinus edulis* and *Juniperus osteosperma* dominate the tree canopy and may form a sparse subcanopy 2-5 m tall where the upper canopy is taller. In most stands, *Pinus edulis* and *Juniperus osteosperma* each have between 3 and 35% canopy cover, although in some sparsely vegetated stands, they may have less. Shrubs are present but provide low to moderate cover. The dwarf-shrub *Artemisia nova* is the most abundant shrub, usually with less than 20% cover, but stands with up to 50% cover have been observed. Other shrubs that are typically found include *Amelanchier utahensis, Artemisia tridentata, Cercocarpus montanus, Ephedra viridis, Gutierrezia microcephala, Purshia stansburiana, Purshia tridentata*, and *Opuntia* spp. Herbaceous species can be relatively diverse between stands, but any one stand usually has low to moderate diversity and less than 10% cover in aggregate. Common species include *Achnatherum hymenoides, Bouteloua gracilis, Carex* spp., *Elymus elymoides, Koeleria macrantha*, and *Poa fendleriana*. Forbs can include *Antennaria parvifolia, Arabis* spp., *Hymenoxys richardsonii, Petradoria pumila, Phlox* spp., and many others.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Herb (field) | *Artemisia nova* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (11-Jan-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Slightly rolling slope approximately 150 m above the main road; narrow ridgetop community, hot and exposed.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0007; and 1 observation point: BRCA.9069); and 2007 Accuracy Assessment (2 points: BRCA_AA.0747, BRCA_AA.0821).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Drake, mod. J. Coles and K.A. Schulz

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus osteosperma / Atriplex* spp. Woodland

### Two-needle Pinyon - Utah Juniper / Saltbush species Woodland

| | |
|---|---|
| CODE | CEGL002366 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Great Basin Pinyon-Juniper Woodland (CES304.773)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This woodland association is described from Capitol Reef National Park in southern Utah and Black Canyon of the Gunnison National Park in western Colorado; it likely occurs elsewhere in the Colorado Plateau. These higher elevation pinyon-juniper stands occur on shale-derived soils at 1583-2083 m. Sites are gentle to steep (4- to 88-degree slopes) and occur on plateau slopes, valley sides, midslopes of hills, and on ridgetops and hogbacks. Substrates are variable and include silty or sandy soils derived from sandstones and shale, rapidly drained gravelly/rocky soils, and soils derived from eroded, highly dissected gypsum parent material with poor infiltration/rapid runoff. The unvegetated ground surface has high cover of biotic crust, bare ground, or sometimes a layer of surface rock and gravel. The vegetation is characterized by an open to moderate (15-25% cover) tree canopy 2-5 m tall that is dominated by *Pinus edulis* and *Juniperus osteosperma* trees, with an open to moderately dense short-shrub layer dominated by *Atriplex confertifolia* or *Atriplex canescens*. Other short and dwarf-shrubs present may include *Artemisia tridentata ssp. wyomingensis, Atriplex cuneata, Chrysothamnus viscidiflorus, Ephedra torreyana, Ephedra viridis, Gutierrezia sarothrae, Krascheninnikovia lanata, Mahonia fremontii*, and the cactus *Opuntia polyacantha*. The open to sparse (<15% cover) herbaceous layer is primarily composed of graminoids such as *Achnatherum hymenoides, Leymus salinus (= Elymus salinus), Pleuraphis jamesii, Poa secunda*, and *Sporobolus flexuosus*. Forbs such as *Eriogonum inflatum* typically provide less than 1% total cover. The introduced annual species *Bromus tectorum* and *Erodium cicutarium* are often abundant. *Atriplex canescens* and *Artemisia tridentata ssp. wyomingensis* are restricted to the stand with non-gypsum parent material. Cryptogams provide up to 27% cover.

**DISTRIBUTION**

*Bryce Canyon National Park*

This type was observed from just one 2007 Accuracy Assessment point, therefore local descriptive information is not available at this time.

*Globally*

This association is described from southern Utah and western Colorado. It has been reported from the Wasatch Formation at the foot of Grand Mesa in western Colorado and is likely to occur in relatively small stands throughout the Colorado Plateau.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This woodland association has been described from the Colorado Plateau in southeastern Utah and western Colorado. These higher elevation pinyon-juniper stands occur on shale-derived soils at 1583-2083 m. Sites are

gentle to steep (4- to 88-degree slopes) and occur on plateau slopes, valley sides, midslopes of hills, and on ridgetops and hogbacks. Substrates are variable and include silty or sandy soils derived from Dakota Formation sandstones and Morrison Formation (Brushy Basin Member) shale, rapidly drained gravelly/rocky soils, and soils derived from eroded, highly dissected gypsum parent material with poor infiltration/rapid runoff. The unvegetated ground surface has high cover of biotic crust, bare ground, or sometimes a layer of surface rock and gravel.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This woodland has an open to moderate (15-25% cover) tree canopy 2-5 m tall that is dominated by *Pinus edulis* and *Juniperus osteosperma* trees, with an open to moderately dense short-shrub layer dominated by *Atriplex confertifolia* or *Atriplex canescens*. Other short and dwarf-shrubs present may include *Artemisia tridentata ssp. wyomingensis, Atriplex cuneata, Chrysothamnus viscidiflorus, Ephedra torreyana, Ephedra viridis, Gutierrezia sarothrae, Krascheninnikovia lanata, Mahonia fremontii*, and the cactus *Opuntia polyacantha*. The open to sparse (<15% cover) herbaceous layer is primarily composed of graminoids such as *Achnatherum hymenoides, Leymus salinus (= Elymus salinus), Pleuraphis jamesii, Poa secunda*, and *Sporobolus flexuosus*. Forbs such as *Eriogonum inflatum* typically provide less than 1% total cover. The introduced annual species *Bromus tectorum* and *Erodium cicutarium* are often abundant. *Atriplex canescens* and *Artemisia tridentata ssp. wyomingensis* are restricted to the stand with non-gypsum parent material. Cryptogams provide up to 27% cover.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Tall shrub/sapling | *Mahonia fremontii* |
| Short shrub/sapling | *Atriplex confertifolia*, *Atriplex cuneata* |
| Short shrub/sapling | *Atriplex canescens*, *Ephedra viridis* |
| Herb (field) | *Gutierrezia sarothrae* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (23-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.1047).
*Local Description Authors:*
*Global Description Authors:* J. Coles, mod. K.A. Schulz

**REFERENCES:** 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Colorado 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**

*Bryce Canyon National Park*

This woodland has a limited distribution and occurs on mesas and badlands. It was sampled on Boat Mesa, in Sheep Canyon, Bridge Canyon, above Swamp Canyon, in the Fairyland Canyon area, along north fork of Yellow Creek, in Ponderosa Canyon and Merrill Hollow.

*Globally*

This association has been described from high ridges in the Colorado Plateau in eastern and southern Utah and western Colorado.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This woodland occurs on mesas, slopes, and badlands formations. The sites are flat to steep (0- to 32-degree slopes), occur between 2228 and 2472 m in elevation, and are oriented to all aspects. The ground surface has low to moderate exposure of bare soil, low to high cover of litter, low to moderate cover of small and large rocks, and sparse cover of downed wood. Litter depths range from 0-2.5 cm. Soils are rapidly drained sandy loams, loams, and clay loams that are derived from the Claron Formation (Pink and White members) and the Kaiparowitz Formation.

*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**

*Bryce Canyon National Park*

Total vegetation cover is low to dense (19-67% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-10 m, have dbh ranging from 16-53 cm, DRCs ranging from 16-22 cm, and provide 3-23% and <1-12% cover, respectively, and *Cercocarpus ledifolius* canopy trees and tall shrubs that provide 2-18% cover. In one stand, emergent *Pinus ponderosa* trees provide 6% cover and attain heights between 10 and 15 m. Other shrubs present include *Quercus gambelii, Purshia tridentata, Cercocarpus montanus*, and *Arctostaphylos patula* with sparse cover. The herbaceous layer is moderately diverse floristically and provides sparse cover. Common bunch grasses include *Leymus salinus* and *Achnatherum hymenoides*. The forb *Astragalus bisulcatus* occurs on one site. *Pinus edulis* saplings up to 2 m tall provide sparse cover.

*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**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Tree canopy | *Cercocarpus ledifolius* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Tall shrub/sapling | *Cercocarpus ledifolius* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* GNR (14-Aug-2001).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*

Pinyon-juniper woodlands.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Entire mesatop/plateau seems to be covered by this association; steep and unstable mesa sideslope; erosion has created badlands topography of steep-sided ridges and ravines; small patch of this type, possibly established due to runoff pattern.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0021, BRCA.0024, BRCA.0362; and 1 observation point: BRCA.9032); and 2007 Accuracy Assessment (10 points: BRCA_AA.0239, BRCA_AA.0244, BRCA_AA.0551, BRCA_AA.0606, BRCA_AA.0647, BRCA_AA.0740, BRCA_AA.0940, BRCA_AA.1017, BRCA_AA.1124, BRCA_AA.1187).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* J. Coles

**REFERENCES:** Cogan et al. 2004, Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii* Woodland

## Two-needle Pinyon - Utah Juniper / James' Galleta Woodland

| | |
|---|---|
| CODE | CEGL002379 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This rare woodland association is currently documented only from Capitol Reef National Park in southeastern Utah; this summary is derived from plots sampled in the park in 1986 and 2005. It occurs on pediment surfaces cut into ridges and hills between 1950 and 2020 m (6400-6625 feet) elevation. Parent materials include basalt alluvium or colluvium overlying Moenkopi siltstone that is occasionally exposed. Soils are rapidly drained and fine-textured. Total vegetation cover is around 30%. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees with between 5 and 15% cover and an understory dominated by *Pleuraphis jamesii* with up to 10% cover. Shrubs do not form a layer (<5% total cover), but scattered individuals of *Gutierrezia sarothrae, Atriplex confertifolia, Shepherdia rotundifolia, Chrysothamnus viscidiflorus*, and *Ephedra torreyana* are commonly present. Associated herbaceous species include *Achnatherum hymenoides, Bouteloua gracilis, Hesperostipa comata*, and a variety of forbs with sparse cover.

**DISTRIBUTION**
*Bryce Canyon National Park*
This associations was observed at only two 2007 Accuracy Assessment points, therefore local descriptive information is not available at this time.

*Globally*
This association has been documented from Capitol Reef National Park in southeastern Utah, in Bryce Canyon National Park in the high plateaus of southern Utah, and in southwestern Colorado at Mesa Verde National Park.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*

Data are not available.

*Globally*
This association has only been described from Capitol Reef National Park. Until further inventory is completed, there is no global information.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This association has only been described from Capitol Reef National Park. Until further inventory is completed, there is no global information.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (23-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This association has only been described from Capitol Reef National Park. Until further inventory is completed, there is no global information.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (2 points: BRCA_AA.0852, BRCA_AA.0886).
*Local Description Authors:*
*Global Description Authors:* J. Coles

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus osteosperma / Purshia stansburiana* Woodland

## Two-needle Pinyon - Utah Juniper / Stansbury's Cliffrose Woodland

| | |
|---|---|
| CODE | CEGL000782 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This woodland association is known from the Colorado Plateau of southern Utah and Colorado south to central Arizona. It occurs on dry sites on canyon rims, ridges and slopes. Elevations range from 1400 to 2165 m. Stands typically occur on gentle to moderately steep slopes on all aspects. The soils are generally shallow and rocky, ranging from sand to clay loam in texture. Rock outcrop and bare soil are common. Parent materials include sandstone and shale. The vegetation is characterized by an open to moderately dense tree canopy (10-60% cover) codominated by *Pinus edulis* and *Juniperus osteosperma*. *Purshia stansburiana* dominates or codominates the sparse to moderately dense short-shrub layer, often with *Artemisia tridentata* in the northern part of its range. *Cercocarpus montanus* and *Purshia tridentata* are scarce or absent. Other shrubs may be present, including *Amelanchier utahensis, Arctostaphylos patula, Chamaebatiaria millefolium, Ephedra viridis, Gutierrezia sarothrae, Quercus gambelii* (<5% cover), or species of *Yucca* and *Opuntia*. Herbaceous cover is variable, ranging from sparse to moderately dense, but generally dominated by graminoids (<5% cover) with scattered perennial forbs.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was observed at just three 2007 Accuracy Assessment points, therefore local descriptive information is not available at this time.

*Globally*

This woodland association occurs in the Colorado Plateau region of central Arizona, western New Mexico, southwestern Colorado, and southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This woodland occurs on the Colorado Plateau of southern Utah and Colorado south to central Arizona, on dry canyon rims, ridges, hills, benches, mesas and occasionally in intermittent drainages. Elevations range from 1400 to 2165 m (4600-7100 feet). Stands typically occur on gentle to moderately steep slopes on all aspects, but range from flat to steep slopes (0-30%). Soils are generally shallow and rocky, ranging in texture from sand in most stands to clay loam or sandy clay. Exposed sandstone or limestone bedrock and bare soil have high cover, and woody plants are generally rooted in cracks and joints in bedrock. A minority of stands may also occur on shale slopes covered by sandstone colluvium. Parent materials are variable and include sandstones and shale of the Moab Tongue of the Curtis Formation, Kayenta Formation, Moenkopi Formation, Morrison Formation, Cedar Mesa sandstone and eolian silt deposits.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*
This woodland association is characterized by an open to moderately dense tree canopy (10-60% cover) codominated by *Pinus edulis* and *Juniperus osteosperma*. *Purshia stansburiana* dominates or codominates the sparse to moderately dense short-shrub layer, often with *Artemisia tridentata* in the northern part of its range. Total vegetation cover can vary from 12% to more than 65%, with tree canopy sometimes falling below 10% cover in very open stands. *Cercocarpus montanus* and *Purshia tridentata* are scarce or absent. Other shrubs may be present, including *Amelanchier utahensis, Arctostaphylos patula, Artemisia bigelovii, Artemisia nova, Artemisia tridentata, Chamaebatiaria millefolium, Ephedra viridis, Ericameria nauseosa, Eriogonum corymbosum, Eriogonum microthecum, Fraxinus anomala, Gutierrezia sarothrae, Quercus gambelii* (<5% cover), *Rhus trilobata, Shepherdia rotundifolia, Symphoricarpos longiflorus*, or species of *Yucca* and *Opuntia*. Herbaceous cover is variable, ranging from sparse to moderately dense, but generally dominated by graminoids (>5% cover) with scattered forbs. Associated graminoids include *Achnatherum hymenoides (= Oryzopsis hymenoides), Aristida purpurea, Bouteloua curtipendula, Bouteloua gracilis, Bouteloua hirsuta, Elymus elymoides, Hesperostipa comata, Hesperostipa neomexicana, Koeleria macrantha, Poa fendleriana, Pleuraphis jamesii*, and *Schizachyrium scoparium*. Forbs may include *Artemisia ludoviciana, Artemisia frigida, Calliandra humilis, Descurainia pinnata, Eriogonum ovalifolium, Lappula occidentalis, Oenothera pallida*, and *Penstemon linarioides*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Tall shrub/sapling | *Amelanchier utahensis* |
| Tall shrub/sapling | *Purshia stansburiana* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive, High), *Descurainia pinnata* (invasive), *Erodium cicutarium* (invasive, Medium/Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4? (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
The global name of this association was changed on 2001-09-04 because of a taxonomic change of the nominal species. *Purshia mexicana var. stansburiana* (Torr.) Welsh is now recognized as *Purshia stansburiana* (Torr.) Henrickson (Kartesz 1999). *Purshia mexicana* (D. Don) Henrickson, a closely related species, occurs in Chihuahua, Durango and Zacateca, Mexico, and possibly extreme southern Arizona, and is not known to be present in this association (Cronquist et al. 1997).

This association appears to be part of a continuum of Colorado Plateau woodland communities growing on fractured sandstone. Stands where *Purshia stansburiana* is the dominant understory shrub are less common than those in which it is a component of a mixed shrub understory that includes *Cercocarpus montanus, Amelanchier utahensis*, and *Cercocarpus intricatus* in mesic stands, or *Coleogyne ramosissima* and *Yucca* spp. in xeric stands. An analysis of the woodland data from four parks (Colorado, Arches, Natural Bridges, Canyonlands) confirmed that *Pinus edulis - Juniperus osteosperma / Purshia stansburiana* Woodland (CEGL000782) is a valid association but not always easy to distinguish from more mixed-shrub woodlands in the field.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (3 points: BRCA_AA.0065, BRCA_AA.0678, BRCA_AA.0694).
*Local Description Authors:*
*Global Description Authors:* K.A. Schulz, mod. J. Coles

**REFERENCES:** BIA 1979, Baker 1980a, Baker 1984a, Bourgeron and Engelking 1994, Britton and Wright 1983, CONHP unpubl. data 2003, Cogan et al. 2004, Cronquist et al. 1997, Driscoll et al. 1984, Hansen et al. 2004d, Isaacson 1967, Kartesz 1999, Larson and Moir 1987, Moir and Carleton 1987, Northcutt 1978, Stuever and Hayden 1997a, USFS 1982, USFS 1985c, Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus osteosperma / Purshia tridentata* Woodland

## Two-needle Pinyon - Utah Juniper / Antelope Bitterbrush Woodland

| | |
|---|---|
| CODE | CEGL000789 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This association is common at middle elevations of the pinyon-juniper woodland zone in western Colorado and northwestern New Mexico. Sites occupy ridges, scarps and mesas with generally gentle to moderate slopes. Elevations range from 1800 to 2330 m (5900-7645 feet) and aspect is variable. Soils are often coarse and rocky, may be shallow, and sometimes contain outcrops of the underlying sandstone or limestone. This association is characterized by a mixed canopy of *Pinus edulis* and *Juniperus* spp. with a shrub layer dominated by *Purshia tridentata*. Canopy cover ranges from 10% in the beetle- and fungus-affected woodlands of southwestern Colorado to around 50% in the mountains of northern New Mexico. The canopy sometimes includes arborescent *Quercus gambelii* in the southern part of the range. The shrub layer may consist almost entirely of *Purshia tridentata* with between 5 and 25% cover, or more often it is mixed with other shrubs that have at least 1% cover, including *Amelanchier utahensis, Artemisia tridentata, Artemisia nova, Cercocarpus montanus, Ephedra viridis, Opuntia polyacantha, Ribes cereum*, and *Yucca baccata*. Graminoids are well-represented to abundant; common species include *Pseudoroegneria spicata, Poa fendleriana, Koeleria macrantha, Carex rossii*, and *Piptatherum micranthum*. The forb component of the understory is often diverse but rarely contributes significantly to the overall vegetation cover. Species noted as occurring in this community include *Astragalus scopulorum, Eriogonum jamesii, Eriogonum racemosum, Penstemon linarioides ssp. coloradoensis, Petradoria pumila, Phlox* spp., and *Stenotus acaulis*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland is common, occurs on varied topography and was sampled near Glory Cove, The Promontory, Shakespeare Point, in Cope Canyon, and adjacent to the northern park boundary within the park and in the Sheep Creek drainage and in Noon Canyon and Oak Hollow outside of the park boundary. It was also observed at 15 2007 Accuracy Assessment points.

*Globally*
This association is documented from the Sandia and Jemez ranges in New Mexico, from Mesa Verde in southwestern Colorado, the high plateaus of southern Utah, and from Dinosaur National Monument in northwestern Colorado.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This common woodland occurs on hills, canyons, breaks, plateaus, and badlands. The sites are gentle to steep (2- to 30-degree slopes), occur between 2030 and 2540 m in elevation, and are oriented to all aspects. The ground surface has sparse to high exposure of bare soil, low to high cover of litter, sparse to high cover of small and large rocks, and sparse cover of downed wood. Litter depths range from 0-2.2 cm. Soils are rapidly drained sandy loams, sandy clay loams, silty clay loams, and clay loams that are derived from the Straight Cliffs Formation (Upper Unit), Sevier Formation, Kaiparowitz Formation, New Alluvium, or Tropic Shale.

*Globally*
This association is common at middle elevations of the pinyon-juniper woodland zone in western Colorado and northwestern New Mexico. Sites occur on ridges, scarps and mesas with gentle to moderate slopes, but a few stands have been recorded on slopes approaching 100%. Elevations range from 1800 to 2330 m (5900-7645 feet) and aspect is variable. Soils are often coarse and rocky, may be shallow, and sometimes have outcrops of the underlying sandstone or limestone.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (30-76% cover) and is characterized by the canopy tree *Pinus edulis* that ranges in height from 2-10 m, has dbh ranging from 13-41 cm, DRC ranging from 13-26 cm, and provides 1-22% cover, and the short shrub *Purshia tridentata* that provides 5-28% cover. *Juniperus osteosperma* trees often occur in the canopy layer, have dbh ranging from 13-43 cm, DRCs ranging from 24-92 cm, and provide sparse to low cover. Additional canopy trees that provide sparse cover include *Juniperus scopulorum, Pinus ponderosa*, and *Pseudotsuga menziesii*. The tall shrubs *Quercus gambelii* and *Cercocarpus montanus* provide sparse to low cover. Other shrubs present include *Tetradymia canescens, Arctostaphylos patula, Chrysothamnus viscidiflorus, Purshia tridentata, Artemisia nova*, and *Gutierrezia sarothrae*. The herbaceous layer is moderately diverse floristically and provides sparse to low cover. Common graminoids are the bunch grasses *Leymus salinus, Elymus elymoides, Achnatherum hymenoides, Hesperostipa comata, Poa fendleriana*, and the non-native grass *Poa pratensis*. The forb layer is floristically diverse with no species present in greater than trace cover (<1%). Tree saplings provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*. Mosses and lichens provide sparse to low cover in some stands.

*Globally*
This association is characterized by a mixed canopy of *Pinus edulis* and *Juniperus* spp. with a shrub layer dominated by *Purshia tridentata*. Canopy cover ranges from 10% in the beetle- and fungus-affected woodlands of southwestern Colorado to around 50% in the mountains of northern New Mexico. The canopy occasionally includes arborescent *Quercus gambelii* in the southern part of the range. The shrub layer may consist almost entirely of *Purshia tridentata* with between 5 and 25% cover, or more often it is mixed with other shrubs that have at least 1% cover, including *Amelanchier utahensis, Artemisia tridentata, Artemisia nova, Cercocarpus montanus, Ephedra viridis, Opuntia polyacantha, Ribes cereum*, and *Yucca baccata*. Graminoids are well-represented to abundant; common species include *Pseudoroegneria spicata, Poa fendleriana, Koeleria macrantha, Carex rossii*, and *Piptatherum micranthum*. The forb component of the understory is often diverse but rarely contributes significantly to the overall vegetation cover. Species noted as occurring in this community include *Astragalus scopulorum, Eriogonum jamesii, Eriogonum racemosum, Penstemon linarioides ssp. coloradoensis, Petradoria pumila, Phlox* spp., and *Stenotus acaulis*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Purshia tridentata* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Artemisia nova*, *Purshia tridentata* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
Some stands of this association in northwestern Colorado have a shrub layer that is codominated by *Artemisia nova* and *Purshia tridentata*. The classification of these stands may need to be revisited to determine whether they are a better fit with the concept of this association or with *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland (CEGL002331).

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Trees and shrubs appear healthy and vigorous; soil texture is stickier than downslope plots, probably reducing moisture absorption of soils; clay slope is eroded into badland-like topography.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (6 plots: BRCA.0084, BRCA.0202, BRCA.0302, BRCA.0305, BRCA.0335, BRCA.0348; and 2 observation points: BRCA.9012, BRCA.9216) and 2007 Accuracy Assessment (15 points: BRCA_AA.0060, BRCA_AA.0081, BRCA_AA.0091, BRCA_AA.0167, BRCA_AA.0169, BRCA_AA.0248, BRCA_AA.0275, BRCA_AA.0283, BRCA_AA.0493, BRCA_AA.0494, BRCA_AA.0651, BRCA_AA.0822, BRCA_AA.0845, BRCA_AA.0848, BRCA_AA.1153).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Erdman 1962, Erdman 1970, Erdman et al. 1969, Floyd 2003, Larson and Moir 1987, Salas et al. 2010, Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia* Woodland

## Two-needle Pinyon - Utah Juniper / Roundleaf Buffaloberry Woodland

| | |
|---|---|
| CODE | CEGL002335 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This woodland association occurs in two distinct situations: At Natural Bridges National Monument and Capitol Reef National Park, stands of this type occupy rolling uplands on eolian, alluvial or residual red sandy silt soils, often in a mosaic with *Pinus edulis - Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland (CEGL000776) and *Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland (CEGL002148). In addition, at Capitol Reef and Canyonlands national parks, stands occur on warm, dry, moderately steep lower slopes where sandstone colluvium overlies slopes of Chinle or Organ Rock shales. Elevations range from 1445 to 2273 m (4740-7460 feet). Soils vary depending on substrate, including sandy loams, sandy clays, and silt loams. This woodland association is locally common in the Colorado Plateau of southern Utah. Total vegetation cover ranges between 15 and 80%. *Juniperus osteosperma* and *Pinus edulis* form a canopy 2-5 m tall and with 10-60% cover. The understory is characterized by a shrub layer dominated by *Shepherdia rotundifolia*. Other shrubs present may include *Artemisia tridentata ssp. wyomingensis, Mahonia fremontii, Artemisia nova*, and *Gutierrezia sarothrae*. Herbaceous species generally have low total cover and vary from site to site. Cryptobiotic soils may have significant cover in sites derived from loess.

**DISTRIBUTION**

*Bryce Canyon National Park*

This woodland occurs primarily on slopes, and was sampled in Campbell, Bryce and Cope canyons, near Glory Cove, and in the Yellow Creek drainage.

*Globally*

This association has been documented from southern Utah. It may also occur in northern New Mexico within the range of *Shepherdia rotundifolia*.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon woodland occurs on canyonsides and valley floors. The sites are moderate to steep (6- to 36-degree slopes), occur between 2021 and 2240 m in elevation, and are oriented to all aspects. The ground surface has no to high exposure of bare soil, no to low exposure of bedrock, moderate to high cover of small and large rocks, low to moderate cover of litter, and sparse cover of downed wood. Litter depths range from 0-1.3 cm. Soils are rapidly drained silty clay loams, sandy loams, and silts that are derived from the Straight Cliffs Formation (Upper Unit), Tropic Shale, Claron Formation (Pink Member), or New Alluvium.

*Globally*

This association occurs in two distinct situations: (1) At Natural Bridges National Monument and Capitol Reef National Park, stands of this type occupy rolling uplands on eolian, alluvial or residual red sandy silt soils, often in a mosaic with *Pinus edulis - Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland (CEGL000776) and *Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland (CEGL002148). (2) In addition, at Capitol Reef and Canyonlands national parks, stands occur on warm, dry, moderately steep lower slopes where sandstone colluvium overlies slopes of Chinle or Organ Rock shales. Elevations range from 1445 to 2273 m (4740-7460 feet). Because this is a relatively xeric woodland, bare soil and rocks may cover up to 70% of the unvegetated surface. Soils vary depending on substrate, including sandy loams, sandy clays, and silt loams.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to moderate (22-33% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-10 m, have dbh ranging from 13-51 cm, and provide 5-21% and 3-14% cover, respectively, and the short shrub *Shepherdia rotundifolia* that provides <1-9% cover. Other shrubs present include *Quercus gambelii, Purshia tridentata, Gutierrezia sarothrae*, and *Eriogonum corymbosum* with sparse cover. The herbaceous layer is low in floristic diversity and provides sparse cover. Common bunch grasses include *Leymus salinus* and *Achnatherum hymenoides*. Tree saplings provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*.

*Globally*

This woodland association is locally common in the Colorado Plateau of southern Utah. Total vegetation cover ranges between 15 and 80%. *Juniperus osteosperma* and *Pinus edulis* form a canopy 2-5 m tall and with 10-60%

cover. The understory is characterized by a shrub layer dominated by *Shepherdia rotundifolia*. Other shrubs present may include *Artemisia tridentata ssp. wyomingensis, Mahonia fremontii, Artemisia nova*, and *Gutierrezia sarothrae*. Herbaceous species generally have low total cover and vary from site to site. Cryptobiotic soils may have significant cover in sites derived from loess.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Shepherdia rotundifolia* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Shepherdia rotundifolia* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (12-Jan-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Topography in this area is alternating low interfluve bumps and ridges, transecting very flat areas where surficial drainage can be seen to have moved litter in wide, braided areas; steep clay hillside that is highly eroded and furrowed; thick physical crust on the surface as well as spots of crusty lichen; steep slope of scree, some bedrock exposure, scattered shrubs.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0195, BRCA.0203, BRCA.0334, BRCA.0404; and 1 observation point: BRCA.9201) and 2007 Accuracy Assessment (14 points: BRCA_AA.0008, BRCA_AA.0047, BRCA_AA.0083, BRCA_AA.0101, BRCA_AA.0121, BRCA_AA.0131, BRCA_AA.0149, BRCA_AA.0163, BRCA_AA.0302, BRCA_AA.0340, BRCA_AA.0675, BRCA_AA.0683, BRCA_AA.0703, BRCA_AA.1029).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles

**REFERENCES:** Salas et al. 2010, Western Ecology Working Group n.d.

*Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland

## Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland

| | |
|---|---|
| CODE | CEGL002148 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Great Basin Pinyon-Juniper Woodland (CES304.773)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This variable woodland association is widespread in parts of western Colorado and eastern Utah. It is found most commonly on mid- to upper slopes, though other topographic positions are possible. It has been sampled at elevations between 1354 and 2389 m and on all aspects. At higher elevations, it tends toward southwestern aspects. Sites range from flat to moderately steep. The ground has variable amounts of litter and often has moderate to high amounts of gravel, rocks, and exposed bedrock. Cryptogamic cover is usually low to moderate, but some sites have up to 55-65% cover. Soils are always rapidly drained to moderately well-drained. Parent materials are also highly variable and can be sandstones, shales, or limestones. The lack of an understory may be due to high rock cover, low soil moisture, or a closed evergreen canopy of pinyon and juniper. This widespread association occurs as relatively sparse to moderately vegetated stands with total vegetation cover ranging from 10-75%. Sparsely vegetated stands (<10% total vegetation cover) composed of only trees are included as a best fit in this woodland association in extremely dry, rocky portions of the Colorado Plateau. The tree canopy is dominated by *Pinus edulis* and *Juniperus osteosperma*. Both typically range from 1-35% cover with some stands having canopy cover by one species up to 50%. The tree canopy is short, usually 2-10 m tall, and open to moderately closed. *Fraxinus anomala* has been observed in the canopy of some stands but always at no more than 5% cover. Several shrub species are commonly found in this association, but they occur as widely scattered individuals or an open shrub stratum. Scattered small *Pinus edulis* and *Juniperus osteosperma* are found along with shrubs such as *Amelanchier utahensis, Artemisia tridentata ssp. wyomingensis, Cercocarpus montanus, Ephedra viridis, Eriogonum microthecum, Shepherdia rotundifolia*, and *Opuntia* spp. The herbaceous layer is low in cover (<5%) and usually low in diversity. *Achnatherum hymenoides, Bouteloua gracilis, Bromus tectorum, Poa fendleriana*, and *Pleuraphis jamesii* are common graminoids. Forbs are not abundant, but typical species include *Descurainia pinnata, Cryptantha* spp., and *Tetraneuris acaulis*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This woodland was sampled in the Mossy Cave area, Tropic Canyon, southeast of Sinking Ship, Campbell Canyon, Death Hollow, Yellow Creek, and Pasture Wash.

*Globally*

This association is known to occur in western Colorado and eastern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This woodland occurs on gentle to steep slopes (2-30%), at all aspects on low, mid and high slope positions. It occurs from 2038 to 2277 m in elevation. Soils are mostly rocky with a few stands on fine sand.

*Globally*

This woodland association is found most commonly on mid- to upper slopes, though other topographic positions are possible, such as valley floors, plateaus, colluvial slopes, hills, canyon rims, canyon sides, mesas, plains, and benches. It has been sampled at elevations between 1354 and 2389 m and on all aspects. At higher elevations, such

as in Black Canyon of the Gunnison National Park it tends toward southwestern aspects. Sites range from flat to moderately steep (0-25 degrees). The ground has variable amounts of litter and often has moderate to high amounts of gravel, rocks, and exposed bedrock. Cryptogamic cover is usually low to moderate, but some sites have up to 55-65% cover. Soils vary in texture and can be loamy sand, silts, loams or silty clay but are always rapidly drained to moderately well-drained. Parent materials are also highly variable and can be sandstones, shales, limestones, among others.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

This woodland is a mix of *Pinus edulis* and *Juniperus osteosperma*, with total cover ranging from 10-30%. The two trees are usually equally matched in cover; occasionally one will have much more cover than the other. In this association, the understory shrubs and herbaceous cover is very low. Some scattered shrubs are usually present with trace to 5% cover. Many stands have no herbaceous cover; those that do have only trace to 1-2%. Observed shrub species include *Cercocarpus montanus, Quercus gambelii, Mahonia fremontii, Ephedra viridis, Atriplex canescens, Purshia mexicana, Eriogonum corymbosum, Shepherdia rotundifolia*, and others, each with 5% or less cover. Herbaceous species observed include *Leymus salinus (= Elymus salinus)* and *Pleuraphis jamesii (= Hilaria jamesii)*.

*Globally*

This widespread pinyon-juniper woodland association occurs as relatively sparse to moderately vegetated stands with total vegetation cover ranging from 10-75%. Sparsely vegetated stands (<10% total vegetation cover) composed of only trees are included as a best fit in this woodland association in extremely dry, rocky portions of the Colorado Plateau. The tree canopy is dominated by *Pinus edulis* and *Juniperus osteosperma*. Both typically range from 1-35% cover with some stands having canopy cover by one species up to 50%. The tree canopy is short, usually 2-10 m tall, and open to moderately closed. *Fraxinus anomala* has been observed in the canopy of some stands at Colorado National Monument but always at no more than 5% cover. Several shrub species are commonly found in this association, but they occur as widely scattered individuals or an open shrub stratum. Scattered small *Pinus edulis* and *Juniperus osteosperma* are found along with shrubs such as *Amelanchier utahensis, Artemisia bigelovii, Artemisia tridentata ssp. wyomingensis, Cercocarpus montanus, Chrysothamnus viscidiflorus, Coleogyne ramosissima, Ephedra viridis, Eriogonum microthecum, Gutierrezia sarothrae, Shepherdia rotundifolia, Symphoricarpos longiflorus*, and *Opuntia* spp., usually *Opuntia fragilis* or *Opuntia polyacantha*. The herbaceous layer is low in cover (<5%) and usually low in diversity. *Achnatherum hymenoides, Bouteloua gracilis, Bromus tectorum, Poa fendleriana*, and *Pleuraphis jamesii* are common graminoids. Forbs are not abundant, but typical species include *Descurainia pinnata, Cryptantha* spp., and *Tetraneuris acaulis*.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

**Exotic/Invasive**: *Bromus tectorum* (invasive, High)

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G5 (15-Dec-2004).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*

Data are not available.

*Globally*
Environmental and physiognomic variability within this association is high. There are few consistent understory species across all parks, but that is part of the concept of this type. The general sparseness of the understory is one of the main diagnostic features. Because of the wide range of circumstances that result in a sparse understory, a lot of variability in the floristic components of the understory is allowed. It is possible that this type will be split into several associations based on environmental factors, since floristic factors are not diagnostic. 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%, and they are considered a variation of the woodland type because of the ecological values of the trees.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: The description is based on 2007 Accuracy Assessment (18 points: BRCA_AA.0154, BRCA_AA.0156, BRCA_AA.0165, BRCA_AA.0261, BRCA_AA.0307, BRCA_AA.0317, BRCA_AA.0320, BRCA_AA.0542, BRCA_AA.0553, BRCA_AA.0661, BRCA_AA.0682, BRCA_AA.0750, BRCA_AA.0818, BRCA_AA.0836, BRCA_AA.0853, BRCA_AA.0854, BRCA_AA.1006, BRCA_AA.1258).
*Local Description Authors:* G. Kittel
*Global Description Authors:* J. Drake, mod. J. Coles and K.A. Schulz

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus edulis - Juniperus* spp. / *Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana)* Woodland

## Two-needle Pinyon - Juniper species / (Wyoming Big Sagebrush, Mountain Big Sagebrush) Woodland

| | |
|---|---|
| CODE | CEGL000776 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This broadly defined woodland association is common in the Colorado Plateau but also occurs on dry foothills and mesas from north-central New Mexico and southern Colorado west to the eastern Mojave Desert, in extreme northwestern Colorado and adjacent Utah. Elevations range from 1465 to 2500 m (4800-8200 feet). Stands occur most often on flat to gentle slopes on all aspects. The soils are generally poorly developed, moderately deep to deep, well-drained to rapidly drained loams and sands. Ground cover is variable; bare soil is common, but bedrock, litter, and large or small rocks can also be abundant on some sites. Parent material includes sandstone and shale. The vegetation is characterized by a typically open tree canopy (10-30% cover but ranges up to 50% cover) that is codominated by *Pinus edulis* and *Juniperus* spp. The species of *Juniperus* varies with geography and elevation. *Juniperus monosperma* is common in north-central New Mexico and southern Colorado. *Juniperus osteosperma* is common from northwestern New Mexico west and north into Arizona and Utah. *Juniperus scopulorum* is more common in higher elevation stands. *Artemisia tridentata* (either *ssp. vaseyana* or *ssp. wyomingensis* depending on location) strongly dominates the sparse to moderately dense short-shrub layer (10-35% cover). *Purshia stansburiana* is typically absent or scarce. Other shrubs present may include *Amelanchier utahensis, Arctostaphylos patula,*

*Cercocarpus montanus, Ephedra viridis, Gutierrezia sarothrae, Quercus gambelii* (typically <5% cover), or species of *Yucca* and *Opuntia*. Herbaceous cover is variable but generally sparse and dominated by graminoids (<5% cover) with scattered forbs.

**DISTRIBUTION**

*Bryce Canyon National Park*

This woodland is uncommon, occurs on deep soils, and was sampled along Sheep Creek Flat, near Glory Cove, and in the Yellow Creek drainage. It was also observed at seven Accuracy Assessment points in 2007.

*Globally*

This woodland association is common on the Colorado Plateau, occurring from north-central New Mexico and southern Colorado west to the Mogollon Rim of Arizona and the eastern Mojave Desert, and in extreme northwestern Colorado and adjacent Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon woodland occurs on valleysides and floors. The sites are gentle (4- to 7-degree slopes), occur between 2020 and 2080 m in elevation, and are oriented to the south or north. The ground surface has moderate to high exposure of bare soil, sparse cover of small rocks, no to moderate cover of litter, and sparse to low cover of downed wood. Litter depths range from 0-1.0 cm. Soils are rapidly drained silty clay loams and clays that are derived from the Straight Cliffs Formation (Upper Unit), or Tropic Shale.

*Globally*

This broadly defined woodland association occurs on dry foothills and mesas across much of the Colorado Plateau and adjacent areas. Elevations range from 1459 to 2502 m. Stands occur most often on flat to gentle slopes but can be found on moderate to moderately steep slopes on all aspects. The soils are often deep, generally poorly developed, moderately well-drained to rapidly drained loams and sands, and skeletal. Ground cover is variable; bare soil is common, but bedrock, litter, and large or small rocks can also be abundant on some sites. Parent material includes sandstone and shale.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to dense (19-67% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-10 m, have dbh ranging from 13-49 cm, and provide <1-12% and 5-11% cover, respectively, and the short shrubs *Artemisia tridentata ssp. vaseyana* or *Artemisia tridentata ssp. wyomingensis* that provide 5-25% cover. Other shrubs present with sparse cover include *Opuntia polyacantha, Krascheninnikovia lanata, Gutierrezia sarothrae*, and *Eriogonum corymbosum*. The herbaceous layer is floristically diverse, provides sparse cover, and includes the bunch grasses *Leymus salinus* and *Hesperostipa comata*. Tree saplings provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*.

*Globally*

This woodland is characterized by a typically open tree canopy (usually 10-30% cover but ranges up to 50% cover) that ranges from 2 to 10 m tall in most stands. The tree canopy is codominated by *Pinus edulis* and *Juniperus* spp. The species of *Juniperus* varies with geography and elevation. *Juniperus monosperma* is common in north-central New Mexico and southern Colorado. *Juniperus osteosperma* is common in stands reported from northwestern New Mexico, western Colorado, Arizona and Utah. *Juniperus scopulorum* is more common in higher elevation stands. *Artemisia tridentata* strongly dominates the relatively sparse to moderately dense short-shrub layer (10-35% cover); either *ssp. vaseyana* or *ssp. wyomingensis* may be present, with *ssp. vaseyana* being more characteristic of higher elevations or more mesic conditions. *Purshia stansburiana* is typically absent or scarce. Other shrubs present may include *Amelanchier utahensis, Arctostaphylos patula, Cercocarpus montanus, Ephedra viridis, Gutierrezia sarothrae, Quercus gambelii* (typically <5% cover), or species of *Yucca* and *Opuntia*. Herbaceous cover is variable but is generally sparse and dominated by graminoids (<5% cover) with scattered forbs. Associated graminoids include *Achnatherum hymenoides (= Oryzopsis hymenoides), Bouteloua gracilis, Carex filifolia, Hesperostipa comata, Koeleria macrantha, Muhlenbergia torreyi, Pascopyrum smithii, Pleuraphis jamesii*, and *Poa fendleriana*. Forbs include species of *Cryptantha, Eriogonum, Penstemon*, and *Phlox*. Cryptogram cover tends to be low, but some stands may have moderate cover.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus monosperma*, *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Artemisia tridentata* ssp. *vaseyana* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
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 *Artemisia tridentata* 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:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Rolling topography with deep soils and developed cryptogrammic soils; pinyon-juniper appear mature and healthy, but there is dieback on all shrub species and near 90% mortality of big sagebrush shrubs in this area; terrain is undulating with many erosion gullies.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0003, BRCA.0326, BRCA.0392) and 2007 Accuracy Assessment (7 points: BRCA_AA.0679, BRCA_AA.0709, BRCA_AA.0744, BRCA_AA.0759, BRCA_AA.0769, BRCA_AA.1046, BRCA_AA.0372).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Drake and J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, Bunting 1987, CONHP unpubl. data 2003, Cogan et al. 2004, Dick-Peddie 1993, Driscoll et al. 1984, Erdman 1970, Everett 1987, Heinze et al. 1962, Isaacson 1967, Jameson et al. 1962, Johnston 1987, Larson and Moir 1987, Mason et al. 1967, Moir and Carleton 1987, Salas et al. 2009, Salas et al. 2010, Stuever and Hayden 1997a, Tiedemann 1978, USFS 1983a, USFS 1985a, USFS 1985e, Warren et al. 1982, Western Ecology Working Group n.d., Wright et al. 1979

## *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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Southern 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**

*Bryce Canyon National Park*

This common woodland occurs on topographic features throughout the lower elevations and was sampled near Sunrise Point, along Sheep Creek Flat, in Jolley and Merrill hollows, above Death Hollow, in Water, Little Henderson, Sheep, Pasture, Tropic, Campbell, and Cope canyons, near Shakespeare Point, and in the Campbell and Yellow creeks and Pasture Wash drainages within the park and in the Sheep Creek drainage outside of the park boundary.

*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**

*Bryce Canyon National Park*

This common woodland occurs on ridges, canyonsides, slopes, interfluves, benches, plateaus, hills, and gullies. The sites are gentle to steep (2- to 37-degree slopes), occur between 2029 and 2407 m in elevation, and are oriented to all

aspects. The ground surface has moderate to high exposure of bare soil, low exposure of bedrock, no to high cover of litter, low to high cover of small and large rocks, and sparse to low cover of downed wood. Litter depths range from 0-2.0 cm. Soils are rapidly drained sandy clay loams, sandy clays, sandy loams, clay loams, silts, loamy sands, silty clays, and silty clay loams that are derived from the Straight Cliffs Formation (Upper Unit), Claron Formation (Pink Member), Tropic Shale, Kaiparowitz Formation, older alluvium, or New Alluvium.

*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**
*Bryce Canyon National Park*
Total vegetation cover is low to moderately dense (13-56% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-10 m, have dbh ranging from 13-78 cm, DRCs ranging from 10-105 cm, and provide 0-23% and 0-16% cover, respectively, and the tall shrub *Cercocarpus montanus* that provides <1-33% cover. The emergent tree layer and remaining canopy tree layer provide sparse to low cover in a few stands and include *Pinus ponderosa, Pseudotsuga menziesii*, and *Juniperus scopulorum*. Other shrubs present with sparse to low cover include *Quercus gambelii, Purshia stansburiana (= Purshia mexicana var. stansburiana), Amelanchier utahensis, Purshia tridentata, Ephedra viridis, Arctostaphylos patula, Symphoricarpos oreophilus, Shepherdia rotundifolia, Ericameria nauseosa, Eriogonum corymbosum, Gutierrezia sarothrae*, and the succulent *Opuntia polyacantha*. The herbaceous layer is floristically diverse and provides sparse to low cover. Common graminoids include bunch grasses *Leymus salinus* and *Achnatherum hymenoides*. Forbs can include *Astragalus bisulcatus, Machaeranthera grindelioides, Oenothera howardii, Stenotus acaulis (= Haplopappus acaulis)*, and *Stenotus armerioides (= Haplopappus armerioides)*. Tree saplings provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*. 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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Tall shrub/sapling | *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus monosperma*, *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Cercocarpus montanus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Trees and shrubs show the effects of surficial downslope erosion and slope movement: pistol butts, large exposed roots, and mounding on the upslope sides of the shrubs; soils possess hydrophobic crusts; runoff does not penetrate beyond the soil surface; slope is steep, with active erosional surfaces and gullying; common vegetation type above the valley bottoms; platy rocks, gravel, and boulders are the common substrate; north-facing aspect has higher cover of *Leymus salinus*.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (18 plots: BRCA.0008, BRCA.0133, BRCA.0139, BRCA.0141, BRCA.0146, BRCA.0147, BRCA.0156, BRCA.0157, BRCA.0198, BRCA.0199, BRCA.0307, BRCA.0309, BRCA.0313, BRCA.0319, BRCA.0324, BRCA.0340, BRCA.0343, BRCA.0363; and 11 observation points: BRCA.9030, BRCA.9034, BRCA.9059, BRCA.9061, BRCA.9064, BRCA.9065, BRCA.9067, BRCA.9224, BRCA.9243, BRCA.9265, BRCA.9268) and 2007 Accuracy Assessment (82 points: BRCA_AA.0016, BRCA_AA.0110, BRCA_AA.0111, BRCA_AA.0113, BRCA_AA.0117, BRCA_AA.0130, BRCA_AA.0141, BRCA_AA.0142, BRCA_AA.0158, BRCA_AA.0177, BRCA_AA.0250, BRCA_AA.0284, BRCA_AA.0292, BRCA_AA.0332, BRCA_AA.0458, BRCA_AA.0510, BRCA_AA.0513, BRCA_AA.0517, BRCA_AA.0526, BRCA_AA.0528, BRCA_AA.0537, BRCA_AA.0545, BRCA_AA.0549, BRCA_AA.0564, BRCA_AA.0574, BRCA_AA.0576, BRCA_AA.0597, BRCA_AA.0626, BRCA_AA.0648, BRCA_AA.0662, BRCA_AA.0665, BRCA_AA.0668, BRCA_AA.0700, BRCA_AA.0704, BRCA_AA.0705, BRCA_AA.0714, BRCA_AA.0725, BRCA_AA.0727, BRCA_AA.0739, BRCA_AA.0749, BRCA_AA.0752, BRCA_AA.0756, BRCA_AA.0764, BRCA_AA.0767, BRCA_AA.0777, BRCA_AA.0783, BRCA_AA.0785,

BRCA_AA.0795, BRCA_AA.0806, BRCA_AA.0815, BRCA_AA.0830, BRCA_AA.0831, BRCA_AA.0857, BRCA_AA.0875, BRCA_AA.0923, BRCA_AA.0926, BRCA_AA.0997, BRCA_AA.1045, BRCA_AA.1136, BRCA_AA.1142, BRCA_AA.1241, BRCA_AA.1252, BRCA_AA.0026, BRCA_AA.0099, BRCA_AA.0120, BRCA_AA.0122, BRCA_AA.0128, BRCA_AA.0136, BRCA_AA.0146, BRCA_AA.0147, BRCA_AA.0153, BRCA_AA.0192, BRCA_AA.0197, BRCA_AA.0218, BRCA_AA.0344, BRCA_AA.0502, BRCA_AA.0615, BRCA_AA.0622, BRCA_AA.0722, BRCA_AA.0732, BRCA_AA.0786, BRCA_AA.0980).
*Local Description Authors:* M. Smith and J. Von Loh
*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, Hansen et al. 2004d, 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 edulis* - *Juniperus* spp. / *Leymus salinus* Woodland

### Two-needle Pinyon - Juniper species / Saline Wildrye Woodland

| | |
|---|---|
| CODE | CEGL002340 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This woodland association is widespread throughout the Colorado Plateau, but limited to small stands on specific substrates. Stands tend to occupy the tops, shoulders, upper and middle slopes of ridges, as well as canyon sides. These sites range from moderately to steeply sloping (47% to more than 100% slopes), although a minority of stands occur on gentle slopes with gradients not exceeding 10%. Elevations range between 1483 and 2301 m (4865-7550 feet). Stands at higher elevations and latitudes (e.g., Black Canyon of the Gunnison National Park and Dinosaur National Monument) tend to be oriented to the south or west, but stands at lower elevations occur primarily on north or east aspects. Parent materials are variable but generally include a significant element of marine shale, sometimes redeposited with other rocks as alluvium or colluvium. Soils are rapidly drained and include sandy clay loams, clay loams and sandy loams. Total vegetation cover ranges from sparse (7%) to moderate (50%) in this variable community, with drier, more exposed sites supporting less overall plant cover. The canopy may be very open to moderate (5 to 30%), and consists of both *Pinus edulis* and *Juniperus osteosperma*. Either tree species may dominate the canopy. Shrubs are generally present but do not provide enough cover to constitute a stratum. Common species include *Ephedra viridis, Shepherdia rotundifolia, Opuntia* spp., and *Chrysothamnus viscidiflorus*. The herbaceous layer is more conspicuous than the shrub layer in this community, consisting of a variety of grasses, among which *Leymus salinus* is clearly dominant. Total herbaceous cover can range from 5% in sparse stands to more than 30% in more sheltered sites. Common associated herbaceous species include *Achnatherum hymenoides* and *Pleuraphis jamesii*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland is uncommon, occurs on alkaline, clay soils, and was sampled along Sheep Creek Flat, at Tropic, along Yellow Creek, and in Campbell Canyon.

*Globally*
This association has been documented from southeastern Utah and western Colorado. It is likely to be found in small stands in similar environments throughout the Colorado Plateau.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This rare woodland occurs on valley, ridge, and hill slopes. Sites are moderate to steep (7- to 27-degree slopes), occur between 2008 and 2085 m in elevation, and are oriented to the north or west. The ground surface has moderate to high exposure of bare soil, low cover of litter, moderate to high cover of small and large rocks, and sparse cover of downed wood. Litter depths range from 0-0.5 cm. Soils are rapidly drained silty clay loams that are derived from the Straight Cliffs Formation (Upper Unit) or Tropic Shale.

*Globally*
This woodland association is widespread throughout the Colorado Plateau, but limited to small stands on specific substrates. Stands tend to occupy well-drained, exposed sites on the tops, shoulders, upper and middle slopes of ridges, as well as canyon sides, gullies, ledges, and colluvial slopes. These sites range from moderately to steeply sloping (47% to more than 100% slopes), although a minority of stands occur on gentle slopes with gradients not exceeding 10%. Elevations range between 1483 and 2301 m (4865-7550 feet), with most stands occurring above 1700 m. Stands at higher elevations and latitudes (e.g., Black Canyon of the Gunnison National Park and Dinosaur National Monument) tend to be oriented to the south or west, but stands at lower elevations occur primarily on north or east aspects. Parent materials are variable but generally include a significant element of Paleozoic or Mesozoic marine shale, sometimes redeposited with other rocks as alluvium or colluvium. Soils are rapidly drained and include sandy clay loams, clay loams and sandy loams.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (24-42% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* that range in height from 2-10 m, have dbh ranging from 12-15 cm, DRCs ranging from 15-61 cm, and provide 1-8% and 1-7% cover, respectively, and the medium-tall bunchgrass *Leymus salinus* that provides 4-20% cover. Few shrubs present have sparse to low cover and include *Cercocarpus montanus, Eriogonum corymbosum, Atriplex canescens, Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. The remaining herbaceous layer is floristically diverse, provides sparse cover, and includes the bunchgrass *Achnatherum hymenoides* and the cushion plant *Petradoria pumila*. Seedling trees provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*.

*Globally*
Total vegetation cover ranges from sparse (7% ) to moderate (50%) in this variable community, with drier, more exposed sites supporting less overall plant cover. The canopy may be very open to moderate (5 to 30%) and consists of both *Pinus edulis* and *Juniperus osteosperma*. Either tree species may dominate the canopy, but both should have at least 2% cover. Shrubs are generally present but do not provide enough cover to constitute a stratum. Common species include scattered *Ephedra viridis, Shepherdia rotundifolia, Opuntia* spp., and *Chrysothamnus viscidiflorus*. The herbaceous layer is more conspicuous than the shrub layer in this community, consisting of a variety of grasses, among which *Leymus salinus* is clearly dominant. Total herbaceous cover can range from 5% in sparse stands to more than 30% in more sheltered sites. Common associated herbaceous species include *Achnatherum hymenoides* and *Pleuraphis jamesii*. Other common graminoids may include *Poa fendleriana, Koeleria macrantha*, and *Vulpia octoflora*; additional forbs include *Arenaria fendleri, Calochortus gunnisonii, Cymopterus bulbosus, Erigeron utahensis, Machaeranthera grindelioides, Phlox hoodii, Sphaeralcea parvifolia, Stanleya pinnata, Stenotus armerioides (= Haplopappus armerioides), Streptanthella longirostris*, and *Tetraneuris acaulis (= Hymenoxys acaulis)*. *Bromus tectorum* is common in stands that have experienced disturbance from roads or grazing.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Short shrub/sapling | *Eriogonum corymbosum* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus edulis* |
| Herb (field) | *Leymus salinus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G4 (26-Jan-2006). This association is likely to be somewhat more common than *Juniperus osteosperma / Leymus salinus* Woodland (CEGL003109), because the combination of *Pinus edulis* and *Juniperus osteosperma* has a greater ecological amplitude than does *Juniperus osteosperma* alone. However, this is an unusual and probably rare type, as *Pinus edulis* usually does not grow in the same habitats or elevations favored by *Leymus salinus*.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
Baker (1982b) cites Shute and West (1978) as reporting a *Pinus edulis - Juniperus osteosperma / Leymus salinus* community in the vicinity of Price, Utah. There is no other information given for this community, other than that it occurs on Mancos shale. All other data used to support this association are derived from vegetation plots gathered by the National Park Vegetation Mapping Program.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Soils are deep, but rocky, with many small rocks scattered over the surface; soil and small rock accumulate on the uphill sides of trees and shrubs, but no considerable root exposure or leaning trees; good regeneration of *Pinus edulis* and *Juniperus osteosperma*; many limestone pebbles; soils are rocky and clayey.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0197, BRCA.0322; and 3 observation points: BRCA.9228, BRCA.9241, BRCA.9263) and 2007 Accuracy Assessment (4 points: BRCA_AA.0337, BRCA_AA.0770, BRCA_AA.0789, BRCA_AA.0808).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, mod. K.A. Schulz

**REFERENCES:** Baker 1982b, Shute and West 1978, Western Ecology Working Group n.d.

## *Pinus edulis* - *Juniperus* spp. / *Quercus gambelii* Woodland

## Two-needle Pinyon - Juniper species / Gambel Oak Woodland

| | |
|---|---|
| CODE | CEGL000791 |
| 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)<br>Two-needle Pinyon - (Juniper species) Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This widespread woodland association is known from the Colorado Plateau and southern Rocky Mountains, occurring from south-central Colorado to south-central New Mexico, west along the Mogollon Rim of Arizona, and north into Utah and western Colorado. Elevations normally range from 1509-2665 m but may be higher in stands in southern New Mexico. Sites are variable but generally are relatively mesic. Stands occur on flat to moderate slopes along drainages and on mesatops, and on moderate to steep, rocky slopes of foothills, mountains and canyons, especially in draws where soil moisture is concentrated, or on northern aspects or where shaded by upper canyon walls. The soils are variable and range from deep to shallow, silty clay to sandy loam, and often gravelly. Litter from *Quercus gambelii* and other shrubs is often extensive (over 50% cover). The vegetation is characterized by an open to moderately dense tree canopy (10-60% cover) codominated by *Pinus edulis* and *Juniperus* spp. 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 in northwestern New Mexico, northern Arizona and in Utah. *Juniperus scopulorum* is more common in higher elevation stands. An occasional *Pinus ponderosa* tree may be present in some stands. *Quercus gambelii* dominates the often patchy, moderately dense tall-shrub layer with at least 5% cover, but often over 25% cover. *Amelanchier utahensis, Cercocarpus montanus, Symphoricarpos oreophilus*, or species of *Yucca* and *Opuntia* are common shrub associates. Herbaceous cover is variable, ranging from sparse to moderately dense, but generally dominated by graminoids (>5% cover) with scattered forbs. Associated graminoids include *Achnatherum hymenoides (= Oryzopsis hymenoides), Bouteloua gracilis, Carex geyeri, Carex rossii, Elymus elymoides, Festuca arizonica, Koeleria macrantha, Muhlenbergia montana, Poa fendleriana*, and *Schizachyrium scoparium*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This common woodland occurs throughout the lower elevations and was sampled near the northern park boundary, near Glory Cove, in Jolley, Mutton, and Merrill hollows, in Water, Agua, Tropic, Sheep Creek, Campbell, Ponderosa, and Cope canyons, near Bulberry and Riggs springs and Pasture Wash, and in the Yellow Creek drainages within the park and in the Sheep and Willis creek drainages, in Noon and Sheep canyons, near Pasture Wash, and along State Highway 54 outside of the park boundary.

*Globally*

This woodland association occurs in foothills and mesas from southern Colorado to south-central New Mexico, west along the Mogollon Rim of Arizona, and north into Utah and western Colorado.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common woodland occurs on ridges, canyonsides and bottoms, benches, plateaus, hills, valleys, and gullies. The sites are gentle to steep (2- to 30-degree slopes), occur between 2008 and 2383 m in elevation, and are oriented to all aspects. The ground surface has sparse to high exposure of bare soil, low to high cover of litter, sparse to moderate cover of small and large rocks, and sparse cover of downed wood. Litter depths range from 0-4.2 cm. Soils are rapidly drained clays, sandy clays, loams, sandy loams, silty clays, loamy sands, and silty clay loams that are derived from the Straight Cliffs Formation (Upper Unit), Claron Formation (Pink Member), Kaiparowitz Formation, Sevier Formation, Wahweep Formation, or New Alluvium.

*Globally*

This widespread woodland association is known from the Colorado Plateau and southern Rocky Mountains, occurring from south-central Colorado to south-central New Mexico, west along the Mogollon Rim of Arizona, and north into Utah and western Colorado. Elevations normally range from 1509-2665 m but may be higher in stands in southern New Mexico. Sites are variable but generally are relatively mesic. Stands occur on flat to moderate slopes along drainages and on mesatops, and on moderate to steep, sometimes rocky slopes of foothills, mountains and canyons, especially in draws where soil moisture is concentrated, or on northern aspects or where shaded by upper canyon walls. Stands are less common on hot south-facing slopes, unless they are located in a moisture-concentrating gully. Soils are variable and range from deep to shallow, silty clay to sandy loam, and are often gravelly or rocky. Litter from *Quercus gambelii* and other shrubs is often extensive (over 50% cover). Parent materials include alluvial, colluvial or eolian deposits derived from sandstone, shale, limestone and rhyolite.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (28-76% cover) and is characterized by the canopy trees *Pinus edulis* and *Juniperus osteosperma* or *Juniperus scopulorum* that range in height from 2-10 m, have dbh ranging from 14-45 cm, DRCs ranging from 13-101 cm, and provide <1-34% and <1-20% cover, respectively, and the tall shrub *Quercus gambelii* that provides 6-60% cover. An emergent tree layer of 10- to 20-m tall *Pinus ponderosa* provides sparse to low cover. The remaining shrubs include *Cercocarpus montanus, Amelanchier utahensis, Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata), Purshia tridentata, Symphoricarpos oreophilus, Arctostaphylos patula, Mahonia fremontii, Shepherdia rotundifolia, Chrysothamnus viscidiflorus, Artemisia nova, Artemisia tridentata ssp. vaseyana, Opuntia polyacantha*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and provides sparse cover. The bunch grasses *Achnatherum hymenoides, Elymus elymoides, Leymus salinus*, and *Poa fendleriana*, and the sedge *Carex rossii* often occur. Common forbs include *Balsamorhiza sagittata, Cordylanthus kingii, Pedicularis centranthera, Machaeranthera grindelioides, Arabis* spp., and *Hedysarum boreale*. Tree saplings provide sparse cover and include *Pinus edulis, Juniperus osteosperma*, and *Pseudotsuga menziesii*. Mosses and dark cyanobacteria provide sparse cover in some stands.

*Globally*

This widespread association is characterized by an open to moderately dense tree canopy (10-70% cover) codominated by *Pinus edulis* and *Juniperus* spp. 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 in northwestern New Mexico, northern Arizona and in Utah. *Juniperus scopulorum* is more common in higher elevation stands. An occasional *Pinus ponderosa* tree may be present is some stands. *Quercus gambelii* dominates the often patchy, moderately dense tall-shrub layer with at least 5% cover, but often with more than 25% cover. *Amelanchier utahensis, Cercocarpus montanus, Symphoricarpos oreophilus*, or species of *Yucca* and *Opuntia* are common shrub associates. Other shrubs, depending on geography, may include *Artemisia tridentata, Artemisia nova, Arctostaphylos patula, Cercocarpus ledifolius, Ephedra viridis, Fendlera rupicola, Gutierrezia sarothrae, Garrya* spp., *Mahonia fremontii, Ptelea trifoliata, Prunus* spp., *Quercus X pauciloba, Robinia neomexicana*, or *Rosa* spp. Herbaceous cover is variable, ranging from sparse to moderately dense, but generally dominated by graminoids (>5% cover) with scattered forbs. Associated graminoids include *Achnatherum hymenoides (= Oryzopsis hymenoides), Bouteloua gracilis, Carex geyeri, Carex rossii, Elymus elymoides, Festuca arizonica, Koeleria macrantha, Muhlenbergia montana, Poa fendleriana*, and *Schizachyrium scoparium*. Common forbs may include *Artemisia frigida, Balsamorhiza sagittata, Geranium caespitosum, Lepidium montanum, Machaeranthera grindelioides, Packera neomexicana, Thalictrum fendleri, Tetraneuris acaulis*, or *Vicia americana*.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis* |
| Tall shrub/sapling | *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |
| Short shrub/sapling | *Purshia tridentata* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus monosperma*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis* |
| Tall shrub/sapling | *Amelanchier utahensis*, *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Descurainia pinnata* (weedy native)

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pinyon-juniper woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terrain is gently rolling and sculpted by erosion; stand is multi-aged with trees of all sizes; *Quercus gambelii* is stunted with dieback on their tops; active slopes with large dirt and soil accumulations on the uphill sides of shrubs and trees; Gambel oak has been a consistent feature of the toeslopes and mesic bottoms, often growing in a dense band and tapering out as you move up or down the slope. The description is based on 2005 and 2006 field data (23 plots: BRCA.0002, BRCA.0005, BRCA.0068, BRCA.0071, BRCA.0131, BRCA.0138, BRCA.0150, BRCA.0170, BRCA.0175, BRCA.0201, BRCA.0300, BRCA.0301, BRCA.0303, BRCA.0306, BRCA.0308, BRCA.0310, BRCA.0316, BRCA.0318, BRCA.0320, BRCA.0333, BRCA.0339, BRCA.0401, BRCA.0403; and 16 observation points: BRCA.9033, BRCA.9043, BRCA.9044, BRCA.9055, BRCA.9060, BRCA.9071, BRCA.9080, BRCA.9219, BRCA.9221, BRCA.9222, BRCA.9225, BRCA.9231, BRCA.9245, BRCA.9249, BRCA.9251, BRCA.9252)and 2007 Accuracy Assessment (45 points: BRCA_AA.0151, BRCA_AA.0168, BRCA_AA.0174, BRCA_AA.0176, BRCA_AA.0216, BRCA_AA.0245, BRCA_AA.0343, BRCA_AA.0421, BRCA_AA.0496, BRCA_AA.0718, BRCA_AA.0729, BRCA_AA.0778, BRCA_AA.0871, BRCA_AA.1185, BRCA_AA.1194, BRCA_AA.1259, BRCA_AA.0009, BRCA_AA.0086, BRCA_AA.0116, BRCA_AA.0175, BRCA_AA.0299, BRCA_AA.0305, BRCA_AA.0330, BRCA_AA.0333, BRCA_AA.0505, BRCA_AA.0577, BRCA_AA.0632, BRCA_AA.0639, BRCA_AA.0640, BRCA_AA.0643, BRCA_AA.0658, BRCA_AA.0664, BRCA_AA.0670, BRCA_AA.0715, BRCA_AA.0762, BRCA_AA.0779, BRCA_AA.0899, BRCA_AA.0916, BRCA_AA.0991, BRCA_AA.1048, BRCA_AA.1049, BRCA_AA.1067, BRCA_AA.1176, BRCA_AA.1193, BRCA_AA.1205).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Coles

**REFERENCES:** Bassett 1987, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, Harmon 1980, Hess and Wasser 1982, Holm 1927, Isaacson 1967, Johnston 1987, Kallender 1959, Larson and Moir 1987, Marr et al. 1973b, Muldavin et al. 1994a, Muldavin et al. 2000b, Steinhoff 1978, Stuever and Hayden 1997a, Vories 1974, Warren et al. 1982, Western Ecology Working Group n.d., Wright 1972, 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)<br>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 3311 m 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 Claron 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* cover may exceed 1%. 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**

*Bryce Canyon National Park*

This sparse woodland is common, occurs on steep slopes and badland formations, and was sampled throughout the park, near Wall of Windows, Inspiration Point, Fairy Castle, the Queen's Garden, Seal Castle, Mormon Temple, Bristlecone Point, Chinese Wall, the Sewage Lagoons, and Shakespeare Point, adjacent to the northern park boundary and Bryce Point Road, east of Bryce Point, in Water, Little Henderson, and Fairyland canyons, and in the East Creek and Campbell Canyon drainages.

*Globally*

This association is known only from Capitol Reef, Bryce Canyon and Cedar Breaks national parks in southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common, sparse woodland occurs on ridges, hills, canyonsides, breaks, badlands, and knobs. Sites are moderate to steep (5- to 28-degree slopes), occur between 2169 and 2504 m in elevation, and are oriented to all aspects. The ground surface has sparse to moderate exposure of bare soil, sparse to low cover of litter, high cover of small rocks, sparse cover of large rocks, and sparse to low cover of downed wood. Litter depths range from 0-1.4 cm. Soils are rapidly drained silts, silty clay loams, clays, sandy clay loams, silty clays, and clay loams derived from the Claron Formation (Pink and White members).

*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**

*Bryce Canyon National Park*

Total vegetation cover is sparse to low (2-24% cover) and is characterized by the canopy tree *Pinus longaeva* that ranges in height from 2-10 m, has dbh ranging from 13-97 cm, and provides 0-7% cover. Associated canopy trees range from 2-10 m tall and include *Picea pungens, Pinus ponderosa, Pinus flexilis*, and *Pseudotsuga menziesii*, have a range of dbh from 12-60 cm, and contribute sparse to low cover. Subcanopy *Picea pungens, Pinus ponderosa, Pinus flexilis*, and *Pseudotsuga menziesii* trees from 2-5 m tall also contribute sparse to low cover. Shrubs may or may not be present with low cover and include *Cercocarpus montanus, Arctostaphylos patula, Juniperus communis, Purshia tridentata*, and *Gutierrezia sarothrae*. The herbaceous layer is moderate to high in floristic diversity and contributes sparse to low cover. Common graminoids include *Leymus salinus* and *Carex rossii*. Forbs provide sparse

cover and include *Eriogonum panguicense* and *Stenotus armerioides (= Haplopappus armerioides)*. Tree saplings up to 2 m tall provide sparse to low cover and include *Pinus longaeva, Pinus ponderosa, Pinus flexilis*, and *Juniperus scopulorum*.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus flexilis*, *Pinus longaeva* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus longaeva* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Aquilegia scopulorum* (G3?), *Eriogonum holmgrenii* (globally critically imperiled, G1), *Primula nevadensis* (globally imperiled, G2)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (23-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
association is known only from Capitol Reef National Monument. Until other data become available, there is no global information. There are few examples of community data from *Pinus longaeva* stands; as more data become available, we expect to be able to identify several types of intermountain bristlecone woodland.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Dead wood lying around and some snags scattered in the area; steep, erosional slopes with little upslope runoff to foster vegetation growth; rain runs off quickly and soil moisture is quite low; no real fire regime for this community, as there is not enough fuel or litter accumulation to carry a fire; bristlecone pine are well-adapted to these steep, Claron Formation slopes.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (18 plots: BRCA.0019, BRCA.0020, BRCA.0055, BRCA.0056, BRCA.0127, BRCA.0134, BRCA.0151, BRCA.0152, BRCA.0166, BRCA.0186, BRCA.0187, BRCA.0188, BRCA.0189, BRCA.0190, BRCA.0218, BRCA.0284, BRCA.0341,

BRCA.0349; and 2 observation points: BRCA.9025, BRCA.9029); and 2007 Accuracy Assessment (32 points: BRCA_AA.0005, BRCA_AA.0028, BRCA_AA.0031, BRCA_AA.0080, BRCA_AA.0159, BRCA_AA.0173, BRCA_AA.0193, BRCA_AA.0289, BRCA_AA.0301, BRCA_AA.0304, BRCA_AA.0309, BRCA_AA.0311, BRCA_AA.0314, BRCA_AA.0316, BRCA_AA.0321, BRCA_AA.0322, BRCA_AA.0324, BRCA_AA.0328, BRCA_AA.0367, BRCA_AA.0443, BRCA_AA.0499, BRCA_AA.0547, BRCA_AA.0656, BRCA_AA.0800, BRCA_AA.0809, BRCA_AA.0839, BRCA_AA.0884, BRCA_AA.0965, BRCA_AA.0993, BRCA_AA.1041, BRCA_AA.1102, BRCA_AA.0944).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**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)<br>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**
*Bryce Canyon National Park*
This woodland is common, occurs on habitats throughout the park and was sampled near the park entrance, north of the Visitor Center, along Bryce Point Road, Bryce Lodge, residential area, maintenance area, west and southwest of Sunset Campground, North Campground, Whiteman and Peek-a-boo trails, Whiteman Bench, Paria View, near Inspiration Point, Rainbow Point, Shakespeare Point, near Piracy Point, west of the Chinese Wall, Wall of Windows, Queen's Garden, west of Boat Mesa, Paunsaugunt Plateau, Bristlecone Point, below Piracy Point, Corral, Death, Jolley, and Oak hollows, south of Yellow Spring, Bulberry Spring, Yellow, East, and Upper Willis creeks, Sheep, Water, Little Henderson, Ponderosa, Fairyland, Bryce, Bridge, Campbell, and Tropic canyons, and Mossy Cave.

*Globally*
This coniferous woodland association has been reported from the Colorado Plateau (western Colorado and southern Utah) and the eastern Sierra Nevada.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This widespread woodland occurs on plateaus, mesas, parks, ridges, hills, breaks, in canyons, valleys, benches, and swales. Sites are flat to steep (0- to 36-degree slopes), occur between 2062 and 2603 m in elevation, and are oriented to all aspects. The ground surface has moderate to high cover of litter and duff, low 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 0-9.5 cm. Soils are rapidly drained silts, silty loams, silty clay loams, clay loams, sandy clay loams, sandy loams, and loams derived from the Claron Formation (Pink and White members), Straight Cliffs Formation (Upper Unit), Kaiparowitz Formation, and colluvium.

*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**

*Bryce Canyon National Park*

Total vegetation cover is low to dense (20-83% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 2-20 m, has dbh ranging from 12-69 cm, and provides 3-30% cover, and the short shrub *Arctostaphylos patula* that contributes <1-58% cover. Associated canopy trees include *Juniperus scopulorum, Pinus edulis, Pinus flexilis, Pinus longaeva*, and *Pseudotsuga menziesii* that contribute sparse to low cover. Subcanopy *Abies concolor, Cercocarpus ledifolius, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus flexilis, Pinus ponderosa*, and *Pseudotsuga menziesii* trees from 2-10 m tall also contribute sparse to low cover. Other shrubs that may be present with low to sparse cover include *Acer glabrum, Amelanchier utahensis, Cercocarpus montanus, Mahonia fremontii, Quercus gambelii, Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata), Sambucus caerulea, Ceanothus martinii, Chrysothamnus viscidiflorus, Juniperus communis, Purshia tridentata, Symphoricarpos oreophilus, Tetradymia canescens, Chrysothamnus depressus, Gutierrezia sarothrae, Mahonia repens*, and *Paxistima myrsinites*. The herbaceous layer is high in terms of floristic diversity and contributes sparse to moderate cover. Common graminoids include *Achnatherum hymenoides, Carex rossii, Elymus elymoides, Leymus salinus*, and *Poa fendleriana*. Forbs that contribute sparse to low cover include *Arabis perennans, Arenaria fendleri, Cirsium calcareum, Cryptantha abata, Eriogonum alatum, Erysimum capitatum (= Erysimum asperum), Tetraneuris acaulis (= Hymenoxys acaulis), Hymenopappus filifolius, Lithospermum multiflorum, Oenothera howardii, Pedicularis centranthera, Petradoria pumila*, and *Packera multilobata (= Senecio multilobatus)*. Seedling trees up to 2 m tall provide sparse cover and include *Abies concolor, Cercocarpus ledifolius, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus flexilis, Pinus ponderosa*, and *Pseudotsuga menziesii*. Species of moss provide sparse cover on a few sites.

*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**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pinus ponderosa* |
| Tree subcanopy | *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Quercus gambelii* |

| | |
|---|---|
| Short shrub/sapling | *Arctostaphylos patula*, *Purshia tridentata* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus scopulorum*, *Pinus ponderosa* |
| Short shrub/sapling | *Arctostaphylos patula* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Vulnerable**: *Cryptantha abata* (state-vulnerable, G3); **Exotic/Invasive**: *Achillea millefolium* (exotic), *Lactuca serriola* (exotic, Low/Insignificant)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
This plant association is seral in California.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand has established on gullied slope, fire history; spotty fire; ponderosa pine with some Douglas-fir, fire has resulted in dead shrubs and charred tree trunks; ecotone with spotty fire history, some old-growth trees; gentle slope with clumped distribution pattern for vegetation, greenleaf manzanita provides consistent cover; stand has even greenleaf manzanita layer, no apparent fire history; active steep, gravelly slope; evidence of fire, spotty in distribution; mixture of trees with ponderosa pine dominant, slope is active and rocky; ponderosa pine stand has a pinyon - juniper / greenleaf manzanita understory, Claron Formation rocks comprise the surface; Gambel oak and greenleaf manzanita codominant in understory, high ponderosa pine regeneration; predominantly Claron Formation rocks and boulders, many snags and logs, no fire evidence; stand near SH 12, human use evident, logging; dry aspect near trail, ponderosa pine is dominant; active Claron Formation slope, some root exposure for ponderosa pine from slope erosion; stand has higher cover of *Juniperus scopulorum*, thick litter layer; stand has extensive cover by greenleaf manzanita; scattered *Cercocarpus ledifolius* trees in stand; stand on hot, dry exposure, large rocks; cooler slope has more limber and bristlecone pines and Salinas wild rye cover; site is broad ridge with mature trees, area recently burned; stand is on a terrace with *Cercocarpus ledifolius* and Gambel oak present; rolling topography, ground is covered by Claron Formation gravel and rock, fire evidence strong; stand is analogous with Claron Formation distribution; southern exposure, dry slope of Claron Formation rocks, canopy of ponderosa pine open; stand has many ponderosa pine saplings among rock exposures, greenleaf manzanita monoculture as understory; site is steep Claron Formation slope that is gullied; rolling topography, mature to old-growth trees, recent fire with patchy pattern; stand is on Claron Formation slope, scattered ponderosa pine with a diverse understory; stand is gently rolling hills with Claron Formation rock surface; stand has pinyon-juniper understory; moderate sloping area of breaks supports dense cover by graminoids; stand is at base of low hills with Claron Formation exposure, evidence of fires; flat site supports open woodland, fire history; young ponderosa pines on a flat site, no fire history; mature stand of mixed conifer species; stand has mature ponderosa pine and saplings/seedlings, no apparent fire history; stand experienced several fire events; slope position drives vegetation distribution more than aspect; deeper colluvial deposits favor graminoids cover; stand is open pinyon-juniper woodland with emergent ponderosa pine; dense, healthy stand of ponderosa pine and greenleaf manzanita; ponderosa pine trees were thinned around park housing; stand on USFS-managed land has been selectively logged and subject to prescribed burning.

*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (33 plots: BRCA.0006, BRCA.0009, BRCA.0012, BRCA.0018, BRCA.0025, BRCA.0028, BRCA.0031, BRCA.0032, BRCA.0048, BRCA.0065, BRCA.0086, BRCA.0114, BRCA.0115, BRCA.0125, BRCA.0137, BRCA.0143, BRCA.0148, BRCA.0153, BRCA.0162, BRCA.0165, BRCA.0167, BRCA.0168, BRCA.0207, BRCA.0209, BRCA.0217, BRCA.0246, BRCA.0249, BRCA.0250, BRCA.0275, BRCA.0342, BRCA.0360, BRCA.0378, BRCA.0379; and 33 observation points: BRCA.9001, BRCA.9003, BRCA.9004, BRCA.9005, BRCA.9009, BRCA.9011, BRCA.9015, BRCA.9020, BRCA.9022, BRCA.9024, BRCA.9026, BRCA.9027, BRCA.9031, BRCA.9036, BRCA.9038, BRCA.9039, BRCA.9040, BRCA.9041, BRCA.9045, BRCA.9049, BRCA.9054, BRCA.9057, BRCA.9058, BRCA.9063, BRCA.9070, BRCA.9205, BRCA.9206, BRCA.9207, BRCA.9211, BRCA.9237, BRCA.9238, BRCA.9244, BRCA.9262) and 2007 Accuracy Assessment (70 points: BRCA_AA.0067, BRCA_AA.0074, BRCA_AA.0079, BRCA_AA.0212, BRCA_AA.0243, BRCA_AA.0246, BRCA_AA.0260, BRCA_AA.0272, BRCA_AA.0276, BRCA_AA.0277, BRCA_AA.0308, BRCA_AA.0327, BRCA_AA.0348, BRCA_AA.0371, BRCA_AA.0377, BRCA_AA.0408, BRCA_AA.0418, BRCA_AA.0426, BRCA_AA.0427, BRCA_AA.0429, BRCA_AA.0433, BRCA_AA.0435, BRCA_AA.0438, BRCA_AA.0448, BRCA_AA.0452, BRCA_AA.0463, BRCA_AA.0466, BRCA_AA.0470, BRCA_AA.0471, BRCA_AA.0474, BRCA_AA.0506, BRCA_AA.0540, BRCA_AA.0573, BRCA_AA.0588, BRCA_AA.0593, BRCA_AA.0598, BRCA_AA.0600, BRCA_AA.0602, BRCA_AA.0617, BRCA_AA.0657, BRCA_AA.0824, BRCA_AA.0861, BRCA_AA.0862, BRCA_AA.0865, BRCA_AA.0892, BRCA_AA.0919, BRCA_AA.0925, BRCA_AA.0968, BRCA_AA.0986, BRCA_AA.0989, BRCA_AA.0998, BRCA_AA.1118, BRCA_AA.1119, BRCA_AA.1149, BRCA_AA.1159, BRCA_AA.1168, BRCA_AA.1172, BRCA_AA.1178, BRCA_AA.1196, BRCA_AA.1231, BRCA_AA.1239, BRCA_AA.1242, BRCA_AA.0057, BRCA_AA.0070, BRCA_AA.0652, BRCA_AA.0685, BRCA_AA.0728, BRCA_AA.0731, BRCA_AA.0733, BRCA_AA.0921).
*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 / Artemisia nova* Woodland

### Ponderosa Pine / Black Sagebrush Woodland

| | |
|---|---|
| CODE | CEGL000846 |
| 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)<br>Ponderosa Pine Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This Colorado Plateau woodland has been reported from mountains and plateaus in southern Utah and northern Arizona. Stands occur on rocky ridges and benches with various aspects. Elevation ranges from 2100-2750 m (6900-9000 feet). Substrates are typically shallow, gravelly loam, clay loam or silt loam soils derived from basalt or a mix of colluvial shale and sandstone, sometimes with an impermeable subsurface horizon that restricts rooting. Some sites are known to have seasonally high water tables. The vegetation is characterized by an open tree canopy (5-30% cover) that is dominated by *Pinus ponderosa*. Scattered *Juniperus scopulorum* or *Pinus flexilis* trees may also be present. *Artemisia nova* or *Artemisia arbuscula* dominates the typically sparse dwarf-shrub layer with 5-20% cover. Occasionally, this association may occur as a very sparse woodland, with total vegetation cover not exceeding 15%. Other shrub species present may include *Purshia tridentata, Chrysothamnus viscidiflorus, Ericameria parryi, Gutierrezia sarothrae, Quercus gambelii, Symphoricarpos oreophilus*, and *Tetradymia canescens*. If *Quercus*

*gambelii* is present, it has less than 5% cover and much less cover than *Artemisia*. The sparse herbaceous layer (<10% cover) is primarily composed of graminoids with scattered forbs and includes *Achnatherum hymenoides, Bouteloua gracilis, Carex rossii, Elymus elymoides, Leymus salinus (= Elymus salinus), Piptatherum micranthum, Poa fendleriana, Poa secunda, Eriogonum alatum, Eriogonum racemosum, Opuntia* spp., and *Penstemon caespitosus*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This unusual woodland occupies diverse habitats and was sampled east of Buck Knoll and near the northern park boundary, and observed at five Accuracy Assessment points in 2007.

*Globally*

This association occurs on mountains and plateaus in southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This woodland occurs on a plateau and on a bench. Sites are gentle (4- to 5-degree slopes), occur between 2340 and 2442 m in elevation, and are oriented to the west and north. The ground surface has high cover of litter and duff, sparse to low cover of large and small rocks, sparse exposure of bare soil, and sparse cover of downed wood. Litter depths range from 0-2.6 cm. Soils are rapidly drained sandy clay loams and silt loams derived from the Claron Formation (Pink Member).

*Globally*

This Colorado Plateau woodland has been reported from hills, mountains and plateaus in southern Utah and northern Arizona. Stands occur on rocky ridges and benches with various aspects. Sites are on gentle to moderate slopes. Elevation ranges from 2100-2750 m (6900-9000 feet). Substrates are typically shallow, gravelly loam, sandy loam, clay loam or silt loam soils derived from basalt or a mix of colluvial shale and sandstone, sometimes with an impermeable subsurface horizon that restricts rooting. Some sites are known to have seasonally high water tables.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (32-34% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-20 m, has dbh ranging from 17-61 cm, and provides 12-14% cover, and *Artemisia nova* dwarf-shrubs that provide 7% cover. An emergent tree layer of 15- to 20-m tall *Pinus ponderosa* provides sparse cover in one stand. The subcanopy layer is present in one stand, provides sparse cover, and includes 2- to 5-m tall *Juniperus scopulorum, Pinus edulis*, and *Pinus ponderosa*. Other shrubs present include *Chrysothamnus viscidiflorus, Purshia tridentata, Tetradymia canescens, Artemisia frigida, Chrysothamnus depressus*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and contributes sparse cover. Common graminoids include *Carex rossii, Elymus elymoides*, and *Koeleria macrantha*. Forbs include *Castilleja linariifolia, Eriogonum racemosum*, and *Packera multilobata (= Senecio multilobatus)*. Seedling trees up to 2 m tall provide sparse cover and include *Juniperus scopulorum, Picea pungens*, and *Pinus ponderosa*.

*Globally*

This association is characterized by a typically open (5-30% cover) to moderately dense (60%) tree canopy that is dominated by *Pinus ponderosa*. Scattered *Juniperus monosperma, Juniperus scopulorum, Pinus edulis*, or *Pinus flexilis* trees may also be present. *Artemisia nova* dominates the typically sparse dwarf-shrub layer with 5-20% cover. Occasionally, this association may occur as a very sparse woodland, with total vegetation cover not exceeding 15%. Other shrub species present may include *Purshia tridentata, Chrysothamnus viscidiflorus, Ericameria parryi, Gutierrezia sarothrae, Quercus gambelii, Symphoricarpos oreophilus*, and *Tetradymia canescens*. If *Quercus gambelii* is present, it has less than 5% cover and much less cover than *Artemisia*. The sparse but often diverse herbaceous layer (<10% cover) is primarily composed of graminoids with scattered forbs and includes *Achnatherum hymenoides, Antennaria parvifolia, Bouteloua gracilis, Carex rossii, Elymus elymoides, Erigeron divergens, Leymus salinus (= Elymus salinus), Piptatherum micranthum, Poa fendleriana, Poa secunda, Eriogonum alatum, Eriogonum racemosum, Hymenoxys richardsonii, Ipomopsis aggregata, Eriogonum racemosum, Opuntia* spp., *Penstemon caespitosus*, and *Sporobolus contractus*.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Herb (field) | *Artemisia nova* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Herb (field) | *Artemisia nova* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Trifolium repens* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Deep soil of gently rolling hills, multiple-aged stand with open canopy; hot, dry slope, rocky substrate, diverse layer of forbs and grasses.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0181, BRCA.0354); and 2007 Accuracy Assessment (5 points: BRCA_AA.0038, BRCA_AA.0046, BRCA_AA.0062, BRCA_AA.0105, BRCA_AA.0362).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, FEIS 2001, Johnston 1987, Larson and Moir 1987, Roberts et al. 1992, Stuever and Hayden 1997b, West and Hassan 1985, Western Ecology Working Group n.d., Wright et al. 1979, Youngblood and Mauk 1985

## *Pinus ponderosa / Cercocarpus montanus* Woodland

## Ponderosa Pine / Alderleaf Mountain-mahogany Woodland

| | |
|---|---|
| CODE | CEGL000851 |
| 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)<br>Ponderosa Pine Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This *Pinus ponderosa* woodland occurs on dry rocky slopes in the southern Rocky Mountains and upper plateaus of southern Utah, from 1700 to 2710 m (5570-8900 feet) elevation. Typically, this association occurs just above the shrubland zone on shallow, rocky, poorly developed soils. Aspects are predominately south-, southeast-, and southwest-facing slopes that are moderate to steep (18-60%). This association is an open woodland with scattered *Pinus ponderosa* trees, generally with less than 50% cover, over a matrix of shrubs. *Juniperus scopulorum* and *Pseudotsuga menziesii* individuals may be present. The community is strongly dominated by *Cercocarpus montanus*. Other shrubs present may include *Acer grandidentatum, Arctostaphylos patula, Artemisia frigida, Ceanothus martinii, Rhus trilobata, Ribes cereum, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus*, and *Yucca glauca*. Herbaceous cover ranges from 10-70%, depending on shrub density. Grasses are typically more abundant than forbs and commonly include one or more of the following species: *Bromus tectorum, Elymus albicans, Festuca arizonica, Carex rossii, Elymus lanceolatus, Hesperostipa comata, Bouteloua gracilis, Muhlenbergia montana*, and *Koeleria macrantha (= Koeleria cristata)*. Forb species include *Artemisia ludoviciana, Geranium caespitosum, Heterotheca villosa, Leucocrinum montanum, Allium textile, Grindelia subalpina, Argentina anserina, Cryptantha thyrsiflora*, and *Eriogonum umbellatum*. Exposed bedrock outcrops or bare ground are common, comprising approximately 25-35% cover.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was observed at just three Accuracy Assessment points in 2007.

*Globally*

This association is known primarily from the Colorado Rocky Mountains. It is thought to occur north to Wyoming and south to New Mexico. It may occur disjunctly in the Black Hills (eastern Wyoming, South Dakota).

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This ponderosa pine woodland occurs on steep (22-30%) mid- and upper slopes with northern exposures at 2178-2320 m in elevation. Ground cover is mostly litter (80-90%) with some bare ground. Soils are sandy loams derived from the Pink Clarion Formation.

*Globally*

This woodland occurs on the driest aspects that support coniferous woodlands of *Pinus ponderosa* in the southern Rocky Mountains at 1700 to 2710m (5570-8900 feet) elevation. Typically, this association occurs on dry rocky hillsides just above the shrubland zone on shallow, rocky, poorly developed soils. Aspects are predominately south-, southeast-, and southwest-facing, on slopes that are moderate to steep (18-60%). At higher elevations, the association occupies ridgetops and adjacent upper slopes. Exposed bedrock outcrops or bare ground are common, comprising approximately 25-35% cover.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

This open woodland is characterized by scattered *Pinus ponderosa* often mixed with *Pinus edulis, Juniperus osteosperma*, and *Pseudotsuga menziesii*. *Cercocarpus montanus* forms a dense subcanopy/tall-shrub layer with 7-20% cover. Other shrubs may include *Quercus gambelii, Acer grandidentatum, Arctostaphylos patula, Symphoricarpos oreophilus*, and *Ceanothus martinii*. The herbaceous layer is very sparse, with less than 10% cover.

*Globally*

This woodland type comprises dry foothills vegetation with scattered *Pinus ponderosa* trees, generally with less than 50% cover. *Juniperus scopulorum* and *Pseudotsuga menziesii* individuals may be present but never abundant. The community is open in appearance and characterized by a matrix of shrubs, strongly dominated by *Cercocarpus montanus*. Other shrubs present may include *Rhus trilobata, Ribes cereum, Artemisia frigida, Purshia tridentata, Yucca glauca*, and *Quercus gambelii*. Herbaceous cover ranges from 10-70%, depending on shrub density. Grasses are typically more abundant than forbs and commonly include one or more of the following species: *Bromus tectorum, Elymus albicans, Festuca arizonica, Carex rossii, Elymus lanceolatus, Hesperostipa comata, Bouteloua*

*gracilis, Muhlenbergia montana*, and *Koeleria macrantha (= Koeleria cristata)*. Forb species include *Artemisia ludoviciana, Geranium caespitosum, Heterotheca villosa, Leucocrinum montanum, Allium textile, Grindelia subalpina, Argentina anserina, Cryptantha thyrsiflora*, and *Eriogonum umbellatum*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Tall shrub/sapling | *Cercocarpus montanus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Shrub/sapling (tall & short) | *Cercocarpus montanus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: This description is based on 2007 Accuracy Assessment (3 points: BRCA_AA.0059, BRCA_AA.0094, BRCA_AA.0221).
*Local Description Authors:* G. Kittel
*Global Description Authors:* G. Kittel, mod. S.L. Neid

**REFERENCES:** Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, DeVelice et al. 1986, Driscoll et al. 1984, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Johnston 1987, Kahler 1973, Lynn et al. n.d., Peet 1975, Peet 1981, Thilenius 1971, Thilenius 1972, Western Ecology Working Group n.d.

## *Pinus ponderosa / Hesperostipa comata* Colorado Plateau Woodland [Park Special]

### Ponderosa Pine / Needle-and-Thread Colorado Plateau Woodland

| | |
|---|---|
| CODE | CEPS005361 |
| 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)<br>Ponderosa Pine Woodland Alliance |

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland occurs on deep, mesic soils at low elevations and was sampled near Paria View, in Mud Canyon, and in Oak Hollow.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This woodland occurs in valleys. Sites are gentle (1- to 3-degree slopes), occur between 2435 and 2533 m in elevation, and are oriented to the north and south. The ground surface has moderate to high cover of litter and duff, no to moderate cover of small rocks, sparse to low exposure of bare soil, and sparse to low cover of downed wood. Litter and duff measure from 0-3 cm deep. Soils are rapidly drained and derived from the Claron Formation (White Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (30-86% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 10-15 m, has 16-63 cm dbh, and provides 10-14% cover; and the medium-tall bunchgrass *Hesperostipa comata* that contributes 4-11% cover. The subcanopy layer provides sparse cover, ranges from 5-10 m tall, and includes *Juniperus scopulorum, Populus tremuloides, Pseudotsuga menziesii*, and *Pinus ponderosa*. Shrubs that may be present with low to sparse cover include *Amelanchier utahensis, Arctostaphylos patula, Juniperus communis, Chrysothamnus viscidiflorus, Symphoricarpos oreophilus*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and provides sparse to low cover. Associated graminoids include *Achnatherum pinetorum, Carex rossii, Elymus elymoides, Poa fendleriana*, and the non-native *Poa pratensis*. Forbs include *Antennaria parvifolia, Cirsium calcareum*, and *Packera multilobata (= Senecio multilobatus)*. Tree saplings provide sparse to low cover and include *Abies concolor, Juniperus scopulorum, Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus scopulorum* |
| Tree subcanopy | *Populus tremuloides* |
| Short shrub/sapling | *Juniperus communis* |
| Herb (field) | *Achnatherum pinetorum*, *Hesperostipa comata*, *Poa pratensis* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (8-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: One stand experienced a recent burn that killed all small trees and a few mature trees; quaking aspen form an understory in one stand and are regenerating; mature ponderosa pine stand with decadent quaking aspen trees.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (2 plots: BRCA.0080, BRCA.0169; and 1 observation point: BRCA.9212) and 2007 Accuracy Assessment (1 point: BRCA_AA.0269).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus ponderosa / Leymus salinus* Woodland [Provisional]

## Ponderosa Pine / Saline Wildrye Woodland

| | |
|---|---|
| CODE | CEGL005362 |
| 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)<br>Ponderosa Pine Woodland Alliance |

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*
This open woodland is described only from Bryce Canyon National Park on the Paunsaugunt Plateau in southern Utah. This common woodland occurs on hillslopes, flat mesatops, in swales and valley bottoms, between 2136 and 2465 m in elevation, at all aspects. Soils range from rapidly drained loams and sandy loams to silty clays. The vegetation is characterized by the canopy tree *Pinus ponderosa* with 2-49% cover, and the medium-tall bunchgrass *Leymus salinus* that contributes 3-32% cover. Other trees present may include *Juniperus scopulorum, Pinus flexilis, Pinus edulis*, and *Pseudotsuga menziesii*. A few scattered shrubs may include *Ceanothus martinii, Chrysothamnus viscidiflorus, Purshia tridentata, Symphoricarpos oreophilus, Tetradymia canescens, Artemisia nova, Chrysothamnus depressus, Gutierrezia sarothrae*, and *Mahonia repens*. The herbaceous layer has sparse to moderate cover. Additional graminoids include *Achnatherum hymenoides, Carex rossii, Elymus elymoides, Hesperostipa comata, Koeleria macrantha*, and *Poa fendleriana*. Various forbs are also present at low cover, and a few stands have sparse cover of moss or biotic soil crust (dark cyanobacteria, lichens, and mosses).

**DISTRIBUTION**

*Bryce Canyon National Park*

This woodland is common and occurs on gentle slopes with deep soils. It was sampled near the park entrance, Visitor Center, North Campground, sewage lagoons, northern park boundary, Paria Viewpoint, southwest of Boat Mesa, along the road to and on Fairyland Point, south of Fairyland Point, and in Water and Little Henderson canyons.

*Globally*

Data are not available.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common woodland occurs on hills, plateaus, mesas, plains, swales, and valley bottoms and slopes. Sites are flat to steep (0- to 20-degree slopes), occur between 2136 and 2465 m in elevation, and are oriented to all aspects. The ground surface has sparse to high cover of litter and duff, no to moderate cover of small and large rocks, low to high exposure of bare soil, and sparse cover of downed wood. Litter and duff measure from 0-3.2 cm deep. Soils are rapidly drained loams, silty clay loams, clay loams, sandy loams, sandy clay loams, silty clays, and silts derived from the Claron Formation (Pink and White members), or from New Alluvium.

*Globally*

Data are not available.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to dense (18-98% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-20 m, has 12-86 cm dbh, and provides 2-49% cover, and the medium-tall bunchgrass *Leymus salinus* that contributes 3-32% cover. Associated canopy trees include 5- to 20-m tall *Juniperus scopulorum, Pinus flexilis*, and *Pseudotsuga menziesii* that provide low cover. The subcanopy layer provides sparse cover, ranges from 2-10 m tall, and includes *Juniperus scopulorum, Pinus edulis, Pinus ponderosa*, and *Pseudotsuga menziesii*. Shrubs that may be present include *Ceanothus martinii, Chrysothamnus viscidiflorus, Purshia tridentata, Symphoricarpos oreophilus, Tetradymia canescens, Artemisia nova, Chrysothamnus depressus, Gutierrezia sarothrae*, and *Mahonia repens*. The herbaceous layer is floristically diverse and provides sparse to moderate cover. Associated graminoids include *Achnatherum hymenoides, Carex rossii, Elymus elymoides, Hesperostipa comata, Koeleria macrantha*, and *Poa fendleriana*. Forbs include *Arenaria fendleri, Cirsium calcareum, Eriogonum racemosum, Erysimum capitatum (= Erysimum asperum), Hymenopappus filifolius, Lithospermum multiflorum, Oenothera howardii, Petradoria pumila, Potentilla crinita*, and *Packera multilobata (= Senecio multilobatus)*. Tree saplings provide sparse to low cover and include *Juniperus scopulorum, Pinus flexilis*, and *Pinus ponderosa*. A few stands have sparse cover by moss species or biotic soil crust (dark cyanobacteria, lichens, and mosses).

*Globally*

Data are not available.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pinus ponderosa* |
| Herb (field) | *Hesperostipa comata*, *Leymus salinus*, *Poa fendleriana* |

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Agropyron cristatum* (exotic, Medium/Low), *Bromus tectorum* (exotic, High), *Lactuca serriola* (exotic, Low/Insignificant), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low), *Trifolium repens* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (8-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Flat site between low hills, young ponderosa pine with grassy understory; park-like, even-aged stand of ponderosa pine, fire scarring; deep, gravelly soils support graminoids not greenleaf manzanita; open mixed-age stand of ponderosa pine and Douglas-fir, scattered rocks on deep soil; very young and even-aged stand of ponderosa pine with a few mature trees, recently burned; outcrops and cobbles on one site, recently burned; large park-like ponderosa pine stand with grasses over 1 m tall, recently burned; rolling topography results in patchy distribution of trees and shrubs, recent fire eliminated many shrubs; site is flat bottomland of Claron Formation origin, sparse vegetation; thinner drier soils over bedrock, slightly elevated from swale, recent prescribed fire; intense ground fire removed most shrubs and litter, limestone rocks armor the ground surface; white limestone rocks on Pink Claron Formation slope, long fire history; open woodland, fire history; mixed stand, fire history; flat area supporting multi-aged stand of ponderosa pine.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (15 plots: BRCA.0027, BRCA.0088, BRCA.0089, BRCA.0090, BRCA.0094, BRCA.0095, BRCA.0105, BRCA.0142, BRCA.0145, BRCA.0205, BRCA.0214, BRCA.0220, BRCA.0282, BRCA.0287, BRCA.0350; and 1 observation point: BRCA.9010) and 2007 Accuracy Assessment (19 points: BRCA_AA.0036, BRCA_AA.0055, BRCA_AA.0085, BRCA_AA.0112, BRCA_AA.0125, BRCA_AA.0181, BRCA_AA.0199, BRCA_AA.0213, BRCA_AA.0227, BRCA_AA.0232, BRCA_AA.0249, BRCA_AA.0266, BRCA_AA.0454, BRCA_AA.0501, BRCA_AA.0541, BRCA_AA.1028, BRCA_AA.0187, BRCA_AA.0482, BRCA_AA.1237).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *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)<br>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**

*Bryce Canyon National Park*

This woodland is common, occurs on Claron Formation exposures, and was sampled along State Highway 54, near the northern park boundary, at the park entrance and Bryce Lodge, at the Sunset Camper Store, south and southwest of Sunset Campground, on Shakespeare Point, in Shinglemill Swale, and in Water and Little Henderson canyons.

*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**

*Bryce Canyon National Park*

This common woodland occurs on plateaus, plains, hills, slopes, swales, valley floors, and terraces adjacent to washes. Sites are flat to moderately sloped (0- to 14-degree slopes), occur between 2196 and 2428 m in elevation, and are oriented to all aspects. The ground surface has moderate to high cover of litter and duff, sparse to moderate cover of large and small rocks, sparse to moderate exposure of bare soil, and sparse cover of downed wood. Litter depths range from 0-6.1 cm. Soils are rapidly drained loams, sandy loams, sandy clay loams, silty clay loams, clay loams, silt loams, and silty clays derived from Claron Formation (Pink Member) and New 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**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (25% -79% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-20 m, has dbh ranging from 12-87 cm, and provides 4-35% cover, and *Purshia tridentata* short shrubs that provide 3-30% cover. Associated canopy trees include *Juniperus scopulorum, Pinus edulis*, and *Pseudotsuga menziesii* that contribute sparse cover. Subcanopy *Juniperus scopulorum, Pinus edulis, Pinus flexilis*, and *Pinus ponderosa*, trees from 2-5 m tall also contribute sparse to low cover. Other shrubs present include *Cercocarpus montanus, Quercus gambelii, Arctostaphylos patula, Ceanothus martinii, Chrysothamnus viscidiflorus, Symphoricarpos oreophilus, Tetradymia canescens, Artemisia nova, Chrysothamnus depressus, Gutierrezia sarothrae*, and *Mahonia repens*. The herbaceous layer is high in floristic diversity and contributes sparse to moderate cover. Common graminoids include *Achnatherum hymenoides, Carex rossii, Elymus elymoides, Hesperostipa comata, Koeleria macrantha, Leymus salinus*, and *Poa fendleriana*. Forbs include *Arenaria*

*fendleri, Eriogonum racemosum, Erysimum capitatum (= Erysimum asperum), Hymenopappus filifolius, Hymenoxys richardsonii, Petradoria pumila*, and *Packera multilobata (= Senecio multilobatus)*. Seedling trees up to 2 m tall provide sparse cover and include *Juniperus scopulorum, Pinus edulis*, and *Pinus ponderosa*.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |
| Short shrub/sapling | *Purshia tridentata* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* var. *scopulorum* |
| Shrub/sapling (tall & short) | *Purshia tridentata* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Tragopogon dubius* (exotic, Medium/Low), *Trifolium repens* (exotic, Medium/Low)

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Open woodland with clumped distribution of shrubs; stand occurs on USFS-managed land, thinned community of widely spaced trees and dense antelope bitterbrush shrubs; burn caused patchy distribution of antelope bitterbrush; multi-aged stand occurs on limestone gravel and rocks; open forest stand with vigorous understory; evidence of logging in one stand, stumps present;

stand has large snags and large downed wood, shrubs are drought-stressed; occurs as a narrow strip of vegetation on wash banks; old-growth stand with an abundance of fuel.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (11 plots: BRCA.0013, BRCA.0014, BRCA.0033, BRCA.0116, BRCA.0144, BRCA.0208, BRCA.0210, BRCA.0211, BRCA.0280, BRCA.0345, BRCA.0352; and 4 observation points: BRCA.9002, BRCA.9019, BRCA.9210, BRCA.9230) and 2007 Accuracy Assessment (27 points: BRCA_AA.0011, BRCA_AA.0015, BRCA_AA.0030, BRCA_AA.0032, BRCA_AA.0182, BRCA_AA.0255, BRCA_AA.0285, BRCA_AA.0298, BRCA_AA.0303, BRCA_AA.0315, BRCA_AA.0318, BRCA_AA.0319, BRCA_AA.0339, BRCA_AA.0369, BRCA_AA.0376, BRCA_AA.0378, BRCA_AA.0385, BRCA_AA.0399, BRCA_AA.0461, BRCA_AA.0484, BRCA_AA.0562, BRCA_AA.0970, BRCA_AA.1030, BRCA_AA.1243, BRCA_AA.0225, BRCA_AA.0247).
*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

## *Pinus ponderosa / Quercus gambelii* Woodland

## Ponderosa Pine / Gambel Oak Woodland

| | |
|---|---|
| CODE | CEGL000870 |
| 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)<br>Ponderosa Pine Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This major ponderosa pine woodland is widespread and has been reported from foothills, mountains and plateaus from Colorado to Texas, west to Arizona and Nevada. Elevation ranges from 1830-2800 m (6000-9200 feet). Stands often occur along drainages, on lower and middle slopes and benches on all aspects. Soils are typically shallow and rocky, ranging from sandy loams to clay loams. At El Malpais National Monument in western New Mexico, it generally occurs on rolling lava plateaus, steep sideslopes of volcano craters, on gentle toeslopes of low cinder hills, or on sandstone outcrops. Substrates are derived from basalt or sandstone, with rock, gravel, and occasional patches of sandy soil. Litter is often abundant in patches. *Pinus ponderosa* dominates or sometimes codominates the sparse to moderately dense tree canopy with *Pinus edulis* and *Juniperus* spp. *Pseudotsuga menziesii* is accidental and *Abies concolor* is not present. *Quercus gambelii* dominates both the subcanopy (tree form, if present) and the typically moderately dense tall-shrub layer consisting of dense clumps of oak. *Quercus gambelii* must have at least 5% cover, but there is frequently over 25%. At higher elevations, the *Quercus gambelii* are more treelike, and *Symphoricarpos oreophilus* will be present with significant cover in the short-shrub layer. At lower elevations, scattered *Artemisia tridentata ssp. vaseyana, Pinus edulis*, and *Juniperus osteosperma* are often present. At El Malpais, *Forestiera pubescens* is the most commonly occurring shrub, along with occasional *Ribes cereum*. Other common shrub species may include *Amelanchier* spp., *Mahonia repens*, and *Rosa woodsii*. The herbaceous layer is generally sparse and composed of mostly graminoids and scattered forbs.

**DISTRIBUTION**

*Bryce Canyon National Park*
This woodland is common, occupies deep, mesic soils and was sampled in Bryce, Cope, Bulldog and Swamp canyons, Mutton Hollow, Sheep Creek, Ponderosa Ridge, Willis Creek headwaters and Bulberry Spring.

*Globally*
This ponderosa pine woodland association is widespread in the southern Rocky Mountains and southwestern U.S. and occurs in foothills, mountains and plateaus from Colorado to Trans-Pecos Texas, west to Arizona and Nevada.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This common woodland occurs on canyon bottoms and valley floors, on canyonsides, hills, and ridges, and on wash terraces. Sites are gentle to steep (3- to 30-degree slopes), occur between 2051 and 2396 m in elevation, and are oriented to all aspects. The ground surface has low to high cover of litter and duff, sparse to high cover of large and small rocks, sparse to moderate exposure of bare soil, and sparse cover of downed wood. Litter and duff depths range from 0-5.7 cm. Soils are rapidly drained sandy loams, loams, silty clays, silty clay loams, and clay loams derived from the Straight Cliffs Formation (Upper Unit), Claron Formation (Pink Member), or New Alluvium.

*Globally*
This woodland association is widespread and has been reported from foothills, mountains and plateaus from Colorado to Trans-Pecos Texas, west to Arizona and Nevada. Elevation ranges from 1830-2800 m (6000-9200 feet). Stands often occur along drainages, on lower and middle slopes and benches on all aspects. Slopes are typically gentle or moderate, but may also be steep (>45%). Soils are typically shallow and rocky ranging from sandy loams to clay loams. Parent materials are commonly sandstones, but fractured limestone, basalt, andesite, and alluvium are also reported. At El Malpais National Monument in western New Mexico, it gently occurs on rolling lava plateaus, steep sideslopes of volcano craters, on gentle toeslopes of low cinder hills, or on sandstone outcrops. Substrates are derived from basalt or sandstone, with rock, gravel, and occasional patches of sandy soil. High litter cover (70-90%) about 5 cm deep is common in many stands. Rock outcrops (about 10%) and some bare soil are not uncommon. This conifer woodland transitions to *Quercus gambelii* shrubland in drier sites and at lower elevations. This community is the highest elevation *Pinus ponderosa* / oak woodland present in Trans-Pecos Texas. It typically grades downslope to *Pinus ponderosa / Quercus hypoleucoides* Woodland (CEGL000872).

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (27->99% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-20 m, has dbh ranging from 13-63 cm, and provides 4-26% cover, and *Quercus gambelii* tall shrubs that provide 6-66% cover. The associated canopy tree *Pseudotsuga menziesii* provides sparse cover. The subcanopy layer is 2-5 m tall, provides sparse to low cover, and includes *Cercocarpus ledifolius, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus ponderosa*, and *Pseudotsuga menziesii*. Other shrubs that may be present include *Acer grandidentatum, Amelanchier utahensis, Betula occidentalis, Cercocarpus montanus, Peraphyllum ramosissimum, Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata), Arctostaphylos patula, Ceanothus martinii, Chrysothamnus viscidiflorus, Juniperus communis, Purshia tridentata, Tetradymia canescens, Symphoricarpos oreophilus, Mahonia repens*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and contributes sparse to low cover. Common graminoids include *Achnatherum hymenoides, Carex rossii, Elymus elymoides, Leymus salinus*, and *Poa fendleriana*. Forbs include *Achillea millefolium, Hymenoxys richardsonii, Lithospermum multiflorum*, and *Solidago velutina*. Seedling trees up to 2 m tall provide sparse cover and include *Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus ponderosa*, and *Pseudotsuga menziesii*.

*Globally*
This broadly defined coniferous woodland is widespread and is characterized by a sparse to moderately closed evergreen needle-leaved tree canopy dominated by *Pinus ponderosa*, or sometimes codominated by *Pinus edulis* and scattered *Juniperus scopulorum, Juniperus monosperma*, or *Juniperus osteosperma*. In southern stands *Juniperus deppeana* and *Pinus strobiformis* may be present to codominant. *Pseudotsuga menziesii* is accidental and *Abies concolor* is not present. *Quercus gambelii* dominates both the subcanopy (tree form, if present) and the typically moderately dense tall-shrub layer, which consists of dense clumps of oak. This community must have at least 5% cover of *Quercus gambelii*, but there is frequently over 25%. At higher elevations, the *Quercus gambelii* are more

treelike, and *Symphoricarpos oreophilus* will be present with significant cover in a short-shrub layer. At lower elevations, scattered *Artemisia tridentata ssp. vaseyana, Pinus edulis*, and *Juniperus osteosperma* are often present. At El Malpais, *Forestiera pubescens* is the most commonly occurring shrub, along with occasional *Ribes cereum*. Other common shrub species may include *Arctostaphylos patula, Amelanchier* spp., *Cercocarpus montanus, Juniperus communis, Mahonia repens, Robinia neomexicana, Rosa woodsii*, and *Shepherdia rotundifolia*. The herbaceous layer is generally sparse (<10% cover) but may equal the shrub cover. It is composed of mostly graminoids, such as *Bouteloua gracilis, Elymus elymoides, Festuca arizonica, Koeleria macrantha, Muhlenbergia longiligula, Muhlenbergia montana, Poa fendleriana, Schizachyrium scoparium*, and *Carex* spp., especially *Carex geyeri* and *Carex rossii*. Scattered forbs include *Artemisia ludoviciana, Balsamorhiza sagittata, Eriogonum* spp., *Erigeron* spp., *Hymenoxys* spp., *Lithospermum multiflorum, Packera multilobata*, and *Wyethia amplexicaulis*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus scopulorum* |
| Tall shrub/sapling | *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Tall shrub/sapling | *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Chenopodium leptophyllum* (weedy native)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
This ponderosa pine woodland is a broadly defined plant association. Stuever and Hayden (1997b) report seven phases for this plant association: the *Quercus gambelii, Festuca arizonica, Muhlenbergia longiligula, Pinus edulis, Muhlenbergia montana, Bouteloua gracilis*, and *Robinia neomexicana* phases. More classification review is needed to further define the relationships between these phases and other similar plant associations.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand is narrow and has established on wash banks, cattle grazing evident; stand occurs in canyon bottom near the channel, mostly young trees; open forest stand with historic fire evidence; steep slope of Pink Claron Formation; treelike Gambel oak in a braided, rocky wash channel; 2002 burn effects on Gambel oak and ponderosa pine trees, Gambel oak is resprouting successfully; deep, fine soils.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (8 plots: BRCA.0072, BRCA.0093, BRCA.0163, BRCA.0164, BRCA.0178, BRCA.0311, BRCA.0356, BRCA.0357; and 1 observation point: BRCA.9215), and 2007 Accuracy Assessment (21 points: BRCA_AA.0358, BRCA_AA.0518,

BRCA_AA.0534, BRCA_AA.0552, BRCA_AA.0582, BRCA_AA.0608, BRCA_AA.0620, BRCA_AA.0688, BRCA_AA.0797, BRCA_AA.0878, BRCA_AA.0920, BRCA_AA.1077, BRCA_AA.1093, BRCA_AA.1175, BRCA_AA.1186, BRCA_AA.1192, BRCA_AA.0351, BRCA_AA.0538, BRCA_AA.0663, BRCA_AA.0781, BRCA_AA.0863).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* K.A. Schulz, mod. J. Coles and M.E. Hall

**REFERENCES:** Alexander et al. 1984a, Alexander et al. 1987, Bader 1932, Blackburn et al. 1969d, Blackburn et al. 1969e, Bourgeron and Engelking 1994, Bradley et al. 1992, Bunin 1975c, CONHP unpubl. data 2003, Clary 1992, Cogan et al. 2004, DeVelice et al. 1986, Diamond 1993, Dixon 1935, Donart et al. 1978a, Driscoll et al. 1984, Fitzhugh et al. 1987, Hanks et al. 1983, Hansen et al. 2004c, Hansen et al. 2004d, Hanson and Ball 1928, Harmon 1980, Helm 1977, Hess and Wasser 1982, Johnston 1987, Johnston and Hendzel 1985, Larson and Moir 1987, Madany and West 1980b, Marr et al. 1973a, Muldavin et al. 1996, Nixon 1967b, Peet 1975, Peet 1981, Roberts et al. 1992, Savage and Swetnam 1990, Schmoll 1935, Somers et al. 1980, Steinhoff 1978, Stuever and Hayden 1997b, Terwilliger et al. 1979a, USFS 1983b, Wasser and Hess 1982, Western Ecology Working Group n.d., Wright et al. 1973, Youngblood and Mauk 1985

## *Pinus ponderosa* / Sparse Understory Woodland [Provisional]

### Ponderosa Pine / Sparse Understory Woodland

| | |
|---|---|
| CODE | CEGL002384 |
| 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)<br>Ponderosa Pine Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This open woodland association has been described from Capitol Reef and Bryce Canyon national parks. It occurs on the bottoms and sides of intermittent stream drainages, in depressions between small hills and in valleys. Sites are gentle to moderately steep (2- to 27-degree slopes), occur between 2111 and 2592 m in elevation, and are oriented to all aspects. The unvegetated ground surface has low to high cover of litter and duff, low to high cover of small rocks, sparse to low amounts of bare soil, and sparse to moderate cover of downed wood. Litter and duff depths range from 0.2-2.8 cm in one stand. Soils are moderately well-drained and are derived from Navajo sandstone, the Kaiparowitz, Claron and Straight Cliff formations, and are often re-deposited as alluvium. Total vegetation cover ranges up to 65% and is characterized by an open canopy, typically 15-20 m tall, of *Pinus ponderosa* trees that range in cover from 4-60%. A subcanopy layer of 2- to 5-m tall *Pinus edulis, Juniperus osteosperma, Juniperus scopulorum*, and *Pseudotsuga menziesii* trees provides sparse cover. Shrubs that may be present include *Artemisia frigida, Arctostaphylos patula, Chrysothamnus viscidiflorus, Purshia tridentata, Tetradymia canescens, Artemisia nova, Symphoricarpos oreophilus*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and provides sparse cover. Common graminoids include *Poa fendleriana, Carex rossii, Leymus salinus (= Elymus salinus)*, and *Muhlenbergia montana*. Forbs commonly present are *Stephanomeria minor (= Stephanomeria tenuifolia, Erysimum capitatum (= Erysimum asperum)*, and *Lithospermum multiflorum*. Tree saplings may provide sparse cover stand and include *Pinus ponderosa* and *Juniperus scopulorum*.

**DISTRIBUTION**
*Bryce Canyon National Park*

This woodland occurs on slopes and in depressions and was sampled along East Creek, Inspiration Point, Swamp Canyon, The Promontory, Tropic Canyon, near the Visitor Center, Whiteman Bench, Podunk Creek and southwest of Sunset Campground.

*Globally*
This association is known from Capitol Reef and Bryce Canyon national parks. It is likely to occur in isolated canyons throughout the Colorado Plateau.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This woodland occurs in a depression between small hills and in a valley. Sites are gentle to moderately steep (2- to 27-degree slopes), occur between 2111 and 2592 m in elevation, and are oriented to all aspects. The ground surface has low to high cover of litter and duff, no to high cover of small rocks, sparse to low exposure of bare soil, and sparse to moderate cover of downed wood. Litter and duff depths range from 0.2-2.8 cm in one stand. Soils are moderately well-drained and are derived from the Kaiparowitz, Claron and Straight Cliff formations.

*Globally*
It occurs on the bottoms and sides of intermittent stream drainages, in depressions between small hills and in valleys. Sites are gentle to moderately steep (2- to 27-degree slopes), occur between 2111 and 2592 m in elevation, and are oriented to all aspects. The unvegetated ground surface has low to high cover of litter and duff, low to high cover of small rocks, sparse to low amounts of bare soil, and sparse to moderate cover of downed wood. Litter and duff depths range from 0.2-2.8 cm in one stand. Soils are moderately well-drained and are derived from Navajo sandstone, the Kaiparowitz, Claron and Straight Cliff formations, and are often re-deposited as alluvium.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to dense (17-67% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 2-5 m and provides 4-60% cover. The dbh range from 4-11 cm in the younger, denser stand. The remaining canopy layer includes sparse cover of *Juniperus scopulorum* and *Pseudotsuga menziesii*. Shrubs that may be present include *Arctostaphylos patula, Chrysothamnus viscidiflorus, Purshia tridentata, Tetradymia canescens, Artemisia nova, Symphoricarpos oreophilus*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and provides sparse cover. Common graminoids include *Carex rossii, Poa fendleriana, Leymus salinus (= Elymus salinus)*, and *Muhlenbergia montana*. Forbs include *Erysimum capitatum (= Erysimum asperum)* and *Lithospermum multiflorum*. Tree saplings provide sparse cover in one stand and include *Pinus ponderosa* and *Juniperus scopulorum*.

*Globally*
Total vegetation cover ranges up to 65% and is characterized by an open canopy, typically 15-20 m tall, of *Pinus ponderosa* trees that range in cover from 4-60%. A subcanopy layer of 2- to 5-m tall *Pinus edulis, Juniperus osteosperma, Juniperus scopulorum*, and *Pseudotsuga menziesii* trees provides sparse cover. Shrubs that may be present include *Artemisia frigida, Arctostaphylos patula, Chrysothamnus viscidiflorus, Purshia tridentata, Tetradymia canescens, Artemisia nova, Symphoricarpos oreophilus*, and *Gutierrezia sarothrae*. The herbaceous layer is floristically diverse and provides less than 5% total cover. Common graminoids include *Poa fendleriana, Carex rossii, Leymus salinus (= Elymus salinus)*, and *Muhlenbergia montana*. Forbs commonly present are *Stephanomeria minor (= Stephanomeria tenuifolia, Erysimum capitatum (= Erysimum asperum)*, and *Lithospermum multiflorum*. Tree saplings may provide sparse cover and include *Pinus ponderosa* and *Juniperus scopulorum*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Herb (field) | *Gutierrezia sarothrae* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (23-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
This association is similar to *Pinus ponderosa* Sparse Woodland [Park Special] from Bryce Canyon, which differs in the very sparse canopy (<5% total cover).

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Rocky slope with trees invading from surrounding forest; young, even-aged stand of ponderosa pine with a few mature trees, most trees have basal fire-scarring.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0011, BRCA.0269), and 2007 Accuracy Assessment (13 points: BRCA_AA.0129, BRCA_AA.0235, BRCA_AA.0237, BRCA_AA.0346, BRCA_AA.0400, BRCA_AA.0412, BRCA_AA.0455, BRCA_AA.0472, BRCA_AA.0491, BRCA_AA.0693, BRCA_AA.0707, BRCA_AA.1174, BRCA_AA.1244).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *Abies concolor / Cercocarpus ledifolius* Woodland

## White Fir / Curl-leaf Mountain-mahogany Woodland

| | |
|---|---|
| CODE | CEGL000885 |
| 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 | *ABIES CONCOLOR* WOODLAND ALLIANCE (A.553)<br>White 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 woodland association has only been described in Utah. It is most frequently found in the Pine Valley Mountains of southwestern Utah, but also occurs on the Wasatch, Paunsaugunt and Tavaputs plateaus, the Tushar and Pahvant mountains of the Fishlake National Forest, and Bryce Canyon National Park. This community ranges from 2130-2860 m (7000-9400 feet) elevation on gentle to steep, straight or convex slopes with northern exposures. This association is found primarily on andesitic volcanics but also on other igneous and sedimentary substrate. Surface soils are mostly loam and silt loam. *Abies concolor* is the climax tree for this association, although few mature stands have been observed. *Pseudotsuga menziesii* and *Pinus ponderosa* dominate the sites as the major seral

species, with *Pinus flexilis* and *Juniperus scopulorum* occurring more infrequently and in smaller amounts as minor seral species. The shrub layer is often dense, with *Cercocarpus ledifolius, Quercus gambelii, Amelanchier alnifolia, Mahonia repens (= Berberis repens)*, and *Symphoricarpos oreophilus* commonly present. *Carex rossii* and *Poa fendleriana* are the most characteristic graminoids. Forbs are negligible.

**DISTRIBUTION**
*Bryce Canyon National Park*
This type was observed at only one Accuracy Assessment point in 2007, therefore no local description is available.

*Globally*
This association has only been described in Utah. It is most frequently found in the Pine Valley Mountains of southwestern Utah, but also occurs on the Wasatch, Paunsaugunt and Tavaputs plateaus, the Tushar and Pahvant mountains of the Fishlake National Forest, and Bryce Canyon National Park.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This community ranges from 2130-2860 m (7000-9400 feet) elevation on gentle to steep, straight or convex slopes with northern exposures. This association is found primarily on andesitic volcanics but also on other igneous and sedimentary substrate. Surface soils are mostly loam and silt loam. Most sites have high amounts of exposed rock and bare soil with litter accumulations averaging 2.6 cm.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
*Abies concolor* is the climax tree for this association, although few mature stands have been observed. *Pseudotsuga menziesii* and *Pinus ponderosa* dominate the sites as the major seral species, with *Pinus flexilis* and *Juniperus scopulorum* occurring more infrequently and in smaller amounts as minor seral species. The shrub layer is often dense, with *Cercocarpus ledifolius, Quercus gambelii, Amelanchier alnifolia, Mahonia repens (= Berberis repens)*, and *Symphoricarpos oreophilus* commonly present. *Carex rossii* and *Poa fendleriana* are the most characteristic graminoids. Forbs are negligible.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
This type was observed through one AA point, therefore no local description is available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0585).
*Local Description Authors:* G. Kittel
*Global Description Authors:* L.D. Engelking

**REFERENCES:** Bourgeron and Engelking 1994, Driscoll et al. 1984, Mauk and Henderson 1984, Western Ecology Working Group n.d., Youngblood and Mauk 1985

## *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)<br>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**
*Bryce Canyon National Park*
This forest has limited distribution, occurs on hillslopes and canyonside topography, and was sampled in the vicinity of Fairyland Point, near Paria View, and west of Noon Canyon Butte.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This forest occurs on the midslopes of hills and along the side of a canyon. Sites are steep (16- to 25-degree slopes), occur between 2369 and 2473 m in elevation, and are oriented to all aspects. The ground surface has moderate to high cover of litter and duff, low to high cover of rocks, and sparse cover of downed wood. Exposure of bare soil ranges from none to low. Soils are rapidly drained and are derived from the Claron Formation (Pink and White members).

*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**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (43-62% cover) and is characterized by the canopy tree *Pseudotsuga menziesii* that ranges in height from 10-15 m and provides 5-20% cover, and the short shrub *Arctostaphylos patula* that provides 16-35% cover. *Pinus ponderosa* canopy trees provide 8-13% cover. The subcanopy layer provides sparse cover and includes 2- to 5-m tall *Pseudotsuga menziesii, Pinus ponderosa*, and *Juniperus scopulorum* trees. Other short- and dwarf-shrub species are low in terms of floristic diversity, provide sparse cover, and include *Ceanothus martinii, Purshia tridentata, Symphoricarpos oreophilus*, and *Mahonia repens*. The herbaceous layer is represented by the medium-tall bunchgrass *Leymus salinus* that provides sparse cover in some stands. Seedling *Pseudotsuga menziesii* provide sparse cover in one stand.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pseudotsuga menziesii* |
| Tree canopy | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus scopulorum* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa*, *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Arctostaphylos patula* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Mixed forest and shrub stand with Douglas-fir and greenleaf manzanita dominant; Claron Formation exposure an important driver for some stands; there is no indication of recent or historic fires.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 observation points: BRCA.9016, BRCA.9021, BRCA.9042, BRCA.9213) and 2007 Accuracy Assessment (3 points: BRCA_AA.0259, BRCA_AA.0514, BRCA_AA.1152).
*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

## *Picea pungens / Betula occidentalis* Woodland

## Blue Spruce / Water Birch Woodland

| | |
|---|---|
| CODE | CEGL002637 |
| 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 | Temporarily flooded temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.d.) |
| ALLIANCE | *PICEA PUNGENS* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.567)<br>Blue Spruce Temporarily Flooded Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)
Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This blue spruce association is known from Colorado, southern Utah possibly northern New Mexico. It is a cool, moist riparian woodland occurring in deep, narrow canyons and alcoves in the foothills of lower montane elevations of 2200-2700 m. *Betula occidentalis* forms an open to thick band in deep, subirrigated soils along narrow floodplains, streambanks and terraces, with branches overhanging the stream. Mature *Picea pungens* dominates the canopy (10-60% cover), and *Populus tremuloides* may be present as well. *Betula occidentalis* is always present in the shrub understory (20-40% cover), often joined by *Alnus incana*. Other shrubs include *Salix exigua, Salix bebbiana*, and *Cornus sericea*. *Equisetum arvense* is always present in the sparse or dense herbaceous layer. Common associates may include forbs such as *Rudbeckia laciniata, Heracleum sphondylium, Fragaria virginiana, Mertensia ciliata*, and the graminoid *Calamagrostis canadensis*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This wooded wetland association was sampled on just one site, along the Peek-a-boo Loop Trail.

*Globally*
This woodland association is known from southern Utah and the central portion of the southern Rockies eastern slope in Colorado, and is expected to occur throughout the southern Rocky Mountains in Colorado and probably New Mexico.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This unique wooded wetland association occurs in an alcove. The site is moderate (10-degree slope), occurs at 2310 m in elevation, and is oriented to the north. The ground surface has moderate to high cover of litter and duff, sparse to low cover of large and small rocks, sparse cover by downed wood, and low to moderate exposure of bare soil. Soils are somewhat poorly drained and are derived from the Claron Formation (Pink Member).

*Globally*
This association is a cool, moist riparian woodland occurring in deep, narrow canyons and alcoves in the foothills, at lower montane elevations (2200-2700 m) in Utah, Colorado and possibly northern New Mexico. *Betula occidentalis* forms an open to thick band of cover in deep, subirrigated soils along narrow floodplains, streambanks and terraces.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (47% cover) and is characterized by the canopy tree *Picea pungens* that ranges in height from 10-15 m and provides 15% cover, and the tall shrub *Betula occidentalis* that is 2-5 m tall and provides 5% cover. Associated canopy trees include *Abies concolor* and *Pseudotsuga menziesii* that contribute low cover. Subcanopy *Abies concolor, Juniperus scopulorum*, and *Acer grandidentatum* trees from 2-5 m tall contribute sparse to low cover. The remaining tall-shrub layer includes sparse cover of *Cercocarpus montanus*. Short and dwarf-shrubs present are low in floristic diversity, provide sparse cover, and include *Juniperus communis, Arctostaphylos patula*, and *Mahonia repens*.

*Globally*
*Picea pungens* dominates the canopy with 10-60% cover. Other trees that may be present include *Populus tremuloides* (5-30% cover). The shrub canopy is dominated by *Betula occidentalis* with 5-40% cover. Other shrubs that may be present include *Alnus incana* (10-35% cover), *Salix exigua* (10-30%), *Salix bebbiana* (10%), and *Cornus sericea* (10%). The herbaceous undergrowth can be dense to open. Forb species that may be present include *Rudbeckia laciniata* (1-15%), *Heracleum maximum* (1-15%), *Fragaria virginiana* (1-5%), *Mertensia ciliata* (1-5%), and *Equisetum arvense* (1-10% cover). Graminoid species that may be present include *Calamagrostis canadensis* (1-40%), *Calamagrostis canadensis, Agrostis scabra, Bromus inermis*, and *Poa pratensis*

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Picea pungens*, *Pseudotsuga menziesii* |
| Tall shrub/sapling | *Betula occidentalis* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Picea pungens* |
| Tree canopy | *Populus tremuloides* |
| Shrub/sapling (tall & short) | *Betula occidentalis* |
| Herb (field) | *Equisetum arvense* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G2 (30-Dec-2000). This riparian conifer woodland is known only from Colorado and southern Utah, though it may occur in northern New Mexico. Stands are threatened by development, road building and maintenance, recreational use, streamflow alterations, and improper livestock grazing throughout its range. There is only one occurrence reported and it is in declining condition. Additional survey work is needed to document sites to protect and possibly restore.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Classification is based on 7 quantitative plots. Two closely related communities include *Pseudotsuga menziesii / Betula occidentalis* Woodland (CEGL002639), which lacks *Picea pungens* and *Picea pungens / Equisetum arvense* Woodland (CEGL000389), where the shrub layer is sparse and does not have significant cover of *Betula occidentalis*. The conifer/*Equisetum arvense* community type (Padgett et al. 1989) has *Picea pungens* and *Betula occidentalis*, but not consistently.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Sheltered head of drainage, small but distinct community, north aspect.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 observation point: BRCA.9037) and 2007 Accuracy Assessment (1 point: BRCA_AA.1104).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* A.E. Black, mod. G. Kittel

**REFERENCES:** Burns and Honkala 1990a, CONHP unpubl. data 2003, Carsey et al. 2003a, Hansen et al. 1988b, Johnston 1987, Kittel et al. 1997a, Kittel et al. 1999a, Manning and Padgett 1995, Padgett et al. 1989, Western Ecology Working Group n.d.

## *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)<br>Curl-leaf Mountain-mahogany Woodland Alliance |

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*
This woodland association is decribed 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**

*Bryce Canyon National Park*

This woodland has limited distribution, occurs on topographically low sites, and was sampled in Fairland Canyon and the Yellow Creek drainage.

*Globally*

Data are not available.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This woodland occurs on a wash terrace and a canyon bottom. The sites are gentle (1- to 2-degree slopes), occur between 2141 and 2154 m in elevation, and are oriented to the south. The ground surface has sparse exposure of bare soil, high cover of litter, low cover of small rocks, sparse cover of large rocks, and low cover of downed wood. Soils are rapidly drained sandy loams and sandy clay loams derived from New Alluvium.

*Globally*

Data are not available.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (26-40% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and provides 26-40% cover and the short shrub *Arctostaphylos patula* that provides 7-8% cover. The emergent tree layer provides sparse cover and includes *Pseudotsuga menziesii* and *Pinus ponderosa* between 10 and 15 m tall. The subcanopy tree layer includes sparse cover by *Juniperus scopulorum* and *Pinus edulis* that are from 2-5 m tall. The tall-shrub layer is represented by *Amelanchier utahensis* and *Cercocarpus montanus* that provide sparse cover. The remaining short and dwarf-shrubs have low floristic diversity, provide sparse cover, and include *Symphoricarpos oreophilus, Ericameria nauseosa*, and *Mahonia repens*. The herbaceous layer is low in floristic diversity and is not present or contributes sparse cover in these stands. Tree saplings provide sparse cover and include *Pinus ponderosa, Pseudotsuga menziesii*, and *Cercocarpus ledifolius*.

*Globally*

Data are not available.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Cercocarpus ledifolius* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* GNR (3-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Dense thicket of *Cercocarpus ledifolius* on both sides of Yellow Creek, with substrates made up of colluvium washed down a side drainage; drainage system floods.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0128, BRCA.0406) and 2007 Accuracy Assessment (5 points: BRCA_AA.0525, BRCA_AA.0589, BRCA_AA.0812, BRCA_AA.0969, BRCA_AA.1190).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *Cercocarpus ledifolius / Artemisia tridentata* Woodland

## Curl-leaf Mountain-mahogany / Big Sagebrush Woodland

| | |
|---|---|
| CODE | CEGL000960 |
| 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)<br>Curl-leaf Mountain-mahogany Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland (CES304.772)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This woodland is known from Nevada, Idaho and southern Utah. The following description is from southern Nevada and southern Utah stands. This woodland occurs on high mountain slopes and ridges or low washes at 2072 to 2835 m (6800-9300 feet) elevation. Soils are rapidly drained sandy loams derived from alluvium or rhyolitic welded ash-flows. This woodland appears as clumps of taller *Cercocarpus ledifolius* amongst a sea of the lower statured *Artemisia tridentata*. Other tree species may include *Juniperus osteosperma, Juniperus scopulorum*, pinyon spp., and *Pinus ponderosa*. Other shrubs include *Amelanchier pallida, Purshia tridentata, Chrysothamnus* spp., *Gutierrezia sarothrae, Tetradymia canescens, Sambucus caerulea, Symphoricarpos* spp., and *Ericameria nauseosa*. The herbaceous layer has sparse cover and includes the bunch grasses *Achnatherum hymenoides* and *Elymus elymoides*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland occurs in drainages and was sampled along Pasture Wash.

*Globally*
This woodland is known from Nevada, Idaho and southern Utah.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*

This woodland occurs on a wash bottom. The site is gentle (1-degree slope), occurs at 2072 m in elevation, and is oriented to the south. The ground surface has low exposure of bare soil, moderate cover of small rocks, sparse to low cover of sand and large rocks, and moderate cover of litter. There is low cover of downed wood and moss. Soils are rapidly drained sandy loams derived from New Alluvium.

*Globally*
This woodland occurs on high mountain slopes and ridges or low washes at 2072 to 2835 m (6800-9300 feet) elevation. Soils are rapidly drained sandy loams derived from alluvium or rhyolitic welded ash-flows.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (25% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and provides 7% cover, and the tall shrub *Artemisia tridentata ssp. tridentata* that provides 7% cover. The remaining canopy layer provides sparse cover and includes *Juniperus osteosperma* and *Juniperus scopulorum*. The subcanopy layer ranges from 2-5 m tall, provides sparse cover, and includes *Juniperus scopulorum* and *Pinus ponderosa*. Short shrubs present provide low cover (up to 17%) and include *Purshia tridentata* and *Ericameria nauseosa*. The herbaceous layer is moderately diverse floristically, provides sparse cover, and includes the bunch grasses *Achnatherum hymenoides* and *Elymus elymoides*. Tree saplings provide sparse cover and include *Pinus edulis* and *Juniperus osteosperma*. Cryptogram cover is low (6%) and includes mosses and dark cyanobacteria.

*Globally*
This woodland appears as clumps of taller *Cercocarpus ledifolius* amongst a sea of the lower statured *Artemisia tridentata*. Other tree species may include *Juniperus osteosperma, Juniperus scopulorum*, pinyon spp., and *Pinus ponderosa*. Other shrubs include *Amelanchier pallida, Purshia tridentata, Chrysothamnus* spp., *Gutierrezia sarothrae, Tetradymia canescens, Sambucus caerulea, Symphoricarpos* spp., and *Ericameria nauseosa*. The herbaceous layer has sparse cover and includes the bunch grasses *Achnatherum hymenoides* and *Elymus elymoides*. In Nevada, herbs listed include no grasses, and the following forbs were noted for their uniqueness to this habitat: *Selaginella watsonii, Phlox pulvinata, Androsace septentrionalis ssp. puberulenta, Castilleja viscidula*, and *Penstemon pudicus*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Cercocarpus ledifolius* |
| Tall shrub/sapling | *Artemisia tridentata* ssp. *tridentata* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Penstemon pudicus* (globally critically imperiled, G1)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G4 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Shrubs are a mixture of wash and upland species; most of the *Cercocarpus ledifolius* plants are less than 1 m tall, young, and only one in the tree canopy on plot; occasional flooding disturbance, though most of the water is probably concentrated in the main channel.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0315).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**REFERENCES:** Beatley 1976, Blackburn et al. 1969d, Bourgeron and Engelking 1994, Driscoll et al. 1984, Heinze et al. 1962, Western Ecology Working Group n.d.

## *Cercocarpus ledifolius / Quercus gambelii* Woodland [Provisional]

## Curl-leaf Mountain-mahogany / Gambel Oak Woodland

| | |
|---|---|
| CODE | CEGL005359 |
| 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)<br>Curl-leaf Mountain-mahogany Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland (CES304.772)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This woodland association is currently described from Bryce Canyon National Park in Utah. It is also reported from Grand Canyon National Park in Arizona. Additional global information will be added as it becomes available. This woodland occurs on a mesatop. The sites are gentle (3-degree slope), occur between 2434 and 2435 m in elevation, and are oriented to the east or west. The ground surface has low exposure of bare soil, high cover of litter, low cover of small rocks, and sparse cover of downed wood. Litter depths range from 0.1-2.6 cm. Soils are rapidly drained silty clay loams or loams derived from new alluvium. Total vegetation cover is dense (70-84% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and the tall shrub *Quercus gambelii*. The remaining canopy layer provides sparse cover and includes *Juniperus osteosperma*. The herbaceous layer is moderately diverse floristically and provides sparse to moderate cover. The medium-tall bunch grasses *Leymus salinus* and *Pseudoroegneria spicata (= Elymus spicatus)* provide low to moderate cover. Forbs include *Lappula occidentalis, Packera multilobata (= Senecio multilobatus)*, and *Chaetopappa ericoides*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This unusual woodland occurs on deep soils and was sampled on the high slopes of Boat Mesa. It was also observed at four Accuracy Assessment points in 2007.

*Globally*
This woodland association is currently only known from Bryce Canyon National Park, Utah, and Grand Canyon National Park, Arizona. Additional range information will be added as it becomes available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This woodland occurs on a mesatop. The sites are gentle (3-degree slope), occur between 2434 and 2435 m in elevation, and are oriented to the east or west. The ground surface has low exposure of bare soil, high cover of litter, low cover of small rocks, and sparse cover of downed wood. Litter depths range from 0.1-2.6 cm. Soils are rapidly drained silty clay loams or loams derived from New Alluvium.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is dense (70-84% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and provides 30-38% cover, and the tall shrub *Quercus gambelii* that provides 20-23% cover. The remaining canopy layer provides sparse cover and includes *Juniperus osteosperma*. The herbaceous layer is moderately diverse floristically and provides sparse to moderate cover. The medium-tall bunch grasses *Leymus salinus* and *Pseudoroegneria spicata (= Elymus spicatus)* provide low to moderate cover. Forbs include *Lappula occidentalis, Packera multilobata (= Senecio multilobatus)*, and *Chaetopappa ericoides*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Cercocarpus ledifolius* |
| Tall shrub/sapling | *Quercus gambelii* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Cercocarpus ledifolius* |
| Tall shrub/sapling | *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (7-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Flat mesatop with deep soils and a scattering of pea-sized rocks on the surface; mixed-age *Cercocarpus ledifolius* stand, surrounded by a mature pinyon-juniper woodland.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (2 plots: BRCA.0022, BRCA.0023) and 2007 Accuracy Assessment (4 points: BRCA_AA.0268, BRCA_AA.0495, BRCA_AA.0618, BRCA_AA.0696).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* M. Smith and J. Von Loh

**REFERENCES:** Western Ecology Working Group n.d.

## *Populus angustifolia - Juniperus scopulorum* Woodland

## Narrowleaf Cottonwood - Rocky Mountain Juniper Woodland

| | |
|---|---|
| CODE | CEGL002640 |
| PHYSIOGNOMIC CLASS | Woodland (II) |
| PHYSIOGNOMIC SUBCLASS | Deciduous woodland (II.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous woodland (II.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural cold-deciduous woodland (II.B.2.N.) |
| FORMATION | Temporarily flooded cold-deciduous woodland (II.B.2.N.b.) |
| ALLIANCE (A.641) | *POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE<br>Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**

*Globally*

This semi-riparian woodland association occurs in north-central Wyoming, western Colorado and northern New Mexico on terraces or slopes of gorges, ravines, and moderate-sized intermittent or perennial drainages between 1740 and 2400 m (5725-7875 feet) elevation. This type usually occurs on high, dry stream terraces with level slopes and a sandy surface soil texture. Stands are infrequently flooded (10- to 100-year recurrence intervals). The vegetation is characterized by moderately open canopies (25-60% cover) dominated by *Populus angustifolia*, with *Juniperus scopulorum* or occasionally *Juniperus monosperma, Betula occidentalis*, or *Pinus edulis* in the subcanopy. An open grassy understory with abundant *Sporobolus cryptandrus* is characteristic, although other grasses such as *Carex geyeri, Juncus balticus, Leymus cinereus*, and *Poa fendleriana* may also be present. In disturbed stands the native grasses may have been replaced by exotic species such as *Bromus inermis*. Although shrubs are uncommon, those present, such as *Brickellia californica, Quercus gambelii, Artemisia tridentata, Mahonia repens, Purshia tridentata, Rosa woodsii*, and *Symphoricarpos oreophilus*, reflect relatively dry site conditions. The herbaceous understory also reflects open, dry site conditions. Facultative and upland forbs such as *Thalictrum fendleri, Achillea millefolium, Maianthemum stellatum, Solidago nemoralis*, and *Penstemon barbatus* are common. In open areas *Bouteloua curtipendula* is common. Regardless of the drier conditions, a variety of native wetland indicators can occur, including *Juncus effusus, Glyceria striata, Carex nebrascensis, Agrostis exarata, Rudbeckia laciniata, Equisetum arvense, Epilobium ciliatum, Mertensia ciliata*, and *Equisetum laevigatum*. Many stands have decadent *Populus angustifolia* trees that are being replaced by *Juniperus scopulorum*. Other stands periodically flood and retain a large amount of woody debris. In all cases the vegetation and topographic position indicate a community that is becoming isolated from the water table. As the water table drops, the facultative and obligate wetland plants will be replaced by upland species.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was observed only at one Accuracy Assessment point in 2007, therefore no local descriptive information is available at this time.

*Globally*

This association has been documented in north-central Wyoming, western Colorado and northern New Mexico. It may occur in Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

The community is found in mountainous regions of north-central Wyoming, western Colorado and northern New Mexico on terraces or slopes of gorges, ravines, and moderate-sized intermittent or perennial drainages with elevations ranging from 1740 to 2400 m (5725-7875 feet). This type usually occurs on higher and drier terraces that

have a relatively flat surface topography, and they are mostly composed of sandy alluvial sediments. As a result, stands are infrequently flooded (10- to 100-year recurrence intervals). Soils are young, weakly developed Entisols. Thick organic layers (Mollisols) have had time to develop in some stands. Soils tend to be dry, well-drained and mostly sandy or silty at the surface, although commonly gravelly/cobbly with depth. Some of the lower terraces may be very moist at depths within the rooting zone, particularly during seasonal high water events.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
The species composition and percent cover in this association are variable and depend on aspect, elevation, and streamflow, in addition to the degree of disturbance by recreational use and livestock grazing. This type is characterized by mature, moderately open stands (25-60% cover) dominated by *Populus angustifolia*, with *Juniperus scopulorum* or occasionally *Juniperus monosperma, Betula occidentalis*, or *Pinus edulis* in the subcanopy. Total biomass and canopy cover are usually low. An open grassy understory with abundant *Sporobolus cryptandrus* is characteristic, although other grasses such as *Carex geyeri, Juncus balticus, Leymus cinereus*, and *Poa fendleriana* may also be present. In disturbed stands the native grasses may have been replaced by exotic species such as *Bromus inermis*. Cottonwood reproduction occurs vegetatively from root sprouts, and young junipers are common. Although shrubs are uncommon, those present, such as *Brickellia californica, Quercus gambelii, Artemisia tridentata, Mahonia repens, Purshia tridentata, Rosa woodsii*, and *Symphoricarpos oreophilus*, reflect relatively dry site conditions. The herbaceous understory also reflects the open, drier site conditions. Facultative and upland forbs such as *Thalictrum fendleri, Achillea millefolium, Maianthemum stellatum, Solidago nemoralis*, and *Penstemon barbatus* are common. In open areas *Bouteloua curtipendula* is common. Regardless of the drier conditions, a variety of native wetland indicators can occur: *Juncus effusus, Glyceria striata, Muhlenbergia racemosa, Carex nebrascensis, Agrostis exarata, Rudbeckia laciniata, Equisetum arvense, Epilobium ciliatum, Mertensia ciliata, Lycopus asper, Equisetum laevigatum*, and *Asclepias incarnata*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus angustifolia* |
| Tree subcanopy | *Juniperus scopulorum* |
| Herb (field) | *Sporobolus cryptandrus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus inermis* (exotic, High/Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G2G3 (7-Apr-1998).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
These mature riparian forests occupy some of the driest sites in the floodplain. Some stands may be directly adjacent to the stream but still situated several meters above it due to downcut streambanks, or they may be dry because the stream only flows intermittently. In these stands, the cottonwoods have limited self-sustaining capabilities except vegetatively by root sprouts. Many of the trees are often decadent or dying, and junipers are commonly growing up

under them, colonizing the drying terraces. Further, the presence of juniper in these and other floodplain communities is often considered invasive. Juniper, as a codominant in these communities, is at least viewed as an indicator that flooding occurs infrequently. Only the largest of floods will remove these communities.

This type is a refinement of the *Populus angustifolia / Juniperus scopulorum* Association reported by Muldavin (1991) for northern New Mexico and Kittel et al. (1994, 1996) for Colorado. It is synonymous with *Populus angustifolia / Physocarpus monogynus - Padus virginiana* in Bighorn National Forest, Wyoming (Girard et al. 1997), and *Populus angustifolia - Juniperus scopulorum* in New Mexico (Durkin et al. 1995a). *Padus virginiana* is an old name for *Prunus virginiana*.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0754).
*Local Description Authors:*
*Global Description Authors:* Muldavin et al., mod. J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Cooper and Cottrell 1990, Durkin et al. 1994b, Durkin et al. 1995a, Girard et al. 1997, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Muldavin 1991, Muldavin et al. 2000a, Western Ecology Working Group n.d.

## *Populus angustifolia / Betula occidentalis* Woodland

## Narrowleaf Cottonwood / Water Birch Woodland

| | |
|---|---|
| CODE | CEGL000648 |
| PHYSIOGNOMIC CLASS | Woodland (II) |
| PHYSIOGNOMIC SUBCLASS | Deciduous woodland (II.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous woodland (II.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural cold-deciduous woodland (II.B.2.N.) |
| FORMATION | Temporarily flooded cold-deciduous woodland (II.B.2.N.b.) |
| ALLIANCE | *POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)<br>Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This lush, deciduous, riparian woodland occurs in mountains and canyons of Nevada, Utah, Idaho, Wyoming, and Colorado on stream terraces or floodplains bordering streams. Elevation ranges from 1450-2600 m. This community is one of the wetter *Populus angustifolia* plant associations, which indicates a perennial source of water. Some stands occur on hillside seeps. Substrate is well-drained, rocky and coarse-textured alluvial soil. Water tables are generally between 0.5-4 m below the surface. The upper tree canopy is open (typically less than 60% cover) and is dominated by *Populus angustifolia*, with *Acer negundo* occasionally codominating in late-seral stands. *Pseudotsuga menziesii* and *Juniperus scopulorum* are scattered in some stands. *Betula occidentalis* forms a moderate to dense short-tree/tall-shrub canopy, often forming a thicket along the stream. Other species, such as *Alnus incana, Acer grandidentatum, Acer glabrum, Amelanchier alnifolia*, and several species of *Salix*, including *Salix lutea, Salix lucida ssp. lasiandra (= Salix lasiandra)*, and *Salix bebbiana*, may be present. The moderately dense short-shrub layer may include *Cornus sericea, Paxistima myrsinites, Rosa* spp., *Mahonia repens, Ribes aureum, Symphoricarpos* spp., and *Rhus trilobata* on drier sites. The herbaceous layer may be sparse to dense, depending on the density of the shrub and tree layers. Common species include *Equisetum arvense, Osmorhiza berteroi (= Osmorhiza chilensis), Carex pellita (= Carex lanuginosa), Maianthemum stellatum, Achillea millefolium*, and the

introduced species *Bromus inermis, Poa pratensis*, and *Taraxacum officinale*. The dominance of *Betula occidentalis* separates this association from other *Populus angustifolia* riparian woodlands.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was only observed at one Accuracy Assessment point in 2007, therefore local descriptive information is not available at this time.

*Globally*

This association occurs in the mountains and canyons of Utah, Nevada, Idaho, Wyoming, and Colorado. These riparian woodlands are a major type in the Wasatch Mountains but appear to be a minor association elsewhere.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This lush, deciduous, riparian woodland occurs in mountains and narrow canyons of Nevada, Utah, Idaho, Wyoming, and Colorado on stream terraces or floodplains bordering streams. Elevation ranges from 1450-2600 m (4760-8525 feet). This community is one of the wetter *Populus angustifolia* plant associations, which indicates a perennially high water table. Some stands occur on hillside seeps. Substrates are typically well-drained, coarse-textured, rocky alluvium. Soils often have a surface layer of partially decomposed organic matter 5-10 cm (2-4 inches) thick. Subsurface layers are very coarse, with 10-60% gravel or cobbles. Subsurface textures range from clay loams to loamy sands (Padgett et al. 1989, Kittel et al. 1999b, Carsey et al. 2003a). Water tables are generally between 0.5-4 m below the surface.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

The upper tree canopy is open (typically 10-60% cover) and is dominated by *Populus angustifolia*, with *Acer negundo* occasionally codominating in late-seral stands. *Pseudotsuga menziesii* and *Juniperus scopulorum* are scattered in some stands. *Betula occidentalis* forms a moderate to dense short-tree/tall-shrub canopy, often forming a thicket along the stream. Other species, such as *Alnus incana, Acer grandidentatum, Acer glabrum, Amelanchier alnifolia*, and several species of *Salix*, including *Salix lutea, Salix ligulifolia (= Salix eriocephala var. ligulifolia), Salix irrorata, Salix lucida ssp. lasiandra (= Salix lasiandra)*, and *Salix bebbiana*, may be present. The moderately dense short-shrub layer may include *Cornus sericea, Mahonia repens, Paxistima myrsinites, Prunus virginiana, Rosa* spp., *Rhus trilobata, Ribes aureum, Ribes inerme, Rubus parviflorus, Symphoricarpos* spp., and *Rhus trilobata* on drier sites. The herbaceous layer may be sparse to dense, depending on the density of the shrub and tree layers. Common species include *Achillea millefolium, Angelica ampla, Equisetum* spp., *Osmorhiza berteroi (= Osmorhiza chilensis), Carex pellita (= Carex lanuginosa), Carex utriculata, Glyceria striata, Maianthemum stellatum, Phragmites australis, Rudbeckia laciniata*, and the introduced species *Agrostis gigantea, Bromus inermis, Dactylis glomerata, Poa pratensis, Melilotus* spp., *Taraxacum officinale*, and *Trifolium repens* (Padgett et al. 1989, Kittel et al. 1999b, Carsey et al. 2003a). The dominance of *Betula occidentalis* separates this association from other *Populus angustifolia* riparian woodlands.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus angustifolia* |
| Tall shrub/sapling | *Betula occidentalis* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus inermis* (invasive, High/Medium), *Poa pratensis* (invasive, Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3 (27-Dec-1999). This riparian woodland is uncommon and occurs locally throughout much of its range. Although this association appears stable, the condition of high-quality occurrences is extremely threatened because of easy access to this relatively low-elevation community. Development, heavy recreational use, expansion and maintenance of roads and railroads, improper grazing, and modification of hydrologic processes threaten this community with the introduction of non-native species, accelerated erosion, and damage to native vegetation. Hydrologically modified streams may lack the processes necessary to regenerate the *Populus angustifolia* tree canopy.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0765).
*Local Description Authors:*
*Global Description Authors:* K.A. Schulz, mod. J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Cooper and Cottrell 1990, Driscoll et al. 1984, IDCDC 2005, Jones 1992b, Jones and Ogle 2000, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova 1986, Olson and Gerhart 1982, Padgett et al. 1988b, Padgett et al. 1989, Smith 1994b, Walford 1996, Western Ecology Working Group n.d.

## *Populus angustifolia / Cornus sericea* Woodland

## Narrowleaf Cottonwood / Red-osier Dogwood Woodland

| | |
|---|---|
| CODE | CEGL002664 |
| PHYSIOGNOMIC CLASS | Woodland (II) |
| PHYSIOGNOMIC SUBCLASS | Deciduous woodland (II.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous woodland (II.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural cold-deciduous woodland (II.B.2.N.) |
| FORMATION | Temporarily flooded cold-deciduous woodland (II.B.2.N.b.) |
| ALLIANCE | *POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)<br>Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This narrowleaf cottonwood forest type is found in the western Great Plains and western mountain regions of the United States, north into Alberta, Canada. Elevations range from 2360 to 2720 m (7750-8900 feet) in northern New Mexico to 945 to 2044 m (3100-6700 feet) in Montana (east of the Continental Divide). Stands occur along major

streams and small to moderate-sized rivers in the foothill-montane zone and northern plains and in the grassland zone of Alberta. Sites include narrow valleys (10 m) with swift, steep streams (4% gradient) where it occurs on narrow benches, and on wide valleys (150 m) on broad floodplains along, moderately steep, meandering rivers (2% gradients). Soils are highly variable and stratified. The vegetation is characterized by a closed to open canopy of deciduous trees dominated by *Populus angustifolia* and a thick understory of *Cornus sericea*. The tree canopy composition is highly variable but typically has less than 10% cover of other tree species, including conifers *Picea pungens, Pseudotsuga menziesii, Pinus ponderosa, Abies concolor, Abies lasiocarpa*, and deciduous trees such as *Populus tremuloides* in mountains and *Populus deltoides* in lower foothills and on plains. *Populus X acuminata* may codominate stands in the Great Basin and in Alberta. In northern plains, stands may have *Populus deltoides* and/or *Populus balsamifera ssp. trichocarpa (= Populus trichocarpa)* present. The introduced tree *Elaeagnus angustifolia* may be common on disturbed stands. The moderately dense to dense shrub layer consists mostly of *Cornus sericea* (10-80%) but may be diverse. Other shrub species can be abundant, but rarely more than *Cornus sericea*, and may include *Acer glabrum, Alnus incana, Amelanchier* spp., *Crataegus rivularis, Betula occidentalis, Lonicera involucrata, Prunus virginiana, Quercus gambelii, Ribes* spp., *Rosa woodsii, Rubus* spp., many species of *Salix*, and *Symphoricarpos* spp. The herbaceous cover can be abundant (>50% cover) and diverse. Forb species may include *Equisetum arvense, Heracleum maximum, Maianthemum stellatum, Rudbeckia laciniata, Osmorhiza* spp., *Solidago canadensis*, and *Symphyotrichum foliaceum (= Aster foliaceus)*. Graminoid cover can also be abundant and includes *Bromus anomalus, Carex pellita (= Carex lanuginosa), Elymus glaucus, Glyceria striata*, and *Phalaris arundinacea*. Introduced species, such as *Agrostis gigantea, Agrostis stolonifera, Alopecurus pratensis, Bromus inermis, Cirsium arvense, Dactylis glomerata, Medicago sativa, Phleum pratense, Poa compressa, Poa palustris*, and *Poa pratensis*, are often abundant.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was only observed at one Accuracy Assessment point in 2007, therefore local descriptive information is not available at this time.

*Globally*

This narrowleaf cottonwood forest type is found in the western Great Plains and western mountain regions of the United States, ranging from Montana west to Oregon, south to New Mexico and possibly Nevada, east to Colorado and north to the Black Hills of South Dakota. It is common in the upper Rio Grande and Pecos watersheds in north-central New Mexico and widespread in the southern Rocky Mountains. It is also found north into the Oldman River drainage of southwestern Alberta, Canada.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This narrowleaf cottonwood forest type is found in the western Great Plains and western mountain regions of the United States. Elevations range from 2360 to 2720 m (7750-8900 feet) in northern New Mexico to 945 to 2044 m (3100-6700 feet) in Montana (east of the Continental Divide), where it occurs at intermediate elevations below *Populus balsamifera ssp. trichocarpa (= Populus trichocarpa)* and above *Populus deltoides* (Hansen et al. 1995), and is found at mid-elevations in Alberta (770-1180 m [2526-3871 feet]). Stands occur along major streams and small to moderate-sized rivers in the foothill-montane zone and northern plains and in Alberta is usually associated with recent sediment deposits on floodplains along major streams and rivers (Thompson and Hansen 2002). Sites include narrow valleys (10 m) with swift, steep streams (4% gradient), where it occurs on narrow benches, and on wide valleys (150 m) on broad floodplains along, moderately steep, meandering rivers (2% gradients) (Kittel et al. 1999b, Carsey et al. 2003a). Canyons are not generally associated with where this association occurs on the Alberta plains. Stream channels vary widely in slope and width and range from steep and narrow to broad, moderately sinuous with moderate gradients to broad, highly sinuous with low gradients. Soils are highly variable and stratified and are moist, weakly developed Entisols (Fluvaquents or Udifluvents) or Regosols. Soil textures include silty clays, silty clay loams, clay loams, sandy clays, sandy clay loams, and loamy sands. The soils are 0.5-1 m deep and become skeletal at depth. Soils are typically moist, and some are mottled because of a shallow water table. Soils are commonly wet within 1 m, especially during seasonal flooding (Muldavin et al. 2000a).

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*
Data are not available.

*Globally*
This association is one of the most diverse cottonwood-dominated riparian woodlands and is characterized by a closed to open canopy of deciduous trees and a thick understory of *Cornus sericea*. It is highly variable in the number of tree and shrub species present; however, it is generally recognized by a clear dominance of *Populus angustifolia* (20-70% cover), typically with less than 10% cover of other tree species. The upper canopy can consist of several species, including conifers *Picea pungens, Pseudotsuga menziesii, Pinus ponderosa, Abies concolor, Abies lasiocarpa*, and deciduous trees, such as *Populus tremuloides* in mountains and *Populus deltoides* in lower foothills and on plains (Kittel et al. 1999b, Carsey et al. 2003a). *Populus X acuminata* may codominate stands in the Great Basin (Manning and Padgett 1995), and *Populus balsamifera ssp. trichocarpa (= Populus trichocarpa)* may be present in northern stands (Hansen et al. 1995, Hall and Hansen 1997). The introduced tree *Elaeagnus angustifolia* may be common on disturbed stands. The moderately dense to dense shrub layer consists mostly of *Cornus sericea* (10-80%) but may be diverse. Other shrub species can be abundant, but rarely more than *Cornus sericea*, and may include *Acer glabrum, Alnus incana, Amelanchier* spp., *Crataegus rivularis, Betula occidentalis, Lonicera involucrata, Prunus virginiana, Quercus gambelii, Ribes* spp., *Rosa woodsii, Rubus* spp., *Salix X bebbii, Salix ligulifolia (= Salix eriocephala var. ligulifolia), Salix exigua, Salix drummondiana, Salix irrorata, Salix lucida ssp. caudata, Salix lutea, Salix monticola*, and *Symphoricarpos* spp. The vine *Clematis ligusticifolia* may be abundant is some stands. Stands vary in aspect and shade provided; some are relatively moist and shady, others are relatively dry and open. In moister environments, herbaceous cover can be abundant (>50% cover) and diverse. Forb species may include *Achillea millefolium, Aconitum columbianum, Equisetum arvense, Galium* spp., *Geum macrophyllum, Heracleum maximum, Maianthemum stellatum, Mertensia* spp., *Rudbeckia laciniata, Osmorhiza* spp., *Solidago canadensis*, and *Symphyotrichum foliaceum (= Aster foliaceus)*. Graminoid cover can also be abundant and includes *Bromus anomalus, Carex pellita (= Carex lanuginosa), Elymus glaucus, Glyceria striata*, and *Phalaris arundinacea*. Introduced species, such as *Agrostis gigantea, Agrostis stolonifera, Alopecurus pratensis, Bromus inermis, Cirsium arvense, Dactylis glomerata, Medicago sativa, Phleum pratense, Poa compressa, Poa palustris*, and *Poa pratensis*, are often abundant. In Alberta, confers are not a significant factor. *Populus angustifolia* dominates the canopy (30-60% cover), although *Populus deltoides* and *Populus balsamifera* may also be present. Throughout its range in Alberta, *Cornus sericea* is always present in the shrub layer but varies in cover from sparse (3%) to high (60%). Other shrubs that may be present with significant cover are *Rosa* spp., *Salix exigua*, and *Symphoricarpos occidentalis*. Graminoids do not usually make up a significant component, although in some stands, *Agrostis stolonifera* has up to 30% cover (although it may be absent). No forbs were significant or consistently present in the 17 stands looked at by Thompson and Hansen (2002).

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus angustifolia*, *Populus* x *acuminata* |
| Short shrub/sapling | *Cornus sericea* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
The community is densely shaded and provides valuable cover for wildlife. Seasonally high water tables allow for continued reproduction of the cottonwoods, alders, dogwood and the numerous other obligate riparian shrubs and herbs. Minimal disturbance from recreation, livestock usage, forestry practices, and mining maintain the biodiversity and good condition of the community. Severe alterations of the hydrology or upland conditions can contribute to loss of valuable habitat.

In the upper canyon segments, floodplains are narrow along the river, and the coniferous *Picea pungens* becomes more dominant, mixing with *Alnus incana ssp. tenuifolia* on the streambanks. In wider valleys, *Populus angustifolia* will dominate higher and drier terraces which will contain fewer shrubs and more junipers or introduced grasses from nearby hay meadows. Uplands are typically dominated by mixed coniferous forests of spruce and fir on cooler north-facing aspects or *Pinus ponderosa* on drier slopes.

In Alberta, stands dominated by pure *Populus angustifolia* are being lost to stands dominated by hybrids of *Populus angustifolia* and *Populus balsamifera* (Floate 2004).

This type was first described by Baker (1989b) in Colorado and is part of a group of ecologically related types that include (1) the *Populus angustifolia / Alnus incana* type with less *Cornus* reported for Colorado by Baker (1989b), Kittel and Lederer (1993), Kittel et al. (1994, 1996), Walford and Baker (1995), and Richard et al. (1996); and (2) the *Populus angustifolia / Cornus sericea* type that generally lacks *Alnus incana ssp. tenuifolia* and has been well-documented for the southern Rocky Mountains (Kittel and Lederer 1993, Kittel et al. 1994, 1995), and by Hansen et al. (1990), Johnston (1987), Padgett et al. (1988b, 1989), and Youngblood et al. (1985a, 1985b). This type as described here is probably inclusive of the above two types.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0417).
*Local Description Authors:*
*Global Description Authors:* H. Marriott and D. Faber-Langendoen, mod. E. Muldavin et al., K.A. Schulz, L. Allen

**REFERENCES:** Allen 2005, Baker 1989b, Bourgeron and Engelking 1994, CONHP pers. comm., CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Crowe et al. 2004, DeLeuw, Cather & Company 1977, Driscoll et al. 1984, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Johnston 1987, Jones 1992b, Jones and Ogle 2000, Kagan et al. 2000, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova et al. 1988b, MTNHP 2002b, Manning and Padgett 1995, Marriott and Faber-Langendoen 2000, Muldavin et al. 1993b, Muldavin et al. 2000a, Padgett et al. 1988b, Padgett et al. 1989, Richard et al. 1996, Thompson and Hansen 2002, Walford and Baker 1995, Western Ecology Working Group n.d., Youngblood et al. 1985a, Youngblood et al. 1985b

## *Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus)* Woodland

## Narrowleaf Cottonwood / (Common Snowberry, Western Snowberry, Mountain Snowberry) Woodland

| | |
|---|---|
| CODE | CEGL002648 |
| PHYSIOGNOMIC CLASS | Woodland (II) |
| PHYSIOGNOMIC SUBCLASS | Deciduous woodland (II.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous woodland (II.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural cold-deciduous woodland (II.B.2.N.) |
| FORMATION | Temporarily flooded cold-deciduous woodland (II.B.2.N.b.) |
| ALLIANCE | *POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)<br>Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**

*Globally*

This deciduous forest occurs on narrow montane valley floodplains, on upper terraces, outer edges of floodplains, on alluvial bars of major rivers, along terraces of flashy washes, as well as around lakes and ponds. It occurs between 945 and 2550 m (3100-8350 feet) elevation. Soils are shallow to deep, fine-textured sandy loams and clay loams over coarser materials. Few to many coarse fragments occur in the upper soil layers. This deciduous forest is dominated by a very open to nearly closed canopy of mature *Populus angustifolia, Populus X acuminata*, or *Populus X intercurrens*. Other trees present may include *Juniperus scopulorum, Populus balsamifera, Populus tremuloides, Picea pungens, Pinus ponderosa*, or *Pinus contorta*. The shrub layer in mesic stands is dominated by one of several species of *Symphoricarpos*: *Symphoricarpos albus, Symphoricarpos rotundifolius, Symphoricarpos occidentalis*, or *Symphoricarpos oreophilus*. Other shrub species that may be scattered but never as abundant as *Symphoricarpos* include *Prunus virginiana, Quercus gambelii, Cornus sericea, Ribes lacustre, Ribes cereum, Rosa woodsii, Alnus incana, Betula occidentalis*, and *Salix bebbiana*. Graminoids and forbs present include *Agrostis stolonifera, Bromus inermis, Poa pratensis, Phleum pratense, Elymus* spp., *Balsamorhiza sagittata, Eriogonum umbellatum, Cirsium arvense, Glycyrrhiza lepidota, Melilotus officinalis, Maianthemum stellatum (= Smilacina stellata), Solidago canadensis*, and *Achillea millefolium*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This wooded wetland has limited distribution and was sampled only once on a low terrace in Swamp Canyon.

*Globally*

This forest association is found in Front Range canyons of Colorado, and in southern Utah High Plateau flashy riparian areas.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This riparian woodland occurs on the terrace of a wash. The site is gentle (2-degree slope), occurs at 2225 m, and is oriented to the southeast. The ground surface has high cover of litter and duff, sparse cover of large and small rocks, sparse cover of downed wood, and sparse exposure of bare soil. Soils are moderately well-drained and are derived from New Alluvium.

*Globally*

This deciduous forest occurs on narrow montane valley floodplains, on upper terraces, outer edges of floodplains, on alluvial bars of major rivers, along terraces of flashy washes, as well as around lakes and ponds. It occurs between 945 and 2550 m (3100-8350 feet) elevation. Soils are shallow to deep, fine-textured sandy loams and clay loams over coarser materials. Few to many coarse fragments occur in the upper soil layers. *Populus angustifolia* occupies elevations above broad-leaved cottonwoods in Colorado and Wyoming, and between the range of black cottonwood (*Populus balsamifera ssp. trichocarpa*, which is higher) and plains cottonwood (*Populus deltoides*, at lower elevations) in Montana and Idaho.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (49% cover) and is characterized by the canopy tree *Populus X intercurrens* that ranges in height from 10-15 m and provides 12% cover. An associated canopy tree is *Juniperus scopulorum* that contributes 7% cover. An emergent tree layer of 15- to 20-m tall *Pinus ponderosa* also provides 7% cover. The remaining short-shrub layer is represented by *Rosa woodsii* that provides sparse cover.

*Globally*

This deciduous forest is dominated by a very open to nearly closed canopy of mature *Populus angustifolia*. Other trees present may include *Juniperus scopulorum, Populus balsamifera, Populus tremuloides, Populus X intercurrens*, or *Populus X acuminata*, the cross between broadleaf cottonwoods and narrowleaf cottonwoods at higher elevations, *Picea pungens, Pinus ponderosa*, or *Pinus contorta*. The shrub layer in mesic stands is dominated

by one of several species of *Symphoricarpos*: *Symphoricarpos albus, Symphoricarpos rotundifolius, Symphoricarpos occidentalis*, or *Symphoricarpos oreophilus*. Other shrub species that may be scattered but never as abundant as *Symphoricarpos* include *Prunus virginiana, Quercus gambelii, Cornus sericea, Ribes lacustre, Ribes cereum, Rosa woodsii, Alnus incana, Betula occidentalis*, and *Salix bebbiana*. Graminoids and forbs present include *Agrostis stolonifera, Bromus inermis, Poa pratensis, Phleum pratense, Elymus* spp., *Balsamorhiza sagittata, Eriogonum umbellatum, Cirsium arvense, Glycyrrhiza lepidota, Melilotus officinalis, Maianthemum stellatum (= Smilacina stellata), Solidago canadensis*, and *Achillea millefolium*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus scopulorum*, *Pinus ponderosa* |
| Tree canopy | *Populus* x *intercurrens* |
| Short shrub/sapling | *Symphoricarpos oreophilus* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus angustifolia* |
| Shrub/sapling (tall & short) | *Symphoricarpos albus*, *Symphoricarpos occidentalis*, *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G2Q (7-Apr-1998).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
We include stands dominated by *Populus angustifolia, Populus X intercurrens*, or *Populus X acuminata*, the cross between broadleaf cottonwoods and narrowleaf cottonwoods at higher elevations, and any species of *Symphoricarpos*, because they all occupy a similar ecological niche within the riparian zone, that is, the higher, older terraces. *Symphoricarpos* species are wide-ranging across the West and even into the Midwest, while the cottonwood dominating the overstory is the better indicator for the geographic distribution of the association.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Small patch of vegetation established on a wash terrace.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 observation point: BRCA.9236).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**REFERENCES:** CONHP unpubl. data 2003, Carsey et al. 2003a, Hall and Hansen 1997, Hansen et al. 1995, IDCDC 2005, Kittel et al. 1994, Kittel et al. 1999b, Western Ecology Working Group n.d.

## *Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis)* Shrubland

## Greenleaf Manzanita - Gambel Oak - (Utah Serviceberry) Shrubland

| | |
|---|---|
| CODE | CEGL002695 |
| 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)<br>Greenleaf Manzanita Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Semi-Desert Chaparral (CES304.001)
Mogollon Chaparral (CES302.741)
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This tall shrubland is known only from southern Utah, from Zion and Bryce Canyon national parks. This shrubland occurs on gentle to steep slopes of mesas and high-elevation plateaus, from 1829 to 2109 m (6000-6919 feet). It occurs at all aspects on mostly well-drained sandy loam soil. Stands of this association are common and widespread in Zion National Park and less common in Bryce Canyon National Park. *Arctostaphylos patula* and *Quercus gambelii* codominate, each with cover ranging from 5 to 50%. Other shrubs occur with less than 10% cover and include *Mahonia fremontii, Mahonia repens, Cercocarpus montanus, Ceanothus martinii, Amelanchier utahensis, Symphoricarpos oreophilus, Quercus turbinella*, and *Ericameria nauseosa*. The herbaceous layer provides sparse cover and includes grasses, such as *Poa fendleriana, Bouteloua gracilis, Leymus salinus*, and *Sporobolus cryptandrus*, and forbs *Maianthemum stellatum (= Smilacina stellata), Physaria chambersii*, and *Stenotus armerioides (= Haplopappus armerioides)*. A few emergent trees are often present near this community and include *Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma*, both as large trees and as saplings.

**DISTRIBUTION**

*Bryce Canyon National Park*

This uncommon short shrubland was sampled on colluvium near Tropic Trail, in Jolley Hollow, and Sheep Canyon.

*Globally*

This association has currently only been described from Zion and Bryce Canyon national parks in southwestern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon short shrubland occurs on colluvial slopes, canyonsides, and the toeslopes of valleys. The sites are gentle to steep (3- to 35-degree slopes), occur between 2090 and 2109 m in elevation, and are oriented to the southeast or west. The ground surface has sparse to low exposure of bare soil, no to low cover of litter, and low to high cover of small rocks and downed wood. Soils are rapidly drained sandy loams and clay loams derived from the Claron Formation (Pink Member) or colluvium.

*Globally*

This shrubland occurs on gentle to steep slopes of mesas and high-elevation plateaus, from 1829 to 2109 m (6000-6919 feet). It occurs at all aspects on mostly well-drained sandy loam soil.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (35-53% cover) and is characterized by the short shrub *Arctostaphylos patula* that provides 8-17% cover and the tall shrub *Quercus gambelii* that provides 1-28% cover. The tall shrub *Amelanchier utahensis* is sometimes present in stands, providing up to 4% cover. The 5- to 15-m tall canopy trees *Pinus ponderosa, Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma* provide sparse cover. The remaining tall and short shrubs have low in floristic diversity, provide sparse to low cover, and include *Mahonia*

*fremontii, Cercocarpus montanus*, and *Ceanothus martinii*. The dwarf-shrub *Mahonia repens* provides sparse cover. The herbaceous layer provides sparse cover (up to 8%) and includes the medium-tall bunchgrass *Leymus salinus* and the forbs *Maianthemum stellatum (= Smilacina stellata), Physaria chambersii*, and *Stenotus armerioides (= Haplopappus armerioides)*. *Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma* saplings provide sparse cover.

*Globally*
Stands of this association are common and widespread in Zion National Park and less common in Bryce Canyon National Park. *Arctostaphylos patula* and *Quercus gambelii* codominate, each with cover ranging from 5 to 50%. Other shrubs occur with less than 10% cover and include *Mahonia fremontii, Mahonia repens, Cercocarpus montanus, Ceanothus martinii, Amelanchier utahensis, Symphoricarpos oreophilus, Quercus turbinella*, and *Ericameria nauseosa*. The herbaceous layer provides sparse cover and includes grasses, such as *Poa fendleriana, Bouteloua gracilis, Leymus salinus*, and *Sporobolus cryptandrus* and forbs *Maianthemum stellatum (= Smilacina stellata), Physaria chambersii*, and *Stenotus armerioides (= Haplopappus armerioides)*. A few emergent trees are often present near this community and include *Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma*, both as large trees and as saplings.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (14-Aug-2001).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Substrate is a colluvial slope derived from the Claron Formation (Pink Member); slopes here are loose pebbly colluvium actively moving downslope; plants are generally mounded on their uphill sides, and open patches between shrubs tend to be active scree slides; terrain is a valley bottom that has filled with colluvium, mostly limestone from adjacent cliffs.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0136, BRCA.0361, BRCA.0370); and 2007 Accuracy Assessment (3 points: BRCA_AA.0587, BRCA_AA.0590, BRCA_AA.1051).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel

**REFERENCES:** Cogan et al. 2004, 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)<br>Greenleaf Manzanita Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Semi-Desert Chaparral (CES304.001)
Mogollon 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**

*Bryce Canyon National Park*

This uncommon shrubland was sampled on colluvial slopes near the Visitor Center, Paria Viewpoint, Bryce Point, Jolley Hollow, north of Swamp Canyon, Podunk Creek, Ponderosa Canyon, Queen's Garden, Short Canyon, Water-Tropic Canyons area, Whiteman Bench and in Agua Canyon.

*Globally*

This association has been sampled extensively from Zion National Park in southwestern Utah with additional stands observed in Colorado National Monuments in western Colorado.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This short shrubland occurs on high, exposed slopes. Sites are gentle to steep (3- to 30-degree slopes), occur between 2127 and 2604 m in elevation, and are oriented to all aspects. The ground surface has low to moderate exposure of bare soil, moderate to high cover of litter, low to moderate cover of small rocks, and sparse cover of downed wood. Soils are rapidly drained sandy loams and silty clay loams derived from the Claron Formation (Pink and White members).

*Globally*

This association usually occurs on mesatops and plateaus between 1737 and 2377 m elevation. Slopes can have any aspect and are gentle to moderately sloping. One lower elevation site (1558 m) was observed on a steep northeast slope. Soils are sands to sandy loams.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (27-66% cover) and is characterized by the short shrub *Arctostaphylos patula* that provides 10-60% cover. A canopy layer of *Pinus ponderosa, Pseudotsuga menziesii, Abies concolor, Pinus edulis*, or *Juniperus scopulorum* trees with heights ranging between 5 and 15 m provides sparse cover. The remaining short shrubs provide low cover and include *Purshia tridentata, Ceanothus martinii, Cercocarpus montanus*, and *Tetradymia canescens*. The dwarf-shrub *Mahonia repens* provides sparse cover. The herbaceous layer is floristically diverse and provides sparse cover. Common graminoids include *Achnatherum hymenoides, Carex rossii, Poa fendleriana, Leymus salinus*, and non-native *Bromus inermis*. Commonly observed forbs include

*Tetraneuris acaulis (= Hymenoxys acaulis), Tragopogon dubius, Arenaria fendleri*, and *Machaeranthera grindelioides*. *Pinus ponderosa* and *Juniperus scopulorum* saplings provide sparse cover.

*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*, 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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Cercocarpus montanus* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Arctostaphylos patula* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
**Vulnerable**: *Yucca elata* var. *utahensis* (vulnerable, G5T3?)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (14-Aug-2001).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Rolling hills of open/exposed white rock substrate at the edge of the breaks; *Arctostaphylos patula* is the main litter-producer here, with any of the ground not covered with *Arctostaphylos patula* being white, gravelly Claron; many old snags in the area; fire has had a significant impact on this woodland, leaving a patchy understory varying from sparse to relatively dense shrubs; occurs on sandy soils of ridge slope.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0016, BRCA.0215, BRCA.0283, BRCA.0294; and 1 observation point: BRCA.9250), and 2007 Accuracy Assessment (21 points: BRCA_AA.0152, BRCA_AA.0215, BRCA_AA.0265, BRCA_AA.0325, BRCA_AA.0465, BRCA_AA.0473, BRCA_AA.0475, BRCA_AA.0481, BRCA_AA.0498, BRCA_AA.0504, BRCA_AA.0524, BRCA_AA.0567, BRCA_AA.0581, BRCA_AA.0586, BRCA_AA.0601, BRCA_AA.0603, BRCA_AA.0634, BRCA_AA.0791, BRCA_AA.0805, BRCA_AA.1056, BRCA_AA.1138).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* J. Drake

**REFERENCES:** CONHP unpubl. data 2003, Cogan et al. 2004, Western Ecology Working Group n.d.

## *Artemisia nova - Purshia tridentata / Poa fendleriana* Shrubland

## Black Sagebrush - Antelope Bitterbrush / Muttongrass Shrubland

| | |
|---|---|
| CODE | CEGL002345 |
| 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 NOVA* SHRUBLAND ALLIANCE (A.1105)<br>Black Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

As of the publication of this report, the information from Bryce Canyon National Park has not been incorporated into the Global description for this type, and the association has only been described from Capitol Reef National Park; this summary is derived from plot data collected in the park in 2004. The association is restricted to openings between ponderosa pine stands in the northwestern corner of the park on the flank of Thousand Lakes Mountain; one site is being invaded by ponderosa pine and Douglas-fir trees. Sites are gentle to moderately steep (5-30% slopes), occur between 2779 and 2803 m elevation, and are oriented to eastern and southeastern aspects. The unvegetated surface has moderate to high exposure of bare soil and sparse litter, and one stand has moderate to high cover of large and small rocks and gravel. Parent materials are volcanic rocks that have eroded and deposited as boulders. Soils are rapidly drained sandy clays and loams. Total vegetation cover ranges from 24 to 80%. The vegetation is characterized by *Artemisia nova* and *Purshia tridentata* ranging in cover from 5 to 55%, and the short bunchgrass *Poa fendleriana* that ranges in cover from trace to 15%. Associated shrubs include *Artemisia frigida, Chrysothamnus viscidiflorus, Symphoricarpos oreophilus*, and *Tetradymia canescens*. The herbaceous layer provides sparse to low cover; commonly observed graminoids include *Carex rossii, Elymus elymoides*, and *Elymus lanceolatus*. Forbs are diverse in terms of species composition but provide sparse cover and include *Antennaria parvifolia, Castilleja linariifolia, Eriogonum umbellatum, Eriogonum racemosum, Stephanomeria spinosa (= Lygodesmia spinosa), Machaeranthera canescens, Penstemon strictus*, and *Packera multilobata (= Senecio multilobatus)*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This shrubland is uncommon, occurs on moderately deep soils, and was sampled near the northern park boundary, Shakespeare Point, and along the rim of Tropic Canyon.

*Globally*

This association is known from Capitol Reef and Bryce Canyon National Parks in southeastern Utah. It may occur nearby in the highlands of Boulder and Thousand Lakes mountains.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon shrubland occurs on high level slopes of saddles and plateaus and in a swale. The sites are gentle to moderate (2- to 15-degree slopes), occur between 2321 and 2342 m in elevation, and are oriented to the north or west. The ground surface has moderate exposure of bare soil, high cover of litter, and sparse cover of small rocks and downed wood. Soils are rapidly drained loams and clay loams that are derived from the Wahweep Formation.

*Globally*

This association is known from Capitol Reef and Bryce Canyon National Parks. Until there is additional data, no global information is available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (40-75% cover) and is characterized by the short shrubs *Purshia tridentata* and *Artemisia nova* that provide 16-23% and 4-14% cover, respectively. Other short- and dwarf-shrub species are low in terms of floristic diversity, provide sparse cover, and include *Tetradymia canescens, Chrysothamnus depressus, Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae*. The herbaceous layer is moderately diverse floristically and provides sparse to low cover. Common bunch grasses include *Poa fendleriana, Elymus elymoides, Leymus salinus*, and *Achnatherum hymenoides*. Forbs include *Leptodactylon pungens, Phlox hoodii*, and *Sphaeralcea coccinea*.

*Globally*
This association is known from Capitol Reef and Bryce Canyon National Parks. Until there is additional data, no global information is available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Purshia tridentata* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (17-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
This association had a previous name of *Purshia tridentata – Artemisia nova* Shrubland [Park Special].

*Globally*
This association is known from Capitol Reef and Bryce Canyon National Parks.. Until there is additional data, no global information is available.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terrain is a low eroded ridge with a few vegetated furrows running down the side; soil is rocky and appears to be fairly deep; vegetation is thick and thriving this year, although there are some dead branches in the shrubs, possibly from past drought.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0331, BRCA.0344, BRCA.0351), and 2007 Accuracy Assessment (3 points: BRCA_AA.0010, BRCA_AA.0050, BRCA_AA.0058).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, modified by G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *Artemisia nova / Elymus elymoides* Shrubland

## Black Sagebrush / Squirreltail Shrubland

| | |
|---|---|
| CODE | CEGL001418 |
| 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 NOVA* SHRUBLAND ALLIANCE (A.1105)<br>Black Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This association is found in the foothills, plateaus and mountains of Nevada and Utah. Stands occur on well-drained slopes, knolls and ridges. Substrates are typically shallow, gravelly or stony soils derived from calcareous parent materials such as limestone. These soils are frequently coarse-textured, but subsoil argillic horizons are common. There is often an impenetrable subsurface layer from a duripan, caliche, or bedrock. *Artemisia nova* plants often grow in adjacent *Artemisia tridentata* shrublands that are found on deeper soils in basins. Combined ground cover of bare ground, rock and gravel is often high (about 70% cover). Litter is concentrated under the shrub canopies. The vegetation is characterized by an open dwarf-shrub canopy (10-30% cover) that is dominated by *Artemisia nova* and a sparse herbaceous layer dominated by the perennial graminoid *Elymus elymoides* with scattered forbs. *Atriplex confertifolia, Artemisia tridentata, Chrysothamnus viscidiflorus, Ephedra nevadensis, Ephedra viridis*, and *Grayia spinosa* are common shrub associates that may be present in smaller amounts. The herbaceous layer includes low cover of species of *Comandra, Cryptantha, Erigeron, Eriogonum, Machaeranthera, Phlox, Penstemon*, and *Poa secunda*. Introduced annual graminoids such as *Bromus rubens* and *Bromus tectorum* are common in disturbed stands.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was observed from one Aaccuracy Assessment point in 2007, therefore no local description is available at this time.

*Globally*

This dwarf-shrubland association occurs in the foothills, plateaus and mountains of Nevada and Utah at elevations above 1525 m (5000 feet).

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This association is found in the foothills, plateaus and mountains of Nevada and Utah. Elevation ranges from 1525-2200 m (5000-7200 feet). Stands occur on well-drained slopes and ridges. Soils are typically shallow, gravelly or stony, and often are derived from calcareous parent materials such as limestone. Soil is often coarse-textured, and subsoil argillic horizons are common. There is often an impenetrable subsurface layer from a duripan, caliche, or bedrock. *Artemisia nova* plants often grow in adjacent *Artemisia tridentata* shrublands that are found on deeper soils in basins. Combined ground cover of bare ground, rock and gravel is often high (about 70% cover). Litter is concentrated under the shrub canopies.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*
This association is characterized by an open dwarf-shrub canopy (10-30% cover) that is dominated by *Artemisia nova* and a sparse herbaceous layer dominated by the perennial graminoid *Elymus elymoides* with scattered forbs. *Atriplex confertifolia, Artemisia tridentata, Chrysothamnus viscidiflorus, Ephedra nevadensis, Ephedra viridis*, and *Grayia spinosa* are common shrub associates that may be present in smaller amounts. Other herbaceous species include *Comandra umbellata ssp. pallida (= Comandra pallida), Cryptantha* spp., *Erigeron* spp., *Eriogonum microthecum, Machaeranthera canescens, Phlox longifolia, Penstemon* spp., and *Poa secunda*. Introduced annual graminoids such as *Bromus rubens* and *Bromus tectorum* are common in disturbed stands.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Elymus elymoides* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus rubens* (exotic), *Bromus tectorum* (exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0323).
*Local Description Authors:*
*Global Description Authors:* K.A. Schulz

**REFERENCES:** Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, Jensen et al. 1988a, Lewis 1975a, Ostler et al. 2000, Peterson 2008, Rickard and Beatley 1965, Tisdale and Hironaka 1981, Western Ecology Working Group n.d., Wright et al. 1979

## *Artemisia nova / Hesperostipa comata* Shrubland

## Black Sagebrush / Needle-and-Thread Shrubland

| | |
|---|---|
| CODE | CEGL001425 |
| 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 NOVA* SHRUBLAND ALLIANCE (A.1105)<br>Black Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This association is found in the foothills, plateaus and mountains of Nevada, Idaho, northwestern Colorado and Utah. Stands occur on flat mesatops, benches and plains or on steep pediment slopes, knolls and ridges, and elevations range from 1890 to 2530 m. Aspects are often southern. Substrates are typically shallow, stony soils often derived from calcareous parent materials such as limestone. Soil textures are variable and range from sandy, loamy, fine-textured or skeletal; argillic subsoil horizons are common. There is often an impenetrable subsurface layer from a duripan, caliche, or bedrock. Combined ground cover of bare ground, rock and gravel is often high (about 70% cover). Litter is concentrated under the shrub canopies. The vegetation is characterized by an open dwarf-shrub canopy (10-30% cover) that is dominated by *Artemisia nova* and a sparse herbaceous layer dominated by the perennial graminoid *Hesperostipa comata* with scattered forbs. Scattered *Chrysothamnus viscidiflorus, Ericameria parryi, Grayia spinosa, Krascheninnikovia lanata*, and *Tetradymia canescens* are common shrub associates that may be present in smaller amounts. *Achnatherum hymenoides, Elymus elymoides, Koeleria macrantha, Pleuraphis jamesii, Poa fendleriana*, or *Poa secunda* may be present in the herbaceous layer but have sparse cover. Forbs include species of *Astragalus, Erigeron, Eriogonum, Packera, Phlox*, and *Penstemon*. Introduced annual graminoids such as *Bromus rubens* and *Bromus tectorum* are common in disturbed stands.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland is common and was sampled near Fairyland Point, the northern park boundary and entrance, Paria View, southwest of Sunset Campground, and in the East Creek drainage, and several additional areas during 2007 Accuracy Assessment.

*Globally*

This dwarf-shrubland association is present in the southern part of the Intermountain Region above 1890 m (6200 feet). This includes northern Utah and Nevada, northwestern Colorado (Jackson and Moffit counties) and southeastern Idaho.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common short shrubland occurs on plains, plateaus, valley floors, and swales. The sites are flat to gentle (0- to 5-degree slopes), occur between 2307 and 2431 m in elevation, and are oriented to all aspects. The ground surface has moderate to high exposure of bare soil, moderate cover of litter, sparse to moderate cover of small rocks, and sparse cover of downed wood. Soils are deep, rapidly drained silts, silty clay loams, clays, silty clays, silty loams, and loams that are derived from New Alluvium.

*Globally*

This association is found in the foothills, plateaus and mountains of Nevada, Idaho, northwestern Colorado and Utah. Elevation ranges from 1890-2530 m (6200-8300 feet). In Nevada, stands possibly could be found as low as 1676 m (5500 feet) elevation. Stands occur on flat mesatops, benches and plains or on steep pediment slopes and ridges. Aspects are often southern. Soils are typically shallow, stony, and often derived from calcareous parent materials such as limestone. Soil textures are variable and range from sandy, loamy, fine-textured or skeletal; argillic subsoil horizons are common. There is often an impenetrable subsurface layer from a duripan, caliche, or bedrock. *Artemisia nova* plants often grow in adjacent *Artemisia tridentata* shrublands that are found on deeper soils in basins. Combined ground cover of bare ground, rock and gravel is often high (about 70% cover). Litter is concentrated under the shrub canopies.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (29-59% cover) and is characterized by the short shrub *Artemisia nova* that provides 6-33% cover and the medium-tall bunchgrass *Hesperostipa comata* that provides 3-20% cover. The remaining short and dwarf-shrubs are moderate in terms of floristic diversity, provide sparse to low cover, and include *Chrysothamnus depressus, Tetradymia canescens, Gutierrezia sarothrae, Artemisia frigida, Purshia*

*tridentata*, and *Chrysothamnus viscidiflorus*. The remaining graminoid layer is moderately diverse floristically, provides sparse to low cover and includes *Poa fendleriana, Carex rossii, Leymus salinus, Hesperostipa comata, Koeleria macrantha*, and non-native *Poa pratensis*. Forbs are moderately diverse floristically, provide sparse to low cover, and include *Leptodactylon pungens, Potentilla crinita, Linum perenne, Achillea millefolium, Taraxacum officinale*, and *Tragopogon dubius*.

*Globally*
This association is characterized by an open dwarf-shrub canopy (10-30% cover) that is dominated by *Artemisia nova* and a sparse herbaceous layer dominated by the perennial graminoid *Hesperostipa comata* with scattered forbs. Scattered *Chrysothamnus viscidiflorus, Ericameria parryi, Grayia spinosa, Krascheninnikovia lanata*, and *Tetradymia canescens* are common shrub associates that may be present in smaller amounts. *Achnatherum hymenoides, Elymus elymoides, Koeleria macrantha, Pleuraphis jamesii, Poa fendleriana*, or *Poa secunda* may be present in the herbaceous layer but have sparse cover. Other herbaceous species include *Astragalus* spp., *Erigeron* spp., *Eriogonum racemosum, Leptodactylon pungens, Packera multilobata, Phlox longifolia*, and *Penstemon* spp. Introduced annual graminoids such as *Bromus rubens* and *Bromus tectorum* are common in disturbed stands.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Hesperostipa comata* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Hesperostipa comata* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
**Exotic/Invasive**: *Bromus rubens* (exotic), *Bromus tectorum* (exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3? (26-Feb-2004). This dwarf-shrubland association is present in the southern part of the Intermountain Region above 1890 m (6200 feet). This includes northern Utah and Nevada and southeastern Idaho, where small stands occur on southern aspects of flat mesatops, benches and plains, or on steep pediment slopes, knolls and ridges. The number, condition, and size of stands have been declining due to intensive range management, introduction of exotic species, alteration of fire regime, and road development from off-road vehicles (ORV). Remote stands are mostly being threatened through range management of livestock. These stands become more exposed to exotic weed invasion and lose the presence of perennial grasses and soil crust. Fire frequency is increased by the invasion of introduced annual grasses, such as *Bromus tectorum* or *Bromus rubens*, which provide fine fuels that allow fires to spread.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**

*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Soils appear deep with high clay content; fire burned through here at some point in the last 5-10 years; *Artemisia nova* shrubs have suffered some dieback, possibly due to recent drought.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (10 plots: BRCA.0029, BRCA.0030, BRCA.0096, BRCA.0221, BRCA.0222, BRCA.0252, BRCA.0295, BRCA.0296, BRCA.0329, BRCA.0330) and 2007 Accuracy Assessment (13 points: BRCA_AA.0027, BRCA_AA.0033, BRCA_AA.0084, BRCA_AA.0093, BRCA_AA.0355, BRCA_AA.0387, BRCA_AA.0396, BRCA_AA.0487, BRCA_AA.0799, BRCA_AA.0847, BRCA_AA.1230, BRCA_AA.1234, BRCA_AA.0479).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz

**REFERENCES:** Baker and Kennedy 1985, Blackburn et al. 1968c, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, Hironaka et al. 1983, Peterson 2008, Roberts et al. 1992, Tisdale and Hironaka 1981, Western Ecology Working Group n.d., Wright et al. 1979, Zamora and Tueller 1973

## *Artemisia nova / Poa fendleriana* Shrubland

## Black Sagebrush / Muttongrass Shrubland

| | |
|---|---|
| CODE | CEGL002698 |
| 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 NOVA* SHRUBLAND ALLIANCE (A.1105)<br>Black Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This short-shrub association occurs locally in southern Utah and western Colorado on the slopes and tops of ridges and plateaus, as well as the sides of drainages. Stands are usually small to medium-sized patches in a mosaic of other types of shrubland. Elevations range from 1830 to 3000 m (6000-9840 feet). Stands occur on gentle to moderately steep slopes with a tendency toward north and east aspects. Soils and substrates are variable but generally are rocky and shallow. The vegetation is characterized by a shrub layer dominated by *Artemisia nova* with between 5 and 25% cover; associated species such as *Amelanchier utahensis, Artemisia tridentata, Tetradymia canescens, Symphoricarpos oreophilus*, and *Purshia tridentata* contribute another 10-25%. The herbaceous layer is diverse, but *Poa fendleriana* is among the dominants with between 5 and 20% cover. Other common grasses include *Koeleria macrantha, Bouteloua gracilis, Elymus elymoides*, and *Poa secunda*. Forbs contribute relative little cover and are inconsistent among sites.

**DISTRIBUTION**
*Bryce Canyon National Park*
This short shrubland is common, occurs on deep soils, and was sampled near Swamp Canyon Trailhead, the northern park boundary, at Ruby's Inn, on Shakespeare Point, on Shinglemill Swale and in Oak Hollow in the environs.

*Globally*
This association has been documented from Zion and Capitol Reef national parks in southern Utah and from Curecanti National Recreation Area in western Colorado.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*

This common short shrubland occurs on hillsides, plateaus, valleys, and a swale. The sites are gentle to moderate (1- to 11-degree slopes), occur between 2296 and 2460 m in elevation, and are oriented to all aspects. The ground surface has moderate to high exposure of bare soil, low to moderate cover of litter, sparse to moderate cover of small rocks, and sparse cover of downed wood. Soils are rapidly drained loams, sandy clay loams, silty clay loams, silt loams, and sandy loams that are derived from older alluvium.

*Globally*
This short-shrub association occurs locally in southern Utah and western Colorado on the slopes and tops of ridges, mesas and plateaus, as well as the sides of drainages. Elevations range from 1830 to 3000 m (6000-9840 feet). Stands occur on gentle to moderately steep slopes (3-35%) with a tendency toward north and east aspects. Soils and substrates are variable but generally are rocky and shallow, with bare ground, gravel and rock providing a high percentage of the unvegetated ground cover. There is a slight tendency for *Artemisia nova* shrublands to occur on calcareous substrates such as limestone, marlstone and some types of volcanic rock.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (27-56% cover) and is characterized by the short shrub *Artemisia nova* that provides 2-25% cover and the short bunchgrass *Poa fendleriana* that provides 1-34% cover. The remaining short and dwarf-shrubs are low in floristic diversity, provide sparse to low cover, and include *Chrysothamnus depressus, Artemisia pygmaea, Eriogonum microthecum, Purshia tridentata, Tetradymia canescens*, and *Chrysothamnus viscidiflorus*. The remaining graminoid layer is moderate in floristic diversity, provides sparse to low cover, and includes *Bouteloua gracilis, Hesperostipa comata, Koeleria macrantha*, the seeded bunchgrass *Agropyron cristatum*, and non-native rhizomatous grasses *Poa pratensis* and *Bromus inermis*. Forb species composition is diverse, provides sparse to low cover, and includes *Leptodactylon pungens, Machaeranthera grindelioides, Comandra umbellata, Achillea millefolium, Cordylanthus kingii*, and *Antennaria rosulata*.

*Globally*
This short-shrub association occurs in small patches, usually surrounded by other types of shrublands. Total vegetation cover ranges from 10 to 60%. The shrub layer is dominated by *Artemisia nova* with between 5 and 25% cover; associated species such as *Amelanchier utahensis, Artemisia tridentata, Tetradymia canescens, Symphoricarpos oreophilus*, and *Purshia tridentata* contribute another 10-25%. The herbaceous layer is diverse, but *Poa fendleriana* is among the dominants with between 5 and 20% cover. Other common grasses include *Koeleria macrantha, Bouteloua gracilis, Elymus elymoides*, and *Poa secunda*. Forbs contribute relative little cover and are inconsistent among sites.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Hesperostipa comata*, *Poa fendleriana* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Poa fendleriana* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Agropyron cristatum* (exotic, Medium/Low), *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* GNR (14-Aug-2001).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland; wooded wetlands. One sampled stand (BRCA.0078) occurs intermixed with widely spaced seeps with large individual spruce trees. It was noted that these seeps and their component vegetative cover belong to a different community than sagebrush shrubland.

*Globally*
This association may be a southern analogue of *Artemisia nova / Pseudoroegneria spicata* Shrubland (CEGL001424), which is common from northwestern Colorado north through Wyoming and the Columbia Basin.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Soils are deeper, finer, and rock-free compared to the neighboring woodland; some dieback on the *Artemisia nova* shrubs, possibly related to recent drought; hillsides on both sides of Podunk Creek and the Sevier River were slightly terraced for erosion control in 1960.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (6 plots: BRCA.0078, BRCA.0117, BRCA.0118, BRCA.0245, BRCA.0346, BRCA.0347) and 2007 Accuracy Assessment (18 points: BRCA_AA.0004, BRCA_AA.0013, BRCA_AA.0014, BRCA_AA.0025, BRCA_AA.0037, BRCA_AA.0043, BRCA_AA.0054, BRCA_AA.0056, BRCA_AA.0063, BRCA_AA.0114, BRCA_AA.0132, BRCA_AA.0555, BRCA_AA.0557, BRCA_AA.0559, BRCA_AA.0561, BRCA_AA.0712, BRCA_AA.0880, BRCA_AA.1044).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* J. Coles

**REFERENCES:** Cogan et al. 2004, Western Ecology Working Group n.d.

## *Artemisia nova* Shrubland

## Black Sagebrush Shrubland

| | |
|---|---|
| CODE | CEGL001417 |
| 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 NOVA* SHRUBLAND ALLIANCE (A.1105)<br>Black Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This broadly defined association is reported from eastern Wyoming and western Colorado to eastern California but may be found elsewhere in the interior western U.S. Stands occur at middle to upper elevations of 1400 to 2730 m (4590-8960 feet) on mountain and hillslopes, ridges, mesatops, alluvial fans and river bluffs. Sites are nearly level to steeply sloping; aspects are variable. Soils are shallow (often <30 cm deep), well-drained, and coarse-textured with high cover of gravel and cobble (desert pavement). Soil texture ranges from gravelly loam to sandy clay loam. The vegetation is characterized by an open to moderately dense (12-40% cover) dwarf-shrub layer (<0.5 m tall) that is dominated by *Artemisia nova*. Other woody species present include *Picrothamnus desertorum (= Artemisia spinescens), Atriplex confertifolia, Artemisia tridentata, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra* spp., *Grayia spinosa, Krascheninnikovia lanata*, and *Opuntia erinacea*. Diagnostic of this community is a sparse herbaceous understory with only scattered grasses and forbs. Common grasses may include *Achnatherum*

*hymenoides, Aristida purpurea, Hesperostipa comata, Pleuraphis jamesii, Pseudoroegneria spicata*, and *Poa secunda*. Forbs such as *Erysimum capitatum (= Erysimum asperum), Erigeron aphanactis, Stenotus acaulis*, and *Phlox* spp. may also be present. Scattered trees may be present, such as *Juniperus osteosperma, Pinus edulis, Pinus monophylla*, or *Yucca brevifolia*, depending on location. Introduced species are important in some stands and may include *Bromus tectorum, Salsola kali*, and *Halogeton glomeratus*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland is common, occupies deep, fine soils and was sampled within the park near the Visitor Center, along the northern boundary, southwest of Sunset Camp, along the main access road, in Long and Puma hollows, at Fairyland Point, in the East Creek drainage, and in the environs near the confluence of Sevier and Podunk creeks and in Water Canyon.

*Globally*

This association occurs from eastern Wyoming south to west-central Colorado and west to eastern California.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common short shrubland occurs in valleys, meadows, and swales and on plateaus and slopes. Sites are flat to moderate (0- to 11-degree slopes), occur between 2322 and 2467 m in elevation, and are oriented to the west or north. The ground surface has low to high exposure of bare soil, low to moderate cover of litter, sparse to high cover of small rocks, and sparse cover of downed wood. Soils are deep, rapidly drained silty clay loams, loams, silty clays, and silts derived from older alluvium or Claron Formation (White Member).

*Globally*

Stands occur at middle to upper elevations (1400-2730 m) on mountain and hillslopes, ridges, mesatops, alluvial fans and river bluffs. Sites are nearly level to steeply sloping; aspects are variable, but stands are reported from northwestern slopes. Soils are often shallow (<30 cm deep), well-drained, calcareous and coarse-textured with high cover (35-70% cover) of gravel and cobble (desert pavement). Soil texture ranges from gravelly loam to sandy clay loam. Adjacent vegetation includes *Juniperus osteosperma*-dominated woodlands. At Dinosaur National Monument, stands of *Artemisia nova* indicate limestone; at Mesa Verde National Park, stands occur in deep soils at the heads of drainages, as islands in a tall, mixed *Quercus - Amelanchier* shrubland.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to moderately dense (20-55% cover) and is characterized by the short shrub *Artemisia nova* that provides 12-40% cover. Scattered tree species of *Pinus edulis* and *Juniperus scopulorum* provide sparse cover in some stands and attain heights of 2-5 m. The short- and dwarf-shrub species present provide sparse to low cover, and include *Purshia tridentata, Ericameria nauseosa, Chrysothamnus depressus, Ericameria parryi (= Chrysothamnus parryi), Chrysothamnus vaseyi, Chrysothamnus viscidiflorus, Tetradymia canescens, Artemisia frigida*, and *Gutierrezia sarothrae*. The herbaceous layer is moderate to high in terms of floristic diversity and provides sparse to low cover. The graminoid layer includes *Achnatherum pinetorum, Bouteloua gracilis, Elymus elymoides, Hesperostipa comata, Koeleria macrantha, Leymus salinus, Poa fendleriana*, and non-native rhizomatous grasses *Poa pratensis, Thinopyrum intermedium (= Elymus hispidus)*, and *Bromus inermis*. Forbs include *Linum perenne, Calylophus lavandulifolius, Potentilla crinita, Achillea millefolium, Cordylanthus kingii*, and *Eriogonum racemosum*.

*Globally*

This association has an open to moderately dense (10-40% cover) dwarf-shrub layer (<0.5 m tall) that is dominated by *Artemisia nova*. Other woody species present include *Picrothamnus desertorum (= Artemisia spinescens), Artemisia tridentata, Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra nevadensis, Ephedra torreyana, Ephedra viridis, Grayia spinosa, Krascheninnikovia lanata*, and *Opuntia erinacea*. Diagnostic of this community is a sparse herbaceous understory with only scattered grasses and forbs. Common grasses may include *Achnatherum hymenoides, Aristida purpurea, Hesperostipa comata, Pleuraphis jamesii*, and *Poa secunda*. Forbs such as *Erysimum capitatum (= Erysimum asperum), Erigeron aphanactis*, and *Phlox viridis* may be present. Scattered *Juniperus osteosperma, Pinus monophylla*, and *Yucca brevifolia* may be present in eastern Mojave stands such as Cottonwood Mountains in Death Valley National Park in California. *Juniperus osteosperma*

and *Pinus edulis* have been noted in Colorado Plateau stands. Introduced species are important in some stands and may include *Bromus tectorum, Salsola kali*, and *Halogeton glomeratus*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Hesperostipa comata*, *Koeleria macrantha*, *Poa fendleriana*, *Thinopyrum intermedium* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium), *Thinopyrum intermedium* (exotic, Medium/Insignificant)

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (exotic, High), *Halogeton glomeratus* (exotic, High/Medium), *Salsola kali* (exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
This wide-ranging and broadly defined association is distinguished from other *Artemisia nova* dwarf-shrublands by the lack of a significant graminoid layer and therefore is quite variable in species composition. Blackburn et al. (1968c) described an *Artemisia nova / Bromus tectorum* association that may be included here until a new *Artemisia nova / Bromus tectorum* Shrubland association is created in the USNVC.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Homogenous black sagebrush shrubland occupies this broad valley in a forest clearing; diverse herbaceous understory; many small white rocks throughout plot (Claron-derived); terraced hillside that appears seeded with non-natives, and heavily grazed by cattle; area has experienced fire as evidenced by the blackened trunks on surrounding trees and many burned stubs of shrubs in the meadow; soils are deep but pebbly, a lot of bare reddish soil between shrubs; stand on terrace seeded with exotic grasses, area is heavily grazed; large meadow with deep, pebbly soil; slopes of site terraced and seeded with exotic grasses during the 1960s as part of a range improvement project; community occupies a linear depression.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (6 plots: BRCA.0010, BRCA.0053, BRCA.0058, BRCA.0085, BRCA.0106, BRCA.0286; and 5 observation points: BRCA.9017, BRCA.9046, BRCA.9053, BRCA.9217, BRCA.9247) and 2007 Accuracy Assessment (10 points: BRCA_AA.0035, BRCA_AA.0097, BRCA_AA.0364, BRCA_AA.0401, BRCA_AA.0414, BRCA_AA.0467, BRCA_AA.0469, BRCA_AA.0485, BRCA_AA.1229, BRCA_AA.1235).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Drake and J. Coles

**REFERENCES:** Beatley 1976, Blackburn et al. 1968c, Bourgeron and Engelking 1994, Driscoll et al. 1984, Heinze et al. 1962, Leary and Peterson 1984, Milton and Purdy 1983, Peterson 1984, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d.

## *Artemisia tridentata ssp. vaseyana / Pascopyrum smithii* Shrubland

## Mountain Big Sagebrush / Western Wheatgrass Shrubland

| | |
|---|---|
| CODE | CEGL001028 |
| 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 TRIDENTATA SSP. VASEYANA* SHRUBLAND ALLIANCE (A.831)<br>Mountain Big Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This mesic sagebrush association occurs in upland areas where snow accumulates, including swales and valley bottoms. Documented stands are known from Wyoming, Montana and northern and western Colorado. Elevations range from 2200 to 2500 m (7200-8200 feet). Sites are level to gently sloping and may be oriented to any aspect. Soils may be derived from eolian sediments, sandstone or shale, and often have a silty loam or clay loam texture. The amount of litter on the ground surface is inversely proportional to the intensity of grazing. Total vegetation cover ranges from a low of around 20% to approximately 75%. *Artemisia tridentata ssp. vaseyana* dominates the shrub layer with 10 to 50% cover, and *Pascopyrum smithii* dominates a diverse herbaceous layer. Other shrubs comprise a minority of the shrub canopy, including *Symphoricarpos oreophilus, Amelanchier utahensis, Purshia tridentata, Ericameria nauseosa, Tetradymia canescens, Krascheninnikovia lanata*, and *Chrysothamnus viscidiflorus*. The grass component of the understory is often diverse and may include a combination of *Poa fendleriana, Achnatherum pinetorum, Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Leymus cinereus, Hesperostipa comata, Elymus elymoides*, and *Poa secunda*. Forbs such as *Artemisia frigida, Achillea millefolium*, and *Phlox hoodii ssp. muscoides (= Phlox bryoides)* generally contribute little cover.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland has limited distribution, occurs on deep soils, and was sampled near Yellow Creek.

*Globally*

This association is known from Montana, northern and western Colorado, and Wyoming.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This short shrubland occupies a basin. The site is gentle (3-degree slope), occurs at 2025 m in elevation, and is oriented to the southeast. The ground surface has moderate exposure of bare soil, moderate cover of litter, and sparse cover of small rocks and downed wood. Soils are rapidly drained clays.

*Globally*

This mesic sagebrush association occurs in uplands in areas where snow accumulates, including swales and valley bottoms. Documented stands are in Wyoming and in northern and western Colorado, but this association is likely to be widespread. Elevations range from 2200 to 2500 m (7200-8200 feet). Sites are level to gently sloping and may occur on any aspect. Soils may be derived from eolian deposits, sandstone or shale, and often have a silty loam or clay loam texture. The amount of litter on the ground surface is inversely proportional to the intensity of grazing.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (29% cover) and is characterized by the short shrub *Artemisia tridentata ssp. vaseyana* that provides 11% cover and the rhizomatous grass *Pascopyrum smithii* that provides 15% cover. The remaining short shrub *Atriplex canescens* and dwarf-shrub *Gutierrezia sarothrae* provide sparse cover. The remaining herbaceous layer provides sparse cover and includes the grasses *Pseudoroegneria spicata (= Elymus*

*spicatus)* and *Elymus elymoides*. Forbs provide sparse cover and include *Heliomeris longifolia (= Viguiera longifolia)* and *Sphaeralcea coccinea*.

*Globally*
Total vegetation cover in these sagebrush shrublands ranges from 20% to approximately 75%. *Artemisia tridentata ssp. vaseyana* dominates the shrub layer with 10-50% cover, and *Pascopyrum smithii* dominates the diverse herbaceous layer. Other shrubs may comprise a minor component of the shrub canopy, including *Symphoricarpos oreophilus, Amelanchier utahensis, Purshia tridentata, Ericameria nauseosa, Tetradymia canescens, Krascheninnikovia lanata*, and *Chrysothamnus viscidiflorus*. The grass component of the understory is often diverse and may include a combination of *Poa fendleriana, Achnatherum pinetorum, Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Leymus cinereus, Hesperostipa comata, Elymus elymoides*, and *Poa secunda*. Forbs such as *Artemisia frigida, Achillea millefolium*, and *Phlox hoodii ssp. muscoides (= Phlox bryoides)* generally contribute little cover.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia tridentata* ssp. *vaseyana* |
| Herb (field) | *Pascopyrum smithii* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia tridentata* ssp. *vaseyana* |
| Herb (field) | *Pascopyrum smithii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3? (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Several dead or partly dead shrubs in this area, the majority of them sagebrush; soil surface is mostly rock-free, with a physical crust that is cracking as it dries.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0405) and 2007 Accuracy Assessment (2 points: BRCA_AA.0776, BRCA_AA.0859).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles

**REFERENCES:** Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Jones 1992b, MTNHP 2002b, Rzedowski 1981, Skull Point Mine Application n.d., Skull Point Mine Permit Renewal n.d., Smith 1966, Terwilliger and Smith 1978, Western Ecology Working Group n.d.

## *Artemisia tridentata ssp. wyomingensis / Leymus salinus* Shrubland

## Wyoming Big Sagebrush / Saline Wildrye Shrubland

| | |
|---|---|
| CODE | CEGL002813 |
| 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 TRIDENTATA SSP. WYOMINGENSIS* SHRUBLAND ALLIANCE (A.832)<br>Wyoming Big Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This shrubland association has been described from Dinosaur National Monument in northwestern Colorado and Bryce National Park in southern Utah, but may be expected on marine shale substrates in southern Wyoming and northeastern Utah as well. The association occupies badland hills of Mancos and Tropic shales from 1700 to 2132 m (5600-8600 feet) in elevation. The barren, rocky substrate has clayey to sandy loam well-drained soils. The vegetation is dominated by *Artemisia tridentata ssp. wyomingensis* with 10-30% cover. *Artemisia frigida, Atriplex confertifolia, Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae* are often present with sparse cover. *Leymus salinus* dominates the herbaceous understory with 1 to 12% cover and is typically associated with *Achnatherum hymenoides*. Forb species typically include *Erysimum capitatum (= Erysimum asperum), Phlox hoodii*, and *Stenotus acaulis*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland was sampled only once in Jolley Hollow, and at two Accuracy Assessment points in 2007.

*Globally*

This shrubland is known from exposures of Mancos shale adjacent to the east end of Dinosaur National Monument in northwestern Colorado, and on Tropic shale in western Bryce Canyon National Park, and may be expected on marine shale substrates in southern Wyoming and northeastern Utah as well.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This short shrubland occupies a valley bottom. The site is gentle (1-degree slope), occurs at 2132 m in elevation, and is oriented to the southeast. The ground surface has high exposure of bare soil, moderate cover of litter, and sparse cover of downed wood. Soils are rapidly drained sandy loams that are derived from New Alluvium.

*Globally*

The shrubland occurs on very steep (60-75%), south-facing mountain and canyon slopes and gentle valley bottoms, from 1700 to 2620 m (5600-8600 feet) elevation. Coarse loamy sand soils on these dry, exposed sites are dominated by boulders, rock or bare ground, derived from gneiss and other metamorphic rock or sedimentary materials. The association occupies badland hills of Mancos and Tropic shales. The barren, rocky substrate has clayey to sandy loam well-drained soils.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (50% cover) and is characterized by the short shrub *Artemisia tridentata ssp. wyomingensis* that provides 30% cover and the medium-tall bunchgrass *Leymus salinus* that provides 12% cover. Scattered canopy trees of *Pinus edulis* attain 2-5 m in height and provide sparse cover. The remaining shrubs include *Chrysothamnus viscidiflorus, Gutierrezia sarothrae*, and *Artemisia frigida* and provide low cover. The forb *Erysimum capitatum (= Erysimum asperum)* provides sparse cover.

*Globally*
The vegetation is dominated by *Artemisia tridentata ssp. wyomingensis* with 10-30% cover. *Artemisia frigida, Atriplex confertifolia, Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae* are often present with sparse cover. *Leymus salinus* dominates the herbaceous understory with 1 to 12% cover and is typically associated with *Achnatherum hymenoides*. Forb species typically include *Erysimum capitatum (= Erysimum asperum), Phlox hoodii*, and *Stenotus acaulis*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia tridentata* ssp. *wyomingensis* |
| Herb (field) | *Leymus salinus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (5-Jul-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
The floristics are similar to the *Artemisia tridentata ssp. wyomingensis-Atriplex confertifolia/Elymus salina* Association described by (Baker 1982b), but it is not codominated by both shrub species.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Sagebrush community is quite anomalous with the surrounding pinyon-juniper woodlands, which contain no sagebrush at all; topography here apparently allows for the deep, fine soils to accumulate in this small basin-like area.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0140) and 2007 Accuracy Assessment (2 points: BRCA_AA.0760, BRCA_AA.0763).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, mod. G. Kittel

**REFERENCES:** Baker 1982b, Western Ecology Working Group n.d.

## *Chrysothamnus viscidiflorus / Hesperostipa comata* Shrubland

## Yellow Rabbitbrush / Needle-and-Thread Shrubland

| | |
|---|---|
| CODE | CEGL002799 |
| 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 | *CHRYSOTHAMNUS VISCIDIFLORUS* SHRUBLAND ALLIANCE (A.2651)<br>Yellow Rabbitbrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This association occurs on disturbed ridges and valleys in the northern Colorado Plateau of Colorado and Utah and into the southern Rocky Mountains between 1800 and 2440 m (5900-8000 feet) elevation. Slopes range from gentle to moderately steep. Soils have textures ranging from silt loam to sandy loam to loamy sand, and bare soil covers most of the unvegetated ground surface. The total vegetation cover rarely exceeds 60% and is characterized by an open shrub canopy of *Chrysothamnus viscidiflorus* with between 5 and 35% cover. The native bunchgrass *Hesperostipa comata* contributes 10 to 20% cover. Other short shrubs providing sparse cover include *Symphoricarpos oreophilus, Artemisia nova*, and *Tetradymia canescens*. The herbaceous layer is diverse in terms of species composition. Associated graminoids include *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Pascopyrum smithii, Poa fendleriana*, and *Poa secunda*. Forbs are diverse but contribute very little cover, including *Chenopodium leptophyllum, Crepis acuminata, Cryptantha cinerea var. jamesii, Erigeron engelmannii, Eriogonum umbellatum, Lupinus caudatus, Opuntia fragilis, Packera tridenticulata, Sedum lanceolatum, Senecio spartioides, Leptodactylon pungens, Heterotheca villosa (= Chrysopsis villosa)*, and *Schoenocrambe linifolia*. This community generally occurs in areas that have experienced significant disturbance (such as fire) or on-going natural disturbance such as season-long grazing.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland was sampled near the northern park boundary. It was also observed at four Accuracy Assessment points in 2007.

*Globally*

This association is apparently relatively uncommon and has been documented from western Colorado and Utah. It is likely to occur throughout the interior western U.S. in sandy, disturbed areas that normally support sagebrush shrublands.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This rare short shrubland occurs on a plateau. The site is gentle (3-degree slope), occurs at 2307 m in elevation, and is oriented to the west. The ground surface has high exposure of bare soil, moderate cover of litter, and sparse cover of small rocks. Soils are rapidly drained sandy loams and parent materials are obscured by soil.

*Globally*

This association occurs on level to moderately sloping disturbed sites on ridges and in valleys between 1800 and 2440 m (5900-8000 feet) elevation. Substrates include eolian sands, metamorphic rocks, granite or limestone, and the soil is likewise variable, with textures ranging from silt loam to sandy loam to loamy sand. Bare soil covers most of the unvegetated ground surface.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

This shrubland is rare and occurs on deep soils. Total vegetation cover is low (19% cover) and is characterized by the short shrub *Chrysothamnus viscidiflorus* that provides 7% cover and the medium-tall bunchgrass *Hesperostipa*

*comata* that provides 6% cover. The remaining short- and dwarf-shrub layers are low in floristic diversity, provide sparse cover, and include *Tetradymia canescens, Artemisia nova*, and *Opuntia fragilis*. The remaining grasses are low in floristic diversity, provide sparse cover, and include *Bouteloua gracilis, Poa secunda*, and non-native annual *Bromus tectorum*. The forb layer includes *Senecio spartioides, Leptodactylon pungens*, and *Heterotheca villosa (= Chrysopsis villosa)*.

*Globally*
The total vegetation cover rarely exceeds 60% and is characterized by an open shrub canopy of *Chrysothamnus viscidiflorus* with between 5 and 35% cover. The native bunchgrass *Hesperostipa comata* contributes 10 to 20% cover. Other short shrubs providing sparse cover include *Symphoricarpos oreophilus, Artemisia nova*, and *Tetradymia canescens*. The herbaceous layer is diverse in terms of species composition. Associated graminoids include *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Pascopyrum smithii, Poa fendleriana*, and *Poa secunda*. The non-native *Bromus tectorum* may also be present. Forbs are diverse but contribute very little cover, including *Chenopodium leptophyllum, Crepis acuminata, Cryptantha cinerea var. jamesii, Erigeron engelmannii, Eriogonum umbellatum, Lupinus caudatus, Opuntia fragilis, Packera tridenticulata, Sedum lanceolatum, Senecio spartioides, Leptodactylon pungens, Heterotheca villosa (= Chrysopsis villosa)*, and *Schoenocrambe linifolia*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Chrysothamnus viscidiflorus* |
| Herb (field) | *Hesperostipa comata* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Chrysothamnus viscidiflorus* |
| Herb (field) | *Achnatherum hymenoides*, *Hesperostipa comata* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Bromus tectorum* (exotic, High)

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (23-Jun-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terrain is rolling with the plot located above a shallow swale; plants appear vigorous, except the *Opuntia fragilis* dwarf-shrubs that appear dead.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0299) and 2007 Accuracy Assessment (4 points: BRCA_AA.0240, BRCA_AA.0254, BRCA_AA.0267, BRCA_AA.0436).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, mod. G. Kittel

**REFERENCES:** Bell et al. 2009, Western Ecology Working Group n.d.

## *Ericameria nauseosa* Shrubland

## Rubber Rabbitbrush Shrubland

| | |
|---|---|
| CODE | CEGL002713 |
| 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 | *ERICAMERIA NAUSEOSA* SHRUBLAND ALLIANCE (A.835)<br>Rubber Rabbitbrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This is a broadly defined, semi-arid upland shrubland currently described from western Colorado, Nevada, and Utah and is likely more widespread. Elevations range from 1191 to 2420 m (3900-8000 feet). Stands occur on flat to gently sloping (<8%), dry alluvial terraces above ephemeral washes or perennial stream and river channels or may form a band in the alluvial flats above playas. Substrates are deep, moderately well- to well-drained silty clay loam to sandy loam soils derived from stratified alluvium. The ground surface has moderate to high cover of bare soil. The vegetation is characterized by a moderately dense to dense (40-70% cover) shrub canopy dominated by *Ericameria nauseosa* shrubs 0.5-3 m tall, with a relatively sparse herbaceous layer. Some stands have low diversity, others have additional associated short and dwarf-shrubs such as *Artemisia frigida, Artemisia tridentata ssp. wyomingensis, Atriplex canescens, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Psorothamnus polydenius, Rosa woodsii, Sarcobatus vermiculatus*, and *Tetradymia tetrameres*. The sparse herbaceous layer is a mixture of grasses and forbs. Grass cover is generally low and may include native species such as *Achnatherum lettermanii, Achnatherum hymenoides, Distichlis spicata, Pseudoroegneria spicata, Sporobolus airoides*, and *Elymus elymoides*. Non-native grasses include *Bromus tectorum* and *Poa pratensis*. Common forbs may include the native species *Erigeron flagellaris, Tragopogon dubius, Achillea millefolium, Agoseris glauca, Potentilla crinita, Artemisia ludoviciana, Eriogonum hookeri, Rumex salicifolius*, and *Verbesina encelioides*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This shrubland is locally common and was sampled near Riggs Spring, in Bridge and Swamp canyons, and in Ponderosa Canyon just outside the park boundary.

*Globally*

This is a broadly defined upland shrubland association currently described from western Colorado, Utah and Nevada, but it likely occurs more widely in the western U.S.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This locally common short shrubland occurs on deep soils of valley bottoms. The sites are flat to gentle (0- to 3-degree slopes), occur between 2221 and 2430 m in elevation, and are oriented to all aspects. The ground surface has sparse to moderate exposure of bare soil, moderate to high cover of litter, and sparse cover of small rocks and downed wood. Soils are rapidly drained sandy loams, loams, silty clay loams, or silty clays that are derived from New Alluvium.

*Globally*

This is a broadly defined, semi-arid upland shrubland association currently described from western Colorado , Nevada, and Utah and is likely more widespread. Elevations range from 1191-2420 m (3900-8000 feet). Stands occur on flat to gently sloping (<8%), dry alluvial terraces above ephemeral washes or perennial stream and river channels or may form a band in the alluvial flats above playas. Substrates are deep, moderately well- to well-drained silty clay loam to sandy loam soils derived from stratified alluvium. Sand or other coarse-textured material may underlay finer-textured layers (Bundy et al. 1996). The ground surface has moderate to high cover of bare soil.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (34-75% cover) and is characterized by the short shrub *Ericameria nauseosa* that provides 32-70% cover. Other shrubs present include *Rosa woodsii, Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae*. The herbaceous layer has low to moderate floristic diversity and provides low to moderate cover. Grasses include the native bunch grasses *Achnatherum lettermanii* and *Achnatherum hymenoides*, the seeded exotic bunchgrass *Agropyron cristatum*, and the non-native rhizomatous grass *Poa pratensis*. The forb layer includes *Taraxacum officinale, Descurainia pinnata, Erigeron flagellaris, Tragopogon dubius, Achillea millefolium, Agoseris glauca, Potentilla crinita*, and *Artemisia ludoviciana*.

*Globally*

The vegetation is characterized by a moderately dense to dense (40-70% cover) shrub canopy dominated by *Ericameria nauseosa* shrubs 0.5-3 m tall, with a relatively sparse herbaceous layer. In Colorado, stands have low diversity. Additional associated short and dwarf-shrubs are *Artemisia frigida, Artemisia tridentata ssp. wyomingensis*, and *Rosa woodsii*. In Nevada, stands are more diverse, and several other shrubs, such as *Atriplex canescens, Psorothamnus polydenius, Sarcobatus vermiculatus*, and *Tetradymia tetrameres*, may be important. The sparse herbaceous layer is a mixture of grasses and forbs. Native grasses include *Achnatherum hymenoides, Distichlis spicata*, and *Elymus elymoides*. Common forbs may include the non-natives *Cirsium arvense, Descurainia incana ssp. incisa, Erodium cicutarium, Lepidium campestre, Iva axillaris, Salsola tragus*, and *Sisymbrium altissimum*, and the natives *Eriogonum hookeri, Rumex salicifolius*, and *Verbesina encelioides*. The introduced annual grass *Bromus tectorum* and native grasses *Pseudoroegneria spicata* and *Sporobolus airoides* are typically absent or have low cover.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Ericameria nauseosa* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Ericameria nauseosa* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Agropyron cristatum* (exotic, Medium/Low), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*

**Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High), *Cirsium arvense* (invasive/exotic, High/Medium), *Descurainia pinnata* (invasive/exotic), *Erodium cicutarium* (invasive/exotic, Medium/Low), *Iva axillaris* (invasive/exotic), *Lepidium campestre* (invasive/exotic), *Poa pratensis* (invasive/exotic, Medium), *Salsola tragus* (invasive/exotic), *Sisymbrium altissimum* (invasive/exotic), *Taraxacum officinale* (invasive/exotic), *Tragopogon dubius* (invasive/exotic, Medium/Low)

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G5 (26-Jun-2001).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*

Montane shrubland.

*Globally*

This broadly defined upland *Ericameria nauseosa* association is not limited to washes or dune/sandsheet shrubland. Diagnostic of this type is a sparse herbaceous layer that is not dominated by the widespread introduced annual grass *Bromus tectorum* or the native grasses *Pseudoroegneria spicata* or *Sporobolus airoides*. One of the stands classified

by Bundy et al. (1996) is codominated by *Tetradymia tetrameres*. These transitional types are difficult to classify, and further survey and classification work are needed to fully characterize this association.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Soils are deep, free from rocks and fairly sandy; shrubs are growing thickly, wall-to-wall, on this valley floor; many dead branches are in the shrubs, possibly from past drought; growth looks lush this year.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0185, BRCA.0359, BRCA.0377, BRCA.0385) and 2007 Accuracy Assessment (5 points: BRCA_AA.0200, BRCA_AA.0201, BRCA_AA.0745, BRCA_AA.0828, BRCA_AA.1224).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Bundy et al. 1996, FEIS 2006, McArthur et al. 1997, USFS 1937, Western Ecology Working Group n.d.

## *Artemisia pygmaea* Shrubland [Park Special]

## Pygmy Sagebrush Shrubland

| | |
|---|---|
| CODE | CEPS005358 |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A.) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural extremely xeromorphic evergreen shrubland (III.A.5.N.) |
| FORMATION | Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland (III.A.5.N.a.) |
| ALLIANCE | *ARTEMISIA PYGMAEA* SHRUBLAND ALLIANCE (A.1106)<br>Pygmy Sagebrush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This dwarf-shrubland is unique, occupies rocky hilltops and was sampled only once near the northern park boundary, and observed in three locations during Accuracy Assessment in 2007. No local information is available.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This unique dwarf-shrubland stand occurs on a small hilltop. The site is moderate (12-degree slope), occurs at 2307 m in elevation, and is oriented to the west. The ground surface has moderate exposure of bare soil, sparse cover of litter, and sparse to high cover of small and large rocks. Soils are rapidly drained and are derived from the Wahweep Formation.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*
Total vegetation cover is sparse to low (12% cover) and is characterized by the dwarf-shrub *Artemisia pygmaea* that provides 5% cover. *Chrysothamnus depressus* is also present. The herbaceous layer is low in terms of floristic diversity and includes the cushion plants *Petradoria pumila* and *Phlox hoodii* that provide sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Artemisia pygmaea* |
| Herb (field) | *Petradoria pumila*, *Phlox hoodii* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (7-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand occupies the top of a small rocky hill and is unique in the area.
*Bryce Canyon National Park* Plots: The description is based on 2005 (1 observation point: BRCA.9214) and 2007 Accuracy Assessment (3 points: BRCA_AA.0018, BRCA_AA.0021, BRCA_AA.0041).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Atriplex canescens - Artemisia tridentata* Shrubland

## Fourwing Saltbush - Big Sagebrush Shrubland

| | |
|---|---|
| CODE | CEGL001282 |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A.) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural extremely xeromorphic evergreen shrubland (III.A.5.N.) |
| FORMATION | Facultatively deciduous extremely xeromorphic subdesert shrubland (III.A.5.N.b.) |
| ALLIANCE | *ATRIPLEX CANESCENS* SHRUBLAND ALLIANCE (A.869)<br>Fourwing Saltbush Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)
Sonora-Mojave Mixed Salt Desert Scrub (CES302.749)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This shrubland is found on the western slope of the Colorado Rocky Mountains, Colorado Plateau, Great Basin, and Mojave Desert. Elevation ranges from 1160-2100 m (3800-6900 feet). Stands occur on level plains, valley bottoms, alluvial flats, stream terraces, low and midslopes . Slopes are typically less than 25%, but this shrubland has been documented on steep slopes as well. It occurs on all aspects, Substrates are well-drained, typically fine-textured soils (silty loam and clay) but may include coarser-textured soils (loamy sand). The vegetation is characterized by a sparse to moderately dense (10-35% cover) short-shrub layer that is codominated by *Atriplex canescens* and *Artemisia tridentata*. On some sites, *Pinus edulis* and/or *Juniperus osteosperma* canopy trees provide sparse cover. Associated shrubs include *Chrysothamnus viscidiflorus, Ephedra nevadensis, Ericameria nauseosa, Gutierrezia sarothrae, Gutierrezia microcephala, Krascheninnikovia lanata, Lycium* spp., and *Opuntia* spp. *Sarcobatus vermiculatus* and *Suaeda moquinii* may be present with low cover on more saline sites. The sparse to moderate herbaceous layer (10-20% cover) is dominated by graminoids with scattered forbs. *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides*, and *Pascopyrum smithii* are common grasses. Forbs may include *Cirsium neomexicanum, Eriogonum inflatum, Eriogonum racemosum, Penstemon* spp., or *Sphaeralcea coccinea*. Introduced species are common in disturbed stands.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland is common and occurs on saline clay soils. It was sampled in Campbell, Bryce and Yellow creek drainages, near the Tropic Canyon Trailhead, on Sheep Creek Flat, in Death Hallow, and in Campbell and Cope canyons.

*Globally*

This shrubland is found on the western slope of the Colorado Rocky Mountains, Colorado Plateau, Great Basin, and Mojave Desert.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This common short shrubland occurs on valley bottoms, hills, ridges, and canyonside habitats. Sites are flat to steep (0- to 36-degree slopes), occur between 2002 and 2088 m in elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil, low cover of litter, sparse to low cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained silty clays, silty clay loams, loamy sands, clay loams, and clays derived from Tropic Shale, the Straight Cliffs Formation, or New Alluvium.

*Globally*

This shrubland is found on the western slope of the Colorado Rocky Mountains, Colorado Plateau, Great Basin, and Mojave Desert. Elevation ranges from 1160-2100 m (3800-6900 feet). Stands occur on level plains, canyon floors, valley bottoms, alluvial flats, stream terraces, benches, low and midslopes. Slopes are typically less than 25%, but this shrubland has been documented on steep slopes. It occurs on all aspects, but northwest-, east- and southeast-facing slopes are common. Substrates are well-drained, typically fine-textured soils (silty loam and clay) but may

include coarser-textured soils (loamy sand). Some stands may be subject to periodic flooding. Evidence of erosion, such as rills and gullies, is common (Warren et al. 1982).

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to moderate (10-31% cover) and is characterized by the short shrub *Atriplex canescens* that provides 1-17% cover and *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. vaseyana*, or *Artemisia tridentata ssp. wyomingensis* that provide 0-12% cover. On some sites, *Pinus edulis* and/or *Juniperus osteosperma* canopy trees provide sparse cover and attain heights between 2 and 5 m. The remaining short and dwarf-shrubs are low in terms of floristic diversity, provide sparse to low cover, and include *Atriplex confertifolia, Eriogonum corymbosum, Ephedra viridis, Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. The herbaceous layer is low in terms of species composition and provides sparse to low cover. Common bunch grasses include *Pleuraphis jamesii, Elymus elymoides, Leymus salinus, Pleuraphis jamesii (= Hilaria jamesii), Achnatherum hymenoides*, the seeded grass *Agropyron cristatum*, and the non-native annual grass *Bromus tectorum*. Forbs include *Heliomeris longifolia (= Viguiera longifolia), Lappula occidentalis, Machaeranthera canescens, Oenothera caespitosa, Eriogonum* sp., and *Sphaeralcea coccinea*.

*Globally*

This association is characterized by a sparse to moderately dense (10-35% cover) short-shrub layer (1-2 m tall) that is codominated by *Atriplex canescens* and *Artemisia tridentata*. On some sites, *Pinus edulis* and/or *Juniperus osteosperma* canopy trees provide sparse cover. Associated shrubs include *Chrysothamnus viscidiflorus, Ephedra viridis, Ephedra nevadensis, Eriogonum corymbosum, Ericameria nauseosa, Gutierrezia sarothrae, Gutierrezia microcephala, Krascheninnikovia lanata, Lycium* spp., and *Opuntia* spp. (Warren et al. 1982, Roberts et al. 1992). *Sarcobatus vermiculatus* and *Suaeda moquinii* may be present with low cover on more saline sites. The sparse to moderately dense (10-20% cover) herbaceous layer is dominated by graminoids with scattered forbs. *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Leymus salinus, Pleuraphis jamesii, Pascopyrum smithii*, and *Sporobolus cryptandrus* are common grasses. Forbs may include *Abronia fragrans, Cirsium neomexicanum, Eriogonum inflatum, Eriogonum racemosum, Heliomeris longifolia (= Viguiera longifolia), Lappula occidentalis, Machaeranthera canescens, Mentzelia multiflora, Oenothera caespitosa, Penstemon* spp., *Rumex hymenosepalus*, or *Sphaeralcea coccinea*. Introduced species such as *Agropyron cristatum, Arctium minus, Bromus rubens, Bromus tectorum, Carduus nutans, Chenopodium album, Cirsium arvense, Convolvulus arvensis, Descurainia sophia, Erodium cicutarium, Lactuca serriola, Lappula occidentalis, Medicago sativa, Salsola tragus*, and *Tragopogon dubius* are common in disturbed stands. Cryptogams are generally sparse but one sampled plot had 25% cover.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Artemisia tridentata* ssp. *tridentata* |
| Short shrub/sapling | *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens* |
| Herb (field) | *Krascheninnikovia lanata* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia tridentata*, *Atriplex canescens* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Agropyron cristatum* (exotic, Medium/Low), *Bromus tectorum* (exotic, High)

*Globally*

**Exotic/Invasive**: *Agropyron cristatum* (invasive/exotic, Medium/Low), *Arctium minus* (invasive/exotic, Medium/Insignificant), *Bromus rubens* (invasive/exotic), *Bromus tectorum* (invasive/exotic, High), *Carduus nutans* (invasive/exotic, High/Low), *Chenopodium album* (invasive/exotic), *Cirsium arvense* (invasive/exotic, High/Medium), *Convolvulus arvensis* (invasive/exotic, Medium/Low), *Descurainia sophia* (invasive/exotic,

Medium/Low), *Erodium cicutarium* (invasive/exotic, Medium/Low), *Lactuca serriola* (invasive/exotic, Low/Insignificant), *Lappula occidentalis* (invasive/exotic), *Medicago sativa* (invasive/exotic, Insignificant), *Salsola tragus* (invasive/exotic), *Tragopogon dubius* (invasive/exotic, Medium/Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (20-Sep-2000).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Salt-tolerant shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Tropic Shale controls the presence of this community; soils are deep, non-rocky and dark brown with high clay content; terrain is cut by several dry erosion gullies, but they do not seem to affect the vegetation distribution or species composition; gullied, steep slope with sparse vegetation.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (8 plots: BRCA.0191, BRCA.0194, BRCA.0323, BRCA.0325, BRCA.0336, BRCA.0373, BRCA.0396, BRCA.0398; and 2 observation points: BRCA.9227, BRCA.9229) and 2007 Accuracy Assessment (12 points: BRCA_AA.0563, BRCA_AA.0724, BRCA_AA.0735, BRCA_AA.0802, BRCA_AA.0866, BRCA_AA.0357, BRCA_AA.0807, BRCA_AA.0823, BRCA_AA.0837, BRCA_AA.0840, BRCA_AA.1016, BRCA_AA.1040).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, Bunting 1987, Cogan et al. 2004, Driscoll et al. 1984, Everett 1987, Howard 1999, Howard 2003, Peterson 2008, Roberts et al. 1992, Tirmenstein 1999c, Warren et al. 1982, Western Ecology Working Group n.d., Wright 1980, Wright et al. 1979

## *Atriplex confertifolia* Great Basin Shrubland

## Shadscale Great Basin Shrubland

## Great Basin Shadscale Shrubland

| | |
|---|---|
| CODE | CEGL001294 |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A.) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural extremely xeromorphic evergreen shrubland (III.A.5.N.) |
| FORMATION | Facultatively deciduous extremely xeromorphic subdesert shrubland (III.A.5.N.b.) |
| ALLIANCE | *ATRIPLEX CONFERTIFOLIA* SHRUBLAND ALLIANCE (A.870)<br>Shadscale Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This shrub association occurs in scattered stands on ridges, flats, alluvial fans, talus slopes and badlands throughout the Colorado Plateau and Great Basin, often in a matrix of other high desert shrublands. Sites tend to occur on level to gentle slopes between 1158 and 2194 m (3800-7200 feet) elevation. Soils tend to be alkaline, shallow, well-drained clay loams, sometimes with a high rock or gravel content. Parent materials are variable but generally include a high percentage of calcareous source rocks. Total vegetation cover rarely exceeds 20% and is clearly dominated by *Atriplex confertifolia*. Many other species of shrubs may also be present, although they contribute little to the total

canopy, including *Krascheninnikovia lanata, Kochia americana, Picrothamnus desertorum, Acamptopappus shockleyi, Atriplex canescens, Ephedra nevadensis, Sarcobatus vermiculatus*, and *Ericameria nauseosa*. The herbaceous layer rarely has more than 5% total cover; species vary greatly by location, but common graminoids include *Elymus multisetus, Elymus elymoides, Leymus salinus, Poa secunda, Dasyochloa pulchella (= Erioneuron pulchellum)*, and *Pleuraphis jamesii*. Forbs are diverse but only contribute measurable cover in unusually wet years; *Chaenactis douglasii, Phacelia crenulata*, and *Mentzelia albicaulis* are widespread. Disturbed sites have high cover of *Bromus tectorum*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short shrubland is uncommon and occurs on alkaline, clay soils, and was sampled in the Campbell and Yellow creek drainages.

*Globally*

This association has been documented from plots in western Colorado and southern Utah. It is also reported to occur in Nevada (Rickard and Beatley 1965, Blackburn et al. 1968a) and the Cottonwood Mountains in Death Valley National Park, California (Peterson 1984).

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon short shrubland occurs on valley bottoms, hills, ridges, and badland exposures. The sites are gentle to steep (4- to 37-degree slopes), occur between 2014 and 2077 m in elevation, and are oriented to the south or west. The ground surface has high exposure of bare soil, low cover of litter, sparse to low cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained silty clay loams, clays, and silty clays derived from Tropic Shale.

*Globally*

This shrub association occurs in scattered stands on ridges, flats, alluvial fans, talus slopes and badlands throughout the Colorado Plateau and Great Basin. Sites tend to occur on level to gentle slopes between 1158 and 2194 m (3800-7200 feet) elevation. Soils tend to be alkaline, shallow, well-drained and have clay loam textures, sometimes with a high rock and/or gravel content. Parent materials are variable but generally include a high percentage of calcareous source rocks.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is sparse to moderate (11-20% cover) and is characterized by the short shrub *Atriplex confertifolia* that provides 1-16% cover. Other short and dwarf-shrubs present provide sparse cover, and include *Atriplex canescens, Gutierrezia sarothrae, Krascheninnikovia lanata*, and *Sarcobatus vermiculatus* with up to 9% cover. The herbaceous layer is low in floristic diversity and provides sparse to low cover. The graminoid layer provides sparse cover and includes the bunch grasses *Pleuraphis jamesii, Elymus elymoides*, and *Leymus salinus*, and the non-native annual *Bromus tectorum*. The forbs *Atriplex powellii* and *Sphaeralcea coccinea* and the exotic annual *Salsola tragus* provide sparse cover.

*Globally*

This association often occurs in a matrix of other high desert shrublands. Total vegetation cover rarely exceeds 20% and is clearly dominated by *Atriplex confertifolia*. Many other species of shrubs may also be present, although they contribute little to the total canopy, including *Krascheninnikovia lanata, Kochia americana, Picrothamnus desertorum, Acamptopappus shockleyi, Atriplex canescens, Ephedra nevadensis, Sarcobatus vermiculatus*, and *Ericameria nauseosa*. The herbaceous layer rarely has more than 5% total cover; species vary greatly by location, but common graminoids include *Elymus multisetus, Elymus elymoides, Leymus salinus, Poa secunda, Dasyochloa pulchella (= Erioneuron pulchellum)*, and *Pleuraphis jamesii*. Forbs are diverse but only contribute more than trace cover in unusually wet years; *Atriplex powellii, Sphaeralcea coccinea, Chaenactis douglasii, Phacelia crenulata*, and *Mentzelia albicaulis* and the exotic annual *Salsola tragus* are widespread. Disturbed sites have high cover of *Bromus tectorum*.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Atriplex confertifolia* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Atriplex confertifolia* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Bromus tectorum* (exotic, High), *Salsola tragus* (exotic)

*Globally*
**Vulnerable**: *Acamptopappus shockleyi* (vulnerable, G3?); **Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High), *Salsola tragus* (invasive/exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Salt-tolerant shrubland.

*Globally*
This broadly defined association describes *Atriplex confertifolia* shrublands that have either a sparse understory or lack any diagnostic species in the understory. It also includes degraded stands that have an understory dominated by weedy species.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terrain is a shale ridge with a noticeable step where the plot is located; surface has a variety of rocks scattered around, but mostly it forms a physical crust that cracks as it dries; several dead bunches of grass are sticking out of the mud; steep slope probably moves a little each time it rains.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (5 plots: BRCA.0192, BRCA.0193, BRCA.0394, BRCA.0395, BRCA.0397) and 2007 Accuracy Assessment (7 points: BRCA_AA.0287, BRCA_AA.0294, BRCA_AA.0686, BRCA_AA.0689, BRCA_AA.0742, BRCA_AA.0755, BRCA_AA.0787).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, mod. G. Kittel

**REFERENCES:** Beatley 1976, Blackburn et al. 1968a, Bourgeron and Engelking 1994, Bradley 1964, Driscoll et al. 1984, Leary and Peterson 1984, Peterson 1984, Peterson 2008, Rickard and Beatley 1965, Western Ecology Working Group n.d.

## *Amelanchier (utahensis, alnifolia) - Cercocarpus montanus* Shrubland

## (Utah Serviceberry, Saskatoon Serviceberry) - Alderleaf Mountain-mahogany Shrubland

| | |
|---|---|
| CODE | CEGL001070 |
| 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 | *AMELANCHIER UTAHENSIS* SHRUBLAND ALLIANCE (A.916)<br>Utah Serviceberry Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

The description for this association is based on information from Colorado and Utah; its characteristics in Nevada are unknown and will be described when more information becomes available. This plant association is found on moderate to steeply sloping colluvial slopes, canyons, ridges and in alcoves. Sites may be oriented to any aspect. Elevation ranges between 1586 and 2595 m (5200-8500 feet). Relative to other mixed mountain shrub types, it is found on the driest sites with the least soil development and relatively low diversity. Soils range from shallow to deep but are generally always rocky with a high cover of surface rock. The vegetation is characterized by a more open shrub layer and a sparse understory relative to other mixed mountain shrub types. Total vegetation cover often does not exceed 50%. *Amelanchier utahensis* and *Cercocarpus montanus* are the dominants of as many as 16 shrub species in this association. Typical associated shrub species include *Artemisia bigelovii, Artemisia tridentata, Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Eriogonum corymbosum, Peraphyllum ramosissimum, Purshia tridentata, Rhus trilobata, Fraxinus anomala*, and *Tetradymia canescens*. *Symphoricarpos oreophilus* can dominate the lower shrub layer, which may also include *Brickellia microphylla, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens*, and *Paxistima myrsinites*. Succulents such as *Opuntia* spp. or *Yucca* spp. may also have minor cover. If *Quercus gambelii* is present, cover is low (<5%). Scattered trees of *Juniperus osteosperma, Juniperus scopulorum*, or *Pinus edulis* may be present in some stands. *Achnatherum hymenoides (= Oryzopsis hymenoides)* is the most common species in the diverse herbaceous layer. Other graminoid species may include *Poa fendleriana, Koeleria macrantha, Achnatherum lettermanii, Pseudoroegneria spicata, Elymus lanceolatus, Hesperostipa comata*, and *Leymus salinus*. Forb species may include *Arenaria fendleri, Chaenactis douglasii, Cryptantha flava, Cymopterus purpureus, Balsamorhiza sagittata, Eriogonum umbellatum, Galium coloradoense, Heterotheca villosa, Lepidium montanum, Lithospermum ruderale, Petradoria pumila, Phlox longifolia, Physaria acutifolia, Senecio integerrimus, Sphaeralcea coccinea, Stanleya pinnata, Stenotus acaulis*, and *Streptanthella longirostris*. Disturbed sites may have high cover of *Bromus tectorum*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This tall-shrub association was sampled only once on a hillside near Rainbow Point.

*Globally*

This association is documented from stands in western Colorado and southern and eastern Utah. It has been reported from Nevada and is likely to occur in xeric areas of mixed mountain shrubland throughout the plateaus and foothills of Colorado and in higher elevations of the Colorado Plateau, western Rocky Mountains and Intermountain West.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall shrubland occurs on the high slope of a hill. The site is steep (22-degree slope), occurs at 2377 m in elevation, and is oriented to the north. The ground surface has low exposure of bare soil, sparse cover of downed wood, and sparse cover of small and large rocks. Soils are rapidly drained silty clays derived from the Straight Cliffs Formation.

*Globally*

The description for this association is based on information from Colorado and Utah; its characteristics in Nevada are unknown and will be described when more information becomes available. This plant association is found on moderate to steeply sloping colluvial slopes, canyons, ridges and in alcoves. Sites may be oriented to any aspect. Elevations range between 1586 and 2500 m (5200-8200 feet). Relative to other mixed mountain shrub types, it is found on the driest sites with the least soil development and relatively low diversity. Exposed ground is moderate to extensive, averaging 40%. Soils range from shallow to deep, from loams to silty clays, but are generally always rocky with a high cover of surface rock.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (72% cover) and is characterized by the tall shrubs *Amelanchier utahensis* that provides 3% cover and *Cercocarpus montanus* that provides 47% cover. The canopy trees *Pinus edulis* and *Juniperus osteosperma* provide sparse cover and attain heights between 5 and 10 m. The remaining tall shrubs

*Quercus gambelii* and *Peraphyllum ramosissimum* and the short shrub *Symphoricarpos oreophilus* provide low cover. The bunchgrass *Poa fendleriana* and the forbs *Balsamorhiza sagittata* and *Cymopterus purpureus* provide sparse cover. Moss provides low cover (4% cover).

*Globally*
The vegetation is characterized by a more open shrub layer with a sparse understory relative to other mixed mountain shrub types. Total vegetation cover often does not exceed 50%. *Amelanchier utahensis* and *Cercocarpus montanus* are the dominants of as many as 16 shrub species in this association. Typical shrub species include *Artemisia bigelovii, Artemisia tridentata, Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Eriogonum corymbosum, Peraphyllum ramosissimum, Purshia tridentata, Rhus trilobata, Fraxinus anomala*, and *Tetradymia canescens*. *Symphoricarpos oreophilus* can dominate the lower shrub layer, which may also include *Brickellia microphylla, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens*, and *Paxistima myrsinites*. Scattered individuals of *Juniperus osteosperma* and *Pinus edulis* may occur. Succulents such as *Opuntia* spp. or *Yucca* spp. may also have minor cover. *Achnatherum hymenoides (= Oryzopsis hymenoides)* is the most common species in the diverse herbaceous layer. Other graminoid species may include *Poa fendleriana, Koeleria macrantha, Achnatherum lettermanii, Cymopterus purpureus, Pseudoroegneria spicata, Elymus lanceolatus, Hesperostipa comata*, and *Leymus salinus*. Forb species may include *Arenaria fendleri, Chaenactis douglasii, Cryptantha flava, Balsamorhiza sagittata, Eriogonum umbellatum, Galium coloradoense, Heterotheca villosa, Lepidium montanum, Lithospermum ruderale, Petradoria pumila, Phlox longifolia, Physaria acutifolia, Senecio integerrimus, Sphaeralcea coccinea, Stanleya pinnata, Stenotus acaulis*, and *Streptanthella longirostris, Tetraneuris acaulis (= Hymenoxys acaulis)*. Disturbed sites may have high cover of *Bromus tectorum*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Amelanchier utahensis*, *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |

*Globally*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Amelanchier utahensis* |
| Tall shrub/sapling | *Cercocarpus montanus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Sclerocactus whipplei* (globally imperiled, G1G3); **Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G2? (12-Nov-2008). This association is well-known from Colorado and throughout Utah. It also occurs in Nevada, but no information is available on its conservation status there. Very little is known about the larger scale abiotic factors that contribute to the distribution. The global rank should be at least a G3 based on the numbers of sites documented at several National Park Service units.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**

*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Shrub density is high; small to medium white and reddish rocks are scattered along the slope.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0070).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* L. Tasker, mod. J. Coles and G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data, CONHP unpubl. data 2003, Driscoll et al. 1984, Tiedemann 1978, Vories 1974, Western Ecology Working Group n.d.

## *Prunus virginiana - (Prunus americana)* Shrubland

## Chokecherry - (American Plum) Shrubland

| | |
|---|---|
| CODE | CEGL001108 |
| 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 | *PRUNUS VIRGINIANA* SHRUBLAND ALLIANCE (A.919)<br>Chokecherry Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Northern Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994)
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)
Western Great Plains Wooded Draw and Ravine (CES303.680)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This widespread small-patch shrubland is known from the Columbia Plateau of eastern Washington and eastern Oregon, throughout much of the western Great Plains, Rocky Mountain and interior western U.S. It occurs in the foothills and lower slopes of mountain ranges, along higher creeks and upper alluvial terraces of perennial streams, and in draws and ravines of high plateaus and the Great Plains. The elevational range is 680 to 2652 m (2234-8700 feet). This association grows at the interface between larger riparian areas and the adjacent upland and occurs as small dense thickets, narrow bands, or irregular patches. It often occupies draws, ephemeral creeks in steep narrow-bottomed canyons, and shallow ravines. It can occur on slopes below seeps and springs and on high slopes where snow collects. Shrub cover ranges from 100% to more open stands of 30%. Shrub cover is generally greater in drainage bottoms and on lowermost slopes, and less on upper slopes. *Prunus virginiana* is usually the dominant shrub species, but *Prunus americana* may be solely present to codominant as well. Stands can be dominated by one species but are often a mix of three to six other shrub species, which can be as abundant and even more abundant than the *Prunus*. Other shrubs include *Rhus trilobata, Ribes aureum, Ribes cereum, Ribes lacustre, Ribes inerme, Salix exigua, Sambucus* spp., *Amelanchier* spp., *Amorpha canescens, Ericameria nauseosa, Symphoricarpos oreophilus, Symphoricarpos occidentalis, Juniperus scopulorum, Rosa woodsii*, and *Toxicodendron rydbergii*. In drainage bottoms, herbaceous cover is usually sparse, less than 10%. On slopes, the shrubs typically occur in some grassland type, and graminoid cover can be greater than 75%. Herbaceous species may include *Achnatherum lettermanii, Achnatherum nelsonii, Carex vallicola, Erigeron flagellaris, Leymus cinereus, Geranium caespitosum var. caespitosum, Heracleum maximum (= Heracleum lanatum), Juncus arcticus, Maianthemum stellatum (= Smilacina stellata), Muhlenbergia montana*, and *Potentilla hippiana*. Exotic species *Bromus inermis, Cirsium arvense, Poa pratensis*, and *Bromus tectorum* are common on disturbed sites.

**DISTRIBUTION**
*Bryce Canyon National Park*
This tall shrubland occurs where soils are moist and deep and was sampled at Riggs Spring.

*Globally*

This widespread small-patch shrubland is known from the Columbia Plateau of eastern Washington and eastern Oregon, throughout much of the western Great Plains, Rocky Mountain and interior western U.S.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall shrubland occurs on moist soils from bedrock drainage. The site is gentle (3-degree slope), occurs at 2292 m in elevation, and is oriented to the east. The ground surface has low exposure of bare soil and high cover of litter. Soils are well-drained and are derived from the Straight Cliffs Formation (Upper Unit).

*Globally*

This widespread small-patch shrubland occurs from the Columbia Plateau of eastern Washington, eastern Oregon, throughout much of the western Great Plains, Rocky Mountain and interior western U.S. It occurs in the foothills and lower slopes of mountains, along higher creeks and upper alluvial terraces of perennial streams, in moist soils that receive bedrock runoff in the Colorado Plateau, and in draws and ravines of plateaus and the Great Plains. The elevational range is 716 to 2846 m (2234-9330 feet), and slopes are gentle to steep (to 20 degrees). This association often grows at the interface between larger riparian areas and the adjacent upland, as well as on higher ridges where snow collects, and occurs as small dense thickets, narrow bands or irregular patches. It often occupies draws, ephemeral creeks in steep narrow-bottomed canyons, and shallow ravines. It can occur on slopes below seeps and springs. Stands can also occur as small pockets on higher terraces or as narrow bands along the high-water mark of steep banks and incised channels. It also grows at the base of cliffs adjacent to rivers. Slope varies from flat to very steep, with variable aspects, and can be associated with rock outcrops and talus. Stands are typically on very well-drained, rocky soils but occasionally have finer soils. Soil texture ranges from sandy loam to clay loam.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (48% cover) and is characterized by the tall shrub *Prunus virginiana* that ranges from 1-2 m tall and provides 20% cover. Short shrubs present provide sparse to low cover (up to 10%) and include *Ericameria nauseosa* and *Symphoricarpos oreophilus*. The herbaceous layer is low in terms of floristic diversity and provides low cover (up to 18%). Graminoids include *Carex vallicola, Achnatherum lettermanii, Achnatherum nelsonii*, and the exotic *Poa pratensis*. Forbs include *Erigeron flagellaris* and *Potentilla hippiana*.

*Globally*

Shrub cover ranges from total coverage (>90%) to more open stands of 30% canopy cover, with the higher values tending to occur in sites located in drainage bottoms and on lowermost slopes, and the lower values on higher slopes. *Prunus virginiana* is usually the dominant shrub species, but *Prunus americana* may be solely present to codominant. Stands can be dominated by one species but are often a mix of three to six other shrub species, which can be as abundant and sometimes more abundant than *Prunus*. Other shrubs include *Rhus trilobata, Ribes aureum, Ribes cereum, Ribes lacustre, Ribes inerme, Rosa* spp., *Salix exigua, Sambucus* spp., *Amelanchier* spp., *Amorpha canescens, Artemisia tridentata, Ericameria nauseosa, Symphoricarpos oreophilus, Symphoricarpos occidentalis, Juniperus scopulorum, Rosa woodsii, Mahonia repens*, and *Toxicodendron* spp. The tree *Populus tremuloides* may provide sparse cover. In drainage bottoms, herbaceous cover is usually sparse, less than 10%. On slopes, the shrubs typically occur in a matrix of other shrubland or grassland types, and graminoid cover can be greater than 75%. Herbaceous species are variable. Graminoids include *Achnatherum lettermanii, Achnatherum nelsonii, Artemisia frigida, Bromus carinatus, Carex vallicola, Elymus lanceolatus, Elymus trachycaulus, Juncus balticus, Leymus cinereus, Muhlenbergia montana, Pascopyrum smithii*, and *Poa fendleriana*. Forb species are often diverse but are often relatively mesic. Common species include *Achillea millefolium, Agastache urticifolia, Balsamorhiza sagittata, Delphinium nuttallianum, Erigeron flagellaris, Eriogonum umbellatum, Geranium caespitosum var. caespitosum, Geranium viscosissimum, Heracleum maximum (= Heracleum lanatum), Heterotheca villosa, Maianthemum stellatum (= Smilacina stellata), Mertensia oblongifolia, Osmorhiza berteroi (= Osmorhiza chilensis), Potentilla hippiana*, and *Psoralidium lanceolatum*. Exotic herbaceous species may be present, including *Bromus inermis, Cirsium arvense, Poa pratensis*, and *Bromus tectorum*, especially on disturbed sites.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Prunus virginiana* |

| | |
|---|---|
| Short shrub/sapling | *Symphoricarpos oreophilus* |
| Herb (field) | *Erigeron flagellaris* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Prunus americana*, *Prunus virginiana* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium)

*Globally*
**Exotic/Invasive**: *Bromus inermis* (invasive/exotic, High/Medium), *Bromus tectorum* (invasive/exotic, High), *Cirsium arvense* (invasive/exotic, High/Medium), *Poa pratensis* (invasive/exotic, Medium); **Other**: *Pascopyrum smithii* (G5), *Prunus americana* (G5), *Symphoricarpos occidentalis* (G5)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4Q (1-Feb-1996). This type is widespread, but it represents a broadly defined dominance type, with little information on the associated species or habitats that might help define the type more precisely. If, e.g. a Great Plains type was separated out from the other types, such a type could be relatively rare.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This is a widespread and highly variable, yet distinct, type. In semi-arid regions, it is restricted to mesic and wet areas that often occur as small patches or limited to streambanks. Kovalchik (1987) briefly describes a similar type called Mixed Shrub Canyon Bottom Association from 4 plots. It occurs in low-elevation canyons below U.S. Forest Service ownership in eastern Oregon. Tall shrubs include *Prunus virginiana, Amelanchier alnifolia, Rosa woodsii, Cornus sericea, Salix* spp., *Prunus subcordata*, and/or *Alnus incana*. This may be the same concept.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: A unique stand has become established on deep soil adjacent to the Straight Cliffs Formation (Upper Unit), *Symphoricarpos oreophilus* codominates a portion of the stand.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 observation point: BRCA.9255) and 2007 Accuracy Assessment (1 point: BRCA_AA.1208).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* D. Faber-Langendoen, mod. G. Kittel, J. Coles, K.A. Schulz, K.S. King

**REFERENCES:** Bourgeron and Engelking 1994, CONHP pers. comm., CONHP unpubl. data 2003, Caicco and Wellner 1983n, Carsey et al. 2003a, Copeland 1980a, Driscoll et al. 1984, Evans 1989a, Evans 1989b, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Johnston 1987, Jones 1992b, Jones and Walford 1995, Kagan et al. 2000, Kittel et al. 1996, Kittel et al. 1999b, Kovalchik 1987, Kudray et al. 2004, MTNHP 2002b, Manning and Padgett 1995, Marriott pers. comm., Von Loh et al. 1999, Western Ecology Working Group n.d.

## *Quercus gambelii - Cercocarpus montanus / (Carex geyeri)* Shrubland

## Gambel Oak - Alderleaf Mountain-mahogany / (Geyer's Sedge) Shrubland

| | |
|---|---|
| CODE | CEGL001113 |
| 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 | *QUERCUS GAMBELII* SHRUBLAND ALLIANCE (A.920)<br>Gambel Oak Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This mixed montane shrubland is reported from foothills, mountains and mesatops in western Colorado and Utah. Stands occur on gentle, moderate and steep slopes. Aspect varies with elevation with low-elevation stands restricted to more mesic northern and eastern aspects, and higher elevation stands occurring on southern and western aspects. Substrates are typically shallow and rocky, derived from sandstone and shale parent materials, and range from sandy- to clayey-textured soil. The vegetation is characterized by a moderately dense to dense thicket of tall (2-5 m) deciduous shrubs (on unstable, eroding or talus slopes the shrub canopy may be open). Codominance of *Quercus gambelii* and *Cercocarpus montanus* (at least 10% cover of each) is diagnostic of this plant association, but *Amelanchier utahensis* is often also abundant to codominant. Low cover of other mixed shrub associates is common. *Arctostaphylos patula, Arctostaphylos pungens, Artemisia tridentata, Fendlera rupicola, Fraxinus anomala, Peraphyllum ramosissimum, Physocarpus monogynus, Purshia tridentata, Prunus virginiana, Rhus trilobata, Rosa woodsii, Quercus turbinella, Symphoricarpos oreophilus*, and *Yucca* spp. may be present depending on geography. Occasional *Juniperus osteosperma* and *Pinus edulis* trees may also be present. The herbaceous layer is generally sparse because of the dense overstory, but *Carex geyeri* may provide low to moderate cover.

**DISTRIBUTION**

*Bryce Canyon National Park*

This tall shrubland is uncommon, occurs on moderately deep soils, and was sampled near the Tropic Trail, and at Short Canyon, Pasture Wash, Bulldog Hollow, Riggs Spring, Noon Canyon, Corral Hollow and Ponderosa Ridge during 2007 Accuracy Assessment.

*Globally*

This montane shrubland association occurs in the foothills, mountains and mesatops of Utah and western Colorado.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall shrubland occurs on a valley slope. The site is gentle (5-degree slope), occurs at 2125 m in elevation, and is oriented to the east. The ground surface has sparse exposure of bare soil, high cover of litter, moderate cover of small rocks, sparse cover of large rocks, and low cover of downed wood. Soils are rapidly drained clay loams derived from colluvium.

*Globally*

This mixed montane shrubland association is reported from foothills, mountains and mesa tops in western Colorado and Utah. Elevation ranges from 1550-2500 m (5850-8200 feet). Stands occur on flat to steep slopes. Aspect varies with elevation with low elevation stands restricted to more mesic northern and eastern aspects, and higher elevation stands occurring on southern and western aspects. Substrates range from shallow and rocky, derived from sandstone, shale and alluvium or colluvium parent materials. Soil textures range from sandy to clayey to rapidly drained loamy sands.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (73% cover) and is characterized by the tall shrubs *Quercus gambelii* and *Cercocarpus montanus* that provide 28% and 32% cover, respectively. The canopy trees *Pinus edulis, Juniperus osteosperma*, and *Juniperus scopulorum* range in height from 2-5 m and provide sparse cover. Short-shrub species provide sparse cover and include *Tetradymia canescens* and *Symphoricarpos oreophilus*. The herbaceous layer is low in terms of floristic diversity and provides sparse cover. Forbs include *Chaetopappa ericoides* and *Pedicularis centranthera*. Cryptogram cover is sparse and includes species of moss.

*Globally*
This association is characterized by a moderately dense to dense thicket of tall deciduous shrubs 2-5 m tall (on unstable, eroding or talus slopes the shrub canopy may be more open). Codominance of *Quercus gambelii* and *Cercocarpus montanus* (at least 10% cover of each) is diagnostic of this plant association, but *Amelanchier utahensis* is often also abundant to codominant. Low cover of other mixed shrub associates is common. *Arctostaphylos patula, Arctostaphylos pungens, Artemisia bigelovii, Artemisia tridentata, Ephedra viridis, Fendlera rupicola, Fraxinus anomala, Mahonia fremontii, Peraphyllum ramosissimum, Physocarpus monogynus, Purshia tridentata, Rhus trilobata, Rosa woodsii, Quercus turbinella, Symphoricarpos oreophilus, Tetradymia canescens*, and *Yucca* spp. may be present depending on geography. Occasional *Juniperus osteosperma, Juniperus scopulorum*, and *Pinus edulis* trees may be present also. The herbaceous layer is generally sparse because of dense overstory. It is typically composed of scattered graminoids such as *Achnatherum hymenoides, Carex geyeri, Pleuraphis jamesii, Poa fendleriana, Sporobolus cryptandrus*, and forbs such as *Artemisia ludoviciana, Chaetopappa ericoides, Cirsium neomexicanum, Erigeron utahensis, Heterotheca villosa, Hymenopappus filifolius, Lathyrus* spp., *Lepidium montanum, Lupinus* spp., *Packera multilobata (= Senecio multilobatus), Pedicularis centranthera, Tetraneuris acaulis (= Hymenoxys acaulis)*, and *Vicia americana*. The non-native grass *Bromus tectorum* may also be present to abundant in disturbed stands.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |

*Globally*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Amelanchier utahensis*, *Quercus gambelii* |
| Tall shrub/sapling | *Cercocarpus montanus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Gambel oak woodland.

*Globally*
This plant association is similar to other montane Gambel oak shrublands except for the codominance of *Cercocarpus montanus* (10% cover or more). Other shrubs species may be present to codominant.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**

*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Many dead branches on the shrubs could be related to past drought; this year's growth looks great; site is a junglelike thicket.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0369) and 2007 Accuracy Assessment (8 points: BRCA_AA.0434, BRCA_AA.0628, BRCA_AA.0835, BRCA_AA.0915, BRCA_AA.1071, BRCA_AA.1083, BRCA_AA.1200, BRCA_AA.1225).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Coles and G. Kittel

**REFERENCES:** Baker 1982b, Bourgeron and Engelking 1994, Bradley et al. 1992, CONHP unpubl. data 2003, Clary 1992, Cogan et al. 2004, Dillinger 1970, Driscoll et al. 1984, Ellis and Hackney 1981, Erdman 1962, Ferchau 1973, Hanson and Ball 1928, Keammerer and Peterson 1981, Muldavin et al. 1998b, Pase and Lindenmuth 1971, Schmoll 1935, Vories 1974, Western Ecology Working Group n.d.

## *Quercus gambelii* / Sparse Understory Shrubland

## Gambel Oak / Sparse Understory Shrubland

| | |
|---|---|
| CODE | CEGL002337 |
| 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 | *QUERCUS GAMBELII* SHRUBLAND ALLIANCE (A.920)<br>Gambel Oak Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This association occurs on flat to gently sloping valley floors, canyon bottoms, or narrow high terraces in canyons of the Colorado Plateau and high plateaus of southern Utah. Stands are usually at least 1 m above bankfull stage and rarely, if ever, flood. Elevations range from 1220 to 2190 m (4000-7200 feet). The substrate is a fine sandy alluvium, and oak leaf litter generally covers nearly all the unvegetated surface. The canopy consists of even-aged *Quercus gambelii* stems 5-15 m high with 50-80% canopy closure. The understory consists primarily of oak sprouts less than 0.5 m tall. Scattered individuals of other woody species may occur throughout stands, including *Juniperus scopulorum, Ericameria nauseosa, Rhus trilobata*, and *Acer negundo*. Herbaceous species are usually sparse because of the dense shade cast by the relatively closed canopy but may include *Piptatherum micranthum, Maianthemum stellatum, Stanleya pinnata*, and *Clematis ligusticifolia*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This tall shrubland is uncommon, occurs on deep soils, and was sampled within Glory Cove, in Sheep and Yellow creek drainages, along Tropic Trail, and in Cope Canyon.

*Globally*
This association has been documented in the Colorado Plateau of eastern Utah and from high plateaus of southern Utah. It has been observed at Mesa Verde National Park (not sampled) and in the Front Range foothills of eastern Colorado as well (Castlewood Canyon State Park). It is likely to occur sporadically anywhere high alluvial terraces develop within the range of *Quercus gambelii*.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This tall shrubland occurs on valley floors and canyon bottoms. The sites are gentle (1- to 5-degree slopes), occur between 2028 and 2191 m in elevation, and are oriented to all aspects. The ground surface has no to sparse exposure of bare soil, high cover of litter, and sparse cover of downed wood. Soils are rapidly drained silty clay loams, loamy sands, silts, and clay loams that are derived from New Alluvium.

*Globally*
This association occurs on flat to gently sloping valley floors, canyon bottoms and narrow high terraces in canyons of the Colorado Plateau and high plateaus of southern Utah. Stands are usually at least 1 m above bankfull stage and rarely, if ever, flood. Elevations range from 1220 to 2190 m (4000-7200 feet). The substrate is a fine sandy alluvium, and the soils may have a dark surface horizon with a relatively high percentage of organic matter. Oak leaf litter generally covers nearly all the unvegetated surface, although wood litter from fallen branches and trunks may be significant in some older stands.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is dense (62-99% cover) and is characterized by the tall shrub *Quercus gambelii* that provides 50-90% cover and attains heights between 2 and 10 m. The canopy layer, from 5-10 m tall, provides sparse cover and includes *Pinus edulis* and *Juniperus scopulorum* trees. In one stand, *Acer grandidentatum* canopy trees from 5-10 m tall provide sparse cover. Other tall-shrub species provide sparse cover and include *Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata)*. Short-shrub species is low in terms of species composition, provides sparse cover, and includes *Rosa woodsii* and *Symphoricarpos oreophilus*. The liana *Clematis ligusticifolia* provides moderate cover (up to 25% in one stand). The herbaceous layer is low in floristic diversity and provides sparse cover. The more common forbs include *Maianthemum stellatum (= Smilacina stellata), Thalictrum fendleri, Clematis columbiana*, and *Packera multilobata (= Senecio multilobatus)*. Some stands lack any herbaceous cover.

*Globally*
Stands of this community usually take the form of a dwarf-woodland, with the canopy high enough that it is possible to walk upright through a stand. Stands usually consist of a single clone of *Quercus gambelii* with roughly even-aged stems 8-20 cm in diameter, 5-15 m tall, and with 50 to 80% canopy closure. They may also include scattered individuals of other woody species such as *Acer grandidentatum, Acer negundo, Juniperus scopulorum*, and *Pinus edulis*. Other shrubs that may be present include *Ericameria nauseosa, Forestiera pubescens, Mahonia fremontii, Prunus virginiana, Rhus trilobata, Rosa woodsii*, and *Symphoricarpos oreophilus*. The vines *Clematis columbiana* and *Clematis ligusticifolia* may also be present in the shrub canopy. Graminoid species are usually sparse because of the dense shade cast by the relatively closed canopy but may include *Piptatherum micranthum*. Forbs present include *Artemisia ludoviciana, Comandra umbellata, Heterotheca villosa, Maianthemum stellatum, Tetraneuris acaulis (= Hymenoxys acaulis), Stanleya pinnata, Thalictrum fendleri*, and *Packera multilobata (= Senecio multilobatus)*. The exotic annual grass *Bromus tectorum* is common in some stands.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Quercus gambelii* |
| Short shrub/sapling | *Rosa woodsii* |
| Herb (field) | *Clematis ligusticifolia* |
| Herb (field) | *Thalictrum fendleri* |

*Globally*

| Stratum | Species |
|---|---|
| Tree canopy | *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (12-Jan-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Gambel oak woodland.

*Globally*
This association is distinguished from other Gambel oak associations occurring in the Colorado Plateau by its position on level, abandoned alluvial terraces and the lack of a developed understory.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Homogenous stands of *Quercus gambelii* with thick litter layers composed of leaves; area of toeslopes that may receive increased moisture from drainage off steep slopes; stand is a Gambel oak grove with the liana *Clematis ligusticifolia* abundant.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (5 plots: BRCA.0004, BRCA.0314, BRCA.0327, BRCA.0338, BRCA.0412; and 1 observation point: BRCA.9240) and 2007 Accuracy Assessment (3 points: BRCA_AA.0633, BRCA_AA.0713, BRCA_AA.1065).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, mod. K.A. Schulz and G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *Quercus gambelii / Symphoricarpos oreophilus* Shrubland

## Gambel Oak / Mountain Snowberry Shrubland

| | |
|---|---|
| CODE | CEGL001117 |
| 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 | *QUERCUS GAMBELII* SHRUBLAND ALLIANCE (A.920)<br>Gambel Oak Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):**
Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796)
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)
Southwestern Great Plains Canyon (CES303.664)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This shrubland association is found in foothills, plateaus and mountains from western Texas to southern and western Colorado and throughout southern Utah north into the Wasatch Range, and likely occurs in northern Arizona. It is a mesic upland and non-obligate riparian community. Some stands appear to be transitional between riparian areas and drier upland communities such as *Artemisia* spp. It occurs on cool, moist sites, such as along drainages in canyons and steep draws in more xeric areas, and as a mesic upland shrubland forming extensive stands on cooler northern slopes. Substrates are typically deep, well-drained sandy loam to clay loam derived from alluvium or colluvium. The vegetation is characterized by an open to closed, typically tall-shrub layer (2-5 m tall) that is dominated by *Quercus gambelii*. The understory is composed of a short-shrub layer that is dominated by *Symphoricarpos oreophilus* or a closely related local *Symphoricarpos* species such as *Symphoricarpos rotundifolius* or *Symphoricarpos palmeri*. Other mesic shrubs may be present, including *Amelanchier* spp., *Prunus virginiana, Robinia neomexicana*, and *Brickellia* sp. In some stands, the *Quercus gambelii* develop into small trees that form a tree canopy. These "woodlands" are included in this association because their floristic composition is identical to the tall shrublands. In other stands the oak is mostly under 2 m tall, forming a short-shrub layer. The herbaceous layer is sparse to moderately dense, depending on density of woody canopy, and is often dominated by graminoids, such as species of *Achnatherum, Bromus, Elymus, Poa*, and *Koeleria*. Common forbs include *Vicia americana, Thalictrum fendleri*, and *Achillea millefolium*. Occasionally, tree species are present in the overstory.

**DISTRIBUTION**

*Bryce Canyon National Park*

This tall shrubland is uncommon, occurs on deep soils, and was sampled near Rainbow Point, in Swamp Canyon, and above Water Canyon.

*Globally*

This shrubland is reported from foothills, plateaus and mountains of western Texas to southern and western Colorado, southern Utah north into the Wasatch Range, and likely occurs in Arizona.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall shrubland occurs on hills, canyon rims, and valley floors. Sites are gentle to moderate (6- to 15-degree slopes), occur between 2223 and 2354 m in elevation, and are oriented to all aspects. The ground surface has no to moderate exposure of bare soil, moderate to high cover of litter, no or low cover of small rocks, and sparse cover of downed wood. Soils are rapidly drained silty clay loams or sandy loams that are derived from Boat Mesa Conglomerate.

*Globally*

This shrubland is found in foothills, plateaus and mountains from western Texas to southern and western Colorado, throughout southern Utah north into the Wasatch Range, and likely occurs in northern Arizona. Elevation ranges from 1750-2745 m (6000-8600 feet). It is a mesic upland and non-obligate riparian community. Some stands appear to be transitional between riparian areas and drier upland communities such as *Artemisia* shrublands. It occurs on hills, high slopes, ridges, mesas, canyon rims, knolls and valley floors typically on cooler, moist sites at lower elevations, such as along drainages in canyons and steep draws in more xeric areas, and as a mesic upland shrubland forming extensive stands on cooler northern slopes. Higher-elevation stands occur on all aspects. Substrates are typically deep, well-drained sandy loam to silty clay loam derived from alluvium or colluvium. Parent materials include sandstone, shale, and granite conglomerate.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (38-113% cover) and is characterized by the tall shrub *Quercus gambelii* that attains heights of 2-10 m and provides 27-70% cover, and the short shrub *Symphoricarpos oreophilus* that provides 1-27% cover. In one stand, emergent *Pseudotsuga menziesii* trees to 20 m tall provide sparse cover. A subcanopy tree layer of 2- to 5-m tall *Juniperus scopulorum* provides sparse cover in one stand where *Quercus gambelii* has attained the stature of small trees. Other tall-shrub species present include *Amelanchier utahensis* and *Prunus virginiana*. Other short shrubs present include *Rosa woodsii, Tetradymia canescens, Chrysothamnus viscidiflorus, Artemisia nova*, and *Mahonia repens*. The herbaceous layer is diverse in terms of species composition and provides sparse cover. Graminoids include *Elymus lanceolatus* and non-natives *Poa pratensis* and *Bromus tectorum*. The forb layer includes *Ligusticum porteri, Taraxacum officinale, Chenopodium leptophyllum*, and *Achillea millefolium*.

*Globally*

The vegetation is characterized by an open to closed, tall-shrub layer (2-5 m tall) that is dominated by *Quercus gambelii*. The understory is composed of a short-shrub layer that is dominated by *Symphoricarpos oreophilus* or a closely related local *Symphoricarpos* species such as *Symphoricarpos rotundifolius* or *Symphoricarpos palmeri*. Other shrubs may be present, including *Amelanchier* spp., *Artemisia nova, Artemisia tridentata, Chrysothamnus viscidiflorus, Ericameria nauseosa, Mahonia repens, Peraphyllum ramosissimum, Prunus virginiana, Purshia tridentata, Robinia neomexicana, Rosa woodsii*, and *Tetradymia canescens*. Occasionally, emergent trees such as *Pseudotsuga menziesii* or under canopy trees such as *Juniperus scopulorum* may be present. In some stands, *Quercus gambelii* develop into small trees that form a tree canopy. These "woodlands" are included in this association because their floristic composition is identical to the tall shrublands. In other stands, the oak is mostly under 2 m tall, forming a short-shrub layer. The herbaceous layer is sparse to moderately dense, depending on density of woody canopy, and is often dominated by graminoids, such as species of *Achnatherum, Bromus, Elymus, Poa, Pseudoroegneria spicata*, and *Koeleria macrantha*. Common forbs include *Achillea millefolium, Balsamorhiza sagittata, Chenopodium leptophyllum, Clematis ligusticifolia, Ligusticum porteri, Lupinus argenteus, Thalictrum fendleri*, and *Vicia americana*. Occasionally, tree species are present in the overstory, including *Pinus ponderosa,*

*Juniperus scopulorum*, and *Pseudotsuga menziesii*. Introduced graminoids such as *Bromus inermis* and *Poa pratensis* are often common in stands that have been disturbed by heavy livestock grazing.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Quercus gambelii* |
| Short shrub/sapling | *Rosa woodsii*, *Symphoricarpos oreophilus* |

*Globally*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Quercus gambelii* |
| Tall shrub/sapling | *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus tectorum* (exotic, High), *Chenopodium leptophyllum* (weedy native), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*
**Exotic/Invasive**: *Bromus inermis* (invasive, High/Medium), *Poa pratensis* (invasive, Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Gambel oak woodland.

*Globally*
This plant association is similar to other montane Gambel oak shrublands except for the codominance of *Symphoricarpos oreophilus* with only minor amounts (<10% cover) of *Amelanchier utahensis, Artemisia tridentata*, or *Cercocarpus montanus*.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: So much dieback on the Gambel oak that they appear half-dead, and not a lot of Gambel oak regeneration in the understory; understory is very dense and ground is covered in litter; community is located on a small outcropping of the Boat Mesa Conglomerate, and the extent of that outcrop effectively defines the limits of the community; recent (2-5 years) fire has impacted the community as well, removing most of what was already a very sparse cover of pinyon-juniper, and killing the mature stems of the dominant Gambel oak shrub layer; Gambel oak is tree-sized, overtop scattered juniper, and supports Woods' rose over 2 m tall, ground is covered by leaf litter and limbs.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0069, BRCA.0107; and 1 observation point: BRCA.9235) and 2007 Accuracy Assessment (4 points: BRCA_AA.0444, BRCA_AA.0529, BRCA_AA.1188, BRCA_AA.1251).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. J. Coles

**REFERENCES:** Baker 1982b, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Clary 1992, Cogan et al. 2004, Crane 1982, Driscoll et al. 1984, Erdman 1962, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnston 1987, Kittel et al. 1994, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova et al. 1988a, Muldavin 1994, Muldavin and Mehlhop 1992, Muldavin et al. 1994a, Muldavin et al. 1998b, Muldavin et al. 2000b, Salas et al. 2010, Soil Conservation Service 1978, Western Ecology Working Group n.d., Wright et al. 1979

## *Quercus gambelii* Shrubland

## Gambel Oak Shrubland

| | |
|---|---|
| CODE | CEGL002477 |
| 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 | *QUERCUS GAMBELII* SHRUBLAND ALLIANCE (A.920)<br>Gambel Oak Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This tall shrubland is known from northeastern Arizona and southwestern Colorado and southeastern Utah in the Colorado Plateau north into the Wasatch Range. It also occurs in the high plateaus of southern Utah. Stands occur on southeastern to western aspects at 1884 to 2379 m (6181-7805 feet) elevation on gentle to moderately steep slopes (0-30%). Sites include canyons, mesas, stream terraces and a toeslope at the base of a cliff. The frequently sandy soils have low cover of rock and moderate to high cover of littler on the ground surface. There is frequently evidence of past fires. The vegetation is characterized by an open to dense (25-75% cover), tall-shrub (>10 m) canopy dominated by *Quercus gambelii*. Scattered *Pinus edulis* and *Juniperus osteosperma* trees may be present. Other shrubs (all with <1% cover) are *Ericameria nauseosa, Gutierrezia sarothrae, Mahonia repens, Opuntia phaeacantha*, and *Purshia tridentata*. The herbaceous stratum is variable. *Artemisia ludoviciana* and *Elymus elymoides* are important species as is the exotic annual grass and forb species *Bromus tectorum* and *Erodium cicutarium*, respectively. The herbaceous stratum has a diversity of other species with low cover (<1%).

**DISTRIBUTION**

*Bryce Canyon National Park*

This tall shrubland is uncommon, occurs on mesic deep soils, and was sampled near the eastern park boundary and within Water Canyon.

*Globally*

This association has been reported from southwestern Colorado, on the Colorado Plateau in northeastern Arizona, and from the Wasatch Range of northern Utah and the high plateaus of southern Utah. It likely occurs elsewhere in the region, especially in areas relatively recently disturbed.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall shrubland occurs on canyonsides and stream terraces. The sites are gentle to steep (1- to 38-degree slopes), occur between 2016 and 2101 m in elevation, and are oriented to the east or south. The ground surface has sparse exposure of bare soil, high cover of litter, and sparse cover of downed wood. Soils are rapidly drained silty clay loams.

*Globally*

This tall shrubland is known from northeastern Arizona, southwestern Colorado and southern Utah in the Colorado Plateau and extends north into the Wasatch Range, and south into the high plateaus of southern Utah. Stands occur on southeastern to western aspects at 1884 to 2379 m (6181-7805 feet) elevation on gentle to moderately steep slopes (0-30%). Sites include canyons, ravines, mesas, stream terraces and toeslopes at the base of cliffs. The soils are often sandy loams but may include silty clay loams with low cover of rock and moderate to high cover of litter on the ground surface. There is frequently evidence of past fires.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (86-99% cover) and is characterized by the 2- to 5-m tall *Quercus gambelii* that provides 40-75% cover. Tall shrubs *Amelanchier utahensis* and *Rhus trilobata var. trilobata (= Rhus aromatica var.*

*trilobata)* provide sparse cover. In one stand, the dwarf-shrub *Mahonia repens* provides sparse cover. The herbaceous layer is low in floristic diversity and includes the forbs *Maianthemum stellatum (= Smilacina stellata)* and *Solidago velutina* that provide low to moderate cover.

*Globally*
This tall shrubland is characterized by an open to dense (25-75% cover) tall-shrub (>10 m) dominated by *Quercus gambelii*. Scattered *Pinus edulis* and *Juniperus osteosperma* trees may be present. Other shrubs (all with <1% cover) are *Amelanchier utahensis, Ericameria nauseosa, Gutierrezia sarothrae, Mahonia repens, Opuntia phaeacantha, Rhus trilobata*, and *Purshia tridentata*. The herbaceous stratum is variable and often has a high diversity of species with low cover (<1%), such as *Achillea millefolium var. occidentalis, Achnatherum hymenoides, Artemisia ludoviciana, Balsamorhiza sagittata, Eriogonum racemosum, Elymus elymoides, Elymus trachycaulus ssp. trachycaulus, Galium aparine, Maianthemum stellatum, Poa fendleriana, Pseudoroegneria spicata, Solidago velutina*, and *Vicia americana*. Exotic annual grass and forb species *Bromus tectorum* and *Erodium cicutarium* are frequently present to abundant.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Quercus gambelii* |
| Herb (field) | *Maianthemum stellatum*, *Solidago velutina* |

*Globally*

| Stratum | Species |
|---|---|
| Shrub/sapling (tall & short) | *Quercus gambelii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High), *Erodium cicutarium* (invasive/exotic, Medium/Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (29-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Gambel oak woodland.

*Globally*
This association is intended for shrublands of oak with no other shrubs associated with mixed mountain shrublands (e.g., *Amelanchier* spp., *Symphoricarpos oreophilus, Prunus virginiana, Cercocarpus montanus*, etc.) or a distinctive herbaceous layer. Many stands are in unusual settings, such as recent burns (e.g., Mesa Verde National Park). It is likely to be a transitional phase that will eventually return to a more mixed shrub canopy understory or in some cases become dominated by exotic herbaceous species.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: It is unclear why this distinct community is here and not elsewhere, perhaps the soil moisture is much higher than usual due to groundwater seepage; leaf litter is deep (at least 6") and the duff under that is deeper (8"); fairly dense, though easy to walk through, oak thicket with almost all even-aged oak shrubs and only a few seedlings.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (2 plots: BRCA.0135, BRCA.0171) and 2007 Accuracy Assessment (7 points: BRCA_AA.0164, BRCA_AA.0179, BRCA_AA.0383, BRCA_AA.0780, BRCA_AA.1198, BRCA_AA.1209, BRCA_AA.0119).
*Local Description Authors:* M. Smith and J. Von Loh

*Global Description Authors:* K.A. Schulz

**REFERENCES:** 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)<br>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**

*Bryce Canyon National Park*

This short shrubland is uncommon, occupies slopes, and was sampled near Paria View, Yovimpa Spring, the Swamp Canyon Overlook, and in Swamp Canyon.

*Globally*

This association is known from western Wyoming, Colorado, on the Colorado Plateau and in the high plateaus of Utah, and Oregon.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This short shrubland occurs on ridges, canyon slopes, and on landslides. Sites are moderately steep to steep (8- to 22-degree slopes), occur between 2344 and 2477 m in elevation, and are oriented to all aspects. The ground surface has low to high exposure of bare soil, low to high cover of litter, sparse to low cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained silty clay loams or clay loams that are derived from the Claron Formation (Pink Member) and Kaiparowitz Formation.

*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**

*Bryce Canyon National Park*

Total vegetation cover is moderate (30-52% cover) and is characterized by the short shrub *Symphoricarpos oreophilus* that provides 5-11% cover. The canopy trees *Pinus ponderosa, Abies concolor, Picea pungens, Juniperus scopulorum*, and *Pseudotsuga menziesii* provide sparse to low cover and attain heights between 2 and 20 m. *Juniperus scopulorum* and *Populus tremuloides* provide sparse cover in the subcanopy tree layer that ranges from 2-5 m in height. Tall-shrub species present provide sparse cover and include *Amelanchier utahensis* and *Sambucus caerulea*. Other short-shrub species are moderately diverse floristically, provides sparse cover, and includes *Ceanothus martinii, Juniperus communis, Purshia tridentata, Ribes cereum, Rosa woodsii*, and *Arctostaphylos patula*. The dwarf-shrub *Mahonia repens* provides sparse cover. The herbaceous layer is moderate to high in terms of species composition and provides sparse to low cover. Common graminoids include *Poa fendleriana, Elymus elymoides, Pseudoroegneria spicata (= Elymus spicatus), Achnatherum hymenoides, Hesperostipa comata, Calamagrostis scopulorum, Juncus balticus*, and *Carex rossii*. Forbs include *Artemisia dracunculus, Packera multilobata (= Senecio multilobatus), Taraxacum officinale, Cirsium calcareum, Achillea millefolium, Astragalus kentrophyta*, and *Solidago velutina*.

*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**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Rosa woodsii*, *Symphoricarpos oreophilus* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Symphoricarpos oreophilus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Taraxacum officinale* (exotic)

*Globally*
**Exotic/Invasive**: *Achillea millefolium* (invasive), *Elymus repens* (invasive/exotic, High/Medium), *Poa pratensis* (invasive, Medium), *Taraxacum officinale* (invasive/exotic), *Tragopogon dubius* (invasive/exotic, Medium/Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (14-Aug-2001).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: In this area, tree mortality is nearly 100%, exposing the understory to sunlight; area apparently experienced an intense fire a few years ago; quite a few standing dead trees and many burned logs laying on the ground; stand occupies a seep/spring site with horizontal zonation of vegetation; site is a dry meadow opening in a canyon bottom.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0223, BRCA.0390; and 2 observation points: BRCA.9239; BRCA.9257) and 2007 Accuracy Assessment (3 points: BRCA_AA.0263, BRCA_AA.0508, BRCA_AA.0523).
*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.

## *Cornus sericea* Rocky Mountain Shrubland

### Red-osier Dogwood Rocky Mountain Shrubland

| | |
|---|---|
| CODE | CEGL001165 |
| 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 | *CORNUS SERICEA* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.968)<br>Red-osier Dogwood Temporarily Flooded Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045)
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
Western Great Plains Wooded Draw and Ravine (CES303.680)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**

*Globally*

This riparian tall shrubland is widespread in the Columbia Basin, the Intermountain Basin, and in the Rocky Mountains, and is discontinuously scattered in sheltered areas of the Colorado Plateau. It often forms continuous, narrow bands along streambanks, benches and bars, as well as in slot canyons. Many stands are located on nearly level, frequently flooded banks, in burns in steep avalanche chutes, or otherwise experience periodic disturbance. It also can form very dense, small stands with limited disturbance, often at the base of a cliff. Soils are relatively deep, well-drained silty to sandy clay loams derived from alluvium, colluvium or glacial till. Elevations range from 715 to 2700 m (2300-8800 feet), with the lower elevations occurring at the northern end of the range in Montana, the higher elevations in Utah and Colorado. The tall (1-2 m) deciduous shrub canopy is dominated by *Cornus sericea*, generally accompanied by other tall shrubs, including *Prunus virginiana, Ribes aureum, Crataegus douglasii, Acer glabrum, Alnus incana, Salix bebbiana, Salix scouleriana, Cercocarpus ledifolius*, and *Juniperus scopulorum*. Short shrubs have sparse to moderate cover and include *Rosa woodsii, Symphoricarpos* spp., *Paxistima myrsinites, Mahonia repens, Arctostaphylos patula, Ribes cereum*, and the liana *Clematis ligusticifolia*. The understory is diverse and ranges from sparse to dense depending on how closed the tall-shrub layer is. Common forbs include *Thalictrum occidentale, Solidago canadensis, Aralia nudicaulis, Heracleum maximum, Heliomeris multiflora, Erythronium grandiflorum, Equisetum arvense, Maianthemum stellatum, Sanicula marilandica, Angelica arguta*, and *Symphyotrichum laeve (= Aster laevis)*. Graminoids are generally less important but may include significant cover by *Elymus glaucus* or *Calamagrostis canadensis*. The majority of the herbaceous layer may consist of non-native species, including *Cirsium arvense, Dactylis glomerata, Agrostis stolonifera, Poa palustris, Phalaris arundinacea*, and *Phleum pratense*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This type was observed at two Accuracy Assessment points in 2007, therefore no local descriptive information is available.

*Globally*

This is a widespread western riparian shrubland that is documented by plot data in Washington, Oregon, Idaho, Nevada, Utah, Montana, Wyoming and Colorado.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This tall shrubland association occurs as a narrow stringer adjacent to stream channels, near seeps on moist toeslopes of canyon walls, on narrow benches in ravines, narrow terraces of wider valleys, as well as floodplains. Stands have been documented in the Columbia Basin, the Great Basin, throughout the lower elevations of the Rocky Mountains, and in sheltered riparian areas of the Colorado Plateau. Elevations range from 715 m (3600 feet) near the Canadian border in Montana to 2700 m (8800 feet) in southern Utah and Colorado. Stands may occur on nearly level riparian sites or on steep, wet, rocky slopes or at the base of cliffs. Rocks and litter often cover most of the unvegetated surface. The soils are generally derived from glacial till, alluvium or colluvium and are often sandy loams or clay loams.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This shrubland can be a pure stand of impenetrable *Cornus sericea* or more open with several other shrub species. Typically *Cornus sericea* is the dominant shrub; other shrubs commonly present include *Prunus virginiana, Crataegus douglasii, Acer glabrum, Alnus incana, Ribes aureum, Rosa woodsii, Salix bebbiana, Salix scouleriana, Cercocarpus ledifolius*, and *Juniperus scopulorum*. Short shrubs have sparse to moderate cover and include *Rosa woodsii, Symphoricarpos oreophilus, Symphoricarpos albus, Paxistima myrsinites, Mahonia repens, Arctostaphylos patula*, and *Ribes cereum*. The understory is diverse and ranges from sparse to dense depending on how closed the tall-shrub layer is. Total vegetation cover is rarely less than 75% and often exceeds 100%. Some stands are

dominated by *Heracleum maximum*, others by *Equisetum arvense*, and others by *Maianthemum stellatum* with other forbs, such as *Thalictrum occidentale, Solidago canadensis, Aralia nudicaulis, Heliomeris multiflora, Erythronium grandiflorum, Mimulus eastwoodiae, Aquilegia micrantha, Platanthera zothecina (= Habenaria zothecina)*, and *Artemisia ludoviciana*. *Sanicula marilandica, Angelica arguta*, and *Symphyotrichum laeve (= Aster laevis)*. Graminoids are generally less important but may include significant cover by *Carex aurea, Elymus glaucus, Calamagrostis canadensis*, and *Calamagrostis scopulorum*. The majority of the herbaceous layer may consist of non-native species, including *Cirsium arvense, Dactylis glomerata, Agrostis stolonifera, Poa palustris, Phalaris arundinacea*, and *Phleum pratense*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Cornus sericea* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Arabis crandallii* (globally imperiled, G2G3), *Mimulus eastwoodiae* (rare/endemic, G3G4), *Platanthera zothecina* (globally imperiled, G2); **Exotic/Invasive**: *Agrostis stolonifera* (exotic, Medium/Low), *Cirsium arvense* (exotic, High/Medium), *Dactylis glomerata* (exotic, Medium/Insignificant), *Linaria vulgaris* (exotic, High/Low), *Medicago lupulina* (exotic, Medium/Insignificant), *Phalaris arundinacea* (exotic, High), *Phleum pratense* (exotic, Medium), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Trifolium pratense* (exotic, Low/Insignificant)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4Q (27-Apr-2000).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
This type is listed as *Cornus sericea* Shrubland

*Globally*
This association appears to be a broadly defined type that may be split in the future as more information becomes available. As such it is low-confidence. All references are surprising similar in their acceptance of variability within this type.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (2 point): BRCA_AA.0734, BRCA_AA.0746).
*Local Description Authors:*
*Global Description Authors:* G. Kittel, mod. J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Crawford 2001, Crawford 2003, Crowe and Clausnitzer 1997, Crowe et al. 2004, Diaz and Mellen 1996, Driscoll et al. 1984, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Jankovsky-Jones et al. 2001, Jones 1992b, Jones and Ogle 2000, Kagan et al. 2000, Kittel et al. 1994, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1993, MTNHP 2002b, MacKenzie and Moran 2004, Manning and Padgett 1995, Padgett et al. 1989, WNHP unpubl. data, Western Ecology Working Group n.d., Youngblood et al. 1985a

## *Dasiphora fruticosa ssp. floribunda* Shrubland [Provisional]

## Shrubby-cinquefoil Shrubland

| | |
|---|---|
| CODE | CEGL001105 |
| 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)<br>Shrubby-cinquefoil Temporarily Flooded Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**

*Globally*

This montane to subalpine shrubland is reported in the southern Rocky Mountains of Colorado and Wyoming, the Ruby Mountains of northeastern Nevada, and from the high plateaus of southern Utah. It is a common, often grazing-induced community, and is quite widespread though poorly documented throughout the cool temperate western states. Stands occur on stream terraces and benches above the channel, on drier edges of wetlands, on broad gently sloping valley bottoms and floodplains, and on moderately steep mesic slopes near springs. Elevation ranges from 2200-2690 m (7250-9700 feet). Aspect is variable. Soils vary in amount of rock fragments, texture (clay loam to sandy loam) and depth. Vegetation is characterized by an open to moderately dense (20-50% cover) shrub layer dominated by *Dasiphora fruticosa ssp. floribunda*. A diverse mixture of graminoids and forbs characterizes the sparse to lush (10-50%) herbaceous layer. Graminoids, such as *Achnatherum lettermanii, Bromus porteri, Carex deweyana, Danthonia intermedia, Juncus balticus, Elymus trachycaulus, Festuca saximontana, Festuca thurberi, Leymus cinereus, Muhlenbergia montana*, and *Poa pratensis*, often dominate the herbaceous layer. The more common forbs include *Antennaria rosea, Antennaria microphylla, Erigeron pumilus, Eriogonum umbellatum, Fragaria virginiana ssp. glauca, Potentilla pulcherrima, Potentilla gracilis, Achillea millefolium var. occidentalis, Campanula rotundifolia, Cirsium scariosum (= Cirsium tioganum var. coloradense), Fragaria virginiana, Galium boreale, Iris missouriensis, Pseudocymopterus montanus, Taraxacum officinale*, and *Thalictrum fendleri*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This mesic to wet shrubland occurs on flat river terraces and was sampled on the East Fork of the Sevier River.

*Globally*

Data are not available.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This shrubland occurs on the first terrace of a river. The site is flat and occurs at 2401 m in elevation. The ground surface has high exposure of bare soil and low cover by litter. Soils are poorly drained and are derived from New Alluvium.

*Globally*

This montane to subalpine shrubland association is reported in the southern Rocky Mountains in Colorado and Wyoming, the Ruby Mountains of northeastern Nevada, and the high plateaus of southern Utah. Stands occur on stream terraces above the channel, on drier edges of wetlands, on broad gently sloping valley bottoms and floodplains, and on moderately steep mesic slopes near springs. Elevation ranges 2200-2960 m (7250-9700 feet). Aspect is variable. Soils vary in amount of rock fragments, texture (clay loam to sandy loam) and depth.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (82% cover) and is characterized by *Dasiphora fruticosa ssp. floribunda* short shrubs that are <1 m tall and provide 65% cover. The herbaceous layer is low in terms of species composition and

contributes low cover. The graminoid layer is characterized by the exotic *Poa pratensis* and the native *Juncus balticus* that together provide low cover (up to 14%). Forbs include *Iris missouriensis* and *Taraxacum officinale* that provide sparse cover.

*Globally*
This shrubland is characterized by an open to moderately dense (20-50% cover) shrub layer dominated by *Dasiphora fruticosa ssp. floribunda*, sometimes with *Artemisia cana, Artemisia tridentata*, and *Rosa woodsii* present to codominant. *Deschampsia caespitosa* is absent, or, if present, is entirely overwhelmed by exotic and increaser species. *Juncus balticus* has low cover (<5%). Alpine meadow species are scarce or absent, such as *Carex rupestris var. drummondiana, Carex elynoides, Calamagrostis purpurascens, Festuca brachyphylla, Geum rossii var. turbinatum, Poa reflexa*, and *Trifolium dasyphyllum*. A diverse mixture of graminoids and forbs characterize the sparse to lush (10-50%) herbaceous layer. Graminoids, such as *Achnatherum lettermanii, Bromus porteri, Carex deweyana, Danthonia intermedia, Juncus balticus , Elymus trachycaulus, Festuca saximontana, Festuca thurberi, Muhlenbergia montana*, and *Poa pratensis*, often dominate the herbaceous layer. The more common forbs include *Antennaria rosea, Antennaria microphylla, Erigeron pumilus, Eriogonum umbellatum, Fragaria virginiana, Iris missouriensis, Taraxacum officinale, Potentilla pulcherrima, Achillea millefolium var. occidentalis, Campanula rotundifolia, Cirsium scariosum (= Cirsium tioganum var. coloradense), Galium boreale, Pseudocymopterus montanus*, and *Thalictrum fendleri*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Dasiphora fruticosa* ssp. *floribunda* |
| Herb (field) | *Poa pratensis* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Dasiphora fruticosa* ssp. *floribunda* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*
**Exotic/Invasive**: *Poa pratensis* (invasive introduced forage species, Medium), *Taraxacum officinale* (invasive)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5? (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
*Dasiphora fruticosa ssp. floribunda* shrublands and steppe are highly variable and need more survey and classification work to clarify diagnostic characteristics.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Shrub-scrub wetland occupies the first terrace of the river, seasonally flooded, water removing most litter, Kentucky bluegrass dominates the understory, site grazed by cattle.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 observation point: BRCA.9051) and 2007 Accuracy Assessment (2 points: BRCA_AA.0106, BRCA_AA.0296).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, Driscoll et al. 1984, Loope 1969, Western Ecology Working Group n.d.

## *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)<br>(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**

*Bryce Canyon National Park*

This tall-shrub association is limited to seeps and was sampled in Glory Cove and along State Highway 54. It was also observed at three additional locations during Accuracy Assessment.

*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**

*Bryce Canyon National Park*
This tall shrubland occurs on canal banks and seeps. Sites are gentle (2- to 7-degree slopes), occur between 2024 and 2266 m in elevation, and are oriented to the east and south. The ground surface has moderate to high cover of litter, no to high cover of small rocks, sparse cover of downed wood, and sparse exposure of bare soil. Soils are poorly drained and are derived from New Alluvium and the Wahweep Formation.

*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**
*Bryce Canyon National Park*
Total vegetation cover is dense (>99% cover) and is characterized by *Salix exigua* tall shrubs that are 2-5 m tall and provide 40-70% cover. The remaining tall-shrub layer is moderately diverse floristically, provides low cover (up to 13%) and includes *Salix ligulifolia (= Salix eriocephala var. ligulifolia), Purshia stansburiana (= Purshia mexicana var. stansburiana), Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata)*, and *Quercus gambelii*. Other shrubs present (up to 30%) include *Rosa woodsii, Rosa nutkana, Ericameria nauseosa, Arctostaphylos patula*, and *Dasiphora fruticosa ssp. floribunda*. The herbaceous layer is low in terms of species composition and provides sparse cover. The graminoid layer includes low cover (up to 9%) of *Juncus balticus* and *Agrostis stolonifera*. The fern ally *Equisetum arvense* provides up to 6% cover in one stand. The forb *Platanthera sparsiflora (= Habenaria sparsiflora)* provides sparse cover. *Pinus ponderosa, Juniperus scopulorum* trees and the tall shrub *Betula occidentalis* provide sparse cover in the 2- to 10-m tall canopy tree layer.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Rhus trilobata* var. *trilobata*, *Salix exigua* |
| Short shrub/sapling | *Rosa woodsii* |
| Herb (field) | *Juncus balticus* |
| 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**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Juglans hindsii* (globally critically imperiled, G1); **Exotic/Invasive**: *Ailanthus altissima* (invasive/exotic, Medium), *Bromus inermis* (invasive/exotic, High/Medium), *Elaeagnus angustifolia* (invasive/exotic, High), *Elymus repens* (invasive/exotic, High/Medium), *Linaria vulgaris* (invasive/exotic, High/Low), *Phleum pratense* (invasive/exotic, Medium), *Poa pratensis* (invasive/exotic, Medium), *Rubus discolor* (invasive/exotic, Medium/Insignificant), *Tamarix ramosissima* (invasive/exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (6-May-1999). This type is widespread and common throughout its range.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: One stand has become established on canal banks in strips about 5 m wide; one stand has become established on high groundwater adjacent to highway toe-of-fill.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 observation points: BRCA.9202, BRCA.9232) and 2007 Accuracy Assessment (3 points: BRCA_AA.0082, BRCA_AA.0162, BRCA_AA.0373).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J.F. Drake, mod. E. Muldavin, L. Allen, G. Kittel

**REFERENCES:** ANHIC n.d., 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 unpubl. data, Padgett et al. 1988a, Phillips 1977, Salas and Pucherelli 2002a, Steinauer 1989, Steinauer and Rolfsmeier 2000, TNC 1998d, TNC 1998e, Thompson and Hansen 2002, Vaghti 2003, Von Loh et al. 1999, Von Loh et al. 2000, WNHP unpubl. data, Western Ecology Working Group n.d., Wilson 1970

## *Salix eriocephala* / Mesic Graminoids Shrubland [Provisional]

### Missouri River Willow / Mesic Graminoids Shrubland

| | |
|---|---|
| CODE | CEGL005363 |
| 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 ERIOCEPHALA* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.974)<br>Missouri River Willow Temporarily Flooded Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This willow shrubland association is currently only known from Bryce Canyon National Park in Utah, and the following description is based on occurrences there. Additional global information will be added as it becomes available. This tall shrubland occurs on a valley bottom. The site is flat and occurs at 2207 m in elevation. The ground surface has sparse cover of litter and downed wood. Cryptogram cover is high and includes species of moss. Soils are well-drained silty clays that are derived from new alluvium. Total vegetation cover is dense (97% cover) and is characterized by *Salix eriocephala* (2-5 m tall) and the graminoids *Juncus balticus* and *Carex utriculata*. The tall shrub *Betula occidentalis* provides low cover and attains heights of 5-10 m. Other shrub species provide sparse cover and include *Cornus sericea* and *Rosa woodsii*. The remaining herbaceous layer includes the non-native

rhizomatous grass *Poa pratensis* and the forb *Maianthemum stellatum (= Smilacina stellata)*. *Betula occidentalis* saplings provide sparse cover.

**DISTRIBUTION**
*Bryce Canyon National Park*
This tall shrubland is uncommon, occurs only in valley bottoms, and was sampled in Swamp Canyon, and observed in three locations during Accuracy Assessment.

*Globally*
This shrubland association is currently only known from Bryce Canyon National Park in Utah. Additional range information will be added as it becomes available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This tall shrubland occurs on a valley bottom. The site is flat and occurs at 2207 m in elevation. The ground surface has sparse cover of litter and downed wood. Cryptogram cover is high and includes species of moss. Soils are well-drained silty clays that are derived from New Alluvium.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is dense (97% cover) and is characterized by the 2- to 5-m tall *Salix eriocephala* that provides 37% cover and the graminoids *Juncus balticus* and *Carex utriculata* that provide 34% and 10% cover, respectively. The tall shrub *Betula occidentalis* provides low cover and attains heights of 5-10 m. Other shrub species provide sparse cover and include *Cornus sericea* and *Rosa woodsii*. The remaining herbaceous layer provides sparse cover and includes the non-native rhizomatous grass *Poa pratensis* and the forb *Maianthemum stellatum (= Smilacina stellata)*. *Betula occidentalis* saplings provide sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Salix eriocephala* |
| Herb (field) | *Carex utriculata*, *Juncus balticus* |

*Globally*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Salix eriocephala* |
| Herb (field) | *Carex utriculata*, *Juncus balticus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (10-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Wooded wetlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Large areas of the willow stand are so thick as to be impenetrable; vegetation covers the surface completely; moist soil right at the surface.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0358) and 2007 Accuracy Assessment (3 points: BRCA_AA.0761, BRCA_AA.0087, BRCA_AA.0170).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* M. Smith and J. Von Loh, mod. M.J. Russo

**REFERENCES:** Western Ecology Working Group n.d.

## *Shepherdia argentea* Shrubland

## Silver Buffaloberry Shrubland

| | |
|---|---|
| CODE | CEGL001128 |
| 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 | *SHEPHERDIA ARGENTEA* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.960)<br>Silver Buffaloberry Temporarily Flooded Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
Western Great Plains Badlands (CES303.663)
Western Great Plains Wooded Draw and Ravine (CES303.680)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This mesic buffaloberry shrubland is found in the northern Great Plains of the United States and Canada, and on the western slope of Colorado south to the Paunsaugunt Plateau, Utah. Stands occur on stream terraces, rolling uplands, and badlands, and where moisture is more plentiful than the surrounding landscape, such as in swales, ravines, near streams and ditches, and on northwest- to east-facing slopes. The vegetation is dominated by a moderate to dense canopy of medium-tall shrubs. The most abundant of these, *Shepherdia argentea*, is typically 1.5-3 m tall. Other common shrub species are *Juniperus horizontalis, Prunus virginiana, Ribes* spp., *Rhus aromatica, Rosa woodsii*, and *Symphoricarpos occidentalis*. Graminoids and forbs may have only half the cover of the shrub layer and are quite variable. Graminoids include *Poa pratensis, Pascopyrum smithii*, and *Bromus* spp. Common forbs are *Achillea millefolium, Artemisia ludoviciana*, and *Parietaria pensylvanica*. This community occurs in the landscape as either narrow bands along streams or in small thickets.

**DISTRIBUTION**
*Bryce Canyon National Park*
This tall shrubland is limited to saturated irrigation ditchbanks and was sampled in Tropic Canyon.

*Globally*
This mesic buffaloberry shrubland is found in the northern Great Plains of the United States and Canada, extending from Colorado northward to the Dakotas and to Alberta and Saskatchewan. It is found in the northern Great Plains on stream terraces, rolling uplands, and badlands. Although restricted in distribution in Alberta, it is a dominant type in many areas within its range. It also occurs along streams and gentle floodplains of the western slope of Colorado and on the Paunsaugunt Plateau of southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall shrubland occurs on irrigation ditchbanks. The site is gentle (2-degree slope), occurs at 2024 m in elevation, and is oriented to the southeast. The ground surface has low exposure of bare soil and small rocks and moderate to high cover of litter. Soils are somewhat poorly drained and are derived from Tropic Shale.

*Globally*

This community is found on stream terraces, rolling uplands, and badlands. It occurs where moisture is more plentiful than the surrounding landscape, such as in swales, ravines, near streams and ditches, and on northwest- to east-facing slopes (Hansen and Hoffman 1988, DeVelice et al. 1995). This trend is more pronounced in Wyoming, Colorado and Utah where this community is found only near streams, and it may be less pronounced in Saskatchewan and northern Montana. Soils are loamy sand, sandy loam, silty loam, or loam and are derived from glacial drift, siltstone, or sandstone (USFS 1992, DeVelice et al. 1995). This community does not flood often, but some sites show evidence of a high water table (DeVelice et al. 1995).

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (44% cover) and is characterized by the tall shrub *Shepherdia argentea* that ranges from 2-5 m tall and provides 20% cover. The remaining tall shrub, *Salix exigua*, provides low cover. The canopy and subcanopy layers of *Pinus ponderosa* trees are 2-10 m tall and provide sparse cover. Short shrubs present provide low cover and include *Purshia tridentata* and *Ericameria nauseosa*. The herbaceous layer is represented by the forb *Maianthemum stellatum* that provides sparse cover.

*Globally*

The vegetation is dominated by a moderate to dense canopy of medium-tall shrubs. The most abundant of these, *Shepherdia argentea*, is typically 1.5-3 m tall. Other species commonly found in the shrub layer are *Juniperus horizontalis, Prunus virginiana, Ribes* spp., *Rhus aromatica, Rosa woodsii, Salix exigua*, and *Symphoricarpos occidentalis*. Herbaceous species may be sparse to abundant in this community. Occasionally a tree may be emergent, such as *Pinus ponderosa*. Graminoids and forbs may be quite variable and have only half the cover of the shrub layer (Hansen and Hoffman 1988, USFS 1992). Graminoids include *Poa pratensis, Pascopyrum smithii*, and *Bromus* spp. Common forbs are *Achillea millefolium, Artemisia ludoviciana*, and *Parietaria pensylvanica*. Litter may accumulate in this community (DeVelice et al. 1995). In Utah, mature *Pinus ponderosa* may have a few scattered individuals.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Salix exigua*, *Shepherdia argentea* |
| Short shrub/sapling | *Purshia tridentata* |

*Globally*

| Stratum | Species |
|---|---|
| Shrub/sapling (tall & short) | *Shepherdia argentea* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

**Exotic/Invasive**: *Poa pratensis* (invasive, Medium); **Other**: *Parietaria pensylvanica* (G5)

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G3G4 (1-Feb-1996). The number of occurrences is unknown. The community is reported from Montana (where it is ranked S3?), Wyoming, Colorado (S1), Utah, Saskatchewan, Alberta (S3), and possibly North Dakota.

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand has become established along the banks of an irrigation ditch.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 observation point: BRCA.9246).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Drake, mod. L. Allen and G. Kittel

**REFERENCES:** ANHIC n.d., Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, DeVelice et al. 1995, Driscoll et al. 1984, Hansen and Hoffman 1988, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Jones 1992b, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999b, MTNHP 2002b, NDNHI unpubl. data, Thompson and Hansen 2002, USFS 1992, Von Loh et al. 1999, Von Loh et al. 2000, Western Ecology Working Group n.d.

## *Betula occidentalis* Shrubland

## Water Birch Shrubland

| | |
|---|---|
| CODE | CEGL001080 |
| 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 | Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.) |
| ALLIANCE | *BETULA OCCIDENTALIS* SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.996)<br>Water Birch Seasonally Flooded Shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Columbia Basin Foothill Riparian Woodland and Shrubland (CES304.768)
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This shrubland occurs on stream benches and floodplains in narrow to moderately wide valleys and hillside seeps in mountains, canyons, foothills, and sheltered alcoves across much of the western U.S. Surface water is present for extended periods during the growing season. The water table, after flooding ceases, is variable, extending from saturated to well below the ground surface, but the roots of *Betula occidentalis* are always in saturated soil. Substrates are typically alluvial and range from fairly shallow, finer-textured soils to gravel and boulders. Soils usually have signs of saturation (mottles). The vegetation is characterized by a nearly continuous tall-shrub to small-tree canopy dominated by *Betula occidentalis* along the streambank. Other shrub species include *Alnus incana, Cornus sericea, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Salix* spp., *Amelanchier utahensis, Rhus trilobata, Shepherdia argentea*, and *Prunus virginiana*. Along narrow valleys at higher elevations, conifers may overhang the stream edge. Herbaceous undergrowth can be limited because of the dense shrub canopy. However, if the shrub canopy is open and the stand is on relatively well-drained yet mesic site (for example, elevated river benches), the herbaceous layer can be abundant. It is often a diverse mixture of grasses and forbs that is dominated by disturbance-induced species, including most commonly *Agrostis stolonifera, Cirsium arvense, Phleum pratense*, and *Poa pratensis*. Forb species include *Maianthemum stellatum, Heracleum sphondylium, Thalictrum fendleri*, and *Rudbeckia laciniata*. Graminoid cover is highly variable and can include *Carex utriculata, Carex pellita (= Carex lanuginosa), Carex microptera, Carex nebrascensis, Glyceria* spp., *Juncus balticus*, and introduced hay grasses. Diagnostic of this association is the *Betula occidentalis*-dominated tall-shrub layer and a

variable, weedy, mixed herbaceous undergrowth that occurs on sites that are flooded for extended periods during the growing season.

**DISTRIBUTION**

*Bryce Canyon National Park*

This tall shrubland is limited to riparian areas along streambanks and seeps, and was sampled in Jolley Hollow, on Yellow Spring, Upper Yellow Creek and along Sheep Creek.

*Globally*

This association is known from mountainous regions of many western states, the high plateaus of southern Utah, and sheltered alcoves of canyonlands of eastern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This tall-shrub association occurs on streambanks and springs. Sites are gentle to steep (2- to 27-degree slopes), occur between 2093 and 2199 m in elevation, and are oriented to all aspects. The ground surface has moderate to high cover of litter, low to moderate cover of small rocks, sparse cover of downed wood, and sparse to moderate exposure of bare soil. Soils are poorly drained and are derived from New Alluvium.

*Globally*

This shrubland occupies moderately wide stream benches and floodplains in narrow to moderately wide valleys and hillside seeps in mountains and foothills, as well as on streambanks, canyon bottoms and sheltered alcoves in the Colorado Plateau. It is found primarily along fast-moving, moderate- to high-gradient mountain and foothill streams, although in the Colorado Plateau it occurs more frequently on low-gradient perennial or intermittent streams. Elevation ranges from 910 to 2700 m (2975-6630 feet). Stands also occur along small floodplains of steep-gradient, narrow streams where the valley sideslope meets the stream edge. In high-gradient situations, the community often occurs as narrow, linear stringers where *Betula occidentalis* forms a closed canopy crowding the streambank. Broader stands occur around seeps adjacent to the stream channel, or along isolated springs on hillslopes away from the valley bottom, and on the floodplains of low-gradient streams. Surface water is present for extended periods during the growing season. After flooding ceases, the water table is variable and ranges from nearly saturated to well below the ground surface.

Soils are fairly shallow, ranging from 30 cm to greater than 60 cm, often overlying river cobbles. Most soils have a surface layer of 50-90% organic matter. Subsurface layers range from loam to sand with abundant gravel throughout the profile (Hansen et al. 1995). Skeletal layers, derived from alluvium, occur at a greater depth. In the northern range of Yellowstone National Park, soils typically have a large ash component. Stands along narrow, steep stream channels occur between large alluvial and colluvial boulders and have almost no soil development.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (39-102% cover) and is characterized by *Betula occidentalis* tall shrubs that are 2-5 m tall and provide 8-36% cover. The remaining tall shrubs present provide low to dense cover (up to 50%), and include *Cornus sericea, Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata), Acer glabrum, Quercus gambelii*, and *Salix bebbiana*. Short shrubs provide sparse to low cover (up to 13%), and include *Arctostaphylos patula, Ceanothus martinii, Purshia tridentata*, and *Rosa woodsii*. The herbaceous layer is low in terms of species composition and provides sparse cover by the graminoid *Carex interior* and the fern ally *Equisetum laevigatum*. *Pinus ponderosa, Pseudotsuga menziesii, Pinus edulis, Juniperus scopulorum, Cercocarpus ledifolius*, and *Populus angustifolia* trees provide sparse cover in the canopy layer (5-15 m tall).

*Globally*

*Betula occidentalis* forms a nearly continuous tall-shrub to small-tree canopy with 10-90% cover. Other shrub species include *Alnus incana, Cornus sericea, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Salix exigua, Salix bebbiana, Shepherdia argentea, Jamesia americana, Amelanchier utahensis, Juniperus scopulorum, Arctostaphylos patula, Ceanothus martinii, Purshia tridentata, Prunus virginiana, Rhus trilobata, Salix boothii*, and *Salix monticola*. Along narrow valleys at higher elevations, conifers may overhang the stream edge. At lower elevations, *Populus balsamifera ssp. trichocarpa, Populus tremuloides*, and other *Populus* species may be present. Conifer species present include *Pseudotsuga menziesii, Abies lasiocarpa*, and *Picea pungens*. If the shrub

canopy is dense, herbaceous undergrowth will be limited; if open, the herbaceous layer can be abundant. Herbaceous species are typically weedy or adapted to frequent disturbance. Herbaceous-rich stands generally have equal amounts of forb and graminoid cover. Forb species can include *Aquilegia micrantha, Packera multilobata (= Senecio multilobatus), Maianthemum stellatum, Heracleum sphondylium, Thalictrum fendleri, Equisetum arvense, Equisetum laevigatum, Mentha arvensis, Solidago gigantea*, and *Rudbeckia laciniata*. Graminoid species include *Calamagrostis canadensis, Poa palustris, Carex utriculata, Carex pellita (= Carex lanuginosa), Carex microptera, Carex nebrascensis, Glyceria* spp., and *Juncus balticus*. Introduced species typically present include *Cirsium arvense, Taraxacum officinale, Agrostis stolonifera*, and *Poa pratensis*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Betula occidentalis*, *Cornus sericea* |
| Short shrub/sapling | *Rosa woodsii* |
| Short shrub/sapling | *Purshia tridentata* |

*Globally*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Betula occidentalis* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Exotic/Invasive**: *Agrostis stolonifera* (invasive/exotic, Medium/Low), *Cirsium arvense* (invasive/exotic, High/Medium), *Heracleum sphondylium* (invasive/exotic), *Phleum pratense* (invasive/exotic, Medium), *Poa pratensis* (invasive/exotic, Medium), *Taraxacum officinale* (invasive/exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G4 (26-May-2004). The association is located in U- or V-shaped canyons along moderate- to high-gradient streams with gentle streambanks, floodplains, islands, and alluvial terraces in western and central Montana, northern Wyoming, and central and southern Idaho. It occurs in low-gradient situations in canyon bottoms in the Colorado Plateau of Utah and Colorado. Discontinuous linear stands are present between 915 and 1920 m (3000-6300 feet) elevation on various aspects where the water table is high and soils are of clay, silt or loam. Stand degradation is increasing as a result of threats such as alteration of stream hydrology due to the deposits of excess sedimentation from outside the stream system, road construction, livestock grazing and trailing, introduction of exotic species, and noxious weeds. However, this type is widespread in distribution and is defined to include disturbed stands, so its conservation status is unlikely to be rare.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This association is for stands that don't fit purely graminoid-dominated or forb-dominated understories of other *Betula occidentalis* associations. Stands included here generally have roughly equal amounts of forb and graminoid cover, typically of weedy or disturbance-caused species. Stands with very little herbaceous cover are also included here. It is likely that this type will be split in the future as more inventory is completed and a better review of *Betula occidentalis* associations is completed.

Hansen and Hall (2002) and Hansen et al. (1995) describe the *Betula occidentalis* community type as an early- to mid-seral community associated with disturbance. In Montana, Hansen et al. (1995) consider this type to be seral to various *Salix* spp.-dominated "habitat types," and in eastern and southern Idaho, Hansen and Hall (2002) consider it to be seral to the presence of species representing climax vegetation types. One-half of Hansen et al.'s (1995) stands include *Cornus sericea* (average canopy cover 11%) with mesic forbs included in the undergrowth. *Betula*

*occidentalis / Cornus sericea* Shrubland (CEGL001161) and *Betula occidentalis / Maianthemum stellatum* Shrubland (CEGL001162) are similar to this type but appear to have less exotic species present.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stands have become established along a narrow creek, near the spring in Yellow Spring Meadow, and on both sides of a flowing stream below an alcove.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 observation points: BRCA.9028, BRCA.9068, BRCA.9220) and 2007 Accuracy Assessment (3 points: BRCA_AA.0183, BRCA_AA.0568, BRCA_AA.0810).
*Local Description Authors:* M. Smith and J. Von Loh, mod. G. Kittel
*Global Description Authors:* G. Kittel, mod. J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, Chadde et al. 1988, Crowe and Clausnitzer 1997, Crowe et al. 2004, Driscoll et al. 1984, Evans 1989a, Hall and Hansen 1997, Hansen and Hall 2002, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Jones 1992b, Kittel and Lederer 1993, MTNHP 2002b, Manning and Padgett 1995, Padgett et al. 1989, Weixelman et al. 1996, Western Ecology Working Group n.d.

## *Gutierrezia sarothrae* Wooded Dwarf-shrubland [Park Special]

## Broom Snakeweed Wooded Dwarf-shrubland

| | |
|---|---|
| CODE | CEPS005360 |
| PHYSIOGNOMIC CLASS | Dwarf-shrubland (IV) |
| PHYSIOGNOMIC SUBCLASS | Deciduous dwarf-shrubland (IV.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous dwarf-shrubland (IV.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural cold-deciduous dwarf-shrubland (IV.B.2.N.) |
| FORMATION | Cespitose cold-deciduous dwarf-shrubland (IV.B.2.N.a.) |
| ALLIANCE (A.2528) | *GUTIERREZIA (MICROCEPHALA, SAROTHRAE)* DWARF-SHRUBLAND ALLIANCE<br><br>(Broom Snakeweed, Threadleaf Snakeweed) Dwarf-shrubland Alliance |

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This uncommon to common dwarf-shrub association was sampled on lower slopes near Tropic Trail, Bridge Hollow, and Pasture Wash within the park, as well as along Podunk Creek in the environs.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This dwarf-shrub type occurs on valley slopes. The sites are gentle to moderately steep (5- to 21-degree slopes), occur between 2108 and 2492 m in elevation, and are oriented to the east or south. The ground surface has low to moderate exposure of bare soil, low to moderate cover of litter, sparse cover of downed wood and large rocks, and moderate to high cover of small rocks. Soils are rapidly drained sandy clays, sandy clay loams, and silty clay loams derived from the Kaiparowitz Formation, the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (14-55% cover) and is characterized by the dwarf-shrub *Gutierrezia sarothrae* that provides 4-22% cover. The canopy layer includes *Pinus ponderosa, Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma* trees that provide sparse cover and attain heights between 5 and 10 m. Other shrubs present include *Chrysothamnus viscidiflorus* and *Krascheninnikovia lanata*. The herbaceous layer is floristically diverse and provides sparse to moderate cover. Common grasses include the bunch grasses *Achnatherum hymenoides, Elymus elymoides*, and *Leymus salinus* and the non-native rhizomatous grass *Bromus inermis*. The forb layer includes *Tetraneuris acaulis (= Hymenoxys acaulis), Taraxacum officinale, Artemisia ludoviciana*, and *Calylophus lavandulifolius*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Gutierrezia sarothrae* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Agropyron cristatum* (exotic, Medium/Low), *Bromus inermis* (exotic, High/Medium), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (7-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Dwarf-shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Area has been plowed into furrows, ostensibly for erosion control; hillside has been tightly compacted, possibly by grazing livestock; low, open slope and southern exposure, along with the Pink Claron gravel, seem to be the environmental factors that drive this community.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (5 plots: BRCA.0272, BRCA.0368, BRCA.0382, BRCA.0389, BRCA.0402).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland

## Crispleaf Buckwheat / Saline Wildrye Dwarf-shrubland

CODE CEGL001343

| | |
|---|---|
| PHYSIOGNOMIC CLASS | Dwarf-shrubland (IV) |
| PHYSIOGNOMIC SUBCLASS | Deciduous dwarf-shrubland (IV.B.) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic deciduous dwarf-shrubland (IV.B.3.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural extremely xeromorphic deciduous dwarf-shrubland (IV.B.3.N.) |
| FORMATION | Extremely xeromorphic deciduous subdesert dwarf-shrubland without succulents (IV.B.3.N.a.) |
| ALLIANCE | *ERIOGONUM (CORYMBOSUM, LEPTOCLADON)* DWARF-SHRUBLAND ALLIANCE (A.1126)<br>(Crispleaf Buckwheat, Sand Buckwheat) Dwarf-shrubland Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Shale Badland (CES304.789)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This association is known only from Bryce Canyon National Park. Very limited data are available. It occurs on steep, southwest-facing slopes, on eroded clay soils. Sites are extremely harsh and support few species with low coverage. The vegetation is dominated by *Eriogonum corymbosum, Atriplex canescens, Krascheninnikovia lanata, Leymus salinus (= Elymus salinus)*, and *Achnatherum hymenoides*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was observed at two Accuracy Assessment points in 2007. No local descriptive information is available at this time.

*Globally*

Data are not available.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*

Data are not available.

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G2G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (2 points: BRCA_AA.0341, BRCA_AA.0368).
*Local Description Authors:*
*Global Description Authors:* G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, Driscoll et al. 1984, Roberts et al. 1992, Western Ecology Working Group n.d.

## *Elymus lanceolatus* Herbaceous Vegetation

## Streambank Wheatgrass Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL002588 |
| 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 sod temperate or subpolar grassland (V.A.5.N.c.) |
| ALLIANCE | *ELYMUS LANCEOLATUS* HERBACEOUS ALLIANCE (A.1242)<br>Streambank Wheatgrass Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This streamside wild rye grassland occurs on rolling upland terrain in northwestern and southern Colorado, northeastern Utah and southwestern Wyoming. Stands typically occur as patches and small stands on dry to mesic habitats at elevations from 1600 to 2470 m (5250-8100 feet). Sites are located on generally level to gentle slopes, but may occur on steep slopes. Aspect is not important in determining this community. Soils are generally well-developed, fine-textured silt loams or clay loams derived from shale or eolian loess, less often from alluvium. Litter or bare soil cover much of the unvegetated ground surface. The vegetation is dominated by the perennial grass *Elymus lanceolatus*. Other grasses are generally present, usually with much less cover, and include *Hesperostipa comata, Poa fendleriana, Poa secunda, Achnatherum hymenoides, Elymus elymoides, Leymus cinereus, Pascopyrum smithii*, and *Pseudoroegneria spicata*. Exotics such as *Agropyron cristatum, Bromus inermis* and *Bromus tectorum* may be present in disturbed stands. A variety of forb species may also be present with low to moderate cover. Some of the more consistent species include *Lupinus argenteus, Silene menziesii, Agoseris glauca, Sphaeralcea coccinea*, and *Phlox* spp. Shrubs such as *Amelanchier utahensis* and *Symphoricarpos oreophilus* may occur with minimal cover. Shrubs may provide trace cover, including *Chrysothamnus viscidiflorus* and *Krascheninnikovia lanata*.

**DISTRIBUTION**
*Bryce Canyon National Park*
This association was observed once during Accuracy Assessment in 2007. No local descriptive information is available at this time.

*Globally*
This association is known from northwestern and southern Colorado, northeastern Utah and southwestern Wyoming.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*
Data are not available.

*Globally*
This grassland occurs on rolling upland terrain in northwestern Colorado, northeastern Utah and southwestern Wyoming. Stands typically occur as patches and small stands on dry to mesic habitats. This perennial grassland is found on flat to gentle slopes of valleys, benches, stream terraces and butte rims, and steeper slopes of ridges and hills. Sites are located on generally level to gentle slopes, but include slopes up to 35 degrees. Elevations range from 1600 to 2470 m (5250-8100 feet). Aspect is not important in determining this community. Soils are generally well-developed, fine-textured silt loams or clay loams, and less often coarse-textured loams, that are derived from shale or eolian loess, less often from alluvium. Litter or bare soil cover much of the unvegetated ground surface. The unvegetated surface has moderate to high exposure of bare soil, low to moderate cover of small and large rocks, and moderate to low cover of litter.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This association is dominated by the perennial grass *Elymus lanceolatus*. Other grasses are generally present, usually with much less cover, and include *Hesperostipa comata, Poa fendleriana, Poa secunda, Achnatherum hymenoides, Elymus elymoides, Leymus cinereus, Pascopyrum smithii*, and *Pseudoroegneria spicata*. Non-native grasses *Agropyron cristatum, Bromus inermis*, and *Bromus tectorum* may be common in disturbed stands. A variety of forb species may also be present with low to moderate cover. Some of the more consistently present species include *Achillea millefolium, Agoseris glauca, Astragalus jejunus, Comandra umbellata, Eriogonum brevicaule, Iva axillaris, Linum lewisii, Lupinus argenteus, Packera cana (= Senecio canus), Phlox hoodii, Silene menziesii, Sphaeralcea coccinea*, and non-natives *Ceratocephala testiculata (= Ranunculus testiculatus), Melilotus officinalis*, and *Taraxacum officinale*. Occasional shrubs, such as *Amelanchier utahensis, Artemisia arbuscula ssp. longiloba, Atriplex gardneri, Chrysothamnus viscidiflorus, Krascheninnikovia lanata, Symphoricarpos oreophilus*, and *Tetradymia canescens*, may occur with minimal cover.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Astragalus jejunus* (globally vulnerable, G3); **Exotic/Invasive**: *Agropyron cristatum* (invasive/exotic, Medium/Low), *Bromus inermis* (invasive/exotic, High/Medium), *Bromus tectorum* (invasive/exotic, High), *Ceratocephala testiculata* (invasive/exotic), *Melilotus officinalis* (invasive/exotic, Medium/Low), *Taraxacum officinale* (invasive/exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (7-Apr-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Rhizomatous *Elymus lanceolatus* can easily be confused with the bunchgrass *Pseudoroegneria spicata*, especially in disturbed areas or on steep slopes, where bunches can spread out. It is also difficult to distinguish reliably from the

hybrid of the two species, *Elymus albicans*, which is prevalent east of the Continental Divide but which also occurs at Dinosaur National Monument. Further work is necessary to clarify the ranges and habitats of the three grasses so that *Elymus lanceolatus* Herbaceous Vegetation (CEGL002588) can be readily distinguished from *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660).

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0271).
*Local Description Authors:*
*Global Description Authors:* J. Coles, mod. K.A. Schulz

**REFERENCES:** Western Ecology Working Group n.d.

## *Pascopyrum smithii* Herbaceous Vegetation

## Western Wheatgrass Herbaceous Vegetation

## Western Wheatgrass Mixedgrass Prairie

| | |
|---|---|
| CODE | CEGL001577 |
| 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 sod temperate or subpolar grassland (V.A.5.N.c.) |
| ALLIANCE | *PASCOPYRUM SMITHII* HERBACEOUS ALLIANCE (A.1232)<br>Western Wheatgrass Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):**
Central Mixedgrass Prairie (CES303.659)
Northwestern Great Plains Mixedgrass Prairie (CES303.674)
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, Colorado Plateau, and the interior western United States and Canada at elevations from 600-3000 m (1960-9850 feet). Stands occur on level to gently sloping terrain. They are found on alluvial fans, swales, river terraces, floodplains, valley floors and basins. The soils are typically clay, clay loam, and silt loam but may include sand or loamy sand. *Pascopyrum smithii* strongly dominates the open to dense (15-100% cover) mixedgrass herbaceous layer that grows 0.5-1 m tall. Other graminoids that co-occur and may achieve local dominance are *Koeleria macrantha, Eleocharis palustris*, and *Poa* spp. Many other species common in midgrass prairies and other grasslands are also found in this community, including *Artemisia ludoviciana, Eriogonum* spp., *Bouteloua gracilis, Nassella viridula*, and *Hesperostipa comata (= Stipa comata)*. Shrubs and dwarf-shrubs are rare in this community, but occasional woody plants, such as *Artemisia tridentata, Symphoricarpos* spp., *Ericameria nauseosa*, or *Krascheninnikovia lanata*, may be present. Introduced species, such as *Bromus tectorum, Bromus inermis, Poa pratensis, Melilotus* spp. or *Cirsium arvense*, are common in some stands, especially where disturbed.

**DISTRIBUTION**
*Bryce Canyon National Park*
This grassland has limited distribution, occurs on deep soil of a valley floor, and was sampled on the Sheep Creek Flats.

*Globally*

This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, intermountain western United States and Canada, ranging from North Dakota and Saskatchewan, south to Nebraska and Colorado, and west to northern Arizona, Utah and Idaho.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This mesic herbaceous association occurs on a valley floor. The site is gentle (4-degree slope), occurs at 2062 m in elevation, and is oriented to the southwest. The ground surface has high exposure of bare soil and low cover of litter. Soils are rapidly drained silty clay loams derived from New Alluvium.

*Globally*

This grassland association is widespread in the northern and western Great Plains of the U.S. and Canada, Rocky Mountains, Colorado Plateau, and the intermountain western United States. Elevation ranges from 600-3000 m. Stands occur on level to gently sloping terrain. They are found on alluvial fans, swales, river terraces, floodplains, valley bottoms and basins. The soils are typically deep (40-100 cm), slightly alkaline and well-developed with clay, clay loam, and silt loam textures, but also coarser textures such as sand and loamy sand. Some stands occur on perched water tables. Parent materials include Quaternary landslide deposits, volcanic rocks, sandstones and shale that have eroded and deposited as secondary stream alluvium.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (42% cover) and is characterized by the rhizomatous grass *Pascopyrum smithii* that provides 23% cover. *Pinus edulis* and *Juniperus osteosperma* canopy trees have become established in the stand and provide sparse cover. Short and dwarf-shrubs *Artemisia tridentata ssp. vaseyana, Atriplex canescens*, and *Krascheninnikovia lanata* may be present with sparse cover. The remaining graminoid layer is moderately diverse in terms of species composition, provides low cover, and includes *Pleuraphis jamesii, Pseudoroegneria spicata (= Elymus spicatus), Hesperostipa comata*, and *Bouteloua gracilis*. The forb layer is low in terms of floristic diversity, provides sparse cover, and includes *Sphaeralcea coccinea* and *Calochortus nuttallii*.

*Globally*

This association is characterized by an open to dense (15-100% cover) mixedgrass herbaceous layer that grows 0.5-1 m tall and is strongly dominated by *Pascopyrum smithii*. Herbaceous cover may be significantly less on drier sites or after scarce cool-season precipitation. Other graminoids that co-occur and may achieve local dominance are *Bouteloua gracilis, Distichlis spicata, Eleocharis palustris, Koeleria macrantha*, and *Sporobolus airoides*. Many other species common in prairies and other grasslands are also found in this community, including *Achnatherum lettermanii, Achillea millefolium, Artemisia frigida, Artemisia ludoviciana, Bouteloua curtipendula, Carex* spp., *Eriogonum* spp., *Hesperostipa comata (= Stipa comata), Juncus balticus, Lupinus argenteus, Nassella viridula, Pleuraphis jamesii, Pseudoroegneria spicata (= Elymus spicatus), Poa fendleriana, Poa secunda, Schizachyrium scoparium*, and *Solidago* sp. Shrubs and dwarf-shrubs are rare in this community, but occasional woody plants, such as *Artemisia arbuscula ssp. longiloba, Artemisia tridentata, Artemisia tridentata ssp. vaseyana, Atriplex canescens, Ericameria nauseosa, Krascheninnikovia lanata, Rhus trilobata*, or *Symphoricarpos* spp., may be present. Introduced species, such as *Agropyron cristatum, Cirsium arvense, Bromus japonicus, Bromus tectorum, Ceratocephala testiculata, Conyza canadensis, Iva axillaris, Lactuca serriola, Melilotus* spp., *Poa pratensis, Salsola kali, Sisymbrium altissimum*, and *Taraxacum officinale*, are common in some stands, especially where disturbed.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Pascopyrum smithii*, *Pleuraphis jamesii* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Pascopyrum smithii* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

Data are not available.

*Globally*
**Exotic/Invasive**: *Agropyron cristatum* (exotic, Medium/Low), *Bromus japonicus* (exotic), *Bromus tectorum* (exotic, High), *Ceratocephala testiculata* (exotic), *Cirsium arvense* (exotic noxious weed, High/Medium), *Conyza canadensis* (introduced), *Iva axillaris* (introduced), *Lactuca serriola* (exotic, Low/Insignificant), *Poa pratensis* (exotic, Medium), *Salsola kali* (exotic), *Sisymbrium altissimum* (exotic), *Taraxacum officinale* (exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G5Q (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland.

*Globally*
This community is similar to several others that are dominated or codominated by *Pascopyrum smithii*. As currently defined, it represents a western Great Plains and foothills version of the western wheatgrass types in the central Great Plains. Further work needs to be done to refine the differences in composition and environmental characteristics. See recent descriptions by Thilenius et al. (1995) (*Pascopyrum smithii* sodgrass steppe, a more playa-like wheatgrass type) and by Steinauer and Rolfsmeier (2000). In Nebraska, Steinauer and Rolfsmeier (2000) suggest that their stands may resemble *Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation (CEGL001583). In Alberta, this association is clearly dominated by dense, nearly pure stands of *Pascopyrum smithii* and tends to occur in depressions in areas of fine-textured saline soils with a hardpan layer. The hardpan holds rain and spring runoff.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Grassland is located in a narrow side valley with a relatively flat alluvial floor composed of deep, fine soils; shallow drainage gully along the southeast edge of the valley is thoroughly vegetated with grass.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: Plots: BRCA.0321).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Drake, mod. K.A. Schulz and J. Coles

**REFERENCES:** ANHIC n.d., Aldous and Shantz 1924, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bell et al. 2009, Bourgeron and Engelking 1994, Bunin 1985, CONHP unpubl. data 2003, Christensen and Welsh 1963, Driscoll et al. 1984, FEIS 2001, Godfread 1994, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, Hansen et al. 2004c, Hansen et al. 2004d, IDCDC 2005, Jones and Walford 1995, MTNHP 2002b, Marr and Buckner 1974, Ramaley 1916b, Ramaley 1919b, Ramaley 1942, Shanks 1977, Soil Conservation Service 1978, Steinauer and Rolfsmeier 2000, TNC 1998d, TNC 1998e, Thilenius et al. 1995, Thompson and Hansen 2002, Von Loh 2000, Vujnovic and Bentz 2001, Western Ecology Working Group n.d.

## *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**

*Bryce Canyon National Park*

This semi-arid grassland is unusual and was sampled on the floors of two valleys west of Ponderosa Canyon and in Bridge Hollow.

*Globally*

This association occurs in Nevada and Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This unusual grassland association occurs on valley floors. The sites are gentle (2- to 3-degree slopes), occur between 2444 and 2584 m in elevation, and are oriented to the west or northwest. The ground surface has high exposure of bare soil and low cover of litter. Soils are rapidly drained silty loams or silty clay loams derived from New Alluvium.

*Globally*

Data are not available.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (31-43% cover) and is characterized by the bunchgrass *Achnatherum lettermanii* that provides 12-13% cover. *Pinus ponderosa* and *Picea pungens* trees provide sparse cover in the canopy layer of one plot, attaining heights between 5 and 10 m tall. Short and dwarf-shrubs are low in terms of floristic diversity, provide sparse cover, and include *Chrysothamnus viscidiflorus, Ericameria parryi (= Chrysothamnus parryi)*, and *Chrysothamnus vaseyi*. The remaining graminoid layer is moderate in terms of floristic diversity, provides low cover, and includes *Koeleria macrantha, Carex praegracilis*, non-native *Poa pratensis*, and *Poa fendleriana*. Forbs are diverse, provide sparse cover, and typically include *Antennaria rosulata* and *Antennaria parvifolia*. In one plot, *Potentilla concinna* provides low to moderate cover (17% cover).

*Globally*

Data are not available.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Potentilla concinna* |
| Herb (field) | *Achnatherum lettermanii*, *Koeleria macrantha* |

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (3-Mar-2008).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland; 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 *Achnatherum lettermanii* 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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terrain is a narrow valley with a flat bottom; some grasses have been grazed; pocket gopher activity.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0293, BRCA.0384) and 2007 Accuracy Assessment (1 point: BRCA_AA.0772).
*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.

## *Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata)* Semi-natural Herbaceous Vegetation

## Crested Wheatgrass - (Western Wheatgrass, Needle-and-Thread) Semi-natural Herbaceous Vegetation

## Crested Wheatgrass Semi-natural Grassland

| | |
|---|---|
| CODE | CEGL005266 |
| 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 | *AGROPYRON CRISTATUM* SEMI-NATURAL HERBACEOUS ALLIANCE (A.3563) Crested Wheatgrass Semi-natural Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This crested wheatgrass association occurs most commonly in the northern Great Plains of the United States and Canada. Sites are also reported from the southern Rocky Mountains and Colorado Plateau, and high plateaus of southern Utah, and it likely occurs throughout much of the semi-arid interior West. Stands occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and western rangelands. The vegetation is characterized by a sparse to dense, medium-tall graminoid layer

dominated by *Agropyron cristatum*, an introduced forage species from Russia and Siberia that has been planted extensively in the western United States. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (= )*, as well as others. In the Intermountain West, native grasses *Poa secunda* and *Pseudoroegneria spicata* may be present at low cover.

**DISTRIBUTION**

*Bryce Canyon National Park*

This semi-arid seeded grassland was sampled on valley floors adjacent to the park boundary, near Yellow Creek and in the environs adjacent to the park boundary in Shinglemill Swale.

*Globally*

This community occurs in the northern Great Plains of the United States and Canada and from the southern Rocky Mountains and Colorado Plateau, and it likely occurs throughout much of the semi-arid interior West.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This semi-natural grassland occurs on valley floors. Sites are flat or gentle (0- to 3-degree slopes), occur between 2045 and 2310 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. Soils are rapidly drained loams or silty clay loams derived from older alluvium.

*Globally*

This grassland occurs in the northern Great Plains, southern Rocky Mountains, Colorado Plateau and likely occurs throughout much of the semi-arid interior West. This type can occur in a wide variety of human-disturbed habitats, including railroad and highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and western rangelands. Substrates are variable but tend to be loamy or finer-textured soils such as silt or clay loams.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to moderate (24-42% cover) and is characterized by the non-native bunchgrass *Agropyron cristatum* that provides 7-20% cover. The remaining graminoid layer provides low to moderate cover and includes *Psathyrostachys juncea (= Elymus junceus)* that provides 30% cover on one site and the non-native rhizomatous grass *Bromus inermis* that provides 10-16% cover. Short and dwarf-shrubs are low in terms of species composition, provide sparse cover, and include *Atriplex canescens, Ericameria nauseosa*, and *Gutierrezia sarothrae*. The remaining herbaceous species are low in terms of floristic diversity, provide low cover, and include the forbs *Sphaeralcea coccinea, Melilotus officinalis*, and *Leptodactylon pungens*.

*Globally*

The vegetation is characterized by an open to dense, medium-tall (0.5-1 m) graminoid layer dominated by *Agropyron cristatum*, an introduced forage species from Russia and Siberia that has been planted extensively in the northwestern Great Plains and to a lesser extent in the interior western U.S. such as on the Colorado Plateau. It has also been used to revegetate disturbed areas and has expanded into natural vegetation communities. Other species present are often introduced or weedy and include annuals *Bromus japonicus, Bromus tectorum, Helianthus annuus*, and *Sisymbrium altissimum*, and perennials *Bromus inermis, Convolvulus arvensis, Descurainia sophia, Linaria vulgaris, Melilotus officinalis, Poa pratensis, Psathyrostachys juncea (= Elymus junceus)*, and *Verbascum thapsus*. Remnant native species generally have less than 10% cover and include *Bouteloua gracilis, Nassella viridula, Pascopyrum smithii*, and *Hesperostipa comata* in mixed-grass prairie, and *Poa secunda, Pseudoroegneria spicata*, and *Leptodactylon pungens* in intermountain regions. Short and dwarf-shrubs may provide sparse cover in some stands and include *Atriplex canescens, Ericameria nauseosa*, and *Gutierrezia sarothrae*.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Agropyron cristatum*, *Bromus inermis*, *Psathyrostachys juncea* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Agropyron cristatum* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Agropyron cristatum* (exotic, Medium/Low), *Bromus inermis* (exotic, High/Medium), *Melilotus officinalis* (exotic, Medium/Low), *Psathyrostachys juncea* (exotic, Low/Insignificant)

*Globally*
**Exotic/Invasive**: *Agropyron cristatum* (exotic, Medium/Low), *Bromus inermis* (exotic, High/Medium), *Bromus japonicus* (exotic), *Bromus tectorum* (exotic, High), *Convolvulus arvensis* (exotic, Medium/Low), *Descurainia sophia* (exotic, Medium/Low), *Helianthus annuus* (weedy native), *Linaria vulgaris* (exotic, High/Low), *Melilotus officinalis* (exotic, Medium/Low), *Poa pratensis* (exotic, Medium), *Psathyrostachys juncea* (exotic, Low/Insignificant), *Sisymbrium altissimum* (exotic), *Verbascum thapsus* (exotic, Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNA (invasive) (17-Jun-1999). This is a naturalized type from Europe, widely planted to revegetate roadsides and pastures.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland.

*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.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Outside the park boundary, the community has higher cover of non-native species and shows signs of heavier livestock grazing than stands within the park; plant species diversity is low compared to similar environmental conditions within park-protected areas; stand extends 50 m inside park boundary from origins outside the park, area outside boundary artificially seeded.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0119, BRCA.0121; and 1 observation point: BRCA.9267).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* D. Faber-Langendoen, mod. K.A. Schulz

**REFERENCES:** Butler et al. 2002, Hansen et al. 1984, MTNHP 2002b, Midwestern Ecology Working Group n.d., NDNHI unpubl. data, Peterson 2008, Salas and Pucherelli 2002a, Von Loh et al. 2000

## *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)<br>Smooth Brome Semi-natural Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Southern 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**

*Bryce Canyon National Park*

This semi-natural herbaceous association was sampled along East Creek and at the confluence of Podunk and Sevier creeks within the park and in the Podunk Creek drainage in the environs.

*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**

*Bryce Canyon National Park*

This mesic semi-natural grassland is moderately common where disturbance related to agriculture and grazing occurs and where runoff is sufficient for *Bromus inermis* to spread and maintain. This semi-natural grassland occurs on valleysides and hillslopes. The sites are flat to moderately steep (0- to 11-degree slopes), occur between 2374 and 2481 m in elevation, and are oriented to the west. The ground surface has moderate to high exposure of bare soil, low to moderate cover of litter, and sparse to low cover of small and large rocks. Soils are well-drained to rapidly drained loams, silty clays, or silty clay loams derived from New Alluvium.

*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**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (34-68% cover) and is characterized by the non-native rhizomatous grass *Bromus inermis* that provides 18-60% cover. Short and dwarf-shrubs present provide sparse cover and include *Chrysothamnus viscidiflorus, Artemisia nova*, and *Gutierrezia sarothrae*. The remaining graminoid layer is low in terms of floristic diversity, provides low cover, and includes non-native rhizomatous grasses *Poa pratensis* and

*Thinopyrum intermedium (= Elymus hispidus)* and native *Juncus balticus*. Forb cover is sparse and includes *Taraxacum officinale, Antennaria microphylla, Antennaria rosulata*, and *Tragopogon dubius*.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Bromus inermis*, *Juncus balticus* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Bromus inermis*, *Pascopyrum smithii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Thinopyrum intermedium* (exotic, Medium/Insignificant), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
**Exotic/Invasive**: *Bromus inermis* (invasive, High/Medium), *Cirsium arvense* (exotic, High/Medium), *Poa pratensis* (invasive, Medium)

**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**
*Bryce Canyon National Park*
Grassland; wooded wetland.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Near a canal of standing water with algae, area is wet and has moss on the exposed bare ground; heavily grazed area (by cattle); site has been plowed and seeded.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0059, BRCA.0079, BRCA.0271).
*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 unpubl. data, Salas and Pucherelli 2002a, Trammel and Butler 1995, Von Loh et al. 2000

## *Hesperostipa comata* Great Basin Herbaceous Vegetation

### Needle-and-Thread Great Basin Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL001705 |
| 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 | *HESPEROSTIPA COMATA* BUNCH HERBACEOUS ALLIANCE (A.1270)<br>Needle-and-Thread Bunch Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This semi-arid grassland occurs on the Great Basin and Colorado Plateau and high plateaus of southern Utah, east into the western slope of the southern Rocky Mountains. Stands are found on a variety of sites, such as on point bars, stream terraces, in sand-filled potholes in slickrock washes, on plains, valleys, canyon floors, gentle hillslopes, knolls and bluffs, mesatops, and plateau parks. Sites are generally flat to gently sloping, but occasionally are steep (to 53% slope). Soils are variable and range from sand to silty clay. The unvegetated surface has moderate to high cover of bare soil with sparse to moderate cover of litter. Biological soil crusts are often present with low cover. The vegetation is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) that is strongly dominated by the medium-tall, cool-season bunchgrass *Hesperostipa comata*, but it may also include stands with less than 10% total vegetation cover. Low cover of other grasses, such as *Achnatherum hymenoides, Achnatherum lettermanii, Aristida purpurea, Elymus elymoides, Koeleria macrantha, Leymus salinus, Pleuraphis jamesii, Poa fendleriana*, or *Sporobolus cryptandrus*, may be present. However, *Bouteloua eriopoda* is not present. Forb cover ranges from sparse to moderate and may be diverse. Associated forbs include *Balsamorhiza sagittata, Hymenopappus filifolius, Machaeranthera canescens, Sphaeralcea coccinea, Vicia americana*, and species of *Antennaria, Astragalus, Cryptantha, Eriogonum, Gilia*, and *Lappula*. Scattered shrubs and dwarf-shrubs may present with less than 5% total cover. Common species include *Artemisia tridentata, Chrysothamnus viscidiflorus, Ericameria nauseosa, Gutierrezia sarothrae, Krascheninnikovia lanata, Opuntia polyacantha*, and *Symphoricarpos oreophilus*. The widespread introduced annual grass *Bromus tectorum* often contributes significant cover in disturbed stands. Some stands have high cover of biological soil crusts.

**DISTRIBUTION**

*Bryce Canyon National Park*

This bunchgrass grassland is uncommon and occurs on semi-arid slopes and plateau tops, and was sampled west of Aqua Canyon and near the Tropic Trailhead. It was also observed at five Accuracy Assessment points in 2007.

*Globally*

This grassland is found on the west slope of the Colorado Rocky Mountains, on the Colorado Plateau and in the Great Basin in Colorado and Utah, and probably occurs in adjacent states.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This bunchgrass grassland occupies ridges and valleys. The sites are gentle (2- to 3-degree slopes), occur between 2027 and 2683 m in elevation, and are oriented to the south. The ground surface has moderate to high exposure of bare soil, no to moderate cover of litter, and sparse cover of downed wood. Soils are rapidly drained clay loams and silty clay loams derived from Tropic Shale.

*Globally*
This grassland occurs on the Great Basin and Colorado Plateau east into the western slope of the southern Rocky Mountains. Stands are found a variety of sites, such as on point bars, stream terraces, in sand-filled potholes in slickrock washes, on plains, valleys, canyon floors, gentle hillslopes, knolls and bluffs, mesatops, and plateau parks. Sites are generally flat to gently sloping, but occasionally are steep (to 53% slope). Elevation ranges from 1250-2683 m. The unvegetated surface has moderate to high cover of bare soil with sparse to moderate cover of litter. Biological soil crusts are often present with low cover. Soils are variable and include sand, cobbles, sandy, silt and clay loams and silty clay. Common parent materials are sandstones and shale that have been eroded and redistributed in alluvial and eolian deposits, but include Tertiary volcanic rocks. Fires may be important in maintaining these grasslands by reducing woody cover, but burning during the growing season could also damage *Hesperostipa comata* plants.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (16-39% cover) and is characterized by the medium-tall bunchgrass *Hesperostipa comata* that provides 5-22% cover. Shrubs, when present, are much shorter in stature than the tall grass, provide sparse to low cover, and include *Purshia tridentata, Chrysothamnus depressus, Krascheninnikovia lanata, Artemisia tridentata ssp. tridentata*, and *Ribes cereum*. The remaining graminoid layer is moderately diverse floristically, provides low cover, and includes the non-native rhizomatous grass *Poa pratensis*, native bunch grasses *Koeleria macrantha, Leymus salinus*, and *Achnatherum lettermanii*, and the non-native annual *Bromus tectorum*. Forbs are uncommon, provide sparse cover, and include *Sphaeralcea coccinea* and *Tragopogon dubius*.

*Globally*
This association is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) that is strongly dominated by the medium-tall, cool-season bunchgrass *Hesperostipa comata*, but it may also include stands with less than 10% total vegetation cover. Low cover of other grasses, such as *Achnatherum hymenoides, Achnatherum lettermanii, Aristida purpurea, Elymus elymoides, Koeleria macrantha, Leymus salinus, Pleuraphis jamesii, Poa fendleriana, Poa secunda, Sporobolus airoides*, or *Sporobolus cryptandrus*, may be present. However, *Bouteloua eriopoda* is not present. Forb cover ranges from sparse to moderate and may be diverse. Associated species include *Artemisia campestris, Artemisia dracunculus, Artemisia ludoviciana, Balsamorhiza sagittata, Cirsium arizonicum, Cryptantha crassisepala, Hymenopappus filifolius, Machaeranthera canescens, Sphaeralcea coccinea, Vicia americana*, and species of *Antennaria, Astragalus, Eriogonum, Gilia*, and *Lappula*. Scattered shrubs and dwarf-shrubs may present with less than 5% total cover. *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. vaseyana, Atriplex canescens, Chrysothamnus depressus, Chrysothamnus viscidiflorus, Ericameria nauseosa, Gutierrezia sarothrae, Krascheninnikovia lanata, Opuntia polyacantha, Purshia tridentata, Ribes cereum*, and *Symphoricarpos oreophilus* have been reported from this grassland. The widespread introduced annual grass *Bromus tectorum* often contributes significant cover in disturbed stands. Several other exotic species may be present to abundant and include *Salsola tragus, Bassia scoparia (= Kochia scoparia), Poa pratensis, Sisymbrium altissimum*, and *Tragopogon dubius*. Some stands have high cover of cryptogams on the soil, including *Collema tenax, Tortula ruralis, Buellia papillata*, and *Fulgensia bracteata* (Kleiner and Harper 1977).

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Krascheninnikovia lanata* |
| Herb (field) | *Hesperostipa comata* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Hesperostipa comata* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*

**Exotic/Invasive**: *Bromus tectorum* (exotic, High), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
**Vulnerable**: *Arabis crandallii* (globally imperiled, G2G3), *Astragalus anisus* (globally imperiled, G2G3), *Cirsium arizonicum* (UT state -vulnerable, G5); **Exotic/Invasive**: *Bassia scoparia* (exotic, Low), *Bromus tectorum* (exotic, High), *Poa pratensis* (exotic, Medium), *Salsola tragus* (exotic), *Sisymbrium altissimum* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G2G4 (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland; dwarf-shrubland.

*Globally*
This association is composed of relatively pure *Hesperostipa comata* grasslands in the Intermountain West. The similar associations are distinguished by the codominance by other grass species or a shrub layer.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Community inhabits a broad, flat ridgetop with deeper, finer soils than the forested areas on the ridge slopes.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0110, BRCA.0372) and 2007 Accuracy Assessment (5 points: BRCA_AA.0040, BRCA_AA.0045, BRCA_AA.0051, BRCA_AA.0382. BRCA_AA.0801).
*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, Coles pers. comm., Daubenmire 1970, Driscoll et al. 1984, FEIS 1998, Kleiner 1968, Kleiner 1983, Kleiner and Harper 1977, Peterson 2008, Thilenius et al. 1995, Western Ecology Working Group n.d.

## *Poa fendleriana* Herbaceous Vegetation

### Muttongrass Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL001925 |
| 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 FENDLERIANA* HERBACEOUS ALLIANCE (A.1336)<br>Muttongrass Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This herbaceous association was observed on lower slopes of hills and midslopes of ridges and mesas in western Colorado, eastern and southern Utah and is likely more widespread. Sites are flat, moderately steep to steep (11-55% slopes), occur between 2339 to 2700 m elevation, and include all aspects. The unvegetated surface has sparse to low cover of litter and low to high cover by large and small rocks and exposures of bare soil. Parent materials are Tertiary volcanic rocks that have eroded to colluvium or talus on slopes. Soils are rapidly drained and texturally range from loamy sand to sandy clay loam and sandy loam. This sparsely to moderately vegetated grassland is characterized by the bunchgrass *Poa fendleriana* that provides from up to 25% cover. The herbaceous layer is often diverse and may include low cover of graminoids such as *Achnatherum pinetorum, Agropyron cristatum, Bouteloua*

*gracilis, Bromus tectorum*, and *Elymus elymoides*. Forbs commonly present include *Antennaria dimorpha, Eriogonum umbellatum, Lepidium montanum, Phlox hoodii, Senecio spartioides var. multicapitatus (= Senecio multicapitatus)*, and *Sphaeralcea parvifolia*. Scattered tall, short and dwarf-shrubs may be present, such as *Artemisia frigida, Chrysothamnus depressus, Fraxinus anomala, Gutierrezia sarothrae, Krascheninnikovia lanata, Mahonia fremontii*, and *Purshia tridentata*. Cryptogam cover is sparse for all sampled stands.

**DISTRIBUTION**

*Bryce Canyon National Park*

This short bunchgrass grassland has limited distribution and was sampled in meadows on two plateau tops and on a valley floor, near Farview Point and the Paria Viewpoint.

*Globally*

This herbaceous association was observed on lower slopes of hills and midslopes of ridges and mesas in western Colorado and eastern Utah and is likely more widespread.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This herbaceous association occurs on plateaus and valley floors. Sites are flat to gently sloped (0- to 3-degree slopes) and occur between 2443 and 2691 m in elevation. The ground surface has moderate to high exposure of bare soil, low to moderate cover of litter, no to low cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained silty clay loams derived from the Claron Formation (White Member) and formed in New Alluvium.

*Globally*

This herbaceous association was observed on lower slopes of hills and midslopes of ridges and mesas. Sites occur on moderately steep to steep (11-55%) slopes between 1750 and 2700 m elevation and include all aspects. The unvegetated surface has sparse to low cover of litter and low to high cover by large and small rocks and exposures of bare soil. Parent materials are Tertiary volcanic rocks that have eroded to colluvium or talus on slopes or sandstones that have been eroded to alluvium. Soils are well- to rapidly drained and texturally range from loamy sand to sandy clay loam and sandy loam. The cryptogamic soil community provides low cover.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (35-52% cover) and is characterized by the short bunchgrass *Poa fendleriana* that provides 7-15% cover. *Pinus ponderosa* and *Pseudotsuga menziesii* canopy trees provide sparse cover and attain heights between 5 and 10 m tall in plateau stands. Short and dwarf-shrubs present include *Chrysothamnus depressus, Chrysothamnus viscidiflorus, Ribes cereum, Ceanothus martinii*, and *Symphoricarpos oreophilus*. The remaining graminoid layer is moderate in terms of floristic diversity, provides low cover, and includes *Hesperostipa comata, Koeleria macrantha, Carex rossii*, and *Poa secunda*. The forb layer is floristically diverse, provides low to moderate cover, and includes *Balsamorhiza sagittata, Potentilla crinita, Taraxacum officinale*, and *Erigeron flagellaris*. *Abies concolor* and *Pseudotsuga menziesii* saplings provide sparse cover.

*Globally*

This herbaceous association is characterized by a sparse to moderately dense herbaceous layer (5-40% total cover) that is typically dominated by the bunchgrass *Poa fendleriana* that provides from up to 25% cover. The herbaceous layer is often diverse and may include graminoids that provide low cover of *Achnatherum pinetorum, Agropyron cristatum, Bouteloua gracilis, Bromus tectorum*, and *Elymus elymoides*. Forbs commonly present include *Antennaria dimorpha, Eriogonum umbellatum, Lepidium montanum, Phlox hoodii, Senecio spartioides var. multicapitatus (= Senecio multicapitatus)*, and *Sphaeralcea parvifolia*. Scattered tall, short and dwarf-shrubs may be present, such as *Artemisia frigida, Chrysothamnus depressus, Fraxinus anomala, Gutierrezia sarothrae, Krascheninnikovia lanata, Mahonia fremontii*, and *Purshia tridentata*. The cryptogamic soil community provides low cover and includes dark cyanobacteria, moss, *Collema* sp., and *Fulgensia* sp.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Balsamorhiza sagittata*, *Potentilla crinita* |

| | |
|---|---|
| Herb (field) | *Koeleria macrantha*, *Poa fendleriana* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Poa fendleriana* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Taraxacum officinale* (exotic)

*Globally*
**Exotic/Invasive**: *Agropyron cristatum* (invasive/exotic, Medium/Low), *Bromus tectorum* (invasive/exotic, High)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GU (23-Feb-1994).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland.

*Globally*
Data from Loder (1964) and Olgeirson (1972, 1974) indicate that this association may also occur in the subalpine/alpine zones. The data contained in these references do not give enough information to say for certain that this is a valid association. More field inventories are needed.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Natural opening with no signs of recent fire; no stumps or logs present; the meadow is being invaded by white fir seedlings and saplings; limestone rocks are scattered throughout the meadow; deep fine soils of valley floor, some invasion by ponderosa pine saplings along stand margins.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0213, BRCA.0233, BRCA.0237).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Loder 1964, Olgeirson 1972, Olgeirson 1974, Western Ecology Working Group n.d.

## *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)<br>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**

*Bryce Canyon National Park*

This semi-natural mesic grassland was sampled only on valley floors near Fairyland Point and along the East Fork of the Sevier River, and in similar settings elsewhere in the park at seven Accuracy Assessment points in 2007.

*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**

*Bryce Canyon National Park*

This semi-natural herbaceous association occurs on valley floors along streambanks. Sites are flat and occur between 2331 and 2396 m in elevation. The ground surface has moderate to high exposure of bare soil and low cover of litter. Soils are well-drained clays derived from New Alluvium.

*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**

*Bryce Canyon National Park*

Total vegetation cover is dense (61-85% cover) and is characterized by the non-native rhizomatous grass *Poa pratensis* that provides 30-35% cover. The remaining graminoid layer is low to moderate in terms of species composition, provides low to moderate cover, and includes the non-native rhizomatous grass *Bromus inermis* and the native graminoids *Juncus balticus, Carex utriculata*, and *Koeleria macrantha*. The forb layer is moderate in terms of floristic diversity, provides low cover, and includes *Melilotus* sp., *Machaeranthera canescens, Artemisia ludoviciana, Achillea millefolium*, and *Tragopogon dubius*. Short shrub *Salix* sp. provides sparse cover on one site.

*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**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Juncus balticus*, *Poa pratensis* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Poa pratensis* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
**Exotic/Invasive**: *Poa pratensis* (invasive, Medium), *Taraxacum officinale* (exotic)

**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**
*Bryce Canyon National Park*
Grassland.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Soils are deep and fine in this low valley or swale; soil moisture is higher here due to the slightly lower elevation than along the margins of the meadow; site is grazed by cattle, observation characterizes vegetation on the bank of Sevier River.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plo: BRCA.0102; and 1 observation point: BRCA.9050) and 2007 Accuracy Assessment (7 points: BRCA_AA.0178, BRCA_AA.0205, BRCA_AA.0206, BRCA_AA.0208, BRCA_AA.0492, BRCA_AA.0612, BRCA_AA.1134).
*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 unpubl. data, Trammell 1994, USFS 1937, Von Loh et al. 1999, Von Loh et al. 2000

## *Carex utriculata* Herbaceous Vegetation

## Northwest Territory Sedge Herbaceous Vegetation

## Beaked Sedge Wet Meadow

| | |
|---|---|
| CODE | CEGL001562 |
| 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 (ROSTRATA, UTRICULATA)* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1403)<br>(Beaked Sedge, Northwest Territory Sedge) Seasonally Flooded Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):**
Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
North American Arid West Emergent Marsh (CES300.729)
Northern Columbia Plateau Basalt Pothole Pond (CES304.058)
Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
Rocky Mountain Subalpine-Montane Fen (CES306.831)
Temperate Pacific Freshwater Emergent Marsh (CES200.877)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**

*Globally*

This herbaceous wetland association is found throughout much of the western U.S. Stands occur in montane and subalpine areas around the edges of lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains. Sites are flat to undulating, often with a hummocky microtopography. The water table is usually near the surface for most of the growing season. There are a wide variety of soil types for this association. The vegetation is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex utriculata* (20-99% cover). Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* species present include *Carex aquatilis, Carex canescens, Carex lenticularis, Carex aquatilis*, and *Carex microptera*, but usually with low cover. Other graminoid species that may be present include *Calamagrostis canadensis, Eriophorum angustifolium, Glyceria striata*, and *Juncus balticus*. The sparse forb cover can include *Geum macrophyllum, Fragaria virginiana, Mentha arvensis*, and *Mimulus guttatus*. Scattered *Salix* spp. shrubs may be present because these riparian shrublands are often adjacent. *Salix* species vary depending on elevation and geography. This association is distinguished from *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803) by the dominance of *Carex utriculata*. *Carex aquatilis*, if present, is not more than one-third of the total cover.

**DISTRIBUTION**

*Bryce Canyon National Park*

This palustrine wetland association occurs in saturated and flooded soils of valley bottoms, and was sampled in Oak and Puma hollows and in the Podunk Creek drainage.

*Globally*

This wetland association in found at montane and subalpine elevations throughout much of the western U.S.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon mesic graminoid association occurs in valley bottoms with saturated or permanently flooded soils. Sites are flat to gentle (0- to 4-degree slopes), occur between 2456 and 2494 m in elevation, and are oriented to all aspects. The ground surface has high cover of litter, low exposure of bare soil, and low cover by water; species of moss provide low cover in two of three sites. Soils are very poorly drained mucks and peat derived from New Alluvium.

*Globally*
This herbaceous wetland association is found throughout much of the western U.S. Elevation ranges from near sea level in California to more than 3400 m (0-11,150 feet) in the Rocky Mountains. Stands typically occur in montane and subalpine areas around the edges of lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains (Kittel et al. 1999b). Sites are flat to undulating, often with a hummocky microtopography (Kovalchik 1993). The water table is usually near the surface for most of the growing season. There are a wide variety of soil types for this association ranging from saturated organics or fine silty clays to clays over cobbles and alluvium to fine-loamy and sandy-skeletal, with an organic surface layer. Many stands occur on organic muck or peat soils. Mottling and gleying often occur near the surface because of the high water table.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is dense (88-99% cover) and is characterized by the sedge *Carex utriculata* that provides 30-87% cover. The tall-shrub layer (up to 3 m tall) provides sparse cover and includes *Salix geyeriana* and *Salix glauca*. The herbaceous layer is moderately diverse floristically and provides low to moderate cover. The graminoid *Juncus balticus* provides from 20-40% cover in stands where it occurs. The remaining graminoid layer provides low to moderate cover and includes the non-native rhizomatous grass *Poa pratensis*, the native bunchgrass *Deschampsia caespitosa*, and the graminoid *Carex microptera*. The forb layer is moderate in terms of species composition, provides sparse cover, and includes *Achillea millefolium, Erigeron divergens, Polemonium caeruleum*, and *Galium trifidum*.

*Globally*
This plant association is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex utriculata* (20-99% cover). Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* species present include *Carex aquatilis, Carex canescens, Carex lenticularis, Carex microptera, Carex nebrascensis*, and *Carex scopulorum*, but usually with low cover. Other graminoid species that may be present include *Calamagrostis canadensis, Deschampsia caespitosa, Eriophorum angustifolium, Glyceria striata*, and *Juncus balticus*. Sparse forb cover may include *Epilobium* spp., *Geum macrophyllum, Fragaria virginiana, Mentha arvensis, Mimulus guttatus*, and *Polemonium occidentale*. Scattered *Salix* spp. shrubs may be present because these riparian shrublands are often adjacent. *Salix* species vary depending on elevation and geography. *Salix monticola, Salix drummondiana, Salix geyeriana, Salix planifolia, Salix wolfii*, and *Salix exigua* are common species.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Carex utriculata*, *Deschampsia caespitosa*, *Juncus balticus* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Carex utriculata* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Vulnerable**: *Carex microptera* (state-critically imperiled, G5); **Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium)

*Globally*
**Vulnerable**: *Juncus chlorocephalus* (G3?); **Exotic/Invasive**: *Poa pratensis* (invasive, Medium), *Taraxacum officinale* (invasive)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Herbaceous wetland.

*Globally*
*Carex rostrata var. utriculata* (Boott) Bailey was recognized as a distinct species from *Carex rostrata* Stokes and named *Carex utriculata* Boott (Kartesz 1999). This taxonomic change has led to confusion in some of the earlier vegetation classification literature where no distinction was made between the subspecies. *Carex utriculata* Herbaceous Vegetation (CEGL001562) is known only from the western U.S., and for now, *Carex rostrata* communities are known only from the midwestern U.S. and Canada. According to Kartesz (1999), *Carex rostrata* is reported from most of Canada, some Great Lakes states, and Montana, Idaho, and Washington in the western U.S. There is significant overlap in the species ranges, and additional survey work is needed to help clarify this.

This association (CEGL001562) is distinguished from the mixed *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803) and *Carex aquatilis* Herbaceous Vegetation (CEGL001802) by having a clear dominance of *Carex utriculata*. *Carex aquatilis* can be present but can have no more than one-third the cover of *Carex utriculata*. *Carex aquatilis* Herbaceous Vegetation (CEGL001802) can have up to one-third the cover by *Carex utriculata*; in both cases the dominant sedge is at least two-thirds the total cover in the stand. In *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803), there is an even mix, such that the two species have even abundance and distribution throughout the stand, so that it is difficult to say one is more dominant over the other. In addition, *Carex utriculata* occurs on wetter sites than *Carex aquatilis*-dominated stands and often, but not exclusively, occupies organic soils.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: One-quarter of plot is covered in 1-3 inches of water and the rest has boggy soils; small creek runs through the center of plot; area definitely affected by cattle grazing; water wells up out of the ground under artesian pressure.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0083, BRCA.0267, BRCA.0268; and 1 observation point: BRCA.9018).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Achuff et al. 2002a, Andrews 1983, Baker 1983a, Benedict 1983, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Christy 2004, Cogan et al. 2004, Cole 1977b, Cole 1982, Crowe and Clausnitzer 1997, Crowe et al. 2004, Driscoll et al. 1984, Evans 1989b, Franklin and Dyrness 1973, Frenkel et al. 1986, Hall and Hansen 1997, Halpern 1986, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess and Wasser 1982, IDCDC 2005, Jankovsky-Jones et al. 1999, Johnson and Simon 1987, Jones and Ogle 2000, Kagan et al. 2000, Kartesz 1999, Kauffman 1982, Kauffman et al. 1985, Kerr and Henderson 1979, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kunze 1994, Looman 1982, MTNHP 2002b, Manning and Padgett 1995, Mattson 1984, Moseley 1998, Murray 2000, Mutel 1973, Mutel 1976, Mutel and Marr 1973, Mutz and Graham 1982, Mutz and Queiroz 1983, Nachlinger 1985, Norton et al. 1981, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley and Robbins 1909, Ratliff 1982, Schlatterer 1972, Seyer 1979, Seyer 1981, Stuth 1975, Taylor 1984, Titus and Christy 1996a, Titus and Christy 1999, Titus unpubl. data 1996, Tuhy 1981, Tuhy and Jensen 1982, WNHP unpubl. data, Western Ecology Working Group n.d., Wohl and Hammack 1995, Youngblood et al. 1985a, Youngblood et al. 1985b

## *Carex praegracilis* Herbaceous Vegetation

## Clustered Field Sedge Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL002660 |
| 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 PRAEGRACILIS* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1419)<br>Clustered Field Sedge Seasonally Flooded Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
North American Arid West Emergent Marsh (CES300.729)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**

*Globally*

This plant association forms meadows in swales and along stream channels in the prairies of several western states (Montana, Idaho, Wyoming, Colorado, Utah and Arizona) on both sides of the Continental Divide. It ranges in elevation between 610 and 2325 m (2000-7610 feet). The association occurs along small, shallow streams, usually no more than 2-5 m (7-17 feet) wide, with little sinuosity, low gradient and little to no floodplain development. Soils are deep, ranging from heavy clays to sandy clay loams. Often the only vegetation type along small streams, it completely covers the ground in narrow bands following the streambed and dominated by *Carex praegracilis* (20-40% cover), *Eleocharis palustris*, and *Equisetum laevigatum*. Alternatively, it can occur in patches within a mosaic of monotypic stands of wet meadow graminoid species, including *Juncus balticus, Carex nebrascensis, Carex pellita (= Carex lanuginosa)*, and *Schoenoplectus pungens (= Scirpus pungens)*. A few forbs may also be present, such as *Grindelia squarrosa, Ranunculus cymbalaria, Vicia* sp., *Ambrosia confertiflora*, and *Iris missouriensis*. Sometimes shrubs may be present, such as *Ericameria nauseosa, Sarcobatus vermiculatus*, and *Rosa woodsii*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This mesic graminoid association occurs on habitats with saturated soils, and was sampled in Swamp Canyon, near the northern park boundary, and in the park environs in Shinglemill Swale.

*Globally*

This association occurs in appropriate habitat across the Rocky Mountain and northern Great Basin states, southern Arizona and southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This mesic graminoid association occurs in swales and valley bottoms with saturated soils. The sites are flat to gentle (0- to 3-degree slopes), occur between 2210 and 2310 m in elevation, and are oriented to all aspects. The ground surface has sparse exposure of bare soil and high cover of litter. Soils are moderately well-drained to well-drained silty clays or silty clay loams derived from New Alluvium.

*Globally*

This plant association forms meadows in swales and along stream channels in the prairies of several western states (Montana, Idaho, Wyoming, Colorado, Utah and Arizona) on both sides of the Continental Divide. It is found between 610 and 2325 m (2000-7610 feet) in elevation. The association occurs along small, shallow streams, usually no more than 2-5 m (7-17 feet) wide, with little sinuosity, low gradient and little to no floodplain development. Soils are deep, ranging from heavy clays to sandy clay loams.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (37-79% cover) and is characterized by the graminoid *Carex praegracilis* that provides 10-40% cover. The remaining graminoid layer provides low to moderate cover and includes the non-native sod-forming grass *Poa pratensis* and natives *Juncus balticus, Eleocharis palustris*, and non-native *Festuca ovina*. The forb layer is low in terms of species composition, provides sparse cover, and includes *Iris missouriensis*. The short shrub *Rosa woodsii* provides 40% cover in one stand.

*Globally*
Often the only vegetation type along small streams, it completely covers the ground in narrow bands following the streambed and dominated by *Carex praegracilis* (20-40% cover), *Eleocharis palustris*, and *Equisetum laevigatum*. Alternatively, it can occur in patches within a mosaic of monotypic stands of wet meadow graminoid species, including *Juncus balticus, Carex nebrascensis, Carex pellita (= Carex lanuginosa)*, and *Schoenoplectus pungens (= Scirpus pungens)*. A few forbs may also be present, such as *Grindelia squarrosa, Ranunculus cymbalaria, Vicia* sp. *Ambrosia confertiflora*, and *Iris missouriensis*. Sometimes shrubs may be present, such as *Ericameria nauseosa, Sarcobatus vermiculatus*, and *Rosa woodsii*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Carex praegracilis*, *Juncus balticus*, *Poa pratensis* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Festuca ovina* (exotic, Insignificant), *Pascopyrum smithii* (weedy native), *Poa pratensis* (exotic, Medium)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G3G4 (5-Feb-2001). This association is known from several western states, although few stands have been well-documented. Stands are small meadows in Colorado (1-20 acres), but it is known to form large meadows in southwestern Montana. Occurrences on federal lands are often in a degraded condition. The highest conditions exist on unprotected private lands. Soil compaction and compositional shifts from grazing and heavy recreational use are the greatest threats. The global rank was changed from G2 to G3G4 to reflect the wide distribution of the type as well as its apparent abundance in several states (Montana and Wyoming).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Herbaceous wetland.

*Globally*
This association is known from several western states (MT, ID, WY, UT, CO and AZ), although few stands have been well-documented. This type needs to be compared with *Carex praegracilis - Carex aquatilis* Herbaceous Vegetation (CEGL001821), as they are probably the same type. A single plot was sampled in southern Arizona that is codominated by *Ambrosia confertiflora*. More research is needed to verify that the southern stands should be included in the concept of this association.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: High water table in the swale bottom, along with the fine alluvial soils; boundaries of the community are clearly delineated by soil moisture; western section of meadow is slightly higher in elevation and drier, willow shrubs are present and scattered.

*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0120, BRCA.0122, BRCA.0123, BRCA.0376; and 1 observation point: BRCA.9234).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* R.J. Rondeau, mod. M.S. Reid, K.A. Schulz, G. Kittel

**REFERENCES:** CONHP Ecology Team 2001, Carsey et al. 2003a, Culver and Sanderson 1997, Durkin et al. 1994b, Hansen et al. 1988b, Hansen et al. 1995, IDCDC 2005, Jones and Walford 1995, Kagan et al. 2004, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, MTNHP 2002b, Western Ecology Working Group n.d.

## *Juncus balticus* Herbaceous Vegetation

## Baltic Rush Herbaceous Vegetation

## Baltic Rush Wet Meadow

| | |
|---|---|
| CODE | CEGL001838 |
| 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 | *JUNCUS BALTICUS* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1374)<br>Baltic Rush Seasonally Flooded Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):**
Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
Boreal Wet Meadow (CES103.873)
North American Arid West Emergent Marsh (CES300.729)
Northern Columbia Plateau Basalt Pothole Pond (CES304.058)
Western Great Plains Open Freshwater Depression Wetland (CES303.675)
Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This Baltic rush community is found widely throughout the western United States and into western Canada. This herbaceous wet meadow occurs as small to extensive, open to typically dense patches on flat stream benches, along overflow channels, and near springs. Habitats are often alkaline meadows and may have long-term grazing disturbance. Soils are variable and range from poorly to well-drained, sandy clay loam to fine sand-textured and are usually mottled or gleyed. Stands are characterized by dense swards of *Juncus balticus*. In montane zones and the Great Basin, minor cover of *Carex* species, including *Carex aquatilis, Carex praegracilis, Carex nebrascensis*, or *Carex utriculata*, is often present; other common species include *Deschampsia caespitosa, Distichlis spicata, Glyceria striata, Hordeum jubatum, Muhlenbergia asperifolia, Pascopyrum smithii, Phleum alpinum*, and *Sporobolus airoides*. The introduced perennial sod grasses *Poa pratensis* or *Agrostis stolonifera* codominate some stands. Forb cover is generally low and includes wetland species such as *Caltha leptosepala, Rumex aquaticus*, and *Dodecatheon pulchellum*. *Iris missouriensis* can be common in heavily grazed stands. Shrubs are not common. This association is often considered to be a grazing-induced community since it increases with disturbance, though it can be a stable late-seral community.

**DISTRIBUTION**
*Bryce Canyon National Park*
This palustrine wetland association occurs only on valley bottoms and low swales, and was sampled near the North Campground. It was also observed at six Accuracy Assessment points in 2007.

*Globally*

This Baltic rush wet meadow community is found widely throughout the western United States, ranging from South Dakota and Nebraska west to Washington, south to California, and east to New Mexico. It also occurs in western Canada.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This herbaceous wetland association occurs in the bottom of a swale. The site is flat and occurs at 2385 m in elevation. The ground surface has low exposure of bare soil and moderate to high cover of litter. Soils are well-drained silty clays that formed in New Alluvium.

*Globally*

This broadly defined and widespread herbaceous wetland community is found throughout western North America. Elevation ranges from 138 to 3500 m (454-11,475 feet). Far northern stands in the Boreal Plains are at about 800 m (2625 feet). Stands usually occur as small, dense patches on flat to gently sloping sites near seeps and streams. Stream channels are highly variable in size and type, ranging from narrow to moderately wide, and from deeply entrenched to very sinuous (Kittel et al. 1999b). In the boreal regions, this community occurs more commonly on gradual sandy shorelines. Soils are also variable and range from sandy well-drained to poorly drained silty clay loam or silty clay alluvium to organic muck; however, soils tend to be finer-textured, alkaline and may be saline (Brotherson and Barnes 1984, Padgett et al. 1989, Kittel et al. 1999b). Sites with sandy soils are usually saturated for part of the growing season or have high water tables. Cobbles and gravel are common on many sites, and gleyed and mottled horizons are often present because of flooding or high water tables (Kittel et al. 1999b).

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (61% cover) and is characterized by the graminoid *Juncus balticus* that provides 37% cover. The remaining herbaceous layer is low to moderate in terms of floristic diversity and provides sparse to moderate cover. The non-native rhizomatous grass *Poa pratensis* provides 24% cover in the graminoid layer. The forb layer is low in terms of floristic diversity, provides sparse cover, and includes *Potentilla crinita, Artemisia ludoviciana*, and *Achillea millefolium*.

*Globally*

This broadly defined association is characterized by a low (<50 cm), open to typically dense graminoid layer dominated by the rhizomatous perennial *Juncus balticus*. In montane zones and the Great Basin, minor cover of *Carex* species, including *Carex aquatilis, Carex praegracilis, Carex microptera, Carex nebrascensis*, or *Carex utriculata*, is often present. Other common graminoids include *Deschampsia caespitosa, Distichlis spicata, Glyceria striata, Hordeum brachyantherum, Hordeum jubatum, Muhlenbergia andina, Muhlenbergia asperifolia, Pascopyrum smithii, Poa nemoralis ssp. interior, Phleum alpinum*, and *Sporobolus airoides*. Forb cover is generally low but may include *Achillea millefolium, Artemisia ludoviciana, Caltha leptosepala, Cirsium scariosum (= Cirsium tioganum), Dodecatheon pulchellum, Glaux maritima, Iris missouriensis, Maianthemum stellatum, Rumex aquaticus, Polygonum bistortoides, Potentilla plattensis*, and *Solidago canadensis*. Many other forb species may be present, given the wide elevational amplitude and broad geographic spread of this type. Shrubs and dwarf-shrubs are not common; however, *Artemisia frigida* cover may be significant in some stands, and occasional *Artemisia cana, Artemisia tridentata ssp. tridentata, Dasiphora fruticosa ssp. floribunda, Ericameria nauseosa, Populus* spp., *Rosa woodsii, Salix* spp., or *Sarcobatus vermiculatus* shrubs may occur. Some stands may be codominated by the introduced perennial sod grasses *Poa pratensis, Bromus inermis*, or *Agrostis stolonifera*. Other introduced species, such as *Cirsium arvense, Cirsium vulgare, Erodium cicutarium, Iva axillaris, Lactuca serriola, Phleum pratense, Taraxacum officinale, Thinopyrum intermedium, Trifolium* spp., *Tragopogon dubius, Xanthium strumarium*, and others, may occur in disturbed stands.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Juncus balticus*, *Poa pratensis* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Juncus balticus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium)

*Globally*
**Exotic/Invasive**: *Agrostis stolonifera* (weedy native, Medium/Low), *Bromus inermis* (exotic, High/Medium), *Cirsium arvense* (exotic noxious weed, High/Medium), *Cirsium vulgare* (exotic noxious weed, Medium/Low), *Erodium cicutarium* (exotic, Medium/Low), *Iva axillaris* (noxious weed), *Lactuca serriola* (exotic, Low/Insignificant), *Phleum pratense* (exotic, Medium), *Poa pratensis* (invasive, Medium), *Taraxacum officinale* (exotic), *Thinopyrum intermedium* (exotic, Medium/Insignificant), *Tragopogon dubius* (exotic, Medium/Low), *Xanthium strumarium* (noxious weed)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G5 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Herbaceous wetlands.

*Globally*
This association is often considered to be a grazing-induced community since it increases with grazing disturbance. Based on the extensive geographic and environmental range (from alpine meadows to sagebrush-dominated landscapes), it verges on astonishing that any number of *Juncus balticus* associations have not been recognized.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Site is a low point in the meadow; no standing water here, but the soil is moist near the surface.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0206) and 2007 Accuracy Assessment (6 points: BRCA_AA.0214, BRCA_AA.0219, BRCA_AA.0224. BRCA_AA.0288, BRCA_AA.0437, BRCA_AA.0462).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Drake, mod. D. Faber-Langendoen, K.A. Schulz, L. Allen, G. Kittel

**REFERENCES:** ANHIC n.d., Baker 1984a, Bell et al. 2009, Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bunin 1985, Butler et al. 2002, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Christy 2004, Cogan et al. 2004, Cowardin et al. 1979, Crowe and Clausnitzer 1997, Crowe et al. 2004, Donnelly et al. 2006, Driscoll et al. 1984, Evans 1989b, Evenden 1990, Faber-Langendoen 2001, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1995, Henderson and McAllister 1983, Hess 1981, IDCDC 2005, Jankovsky-Jones et al. 1999, Jankovsky-Jones et al. 2001, Johnston 1987, Jones 1992b, Jones and Walford 1995, Kagan et al. 2000, Kartesz 1994a, Kierstead and Pogson 1976, Kittel and Lederer 1993, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Klein et al. 2007, Komarkova 1986, Kovalchik 1987, Kunze 1994, MTNHP 2002b, Manning 1988, Manning and Padgett 1991, Manning and Padgett 1992, Muldavin et al. 2000a, Muldavin et al. 2003, Muldavin et al. 2006, Murray 2000, Mutel 1973, Mutz and Graham 1982, Olson and Gerhart 1982, Padgett 1981, Padgett 1982, Padgett et al. 1989, Peterson 2008, Rector 1979, Richard et al. 1996, Shupe et al. 1986, Stewart 1940, TNC 1998d, Taylor 1980, Taylor and Teare 1979a, Thompson and Hansen 2002, Titus and Christy 1996a, Tuhy and Jensen 1982, Volland 1976, WNHP unpubl. data, Wasser and Hess 1982, Western Ecology Working Group n.d., Youngblood et al. 1985a

## *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)<br>Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)

**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**

*Bryce Canyon National Park*

This semi-natural mesic graminoid association is limited in the park and was sampled on valley floors near Yovimpa Pass and Podunk Creek.

*Globally*

This semi-natural grassland is widespread in the western U.S. and northern Great Plains.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This mesic semi-natural herbaceous association occurs on valley floors. The sites are flat and occur between 2505 and 2518 m in elevation. The ground surface has sparse to low exposure of bare soil, moderate to high cover of litter, and sparse cover of small rocks. Soils are well-drained silty clay loams derived from New Alluvium.

*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**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (47-65% cover) and is characterized by the non-native rhizomatous grass *Poa pratensis* that provides 25-47% cover. Short shrubs present may include *Chrysothamnus viscidiflorus* and *Dasiphora fruticosa ssp. floribunda*. The remaining graminoid layer is low in terms of floristic diversity, provides low cover, and includes *Hesperostipa comata, Juncus balticus*, and *Agrostis stolonifera*. The fern ally *Equisetum laevigatum* provides low cover in one stand. The forb layer is diverse floristically, provides low cover, and includes *Potentilla gracilis, Arnica chamissonis, Taraxacum officinale*, and *Erigeron flagellaris*.

*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**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Poa pratensis* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Poa pratensis* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*

**Exotic/Invasive**: *Achillea millefolium* (invasive), *Agrostis stolonifera* (invasive, Medium/Low), *Bromus inermis* (invasive, High/Medium), *Cirsium arvense* (invasive, High/Medium), *Elymus repens* (invasive, High/Medium), *Linaria vulgaris* (invasive, High/Low), *Phleum pratense* (invasive, Medium), *Poa pratensis* (invasive, Medium), *Taraxacum officinale* (invasive)

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* GNA (invasive) (1-Dec-1997).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*

Grassland.

*Globally*

Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**

*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Site apparently ungrazed by cattle; site is moist but there is no standing water or drainage channels; community is a drier meadow compared to other parts of the valley floor that are lower by up to 2 feet; spruce trees are encroaching from each side.

*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (2 plots: BRCA.0256, BRCA.0266) and 2007 Accuracy Assessment (1 point: BRCA_AA.0395).
*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

### Sandberg 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)<br>Sandberg Bluegrass Seasonally Flooded Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Southern 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**
*Bryce Canyon National Park*
This semi-arid grassland occurs on valley floors, has limited distribution in the park, and was sampled in the East Creek drainage.

*Globally*
This grassland association occurs across the intermountain western U.S. from western Colorado to California, north to Idaho and Oregon.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short bunchgrass association occurs on valley floors. The site is flat and occurs at 2375 m in elevation. The ground surface has moderate exposure of bare soil and moderate cover of litter. Soils are rapidly drained silty clays that were formed in alluvium.

*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**

*Bryce Canyon National Park*

Total vegetation cover is dense (85% cover) and is characterized by the short bunchgrass *Poa secunda* that provides 30% cover. Short and dwarf-shrubs present provide low cover and include *Chrysothamnus viscidiflorus, Krascheninnikovia lanata*, and *Artemisia frigida*. The remaining graminoid layer is moderate in terms of floristic diversity, provides moderate cover, and includes the non-native rhizomatous grass *Poa pratensis* and the native graminoids *Koeleria macrantha, Juncus balticus*, and *Elymus trachycaulus*. The forb layer is floristically diverse, provides low cover, and includes *Machaeranthera canescens, Taraxacum officinale, Tragopogon dubius*, and *Achillea millefolium*.

*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**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Chrysothamnus viscidiflorus* |
| Herb (field) | *Artemisia frigida*, *Krascheninnikovia lanata* |
| Herb (field) | *Machaeranthera canescens* |
| Herb (field) | *Juncus balticus*, *Poa secunda* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Poa secunda* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*

**Exotic/Invasive**: *Descurainia sophia* (exotic, Medium/Low), *Iva axillaris* (introduced), *Lepidium perfoliatum* (exotic, Low/Insignificant), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low), *Trifolium dubium* (exotic)

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G4? (1-Feb-1996).

**CLASSIFICATION COMMENTS**

*Bryce Canyon National Park*

Grassland.

*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**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Valley with mesic grasses in the bottom of East Creek drainage is extensive, but its composition varies depending on water table; soils are deep and not rocky here, with a high clay component.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0052).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz

**REFERENCES:** Bell et al. 2009, 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, Peterson 2008, Western Ecology Working Group n.d.

## *Eleocharis quinqueflora* Herbaceous Vegetation

## Few-flower Spikerush Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL001836 |
| 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 | Saturated temperate or subpolar grassland (V.A.5.N.m.) |
| ALLIANCE | *ELEOCHARIS (QUINQUEFLORA, ROSTELLATA)* SATURATED HERBACEOUS ALLIANCE (A.1423)<br>(Few-flower Spikerush, Beaked Spikerush) Saturated Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

**USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This wetland association is found in the upper subalpine and lower alpine in the western United States and forms uniform peatland communities. Sites can occur in wet basins, stream terraces, ponds, cirque basins, and marshy meadows associated with seeps. Substrates are typically poorly drained, nutrient-poor, organic soils that are wet or saturated throughout the summer. Surface layers may dry out in late summer on some sites. Peat layers range from thin peat over quartzite sands to deep peat occasionally as deep as 2 m. The vegetation is characterized by a moderately dense to dense herbaceous layer that is strongly dominated by *Eleocharis quinqueflora*. *Carex aquatilis* is a common graminoid associate that may codominate some stands. Vegetation growth is relatively sparse compared to other wetlands, especially in higher elevation stands. Other graminoids may include *Carex buxbaumii, Carex illota, Carex jonesii, Carex lachenalii* (on extremely nutrient-poor sites), *Carex scopulorum, Carex utriculata, Deschampsia caespitosa*, and *Eleocharis rostellata*. Forb cover is generally low but often includes *Caltha leptosepala, Dodecatheon alpinum, Oreostemma alpigenum (= Aster alpigenus), Pedicularis groenlandica*, and *Polygonum bistortoides*. Scattered shrubs may also be present, such as *Betula glandulosa* or *Salix planifolia*. Diagnostic of this herbaceous wetland community is the dominance or codominance of *Eleocharis quinqueflora* and the presence of surface water for extended periods during the growing season.

**DISTRIBUTION**
*Bryce Canyon National Park*
This palustrine herbaceous wetland is uncommon, occurs on saturated and flooded soils of valley bottoms, and was sampled near Fairyland Point, in the Noon Canyon drainage, and near Yellow Spring.

*Globally*
This vegetation type is found in the upper subalpine and lower alpine in the western United States.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This herbaceous wetland association occurs in valley bottoms, meadows, marshes, and springs with saturated or permanently flooded soils. The sites are flat to gentle (0- to 3-degree slopes), occur between 2147 and 2334 m in elevation, and are oriented to all aspects. The ground surface has low to moderate exposure of bare soil and moderate cover of litter. Moss provides low cover in two occurrences. Soils are poorly drained to very poorly drained muck or clay loams derived from New Alluvium.

*Globally*

This wetland association is found in the upper subalpine and lower alpine zones in the western United States and forms uniform peatland communities. Elevation ranges from 1430 to 3800 m (4700-12,300 feet). Sites can occur in wet basins, stream terraces, ponds, cirque basins, and marshy meadows associated with seeps. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Adjacent stream channels are narrow and sinuous headwater rivulets (Rosgen's Channel Type: E4-5) with lateral seepage from surrounding toeslopes. Substrates are typically poorly drained, nutrient-poor, organic soils that are wet or saturated throughout the summer (Cryohemists, Cryofibrists or Borofibrists, Borochemists, and Borosaprists) (Komarkova 1979, Kovalchik 1987, Padgett et al. 1989, Hansen et al. 1995, Kittel et al. 1999b). Surface layers may dry out in late summer on some sites. Peat layers range from thin peat over quartzite sands to deep peat occasionally as deep as 2 m (Cooper 1990).

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate to dense (38-99% cover) and is characterized by the graminoid *Eleocharis quinqueflora* that provides 10-40% cover. The short shrub *Dasiphora fruticosa ssp. floribunda* provides sparse cover. The remaining graminoid layer provides low to moderate cover and includes the non-native grass *Poa pratensis* and the native graminoids *Muhlenbergia filiformis* and *Juncus balticus*. The forb layer is moderate in terms of floristic diversity, provides sparse cover, and includes *Tragopogon dubius, Taraxacum officinale, Machaeranthera canescens*, and *Epilobium ciliatum*.

*Globally*

This wetland association is characterized by a moderately dense to dense herbaceous layer that is strongly dominated by *Eleocharis quinqueflora*. *Carex aquatilis* is a common graminoid associate that may codominate some stands (Padgett et al. 1989). Vegetation growth is relatively sparse compared to other wetlands, especially in higher elevation stands (Carsey et al. 2003a, 2003b). Other graminoids may include *Carex buxbaumii, Carex illota, Carex jonesii, Carex lachenalii* (on extremely nutrient-poor sites), *Carex scopulorum, Carex simulata, Carex utriculata, Deschampsia caespitosa, Eleocharis rostellata, Trichophorum caespitosum (= Scirpus cespitosus)*, and *Triglochin palustris*. Forb cover is generally low but often includes *Caltha leptosepala, Dodecatheon alpinum, Mimulus primuloides, Oreostemma alpigenum (= Aster alpigenus), Pedicularis groenlandica*, and *Polygonum bistortoides* (Jensen and Tuhy 1981, Mattson 1984, Padgett et al. 1989, Cooper 1990, Hansen et al. 1995, Manning and Padgett 1995, Kittel et al. 1999b). Scattered shrubs may also be present, such as *Betula glandulosa, Dasiphora fruticosa ssp. floribunda*, or *Salix planifolia*. Rare species *Carex lachenalii* and *Eriophorum angustifolium* grow locally on sites too nutrient-poor for other species. Diagnostic of this herbaceous wetland community is the dominance or codominance of *Eleocharis quinqueflora* and the presence of surface water for extended periods during the growing season.

Adjacent riparian vegetation may include marshes and wet meadows dominated by various species such as *Carex aquatilis, Carex utriculata, Eleocharis palustris*, and *Caltha leptosepala*, or shrublands dominated by *Salix planifolia* or *Betula glandulosa*. Drier sites include mesic spruce-fir forests, *Salix brachycarpa* shrublands, and *Deschampsia caespitosa* meadows. Upland vegetation is often alpine talus slopes, krummholz, dry-mesic spruce-fir or lodgepole pine forests, and subalpine *Festuca thurberi* grasslands that occur on adjacent hillslopes (Manning and Padgett 1995, Kittel et al. 1999b).

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Eleocharis quinqueflora*, *Juncus balticus*, *Poa pratensis* |

*Globally*

| Stratum | Species |
|---|---|
| Herb (field) | *Eleocharis quinqueflora* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G4 (1-Feb-1996).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland; herbaceous wetland.

*Globally*
*Eleocharis pauciflora* is a synonym for *Eleocharis quinqueflora*. This is a widespread, broadly defined wetland of the western U.S. Additional associations may be described after further survey and classification work.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Vegetation is extremely dense with few canopy openings; marsh area results from spring flows that provide water most of the year; some surface depressions have shallow, stagnant pools of water.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0109, BRCA.0312, BRCA.0408).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* T. Keeler-Wolf, mod. K.A. Schulz

**REFERENCES:** Boggs 2000, Bourgeron and Engelking 1994, Briggs and MacMahon 1983, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Christy 2004, Cole 1977b, Cole 1982, Cooper 1990, Crowe and Clausnitzer 1997, Crowe et al. 2004, Driscoll et al. 1984, Hansen et al. 1988b, Hansen et al. 1995, IDCDC 2005, Jankovsky-Jones et al. 1999, Jensen and Tuhy 1981, Johnston 1987, Kagan et al. 2000, Kittel et al. 1999b, Komarkova 1976, Komarkova 1979, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, MTNHP 2002b, Manning and Padgett 1992, Manning and Padgett 1995, Mattson 1984, Murray 2000, Padgett et al. 1989, Richard et al. 1996, Rosgen 1996, Seyer 1979, Titus unpubl. data 1995, Western Ecology Working Group n.d., Wilson 1969, Wilson 1986

## *Artemisia nova / Leymus salinus* Shrub Herbaceous Vegetation

### Black Sagebrush / Saline Wildrye Shrub Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL001421 |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.) |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub |
| ALLIANCE | *ARTEMISIA NOVA* SHRUB HERBACEOUS ALLIANCE (A.1567) layer (V.A.7.N.e.) Black Sagebrush Shrub Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This plant association is reported from widely separated sites in the Lemhi Range in Idaho and in the Colorado Plateau of western Colorado and high plateaus of southern Utah. In Idaho, the association occurs on gentle lower slopes composed of volcanic tuffs, at approximately 1680 to 1890 m (5500-6200 feet) elevation. Constant downslope soil movement and a high shrink-swell ratio create a highly unstable substrate. In Colorado, this association is known from ridges of Morrison Formation shales. The dwarf-shrub vegetation is dominated by *Artemisia nova*. Vegetation cover and composition information is available for Colorado stands only. The community is relatively open and sparse appearing, with total vegetation rarely exceeding 30%. Other shrubs are often present in Colorado stands, including *Atriplex confertifolia* and *Krascheninnikovia lanata*. The herbaceous layer is clearly dominated by *Leymus salinus* with 3-15% cover. The herbaceous layer is usually diverse and may include *Achnatherum hymenoides, Bouteloua gracilis, Pascopyrum smithii, Pleuraphis jamesii, Poa fendleriana, Poa secunda, Calochortus gunnisonii, Sphaeralcea coccinea, Stanleya pinnata, Streptanthella longirostris*, and *Townsendia incana*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This association was observed only once during Accuracy Assessment in 2007, therefore no local information is available.

*Globally*

This plant association occurs within the southwestern region of the Bitterroot Mountains ecoregional section, within east-central Idaho, as well as in Colorado National Monument in western Colorado. It was observed on the high plateau of southern Utah. It is likely to be found elsewhere in the northern Colorado Plateau where Morrison Formation shales outcrop at around 2000 m elevation.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*

This plant association is reported from widely separated sites in the southern end of the Lemhi Range in Idaho and in the Colorado Plateau of western Colorado. In Idaho, the association occurs on gentle lower slopes composed of volcanic tuffs, at approximately 1680 to 1890 m (5500-6200 feet) elevation. Constant downslope soil movement and a high shrink-swell ratio create a highly unstable substrate. In Colorado, this association is known from gentle to moderate slopes on somewhat barren ridges, benches and hills of Morrison Formation shales between 1960 and 2089 m (6430-6854 feet). Bare soil and gravel cover much of the unvegetated ground surface.

In Idaho, the region where the association occurs is to the east of a major mountain mass which strongly affects the climate of the region. The high mountains to the west create a rainshadow, allowing only occasional incursions of moisture-laden winter storms from the Pacific. Average annual precipitation is low, ranging from 17.8 cm (7 inches) in the valleys, such as along the Salmon River, to roughly 114.3 cm (45 inches) at the highest elevations. There is a peak during May and June, when convective showers are common, but winters are relatively dry. Summers are cool and winters cold. The region is mountainous with high, massive ranges, dissected by deep valleys. The bedrock is a heterogeneous formation of volcanic and sedimentary rock, with only minor amounts of granitics, known as Challis Volcanics. At lower elevations along the Salmon River the most common rock types of this formation are tuffs and andesites. A flora endemic to the Lemhi region, known collectively as Challis Endemics, occurs on these substrates and is joined by a flora of species disjunct from drier regions of the Great Basin. Much of the Challis endemic region roughly coincides with an area receiving less than 20.3 cm (8 inches) of precipitation annually, combined with low-elevation occurrences of andesites and tuffs of the Challis Volcanics.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Data are not available.

*Globally*
The dwarf-shrub vegetation is dominated by *Artemisia nova*. Vegetation cover and composition information is available for Colorado stands only. The community is relatively open and sparse appearing, with total vegetation rarely exceeding 30%. Other shrubs are often present in Colorado stands, including *Atriplex confertifolia* and *Krascheninnikovia lanata*. The herbaceous layer is clearly dominated by *Leymus salinus* with 3-15% cover. The herbaceous layer is usually diverse and may include *Achnatherum hymenoides, Bouteloua gracilis, Pascopyrum smithii, Pleuraphis jamesii, Poa fendleriana, Poa secunda, Calochortus gunnisonii, Sphaeralcea coccinea, Stanleya pinnata, Streptanthella longirostris*, and *Townsendia incana*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*

| Stratum | Species |
|---|---|
| Shrub/sapling (tall & short) | *Artemisia nova* |
| Herb (field) | *Leymus salinus* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Sclerocactus whipplei* (globally imperiled, G1G3); **Other**: *Leymus salinus* ssp. *salmonis* (endemic to the Challis Volcanics, G5T3?)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* G1G2Q (29-Oct-1997). This naturally rare plant association occurs over a relatively narrow geographic range, in the southwestern region of the Bitterroot Mountains ecoregional section, within east-central Idaho. It is found on gentle lower slopes composed of volcanic tuffs, at approximately 1680 to 1890 m (5500-6200 feet) elevation. The volcanic tuff substrate is typically unstable, with constant downslope movement of soil surface layers and a high shrink-swell ratio. The association is protected in proposed and established conservation sites. However, information is not available to confirm the representative quality of these occurrences. Appropriate inventory and monitoring work has not been completed to provide information necessary to adequately understand and describe current condition, trend or threat. Quantitative stand composition and environmental data are not available to verify that the association is a discrete classification unit, thus a "Q" is added to the global rank. However, now that the concept of the association has been expanded to include other subspecies of *Leymus salinus*, the global rank should probably be revisited. While it is unlikely that this is a common type, it is no longer a narrowly restricted endemic association.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
In Idaho, this association includes *Leymus salinus ssp. salmonis*, a subspecies endemic to the Challis Volcanics. In the Colorado Plateau, the subspecies is *Leymus salinus ssp. salinus*. The two are combined in this description. It was observed during map accuracy assessment in Bryce Canyon National Park but no descriptive information was collected.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0242).
*Local Description Authors:*
*Global Description Authors:* M.S. Reid, mod. S.K. Rust and J. Coles

**REFERENCES:** Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Caicco and Wellner 1983g, Driscoll et al. 1984, Moseley 1987b, Western Ecology Working Group n.d.

## *Chrysothamnus viscidiflorus - Ericameria parryi* Shrub Herbaceous Vegetation [Provisional]

### Yellow Rabbitbrush - Parry's Rabbitbrush Shrub Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL002781 |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.) |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub |
| ALLIANCE | *CHRYSOTHAMNUS VISCIDIFLORUS* SHRUB HERBACEOUS ALLIANCE (A.1524)<br>layer (V.A.7.N.e.)<br>Yellow Rabbitbrush Shrub Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This is a dry, sparse herbaceous shrubland thought to be primarily the result of disturbance by ungulate overgrazing. At present it is known from central Colorado and southern Utah. The following description is from Colorado stands only. This shrubland occurs at an elevation of approximately 2535-2580 m (8325-8462 feet). It occupies decomposing granite gravels with fine silt and clay soil particles interspersed. Stand exposure ranges from northeast to southeast (60-165 degrees), and the slopes are moderately steep, from 5-11%. The sites are considered well-drained to rapidly drained. Similar sites elsewhere would support a *Festuca arizonica - Muhlenbergia filiculmis* grassland. The dominant dwarf-shrubs, e.g., *Chrysothamnus viscidiflorus* and *Ericameria parryi, Artemisia frigida*, and *Gutierrezia sarothrae*, typically provide from 20-35% foliar cover. Grass species common in these stands include *Bouteloua gracilis, Muhlenbergia filiculmis, Festuca arizonica, Elymus elymoides*, and *Koeleria macrantha*, and they provide from 15-25% foliar cover. Foliar cover by forbs was less than 5% for all stands sampled and typically was in the range of 2-4%. The more common forbs observed included *Hymenoxys richardsonii, Geranium caespitosum*, and *Besseya plantaginea*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This shrubland was sampled at East Creek, Bridge Hollow, and Weather Station Ridge.

*Globally*

This association occurs in central Colorado and southern Utah, and is likely to occur elsewhere in the western U.S.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This shrubland occurs mostly on low slopes between 2378 and 2689 m in elevation, facing all aspects. Half of the sample points occur on alluvial soils, the other half on slopes just above alluvial settings. Soil is rocky with surface cover of gravel (5-50%), litter (5-70%) or bare ground (20-60%).

*Globally*

This is a dry, sparse herbaceous shrubland thought to be primarily the result of disturbance by ungulate overgrazing. At present it is known from central Colorado and southern Utah. The following description is from Colorado stands only. This shrubland occurs at an elevation of approximately 2535-2580 m (8325-8462 feet). It occupies decomposing granite gravels with fine silt and clay soil particles interspersed. Stand exposure ranges from northeast to southeast (60-165 degrees), and the slopes are moderately steep, from 5-11%. The sites are considered well-drained to rapidly drained. Similar sites elsewhere would support a *Festuca arizonica - Muhlenbergia filiculmis* grassland.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
This shrubland is dominated by *Chrysothamnus viscidiflorus, Ericameria parryi*, or *Chrysothamnus depressus* or often a mixture of all three. Shrubs are of low stature, about 0.3 to 1 m (1-3 feet) in height, with a very open and clumpy canopy of 10-15% total cover. Some stands have all three species, while others have only one of the dominants listed. Other associated shrubs include *Tetradymia canescens, Gutierrezia sarothrae, Ribes cereum, Ceanothus martinii*, and *Purshia tridentata*. Undergrowth is dominated primarily by grasses such as *Muhlenbergia montana, Hesperostipa comata*, and *Achnatherum lettermanii*. Cover ranges from sparse (1-2%) to high (32%).

*Globally*
The dominant dwarf-shrubs, e.g., *Chrysothamnus viscidiflorus* and *Ericameria parryi, Artemisia frigida*, and *Gutierrezia sarothrae*, typically provide from 20-35% foliar cover. Grass species common in these stands include *Bouteloua gracilis, Muhlenbergia filiculmis, Festuca arizonica, Elymus elymoides*, and *Koeleria macrantha*, and they provide from 15-25% foliar cover. Foliar cover by forbs was less than 5% for all stands sampled and typically was in the range of 2-4%. The more common forbs observed included *Hymenoxys richardsonii, Geranium caespitosum*, and *Besseya plantaginea*.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Chrysothamnus viscidiflorus*, *Ericameria parryi* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (27-Aug-2002).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
This type was observed during map accuracy assessment for Bryce Canyon National Park, but no data or descriptive information were collected.

**CLASSIFICATION CONFIDENCE:** 3 - Weak

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: This association was only observed during Accuracy Assessment.
*Bryce Canyon National Park* Plots: This description is based on 2007 Accuracy Assessment (6 points: BRCA_AA.0384, BRCA_AA.0691, BRCA_AA.0934, BRCA_AA.0992, BRCA_AA.1001, BRCA_AA.1003).
*Local Description Authors:* G. Kittel
*Global Description Authors:* G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

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

## Antelope Bitterbrush / Needle-and-Thread Shrub Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL001498 |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.) |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub |
| ALLIANCE | *PURSHIA TRIDENTATA* SHRUB HERBACEOUS ALLIANCE (A.1523)<br>layer (V.A.7.N.e.)<br>Antelope Bitterbrush Shrub Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**

*Globally*

This plant association is known from the Intermountain West, from western Idaho, eastern Washington, Oregon, and southern Utah. The association occurs on gently sloped sand to well-drained silty clay loams located from 152 to 2649 m (500-8691 feet) elevation. Dispersed *Purshia tridentata* forms an open shrub canopy (with an average 20% canopy cover) over an herbaceous layer dominated by *Hesperostipa comata (= Stipa comata)* (averaging >50% cover). *Ericameria nauseosa (= Chrysothamnus nauseosus)* and *Chrysothamnus viscidiflorus* are occasionally present and increase in cover with disturbance. *Poa secunda* is usually also present in the understory and occurs with 20-50% cover. Additional bunch grasses, *Poa secunda* and *Poa fendleriana*, also may occur in the graminoid layer, with 20-50% cover. Other abundant perennial grasses may include *Achnatherum hymenoides (= Oryzopsis hymenoides), Koeleria macrantha*, and *Elymus lanceolatus*. The perennial forb layer may include *Lithophragma glabrum, Leptodactylon pungens, Chenopodium atrovirens, Chenopodium leptophyllum*, and *Potentilla crinita*. A cryptogamic layer is well-developed in the most undisturbed stands.

**DISTRIBUTION**

*Bryce Canyon National Park*

This shrub herbaceous association is uncommon, occurs where there are deep soils, and was sampled near the northern park boundary, on Whiteman Bench, and outside of Tropic Canyon within the park and in Water Canyon of the environs.

*Globally*

The association occurs in the western Columbia Plateau and the Utah High Plateau ecoregions. Occurrences are known from Douglas, Franklin and Grant counties, Washington; Morrow County, Oregon; Ada and Payette counties, Idaho; and Garfield and Kane counties, Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This uncommon shrub herbaceous association occurs on plains, plateaus, and swales. The sites are gentle (1- to 5-degree slopes), occur between 2320 and 2649 m in elevation, and are oriented to all aspects. The ground surface has low to high exposure of bare soil, sparse to high cover of litter, sparse to low cover of downed wood, and sparse cover of small rocks. Soils are rapidly drained silty clay loams, silty clays, and silt loams that are derived from the Wahweep Formation.

*Globally*

This association occurs in the western Columbia Plateau (western Idaho, eastern Washington, Oregon) and southern Utah High Plateau Ecoregions (southern Utah). In the Columbia Plateau, loess is thick in some portions of the region, and alluvial deposits of variable parent materials are patchy along streams and rivers. Thick mantles of sand from periodically glacially dammed lakes cover some portions of the region. In other areas, valleys and canyons (coulees) have been deeply scoured into the basalt by glacial flooding. The climate of the region is characterized by a mix of continental and maritime influences. It is in the rainshadow of the Cascades, with annual precipitation

between 23 and 51 cm (9-20 inches). Between 55% and 75% of the precipitation falls during October through March as snow, and summers are typically dry. Summer temperatures can be hot, and winters are typically cold. This association occurs on flats to gentle slopes of old sand dunes, from 152 to 2649 m (500-8691 feet) elevation. It often occurs in a patchwork with sand dunes and sandy Palouse grasslands. The soils are deep infertile sands. In the southern Utah High Plateau, climate is drier with greater temperature extremes, at least in the summer. Soils are more silty loams, but are still well drained.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is moderate (29-43% cover) and is characterized by the short shrub *Purshia tridentata* that provides 6-16% cover and the medium-tall bunchgrass *Hesperostipa comata* that provides 11-17% cover. Emergent *Pinus ponderosa* trees to 20 m tall are scattered throughout the association and provide sparse to low cover. Other short- and dwarf-shrub species are moderately diverse floristically, provide sparse to low cover, and include *Tetradymia canescens, Chrysothamnus depressus, Ericameria parryi (= Chrysothamnus parryi), Chrysothamnus viscidiflorus*, and *Artemisia nova*. The remaining graminoid layer is low to moderate in terms of floristic diversity, provides sparse to low cover, and includes *Poa fendleriana, Elymus elymoides, Koeleria macrantha*, and *Achnatherum hymenoides*. The forb layer is floristically diverse, provides sparse cover, and includes *Leptodactylon pungens, Chenopodium atrovirens, Chenopodium leptophyllum*, and *Potentilla crinita*.

*Globally*

The broad-leaved semi-evergreen shrub *Purshia tridentata* is scattered (averaging 10-20% cover) over an herbaceous layer dominated by the 0.5-m tall perennial bunchgrass *Hesperostipa comata (= Stipa comata)* (averaging 15-50% cover). The evergreen microphyllous shrubs *Ericameria nauseosa (= Chrysothamnus nauseosus), Ericameria parryi (= Chrysothamnus parryi), Chrysothamnus viscidiflorus, Chrysothamnus depressus, Tetradymia canescens*, and *Artemisia nova*, some of which are known to increase in cover with disturbance, may also occur. Additional bunch grasses, *Poa secunda* and *Poa fendleriana*, occur in the graminoid layer, with 20-50% cover. Other abundant perennial grasses may include *Achnatherum hymenoides (= Oryzopsis hymenoides), Koeleria macrantha*, and *Elymus lanceolatus*. The perennial forb layer may include *Lithophragma glabrum, Leptodactylon pungens, Chenopodium atrovirens, Chenopodium leptophyllum*, and *Potentilla crinita*. A cryptogamic layer is well-developed in the most undisturbed stands.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Purshia tridentata* |
| Herb (field) | *Hesperostipa comata*, *Poa fendleriana* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Purshia tridentata* |
| Herb (field) | *Hesperostipa comata*, *Poa secunda* |

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Chenopodium leptophyllum* (weedy native); **Other**: *Chenopodium atrovirens* (G5)

*Globally*

**Other**: *Bromus tectorum* (This species invades and increases in stands of this association disturbed by grazing. Most stands in Oregon have been converted to a *Bromus tectorum*-dominated vegetation type., GNR), *Plantago patagonica* (This species invades and increases in stands of this association disturbed by grazing., G5)

**CONSERVATION STATUS RANK**

*Global Rank & Reasons:* G2 (30-Nov-1998). This Columbia Basin association occurs with discrete habitat conditions in well-dispersed stands and is restricted to sandy, weakly developed soils. The number, condition and size of stands have declined significantly due to land conversion to cultivation, intensive range management,

introduction of exotic species, and alteration of fire disturbance regimes. Few high-quality occurrences are known. Protected occurrences are typically not of high-quality condition and/or are small in size.

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 1 - Strong

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Fine and clayey soils here, may be why the trees aren't as thick here since the deeper-wooded areas have had less clayey soils; some dead shrubs and dead branches in live shrubs are present, probably the result of past drought; evidence of a light fire that passed through here in the last 3-4 years.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots): BRCA.0104, BRCA.0239, BRCA.0353, BRCA.0355) and 2007 Accuracy Assessment (2 points: BRCA_AA.0024, BRCA_AA.0881).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* M.S. Reid, mod. S.K. Rust and G. Kittel

**REFERENCES:** Bourgeron and Engelking 1994, Cooper 2003, Daubenmire 1970, Driscoll et al. 1984, Hironaka et al. 1983, Kagan et al. 2000, Poulton 1955, UNESCO 1973, WNHP unpubl. data, Western Ecology Working Group n.d.

## *Mimulus guttatus* - (*Mimulus* spp.) Herbaceous Vegetation

## Seep Monkeyflower - (Monkeyflower species) Herbaceous Vegetation

| | |
|---|---|
| CODE | CEGL005305 |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial forb vegetation (V.B.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar perennial forb vegetation (V.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.) |
| FORMATION | Temporarily flooded temperate perennial forb vegetation (V.B.2.N.d.) |
| ALLIANCE | *MIMULUS GUTTATUS* TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.2676)<br>Seep Monkeyflower Temporarily Flooded Herbaceous Alliance |

**ECOLOGICAL SYSTEM(S):USFWS WETLAND SYSTEM:** Palustrine

**CONCEPT SUMMARY**
*Globally*
This small community is known from California's Coast Ranges, Sierra Nevada below 1220 m (4000 feet) elevation, and northeastern California, as well as central and southern Utah and Colorado. *Mimulus guttatus* is a small, delicate herb growing within the splash zone of small first-order streams, seeps, springs and hanging gardens. It occurs from 300 to 2390 m (1000-7840 feet) in elevation. This community is often found in narrow linear strips, occasionally broadening into small hollows, often overlooked for sampling, but universally recognized. It can occur on very steep cascades and waterfalls, on flat to steep seeps, or along gentle streams and floodplains (3-5%). The floristic composition is variable; several different species of *Mimulus* (*Mimulus guttatus, Mimulus lewisii, Mimulus moschatus*) may be the most dominant present. Generally mosses are present, as well as several other water-dependent herbaceous plants such as *Stellaria media, Collinsia heterophylla, Cardamine* spp., *Eleocharis* spp., *Epilobium* spp., *Equisetum arvense, Carex* spp., *Salix* spp., *Juncus* spp., *Veronica americana, Rorippa nasturtium-aquaticum, Cardamine* spp., and *Rorippa* spp. (= *Nasturtium* spp.). Graminoid species are usually present as well, often less abundant than the forb component, but usually very mesic.

**DISTRIBUTION**

*Bryce Canyon National Park*

This palustrine wetland association has a limited distribution and was observed in one valley, in the East Creek drainage.

*Globally*

This small community is known from California's Coast Ranges, Sierra Nevada below 1220 m (4000 feet) elevation, northeastern California, the Cascades of Oregon, central and southern Utah, and Colorado.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This palustrine wetland association occurs in a wet meadow on a valley bottom. The site is flat and occurs at 2391 m in elevation. The ground surface has moderate exposure of bare soil and moderate to high cover of litter. Soils are well-drained silt loams that formed in alluvium.

*Globally*

*Mimulus guttatus* is a small, delicate herb growing within the splash zone of small first-order streams, seeps, springs and hanging gardens. It occurs from 300 to 2390 m (1000-7840 feet) in elevation. This small community is often found in narrow linear strips, occasionally broadening into small hollows, often overlooked for sampling, but universally recognized. It can occur on very steep cascades and waterfalls, on flat to steep seeps, or along gentle streams and floodplains (3-5%) often bordered by a wet meadow community (graminoid- or forb-dominated). Substrates include mixed alluvium, serpentinite, and volcanics.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is dense (85% cover) and is characterized by the forb *Mimulus guttatus* that provides 7% cover. The graminoid layer is moderately diverse floristically, provides moderate cover, and is characterized by the non-native rhizomatous grass *Poa pratensis* and the native graminoids *Juncus balticus* and *Koeleria macrantha*. The remaining forb layer is floristically diverse, provides low cover, and includes *Symphyotrichum ascendens (= Aster ascendens), Polygonum douglasii, Achillea millefolium, Epilobium ciliatum*, and *Taraxacum officinale*.

*Globally*

The floristic composition is variable; several different species of *Mimulus* (*Mimulus guttatus, Mimulus lewisii, Mimulus moschatus*) may be the most dominant present. Generally, mosses are present, as well as several other water-dependent herbaceous plants such as *Stellaria media, Collinsia heterophylla, Cardamine* spp., *Eleocharis* spp., *Epilobium* spp., *Equisetum arvense, Carex* spp., *Salix* spp., *Juncus* spp., *Veronica americana, Rorippa nasturtium-aquaticum, Cardamine* spp., and *Rorippa* spp. (= *Nasturtium* spp.). Graminoid species are usually present as well, often less abundant than the forb component, but usually very mesic. Occasionally, the graminoid component may be more abundant, and the *Mimulus* spp. component serves as an indicator species to this community.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Mimulus guttatus*, *Symphyotrichum ascendens* |
| Herb (field) | *Juncus balticus*, *Poa pratensis* |

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**

*Bryce Canyon National Park*

**Exotic/Invasive**: *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic)

*Globally*

**Exotic/Invasive**: *Stellaria media* (exotic, Low)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (9-Mar-2007).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Herbaceous wetland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Large flat area is obviously moist and may even hold standing water during some times of the year; plants are packed tightly into every available square inch of soil.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0251).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* G. Kittel and J. Evens

**REFERENCES:** Diaz and Mellen 1996, Klein et al. 2007, Padgett et al. 1989, Potter 2005, Smith 1998b, Western Ecology Working Group n.d.

## *Eriogonum corymbosum* Badlands Sparse Vegetation

## Crispleaf Buckwheat Badlands Sparse Vegetation

| | |
|---|---|
| CODE | CEGL002979 |
| PHYSIOGNOMIC CLASS | Sparse Vegetation (VII) |
| PHYSIOGNOMIC SUBCLASS | Unconsolidated material sparse vegetation (VII.C.) |
| PHYSIOGNOMIC GROUP | Sparsely vegetated soil slopes (VII.C.3.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural sparsely vegetated soil slopes (VII.C.3.N.) |
| FORMATION | Dry slopes (VII.C.3.N.b.) |
| ALLIANCE | PAINTED DESERT SPARSELY VEGETATED ALLIANCE (A.2545)<br>Painted Desert Sparsely Vegetated Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Shale Badland (CES304.789)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This unusual sparse short-shrub association occurs on barren shale badlands. Sites are flat to steep slopes, occur between 1219 and 2670 m (4000-8760 feet) elevation, and are oriented to all aspects. The unvegetated surface has high exposure of bare soil, up to 88%. Litter is sparse. Parent materials are Moenkopi, Morrison, Mancos, Tropic or Chinle shales and the Clarion Formation that erode to badlands deposits. Vegetation has difficulty taking hold on the highly erosive surface. Soils are rapidly drained clay loams or silty loams. Total vascular vegetation cover for this association rarely exceeds 20% and is usually closer to 10%. The vegetation is characterized by an open canopy of *Eriogonum corymbosum* that ranges in foliar cover from 5 to 20%. Associated shrubs include *Atriplex confertifolia, Ephedra torreyana, Ericameria nauseosa, Psorothamnus fremontii, Salvia dorrii, Gutierrezia sarothrae, Chrysothamnus viscidiflorus, Xylorhiza glabriuscula*, and *Coleogyne ramosissima*. The herbaceous layer is low in species diversity and provides sparse cover. No species of graminoid or forb provides greater than 1% cover. Graminoids recorded include *Achnatherum hymenoides, Aristida purpurea, Elymus elymoides, Hesperostipa comata, Leymus salinus*, and *Pleuraphis jamesii*. Forbs include *Astragalus kentrophyta, Lomatium minimum, Machaeranthera canescens, Sphaeralcea coccinea, Chamaesyce fendleri, Amsonia tomentosa, Thelesperma subnudum var. subnudum*, and *Cryptantha tenuis*. At Bryce Canyon, *Pinus edulis* and *Juniperus osteosperma* saplings provide sparse cover in some stands.

**DISTRIBUTION**

*Bryce Canyon National Park*
This sparse dwarf-shrubland is unusual and occurs on badlands. It was sampled at Rainbow Point and in Jim Hollow near Yellow Creek. It was also observed at seven Accuracy Assessment points in 2007.

*Globally*
This association has been described from southern and eastern Utah.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This sparse shrubland occurs on a valleyside and ridges. Sites are steep (22- to 27-degree slopes), occur between 2019 and 2669 m in elevation, and are oriented to all exposures. The ground surface has moderate to high exposure of bare soil, low cover of litter, no to sparse exposure of bedrock, and sparse to low cover of small and large rocks. Soils are rapidly drained clays derived from Tropic Shale and Claron Formation (Pink Member).

*Globally*
This unusual sparse short-shrub association occurs on barren shale badlands. Sites are flat to gentle to moderately steep, occur between 1219 and 2670 m (4000-8760 feet) elevation, and are oriented to all aspects. The unvegetated surface has high exposure of bare soil, up to 88%, although some slopes have a moderate cover of colluvial boulders. Litter is sparse. Parent materials are Moenkopi, Morrison, Mancos, Tropic or Chinle shales and Clarion Formation that erode to badlands deposits. Vegetation has difficulty taking hold on the highly erosive surface. Soils are rapidly drained sandy clays or silty clays.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (5-24% cover) and is characterized by the short shrub *Eriogonum corymbosum* that provides 2-12% cover. The canopy tree layer provides sparse cover, attains heights between 5 and 10 m, and includes *Pinus edulis* and *Juniperus osteosperma*. The remaining short- and dwarf-shrubs are moderate in terms of floristic diversity, provide sparse to low cover, and include *Chrysothamnus depressus* and *Gutierrezia sarothrae*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse cover. The graminoid layer includes *Achnatherum hymenoides, Hesperostipa comata, Leymus salinus*, and *Pleuraphis jamesii*. Forbs include *Astragalus kentrophyta, Lomatium minimum, Machaeranthera canescens*, and *Sphaeralcea coccinea*. *Pinus edulis* and *Juniperus osteosperma* saplings provide sparse cover in some stands.

*Globally*
Total vascular vegetation cover for this association rarely exceeds 20% and is often closer to 10%. The vegetation is characterized by an open canopy of *Eriogonum corymbosum* that ranges in foliar cover from 5 to 20%. Associated shrubs include *Amsonia tomentosa, Atriplex confertifolia, Ephedra torreyana, Ericameria nauseosa, Psorothamnus fremontii, Salvia dorrii, Gutierrezia sarothrae, Chrysothamnus viscidiflorus, Xylorhiza glabriuscula*, and *Coleogyne ramosissima*. The herbaceous layer is low in species diversity and provides sparse cover. No species of graminoid or forb provides greater than 1% cover. Graminoids recorded include *Achnatherum hymenoides, Aristida purpurea, Elymus elymoides, Hesperostipa comata, Leymus salinus*, and *Pleuraphis jamesii*. Forbs include *Astragalus kentrophyta, Lomatium minimum, Machaeranthera canescens, Sphaeralcea coccinea, Chamaesyce fendleri, Amsonia tomentosa, Thelesperma subnudum var. subnudum*, and *Cryptantha tenuis*. At Bryce Canyon, *Pinus edulis* and *Juniperus osteosperma* saplings provide sparse cover in some stands.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Eriogonum corymbosum* |
| Herb (field) | *Lomatium minimum* |
| Herb (field) | *Achnatherum hymenoides* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Eriogonum corymbosum* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
**Vulnerable**: *Lomatium minimum* (globally vulnerable, G3); **Exotic/Invasive**: *Bromus tectorum* (exotic, High), *Halogeton glomeratus* (exotic, High/Medium)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (22-Jan-2002).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Dwarf-shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Almost no rocks or pebbles here and the drying surface has a physical crust that is cracking into geometric shapes; plants appear dry on this aspect with quite a few dead branches in the shrubs.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (2 plots: BRCA.0391, BRCA.0393; and 1 observation point: BRCA.9261) and 2007 Accuracy Assessment (7 points: BRCA_AA.0279, BRCA_AA.0282, BRCA_AA.0342, BRCA_AA.0350, BRCA_AA.0635, BRCA_AA.0723, BRCA_AA.0092).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* J. Coles, mod. G. Kittel

**REFERENCES:** Cogan et al. 2004, Western Ecology Working Group n.d.

## *Zuckia brandegeei* Sparse Vegetation

### Siltbush Sparse Vegetation

| | |
|---|---|
| CODE | CEGL002493 |
| PHYSIOGNOMIC CLASS | Sparse Vegetation (VII) |
| PHYSIOGNOMIC SUBCLASS | Unconsolidated material sparse vegetation (VII.C.) |
| PHYSIOGNOMIC GROUP | Sparsely vegetated soil slopes (VII.C.3.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural sparsely vegetated soil slopes (VII.C.3.N.) |
| FORMATION | Dry slopes (VII.C.3.N.b.) |
| ALLIANCE | *ZUCKIA BRANDEGEEI* SPARSE VEGETATION ALLIANCE (A.2653)<br>Siltbush Sparse Vegetation Alliance |

**ECOLOGICAL SYSTEM(S):** Inter-Mountain Basins Shale Badland (CES304.789)

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*
This sparsely vegetated association is common on plateaus at Petrified Forest National Park but occurs elsewhere in the Colorado Plateau of northern Arizona and eastern Utah. In Arizona, it is found on plateaus, plains, alluvial fans, steep colluvial and badlands slopes or shale hogbacks. It is also found on eroding shales of the high plateaus of southern Utah. Elevation ranges from 1341-2078 m (4397-6815 feet). The soil is rapidly drained clay loam derived from shales such as the Salt Wash Member of the Morrison Formation or Chinle, Moenkopi, Tropic Shale and Curtis formations. The unvegetated surface typically has high cover of shale chips, sandstone rocks, basalt gravel, conglomerate or petrified wood forming a desert pavement surface. Exposure of bare soil is low. The vegetation has a sparse canopy consisting of *Zuckia brandegeei* with scattered *Atriplex confertifolia* and *Gutierrezia microcephala*.

The herbaceous layer is low in diversity and provides sparse cover. The bunch grasses *Leymus salinus* and *Pleuraphis jamesii* are present. Forbs include *Platyschkuhria integrifolia* and *Xylorhiza venusta*.

**DISTRIBUTION**

*Bryce Canyon National Park*

This sparse short shrubland is uncommon, occurs on steep badland exposures, and was sampled along Yellow Creek and in Death Hollow within the environs.

*Globally*

This association is widespread in the painted desert and canyonlands regions of the Colorado Plateau of Utah and northern Arizona, and high plateaus of southern Utah.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*

This short shrubland occurs on badland exposures of ravines and canyonsides. Sites are steep (20- to 30-degree slopes), occur between 2048 and 2078 m in elevation, and are oriented to all aspects. The ground surface has high exposure of bare soil, low cover of litter, sparse to low cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained clays, silty clays, and silty clay loams derived from Tropic Shale.

*Globally*

This sparsely vegetated association is common on plateaus at Petrified Forest National Park but occurs elsewhere on plains, alluvial fans, steep colluvial and badlands slopes or shale hogbacks in the Colorado Plateau of northern Arizona and eastern Utah. Elevation ranges from 1341-2078 m (4397-6815 feet). The soil is a rapidly drained clay loam derived from shales. Parent material include the Salt Wash Member of the Morrison Formation, or Chinle, Moenkopi, Tropic Shale and Curtis formations or mixed colluvium. The unvegetated surface typically has high cover of shale chips, sandstone rocks, basalt gravel, conglomerate or petrified wood forming a desert pavement surface. Exposure of bare soil is low to high.

**VEGETATION DESCRIPTION**

*Bryce Canyon National Park*

Total vegetation cover is low to moderate (6-39% cover) and is characterized by the short shrub *Zuckia brandegeei* that provides 6-12% cover. Other short-shrub species present include *Atriplex canescens, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Eriogonum corymbosum*, and *Sarcobatus vermiculatus*. The herbaceous layer is low in floristic diversity and provides sparse cover. Common bunch grasses include *Achnatherum hymenoides, Elymus elymoides*, and *Leymus salinus*. The forb layer is variable, with no species present at 1% or more cover, and includes the non-native annual *Salsola tragus* and the natives *Machaeranthera canescens* and *Mentzelia multiflora*.

*Globally*

This association has a sparse canopy consisting of *Zuckia brandegeei* with scattered *Artemisia bigelovii, Atriplex canescens, Atriplex confertifolia, Atriplex obovata, Chrysothamnus viscidiflorus, Coleogyne ramosissima, Ericameria nauseosa, Eriogonum corymbosum, Eriogonum leptocladon, Ephedra torreyana, Ephedra viridis, Xylorhiza glabriuscula, Gutierrezia microcephala, Sarcobatus vermiculatus*, and *Gutierrezia sarothrae*. The herbaceous layer is low in diversity and provides sparse cover. The bunch grasses *Achnatherum hymenoides, Elymus elymoides, Leymus salinus*, and *Pleuraphis jamesii* are present. Forbs include *Arabis holboellii, Cryptantha* sp., *Cymopterus acaulis, Eriogonum inflatum, Galium coloradoense, Machaeranthera canescens, Mentzelia multiflora, Penstemon barbatus, Platyschkuhria integrifolia*, and *Xylorhiza venusta*. The exotics *Bromus tectorum* and *Salsola tragus* may be present in some stands.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Zuckia brandegeei* |
| Herb (field) | *Leymus salinus* |

*Globally*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Zuckia brandegeei* |
| Herb (field) | *Pleuraphis jamesii* |

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Salsola tragus* (exotic)

*Globally*
**Vulnerable**: *Zuckia brandegeei* var. *arizonica* (globally vulnerable; endemic to northeastern Arizona and the southern Colorado Plateau, G4T3); **Exotic/Invasive**: *Bromus tectorum* (invasive/exotic, High), *Salsola tragus* (invasive/exotic)

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (29-Mar-2005).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Dwarf-shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:** 2 - Moderate

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Steep, rockless slope with a hot, dry exposure; slope is regularly transected by gullies/drainage channels; soil mounding on the backsides of the shrubs; most vegetation establishes along ridges not on the steep slope face.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plot: BRCA.0158, BRCA.0159, BRCA.0160, BRCA.0161; and 1 observation point: BRCA.9264); and 2007 Accuracy Assessment (10 points: BRCA_AA.0621, BRCA_AA.0655, BRCA_AA.0669, BRCA_AA.0674, BRCA_AA.0681, BRCA_AA.0695, BRCA_AA.0697, BRCA_AA.0706, BRCA_AA.0710, BRCA_AA.0594).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:* K.A. Schulz, mod. G. Kittel

**REFERENCES:** Western Ecology Working Group n.d.

## *Abies concolor / Purshia tridentata* Forest [Park Special]

## White Fir / Antelope Bitterbrush Forest

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This type was observed at only one Accuracy Assessment point in 2007, therefore no local descriptive information is available.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**

*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0908).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Cercocarpus ledifolius* Woodland Alliance

## Curl-leaf Mountain Mahogany Woodland Alliance

CODE A0586

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland was sampled only twice on colluvial slopes near Paria View and in Pasture Canyon.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short-statured woodland occurs on steep, unstable colluvial slopes. Sites are steep (38- to 45-degree slopes), occur between 2307 and 2409 m in elevation, and are oriented to the southwest. The ground surface has low to high cover of large and small rocks, sparse cover of litter and downed wood, no to high exposure of bedrock, and no to low exposure of bare soil. Soils are rapidly drained and are derived from the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low (13-21% cover) and is characterized by the canopy tree *Cercocarpus ledifolius* that ranges in height from 2-5 m and provides 11-20% cover. *Pinus flexilis* provides sparse cover in the canopy layer of one stand. The tall- and short-shrubs are low in terms of species composition, provide sparse cover, and include *Quercus gambelii* and *Ericameria nauseosa*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Cercocarpus ledifolius* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand has become established on bedrock, site is steep and gullied, data were determined using binoculars; colluvial slope with areas of landslide and rockfall support this stand, unstable slope.

*Bryce Canyon National Park* Plots: The description is based on 2006 field data (2 observation points: BRCA.9203, BRCA.9269).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Picea pungens / Bromus inermis* Woodland [Park Special]

## Blue Spruce / Smooth Brome Woodland

CODE CEPS009558

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This disturbed woodland association is uncommon overall but locally common along the river, and was sampled south of Tropic Reservoir.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This semi-natural woodland association occurs on mechanically terraced slopes above the East Fork of the Sevier River. The site is gentle (5-degree slope), occurs at 2401 m in elevation, and is oriented to the northwest. The ground surface has high cover of litter and duff, high exposure of bare soil, sparse cover of large and small rocks, and sparse cover by downed wood. Soils are rapidly drained loams.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to high (67% cover) and is characterized by the canopy tree *Picea pungens* that ranges in height from 10-15 m and provides 16% cover, and the non-native rhizomatous grass *Bromus inermis* that provides 35% cover. *Pinus ponderosa* is an associated canopy tree that contributes low cover. The short- and dwarf-shrub layers are low in floristic diversity, provide low cover, and include *Artemisia nova, Ericameria parryi*, and *Juniperus communis*. The remaining herbaceous layer is moderately diverse and provides sparse cover. Associated graminoids include *Carex rossii, Juncus balticus*, and *Poa fendleriana*. The more common forbs include *Antennaria rosulata, Arenaria fendleri, Eriogonum racemosum*, and *Potentilla hippiana*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia nova* |
| Herb (field) | *Bromus inermis* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Achillea millefolium* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Slopes were terraced and artificially seeded in the 1960s under a Range Improvement/Erosion Control Project. The site is currently grazed by cattle. *Picea pungens* dominates the mesic portions of the lower slope, while *Pinus ponderosa* occurs on higher, drier slopes.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0182).
*Local Description Authors:* J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Colorado Plateau Woodland [Park Special]

### Ponderosa Pine - Douglas-fir / Greenleaf Manzanita Colorado Plateau Woodland

CODE CEPS009562

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland is common, occurs on Claron Formation exposures, and was sampled along the trail from Bryce Point to Inspiration Point, near Paria View, southwest of Fairyland Point, north of Puma Hollow, Bridge Hollow, Corral Hollow, Whiteman Bench, East Creek, Fairview Point, northwest of Noon Canyon Butte, southwest Mud Canyon Butte, in Oak Hollow, in Water Canyon, west of Agua Canyon, and on the Paunsaugunt Plateau.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*

This common woodland association occurs on the midslopes of mountains, hills, valleys, canyons and on plateau and ridgetops. Sites are gentle to steep (0- to 30-degree slopes), occur between 2259 and 2684 m in elevation, and are oriented to all aspects. The ground surface has low to high cover of litter and duff, sparse to moderate cover of large and small rocks, low to moderate exposure of bare soil, and sparse to moderate cover by downed wood ranges. Litter and duff depths range from 0-8.5 cm. Soils are rapidly drained silty clays, silty clay loams, sandy loams, and sandy clay loams derived from the Claron Formation (Pink and White members).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (25-78% cover) and is characterized by the canopy trees *Pinus ponderosa* and *Pseudotsuga menziesii* that range in height from 5-15 m, have dbh ranging from 12-59 cm and 13-63 cm, respectively, and provide 2-28% and 2-19% cover, respectively, and by the short shrub *Arctostaphylos patula* that contributes 6-26% cover. The remaining canopy layer provides sparse to low cover and includes *Picea pungens, Pinus flexilis*, and *Populus tremuloides*. The subcanopy layer is 2-5 m tall, provides sparse to low cover, and includes *Abies concolor, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus flexilis, Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*. Other shrubs present include *Acer grandidentatum, Amelanchier utahensis,Cercocarpus montanus, Ceanothus martinii, Juniperus communis, Purshia tridentata, Symphoricarpos oreophilus, Mahonia repens*, and *Paxistima myrsinites*. The herbaceous layer is floristically diverse and contributes sparse to low cover. Common graminoids include *Achnatherum hymenoides, Carex rossii, Elymus elymoides, Leymus salinus*, and *Poa fendleriana*. Forbs include *Achillea millefolium, Cirsium calcareum, Erysimum capitatum (= Erysimum asperum)*, and *Packera multilobata (= Senecio multilobatus)*. Tree saplings provide sparse cover and include *Abies concolor, Juniperus scopulorum, Pinus edulis, Pinus flexilis, Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pseudotsuga menziesii* |
| Tree canopy | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus scopulorum* |
| Tall shrub/sapling | *Cercocarpus montanus* |
| Short shrub/sapling | *Arctostaphylos patula* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Achillea millefolium* (exotic), *Agropyron cristatum* (exotic, Medium/Low), *Taraxacum officinale* (exotic)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Douglas-fir forests.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand has high seedling diversity; heavy litter in stand, no evidence of fire; site was logged of large trees historically, rocky substrate; soils are rocky; stand has been thinned; site is a series of rolling ridges and gullies; quaking aspen is colonizing one burned stand.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (9 plots: BRCA.0017, BRCA.0047, BRCA.0081, BRCA.0092, BRCA.0111, BRCA.0130, BRCA.0174, BRCA.0212, BRCA.0297) and 2007 Accuracy Assessment (33 points: BRCA_AA.0044, BRCA_AA.0135, BRCA_AA.0273, BRCA_AA.0423, BRCA_AA.0425, BRCA_AA.0440, BRCA_AA.0451, BRCA_AA.0521, BRCA_AA.0539, BRCA_AA.0591, BRCA_AA.0629, BRCA_AA.0873, BRCA_AA.0877, BRCA_AA.0891, BRCA_AA.0903, BRCA_AA.0947, BRCA_AA.0953, BRCA_AA.0957, BRCA_AA.0958, BRCA_AA.0960, BRCA_AA.0964, BRCA_AA.0967, BRCA_AA.0972, BRCA_AA.0975, BRCA_AA.0995, BRCA_AA.1023, BRCA_AA.1057, BRCA_AA.1064, BRCA_AA.1095, BRCA_AA.1131, BRCA_AA.1155, BRCA_AA.1162, BRCA_AA.1180).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Park Special]

## Ponderosa Pine / Curl-leaf Mountain-mahogany / Greenleaf Manzanita Woodland

CODE CEPS009559

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland occurs on rocky soils at the lowest park elevations, and was sampled in Corral Hollow and in Campbell Canyon, and at six Accuracy Assessment points in 2007.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This woodland occurs on terraces of washes and in a hollow. Sites are gentle (2- to 3-degree slopes), occur between 2211 and 2235 m in elevation, and are oriented to the southeast. The ground surface has moderate to high cover of litter and duff, low to moderate cover of large and small rocks, and low exposure of bare soil. Litter depths range from 0-2.5 cm. Soils are rapidly drained sandy loams and loams derived from New Alluvium.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (38-64% cover) and is characterized by the emergent and canopy tree *Pinus ponderosa* that ranges in height from 10-35 m, has dbh ranging from 34-47 cm, and provides 6-9% cover; the subcanopy tree *Cercocarpus ledifolius* that is 2-10 m tall and provides 4-11% cover; and the short shrub *Arctostaphylos patula* that contributes 4-10% cover. Associated canopy trees include *Juniperus scopulorum* and

*Pseudotsuga menziesii* that contribute sparse cover. Additional subcanopy trees include *Acer grandidentatum, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus ponderosa*, and *Populus tremuloides* that range from 2-10 m tall and contribute sparse cover. Other shrubs present with sparse cover include *Cercocarpus montanus, Mahonia fremontii, Quercus gambelii, Ceanothus martinii, Juniperus communis, Purshia tridentata, Symphoricarpos oreophilus*, and *Mahonia repens*. The herbaceous layer is moderate in floristic diversity and contributes sparse cover. Common graminoids include *Carex rossii* and *Leymus salinus*. Forbs include *Stenotus armerioides (= Haplopappus armerioides), Linum perenne*, and *Lithospermum multiflorum*. Seedling trees up to 2 m tall provide sparse cover and include *Abies concolor, Cercocarpus ledifolius, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis, Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus osteosperma* |
| Tree subcanopy | *Cercocarpus ledifolius* |
| Tall shrub/sapling | *Quercus gambelii* |
| Short shrub/sapling | *Arctostaphylos patula* |
| Herb (field) | *Mahonia repens* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Established on a low terrace adjacent to a wash, soils are rocky; diverse stand of mature ponderosa pine and curl-leaf mountain mahogany, little understory.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0124, BRCA.0126, BRCA.0177) and 2007 Accuracy Assessment (6 points: BRCA_AA.0191, BRCA_AA.0405, BRCA_AA.0536, BRCA_AA.0572, BRCA_AA.0575, BRCA_AA.1158).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

*Pinus ponderosa / Elymus elymoides* - (*Elymus* spp.) Woodland [Park Special]

## Ponderosa Pine / Squirreltail - (Wildrye species) Woodland

CODE CEPS009560

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland is common on gentle to moderately steep slopes with deep soils, and was sampled near the park entrance, Visitor Center, Bryce Corral, Sunset Campground, along Bryce Point Road, at Paria View, on Yovimpa Pass, on Fairyland Point, and in East and Podunk creeks.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This common woodland association occurs on plains, ridges, hills, in hollows, valley slopes and floors, and canyons. Sites are flat to steep (0- to 24-degree slopes), occur between 2325 and 2529 m in elevation, and are oriented to all aspects. The ground surface has low to high cover of litter and duff, sparse to high cover of small and large rocks, no to moderate exposure of bare soil, and sparse cover of downed wood. Litter and duff measure from 0-5.5 cm deep. Soils are rapidly drained silts, silty clays, silty clay loams, sandy clay loams, sandy loams, silty loams, and loams derived from the Claron Formation (Pink and White members), or the Kaiparowitz Formation.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (14-66% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 5-20 m, has 12-107 cm dbh, and provides 0-38% cover, and the short bunch grasses *Elymus elymoides, Elymus glaucus, Thinopyrum intermedium (= Elymus hispidus), Elymus lanceolatus, Pseudoroegneria spicata (= Elymus spicatus)*, and *Leymus salinus (= Elymus salinus)* that contribute <1-8% cover. Associated canopy trees include 2- to 5-m tall *Juniperus scopulorum* and *Pseudotsuga menziesii* that provide low cover. The subcanopy layer provides sparse cover, ranges from 2-10 m tall, and includes *Juniperus osteosperma, Juniperus scopulorum, Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*. Other shrubs present include *Arctostaphylos patula, Ceanothus martinii, Chrysothamnus viscidiflorus, Purshia tridentata, Symphoricarpos oreophilus*, and *Tetradymia canescens*. Dwarf-shrub species provides sparse cover and includes *Artemisia nova, Chrysothamnus depressus, Ericameria parryi (= Chrysothamnus parryi), Gutierrezia sarothrae*, and *Mahonia repens*. The herbaceous layer is floristically diverse and provides sparse to moderate cover. Associated graminoids include *Achnatherum hymenoides, Carex rossii, Hesperostipa comata, Koeleria macrantha, Muhlenbergia montana*, and *Poa fendleriana*. Forbs include *Arenaria fendleri, Castilleja linariifolia, Cirsium calcareum, Eriogonum racemosum, Erysimum capitatum (= Erysimum asperum), Hymenopappus filifolius, Hymenoxys richardsonii, Lithospermum multiflorum, Oenothera howardii, Pedicularis centranthera, Petradoria pumila, Potentilla crinita*, and *Packera multilobata (= Senecio multilobatus)*. Tree saplings provide sparse to low cover and include *Pinus ponderosa, Populus tremuloides*, and *Pseudotsuga menziesii*. A few stands have sparse cover by moss species.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**

*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree (canopy & subcanopy) | *Pinus ponderosa* |
| Herb (field) | *Petradoria pumila* |
| Herb (field) | *Elymus elymoides*, *Hesperostipa comata* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Achillea millefolium* (exotic), *Bromus inermis* (exotic, High/Medium), *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Pine woodlands.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Stand occurs on deep soils with some limestone cobbles, the area has burned historically; dense stand of young trees, possibly re-colonizing post-burn, also there has been more recent fire; fire history with one fire intense enough to kill mature trees; site has been terraced and seeded for erosion control, grazing cattle were present; historic burn onsite; open multi-aged woodland, recently burned, rocky soil; stand limited to flat area of deep soils, past fire; recently burned stand; historically burned stand; burned by prescribed fire, soils are rocky; young stand with a few mature trees, historic fire, soils deep; medium-aged stand with many saplings, recent fire, deep soils; mixed-age stand in woodland park, deep litter and duff layer; historic fire evidence, gravelly soil; intense, recent fire, gravelly soil; recent burn, livestock grazing.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (16 plots: BRCA.0051, BRCA.0060, BRCA.0062, BRCA.0067, BRCA.0101, BRCA.0103, BRCA.0113, BRCA.0219, BRCA.0224, BRCA.0225, BRCA.0226, BRCA.0248, BRCA.0270, BRCA.0276, BRCA.0281, BRCA.0298); and 2007 Accuracy Assessment (1 point: BRCA_AA.1129).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus ponderosa / Petradoria pumila* Woodland [Park Special]

## Ponderosa Pine / Grassy Rock-goldenrod Woodland

CODE CEPS009561

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland occurs on one hilltop along State Highway 54.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This unique woodland association occurs on a hilltop. The site is gentle (5-degree slope), occurs at 2326 m in elevation, and is oriented to the southwest. The ground surface has moderate to high cover of litter and duff, moderate to high cover of small rocks, sparse cover of large rocks, sparse to low exposure of bare soil, and sparse to low cover of downed wood. Soils are well-drained and are derived from the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (27% cover) and is characterized by the canopy and subcanopy tree *Pinus ponderosa* that ranges in height from 5-15 m and provides 6% cover, and the cushion plant *Petradoria pumila* that contributes 5% cover. The remaining subcanopy layer provides sparse cover, ranges from 5-10 m tall, and includes *Juniperus osteosperma* and *Pinus edulis*. Shrubs present include *Purshia tridentata, Artemisia nova, Chrysothamnus depressus*, and *Gutierrezia sarothrae* with sparse cover. The graminoid layer provides sparse cover and includes *Elymus elymoides* and *Achnatherum hymenoides*. Seedling *Pinus edulis* and *Pinus ponderosa* trees provide sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**

*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Ponderosa pine woodland stand with significant cushion plant understory, trees are young and well-spaced.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 observation point: BRCA.9233).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus ponderosa* / Seeded Grasses Semi-natural Woodland [Park Special]

## Ponderosa Pine / Seeded Grasses Semi-natural Woodland

CODE CEPS009563

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This woodland has limited distribution in the park and was sampled only in the Riggs Spring area.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This woodland occurs in a valley. The site is gentle (2-degree slope), occurs at 2254 m in elevation, and is oriented to the east. The ground surface has high cover of litter and duff, sparse to low cover of small rocks, sparse to low exposure of bare soil, and sparse to low cover of downed wood. Soils are moderately well-drained.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (39% cover) and is characterized by the canopy tree *Pinus ponderosa* that ranges in height from 15-20 m and provides 7% cover, and the seeded grasses *Thinopyrum intermedium (= Elymus hispidus)* and *Achnatherum lettermanii* that contribute 20% cover. The subcanopy layer provides sparse cover, ranges from 2-5 m tall, and includes *Juniperus osteosperma, Juniperus scopulorum*, and *Pinus ponderosa*. Shrubs that may be present include *Arctostaphylos patula, Ericameria nauseosa*, and *Symphoricarpos oreophilus*. Associated graminoids provide sparse cover and include *Carex rossii* and *Elymus elymoides*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Pinus ponderosa* |
| Tree subcanopy | *Juniperus scopulorum* |
| Herb (field) | *Achnatherum lettermanii*, *Thinopyrum intermedium* |

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Level area supports mature trees, the understory is variable and diverse.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 observation point: BRCA.9253).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Pinus ponderosa* Sparse Woodland [Park Special]

### Ponderosa Pine Sparse Woodland

CODE CEPS009564

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This unusual woodland was sampled in the Fairyland Canyon, Mossy Cave, Tropic Canyon, and Water-Tropic Canyon areas.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This open sparse woodland occurs only on the Claron Pink Formation and occurs on low and upper slopes. It was observed between 2160 and 2308 m in elevation. The ground cover is open and barren with bare soil (20-60%) and/or gravel (40-60%). Litter cover is very sparse.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
This woodland is characterized by a very open canopy of mature trees. Total tree canopy cover is less than 5%. Tree species present are *Juniperus osteosperma, Pinus flexilis, Pinus ponderosa, Juniperus scopulorum, Pinus edulis*, and *Pseudotsuga menziesii*. The shrub understory is equally sparse with cover rarely reaching 5% and includes *Arctostaphylos patula, Cercocarpus montanus, Tetradymia canescens*, and/or *Cercocarpus montanus*. Herbs, when present, are also very sparse with less than 2% cover and may include *Heterotheca villosa (= Chrysopsis villosa), Cryptantha flava, Eriogonum panguicense, Stenotus armerioides (= Haplopappus armerioides), Machaeranthera grindelioides, Leymus salinus (= Elymus salinus)*, and/or *Pseudoroegneria spicata (= Elymus spicatus)*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Juniperus osteosperma*, *Pinus flexilis* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
This woodland is similar to *Pinus longaeva* Woodland, in that it appears to be restricted to the Claron Formation, but has a consistently more open canopy and no *Pinus longaeva* present in the stands observed for this type.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: The description is based on 2007 Accuracy Assessment (7 points: BRCA_AA.0088, BRCA_AA.0103, BRCA_AA.0148, BRCA_AA.0150, BRCA_AA.0166, BRCA_AA.0184, BRCA_AA.0186).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Populus tremuloides / Acer grandidentatum* Forest [Park Special]

## Quaking Aspen / Bigtooth Maple Forest

CODE CEPS009582

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This type was observed at only one Accuracy Assessment point in 2007, therefore no local descriptive information is available.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.1069).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

*Artemisia tridentata ssp. tridentata / Agropyron cristatum* Semi-natural Shrubland [Park Special]

## Basin Big Sagebrush / Crested Wheatgrass Semi-natural Shrubland

CODE CEPS009566

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This tall shrubland was sampled in Pasture Wash and at the base of Noon Canyon Butte in the environs.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This tall shrubland occurs on canyon bottoms and toeslopes. Sites are gentle (3- to 4-degree slopes), occur between 2103 and 2161 m in elevation, and are oriented to all aspects. The ground surface has low to moderate exposure of bare soil, moderate to high cover of litter, and sparse cover of downed wood. Soils are rapidly drained sandy loams that are derived from New Alluvium.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (53-63% cover) and is characterized by the tall shrub *Artemisia tridentata ssp. tridentata* that provides 18-63% cover, the short shrub *Artemisia tridentata ssp. vaseyana* that provides 20% cover in one stand, and the seeded bunchgrass *Agropyron cristatum* that provides 0-36% cover. The remaining short and dwarf-shrubs *Ericameria nauseosa, Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae* provide sparse cover. The herbaceous layer is represented by additional grasses that provide sparse cover and include *Bouteloua gracilis, Thinopyrum intermedium (= Elymus hispidus), Psathyrostachys juncea (= Elymus junceus)*, and *Elymus lanceolatus*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Artemisia tridentata* ssp. *tridentata* |
| Short shrub/sapling | *Artemisia tridentata* ssp. *vaseyana* |
| Herb (field) | *Agropyron cristatum* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Canyon bottom community on deep alluvial soils, type occurs wherever there are openings in the canopy; community has been strongly shaped by cattle grazing; seeded with exotic grasses, and heavily grazed at some point in the past; crested wheatgrass is the dominant herbaceous species, to the exclusion of other species, big sagebrush shrubs may represent hybrids; stand occurs as a small, unique patch on alluvium.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0304); and 2 observation points: BRCA.9066, BRCA.9226).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Artemisia tridentata ssp. wyomingensis / Elymus lanceolatus* Shrubland [Park Special]

## Wyoming Big Sagebrush / Streambank Wheatgrass Shrubland

CODE CEPS009565

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This shrubland was sampled in Pasture Wash outside of the park boundary.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short shrubland occupies a canyon bottom. The site is gentle (2-degree slope), occurs at 2086 m in elevation, and is oriented to the southwest. The ground surface has high exposure of bare soil, low cover of litter, and sparse cover of downed wood. Soils are deep, rapidly drained clay loams that are derived from New Alluvium.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*

Total vegetation cover is moderate (28% cover) and is characterized by the short shrub *Artemisia tridentata ssp. wyomingensis* that provides 8% cover and the rhizomatous grass *Elymus lanceolatus* that provides 7% cover. The remaining short and dwarf-shrubs provide low cover and include *Tetradymia canescens* and *Gutierrezia sarothrae*. The remaining herbaceous layer provides sparse cover and includes the grasses *Bouteloua gracilis*, the non-native rhizomatous grass *Bromus inermis*, and the seeded bunchgrass *Agropyron cristatum*. Forbs provide sparse cover and include *Chaetopappa ericoides, Artemisia ludoviciana, Comandra umbellata*, and *Sphaeralcea coccinea*. A soil cryptogram layer including dark cyanobacteria provides sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Artemisia tridentata* ssp. *wyomingensis* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Agropyron cristatum* (G5), *Bromus inermis* (G5)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Exotic grasses have probably invaded here from seeded areas down canyon; soils are deep, fine, and not at all rocky.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0317).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Atriplex canescens / Elymus (elymoides, salinus)* Shrubland [Park Special]

## Fourwing Saltbush / (Squirreltail, Saline Wildrye) Shrubland

CODE CEPS009567

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This shrubland was sampled in Yellow Creek, Bryce Creek, Campbell Canyon, and Death Hollow.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This shrubland occurs on gentle to moderate slopes ranging from 1 to 20% grades, mostly on lower slopes and toeslopes but also on midslope and upper slope positions. It occurs from 2009 to 2091 m in elevation. Surface geology is primarily Tropic Shale and Quaternary Alluvium. All sampled stands have signs of soil erosion and much standing dead vegetation.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
This shrubland is dominated by *Atriplex canescens* with 4-15% cover. A few *Pinus edulis* or *Juniperus osteosperma* trees may be present, but only a few individuals. Some stands have near equal cover of *Artemisia tridentata ssp. vaseyana* and *Atriplex canescens*, but only when cover is very low (4%). Other shrubs that may present include *Eriogonum corymbosum* and *Gutierrezia sarothrae*. The herbaceous cover ranges from 1-30% cover and is usually less than 10%. Typical species present include *Leymus salinus (= Elymus salinus), Elymus elymoides, Pascopyrum smithii (= Elymus smithii)*, and *Pleuraphis jamesii (= Hilaria jamesii)*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Atriplex canescens* |
| Herb (field) | *Leymus salinus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
This shrubland is very similar to *Atriplex canescens - Artemisia tridentata* Shrubland (CEGL001282).

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: The description is based on 2007 Accuracy Assessment (14 points: BRCA_AA.0347, BRCA_AA.0366, BRCA_AA.0468, BRCA_AA.0546, BRCA_AA.0701, BRCA_AA.0794, BRCA_AA.0796, BRCA_AA.0798, BRCA_AA.0817, BRCA_AA.0819, BRCA_AA.0829, BRCA_AA.0846, BRCA_AA.0860, BRCA_AA.0864).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Atriplex canescens / Psathyrostachys juncea* Seeded Shrubland [Park Special]

## Fourwing Saltbush / Russian Wildrye Seeded Shrubland

CODE CEPS009568

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This shrubland was sampled only at Yellow Creek.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This shrubland occurs on gentle to flat slopes with southern exposures, on alluvial surfaces with fine silty soils. Elevation ranges from 1999 to 2060 m.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
This shrubland is dominated by *Atriplex canescens*. Other shrub specie present may include *Krascheninnikovia lanata* and *Artemisia tridentata*. The herbaceous cover is characterized by the presence of *Psathyrostachys juncea (= Elymus junceus)* which was seeded for soil erosion abatement. This introduced species has a cover of 3-50%. Other herbaceous species include *Elymus elymoides, Pascopyrum smithii (= Elymus smithii), Agropyron cristatum, Sporobolus airoides*, and *Bouteloua gracilis*, which range in cover from 1 to 10%.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Atriplex canescens* |
| Herb (field) | *Psathyrostachys juncea* |

*Globally*

Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: The description is based on 2007 Accuracy Assessment (4 points: BRCA_AA.0826, BRCA_AA.0856, BRCA_AA.0870, BRCA_AA.0872).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Cercocarpus montanus* Desert Wash Shrubland [Park Special]

## Alderleaf Mountain-mahogany Desert Wash Shrubland

CODE CEPS009570

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This tall shrubland was only sampled on a canyon terrace in Tropic Canyon.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This tall shrubland occurs on a canyon terrace. The site is gentle (3-degree slope), occurs at 2236 m in elevation, and is oriented to the southeast. The ground surface has sparse exposure of bare soil, high cover of small rocks, low cover of large rocks and litter, and sparse cover of downed wood. Soils are rapidly drained sandy clay loams derived from the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low (16% cover) and is characterized by the tall shrub *Cercocarpus montanus* that provides 8% cover. The 5- to 10-m tall canopy trees *Pinus ponderosa* and *Juniperus scopulorum* provide sparse cover. Short-shrubs have low floristic diversity, provide sparse cover, and includes *Purshia tridentata, Ericameria nauseosa*, and *Arctostaphylos patula*. The herbaceous layer is low in floristic diversity, provides sparse cover, and includes the forbs *Solidago velutina, Hymenopappus filifolius*, and *Lithospermum multiflorum*. *Pinus ponderosa* saplings provide sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tall shrub/sapling | *Cercocarpus montanus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terraces and banks are 2-3 feet above the bottom of the wash channel; there's no sign of any recent flooding above the banks; ground is extremely rocky and gravelly without much fine soil.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0375).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Chrysothamnus viscidiflorus* / Mixed Grasses Shrubland [Park Special]

## Yellow Rabbitbrush / Mixed Grasses Shrubland

CODE CEPS009579

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This short shrubland is uncommon and was sampled at Bryce Canyon Lodge, the Bryce/Paria Points area, near the North Campground, the Visitor Center, at Sunrise Point and in the East Creek drainage.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short shrubland occurs on valley bottoms, swales, and meadows. The sites are flat to gentle (0- to 2-degree slopes), occur between 2373 and 2446 m in elevation, and are oriented to all aspects. The ground surface has moderate exposure of bare soil, moderate to high cover of litter, and sparse to low cover of small rocks. Soils are rapidly drained silts, silty loams, and silty clay loams that are derived from New Alluvium or the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate to dense (40-75% cover) and is characterized by the short shrub *Chrysothamnus viscidiflorus* that provides 6-30% cover and five grass species that provide 11-34% cover. Grass species include *Poa secunda, Elymus trachycaulus, Elymus elymoides, Elymus lanceolatus, Koeleria macrantha, Hesperostipa comata, Achnatherum lettermanii*, and non-native *Poa pratensis*. Short and dwarf-shrubs provide sparse cover and include *Tetradymia canescens, Artemisia nova*, and *Artemisia frigida*. The remaining herbaceous layer is moderately diverse floristically, provides sparse to low cover, and includes the forbs *Symphyotrichum ascendens (= Aster ascendens), Taraxacum officinale, Tragopogon dubius, Achillea millefolium, Agoseris glauca, Potentilla crinita*, and *Artemisia ludoviciana*. A few stands may have *Chrysothamnus depressus* and *Ericameria parryi (= Chrysothamnus parryi)* in addition to *Chrysothamnus viscidiflorus*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Chrysothamnus viscidiflorus* |
| Herb (field) | *Elymus lanceolatus*, *Poa pratensis*, *Poa secunda* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Achillea millefolium* (exotic), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Soil is cracked and dry-looking in places, though community suggests that this area is much moister than surrounding slopes; meadow is not totally flat, possibly from prairie dog activity; meadow seems to be a natural opening in the forest without any sign that it was cleared by fire.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0054, BRCA.0204, BRCA.0277) and 2007 Accuracy Assessment (8 points: BRCA_AA.0006, BRCA_AA.0310, BRCA_AA.0413, BRCA_AA.0422, BRCA_AA.0445, BRCA_AA.0392, BRCA_AA.0407, BRCA_AA.0641).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Ericameria nauseosa / Achnatherum lettermanii* Shrubland [Park Special]

## Rubber Rabbitbrush / Letterman's Needlegrass Shrubland

CODE CEPS009571

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This short shrubland has limited distribution and was sampled along drainages in Black Birch Canyon and along the East Fork of the Sevier River.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short shrubland occurs on valley and canyon bottoms. Sites are gentle (3- to 5-degree slopes), occur between 2259 and 2430 m in elevation, and are oriented to all aspects. The ground surface has sparse to low exposure of bare soil, moderate to high cover of litter, and low cover of small rocks and downed wood. Soils are rapidly drained silty clay loams that are derived from the Straight Cliffs Formation (Upper Unit).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (33-58% cover) and is characterized by the short shrub *Ericameria nauseosa* that provides 12-14% cover and the bunchgrass *Achnatherum lettermanii* that provides up to 35% cover. Other shrubs present provide sparse cover and includes *Quercus gambelii Rosa woodsii, Symphoricarpos oreophilus, Chrysothamnus depressus, Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae*. The remaining herbaceous layer

is low in terms of species composition, provides sparse cover, and includes the bunchgrass *Hesperostipa comata*, the non-native *Poa pratensis*, and the forbs *Artemisia dracunculus, Artemisia ludoviciana*, and *Erigeron flagellaris*. Species of moss provide sparse cover (up to 4%) in one stand.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Ericameria nauseosa* |
| Herb (field) | *Achnatherum lettermanii*, *Hesperostipa comata* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Poa pratensis* (exotic, Medium), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Terrain is a small, flat-bottomed valley between two little ridges; soil seems deep and is probably derived from the Straight Cliffs-Upper Formation; several dead shrubs are present, but some of them are regenerating from the base; type is likely under-sampled.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.0381); and 1 observation point: BRCA.9259).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Tetradymia canescens* Shrubland [Park Special]

## Gray Horsebrush Shrubland

CODE CEPS009583

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This type was observed at only one Accuracy Assessment point in 2007, therefore no local descriptive information is available.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0476).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Purshia tridentata / Leymus salinus* Shrubland [Park Special]

## **Antelope Bitterbrush / Saline Wildrye Shrubland**

CODE CEPS009573

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This short shrubland is uncommon, occurs on plateaus, and was sampled in the environs across from an abandoned Standard Oil Station.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short shrubland occurs on a plateau. The site is gentle (2-degree slope), occurs at 2404 m in elevation, and is oriented to the north. The ground surface has moderate to high exposure of bare soil, low cover of litter, and moderate cover of small rocks. Soils are well-drained and are derived from the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (24% cover) and is characterized by the short shrub *Purshia tridentata* that provides 5% cover and the medium-tall bunchgrass *Leymus salinus* that provides 7% cover. Other short-shrub species provide sparse cover and includes *Tetradymia canescens* and *Chrysothamnus viscidiflorus*. The remaining graminoid layer includes sparse cover by *Poa fendleriana* and *Muhlenbergia montana*. The canopy and subcanopy layers provide sparse *Pinus ponderosa* cover for trees ranging from 2-15 m tall.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Leymus salinus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Site is highly disturbed and is near a corral, sampled only because it fell within a BPU.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 observation point: (BRCA. 9023) and 2007 Accuracy Assessment (1 point: BRCA_AA.0229).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Purshia tridentata* Desert Wash Shrubland [Park Special]

## Antelope Bitterbrush Desert Wash Shrubland

CODE CEPS009574

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This short shrubland is uncommon, forms linear stands lining creek beds, and was sampled in the Campbell Creek and Yellow Creek drainages and in Cope and Tropic canyons.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This uncommon short shrubland occurs on stream terraces and dry washes. The sites are flat to gentle (0- to 5-degree slope), occur between 1994 and 2063 m in elevation, and are oriented to the south. The ground surface has low to high exposure of bare soil, low to moderate cover of litter, sparse to moderate cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained sandy loams and sandy clay loams that are derived from New Alluvium.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (18-47% cover) and is characterized by the short shrub *Purshia tridentata* that provides 7-38% cover. The canopy layer provides sparse cover of 2- to 10-m tall *Populus X intercurrens, Pinus edulis*, and *Juniperus osteosperma* trees. The tall-shrub layer is low in terms of floristic diversity, provides sparse cover, and includes *Quercus gambelii, Cercocarpus montanus*, and *Rhus trilobata var. trilobata (= Rhus aromatica var. trilobata)*. Other shrubs present are low in species diversity, provide sparse cover, and include *Arctostaphylos patula* and *Gutierrezia sarothrae*. The herbaceous layer is moderate to high in terms of floristic diversity and provides sparse cover. Common grass species include *Elymus elymoides, Hesperostipa comata*, and the non-natives *Bromus tectorum* and *Bromus inermis*. Forbs include *Tragopogon dubius, Packera multilobata (= Senecio multilobatus), Comandra umbellata*, and *Hymenopappus filifolius*. *Populus X intercurrens, Pinus ponderosa, Pinus edulis*, and *Juniperus osteosperma* saplings provide sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Tree canopy | *Populus* x *intercurrens* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Bromus inermis* (exotic, High/Medium), *Bromus tectorum* (exotic, High), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Sagebrush shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Plot is on a stream terrace that appears to be an abandoned channel of the stream; there isn't much flood debris caught in the shrubs; community occupies the gently sloping banks and low terrace of the wash.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (5 plots: BRCA.0196, BRCA.0332, BRCA.0337, BRCA.0374, BRCA.0399).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Tetradymia canescens / Poa pratensis* Shrubland [Park Special]

## Gray Horsebrush / Kentucky Bluegrass Shrubland

CODE CEPS009575

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM:** Not applicable

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*

This short shrubland is uncommon, occurs adjacent to meadows, and was sampled near the Bryce Corrals. It was also seen at the housing areas, East Creek, and west of the residential area.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short shrubland occurs adjacent to meadows. The site is flat and occurs at 2369 to 2393 m in elevation. The ground surface has high exposure of bare soil and low cover of small rocks and downed wood. Cryptogram cover is sparse and includes species of moss. Soils are rapidly drained silty clay loams.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (35% cover) and is characterized by the short shrub *Tetradymia canescens* that provides 10% cover and the non-native rhizomatous grass *Poa pratensis* that provides 7% cover. Other short shrubs *Chrysothamnus viscidiflorus* and dwarf-shrub *Artemisia frigida* provide sparse cover. The herbaceous layer is low to moderate in floristic diversity and provides sparse cover. The grasses *Koeleria macrantha, Elymus lanceolatus, Leymus salinus (= Elymus salinus), Muhlenbergia montana*, and *Hesperostipa comata* provide sparse cover. Forbs present with sparse cover include *Tragopogon dubius, Potentilla concinna, Potentilla hippiana, Achillea millefolium*, and *Linum perenne*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Tetradymia canescens* |
| Herb (field) | *Poa pratensis* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive**: *Achillea millefolium* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: South of plot are corrals, gravel dump and parking lot; no evidence of fire in the meadow or surrounding *Pinus ponderosa* woodland.

*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0061); and 2007 Accuracy Assessment (6 points: BRCA_AA.0278, BRCA_AA.0290, BRCA_AA.0293, BRCA_AA.0397, BRCA_AA.0410, BRCA_AA.0659).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Carex vallicola* Herbaceous Vegetation [Park Special]

### Valley Sedge Herbaceous Vegetation

CODE CEPS009584

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This type was observed at only one Accuracy Assessment point in 2007, therefore no local descriptive information is available.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Data are not available.
*Bryce Canyon National Park* Plots: 2007 Accuracy Assessment (1 point: BRCA_AA.0188).
*Local Description Authors:* G. Kittel
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Ceanothus martinii / Elymus trachycaulus* Seeded Roadcut Shrub Herbaceous Vegetation [Park Special]

### Martin's Ceanothus / Slender Wheatgrass Seeded Roadcut Shrub Herbaceous Vegetation

CODE CEPS009569

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This shrub herbaceous association occurs only on seeded roadcuts and was sampled along the historic roadcut near Rainbow Point.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This shrub herbaceous association occurs on a historically disturbed roadcut. The site is steep (26-degree slope), occurs at 2695 m in elevation, and is oriented to the west. The ground surface has low exposure of bare soil, sparse cover of small and large rocks, and high cover of litter. Soils are rapidly drained clays derived from the Claron Formation (Pink Member) and were reworked during construction.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (46% cover) and is characterized by the short shrub *Ceanothus martinii* that provides 12% cover and the bunchgrass *Elymus trachycaulus* that provides 21% cover. The remaining short-shrubs provide sparse cover and includes *Arctostaphylos patula* and *Symphoricarpos oreophilus*. The remaining graminoid layer provides low cover and includes *Bromus ciliatus* and *Elymus lanceolatus*. The forb layer is low in terms of species diversity, provides sparse cover, and includes the non-natives *Tragopogon dubius* and *Taraxacum officinale*. *Pseudotsuga menziesii* and *Abies concolor* saplings contribute sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Ceanothus martinii* |
| Herb (field) | *Bromus ciliatus*, *Elymus trachycaulus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Excavated roadway that has been reclaimed by seeding; numerous native species from surrounding communities have also become established; for a disturbed site, this community is remarkably weed-free.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0230).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Elymus elymoides* Herbaceous Vegetation [Park Special]

### Squirreltail Herbaceous Vegetation

CODE CEPS009576

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This uncommon to common grassland association occurs on semi-arid slopes and plateau tops, and was sampled near Rainbow Point, Yovimpa Pass, and Farview Point.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This short bunchgrass association occurs on the slopes and tops of mesas, plateaus, and ridges. The sites are flat to moderately steep (0- to 19-degree slopes), occur between 2535 and 2704 m in elevation, and are oriented to the west. The ground surface has sparse to moderate exposure of bare soil, low to high cover of litter, sparse to low cover of small and large rocks, and moderate cover of downed wood. Soils are rapidly drained clay loams and silty clay loams derived from the Claron Formation (Pink and White members).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is low to moderate (21-47% cover) and is characterized by the short bunchgrass *Elymus elymoides* that provides 4-22% cover. *Pinus ponderosa, Pseudotsuga menziesii*, and *Abies concolor* trees provide sparse cover and attain heights between 5 and 10 m tall. The short and dwarf-shrubs present are diverse in terms of species composition, provide sparse cover, and include *Symphoricarpos oreophilus, Ribes cereum, Ceanothus martinii*, and *Mahonia repens*. The remaining graminoid layer is floristically diverse, provides low cover, and includes the non-native rhizomatous grass *Poa pratensis* and the native graminoids *Poa fendleriana, Carex rossii*, and *Bromus ciliatus*. Forbs are low in terms of floristic diversity, contribute sparse cover, and include *Taraxacum officinale, Erigeron flagellaris, Lithospermum multiflorum, Cirsium calcareum*, and *Tragopogon dubius*. *Abies concolor* and *Pseudotsuga menziesii* saplings provide sparse cover.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Elymus elymoides* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Poa pratensis* (exotic, Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**

*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Canopy and litter layers mostly absent, the understory species diversity is high; signs of fire that killed some trees and blackened the trunks of others; site obviously experienced an intense crownfire that killed all the trees and understory.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (4 plots: BRCA.0075, BRCA.0236, BRCA.0258, BRCA.0264) and 2007 Accuracy Assessment (5 points: BRCA_AA.0230, BRCA_AA.0326, BRCA_AA.0489, BRCA_AA.1126, BRCA_AA.1147).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Elymus trachycaulus* Herbaceous Vegetation [Park Special]

### Slender Wheatgrass Herbaceous Vegetation

CODE CEPS009577

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This herbaceous association is limited to seeded roadside fill, where it was sampled along the park access road near Whiteman Bench.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This herbaceous association occurs on roadway fill. The site is steep (27-degree slope), occurs at 2624 m in elevation, and is oriented to the northwest. The ground surface has high exposure of bare soil, low cover of small and large rocks, and low cover of litter. Soils are rapidly drained clay loams that were deposited in the area during road construction.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (26% cover) and is characterized by the native yet seeded grass bunchgrass *Elymus trachycaulus* that provides 25% cover. Short-shrubs present are low in terms of floristic diversity, provides sparse cover, and includes *Arctostaphylos patula* and *Ceanothus martinii*. The remaining graminoid layer provides sparse cover and includes the non-native *Bromus inermis* and the native bunch grasses *Hesperostipa comata* and *Achnatherum hymenoides*. The forb layer is low in terms of floristic diversity, provides sparse cover, and includes *Tragopogon dubius, Cirsium calcareum*, and *Taraxacum officinale*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Elymus trachycaulus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Bromus inermis* (invasive/exotic, High/Medium), *Taraxacum officinale* (exotic), *Tragopogon dubius* (exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: An artificial site of roadway fill resulting from park road construction; the area has been seeded, but some local native species have colonized from the surrounding forest.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0242).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Heterotheca villosa* / Mixed Grasses Shrub Herbaceous Vegetation [Park Special]

### Hairy False Goldenaster / Mixed Grasses Shrub Herbaceous Vegetation

CODE CEPS009572

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This herbaceous association is uncommon, occurs on lower slopes and swales, and was sampled near the northern park boundary.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*

This herbaceous association occurs on gentle slopes and in swales. The site is gentle (3-degree slope), occurs at 2309 m in elevation, and is oriented to the northwest. The ground surface has moderate exposure of bare soil, moderate cover of litter, and sparse cover of duff. Soils are rapidly drained loam.

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (47% cover) and is characterized by the forb *Heterotheca villosa* that provides 20% cover and a mix of graminoid species that together provide 19% cover. The remaining forbs are low in terms of species diversity and provide sparse cover. The mixed grasses include *Bouteloua gracilis, Vulpia octoflora (= Festuca octoflora), Hesperostipa comata, Koeleria macrantha*, and *Poa fendleriana*. Sparse cover by lichens occurs.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Hesperostipa comata*, *Poa fendleriana* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Grassland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Gently rolling hills and swales typify the habitat, plant distribution is very uniform in species composition and density.
*Bryce Canyon National Park* Plots: The description is based on 2006 field data (1 plot: BRCA.328).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Leymus salinus* Herbaceous Vegetation [Park Special]

### Saline Wildrye Herbaceous Vegetation

CODE CEPS009578

***ECOLOGICAL SYSTEM(S):***

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This bunchgrass grassland is uncommon and occurs on semi-arid slopes and plateau tops, and was sampled near Fairyland Point, along Bryce Point Road, and in the Yellow Creek drainage. It was also observed at five Accuracy Assessment points in 2007.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This medium-tall bunchgrass association occupies the high slopes of rims, plateaus, and hills. Sites are gentle to steep (2- to 32-degree slopes), occur between 2195 and 2465 m in elevation, and are oriented to the south or northwest. The ground surface has low to moderate exposure of bare soil, low to moderate cover of litter, sparse to low cover of small and large rocks, and sparse cover of downed wood. Soils are rapidly drained sandy loams and silty clays derived from the Straight Cliffs Formation (Upper Unit).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is moderate (43-54% cover) and is characterized by the medium-tall bunchgrass *Leymus salinus* that provides 35-38% cover. Short and dwarf-shrubs present include *Purshia tridentata, Tetradymia canescens*, and *Eriogonum corymbosum*. The remaining graminoid layer is low in terms of floristic diversity, provides sparse cover, and includes the bunch grasses *Hesperostipa comata* and *Poa fendleriana*. Forb cover is sparse and includes *Calochortus nuttallii* and *Tragopogon dubius*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Herb (field) | *Leymus salinus* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
**Exotic/Invasive:** *Tragopogon dubius* (invasive/exotic, Medium/Low)

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*

Grassland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Charred trunks of tree snags and burned *Arctostaphylos patula* skeletons; growth here looks young with seedling shrubs and small bunch grasses; distributed throughout the area are burned stumps of larger shrubs.
*Bryce Canyon National Park* Plots: The description is based on 2005 and 2006 field data (3 plots: BRCA.0087, BRCA.0216, BRCA.0410) and 2007 Accuracy Assessment (5 points: BRCA_AA.0230, BRCA_AA.0326, BRCA_AA.0489, BRCA_AA.1126, BRCA_AA.1147).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

**REFERENCES:** Western Ecology Working Group n.d.

## *Tetradymia canescens* Badlands Sparse Vegetation [Park Special]

## Gray Horsebrush Badlands Sparse Vegetation

CODE CEPS009580

**ECOLOGICAL SYSTEM(S):**

**USFWS WETLAND SYSTEM: NOT APPLICABLE**

**CONCEPT SUMMARY**
*Globally*

**DISTRIBUTION**
*Bryce Canyon National Park*
This sparse short shrubland is uncommon, occurs on a canyon slopes and was sampled in Water Canyon.

*Globally*
Data are not available.

**ENVIRONMENTAL DESCRIPTION**
*Bryce Canyon National Park*
This sparse short shrubland occurs on a canyonside. The site is steep (30-degree slope), occurs at 2310 m in elevation, and is oriented to the southeast. The ground surface has high exposure of bare soil, sparse exposure of bedrock, and low cover of small rocks. Soils are rapidly drained silty clays derived from the Claron Formation (Pink Member).

*Globally*
Data are not available.

**VEGETATION DESCRIPTION**
*Bryce Canyon National Park*
Total vegetation cover is very open and sparse (1% cover) and is characterized by the short shrub *Tetradymia canescens* that provides 1% cover. Other short shrubs present include *Eriogonum corymbosum* and *Chrysothamnus depressus* that provide sparse cover. The herbaceous layer is low in floristic diversity, provides sparse cover, and includes the medium-tall bunchgrass *Leymus salinus* and the forbs *Oenothera howardii* and *Astragalus hallii*.

*Globally*
Data are not available.

**MOST ABUNDANT SPECIES**
*Bryce Canyon National Park*

| Stratum | Species |
|---|---|
| Short shrub/sapling | *Tetradymia canescens* |

*Globally*
Data are not available.

**OTHER NOTEWORTHY SPECIES**
*Bryce Canyon National Park*
Data are not available.

*Globally*
Data are not available.

**CONSERVATION STATUS RANK**
*Global Rank & Reasons:* GNR (15-Nov-2010).

**CLASSIFICATION COMMENTS**
*Bryce Canyon National Park*
Montane shrubland.

*Globally*
Data are not available.

**CLASSIFICATION CONFIDENCE:**

**ELEMENT SOURCES**
*Bryce Canyon National Park* Inventory Notes: Individual Plot Notes: Community is on steep erosion surfaces, with variable local aspects, but all on generally east-facing slopes just below the canyon rim; very little moisture here, due to the rapidity of surface runoff, so even rain events will contribute little to the soil moisture; substrate is essentially a veneer of weathered bedrock over the actual bedrock.
*Bryce Canyon National Park* Plots: The description is based on 2005 field data (1 plot: BRCA.0129).
*Local Description Authors:* M. Smith and J. Von Loh
*Global Description Authors:*

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# Appendix G. Illustrated Keys to the Plant Associations of Bryce Canyon National Park

The vegetation of Bryce Canyon National Park was characterized using field data collected in 2005-2007 under the US Geological Survey and National Park Service's Vegetation Mapping Program. A total of 409 plots and 141 observation points of 126 plant associations. To assist in the accurate field identification of these associations, this dichotomous key was developed and illustrated with images taken during the sampling efforts (2005-2007) and credited to NCPN.

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 Park. Because of natural variation within plant associations, it is possible that a community can be keyed using more than one of the physiognomic keys. For sites within ecotones (areas where dominant species intermix between plant associations), it may be difficult to determine a definitive association name. This illustrated key also allows the user to crosswalk plant associations directly to the Bryce Canyon National Park vegetation map so that all research may have a common focal point relative to the baseline years of aerial photography (2002) and field data collection (2005-2006).

## 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 (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. If any layer 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 #6 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. *Artemisia tridentata* ssp. *vaseyana* and *Artemisia tridentata* ssp. *wyomingensis* sometimes hybridize. There are no separate associations for the hybrid entity, so you will

have to assign hybrids to one or the other species, based as best you can on "the preponderance of the evidence". This means that when keying the sagebrush, MOST of the characteristics will point toward one or the other species (e.g., plant shape, inflorescence characteristics, odor, and fluorescence). You may also need to run the stand through both the ssp. *vaseyana* and the ssp. *wyomingensis* sections of the key.

4. The same situation applies to hybrids of *Pseudoroegneria spicata* and *Elymus lanceolatus*.

5. 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.

6. 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 White or Red Claron Formation.

7. 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 and likewise, examples of associations with "woodland" in the name that may occasionally have more than 60% cover.

2. Nearly every stand is mixed in terms of tree dominants for forests and woodlands, making calls more difficult. AA crews should record second and third calls if necessary. Stands of mixed conifers rely on the species present rather than on abundance of any single dominant conifer to represent an association. *Abies concolor* is an important indicator at Bryce Canyon National Park. Stands mixed with *Pseudotsuga menziesii*, *Abies concolor,* and usually other conifers, are called an *Abies concolor* association, unless *Pinus longaeva* is present, in which case it is the indicator species.

3. Treed stands on the White or Red Claron Formation also have unique rules for Bryce Canyon National Park 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* > *Pseudotsuga menziesii* > *Pinus ponderosa*.

4. Generalist species such as *Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae, Poa secunda,* and *Opuntia* spp. are only considered diagnostic if they are overwhelmingly dominant. For example, if you are in a Pinyon - Juniper 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. There are a number of closely related shrubland plant associations at Bryce Canyon National Park that may be confusing in the field, although the key makes them appear easily distinguishable:

    a. Mixed mountain shrublands have been separated into a number of associations. There is often a mix of shrubs present, although not identified in the association name. The notion to keep in mind is that there is a classic "profile" for these associations, but a considerable amount of variation may occur.

        i. *Arctostaphylos patula* is a very common shrub throughout Bryce Canyon National Park, as is *Quercus gambelii*. When these shrubs occur together, even when they are not equally abundant, they are considered to be an *Arctostaphylos patula – Quercus gambelii – (Amelanchier utahensis)* Shrubland. For example, a stand with 80% *Quercus gambelii* and 1% *Arctostaphylos patula* will probably be considered a *Quercus gambelii* Shrubland. But a stand dominated by *Quercus gambelii* with half as much of *Arctostaphylos* scattered throughout the stand, may be considered the mixed type. As a general rule, look for high (or highest) total

abundance over other shrub species within the stand, and for a consistent pattern throughout the stand. These are the criteria of a "characteristic" shrub.

ii. *Artemisia nova* occurs in many shrublands, such as *Purshia tridentata - Artemisia nova* Shrubland with 6-14% cover. But it also occurs in *Purshia tridentata* / *Hesperostipa comata* Shrub Herbaceous Vegetation with up to 6% cover. So pay attention to what shrubs are together and the relative cover of each species; generally when one is twice that of the other, it is considered the dominant species.

iii. *Atriplex canescens* occurs in dry and slightly saline areas, and its overall abundance can be quite low. Several stands in Bryce Canyon National Park occur with low cover of both *Atriplex canescens* and *Artemisia tridentata*, and are considered a mixed type. In other parts of the west, *Atriplex canescens* can be very abundant, with small amounts of *Artemisia tridentata*, and would be considered just an *Atriplex canescens* shrubland. So keep in mind the relative cover of the co-occurring shrubs.

6. 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% cover. In addition, *Chrysothamnus viscidiflorus* and *Purshia tridentata* may 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*

7. 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 *Bromus inermis, Poa pratensis*, and *Juncus balticus*.

8. 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 using the shrubland or herbaceous key, but ratchet down your cover expectations for dominant species and total vegetation cover from what the key may say. Proceed using dominance and relative cover rather than absolute cover measurements.

9. 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.

10. Although not classifiable as an NVC plant association, two woodland communities have distinct photo signatures and are presented as map units in this key, they are:
    - *Pinus ponderosa / Pinus edulis – Juniperus* spp. */ Quercus gambelii* Forest
    - *Pinus ponderosa / Pinus edulis – Juniperus* spp. / Mixed Mountain Shrub Forest

# Key I: Major Physiognomic Groups

**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, Carex, Eleocharis, Elymus, Hesperostipa, Heterotheca, Juncus, Leymus, Pascopyrum,* or *Pseudoroegneria.* **(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 *Amelanchier, Arctostaphylos, Artemisia, Atriplex, Betula, Ceanothus, Cercocarpus (montanus), Chrysothamnus, Dasiphora, Ericameria, Prunus, Purshia, Quercus (gambelii), Salix, Shepherdia, Symphoricarpos, Tetradymia,* or *Zuckia*. **(Key III)**

# Key II: Forest and Woodland Associations

**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 pockets. Canopy dominants include *Populus,* sometimes with *Pseudotsuga menziesii* or *Abies concolor* 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* **(10)**

## Deciduous Forests and Woodlands

**2a** Open forests of *Acer grandidentatum* with a dense understory of *Quercus gambelii*, occurring on ridges or in ravines – ***Acer grandidentatum / Quercus gambelii*** **Forest [Map Unit 2 - White Fir / Gambel Oak – (Bigtooth Maple) Forest]**




**2b** 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 pockets. Canopy dominants include *Populus,* sometimes with *Pseudotsuga menziesii* or *Abies concolor* as a co-dominant **(3)**

**3a** (2) Forests or woodlands characterized by *Populus tremuloides,* often occupying mesic, north-facing slopes. These stands often occur as small patches (<0.5 hectares) along the edges of conifer stands. Conifers are present with less than 25% of the quaking aspen cover or share co-dominance with the quaking aspen. In xeric or post-fire situations, the trees may be dwarfed to little more than tall shrub stature **(4)**

**3b** Forests or woodlands characterized by *Populus angustifolia* occurring within drainage bottoms, in ravines or on alluvial deposits. Examples of these woodlands were found in the Yellow Creek drainage **(7)**

**4a** (3) Quaking aspen forests or woodlands with *Pseudotsuga menziesii* co-dominant. Aspen cover should be no less than 25% of the conifer cover. Other conifers such as *Picea pungens* and *Pinus ponderosa* may be present. *Juniperus communis* is the most dominant shrub, but several shrub species are usually present, including *Paxistima myrsinites, Symphoricarpos oreophilus,* and *Amelanchier utahensis* - ***Populus tremuloides – Pseudotsuga menziesii / Juniperus communis*** **Forest [Map Unit 23 – Aspen Forest Complex]**



**4b** Forests or woodlands characterized by *Populus tremuloides,* often occupying mesic, north-facing slopes. These stands often occur as small patches (<0.5 hectares) along the edges of conifer stands. Conifers are present with less than 25% of the quaking aspen **(5)**

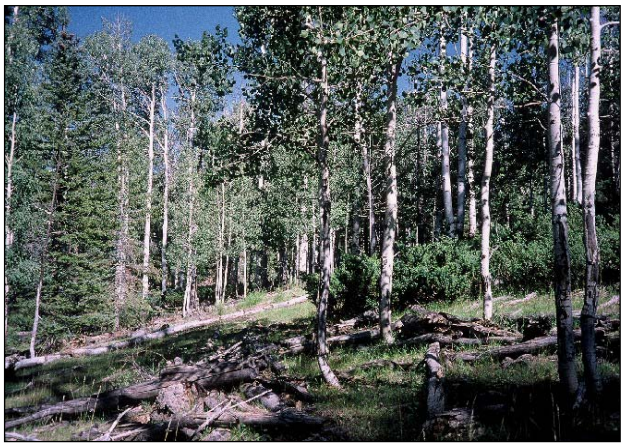
**5a** (4) Quaking aspen forests or woodlands with a tall shrub understory characterized by *Acer grandidentatum* - ***Populus tremuloides / Acer grandidentatum*** **Forest [Park Special] [Map Unit 23 – Aspen Forest Complex]**



**5b** Quaking aspen forests or woodlands with a short shrub understory dominated by either *Juniperus communis* or *Symphoricarpos oreophilus* **(6)**

**6a** (5) Quaking aspen forests or woodlands with a short shrub understory characterized by *Juniperus communis.* Short shrubs such as *Arctostaphylos patula, Paxistima myrsinites, and Symphoricarpos* oreophilus may be present, but the cover of *Juniperus communis* is always greater - ***Populus tremuloides* / *Juniperus communis* Forest [Map Unit 23 – Aspen Forest Complex]**





**6b** Quaking aspen forests or woodlands with a short shrub understory characterized by *Symphoricarpos oreophilus.* Other shrubs present may include *Juniperus communis, Acer grandidentatum,* and *Quercus gambelii* may be present, but the cover of *Juniperus communis* is always greater - ***Populus tremuloides* / *Symphoricarpos oreophilus* Forest [Map Unit 23 – Aspen Forest Complex]**






**7a** (3) Narrowleaf cottonwood woodlands located in the active floodplain or on nearby terraces with *Juniperus scopulorum* co-dominant to dominant in the canopy layer. 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* - *Juniperus scopulorum* Woodland [Map Unit 24 – Narrowleaf Cottonwood Woodland Alliance]**



**7b** Narrowleaf cottonwood woodlands located in the active floodplain and with a well-developed shrub understory of the mesic species *Betula occidentalis, Cornus sericea,* or *Symphoricarpos oreophilus* **(8)**

**8a** (7) Narrowleaf cottonwood woodlands located in the active floodplain or on nearby terraces with a well developed shrub understory of mesic species such as *Symphoricarpos oreophilus*. An understory of upland tree species such as *Juniperus scopulorum* may also occur. 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* / *Symphoricarpos (albus, occidentalis, oreophilus)* Woodland [Map Unit 24 - Narrowleaf Cottonwood Woodland Alliance]**



**8b** Narrowleaf cottonwood woodlands located in the active floodplain and with a well-developed shrub understory of the mesic species *Betula occidentalis* or *Cornus sericea* **(9)**

**9a** (8) Narrowleaf cottonwood woodlands located in the active floodplain or on nearby terraces with a well developed shrub understory of the mesic species *Betula occidentalis*. A variety of other shrubs and grasses occur in the understory - ***Populus angustifolia* / *Betula occidentalis* Woodland [Map Unit 24 — Narrowleaf Cottonwood Woodland Alliance]**



**9b** Narrowleaf cottonwood woodlands located in the ravines with a well developed shrub understory dominated by the mesic species *Cornus sericea, Quercus gambelii, Betula*

*occidentalis* and *Cercocarpus montanus* - ***Populus angustifolia* / *Cornus sericea*** **Woodland [Map Unit 24 — Narrowleaf Cottonwood Woodland Alliance]**



## Evergreen Forests and Woodlands

**10a** (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 individually or in combination provides more than 10-20% of the total vegetation cover, go to 10b **(11)**

**10b** Evergreen forests or woodlands, including "sparse or barren" forests, occupying upland habitats, including flats, slopes, ravines, and ridge tops. Canopy dominants include *Abies, Pinus, Pseudotsuga, Picea,* or *Juniperus*. If *Cercocarpus ledifolius* is present, it is clearly an understory or subcanopy species with *Pinus ponderosa*, *Pseudotsuga menziesii*, *Pinus edulis, Juniperus scopulorum* and/or *Juniperus osteosperma* **(14)**

### *Cercocarpus ledifolius* Woodlands

**11a** (10) *Cercocarpus ledifolius* woodland with an understory dominated by short shrubs such as *Arctostaphylos patula*, *Symphoricarpos oreophilus*, *Purshia tridentata*, *Ericameria nauseosa,* or *Artemisia tridentata* **(12)**

**11b** *Cercocarpus ledifolius* woodland with an understory dominated by the tall shrub Q*uercus gambelii* or with no shrub stratum, only herbaceous species **(13)**

**12a** (11) *Cercocarpus ledifolius* woodland with an understory dominated by the short shrub *Arctostaphylos patula*. Other shrubs and trees may be present, but these generally provide less than 10% cover - ***Cercocarpus ledifolius* / *Arctostaphylos patula* Woodland [Map Unit 25 — Curl-leaf Mountain-mahogany Woodland Complex]**





**12b** *Cercocarpus ledifolius* woodland with an understory dominated by the short shrub *Artemisia tridentata.* Other shrubs may be present such as *Arctostaphylos patula*, *Symphoricarpos oreophilus*, *Purshia tridentata*, or *Ericameria nauseosa,* but none of these are as dominant as big sagebrush - ***Cercocarpus ledifolius* / *Artemisia tridentata* Woodland [Map Unit 25 — Curl-leaf Mountain-mahogany Woodland Complex]**



**13a** (11) *Cercocarpus ledifolius* woodland with an understory dominated by the tall shrub *Quercus gambelii*, and with few other shrubs present - ***Cercocarpus ledifolius* / *Quercus gambelii* Woodland [Map Unit 25 — Curl-leaf Mountain-mahogany Woodland Complex]**



**13b** *Cercocarpus ledifolius* woodland with no understory shrub stratum, only herbaceous species (few shrubs may be present, but not forming a strata). Herbaceous cover may be low to dense, with no one species dominant. If one herbaceous species is clearly dominant, the community has not yet been described from BRCA. Stands are often found along or in channels, as have been documented in Yellow Creek - ***Cercocarpus ledifolius* Woodland Alliance [Map Unit 25 — Curl-leaf Mountain-mahogany Woodland Complex]**



## Conifer Forests and Woodlands

**14a** (10) Evergreen forests and woodlands of the mesa top, cool slopes or sheltered canyons. Pure stands (e.g. *Pinus ponderosa*) or mixed stands of many tree species such as *Abies concolor, Picea pungens, Pinus ponderosa, Pinus flexilis*, and/or *Pseudotsuga menziesii*. If mature *Abies concolor* is present with *Pseudotsuga menziesii* and/or *Pinus ponderosa, Abies concolor* is the indicator species. *Abies concolor* present in Pinyon - Juniper dominated woodlands should be keyed as Pinyon - Juniper types (see 9b). *Pinus longaeva*, if present in mixed stands and the stands are on barren or near barren Claron

formations, key as a *Pinus longaeva* type (see 14b). Otherwise mixed conifer stands rely on dominance **(15)**

**14b** Evergreen forests and woodlands of a variety of habitats (generally below the Breaks), including Claron Formation "barrens", rolling hills of the Straight Cliffs formation, and other steep, exposed slopes. Total tree canopy cover on barrens may be low (<5%) but still considered a tree layer. Forests are dominated by a single (rare) or mix (more typical) of tree species such as *Pinus edulis, Pinus flexilis, Pinus longaeva, Pinus ponderosa, Juniperus scopulorum,* and/or *Juniperus osteosperma.* Claron Formation barrens often have mixed stands of several conifers (listed above in 11a) including *Abies concolor*, of which *Pinus longaeva* is the indicator species. When *Pinus edulis - Juniperus* spp. are the dominant tree species, *Pinus ponderosa* and/or *Pseudotsuga menziesii* may be present with less than 50% relative cover. *Abies concolor* may rarely be present. The understory may be quite barren or may contain abundant shrub and herb layers **(47)**

**15a** (14) Evergreen forests and woodlands usually on moderate to very steep slopes, with mature (at least 4 meters tall) *Abies concolor* present or *Picea pungens* the most abundant conifer in the stand **(16)**

**15b** Evergreen forests and woodlands on level sites or moderate to steep slopes with a canopy dominated by *Pseudotsuga menziesii* and/or *Pinus ponderosa.* Mature *Abies concolor* are not present, but seedlings and/or saplings may contribute low to moderate cover. *Picea pungens* may be present with low cover. *Pinus edulis* and/or *Juniperus* spp. may form a subcanopy **(29)**

**16a** (15) *Abies concolor* at least present to dominant as mature trees, often with several other conifer species. *Picea pungens* may be present but is not the most abundant conifer **(17)**

**16b** *Picea pungens* is the most abundant tree in the stand, but other conifers are often present such as *Pseudotsuga menziesii, Pinus ponderosa, Pinus flexilis*, and *Abies concolor*. *Populus tremuloides* may also occur. A shrub layer may or may not be present. If present, shrubs include *Betula occidentalis, Arctostaphylos* spp.*,* and *Juniperus communis* **(25)**

### *Abies concolor* Forests

**17a** (16) Evergreen forests and woodlands where mature *Abies concolor* is at least present to dominant, often with several other conifer species. A tall shrub layer of *Quercus gambelii* and/or *Acer grandidentatum* is present. Other tall and short shrub species may also be present, but are not dominant **(18)**

**17b** Evergreen forests and woodlands where mature *Abies concolor* is at least present to dominant, often with several other conifer species. The understory is dominated by a tall or short shrub canopy or by a mixture of herbaceous species **(19)**

**18a** (17) *Abies concolor* is the dominant tree with the tall shrub stratum dominated by *Quercus gambelii* - ***Abies concolor* / *Quercus gambelii* Forest [Map Unit 2 — White Fir / Gambel Oak – (Bigtooth Maple) Forest]**



**18b** *Abies concolor* is the dominant tree with the tall shrub stratum dominated by *Acer grandidentatum*. This type has a fairly dense overstory canopy. Stands observed along Agua Canyon Trail - ***Abies concolor* / *Acer grandidentatum* Forest [Map Unit 2— White Fir / Gambel Oak – (Bigtooth Maple) Forest]**



**19a** (17) *Abies concolor* is the dominant tree with the short shrub canopy dominated by *Arctostaphylos patula. Juniperus communis* and *Mahonia repens* may be present but with less cover than *Arctostaphylos patula* - ***Abies concolor* / *Arctostaphylos patula* Forest [Map Unit 3 — White Fir / Manzanita – Mixed Shrub Forest]**




**19b** *Abies concolor* is the dominant or co-dominant tree with the short shrub canopy dominated by species other than *Arctostaphylos patula*, or the understory is dominated by a mixture of herbaceous species **(20)**

**20a** (19) *Abies concolor* is the dominant or co-dominant tree, the stand lacks a shrub stratum/canopy, and has only an herbaceous layer generally exceeding 10% cover. This type occurs as a result of prescribed burns and is quite common in high elevation areas of the park. Graminoid species present are variable and include *Hesperostipa comata, Achnatherum lettermanii*, *Carex rossii, Elymus elymoides, Koeleria macrantha, Poa fendleriana, Poa secunda,* and *Poa pratensis,* ranging in cover from trace to >35% - ***Abies concolor* / Mixed Grasses Forest [Map Unit 5 — White Fir / Mixed Herbaceous Forest]**




**20b** *Abies concolor* is the dominant or co-dominant tree with a short shrub canopy dominated *Purshia tridentata, Cercocarpus ledifolius, Symphoricarpos oreophilus, Juniperus communis,* or *Mahonia repens* **(21)**

**21a** (20) *Abies concolor* is the dominant or co-dominant tree with an understory dominated by *Symphoricarpos oreophilus*. Other shrubs may be present but generally have less than 1%

cover or, if more, then less than half that of *Symphoricarpos oreophilus*. If other shrubs such as *Mahonia repens* are present with equal cover, *Symphoricarpos oreophilus* is the indicator species. ***Abies concolor* / *Symphoricarpos oreophilus* Forest [Map Unit 1 — White Fir Forest Complex]**




**21b** *Abies concolor* is the dominant or co-dominant tree with a short shrub canopy dominated *Purshia tridentata, Cercocarpus ledifolius, Juniperus communis,* or *Mahonia repens* **(22)**

**22a** (21) Low cover woodlands of *Abies concolor* occurring on very steep slopes of Pink Claron with a sparse understory of *Cercocarpus ledifolius* and *Cercocarpus montanus.* Co-dominants in the canopy include *Picea pungens and Pinus flexilis* - ***Abies concolor* / *Cercocarpus ledifolius* Woodland [Map Unit 3 — White Fir / Manzanita – Mixed Shrub Forest]**



**22b** *Abies concolor* is the dominant or co-dominant tree with a short shrub canopy dominated *Purshia tridentata, Juniperus communis,* or *Mahonia repens* **(23)**

**23a** (22) Open woodlands of *Abies concolor* with other mixed conifers and an understory dominated by *Purshia tridentata,* along with *Arctostaphylos patula* and *Ceanothus martini,* occurring on steep slopes of White Claron - ***Abies concolor* / *Purshia tridentata*** **Forest [Park Special] [Map Unit 3 — White Fir / Manzanita – Mixed Shrub Forest]**



**23b** *Abies concolor* is the dominant or co-dominant tree with a short shrub canopy dominated *Juniperus communis* or *Mahonia repens* **(24)**

**24a** (23) *Abies concolor* is the dominant or co-dominant tree with an understory dominated by *Juniperus communis*. Other shrubs may be present but generally have less than 1% cover or, if more, then less than half that of *Juniperus communis*. *Juniperus communis* cover is often sparse and ranges from 1-20% - ***Abies concolor* / *Juniperus communis*** **Forest [Map Unit 1 — White Fir Forest Complex]**





**24b** *Abies concolor* is the dominant or co-dominant tree with an understory dominated by *Mahonia repens*. Other shrubs may be present, including *Juniperus communis,* but

generally with less than 1% cover or, if more, then less than half that of *Mahonia repens* - ***Abies concolor* / *Mahonia repens* Forest [Map Unit 1 — White Fir Forest Complex]**






*Picea pungens* Forests

**25a** (16) *Picea pungens* is the most abundant conifer with an understory dominated by *Betula occidentalis*. *Abies concolor* may be present in small amounts, and other conifer species are generally present. *Salix* species may also be present - ***Picea pungens* / *Betula occidentalis* Woodland [Map Unit 6 — Blue Spruce Forest Complex]**



**25b** *Picea pungens* is the most abundant conifer, but other conifer species are generally present. *Betula occidentalis* not present. Short shrub and/or herbaceous layer present with shrub species including *Acer glabrum*, *Amelanchier alnifolia*, *Arctostaphylos patula, Arctostaphylos uva-ursi*, *Juniperus communis*, *Mahonia repens, Paxistima myrsinites*, *Prunus virginiana*, *Ribes cereum*, *Shepherdia canadensis*, *Symphoricarpos oreophilus*, and/or herbaceous species including *Hesperostipa comata*, *Bromus inermis*, *Calamagrostis scopulorum,* or *Poa pratensis* **(26)**

**26a** (25) *Picea pungens* is the most abundant conifer with a short shrub layer present **(27)**

**26b** *Picea pungens* is the most abundant conifer, and no shrub layer is present. Herbaceous layer is dominated by the introduced rhizomatous grass, *Bromus inermis*. Shrub species may be present but with no greater than 5% cover - ***Picea pungens* / *Bromus inermis* Forest [Park Special] [Map Unit 6 — Blue Spruce Forest Complex]**



**27a** (26) *Picea pungens* is the most abundant conifer and the understory is dominated by *Juniperus communis* - ***Picea pungens* / *Juniperus communis* Forest [Map Unit 6 — Blue Spruce Forest Complex]**



**27b** *Picea pungens* is the most abundant conifer and the short shrub layer is dominated by species of *Arctostaphylos*. Other shrubs and herbs are usually present, but not dominant **(28)**

**28a** (27) *Picea pungens* is the most abundant conifer and the short shrub layer is dominated by *Arctostaphylos uva-ursi*. Other shrubs and herbs are usually present, but not dominant - ***Picea pungens* / *Arctostaphylos uva-ursi* Forest [Map Unit 6 — Blue Spruce Forest Complex]**



**28b** *Picea pungens* is the most abundant conifer and the short shrub layer is dominated by *Arctostaphylos patula*. Other shrubs and herbs are usually present, but not dominant - ***Picea pungens* / *Arctostaphylos patula* Forest [Map Unit 6 — Blue Spruce Forest Complex]**



**29a** (15) Forest and woodlands dominated by *Pseudotsuga menziesii*, or with several conifer species present, of which *Pseudotsuga menziesii* has the highest cover. If mature *Abies concolor* is present as more than a few scattered individuals, go to couplet 12. If *Pinus ponderosa* is present, its cover is not more than half that of *Pseudotsuga menziesii* **(30)**

**29b** Forest and woodland stands where *Pinus ponderosa* is the dominant tree. Several other conifers may be present, such as *Pseudotsuga menziesii, Picea pungens, Pinus edulis, Juniperus* spp., and *Pinus flexilis,* but *Pinus ponderosa* is the most abundant tree, or is co-dominant with at least one other tree species **(32)**

*Pseudotsuga menziesii* Forests

**30a** (29) Forests and woodlands dominated by *Pseudotsuga menziesii* with a tall shrub understory dominated by *Quercus gambelii.* Other shrubs may be present, but they have less than 1% cover, or no more than half the cover of *Quercus gambelii* - ***Pseudotsuga menziesii* / *Quercus gambelii* Forest [Map Unit 4 — Douglas Fir Forest Complex]**



**30b** Forests and woodlands dominated by *Pseudotsuga menziesii* with no tall shrub stratum, and a short shrub layer including *Arctostaphylos patula* or *Symphoricarpos oreophilus*. Other shrubs may include *Ribes cereum, Ribes montigenum, Mahonia repens, Purshia tridentata,* and/or *Tetradymia canescens* **(31)**

**31a** (30) *Pseudotsuga menziesii* woodlands with a short shrub layer dominated by *Arctostaphylos patula* (25-35% cover) - ***Pseudotsuga menziesii* / *Arctostaphylos patula* Forest [Map Unit 4 — Douglas Fir Forest Complex]**



**31b** *Pseudotsuga menziesii* woodlands with a short shrub layer dominated by *Symphoricarpos oreophilus* (up to 15% cover) - ***Pseudotsuga menziesii* / *Symphoricarpos oreophilus* Forest [Map Unit 4 — Douglas Fir Forest Complex]**



## *Pinus ponderosa* Forests and Woodlands

**32a** (29) *Pinus ponderosa* dominated forests and woodlands (with and without other conifers). *Juniperus scopulorum* may contribute low to moderate cover in the subcanopy **(33)**

**32b** *Pinus ponderosa* woodlands where *Pinus ponderosa* (or rarely mixed with *Pseudotsuga menziesii)* generally occurs as decadent, scattered emergent trees above a canopy dominated by *Pinus edulis* and *Juniperus osteosperma* and/or *Juniperus scopulorum.* Tall or short shrub understory is dominated by *Quercus gambelii, Arctostaphylos patula, Purshia tridentata,* and/or *Cercocarpus montanus* **(47)**

**33a** (32) *Pinus ponderosa* forests and woodlands (with and without other conifers) with *Arctostaphylos patula* dominant in the short shrub canopy. Other shrubs or herbaceous layers may be present and abundant, or absent from the stand **(34)**

**33b** *Pinus ponderosa* forests and woodlands where *Arctostaphylos patula* is not present or, if present, is not dominant in the short shrub layer **(36)**

**34a** (33) *Pinus ponderosa* co-dominant with *Pseudotsuga menziesii* [total tree canopy has roughly equal cover of both species] and the understory shrub layer is dominated by *Arctostaphylos patula.* Other shrubs may be present, including *Purshia tridentata, Cercocarpus montanus,* and *Quercus gambelii*, but their cover should be less than half that of *Arctostaphylos patula.* Grass cover (especially *Leymus salinus)* may be low to moderate - ***Pinus ponderosa – Pseudotsuga menziesii*** / ***Arctostaphylos patula*** **Woodland [Park Special] [Map Unit 7 — Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex]**





**34b** *Pinus ponderosa* the dominant conifer, if *Pseudotsuga menziesii* is present, it has one-half or less the cover of *Pinus ponderosa* (i.e. is clearly not co-dominant), and a short shrub layer is dominated by *Arctostaphylos patula* **(35)**

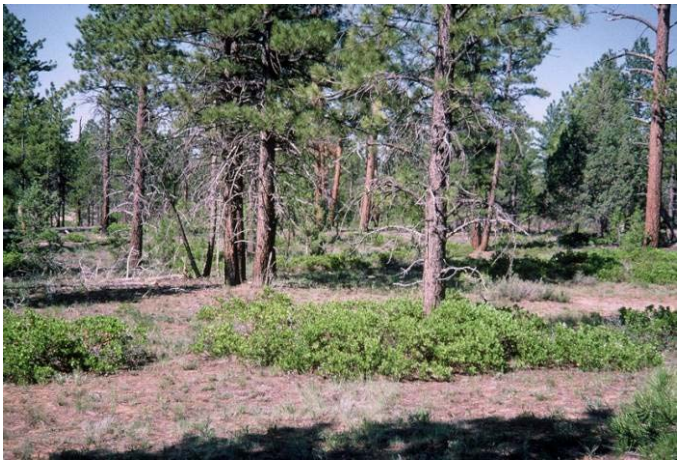
**35a** (34) *Pinus ponderosa* is the dominant conifer, *Cercocarpus ledifolius* is present and abundant enough to create a subcanopy layer, and the short shrub layer is dominated by *Arctostaphylos patula*. The understory may include moderate to high cover of *Leymus salinus* - ***Pinus ponderosa* / *Cercocarpus ledifolius* / *Arctostaphylos patula* Woodland [Park Special] [Map Unit 7 — Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex]**







**35b** *Pinus ponderosa* is the dominant conifer, *Cercocarpus ledifolius* is absent or, if present, is not abundant, and a short shrub layer is dominated by *Arctostaphylos patula*. Other shrubs may be present, including *Purshia tridentata, Cercocarpus montanus,* and *Quercus gambelii*, but their cover should be less than half that of *Arctostaphylos patula.* Grass cover (especially *Leymus salinus)* may be low to moderate - ***Pinus ponderosa* / *Arctostaphylos patula* Woodland [Map Unit 7 — Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex; Map Unit 12 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex**]

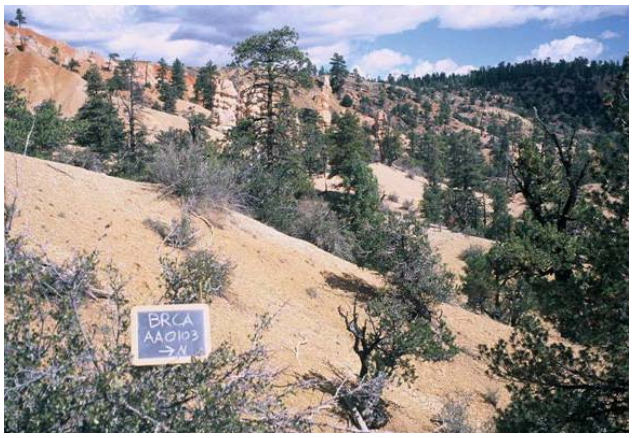


**36a** (33) *Pinus ponderosa* dominated woodland; other conifers may be present with less cover than that of *Pinus ponderosa*. Stands have no shrub layer. A few scattered shrub species may be present but not in abundance to form a layer. An herbaceous layer may or may not be present; herbaceous species may be abundant to scattered or trace **(37)**

**36b** *Pinus ponderosa* dominated woodland; other conifers may be present with less cover than that of *Pinus ponderosa*. Stands have abundant shrub cover with species such as *Quercus gambelii, Cercocarpus montanus, Artemisia nova, Symphoricarpos oreophilus, Mahonia repens,* or *Purshia tridentata,* present individually or in combinations **(43)**

**37a** (36) Very sparse woodlands dominated by *Pinus ponderosa*, and sometimes co-dominated by *Pinus flexilis*, occurring on gentle to steep slopes of the Claron formation, in areas typically dominated by *Pinus longaeva*. Scattered shrubs all with very low cover in the understory include *Arctostaphylos patula, Cercocarpus montanus*, and *Tetradymia canescens*, along with the grass *Leymus salinus* - ***Pinus ponderosa*** **Sparse Woodland [Park Special] [Map Unit 13 – Bristlecone Pine Woodland]**






**37b** *Pinus ponderosa* dominated woodland. The understory is either very sparse or is dominated by herbaceous species **(38)**

**38a** (37) *Pinus ponderosa* dominated woodland. Stands have very little herbaceous cover and little shrub cover due to a dense tree canopy (or in some cases due to a recent burn), although scattered grasses and shrubs may be present (in one stand *Gutierrezia sarothrae* had 7% cover) - ***Pinus ponderosa*** **/ Sparse Understory Woodland [Map Unit 9 — Ponderosa Pine / Mixed Herbaceous Woodland Complex]**





**38b** *Pinus ponderosa* dominated woodland; if other conifers are present their cover is less than that of *Pinus ponderosa*. Stands have no shrub layer but an herbaceous understory with at least 10% cover is present. Stands do not have high amounts of exposed bare ground or, if so, then stands clearly have an herbaceous layer **(39)**

**39a** (38) *Pinus ponderosa* dominated woodland; if other conifers are present their cover is less than that of *Pinus ponderosa*. Herbaceous understory is dominated by non-native and seeded grass species such as quack grass, *Thinopyrum intermedium,* or crested wheatgrass, *Agropyron cristatum* - ***Pinus ponderosa* / Seeded Grasses Semi-Natural Woodland [Park Special] [Map Unit 9 — Ponderosa Pine / Mixed Herbaceous Woodland Complex]**




**39b** *Pinus ponderosa* dominated woodland; if other conifers are present their cover is less than that of *Pinus ponderosa,* with an herbaceous understory. Not like above in all respects **(40)**

**40a** (39) *Pinus ponderosa* dominated woodland, with an herbaceous understory dominated by *Elymus elymoides* (1-8% cover). Other graminoid species may be present including *Carex rossii, Bromus inermis, Leymus salinus, Elymus lanceolatus, Elymus hispidus, Koeleria macrantha, Poa fendleriana, Poa pratensis, Achnatherum hymenoides, Hesperostipa comata,* and others - ***Pinus ponderosa* / *Elymus elymoides* – (*Elymus* spp.) Woodland [Park Special] [Map Unit 9 — *Pinus ponderosa* / Mixed Herbaceous Woodland Complex]**



**40b** *Pinus ponderosa* dominated woodland, with an herbaceous understory dominated by native grasses or forbs, no possibility of introduced (seeded) source **(41)**

**41a** (40) Open *Pinus ponderosa* woodland with an herbaceous understory dominated by the native forb, *Petradoria pumila.* Scattered shrub and grass species are present in the understory and include *Purshia tridentata, Artemisia nova, Chrysothamnus depressus, Elymus elymoides, Stipa hymenoides,* and *Carex rossii* - ***Pinus ponderosa / Petradoria pumila* Woodland [Park Special] [Map Unit 8 – *Pinus ponderosa* / Mixed Mountain Shrub Woodland Complex]**



**41b** *Pinus ponderosa* dominated woodland, with an herbaceous understory dominated by native grasses, no possibility of introduced (seeded) source **(42)**

**42a** (41) *Pinus ponderosa* dominated woodland with an herbaceous understory dominated by native grasses, of which *Hesperostipa comata* is the most abundant graminoid - ***Pinus ponderosa* / *Hesperostipa comata* Colorado Plateau Woodland [Park Special] [Map Unit 9 — Ponderosa Pine / Mixed Herbaceous Woodland Complex]**



**42b** *Pinus ponderosa* dominated woodland with an herbaceous understory dominated by native grasses, of which *Leymus salinus* is the most abundant graminoid, with 3-35% cover. Other graminoids that may also be abundant include *Elymus lanceolatus, Koeleria macrantha, Poa fendleriana, Elymus elymoides, Hesperostipa comata, and/or Achnatherum lettermanii* with trace to 26% cover - ***Pinus ponderosa* / *Leymus salinus* Woodland [Map Unit 9 — Ponderosa Pine / Mixed Herbaceous Woodland Complex]**



**43a** (36) *Pinus ponderosa* dominated woodland with a tall shrub layer dominated by *Quercus gambelii*, other shrubs may be present but are not as abundant as *Quercus gambelii*. In

some examples of this type, *Arctostaphylos patula* may be nearly co-dominant with oak - ***Pinus ponderosa* / *Quercus gambelii* Woodland [Map Unit 10 — Ponderosa Pine / Gambel Oak Woodland; Map Unit 11 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Gambel Oak Woodland]**





**43b** *Pinus ponderosa* dominated woodland with a shrub layer present that is dominated by one or a combination of the following shrub species: *Cercocarpus montanus, Symphoricarpos oreophilus, Purshia tridentata,* and *Artemisia nova* **(44)**

**44a** (43) *Pinus ponderosa* dominated woodland with a tall shrub layer dominated by *Cercocarpus montanus.* A mixture of other shrubs is often present and may include *Cercocarpus ledifolius, Quercus gambelii, Arctostaphylos patula, Purshia tridentata, Shepherdia rotundifolia,* and *Symphoricarpos oreophilus,* but these species are not as abundant as *Cercocarpus montanus* - ***Pinus ponderosa / Cercocarpus montanus* Woodland [Map Unit 8 – Ponderosa Pine / Mixed Mountain Shrub Woodland Complex]**



**44b** *Pinus ponderosa* dominated woodland with a short or dwarf shrub layer present. Tall shrubs may be present but are not abundant enough to form a stratum. Dominant shrub species include *Symphoricarpos oreophilus, Purshia tridentata,* and *Artemisia nova* **(45)**

**45a** (44) *Pinus ponderosa* dominated woodland with a mixed shrub layer dominated by *Purshia tridentata*. Other shrubs present include *Arctostaphylos patula, Ceanothus martinii*, *Cercocarpus montanus*, *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Mahonia repens*, *Quercus gambelii* (up to 1%), *Symphoricarpos oreophilus* (1-11%), and/or *Tetradymia canescens* (trace to 3%). Grass cover may be trace to nearly as high as shrub cover (shrub-herbaceous appearance) - ***Pinus ponderosa* / *Purshia tridentata* Woodland [Map Unit 8 — Ponderosa Pine / Mixed Mountain Shrub Woodland Complex; Map Unit 12 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex]**



**45b** *Pinus ponderosa* dominated woodland with a shrub layer dominated by either *Artemisia nova* or *Symphoricarpos oreophilus* **(46)**

**46a** (45) *Pinus ponderosa* dominated woodland with a short shrub layer dominated by *Symphoricarpos oreophilus* (1-15% cover). Other shrub species may be present with trace to 1% cover and include *Arctostaphylos patula, Artemisia tridentata, Ceanothus martinii, Chrysothamnus depressus, Chrysothamnus parryi, Gutierrezia sarothrae, Juniperus communis, Mahonia repens, Purshia tridentata* (up to 4% cover), *Ribes cereum, Rosa* spp.*, Tetradymia canescens*. Grass cover may be trace to nearly as high as shrub cover (shrub-herbaceous appearance) - ***Pinus ponderosa* / *Symphoricarpos oreophilus* Forest [Map Unit 8 — Ponderosa Pine / Mixed Mountain Shrub Woodland Complex]**



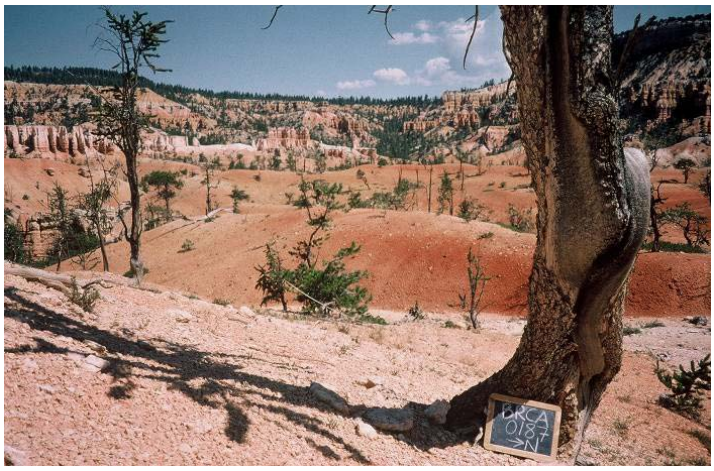

**46b** *Pinus ponderosa* dominated woodland with a dwarf-shrub layer where *Artemisia nova* is the most abundant species (up to 7% cover). Many other shrubs and herbaceous species are present, none with cover greater than that of *Artemisia nova.* Companion species that occur with trace to 2% cover include *Castilleja linariifolia, Chrysothamnus parryi, Elymus elymoides, Eriogonum racemosum, Koeleria macrantha, Purshia tridentata, Senecio multilobatus,* and/or *Tetradymia canescens* - ***Pinus ponderosa* / *Artemisia nova* Woodland [Map Unit 8 — Ponderosa Pine / Mixed Mountain Shrub Woodland Complex]**



### *Pinus longaeva* Woodlands

**47a** (14 or 32) Evergreen conifer forests and woodlands with no *Pinus longaeva* present, where *Pinus edulis* and *Juniperus osteosperma* and/or *Juniperus scopulorum* are the dominant tree species. *Pinus ponderosa* (and more rarely *Pseudotsuga menziesii*) may be present, but these generally occur as scattered emergent trees to the otherwise Pinyon - Juniper dominated woodland (relative cover is less than half that of Pinyon - Juniper). Note also that very rarely *Abies concolor* may be present **(48)**

**47b** Mixed evergreen conifer woodlands and forests, canopy cover ranges from 1-16%. *Pinus longaeva* always present and may or may not be the most abundant tree. Some stands may have most of the conifer species that occur in BRCA. These stands almost exclusively occur on barrens of the Claron Formations, and have very little shrub (commonly *Arctostaphylos patula*) and even less herbaceous cover - ***Pinus longaeva*** **Woodland [Map Unit 13 — Bristlecone Pine Woodland]**




## Pinyon-Juniper Woodlands

**48a** (47) *Pinus* edulis mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum*. The shrub canopy is abundant and several shrub species are usually present, *Cercocarpus montanus* is the most abundant (7-33% cover). Other shrub species present (1-23% cover) 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 16 — Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex; Map Unit 12 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex]**



**48b** *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum*. Stands have a shrub canopy dominated by species other than *Cercocarpus montanus* or there is no shrub layer present. *Pinus ponderosa* (and more rarely *Pseudotsuga menziesii*) may be present, but these generally occur as scattered emergent trees to the otherwise Pinyon - Juniper dominated woodland (relative cover is less than half that of Pinyon - Juniper) **(49)**

**49a** (48) *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum*. A tall shrub layer or subcanopy of *Quercus gambelii* or *Cercocarpus ledifolius* is present **(50)**

**49b** *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum*. No tall shrub or subcanopy present, additional layers include short or dwarf-shrubs or an herbaceous layer **(51)**

**50a** (49) *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum*. A tall shrub layer dominated by *Quercus gambelii* is present. *Cercocarpus ledifolius* is not present. Other shrub species may be present but *Quercus gambelii* is the most abundant and forms a shrub layer to the subcanopy with 7%-60% canopy cover. Other tall shrub species may include *Amelanchier utahensis* or *Peraphyllum ramosissimum.* Short shrub species that may be present include *Cercocarpus montanus* and *Purshia tridentata,* which may have cover >10%, but in these cases *Quercus gambelii* has equal to greater abundance - ***Pinus edulis – Juniperus* spp. / *Quercus gambelii* Woodland [Map Unit 17 — Pinyon Pine - Juniper spp. / Gambel Oak Woodland; Map Unit 11 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Gambel Oak Woodland]**







**50b** *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum*. A tall shrub layer or sub-canopy dominated by *Cercocarpus ledifolius* is present. *Quercus gambelii* may be present and abundant, even appearing co-dominant with *Cercocarpus ledifolius* - ***Pinus edulis – Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland [Map Unit 16 — Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex; Map Unit 12 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex]**

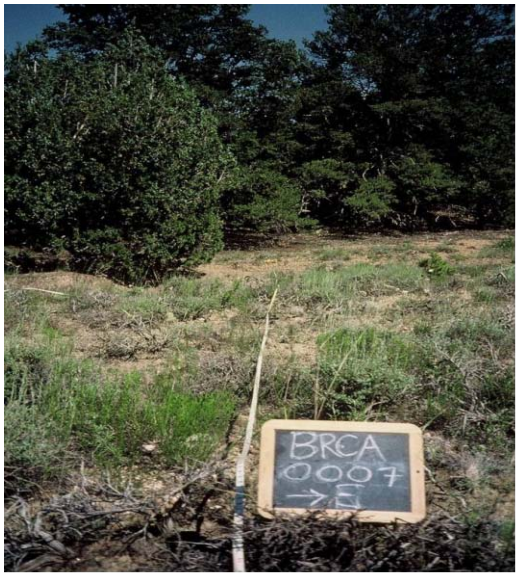


**51a** (49) *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum* and a shrub layer dominated by *Artemisia* species **(52)**

**51b** *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum* and a short shrub layer dominated by species not of the genus *Artemisia* **(53)**

**52a** (51) *Pinus edulis* mixed with *Juniperus osteosperma*. *Artemisia nova* forms a dwarf-shrub layer (7-16% cover). Herbaceous layer may be abundant and species such as *Leymus salinus* may have as much as 10% cover - ***Pinus edulis – Juniperus osteosperma***

**/ *Artemisia nova* Woodland [Map Unit 15 — Pinyon Pine - Juniper spp. / Sagebrush spp. Woodland Complex]**




**52b** *Pinus edulis* mixed with *Juniperus osteosperma* and/or *Juniperus scopulorum* and an open to dense shrub layer dominated by *Artemisia tridentata* sub-species - ***Pinus edulis* – *Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland [Map Unit 15 — Pinyon Pine - Juniper spp. / Sagebrush spp. Woodland Complex]**





**53a** (51) Woodlands with a canopy of both *Pinus edulis* and *Juniperus* spp. and with a grassy understory of *Leymus salinus* or *Pleuraphis jamesii* **(59)**

**53b** Woodlands with a canopy of both *Pinus edulis* and *Juniperus* spp. and with a sparse understory or with a shrub layer dominated by *Arctostaphylos patula, Atriplex* spp., *Shepherdia rotundifolia, Purshia stansburiana* or *Purshia tridentata* **(54)**

**54a** (53) *Pinus edulis* woodlands with *Juniperus osteosperma,* generally occurring on steep, eroding slopes. *Shepherdia rotundifolia* is the most abundant shrub. One to many of several shrub species may be present, but these rarely provide more than 2% cover, including: *Artemisia tridentata* (*ssp. vaseyana, ssp. wyomingensis*), *Cercocarpus montanus, Ericameria nauseosa, Ephedra viridis, Eriogonum corymbosum, Gutierrezia sarothrae, Opuntia polyacantha, Purshia stansburiana, Purshia tridentata, Quercus gambelii,* and/or *Symphoricarpos oreophilus* - ***Pinus edulis – Juniperus osteosperma*** / ***Shepherdia rotundifolia*** **Woodland [Map Unit 16 — Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex]**



**54b** Woodlands with a canopy of both *Pinus edulis* and *Juniperus* spp. and with a sparse understory or with a shrub layer dominated by *Arctostaphylos patula, Atriplex* spp., *Purshia stansburiana* or *Purshia tridentata* **(55)**

**55a** (54) *Pinus edulis* woodlands with *Juniperus osteosperma* and/or *Juniperus scopulorum* and a sparse understory that may include very scattered shrubs - ***Pinus edulis – Juniperus osteosperma*** **/ Sparse Understory Woodland [Map Unit 18 — Pinyon Pine - Juniper spp. / Sparse Understory Woodland]**





**55b** *Pinus edulis – Juniperus* spp. woodlands with a shrub layer dominated by *Arctostaphylos patula, Atriplex* spp., *Purshia stansburiana* or *Purshia tridentata* **(56)**

**56a** (55) *Pinus edulis* woodlands with *Juniperus osteosperma*. *Arctostaphylos patula* is the dominant shrub of a patchy shrub layer that may also include *Cercocarpus montanus*, *Mahonia fremontii*, *Quercus gambelii*, *Shepherdia rotundifolia*, *Symphoricarpos oreophilus*, and/or *Tetradymia canescens*, but these never have more than one-half the cover of *Arctostaphylos patula*. ***Pinus edulis – Juniperus osteosperma* / *Arctostaphylos patula* Woodland [Map Unit 16 — Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex; Map Unit 12 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex]**



**56b** *Pinus edulis – Juniperus* spp. woodlands with a shrub layer dominated by *Atriplex* spp., *Purshia stansburiana* or *Purshia tridentata* **(57)**

**57a** (56) *Pinus edulis* woodlands with *Juniperus osteosperma* and/or *Juniperus scopulorum* and with a shrub understory dominated by *Atriplex canescens* and a grassy understory of mixed species, including *Elymus lanceolatus* **– *Pinus edulis – Juniperus osteosperma* / *Atriplex* spp. Woodland [Map Unit 14 – Pinyon Pine – Juniper spp. / Saline Wildrye Woodland]**



**57b** *Pinus edulis* woodlands with or without *Juniperus osteosperma* and/or *Juniperus scopulorum* and with a shrub layer dominated by *Purshia* spp. **(58)**

**58a** (57) *Pinus edulis* woodlands with *Juniperus osteosperma* and/or *Juniperus scopulorum* and with a shrub understory dominated by *Purshia stansburiana*. *Shepherdia rotundifolia* may be nearly co-dominant with *Purshia stansburiana*, and other shrubs present may include *Quercus gambelii*, *Cercocarpus montanus,* and *Ephedra viridis* - ***Pinus edulis – Juniperus osteosperma / Purshia stansburiana*** **Woodland [Map Unit 16 — Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex]**



**58b** *Pinus edulis* woodlands with a shrub layer dominated by *Purshia tridentata.* Other shrubs may be present including: *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia nova*, *Artemisia tridentata* (ssp. *tridentata*, ssp. *wyomingensis*), *Cercocarpus montanus*, *Chrysothamnus depressus*, *Chrysothamnus viscidiflorus*, *Mahonia fremontii*, *Quercus gambelii*, *Rosa* spp., *Shepherdia rotundifolia*, *Symphoricarpos oreophilus*, and/or *Tetradymia canescens*, but these species are never more than one-half the cover of *Purshia tridentata* - ***Pinus edulis – Juniperus osteosperma / Purshia tridentata***

**Woodland [Map Unit 16 — Pinyon Pine / Mixed Mountain Shrub Woodland Complex; Map Unit 12 – Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex]**






**59a** (53) *Pinus edulis* and *Juniperus* spp. woodland an herbaceous understory dominated by *Leymus salinus.* If *Artemisia nova* is present it is not with enough cover to form a dwarf-shrub layer - ***Pinus edulis – Juniperus* spp. / *Leymus salinus* Woodland [Map Unit 14 – Pinyon Pine – Juniper spp. / Saline Wildrye Woodland]**






**59b** *Pinus edulis* and *Juniperus* spp. Woodlands occurring in alluvial valleys or on hogbacks of Tropic Shale with an herbaceous understory dominated by *Pleuraphis jamesii. Bouteloua gracilis* may be co-dominant in the herbaceous layer – ***Pinus edulis – Juniperus osteosperma / Pleuraphis jamesii* Woodland [Map Unit 14 – Pinyon Pine – Juniper spp. / Saline Wildrye Woodland]**





# KEY III: A Key to the Shrubland Associations of Bryce Canyon National Park

**1a** Tall or short shrublands occupying wetlands, riparian areas, floodplains, canyon floors, alcoves, or other habitats that are either wet or periodically flooded, including the dry streambeds of washes. Characteristic genera include *Betula, Cercocarpus, Cornus, Purshia, Salix,* and *Shepherdia* **(2)**

**1b** Tall, short, or dwarf-shrublands occupying upland habitats or dry, high terraces in the broad valleys of the major rivers. Characteristic genera include *Amelanchier, Arctostaphylos, Artemisia, Atriplex, Ceanothus, Cercocarpus, Chrysothamnus, Dasiphora, Ericameria, Gutierrezia, Kraschenninnikovia, Prunus, Purshia, Quercus (gambelii), Symphoricarpos, Tetradymia,* or *Zuckia* **(8)**

**2a** (1) Tall, riparian shrublands dominated by *Betula occidentalis*. Other shrub species such as *Cornus sericea* may be co-dominant or merely present such as *Purshia tridentata*, *Rhus trilobata*, and/or *Salix bebbiana*, and trees such as *Populus angustifolia, Pinus ponderosa,* and *Pseudotsuga menziesii* may form a minor emergent component of the canopy - ***Betula occidentalis*** **Shrubland [Map Unit 28 — Water Birch Shrubland]**





**2b** Tall or short shrublands of wetlands or in dry washes, dominated by broadleaf mesic or wetland species, including the genera *Cercocarpus*, *Cornus, Purshia, Salix*, and *Shepherdia* **(3)**

**3a** (2) Tall, wetland shrublands dominated by one or more species of *Salix* **(4)**

**3b** Tall or short riparian shrublands dominated by species other than *Salix* and found growing along irrigation ditches, in alluvial valley bottoms or along dry or temporarily wet washes **(5)**

**4a** (3) Tall shrublands in wet meadows (less often on the banks of tributary streams) dominated by a mixture of willow species, including *Salix eriocephala*. Tall emergent shrubs such as *Betula occidentalis* or *Cornus sericea* may be present, but *Salix eriocephala* is the overwhelming dominant. An understory of both forbs and graminoids is generally dense and diverse, with graminoids usually dominant. Common species are *Equisetum* spp., *Calamagrostis stricta, Carex utriculata*, and/or *Juncus balticus* - ***Salix eriocephala* / Mesic Graminoids Shrubland [Map Unit 29 — Willow spp. Temporarily Flooded Shrubland Complex]**




**4b** Tall or short riparian or wetland shrublands in valley bottom sandy washes dominated by *Salix exigua*, which may exist as dense stands (40-70% cover) or may occur as scattered individuals with very low cover (up to 2%) in highly disturbed washes. Other riparian species present include *Salix eriocephala* and/or *Betula occidentalis*, but these are only occasional companions - ***Salix exigua* Temporarily Flooded Shrubland [Map Unit 29 — Willow spp. Temporarily Flooded Shrubland Complex]**



**5a** (5) Dense shrublands of alluvial valley bottoms dominated by *Cornus* sericea, and co-dominated by *Salix eriocephala,* along with *Juniperus scopulorum* and *Quercus gambelii,* with an understory that may include *Juncus* spp. - ***Cornus sericea*** **Rocky Mountain Shrubland [Map Unit 29 — Willow spp. Temporarily Flooded Shrubland Complex]**





**5b** Tall or short riparian shrublands dominated by *Cercocarpus*, *Purshia* or *Shepherdia,* found growing along irrigation ditches or in dry or temporarily wet washes **(6)**

**6a** (5) Shrublands of *Shepherdia argentea* accompanied by *Salix exigua* and *Purshia tridentata* found growing along the edges of irrigation canals/ditches – ***Shepherdia argentea*** **Shrubland [Map Unit 29 — Willow spp. Temporarily Flooded Shrubland Complex]**



**6b** Tall or short riparian shrublands dominated by *Purshia* or *Shepherdia,* usually along dry or temporarily wet washes **(7)**

**7a** (6) Shrubland occupying the braided, sandy or gravelly beds or side slopes of intermittent tributary streams; shrubs are mixed but *Cercocarpus montanus* is generally conspicuous to dominant - ***Cercocarpus montanus*** **Desert Wash Shrubland [Park Special] [Map Unit 27 — Mixed Mountain Shrubland Complex]**



**7b** Shrubland occupying the braided, sandy or gravelly beds or side slopes of intermittent tributary streams; shrubs are mixed but *Purshia tridentata* is generally conspicuous to dominant. While the community is not dominated by wetland obligate species, there are usually one or two obligate to facultative species present, such as *Populus fremontii,*

*Populus x intercurrens*, or *Elaeagnus angustifolia* - ***Purshia tridentata*** **Desert Wash Shrubland [Park Special] [Map Unit 27 — Mixed Mountain Shrubland Complex]**



**8a** (1) Short or dwarf shrublands, with or without a significant herbaceous component, occupying flat to sloping areas adjacent to or surrounded by Pinyon - Juniper woods or on highly eroding badlands. In some stands, the herbaceous component is equal to the shrub cover. Characteristic species include *Atriplex* spp., *Eriogonum corymbosum, Tetradymia canescens*, *Krascheninnikovia lanata,* or *Zuckia brandegeei* (*Artemisia* spp. may be co-dominant) **(9)**

**8b** Tall, short, or dwarf-shrublands of montane forest openings, open valley bottoms, or on highly eroding slopes. Characteristic genera include *Artemisia, Amelanchier, Arctostaphylos, Ceanothus, Chrysothamnus, Dasiphora, Gutierrezia, Prunus, Purshia, Quercus,* or *Symphoricarpos* **(18)**

**9a** (8) Short shrublands dominated by *Zuckia brandegeei*, usually on moderately to steeply sloping badlands. Herbaceous cover may be as high as 15%, but more characteristically there is little to no herbaceous cover. ***Zuckia brandegeei*** **Sparse Vegetation [Map Unit 45 — Mixed Desert Shrubland Complex]**





**9b** Short shrublands dominated by *Atriplex* spp.*, Eriogonum corymbosum* or *Tetradymia canescens***(10)**

**10a** (9) Short shrublands characterized by *Atriplex* spp. **(11)**

**10b** Shrublands characterized by *Tetradymia canescens* or *Eriogonum corymbosum* **(14)**

**11a** (10) Open shrublands of mixed *Atriplex canescens* and *Artemisia tridentata* on alluvial flats. Stands generally have equal cover of each species or within 50% relative cover. Stands with only trace of one and more than 5% of the other key to individual dominance type and are not considered mixed stands. Stands occur in openings adjacent to Pinyon - Juniper woodlands or on the ridges of slopes. Herbaceous cover may be sparse to moderate and includes *Pascopyrum smithii, Elymus elymoides*, and *Pleuraphis jamesii*, among others - ***Atriplex canescens - Artemisia tridentata*** **Shrubland [Map Unit 33 — Bottomland Shrubland Complex]**



**11b** Short shrublands characterized by Atriplex spp., not like above in all respects **(10)**

**12a** (11) Open shrublands of *Atriplex confertifolia* usually on moderately steep to very steep eroding slopes. Other shrubs present typically include *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Eriogonum corymbosum*, *Krascheninnikovia lanata*, and *Sarcobatus vermiculatus*. Herbaceous cover ranges from less than 1% to 5% and often includes *Bromus tectorum*, *Elymus elymoides*, *Elymus salinus*, *Pleuraphis jamesii*, *Salsola tragus*, *Stanleya pinnata*, and/or *Achnatherum hymenoides* - ***Atriplex confertifolia*** **Great Basin Shrubland [Map Unit 45 — Mixed Desert Shrubland Complex]**



**12b** Short shrubland dominated by *Atriplex canescens*, with a grassy understory of *Elymus* spp. occurring on badland hills of Tropic Shale or alluvial bottoms or with a seeded grassy understory of *Psathyrostachys juncea* occurring on alluvial bottoms **(13)**

**13a** (12) Open shrublands of *Atriplex canescens*, with *Krascheninnikovia lanata* present to co-dominant, and with an understory dominated by species of *Elymus (Pascopyrum smithii, Elymus elymoides, Leymus salinus).* Other shrubs and grasses present with low cover include *Eriogonum corymbosum, Atriplex confertifolia, Gutierrezia sarothrae, Pleuraphis jamesii,* and *Artemisia tridentata*. These stands generally occur on badland hills of Tropic Shale, but sometimes extend to lower alluvial flats nearby - ***Atriplex canescens / Elymus (elymoides, salinus)*** **Shrubland [Park Special] [Map Unit 45 – Mixed Desert Shrubland Complex]**





**13b** Shrublands dominated by *Atriplex canescens* with an understory dominated by the seeded grass species *Psathyrostachys juncea* and *Agropyron cristatum,* and occurring on alluvial flats near the park boundary west of Tropic. Some stands have high cover of the native grasses *Elymus elymoides, Pascopyrum smithii, Sporobolus airoides, Bouteloua gracilis,* and *Stipa hymenoides.* Live and dead shrub cover of *Krascheninnikovia lanata* and *Artemisia tridentata* is a common component of these communities - ***Atriplex canescens***

***/ Psathyrostachys juncea* Seeded Shrubland [Park Special] [Map Unit 34 – Big Sagebrush Shrubland Complex]**







**14a** (10) Short shrublands characterized by *Eriogonum corymbosum* **(15)**

**14b** Short shrublands characterized by *Tetradymia canescens* **(16)**

**15a** (14) Dwarf-shrubland or sub-shrubland dominated by *Eriogonum corymbosum.* Shrub cover may be really low, barely 1%, and herbaceous is cover trace - ***Eriogonum corymbosum* Badlands Sparse Vegetation [Map Unit 45 — Mixed Desert Shrubland Complex]**



**15b** Dwarf-shrubland or sub-shrubland dominated by *Eriogonum corymbosum* and a well-developed herbaceous layer dominated by *Leymus salinus,* typically occurring on slopes of shale or colluvium – ***Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland [Map Unit 45 – Mixed Desert Shrubland Complex]**





**16a** (14) Short shrubland with nearly equal herbaceous cover, easily mistaken for a grassland community. *Tetradymia canescens* has the highest cover (up to 10% cover). Other shrub species present include *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Artemisia nova*, and *Artemisia frigida*. The herbaceous layer is dominated by *Poa pratensis*, with smaller amounts of *Hesperostipa comata*, *Elymus lanceolatus*, and *Koeleria macrantha* present, indicating a potentially disturbed grassland - ***Tetradymia canescens*** / ***Poa pratensis*** **Shrubland [Park Special] [Map Unit 41 — Perennial Disturbed Grassland Complex]**



**16b** Short shrublands characterized by *Tetradymia canescens* **(17)**

**17a** (16) Short shrublands on barren badlands with the dominant (or only) shrub being *Tetradymia canescens.* Shrub cover is sparse (up to 1%) and herbaceous cover is trace - ***Tetradymia canescens*** **Badlands Sparse Vegetation [Park Special] [Map Unit 45 – Mixed Desert Shrubland Complex]**



**17b** Short mixed shrublands in valley bottoms with *Tetradymia canescens* dominant and accompanied by a variety of other shrubs, including *Chrysothamnus viscidiflorus, Gutierrezia sarothrae,* and *Artemisia nova*. The herbaceous layer includes *Hesperostipa comata, Poa fendleriana,* and *Elymus lanceolatus* - ***Tetradymia canescens*** **Shrubland [Park Special] [Map Unit 32 – Viscid Rabbitbrush Shrubland Complex]**



**18a** (8) Short and dwarf-shrublands dominated by sagebrush (*Artemisia* spp.). If stands are co-dominated by *Atriplex*, see couplet 11a. Other shrub species may be co-dominant **(19)**

**18b** Tall, short, and dwarf-shrublands dominated by *Amelanchier, Arctostaphylos, Chrysothamnus, Ericameria, Gutierrezia, Prunus, Purshia, Quercus gambelii,* and/or *Symphoricarpos*. *Artemisia* species may be present to abundant, but not dominant nor co-dominant in the shrub canopy layer **(28)**

**19a** (18) Dwarf *Artemisia nova* or *Artemisia pygmaea* shrublands that may have significant herbaceous cover, enough to be considered a shrub-herbaceous community, or the herbaceous cover is sparse **(20)**

**19b** *Artemisia tridentata* (ssp. *tridentata*, *wyomingensis,* or *vaseyana*) shrublands usually with significant herbaceous cover but the understory may be sparse **(25)**

**20a** (19) Dwarf-shrublands dominated by *Artemisia pygmaea.* Other species present include *Chrysothamnus depressus, Phlox hoodii,* and *Petradoria pumila* - ***Artemisia pygmaea*** **Shrubland [Park Special] [Map Unit 37 — Pygmy Sagebrush Dwarf-Shrubland]**



**20b** Dwarf-shrublands dominated by *Artemisia nova.* If co-dominated by *Purshia tridentata* key as a *Purshia* dominated shrubland (see couplet 37a) **(21)**

*Artemisia nova* Shrublands

**21a** (20) *Artemisia nova* dwarf-shrublands with a well-developed herbaceous understory **(22)**

**21b** *Artemisia nova* dwarf-shrublands with low herbaceous cover (<10% cover). Many scattered forbs and grasses may be present, including the forb species *Achillea millefolium, Cordylanthus kingii, Eriogonum racemosum, Eriogonum umbellatum,* and *Potentilla crinita* and the graminoid species *Bouteloua gracilis, Bromus ciliatus, Bromus inermis, Elymus elymoides, Elymus hispidus, Elymus lanceolatus, Leymus salinus, Elymus trachycaulus, Koeleria macrantha, Muhlenbergia montana, Poa fendleriana, Poa pratensis, Hesperostipa comata, Achnatherum hymenoides, Achnatherum lettermanii, and Achnatherum pinetorum,* but none with greater than 7% cover - ***Artemisia nova*** **Shrubland [Map Unit 30 — Black Sagebrush Shrubland Complex]**



**22a** (21) *Artemisia nova* dwarf-shrublands with *Elymus or Leymus* spp. dominant in the understory **(23)**

**22b** *Artemisia nova* dwarf-shrublands with *Poa fendleriana or Hesperostipa comata* dominant in the understory **(24)**

**23a** (22) *Artemisia nova* dwarf-shrublands with nearly equal cover of *Leymus salinus* in the understory – ***Artemisia nova / Leymus salinus*** **Shrub Herbaceous Vegetation [Map Unit 30 — Black Sagebrush Shrubland Complex]**



**23b** *Artemisia nova* dwarf-shrublands with *Elymus elymoides* the most abundant grass. Other short shrubs may be present including *Chrysothamnus* spp. and *Purshia tridentata,* and other herbaceous species present may include *Poa pratensis* and *Potentilla hippiana* – ***Artemisia nova / Elymus elymoides*** **Shrubland [Map Unit 30 — Black Sagebrush Shrubland Complex]**



**24a** (22) *Artemisia nova* dwarf-shrublands with *Poa fendleriana* the most abundant grass (1-35% cover). Other graminoid species include *Elymus elymoides, Poa pratensis, Hesperostipa comata*, and *Achnatherum hymenoides* with 1-8% cover. Individual trees of *Pinus ponderosa, Juniperus scopulorum,* or *Picea pungens* may be present, but are minor components - ***Artemisia nova*** / ***Poa fendleriana*** **Shrubland [Map Unit 30 — Black Sagebrush Shrubland Complex]**



**24b** *Artemisia nova* dwarf-shrublands (6-33% cover) with *Hesperostipa comata* the most abundant grass. Other short shrubs may be present including *Chrysothamnus viscidiflorus* or *Heterotheca villosa* with up to 12% cover. Herbaceous cover is high (20-30%) and may include the species *Bouteloua gracilis, Bromus ciliatus, Carex duriuscula, Carex rossii, Elymus elymoides, Elymus lanceolatus, Leymus salinus, Pseudoroegneria*

*spicata, Koeleria macrantha, Muhlenbergia montana, Poa fendleriana, Poa pratensis, Achnatherum lettermanii,* and *Achnatherum pinetorum*, many of which may have up to 20% cover individually. Stands with high cover of *Poa fendleriana* should have equal or higher cover of *Hesperostipa comata* - ***Artemisia nova*** / ***Hesperostipa comata*** **Shrubland [Map Unit 30 — Black Sagebrush Shrubland Complex]**



*Artemisia tridentata* Shrublands

**25a** (19) Shrublands dominated by *Artemisia tridentata* ssp. *wyomingensis*. (If you think you have a hybrid between ssp. *wyomingensis* and ssp. *vaseyana*, you must assign hybrids to one or the other species, based as best you can on "the preponderance of the evidence.") Many sagebrush stands are nearly if not completely dead **(26)**

**25b** Shrublands dominated by *Artemisia tridentata* ssp. *tridentata* or ssp. *vaseyana*. These types consistently have biotic crust. Some sagebrush are decadent, and many stands are nearly if not completely dead **(27)**

**26a** (25) Shrublands dominated by *Artemisia tridentata* ssp. *wyomingensis*, with an understory dominated by *Elymus lanceolatus* (up to 7% cover). Other herbaceous species present include *Agropyron cristatum, Bouteloua gracilis, Bromus inermis, Leymus salinus,* and *Achnatherum hymenoides* - ***Artemisia tridentata*** **ssp. *wyomingensis*** / ***Elymus lanceolatus*** **Shrubland [Park Special] [Map Unit 34 — Big Sagebrush Shrubland Complex]**



**26b** Shrublands dominated by *Artemisia tridentata* ssp. *wyomingensis* (up to 30% cover) with *Leymus salinus* in the understory (up to 12% cover). *Elymus elymoides* is often co-dominant in the understory. Other shrubs present include *Atriplex canescens, Krascheninnikovia lanata,* and *Gutierrezia sarothrae* - ***Artemisia tridentata*** **ssp. *wyomingensis* / *Leymus salinus* Shrubland [Map Unit 34 — Big Sagebrush Shrubland Complex]**





**27a** (25) Shrublands dominated by *Artemisia tridentata* ssp. *tridentata* with an understory dominated by the seeded grass, *Agropyron cristatum* - ***Artemisia tridentata*** **ssp. *tridentata* / *Agropyron cristatum* Semi-Natural Shrubland [Park Special] [Map Unit 34 — Big Sagebrush Shrubland Complex]**



**27b** Shrublands dominated by *Artemisia tridentata* ssp. *vaseyana*, with an understory dominated by *Pascopyrum smithii.* Other shrubs present include *Gutierrezia sarothrae* and *Atriplex canescens,* and other graminoids present include *Leymus salinus, Achnatherum hymenoides, Pseudoroegneria spicata*, *Agropyron cristatum, Elymus elymoides*, and *Hesperostipa comata* - ***Artemisia tridentata*** **ssp.** ***vaseyana*** / ***Pascopyrum smithii*** **Shrubland [Map Unit 34 — Big Sagebrush Shrubland Complex]**



## Non-Sagebrush Shrublands

**28a** (18) Shrublands with *Quercus gambelii* and/or *Arctostaphylos patula* co-dominant or independently abundant. Stands of *Quercus gambelii* may have a short shrub layer or no other layers may occur. *Quercus gambelii* may be resprouting from recent fires, where much of the upper canopy is dead, or stands may be "old growth", with large trunks and a definite short shrub layer **(29)**

**28b** Shrublands dominated by other shrub species. *Quercus gambelii* and *Arctostaphylos patula* may be present (<5% cover) but are not dominant or co-dominant in the stand **(34)**

**29a** (28) *Quercus gambelii* tall shrublands with no short shrub layer, though a few scattered short shrubs may be present. The understory may be a diverse herbaceous layer or may be sparse **(30)**

**29b** Shrublands with *Quercus gambelii* and/or *Arctostaphylos patula* dominant or co-dominant, with or without a mixed shrub layer that may include *Cercocarpus montanus, Symphoricarpos oreophilus,* and *Amelanchier utahensis* **(31)**

**30a** (23) *Quercus gambelii* tall shrublands with forbs common to abundant, sometimes forming an herbaceous layer. Shrub species including *Rhus trilobata* and *Mahonia repens* may be present with up to 5% cover. Forb species including *Solidago velutina* and *Smilacina stellata* may be moderately abundant (20-40% cover) - ***Quercus gambelii*** **Shrubland [Map Unit 26 — Gambel Oak Shrubland Complex]**




**30b** Dense *Quercus gambelii* tall shrublands (up to 60-90% cover) with sparse to little understory cover. Many understory species may be present, but no one species provides more than 1-2% cover - ***Quercus gambelii*** **/ Sparse Understory Shrubland [Map Unit 26 — Gambel Oak Shrubland Complex]**



**31a** (29) *Quercus gambelii* tall shrublands with abundant *Cercocarpus montanus* as a co-dominant. Other shrubs present may include *Amelanchier utahensis*, *Mahonia fremontii*, *Rhus trilobata*, *Purshia tridentata, Paxistima myrsinites, Peraphyllum ramosissimum, Cercocarpus ledifolius,* and *Symphoricarpos oreophilus*. *Pinus edulis, Juniperus scopulorum* or *Juniperus osteosperma* may occur as a minor component - ***Quercus gambelii – Cercocarpus montanus* / (*Carex geyeri*) Shrubland [Map Unit 26 — Gambel Oak Shrubland Complex]**






**31b** Shrublands with *Quercus gambelii* and/or *Arctostaphylos patula* dominant or co-dominant, with or without a mixed shrub layer that may include *Cercocarpus montanus, Symphoricarpos oreophilus*, and *Amelanchier utahensis* **(32)**

**32a** (31) *Quercus gambelii* tall shrublands (5-27% cover) with a low to moderate short shrub subcanopy of *Symphoricarpos oreophilus* (1-27% cover). Other shrubs that may be present include *Prunus virginiana, Amelanchier utahensis, Tetradymia canescens,* and *Purshia tridentata.* Generally *Arctostaphylos patula* is absent or has <5% cover. Herbaceous understory cover is sparse and may include *Chenopodium* spp., *Arabis* spp., and *Ipomopsis aggregata*, among others - ***Quercus gambelii* / *Symphoricarpos oreophilus* Shrubland [Map Unit 26 — Gambel Oak Shrubland Complex]**




**32b** Shrublands with *Arctostaphylos patula* dominant or co-dominant, with or without *Quercus gambelii* and a mixed shrub layer that may include *Cercocarpus montanus, Symphoricarpos oreophilus,* and *Amelanchier utahensis* **(33)**

**33a** (32) Abundant short shrub layer of *Arctostaphylos patula* (5-25% cover). Generally *Quercus gambelii* tall shrubs are present to co-dominant, but may be absent. *Amelanchier utahensis* tall shrubs may be co-dominant, or absent. Other shrubs present with less than 10% cover include *Ceanothus martinii, Cercocarpus montanus, Gutierrezia sarothrae, Mahonia fremontii, Mahonia repens, Rhus trilobata, Sambucus caerulea, Symphoricarpos oreophilus,* and *Tetradymia canescens.* Commonly occurs on sandier soils with a scattered *Pinus ponderosa* overstory - ***Arctostaphylos patula – Quercus gambelii - (Amelanchier utahensis)*** **Shrubland [Map Unit 31 — Manzanita Shrubland Complex]**



**33b** Abundant short shrub layer of *Arctostaphylos patula* (1-70% cover) or in sparse communities, *Arctostaphylos patula* is the dominant species. *Quercus gambelii* tall shrubs are always absent. Other shrubs present may include *Ceanothus martinii*, *Chrysothamnus parryi*, *Juniperus communis*, *Mahonia repens*, and *Purshia tridentata* (1-5% cover). *Pinus ponderosa* usually present with an open canopy, sometimes resembling

more of a wooded shrubland type - ***Arctostaphylos patula*** **Shrubland [Map Unit 31 — Manzanita Shrubland Complex]**



**34a** (28) Shrublands dominated by *Amelanchier utahensis, Amelanchier alnifolia*, *Cercocarpus montanus, Prunus virginiana*, or *Symphoricarpos oreophilus* occurring on moist or sheltered slopes **(35)**

**34b** Shrublands occurring on wet to dry sites dominated by species other than those listed above, such as *Chrysothamnus viscidiflorus*, *Dasiphora fruticosa*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, or *Purshia tridentata* **(37)**

**35a** (34) Tall shrublands dominated by *Prunus virginiana*; other shrubs present may include *Symphoricarpos oreophilus* and *Ericameria nauseosa*. The herbaceous understory may be diverse, up to 15% cover by several species, or nearly absent - ***Prunus virginiana – (Prunus americana)*** **Shrubland [Map Unit 27 — Mixed Mountain Shrubland Complex]**




**35b** Tall or short shrublands dominated by *Amelanchier utahensis, Amelanchier alnifolia*, *Cercocarpus montanus,* or *Symphoricarpos oreophilus* **(36)**

**36a** (35) Tall shrublands co-dominated by *Amelanchier (utahensis*, *alnifolia)* (3-20% cover) and *Cercocarpus montanus* (3-47% cover). Other shrubs present may include *Peraphyllum ramosissimum, Quercus gambelii*, and *Symphoricarpos oreophilus* (with 1-5% cover) - ***Amelanchier (alnifolia, utahensis) – Cercocarpus montanus*** **Shrubland [Map Unit 27 — Mixed Mountain Shrubland Complex]**



**36b** Short shrublands dominated by *Symphoricarpos oreophilus* (7-11% cover). Other shrubs present with sparse to low cover may include *Arctostaphylos patula*, *Ceanothus martinii*, *Chrysothamnus parryi*, *Mahonia repens*, *Paxistima myrsinites*, *Ribes cereum*, and *Rosa woodsii*. The herbaceous understory may be diverse, but no one species has significant cover except *Elymus elymoides*, which may have up to 5% cover. This type may occur in post-burn areas where a now dead tree canopy may still exist - ***Symphoricarpos oreophilus*** **Shrubland [Map Unit 27 — Mixed Mountain Shrubland Complex]**




**37a** (34) Short shrublands dominated by *Purshia tridentata*. Other shrubs may or may not be present **(38)**

**37b** Short and dwarf-shrublands dominated by genera other than *Purshia*, such as *Chrysothamnus, Dasiphora, Ericameria,* or *Gutierrezia* **(40)**

**38a** (37) Short shrublands dominated by *Purshia tridentata* (16-23% cover) with a dwarf shrub layer dominated by *Artemisia nova* (1-14% cover). Other shrubs present (with trace to 2% cover) may include *Artemisia frigida, Artemisia pygmaea, Heterotheca villosa* (1-10%), *Chrysothamnus depressus, Chrysothamnus parryi, Chrysothamnus viscidiflous, Gutierrezia sarothrae, Opuntia* spp., *Pediocactus simpsonii, Quercus gambelii,* and *Tetradymia canescens* - ***Artemisia nova – Purshia tridentata / Poa fendleriana*** **Shrubland [Map Unit 27 — Mixed Mountain Shrubland Complex]**



**38b** Short shrublands dominated by *Purshia tridentata* and lacking *Artemisia nova.* Graminoid cover is significant and generally higher than the sub-dominant shrubs present **(39)**

**39a** (38) Short shrublands dominated by *Purshia tridentata* with an herbaceous layer dominated by *Hesperostipa comata* (11-17% cover). Other graminoid species that are often present include *Bouteloua gracilis, Elymus elymoides, Pseudoroegneria spicata, Koeleria macrantha, Poa fendleriana, Hesperostipa comata,* and *Achnatherum hymenoides.* Scattered shrubs are often present with trace to 6% cover, and may include *Artemisia nova, Heterotheca villosa, Chrysothamnus depressus, Chrysothamnus parryi, Chrysothamnus vaseyi, Gutierrezia sarothrae, Mahonia repens, Opuntia* spp., *Purshia tridentata, Ribes cereum, Symphoricarpos oreophilus,* and *Tetradymia canescens* - ***Purshia tridentata*** / ***Hesperostipa comata*** **Shrub Herbaceous Vegetation [Map Unit 27 — Mixed Mountain Shrubland Complex]**



**39b** Short shrublands dominated by *Purshia tridentata* (up to 5% cover) with an herbaceous understory dominated by *Leymus salinus* (up to 7% cover). *Pinus ponderosa* may be present with up to 2% cover. Other shrub and herbaceous species that may be present include *Chrysothamnus viscidiflorus, Artemisia nova, Leymus salinus, Hesperostipa comata, Poa fendleriana,* and *Muhlenbergia montana* - ***Purshia tridentata*** / ***Leymus salinus*** **Shrubland [Park Special] [Map Unit 27 — Mixed Mountain Shrubland Complex]**



**40a** (37) Stands dominated by *Chrysothamnus viscidiflorus,* with or without *Ericameria parryi* present to co-dominant, and with low to moderate herbaceous cover (up to 10% cover) with various grasses dominant **(41)**

**40b** Stands dominated by short and dwarf-shrubs other than *Chrysothamnus viscidiflorus* **(43)**

**41a** (40) Stands dominated by *Chrysothamnus viscidiflorus,* with *Ericameria parryi* present to co-dominant, and a variety of grasses and forbs in the understory. Many other shrub species may be present, including *Purshia tridentata, Tetradymia canescens, Chrysothamnus depressus, Artemisia nova,* and *Gutierrezia sarothrae.* Grass species

with low to moderate cover may include *Hesperostipa comata, Koeleria macrantha, Elymus lanceolatus, Poa secunda, Poa pratensis, Achnatherum lettermanii, Achnatherum hymenoides,* and *Muhlenbergia montana* - ***Chrysothamnus viscidiflorus – Ericameria parryi*** **Shrub Herbaceous Vegetation [Map Unit 32 – Viscid Rabbitbrush Shrubland Complex]**



**41b** Short shrublands dominated by *Chrysothamnus viscidiflorus*, a few other scattered shrubs may be present, and herbaceous cover is low to moderate (up to 10% cover) with various grasses dominant **(42)**

**42a** (41) *Chrysothamnus viscidiflorus* shrublands with an herbaceous understory dominated by *Hesperostipa comata*. Many other graminoid species may be present, including *Bouteloua gracilis, Bromus tectorum, Carex duriuscula, Elymus elymoides, Pseudoroegneria spicata, Festuca octoflora*, and *Poa secunda.* This type commonly occurs as a band around other meadow types - ***Chrysothamnus viscidiflorus*** / ***Hesperostipa comata*** **Shrubland [Map Unit 32 — Viscid Rabbitbrush Shrubland Complex]**



**42b** *Chrysothamnus viscidiflorus* dominated short shrublands where there is a significant herbaceous understory that is dominated by multiple graminoid species. Graminoid species present include *Bouteloua gracilis, Bromus ciliatus, Elymus lanceolatus* (0-9% cover), *Pseudoroegneria spicata, Elymus trachycaulus* (0-8% cover), *Juncus balticus, Koeleria macrantha, Poa fendleriana, Poa pratensis* (trace to 25% cover), *Poa secunda* (trace to 24% cover), *Hesperostipa comata*, and *Achnatherum lettermanii.* This type commonly occurs as a band around other meadow types - ***Chrysothamnus viscidiflorus*** / **Mixed Grasses Shrubland [Park Special] [Map Unit 32 — Viscid Rabbitbrush Shrubland Complex]**



**43a** (40) Short shrublands dominated by *Ericameria nauseosa*. Other shrubs are usually present but never as abundant as rubber rabbitbrush **(44)**

**43b** Short and dwarf-shrublands dominated by *Gutierrezia sarothrae, Dasiphora fruticosa,* or *Ceanothus martini* **(45)**

**44a** (43) Short shrublands dominated by *Ericameria nauseosa* (12-29% cover) with a significant understory of *Achnatherum lettermanii* (8-35%) - ***Ericameria nauseosa*** / ***Achnatherum lettermanii*** **Shrubland [Park Special] [Map Unit 33 — Bottomland Shrubland Complex]**



**44b** Short shrublands dominated by *Ericameria nauseosa* (32-70% cover) that may have very little understory due to heavy shrub cover, or may have a significant understory of herbaceous species. *Achnatherum lettermanii*, if present, does not have more than 1% cover - ***Ericameria nauseosa*** **Shrubland [Map Unit 33 — Bottomland Shrubland Complex]**



**45a** (43) Shrublands dominated by *Gutierrezia sarothrae* or *Dasiphora fruticosa* **(46)**

**45b** Short shrublands dominated by *Ceanothus martinii* with an understory dominated by the seeded grass *Elymus trachycaulus* - ***Ceanothus martinii*** / ***Elymus trachycaulus*** **Seeded Roadcut Shrub Herbaceous Vegetation [Park Special] [Map Unit 43 — Roadside Restored Herbaceous Vegetation**



**46a** (45) Dwarf-shrublands dominated by *Gutierrezia sarothrae* (4-22% cover). Trees are usually present, providing 1-4% cover, and may include *Juniperus osteosperma*, *Juniperus scopulorum*, *Picea pungens*, *Pinus edulis*, *Pinus flexilis*, *Pinus ponderosa*, and *Pseudotsuga menziesii*. Other shrub species may be present with trace to 5% cover and include *Artemisia frigida*, *Artemisia tridentata*, *Ceanothus martinii*, *Cercocarpus montanus*, *Heterotheca villosa*, *Chrysothamnus depressus*, *Ericameria nauseosa*, *Chrysothamnus parryi*, *Chrysothamnus viscidiflorus*, *Dasiphora fruticosa*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia* spp., *Prunus virginiana*, *Purshia tridentata*, *Rhus trilobata*, *Ribes cereum*, *Rosa woodsii*, *Symphoricarpos oreophilus*, and *Tetradymia canescens* - ***Gutierrezia sarothrae*** **Wooded Dwarf-shrubland Alliance [Map Unit 45 — Mixed Desert Shrubland Complex]**



**46b** Short shrublands dominated by *Dasiphora fruticosa* (up to 65% cover), often occurring in disturbed sites with *Poa pratensis*, *Juncus balticus,* and *Iris missouriensis* - ***Dasiphora fruticosa* ssp. *floribunda* Shrubland [Map Unit 35 — Shrubby-cinquefoil Shrubland]**



## KEY IV: Herbaceous Associations

**1a** Herbaceous vegetation occupying mesic sites including wetlands, perennial drainages, floodplains, seeps, and springs; community controlled by the water table or subsurface flow of water **(2)**

**1b** Herbaceous vegetation in xeric and upland sites including dry drainages, terraces, and benches; community not controlled by the water table or subsurface flow of water **(10)**

### Wetland and Mesic Herbaceous Communities

**2a** (1) Sites are dominated by forb species of the genera *Mimulus*, *Veronica*, and others. Stands are small and generally limited to saturated creek or seep edges. Grasses may be present to abundant, but the mere presence of *Mimulus* species is enough to key to this type - ***Mimulus guttatus* – (*Mimulus* spp.) Herbaceous Vegetation [Map Unit 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**



**2b** Sites are dominated by grasses and/or graminoid species. Forb species are much less important in terms of total cover and *Mimulus* is not present. Stands range from small to large, occur on subirrigated floodplains, may be limited to a band along stream channels, but may also occur in broad bands if the hydrology is present, possibly occupying the valley floor **(3)**

**3a** (2) Wet or mesic sites dominated by other genera of graminoids, such as *Carex*, *Juncus, Eleocharis,* or *Equisetum. Bromus* spp. or *Poa* spp. may be present to abundant, but the presence of *Carex, Juncus,* or *Eleocharis* overrides any grass dominance as wetland indicator species **(4)**

**3b** Wet or mesic sites dominated by *Leymus salinus, Poa pratensis, Pascopyrum smithii,* and/or *Bromus inermis;* no *Carex* spp. or *Juncus* spp. present **(7)**

**4a** (3) Wet sites dominated or co-dominated by species of *Carex* **(5)**

**4b** Wet sites dominated by non-sedge graminoids (e.g., *Eleocharis* spp., *Juncus* spp.), although sedges with low cover (2-5% cover) are nearly always present **(6)**

**5a** (4) Freshwater to alkaline seepage areas where *Carex praegracilis* is present to dominant (10-40% cover). Other species present with 1-20% cover may include *Eleocharis palustris*, *Calamagrostis* spp., and *Elymus* spp. In disturbed areas, *Poa pratensis* and/or *Juncus balticus* may be present to abundant (1-27% cover) - ***Carex praegracilis*** **Herbaceous Vegetation [Map Unit 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**



**5b** Freshwater seepage areas and streams dominated by *Carex utriculata* (30-80% cover). Several graminoid and forb species may be present, including *Deschampsia caespitosa*, *Juncus balticus* (1-40% cover), *Mentha arvensis, Gentianopsis detonsa, Viola adunca,* and *Polemonium caeruleum* (0-20% cover). A few scattered shrubs may be present, including *Salix geyeriana* (0-7% cover) - ***Carex utriculata*** **Herbaceous Vegetation [Map Unit 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**



**6a** Sites that are saturated throughout the growing season, either on stream margins or near ponds, that are dominated by *Eleocharis quinqueflora.* Stands may be small, narrow and confined to the channel or water source margin or may occur in wide wet meadows or swales. *Juncus balticus* may be present to abundant to dominant, but *Eleocharis* spp. is the indicator species - ***Eleocharis quinqueflora*** **Herbaceous Vegetation [Map Unit 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**



**6b** Sites on the margins of alkaline or freshwater seeps, in heavily grazed wetlands, on the bottoms of broad drainages, or on the margins of overflow channels where water level fluctuates greatly throughout the growing season, that are dominated by *Juncus balticus. Carex* spp., if present, have no more than 2-5% cover - ***Juncus balticus*** **Herbaceous Vegetation [Map Unit 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**



**7a** (3) Wet swales or merely mesic areas with grasslands dominated by *Leymus salinus.* Usually several other graminoid species are present with trace to 5% cover, including *Bromus inermis, Carex rossii, Elymus lanceolatus, Koeleria macrantha, Poa fendleriana, Hesperostipa comata, and Achnatherum hymenoides* - ***Leymus salinus*** **Herbaceous Vegetation [Park Special] [Map Unit 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**

[See picture for type at couplet 11a.]

**7b** Mesic areas with grasslands and meadows dominated by *Poa pratensis or Bromus inermis.* Other species may be present, but *Poa pratensis* and/or *Bromus inermis* is/are the overwhelming dominant(s) **(8)**

**8a** (7) Grasslands and meadows dominated by *Bromus inermis,* usually in old seeded pastures near barns and corrals or along roads. *Bromus inermis* grasslands often spread into adjacent native pastures with *Bouteloua gracilis, Carex egglestonii, Eleocharis* spp., *Elymus hispidus, Elymus trachycaulus, Hordeum brachyantherum, Juncus balticus, Koeleria macrantha, Phleum pratense, Poa glauca, Poa pratensis, Achnatherum lettermanii, Achnatherum pinetorum, and/or Trisetum spicatum,* any of which may have trace to 5% cover - ***Bromus inermis* – (*Pascopyrum smithii*) Semi-Natural Herbaceous Vegetation [Map Unit 41 — Perennial Disturbed Grassland Complex]**




**8b** Grasslands and meadows dominated by *Poa pratensis* **(9)**

**9a** (8) 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 42 — Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic]**



**9b** Mesic sites that may occur in low-lying swales or areas that were once wetter and are now drier for a variety of reasons (not as wet as couplet 9a), and dominated by *Poa pratensis*. If native graminoids are present, none are as abundant as *Poa pratensis*, and one cannot tell what the native grassland community analogue might have been - ***Poa pratensis – (Pascopyrum smithii)*** **Semi-Natural Herbaceous Vegetation [Map Unit 41 — Perennial Disturbed Grassland Complex]**

[See picture for type at couplet 14a.]

## Upland and Dry Herbaceous Communities

**10a** (1) Dry upland to slightly mesic meadows and grasslands dominated by the native grass *Leymus salinus*, the sedge *Carex vallicola* or by introduced or seeded grass species such as *Poa pratensis, Agropyron cristatum, or Bromus inermis* **(11)**

**10b** Dry upland to slightly mesic meadows and grasslands dominated by native species such as *Achnatherum lettermanii*, *Hesperostipa comata*, *Elymus* spp., *Heterotheca villosa*, *Pascopyrum smithii*, *Poa fendleriana*, *Poa secunda,* and others **(14)**

**11a** (10) Grasslands dominated by the native grass *Leymus salinus*. Usually several other species are present with trace to 5% cover and may include *Bromus inermis*, *Carex rossii*, *Elymus lanceolatus*, *Koeleria macrantha*, *Poa fendleriana*, *Hesperostipa comata*, and *Achnatherum hymenoides* - ***Leymus salinus*** **Herbaceous Vegetation [Park Special] [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**11b** Grasslands and meadows dominated by the sedge *Carex vallicola* or by non-native grasses *Poa pratensis, Agropyron cristatum,* or *Bromus inermis.* Other species may be present but one of the above listed species is the obvious dominant species **(12)**

**12a** Upland meadows dominated by the sedge species *Carex vallicola*. Other species present with low cover include *Elymus salinus, Poa fendleriana, Koeleria macrantha, Elymus elymoides, Poa pratensis,* and *Juncus arcticus* – ***Carex vallicola*** **Herbaceous Vegetation [Park Special] [Map Unit 41 — Perennial Disturbed Grassland Complex]**



**12b** Grasslands and meadows dominated by the non-native grasses *Poa pratensis, Agropyron cristatum,* or *Bromus inermis.* Other species may be present but one of the above listed species is the obvious dominant species **(12)**

**13a** (11) Grasslands and meadows dominated by *Bromus inermis,* which often appear in old pastures that were seeded historically. These grasslands often spread into adjacent native pastures with *Bouteloua gracilis, Carex egglestonii, Eleocharis* spp., *Elymus hispidus, Elymus trachycaulus, Hordeum brachyantherum, Juncus balticus, Koeleria macrantha, Phleum pratense, Poa glauca, Poa pratensis, Achnatherum lettermanii, Achnatherum*

*pinetorum,* and *Trisetum spicatum* - ***Bromus inermis – (Pascopyrum smithii)*** **Semi-Natural Herbaceous Vegetation [Map Unit 41 — Perennial Disturbed Grassland Complex]**



**13b** Grasslands and meadows dominated by *Poa pratensis* or *Agropyron cristatum* that occur in slightly-to-heavily disturbed sites (recently or in the historic past), seeded or naturally invaded by non-native or native cultivar species. Sites may have many other grasses present including native species **(13)**

**14a** (12) Dry to mesic sites dominated by *Poa pratensis,* that may be in low lying swales or areas that were once wetter, and are now drier for a variety of reasons. If native graminoids are present, none are as abundant as *Poa pratensis* - ***Poa pratensis – (Pascopyrum smithii)*** **Semi-natural Herbaceous Vegetation [Map Unit 41 — Perennial Disturbed Grassland Complex]**



**14b** Dry sites along ditches, road cuts, power lines, and other disturbed areas that have been seeded with *Agropyron cristatum*. *Bromus inermis* and/or *Psathyrostachys juncea* may also be abundant (0-30% cover), but *Agropyron cristatum* is the indicator species. Native species that may be present are presumed to have become re-established as the site is

succeeding to a more natural state. Stands may be historically (40+ years) to newly seeded - ***Agropyron cristatum*** - (***Pascopyrum smithii, Hesperostipa comata)*** **Semi-Natural Herbaceous Vegetation [Map Unit 41 — Perennial Disturbed Grassland Complex]**



**15a** (10) Stands are sparse to moderately vegetated and dominated by *Heterotheca villosa* (5-27% cover). Other shrubs present may include *Artemisia frigida, Gutierrezia sarothrae,* and *Tetradymia canescens.* Herbaceous cover is relatively high, with mixed grasses that individually have 1-20% cover and may include *Bouteloua gracilis, Elymus lanceolatus, Elymus trachycaulus, Juncus balticus, Koeleria macrantha, Poa fendleriana, Poa pratensis, Poa secunda, Hesperostipa comata,* and *Achnatherum pinetorum.* Many forbs may also be present and one plot supported *Potentilla crinita* with 20% cover - ***Heterotheca villosa*** **/ Mixed Grass Shrub Herbaceous Vegetation [Park Special] [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**15b** Grasslands dominated by the genera *Achnatherum, Hesperostipa, Elymus, Pascopyrum*, and *Poa* **(15)**

**16a** (14) Dry grasslands where *Achnatherum lettermanii* or *Hesperostipa comata* are dominant or characteristic of the stand **(16)**

**16b** Dry grasslands where *Pascopyrum smithii, Elymus* spp., or *Poa* spp. are dominant or are characteristic of the stand. *Achnatherum lettermanii* and *Hesperostipa comata* may be present but are overwhelmed by the dominance of the afore-mentioned species **(17)**

**17a** (15) *Achnatherum lettermanii* is the dominant and characteristic grass. Shrub species that may be present include *Chrysothamnus vaseyi*, *Chrysothamnus depressus, or Ericameria parryi* with 0-6% cover. Other graminoid species present include *Carex egglestonii, Carex praegracilis, Elymus elymoides, Pseudoroegneria spicata, Elymus trachycaulus, Koeleria macrantha, Poa glauca, Achnatherum hymenoides,* and *Trisetum spicatum.* Forbs are abundant; few species have more than 1-2% cover except for *Potentilla concinna*, which may have up to 20% cover - ***Achnatherum lettermanii*** **Herbaceous Vegetation [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**17b** *Hesperostipa comata* is the dominant and characteristic grass. Shrubs with up to 5% cover may include *Artemisia nova, Artemisia tridentata* ssp. *tridentata*, *Ceanothus martinii*, *Chrysothamnus depressus*, *Chrysothamnus parryi*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Mahonia repens*, *Purshia tridentata*, and *Ribes cereum*. *Heterotheca villosa* may be present with up to 20% cover. Other graminoid species present include *Koeleria macrantha*, *Muhlenbergia montana*, *Poa fendleriana*, *Achnatherum hymenoides*, and *Achnatherum lettermanii* with 0-10% cover - ***Hesperostipa comata*** **Great Basin Herbaceous Vegetation [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**18a** (15) Grasslands dominated by *Pascopyrum smithii* (up to 23% cover). Other grass species present, with trace to 8% cover, include *Bouteloua gracilis*, *Elymus elymoides*, *Pseudoroegneria spicata*, *Pleuraphis jamesii*, and *Hesperostipa comata* - ***Pascopyrum smithii*** **Herbaceous Vegetation [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**18b** Grasslands and meadows dominated by *Poa* spp. or *Elymus* spp. **(18)**

**19a** (17) Grasslands or meadows dominated by *Elymus* spp. (19)

**19b** Grasslands or meadows dominated by *Poa* spp. (20)

**20a** Grasslands dominated by *Elymus lanceolatus.* Scattered shrubs with low cover may include *Chrysothamnus* spp., *Tetradymia canescens, Artemisia nova,* and *Gutierrezia sarothrae.* Other grass species present with low cover may include *Poa secunda* and *Stipa lettermanii* - ***Elymus lanceolatus*** **Herbaceous Vegetation Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**20b** Grasslands or meadows dominated by other *Elymus* spp. (19)

**21a** (18) Grasslands dominated by *Elymus elymoides* (4-22% cover), usually occurring post-burn where a now dead tree canopy may still exist. Other graminoid species present, with trace to 6% cover, may include *Bromus ciliatus*, *Bromus inermis*, *Carex praegracilis*, *Carex rossii*, *Elymus glaucus*, *Koeleria macrantha*, *Poa fendleriana*, *Poa pratensis*, *Achnatherum hymenoides*, and *Achnatherum lettermanii*. *Elymus elymoides* is clearly more abundant than any other individual species - ***Elymus elymoides*** **Herbaceous Vegetation [Park Special] [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**21b** Grasslands dominated by *Elymus trachycaulus* (4-25% cover). Other grass species present with up to 7% cover may include *Poa glauca, Poa pratensis, and Achnatherum lettermanii*. Forb species with more than trace cover include *Solidago multiradiata, Penstemon leiophyllus, Geum triflorum, Arenaria fendleri, Achillea millefolium*, and *Lomatium minimum* - ***Elymus trachycaulus*** **Herbaceous Vegetation [Park Special] [Map Unit 43 — Roadside Restored Herbaceous Vegetation]**




**22a** (18) Grasslands dominated by *Poa fendleriana* (7-15% cover). Other grass species present with trace to 4% cover include *Carex rossii*, *Elymus elymoides*, *Elymus lanceolatus*, *Koeleria macrantha*, *Poa secunda*, *Hesperostipa comata*, and *Achnatherum lettermanii*. *Balsamorhiza sagittata* may occur with 9-17% cover - ***Poa fendleriana*** **Herbaceous Vegetation [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



**22b** Grasslands dominated by *Poa secunda* (up to 30% cover). Other herbaceous species with 2-10% cover include *Poa pratensis, Koeleria macrantha, Juncus balticus, Achillea millefolium*, and *Machaeranthera canescens* - ***Poa secunda*** **Herbaceous Vegetation [Map Unit 40 — Dry Meadow Mixed Herbaceous Vegetation Mosaic]**



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*Ericameria nauseosa* / *Achnatherum lettermanii* Shrubland [Park Special] ..... 607
*Ericameria nauseosa* Shrubland ..... 608
*Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland ..... 590
*Eriogonum corymbosum* Badlands Sparse Vegetation ..... 590
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*Gutierrezia sarothrae* Wooded Dwarf-shrubland Alliance ..... 609
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*Hesperostipa comata* Great Basin Herbaceous Vegetation ..... 619
*Heterotheca villosa* / Mixed Grass Shrub Herbaceous Vegetation [Park Special] ..... 618
J
*Juncus balticus* Herbaceous Vegetation ..... 613
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M
*Mimulus guttatus* – (*Mimulus* spp.) Herbaceous Vegetation ..... 611
P
*Pascopyrum smithii* Herbaceous Vegetation ..... 620
*Picea pungens* / *Arctostaphylos patula* Forest ..... 562
*Picea pungens* / *Arctostaphylos uva-ursi* Forest ..... 562
*Picea pungens* / *Betula occidentalis* Woodland ..... 560
*Picea pungens* / *Bromus inermis* Forest [Park Special] ..... 561
*Picea pungens* / *Juniperus communis* Forest ..... 561
*Pinus edulis – Juniperus osteosperma* / *Arctostaphylos patula* Woodland ..... 579
*Pinus edulis – Juniperus osteosperma* / *Artemisia nova* Woodland ..... 577
*Pinus edulis – Juniperus osteosperma / Atriplex* spp. Woodland ..... 579
*Pinus edulis – Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland ..... 576
*Pinus edulis – Juniperus osteosperma / Pleuraphis jamesii* Woodland ..... 581
*Pinus edulis – Juniperus osteosperma / Purshia stansburiana* Woodland ..... 580
*Pinus edulis – Juniperus osteosperma / Purshia tridentata* Woodland ..... 581
*Pinus edulis – Juniperus osteosperma* / *Sherpherdia rotundifolia* Woodland ..... 578
*Pinus edulis – Juniperus osteosperma* / Sparse Understory Woodland ..... 578
*Pinus edulis – Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland ..... 577
*Pinus edulis – Juniperus* spp. / *Cercocarpus montanus* – Mixed Shrubs Woodland ..... 574
*Pinus edulis – Juniperus* spp. / *Leymus salinus* Woodland ..... 581
*Pinus edulis – Juniperus* spp. / *Quercus gambelii* Woodland ..... 576
*Pinus longaeva* Woodland ..... 574
*Pinus ponderosa – Pseudotsuga menziesii* / *Arctostaphylos patula* Woodland [Park Special] ..... 565
*Pinus ponderosa* / *Arctostaphylos patula* Woodland ..... 566
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*Pinus ponderosa* / *Cercocarpus ledifolius* / *Arctostaphylos patula* Woodland [Park Special] ..... 566
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*Pinus ponderosa* / *Hesperostipa comata* Colorado Plateau Woodland [Park Special] ..... 570
*Pinus ponderosa* / *Leymus salinus* Woodland ..... 570
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*Pinus ponderosa* / *Purshia tridentata* Woodland ..... 572
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*Pinus ponderosa* / Seeded Grasses Semi-Natural Woodland [Park Special] ..... 568
*Pinus ponderosa* / Sparse Understory Woodland ..... 567
*Pinus ponderosa* / *Symphoricarpos oreophilus* Forest ..... 572
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*Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Vegetation ..... 614
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*Populus angustifolia* / *Betula occidentalis* Woodland ..... 551
*Populus angustifolia* / *Cornus sericea* Woodland ..... 552
*Populus angustifolia* / *Symphoricarpos (albus, occidentalis, oreophilus)* Woodland ..... 550
*Populus tremuloides – Pseudotsuga menziesii* / *Juniperus communis* Forest ..... 548
*Populus tremuloides / Acer grandidentatum* Forest [Park Special] ..... 548
*Populus tremuloides* / *Juniperus communis* Forest ..... 549
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*Pseudotsuga menziesii* / *Quercus gambelii* Forest ..... 563
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*Purshia tridentata* Desert Wash Shrubland [Park Special] ..... 587
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*Quercus gambelii – Cercocarpus montanus* / (*Carex geyeri*) Shrubland ..... 600
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# 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 902 accuracy assessment field plots sampled at BRCA 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 BRCA vegetation map was 60%. We therefore inspected the original AA plot data, plot photographs, and aerial imagery for approximately 902 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, 2009 to BRCA 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 02/2009 |
|---|---|---|---|---|---|---|---|
| **1** | **1** | *Abies concolor* Forest Complex | White Fir Forest | Slightly undermapped and confused with map class 4 and map class 23 (5). Many mixed stands co-dominated by Douglas-fir and white fir get classified as white fir forests because of successional dynamics. | Combine with map class 4, which results in a map unit with slightly low user's and producer's error. Can retain original linework and/or can retain points that represent true Douglas-fir Forest stands. | Do not combine until resolution is approved by BRCA staff. | See map class 4. Absorb most polygons of map class 4 into this map class but retain linework and add a modifier for distinction. |
| **2** | **2** | *Abies concolor / Quercus gambelii – (Acer grandidentatum*) Forest | White Fir / Gambel Oak – (Bigtooth Maple) Forest | Slightly undermapped and confused with map classes 1, 3, and 8. | None needed. | Fixes we made in AA analysis meeting brought this MC close to 80% accuracy. | N/A |
| **3** | **3** | *Abies concolor / Arctostaphylos patula* Forest | White Fir / Manzanita – Mixed Shrub Forest | Low producer's and user's accuracy. Confusion with map classes 1, 22 and 23 (5) on user's end and major confusion with map classes 7 and 16 on producer's end. | Will absorb map class 22 polygons; map classes 23 and 7 were dealt with by adding *Abies concolor / Arctostaphylos patula* to some calls where deserved and by doing some remapping. | Do not combine until resolution is approved by BRCA staff. | Combine with map class 22. See notes for map class 22. Still some confusion with ponderosa pine woodlands, but accuracy is near 80%. |
| **4** | **4** | *Pseudotsuga menziesii* Forest Alliance | Douglas Fir Forest Complex | Low Producer's and User's accuracy, confused with a number of other mixed conifer map units. | Combine with map class 1, but retain linework (add a modifier) and retain polygons where plots or AA points that classed to *Pseudotsuga menziesii* Forest Alliance (true Douglas-fir) are. | Do not combine until resolution is approved by BRCA staff. | Retain linework but relabel polygons MC1, 2 or 3 with a "ps" modifier to denote that Doug fir may be present. Retain polygons of MC 4 only where documented by a plot or AA point as a true Doug fir woodland. |
| **5** | **6** | *Picea pungens* Forest Alliance | Blue Spruce Forest Complex | OK as is. | None needed. | N/A | Note: map class number changed from original. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **6** | **10** | *Pinus ponderosa* / *Quercus gambelii* Woodland | Ponderosa Pine / Gambel Oak Woodland | Somewhat overmapped. Some confusion with the MC 4 and more confusion with MC 7. | Some remapping of polygons should take care of the error. | Remap as discussed. | Retain map class with <80% accuracy. Still some errors with map classes 4 and 7. Note: map class number changed from original. |
| **7** | **7** | *Pinus ponderosa* – *(Pseudotsuga menziesii)* / *Arctostaphylos patula* Woodland Complex | Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex | Multiple issues with many different map classes, often because burn history alters understory species from the expected (mapper's model). In general, this type was undermapped. | Some remapping needed, especially where this type was confused with map classes 3, 9 and 10. | Remap where there is confusion with map classes 3, 9 and 10. | N/A |
| **8** | **8** | *Pinus ponderosa* / Mixed Mountain Shrub Woodland Complex | Ponderosa Pine / Mixed Mountain Shrub Woodland Complex | Undermapped. Major confusion with map class 9. | Some remapping needed where there is confusion with map class 9. | Remap where there is confusion with MC 9 (no grassy understory evident, shrubs visible). | Retain map class with <80% accuracy. Still somewhat undermapped. |
| **9** | **9** | *Pinus ponderosa* / Mixed Herbaceous Woodland Complex | Ponderosa Pine / Mixed Herbaceous Woodland Complex | Overmapped. Major confusion with map classes 7 and 8; most issues have to do with date since burn. | Several AA plots had grassy understory calls added by analysis team because they were appropriate based on the plot species cover data. | Some remapping needed where there is still confusion with map classes 7 and 8. | Absorb all polygons of old map class 10 and rewrite key to explain that grass understory can be very sparse, but still grass-dominated. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **10** | **9** | *Pinus ponderosa* / Sparse Understory Woodland | Ponderosa Pine / Mixed Herbaceous Woodland Complex | In many cases, the sparse understory is the result of a burn; these polygons appear to field crews as MC 7. The intent of MC 10 is to separate stands with a dense canopy and little understory from more open stands with a denser shrub or grass understory. | Some remapping of polygons with density modifiers, adding second calls that were correct where appropriate, and removing points in recent (post-2002 burns) will improve accuracy significantly. May also need to beef up field key so that field workers understand the intent of MC 10. | Do not combine until resolution is approved by BRCA staff. | Combine with map class 9 because the sparse understory and grassy understory behave similarly with fire. No need to separate these types for park managers. See notes for map class 9. |
| **11** | **13** | *Pinus longaeva* Woodland Alliance | Bristlecone Pine Woodland | Minor confusion with map classes 4, 7, and 9. | Crosswalk new type: *Pinus ponderosa* Sparse Woodland to map class 13. No other changes needed. | Change map unit/classification crosswalk as discussed. Fixes we made in AA analysis meeting brought this MU to >80% accuracy. | Note: map class number changed from original. |
| **12** | **14** | *Pinus edulis* – *Juniperus* spp. / *Elymus salinus* Woodland | Pinyon Pine – Juniper spp. / Saline Wildrye Woodland | A sparse-appearing community in belts on steep, rocky slopes with lots of substrate showing. Overmapped. Major confusion with map class 16, although these polygons have the right species but much lower density than the original concept of MC 16. | Combine with map class 16, but retain linework and be sure to add a modifier to explain the much lower density. | Do not combine until resolution is approved by BRCA staff. | Do not combine; retain map class with <80% accuracy. Much of the confusion is with plots of MC 16 that have *Shepherdia rotundifolia* in the understory. Note: map class number changed from original. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **13** | **15** | *Pinus edulis* – *Juniperus* spp. / *Artemisia* spp. Woodland Complex | Pinyon Pine – Juniper spp. / Sagebrush spp. Woodland Complex | One problem is that Artemisia tridentata shrubs apparent on aerial photos (flown in 2002) died after the drought and were not recorded as old map class 13 plots in 2007. Errors are therefore not all really wrong. | Rare map class, so low accuracy may be more a result of its rarity (undersampling). Retain map unit as-is. | N/A | Retain map class with <80% accuracy; occurs mostly in the eastern environs. Note: map class number changed from original. |
| **14** | **16** | *Pinus edulis* – *Juniperus* spp. / *Arctostaphylos patula* Woodland | Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex | Overmapped. Significant confusion with map class 16. | Combine MC 14 and 15 into MC 16. | Do not combine until resolution is approved by BRCA staff. | Combine with map class 16, but retain old map class 15 as a separate class. This combination brings the final accuracy well above 80%. |
| **15** | **17** | *Pinus edulis* – *Juniperus* spp. / *Quercus gambelii* Woodland Complex | Pinyon Pine – Juniper spp. / Gambel Oak Woodland Complex | Overmapped. Significant confusion with map class 16. | Combine MC 14 and 15 into MC 16. | Do not combine until resolution is approved by BRCA staff. | Retain map class with <80% accuracy because the oak understory has a different fuels regime and wildlife value. Note: map class number changed from original. |
| **16** | **16** | *Pinus edulis* – *Juniperus* spp. / Mixed Mountain Shrub Woodland Complex | Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Woodland Complex | Significant confusion with map classes 14 and 15. | Absorb map class 14 and 15, can keep or dissolve lines. See notes for map class 12, also. | Do not combine until resolution is approved by BRCA staff. | Absorb all polygons of map class 14 into map class 16, this brings accuracy to above 80%. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **17** | **18** | *Pinus edulis / Juniperus* spp. Sparse Woodland | Pinyon Pine – Juniper spp. / Sparse Understory Woodland | Major confusion is with map class 16; this confusion occurs because both units have dense canopy vegetation, but map class 17 has a sparser understory that is not visible because of the high canopy cover. Minor confusion occurs with map classes 13, 14 and 15. | "Errors you can live with". Shrub cover tends to be just over the "sparse" cutoff of 5%. Combining with old map classes 13 and 17 only further blurs the concept of *Pinus edulis – Juniperus* spp. / Mixed Mountain Shrubland. | Do not combine until resolution is approved by BRCA staff. | Okay as is. Retain map class with <80% accuracy. Many errors with other pinyon-juniper map classes are just inclusions of sparse understories within the larger mosaic of shrub understories. |
| **18** | **23** | *Populus tremuloides* Forest Complex | Aspen Forest Complex | Very rare class that was slightly overmapped. | None needed. | N/A | Retain with <80% accuracy because map class is rare and accuracy is based on only a handful of points. |
| **19** | **11** | *Pinus ponderosa / Pinus edulis – Juniperus* spp. / *Quercus gambelii* Forest | Ponderosa Pine / Pinyon Pine – Juniper spp. / Gambel Oak Forest | Undermapped. Minor confusion with map classes 16, 20 and 26. | Combine map classes 19, 20, and 24 into MC 20; this keeps the P– J stands with emergent PINPON and PSEMEN separate from P–J and from PINPON stands, and ends confusion with shrub understory; becomes a mixed mountain shrub understory. | Do not combine until resolution is approved by BRCA staff. | Retain map class with <80% accuracy because the oak understory has a different fuels regime and wildlife value. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **20** | **12** | *Pinus ponderosa* / *Pinus edulis* – *Juniperus* spp. / Mixed Mountain Shrub Forest | Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Forest | Undermapped. Confused with map classes 7, 8, 16, 24 and 31 because of heterogeneity within polygons of canopy emergents, confusion of young ponderosa pine trees with Pinyon Pine – Juniper species, and difficulty telling *Arctostaphylos patula* from other shrubs. | Combine map classes 19, 20, and 24 into MC 20; this keeps the P– J stands with emergent PINPON and PSEMEN separate from P–J and from PINPON stands, and ends confusion with shrub understory; becomes a mixed mountain shrub understory. | Do not combine until resolution is approved by BRCA staff. | Absorb all polygons of map class 24 into map class 20, new map class 12. Do not combine with map class 19 (11). Still somewhat undermapped and small errors associated with a variety of other map classes. |
| **21** | **2** | *Acer grandidentatum* Woodland | White Fir / Gambel Oak – (Bigtooth Maple) Forest | No polygons in current map. | Rare map class, was mapped only where recorded in the field. | N/A | Absorb into MC2. |
| **22** | **3** | *Abies concolor* / Mixed Mountain Shrub Forest | White Fir / Manzanita – Mixed Shrub Forest | Low accuracy - confusion with a number of other map units, and was rarely seen by the AA sampling crew. Very undersampled, probably due to accessibility issues (steep slopes). | Rename the three AA plots called map class 22 in the field to map class 3. Dan will remap the remaining 48 polygons and rename the new map class 3 to incorporate manzanita and other mixed shrubs. | Do not combine until resolution is approved by BRCA staff. | Combine with map class 3 and rename map class: “White Fir / Manzanita – Mixed Shrub Forest.” |
| **23** | **5** | *Abies concolor* / Mixed Herbaceous Forest Complex | White Fir / Mixed Herbaceous Forest | Overmapped. Confused with map classes 1 and 3 (mainly), both closely related types, and somewhat with map class 7. | Issues mostly resolved by adding "reasonable" calls to the association lists, and some remapping. Should be fine now. | Incorporate changes as discussed. Fixes we made in AA analysis meeting brought this MC to >80% accuracy. | Note: map class number changed from original. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
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| **24** | **12** | *Pinus ponderosa* / *Pinus edulis* – *Juniperus* spp. / *Arctostaphylos patula* Woodland | Ponderosa Pine / Pinyon Pine – Juniper spp. / Mixed Mountain Shrub Forest | Overmapped. Confused with map classes 7, 16 and 20. | Combine map classes 19, 20 and 24 into MC 20; this keeps the P– J stands with emergent PINPON and PSEMEN separate from P–J and from PINPON stands, and ends confusion with shrub understory; becomes a mixed mountain shrub understory. | Do not combine until resolution is approved by BRCA staff. | Combine with map class 20 into new map class 12. No management reason to separate manzanita from other mixed mountain shrubs in the understory. |
| **N/A** | **24** | *Populus angustifolia* Woodland Alliance | Narrowleaf Cottonwood Woodland Alliance | N/A | N/A | Two polygons interpreted post-AA analysis based on data from AA points. | N/A |
| **25** | **25** | *Cercocarpus ledifolius* Woodland Alliance | Curl-leaf Mountain-mahogany Woodland Alliance | Rare within BRCA, but under-mapped anyway; significant confusion with map classes 27 and 31. | Retain polygons containing AA plots keyed to this type as a park special map class; otherwise merge polygons into related Mixed Mountain Shrubland Complex or Mixed Mountain Wooded Shrubland. | Do not combine until resolution is approved by BRCA staff. Some remapping of this type post-AA analysis meeting improved the accuracy. | Do not combine. Retain with <80% accuracy because map class is rare and accuracy is based on only a handful of points. |
| **26** | **26** | *Quercus gambelii* Shrubland Alliance | Gambel Oak Shrubland Alliance | Minor confusion with map classes 11, 17 and 27. | Added second calls where appropriate; with some slight remapping of a few polygons, this map unit is very accurate. | Incorporate changes as discussed. Fixes we made in AA analysis meeting brought this MU to >80% accuracy. | N/A |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
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| **27** | **27** | Mixed Mountain Shrubland Complex | Mixed Mountain Shrubland Complex | Confusion on the producer's end with many map classes (11, 12, 25 and 26). Under sampled due to steep slope issues. Overmapped where tree crowns were visible on the aerial imagery. | Expect inclusions of impenetrable pure Gambel oak trees/shrubs in this map unit. Some remapping needed where tree crowns are visible as a layer and where pure oak stands are big enough to pull out separately. | Review of errors revealed a number of easily-fixed mapping errors. More careful review allowed differentiation between this type and the pure oak shrublands. | Retain map class with <80% accuracy because of the wildlife value. Still somewhat overmapped. |
| **28** | **28** | *Betula occidentalis* Shrubland | Water Birch Shrubland | OK as is. Very rare type, so errors have to do with low number of AA points sampled in this type. | None needed. | N/A | N/A |
| **29** | **29** | *Salix* spp. Temporarily Flooded Shrubland Complex | Willow spp. Temporarily Flooded Shrubland Complex | OK as is. Somewhat undermapped and confused with map class 26. | None needed. | Fixes we made in AA analysis meeting brought this MU to >80% accuracy. | N/A |
| **30** | **30** | *Artemisia nova* Shrubland Alliance | Black Sagebrush Shrubland Alliance | Undermapped and confused mainly with map class 32. Errors are with AA plots that contain some *Purshia tridentata* Shrubland but are still keyed to *Artemisia nova* Shrubland Alliance. | Can keep these AA plots as *Artemisia nova* Shrubland Alliance with a *Purshia tridentata* Shrubland modifier, or can merge polygons with surrounding "pure" *Artemisia nova* Shrubland Alliance polygons. Other errors with map class 32 can be resolved by minor boundary revisions. | Make minor boundary revisions. Merging with neighboring pure ARTNOV polygons brought accuracy >80%. | N/A |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
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| **31** | **31** | *Arctostaphylos patula* Shrubland Alliance | Manzanita Shrubland Alliance | Minor confusion on the producer's end with map classes 7, 24, and 25, mostly in sparse polygons where trees are scattered and the shrub cover is low. Also somewhat undermapped and confused with map class 40 in grassy stands. | Review of errors revealed a number of easily-fixed mapping errors; if these are fixed, the accuracy is acceptable. | Fixes we made in AA analysis meeting brought the accuracy up. | Retain map class with <80% accuracy. Errors remain with sparsely wooded stands that keyed to woodlands but were mapped as shrublands. |
| **32** | **32** | *Ericameria* (*Chrysothamnus*) spp. Shrubland Complex | Rabbitbrush spp. Shrubland Complex | Overmapped and confused with map classes 30 and 33. Minor confusion with native and disturbed grasslands on the user's end. | Shift crosswalk to include only scabby upland rabbitbrush species (*parryi, viscidiflorus, discoidea*). Rubber rabbitbrush (*Ericameria nauseosa*) polygons should go to the new combined Bottomland Shrubland Complex. | Change crosswalk. Fixes we made in AA analysis meeting brought the accuracy up. | Retain map class with <80% accuracy. Errors are acceptable because map class is relatively rare. |
| **33** | **33** | Bottomland Shrubland Complex | Bottomland Shrubland Complex | Undermapped. Significant confusion with map classes 32, 34 and 45. | Rare map unit. *Ericameria nauseosa* shrubland plots were mis-mapped based on a crosswalk error - all are good bottomland shrublands and will be re-mapped as such. | Change crosswalk, recalculate accuracy. | Mostly a map class for the environs. Fixes made post-AA analysis brought the accuracy above 80%. |
| **34** | **34** | *Artemisia tridentata* Shrubland Complex | Big Sagebrush Shrubland Complex | Confusion is with *Krascheninnikovia lanata* Shrubland and Mixed Desert Shrubland Complex. | Accuracy is affected by *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) shrub mortality; moved AA plots from map class 34 to 45. Combine MC 34 into MC 45, retaining a modifier for polygons where *Artemisia tridentata* (upland) shrubs survive. | Incorporate changes as discussed, wait on combination of map class 34 and 45 until resolution is approved by BRCA staff. | Retain map class with <80% accuracy because the sagebrush may come back. |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
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| **35** | **35** | *Dasiphora fruticosa* ssp. *floribunda* Shrubland | Shrubby-cinquefoil Shrubland | Not accuracy assessed. | Mapped only in environs. Tiny polygon in park combined with surrounding large wet meadow. | N/A | N/A |
| **36** | **45** | *Krascheninnikovia lanata* Shrubland | Mixed Desert Shrubland Complex | Confusion is with *Artemisia tridentata* Shrubland Complex. | Move into Mixed Desert Shrubland Complex, map class 45. | Do not combine until resolution is approved by BRCA staff. | Combine with map class 45. |
| **37** | **37** | *Artemisia pygmaea* Dwarf-shrubland | Pygmy Sagebrush Dwarf-shrubland | Slightly overmapped. Minor confusion with *Artemisia nova* Shrubland Alliance. | Remap some areas as Black Sagebrush shrublands. | Remap as discussed. | Retain map class with <80% accuracy. Few errors that remain are confusion with black sagebrush shrublands. |
| **40** | **40** | Dry Meadow Mixed Herbaceous Vegetation Mosaic | Dry Meadow Mixed Herbaceous Vegetation Mosaic | Low accuracy on both producer's and user's ends. Confused with map classes 27, 31 and 32 on producer's end and with map class 41 on user's end. Confusion with shrubland map classes is an issue with interpreting post-burn communities. | Minor map fixes improved user's accuracy, but producer's accuracy is still a bit low. | N/A | Retain map class with <80% accuracy. Issue of scale – mapper was pulling out finer detail at <MMU scale whereas field crews were viewing small grasslands as inclusions. |
| **41** | **41** | Perennial Disturbed Grassland Complex | Perennial Disturbed Grassland Complex | Somewhat overmapped and confused with map classes 32, 40 and 42. | Minor map fixes brought the accuracy up to above 80%. | N/A | N/A |
| **42** | **42** | *Carex* spp. – *Juncus* spp. – Wet Meadow Herbaceous Vegetation Mosaic | Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic | Rare type that was confused with map class 41 on user's and producer's ends. | Minor map fixes brought the accuracy up to above 80%. | N/A | N/A |
| **43** | **43** | Roadside Restored Herbaceous Vegetation | Roadside Restored Herbaceous Vegetation | Not accuracy assessed. | N/A | N/A | N/A |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **45** | **45** | Mixed Desert Shrubland Complex | Mixed Desert Shrubland Complex | Somewhat undermapped and confused with map class 48. | Absorb MC 48, but retain known *Zuckia brandegeei* Shrubland plots as buffered points to represent the type. Absorb MC 36, as well. Errors with MC 48 are all in one poorly labeled polygon. | Do not combine/absorb map units until resolution is approved by BRCA staff. Fixing one large polygon will improve accuracy greatly. | Absorb polygons of map class 36, but do not absorb map class 48. Fixes made post-AA analysis brought the accuracy above 80%. |
| **46** | **46** | Claron Formation | Claron Formation | Not accuracy assessed. | N/A | N/A | N/A |
| **47** | **47** | Barren Washes | Barren Washes | Not accuracy assessed. | N/A | N/A | N/A |
| **48** | **48** | *Zuckia brandegeei* Shrubland | Siltbush Shrubland | Significant confusion with the Mixed Desert Shrubland Complex. | Combine with map class 48. Can keep known points separate from the rest of Mixed Desert Shrubland; still call them *Zuckia brandegeei* Shrubland. | Do not combine until resolution is approved by BRCA staff. Fixing one large polygon will improve accuracy greatly. | Mostly in the buffer. Fixes made post-AA analysis to one large polygon (relabeling) brought the accuracy above 80%. |
| **50** | **50** | Transportation, Communications, and Utilities | Transportation, Communications, and Utilities | Not accuracy assessed. | N/A | N/A | N/A |
| **51** | **51** | Mixed Urban or Built-up Land | Mixed Urban or Built-up Land | Not accuracy assessed. | N/A | N/A | N/A |
| **52** | **52** | Croplands and Pastures | Croplands and Pastures | Not accuracy assessed. | N/A | N/A | N/A |
| **54** | **54** | Other Agricultural Lands | Other Agricultural Lands | Not accuracy assessed. | N/A | N/A | N/A |
| **56** | **56** | Intermittent Streams | Intermittent Streams | Not accuracy assessed. | N/A | N/A | N/A |
| **57** | **57** | Reservoirs | Reservoirs | Not accuracy assessed. | N/A | N/A | N/A |
| **59** | **59** | Stock Ponds | Stock Ponds | Not accuracy assessed. | N/A | N/A | N/A |
| **60** | **60** | Strip Mines, Quarries, and Gravel Pits | Strip Mines, Quarries, and Gravel Pits | Not accuracy assessed. | N/A | N/A | N/A |

| Map Class | Final Map Class | Map Class Name | Final Map Class Name | Error Source | Potential Resolution | Instructions for GIS Coordinator | Park Decision 02/2009 |
|---|---|---|---|---|---|---|---|
| **61** | **61** | Seeps and Springs | Seeps and Springs | Not accuracy assessed. | N/A | N/A | N/A |

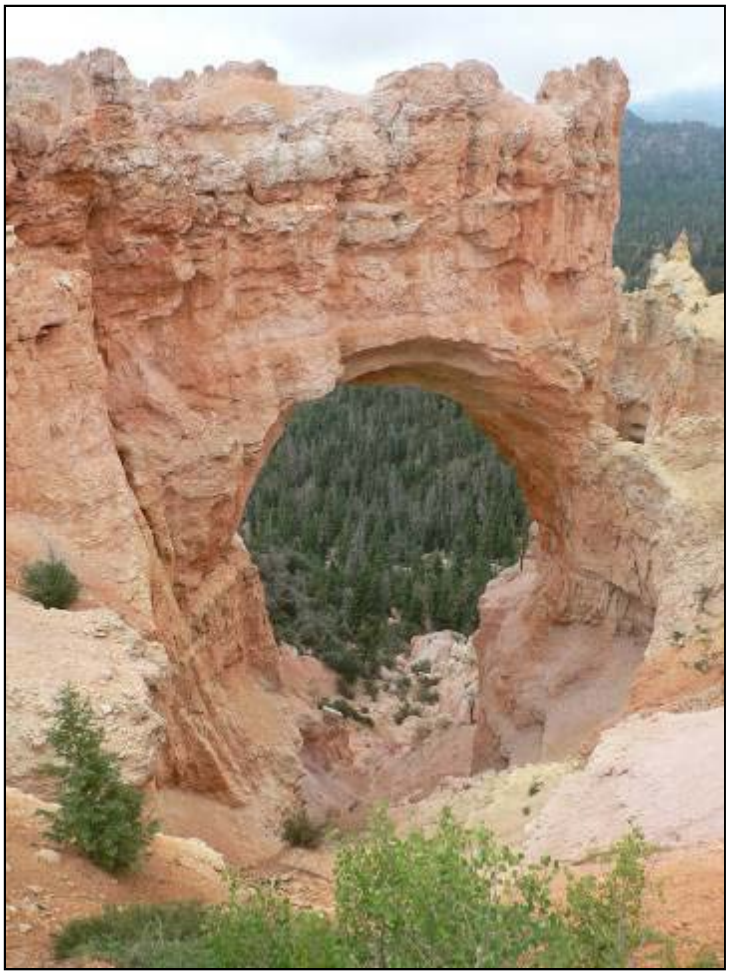
# Appendix J. Map Class Descriptions for Bryce Canyon National Park

## Introduction

This document provides a visual guide and description of the vegetation map classes for the Bryce Canyon National Park Vegetation Mapping Project. Thirty-eight map classes are described in this guide. Nine 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 for each map class



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 BRYCE CANYON NATIONAL PARK

Upland Forest and Woodland ..... 654

White Fir Forest Complex (F-ABIE) ..... 654

White Fir / Gambel Oak – (Bigtooth Maple) Forest (F-WFGO) ..... 656

White Fir / Manzanita – Mixed Shrub Forest (F-WFMS) ..... 658

Douglas Fir Forest Complex (F-PSME) ..... 660

White Fir / Mixed Grass Forest (F-WFMG) ..... 662

Blue Spruce Forest Complex (F-PICE) ..... 664

Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex (W-PPMA) ..... 666

Ponderosa Pine / Mixed Mountain Shrub Woodland Complex (W-PPMS) ..... 668

Ponderosa Pine / Mixed Herbaceous Woodland Complex (W-PPMH) ..... 670

Ponderosa Pine / Gambel Oak Woodland (W-PPGO) ..... 673

Ponderosa Pine / Pinyon Pine - Juniper spp. / Gambel Oak Woodland (W-PPJO) ..... 675

Ponderosa Pine / Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex (W-PPJS) ..... 677

Bristlecone Pine Woodland (W-PILO) ..... 680

Pinyon Pine - Juniper spp. / Saline Wildrye Woodland (W-PJSW) ..... 682

Pinyon Pine - Juniper spp. / Sagebrush spp. Woodland Complex (W-PJSA) ..... 684

Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex (W-PJMS) ..... 686

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Pinyon Pine - Juniper spp. / Sparse Understory Woodland (W-PJSP) ..... 691

Aspen Forest Complex (F-ASPE) ..... 693

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# Upland Forest and Woodland

## Map Class 1
## White Fir Forest Complex (F-ABIE)





Photo credits: NPS

### Associations

*Abies concolor / Juniperus communis* Forest
*Abies concolor / Mahonia repens* Forest
*Abies concolor / Symphoricarpos oreophilus* Forest
*Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest

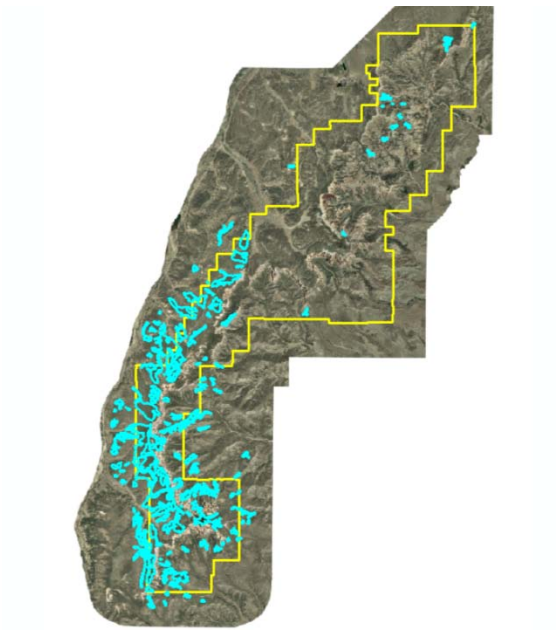
### Common species

- *Abies concolor*
- *Juniperus communis*
- *Mahonia repens*
- *Pseudotsuga menziesii*
- *Symphoricarpos oreophilus*

### F-ABIE Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 264 total polygons<br>140 total polygons in BRCA<br>124 total polygons in the environs |
| Total project area: | 1,384 hectares / 3,420 acres (5.8 %)<br>955 hectares / 2359 acres in BRCA<br>429 hectares / 1,061 acres in the environs |
| Average Polygon Size: | 5.2 hectares / 13 acres |
| Producer's accuracy: | 89% ± 9% |
| User's accuracy: | 89% ± 9% |

### Distribution in Mapping Area

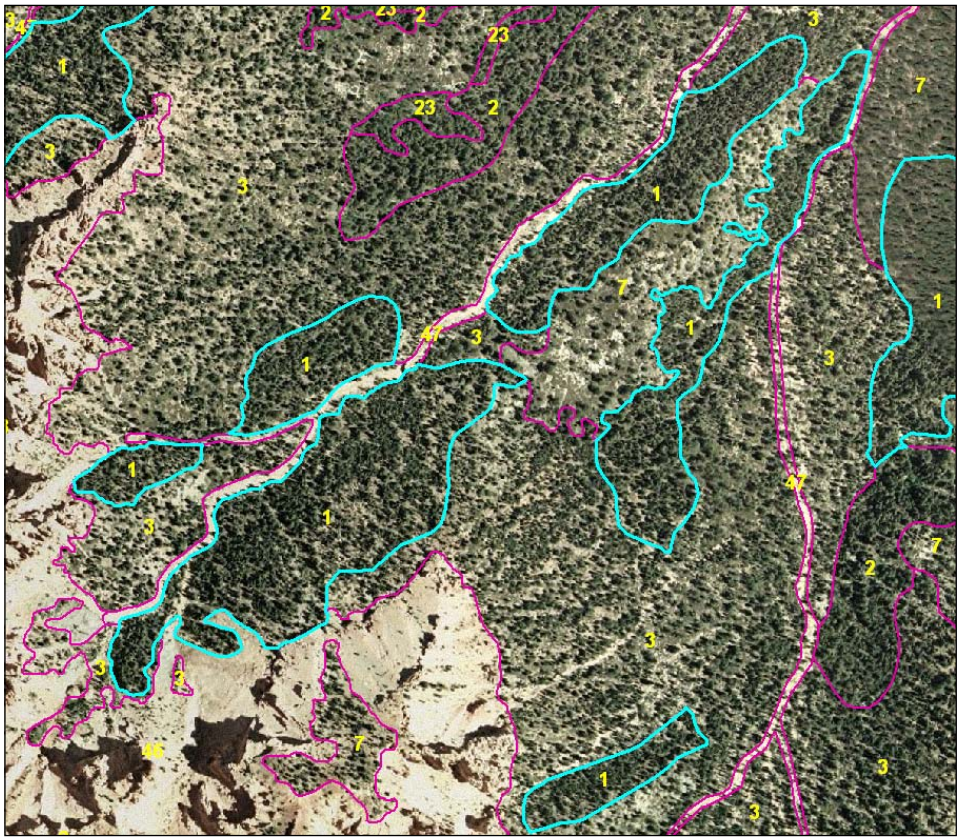


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderate west-to-south-facing slopes above the rims of the main canyon and their major tributaries. White fir is generally dominant, but Douglas-fir, blue spruce, quaking aspen, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands are somewhat xeric and short shrubs including common juniper, western snowberry, mountain lover, and Oregon-grape dominate the understory in many stands, often with only sparse to low cover. The herbaceous layer sometimes includes the graminoids Ross sedge and squirreltail.

## Interpretation

This common map class appears as medium to large irregular polygons on gentle slopes and flats in the southern and southwestern portion of the Park on the Paunsaugunt Plateau edge beginning near Swamp Canyon and in scattered pockets north of Fairyland Point. The color is moderately 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 xeric mixed shrub understories (map class 3) or grassy understories (map class 5) and ponderosa pine – Douglas fir /manzanita woodlands (map class 7).



Example of photo signature for map class F-ABIE (#1).

## Map Class 2
## White Fir / Gambel Oak – (Bigtooth Maple) Forest (F-WFGO)





Photo credits: NPS

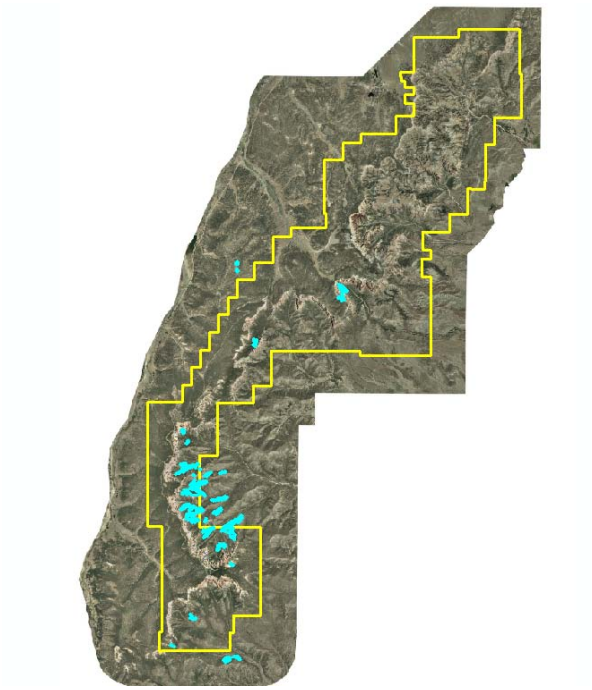
### Associations
*Abies concolor / Quercus gambelii* Forest
*Abies concolor / Acer grandidentatum* Forest
*Acer grandidentatum / Quercus gambelii* Forest (rare)
*Pseudotsuga menziesii / Quercus gambelii* Forest

### Common species
- *Abies concolor*
- *Acer grandidentatum*
- *Pseudotsuga menziesii*
- *Quercus gambelii*

### F-WFGO Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 48 total polygons<br>27 total polygons in BRCA<br>21 total polygons in the environs |
| Total project area: | 177 hectares / 437 acres (0.7 %)<br>134 hectares / 331 acres in BRCA<br>43 hectares / 107 acres in the environs |
| Average Polygon Size: | 3.7 hectares / 9.1 acres |
| Producer's accuracy: | 81% ± 15% |
| User's accuracy: | 85% ± 14% |

### Distribution in Mapping Area

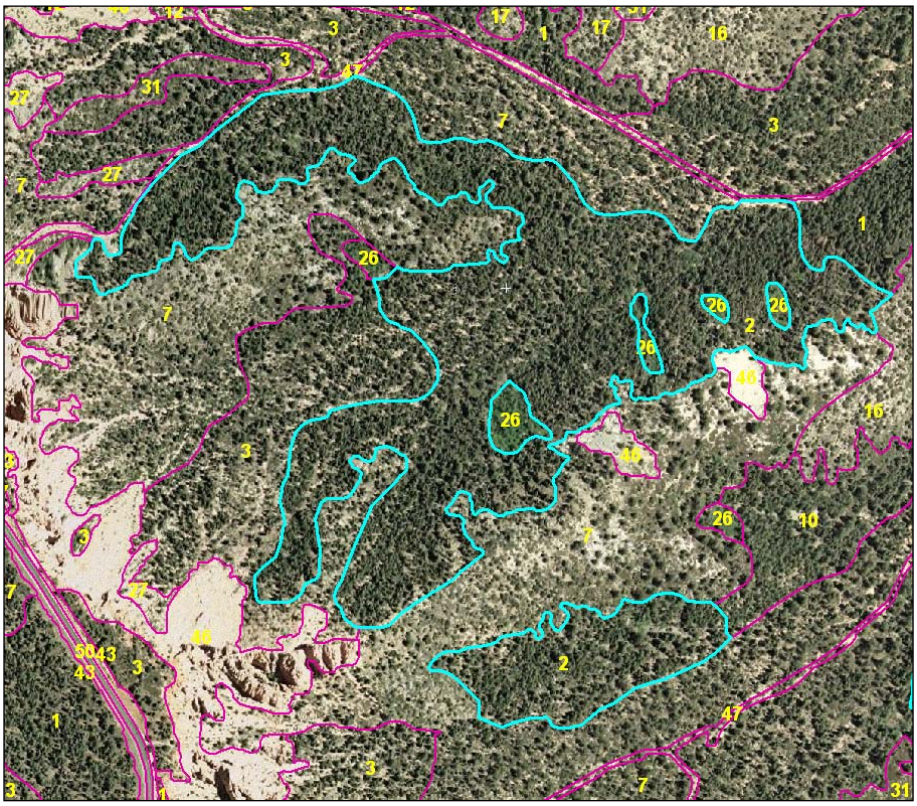


## Distribution/Ecology/Composition

Stands occur primarily on moderately steep to steep northwest-to-north-facing slopes above the rims of the main canyon and their major tributaries or below the geologic feature (Claron Formation). White fir is generally dominant, but Douglas-fir, blue spruce, quaking aspen, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands have mesic and tall shrub understories of Gambel oak and/or Rocky Mountain maple; Utah serviceberry may occur with low cover. The short shrub layer may be comprised of western snowberry, common juniper, mountain lover, and Oregon-grape.

## Interpretation

This uncommon map class appears as small to large irregular but linear polygons on sheltered low slopes and in drainages in the southern to central portion of the Park beginning in a patchy distribution in the vicinity of Paria View. The color is moderate-to-dark green, with tree crowns providing a rough and pebbled texture and shadows producing black spots. Common neighbors include polygons of white fir forests (map classes 1 and 3), ponderosa pine – Douglas fir / manzanita woodlands (map class 7), and pinyon – juniper woodlands with xeric mixed shrub understories (map class 16).




Example of photo signature for map class F-WFGO (#2).

## Map Class 3
## White Fir / Manzanita – Mixed Shrub Forest (F-WFMS)





Photo credits: NPS

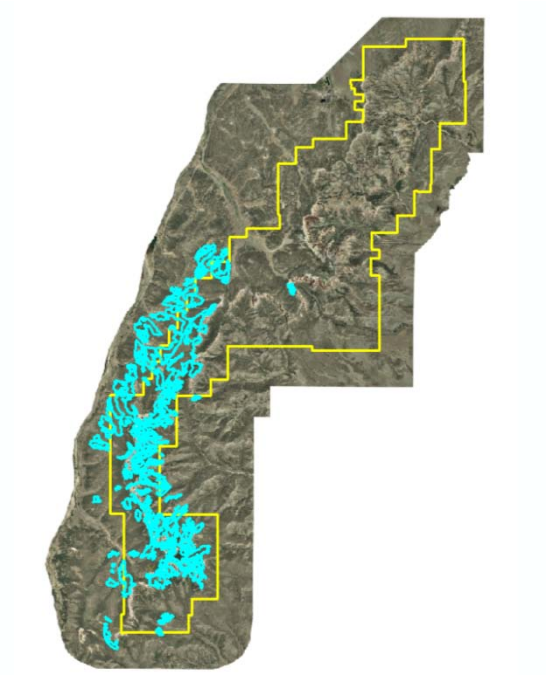
### Associations
*Abies concolor / Arctostaphylos patula Forest*
*Abies concolor / Cercocarpus ledifolius* Woodland
*Abies concolor / Purshia tridentata* Forest
*Pseudotsuga menziesii / Arctostaphylos patula* Woodland

### Common species
- *Abies concolor*
- *Cercocarpus ledifolius*
- *Pseudotsuga menziesii*
- *Arctostaphylos patula*
- *Purshia tridentata*

### F-WFMS Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 203 total polygons<br>140 total polygons in BRCA<br>63 total polygons in the environs |
| Total project area: | 1,421 hectares / 3,512 acres (6 %)<br>919 hectares / 2272 acres in BRCA<br>502 hectares / 1,240 acres in the environs |
| Average Polygon Size: | 7 hectares / 17.3 acres |
| Producer's accuracy: | 86% ± 10% |
| User's accuracy: | 78% ± 10% |

### Distribution in Mapping Area

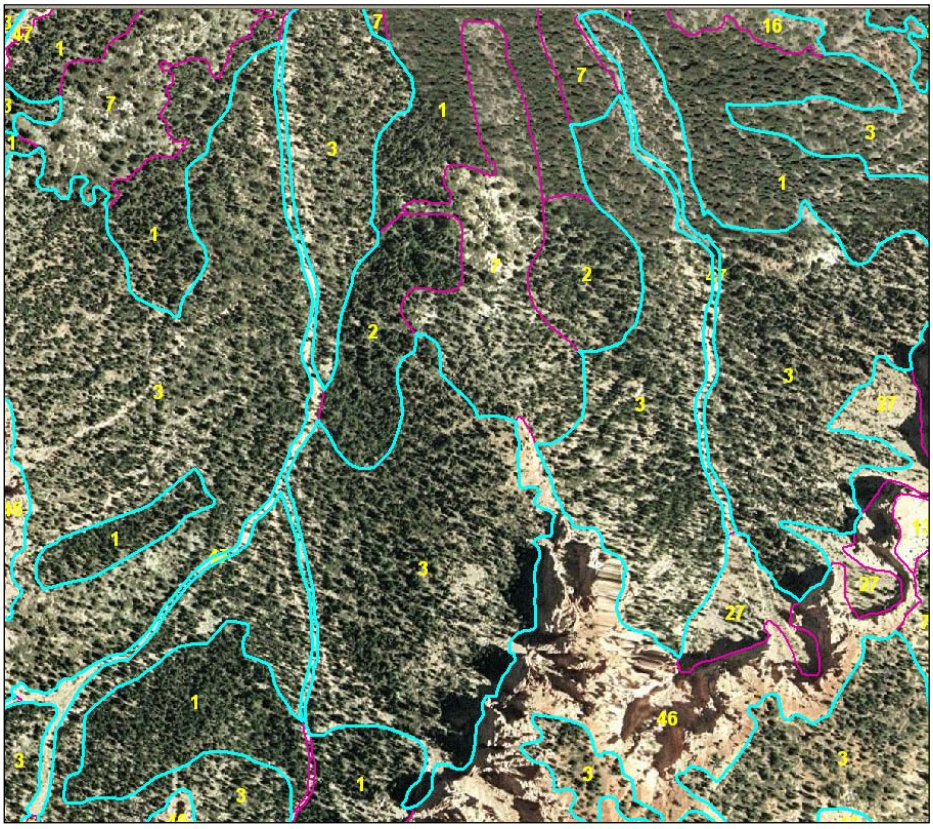


## Distribution/Ecology/Composition

Stands occur on gentle to steep slopes of all aspects above the rims of the main canyon and their major tributaries. White fir is generally dominant, but Douglas-fir, blue spruce, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands are somewhat xeric and include the short shrubs manzanita, bitterbrush, and western snowberry, and the tall shrubs curl-leaf mountain mahogany, serviceberry, and species of currant. Stands on steep slopes have become established in gravel, among boulders and talus, and along gullies.

## Interpretation

This common map class appears as small to large irregular polygons on gentle slopes and flats in the southern portions of the Park, on the edge of Paunsaugunt Plateau beginning near Swamp Canyon and on steep slopes and talus in the southern and southwestern portion of the Park just below the rims of the Pink Cliffs beginning near Yovimpa Point. The color is moderately dark gray-green, with tree crowns providing a rough and pebbled texture and shadows producing black spots. The texture can be blurry due to slope steepness and warping during orthorectification. Common neighbors include polygons of white fir forests (map classes 1 and 2), ponderosa pine – Douglas fir /manzanita woodland (map class 7), and ponderosa pine / mixed grass woodlands (map class 9).




Example of photo signature for map class F-WFMS (#3).

## Map Class 4
## Douglas Fir Forest Complex (F-PSME)





Photo credits: NPS

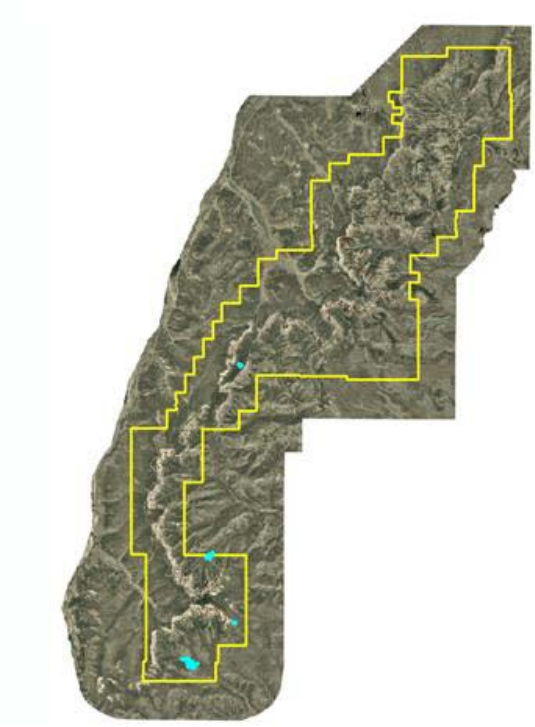
### Associations
*Pseudotsuga menziesii* / *Quercus gambelii* Forest
*Pseudotsuga menziesii* / *Symphoricarpos oreophilus* Forest

### Common species
- *Pseudotsuga menziesii*
- *Symphoricarpos oreophilus*
- *Quercus gambelii*
- *Arctostaphylos patula*

### F-PSME Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 7 total polygons |
| | 6 total polygons in BRCA |
| | 1 total polygons in the environs |
| Total project area: | 23 hectares / 56 acres (0.1 %) |
| | 21 hectares / 51 acres in BRCA |
| | 2 hectares / 5 acres in the environs |
| Average Polygon Size: | 3.2 hectares / 8 acres |
| Producer's accuracy: | 100% |
| User's accuracy: | 71% ± 35% |

### Distribution in Mapping Area

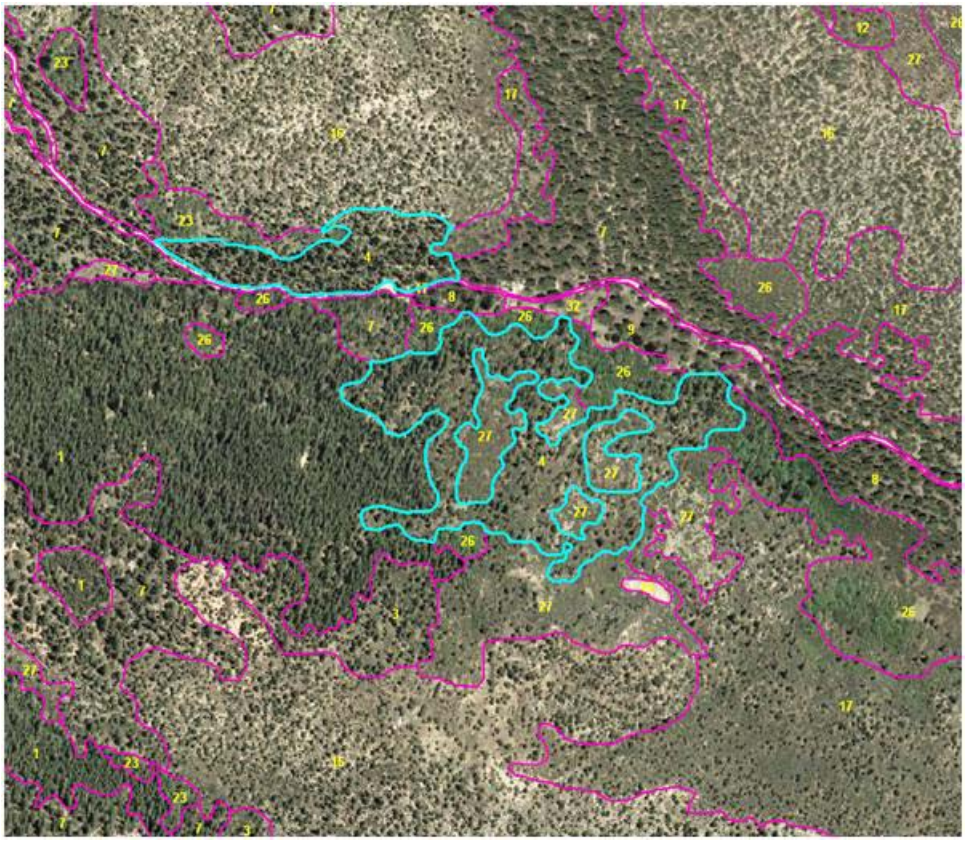


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderate slopes of all aspects above the rims of the main canyon and their major tributaries and in pockets below the rim. Douglas-fir is dominant, but white fir, blue spruce, ponderosa pine, pinyon pine, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands are mesic and shrubs including Gambel oak, common juniper, gooseberry currant, western snowberry, greenleaf manzanita, bitterbrush, and Oregon-grape are present in the understory in many stands.

## Interpretation

This very uncommon map class appears as small to medium irregular polygons on gentle to moderately steep slopes and in drainages in a patchy distribution from Water Canyon to the southern end of the Park. The color is moderately dark gray-green, with tree crowns providing a rough and pebbled texture and shadows producing black spots. This map class was originally mapped more extensively, but due to a low accuracy it was retained as polygons only where documented to occur as Douglas-fir dominated by plots or AA points. Stands of Douglas-fir smaller than MMU size and stands where white fir is present in the canopy with Douglas-fir are now mapped as white fir types.



Example of photo signature for map class F-PSME (#4).

## Map Class 5
## White Fir / Mixed Grass Forest (F-WFMG)





Photo credits: NPS

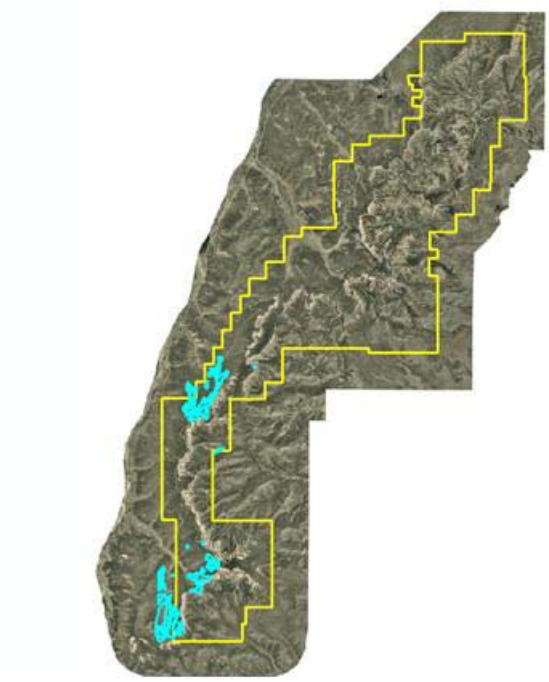
### Associations
*Abies concolor* / Mixed Grasses Forest

### Common species
- *Abies concolor*
- *Koeleria macrantha*
- *Poa secunda*
- *Elymus elymoides*
- *Muhlenbergia montana*
- *Achnatherum lettermanii*
- *Poa fendleriana*
- *Balsamorhiza sagittata*
- *Hesperostipa comata*
- *Carex rossii*

### F-WFMG Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 42 total polygons<br>30 total polygons in BRCA<br>12 total polygons in the environs |
| Total project area: | 294 hectares / 727 acres (1.2 %)<br>139 hectares / 344 acres in BRCA<br>155 hectares / 383 acres in the environs |
| Average Polygon Size: | 7 hectares / 17.3 acres |
| Producer's accuracy: | 82% ± 19% |
| User's accuracy: | 88% ± 16% |

### Distribution in Mapping Area

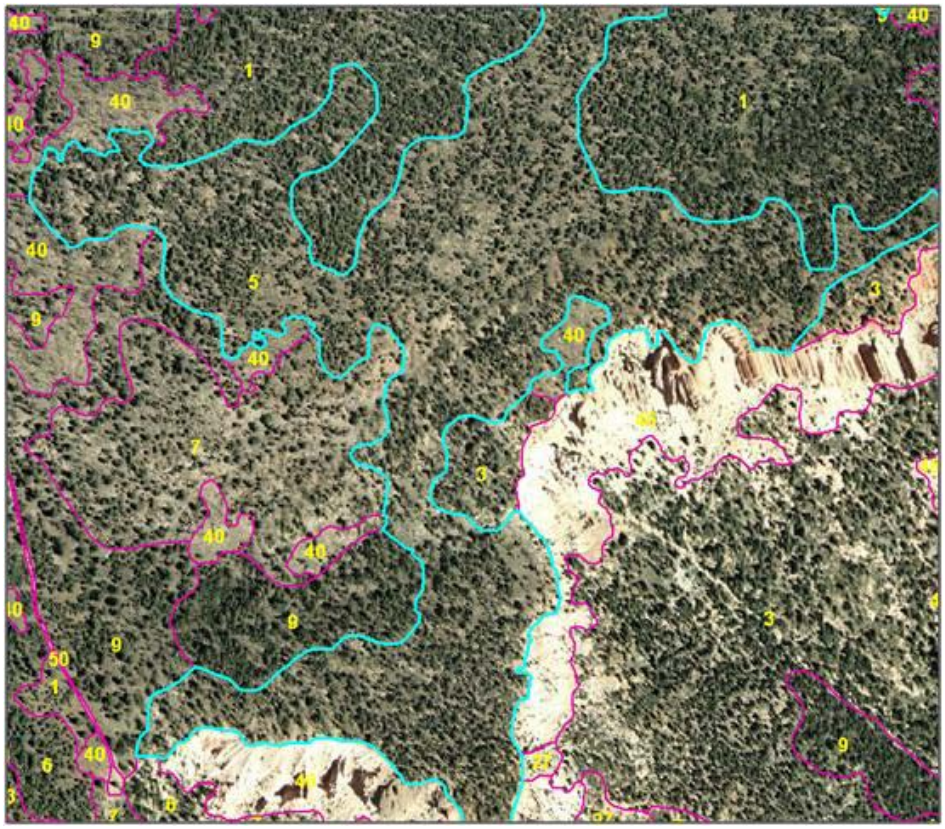


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderate west-to-south-facing slopes above the rims of the main canyon and their major tributaries. White fir is dominant, but Douglas-fir, blue spruce, and ponderosa pine may be present in the canopy or understory layers. Shrubs may provide low cover and include western snowberry, species of rabbitbrush, and Oregon-grape. The stands are xeric and herbaceous vegetation including Letterman needlegrass, Fendler bluegrass, curly bluegrass, squirreltail, Ross's sedge, needle-and-thread grass, mountain muhly, and prairie Junegrass in addition to arrowleaf balsamroot and species of pussytoes dominate the understory in many stands.

## Interpretation

This uncommon map class appears as medium to large irregular polygons on gentle slopes and flats in the southwestern portions of the Park on the Paunsaugunt Plateau edge beginning near Swamp Canyon. 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 gray in color and have a smooth texture. Common neighbors include polygons of white fir forests with sparse or xeric mixed shrub understories (map classes 1 and 3).



Example of photo signature for map class F-WFMG (#5).

## Map Class 6
## Blue Spruce Forest Complex (F-PICE)






Photo credits: NPS

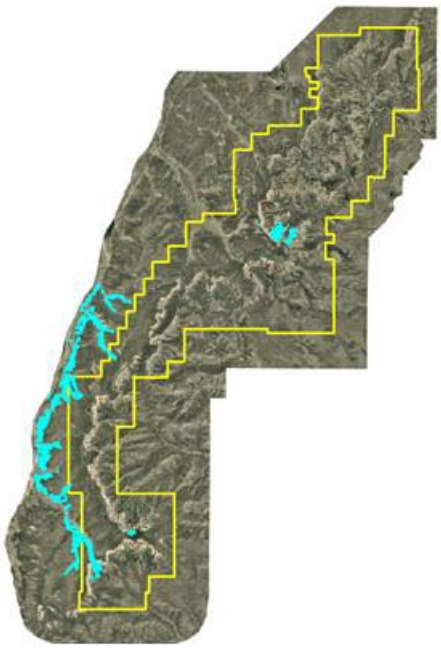
### Associations
*Picea pungens / Arctostaphylos patula* Forest
*Picea pungens / Arctostaphylos uva-ursi* Forest
*Picea pungens / Juniperus communis* Forest
*Picea pungens / Bromus inermis* Forest [Park Special]

### Common species
- *Picea pungens*
- *Arctostaphylos patula*
- *Bromus inermis*
- *Arctostaphylos uva-ursi*
- *Juniperus communis*

### F-PICE Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 153 total polygons<br>27 total polygons in BRCA<br>126 total polygons in the environs |
| Total project area: | 295 hectares / 729 acres (1.2 %)<br>90 hectares / 223 acres in BRCA<br>205 hectares / 506 acres in the environs |
| Average Polygon Size: | 1.9 hectares / 4.8 acres |
| Producer's accuracy: | 91% ± 12% |
| User's accuracy: | 91% ± 12% |

### Distribution in Mapping Area

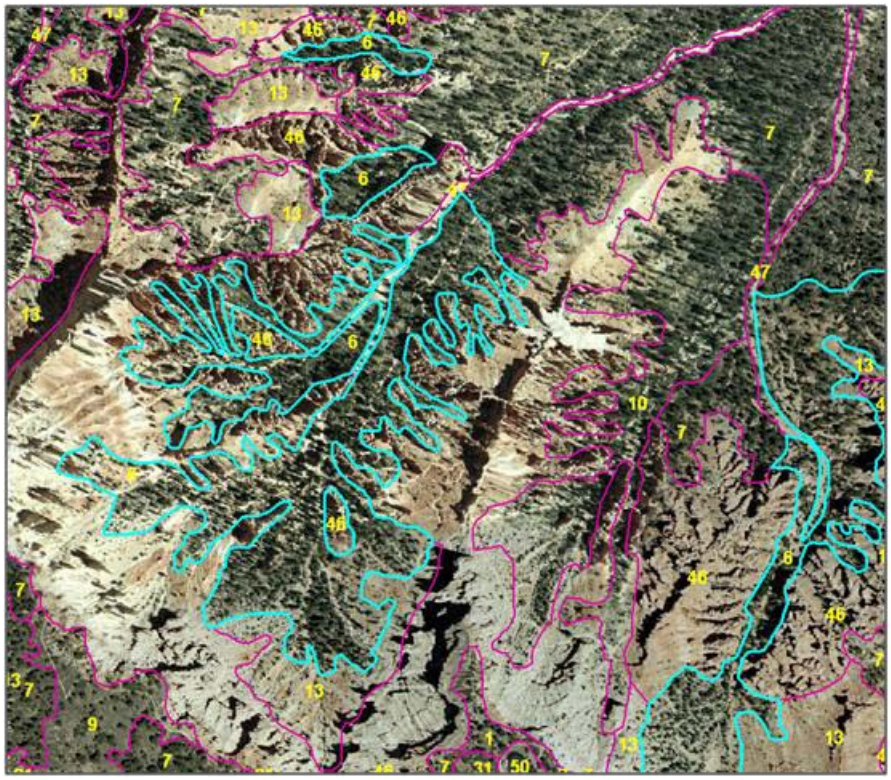


## Distribution/Ecology/Composition

Stands occur primarily on flats adjacent to creeks or on steep north-facing slopes of the main canyon. Blue spruce is dominant, but Douglas-fir, white fir, quaking aspen, ponderosa pine, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands are mesic and short shrubs including common juniper, shortfruit willow, western snowberry, kinnikinnick (bearberry), wax currant, manzanita, and Oregon-grape dominate the understory in many stands. Smooth brome may dominate the understory in some stands.

## Interpretation

This uncommon map class appears as small to medium irregular, rectangular or linear polygons on gentle slopes and flats adjacent to drainages or on steep north-facing ravines or slopes. It occurs within the Park in Bryce Canyon, and near Rainbow Point, but mostly has become established outside the Park along the South Fork of the Sevier River south of Tropic Reservoir. The color is patchy including gray to moderately dark gray-green understory with tree crowns providing a rough and pebbled texture and shadows producing black spots. Within the Park, neighboring polygons are most commonly of bristlecone pine woodlands (map class 13), ponderosa pine – Douglas fir / manzanita woodlands, and steep rocky slopes of exposed Claron formation. Outside the park, the common neighbors are white fir forests (map class 1), black sagebrush shrublands (map class 30), disturbed grasslands (map class 41), and wet meadows (map class 42).



Example of photo signature for map class F-PICE (#6).

## Map Class 7
## Ponderosa Pine – (Douglas Fir) / Manzanita Woodland Complex (W-PPMA)





Photo credits: NPS

### Associations

*Pinus ponderosa / Arctostaphylos patula* Woodland
*Pinus ponderosa – Pseudotsuga menziesii / Arctostaphylos patula* Colorado Plateau Woodland
*Pseudotsuga menziesii / Arctostaphylos patula* Woodland
*Pinus ponderosa / Cercocarpus ledifolius / Arctostaphylos patula* Woodland [Park Special]

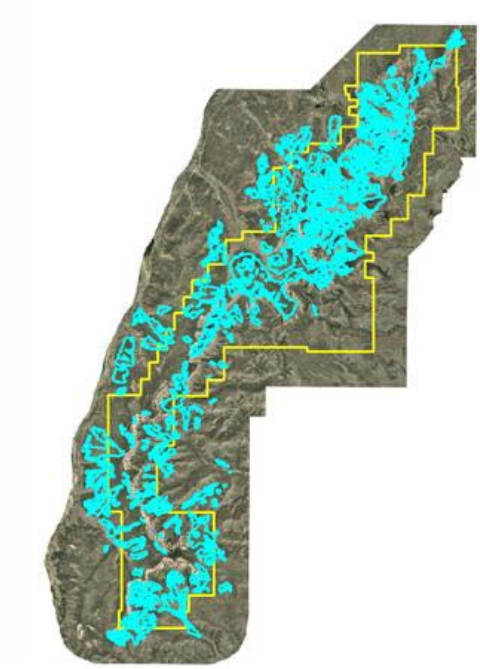
### Common species

- *Pinus ponderosa*
- *Arctostaphylos patula*
- *Purshia tridentata*
- *Pseudotsuga menziesii*
- *Cercocarpus ledifolius*
- *Leymus salinus*

### W-PPMA Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 490 total polygons<br>341 total polygons in BRCA<br>149 total polygons in the environs |
| Total project area: | 4,987 hectares / 12,324 acres (21 %)<br>3771 hectares / 9319 acres in BRCA<br>1,216 hectares / 3,005 acres in the environs |
| Average Polygon Size: | 10.2 hectares / 25.2 acres |
| Producer's accuracy: | 88% ± 7% |
| User's accuracy: | 81% ± 8% |

### Distribution in Mapping Area

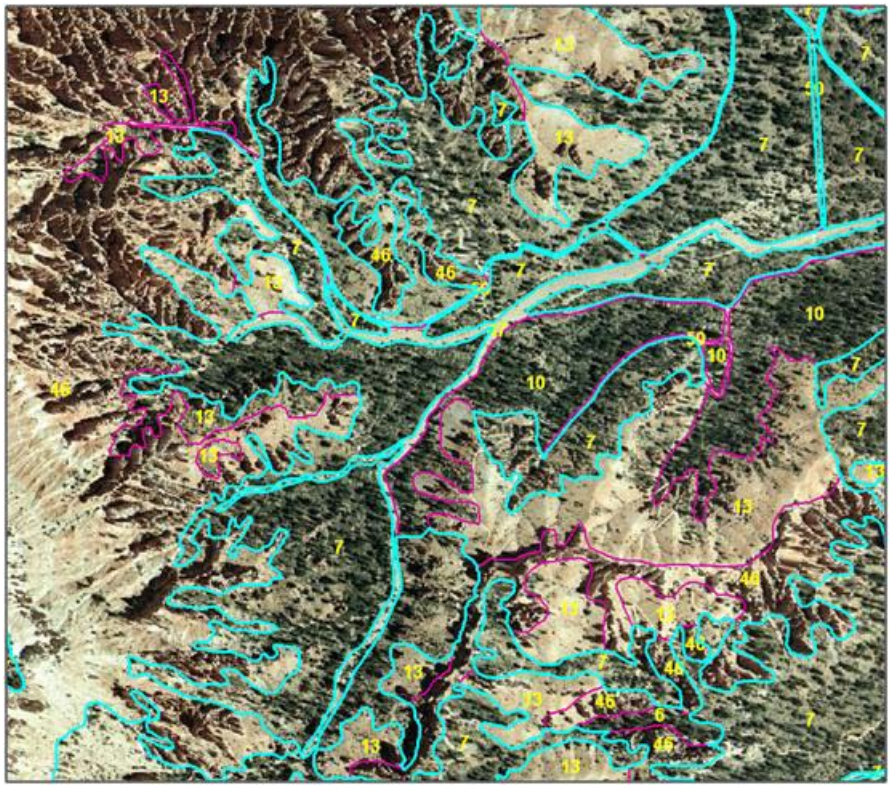


## Distribution/Ecology/Composition

Stands occur on gentle to steep slopes of all aspects, on flats above the rim, and along drainages. Ponderosa pine is dominant on drier sites and shares dominance with Douglas-fir, curl-leaf mountain mahogany, and Rocky Mountain juniper 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, western snowberry, species of rabbitbrush, and species of currant. Common herbaceous species include Salina wildrye and Ross sedge. The stands are mesic to xeric.

## Interpretation

This very abundant map class appears as medium to very large irregular polygons on gentle to moderately steep slopes throughout the Park. 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 and the 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 park, 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-PPMA (#7).

## Map Class 8
## Ponderosa Pine / Mixed Mountain Shrub Woodland Complex (W-PPMS)





Photo credits: NPS

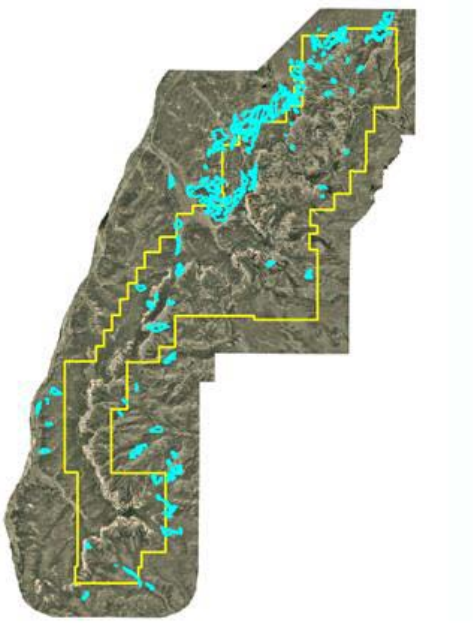
### Associations
*Pinus ponderosa / Artemisia nova* Woodland
*Pinus ponderosa / Cercocarpus montanus* Woodland
*Pinus ponderosa / Petradoria pumila* Woodland
*Pinus ponderosa / Purshia tridentata* Forest
*Pinus ponderosa / Symphoricarpos oreophilus* Forest

### Common species
- *Pinus ponderosa*
- *Symphoricarpos oreophilus*
- *Arctostaphylos patula*
- *Petradoria pumila*
- *Artemisia nova*
- *Purshia tridentata*
- *Leymus salinus*
- *Cercocarpus montanus*

### W-PPMS Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 209 total polygons<br>97 total polygons in BRCA<br>112 total polygons in the environs |
| Total project area: | 881 hectares / 2,177 acres (3.7 %)<br><br>407 hectares / 1006 acres in BRCA<br>474 hectares / 1,171 acres in the environs |
| Average Polygon Size: | 4.2 hectares / 10.4 acres |
| Producer's accuracy: | 82% ± 13% |
| User's accuracy: | 72% ± 13% |

### Distribution in Mapping Area

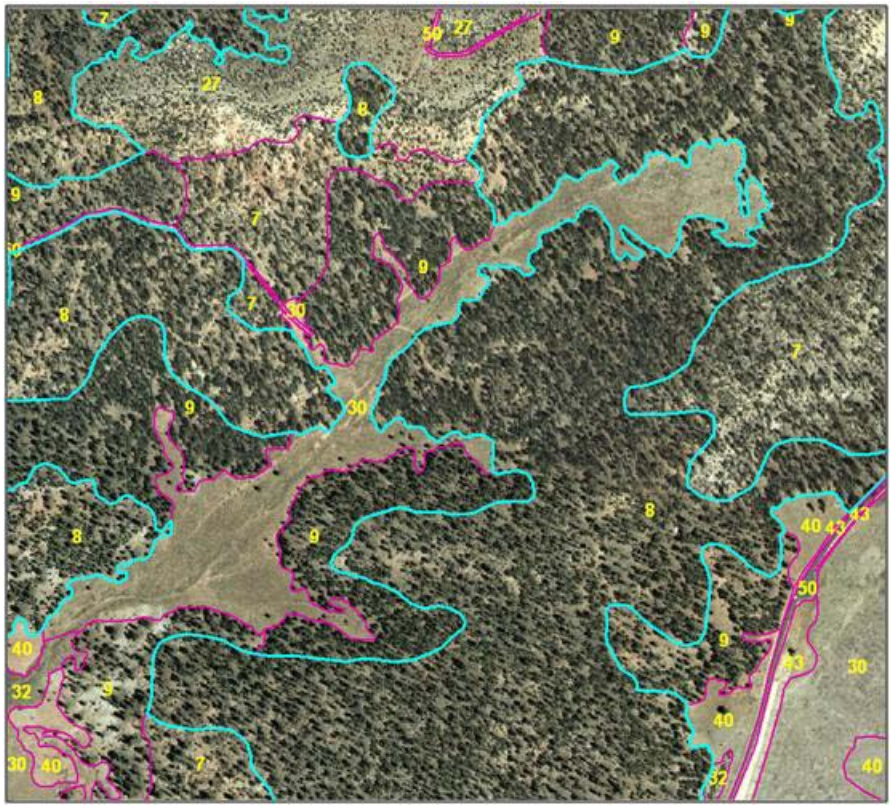


## Distribution/Ecology/Composition

Stands occur primarily on flats above the rim and on gentle to moderately steep, east to southeast-facing slopes and low ridges and hills. Ponderosa pine is dominant and typically provides low to moderate cover. Trees that may occasionally occur in these stands include pinyon pine and Utah juniper. The short shrubs bitterbrush, black sagebrush, mountain mahogany and western snowberry are dominant in the understory or as small to medium-sized patches between trees. Additional shrub cover may occur and include species of rabbitbrush, greenleaf manzanita, and species of sagebrush. Some stands have a forb-dominated understory of predominantly rock goldenrod. The stands are xeric.

## Interpretation

This somewhat uncommon map class appears as medium to large irregular polygons on flats and on gentle to moderately steep slopes concentrated in the northwest portion of the Park at the edge of the Paunsaugunt Plateau and scattered above and below the rim to the south Park boundary. The color is dark gray green for the shrub cover where it is dense 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. Common neighbors include polygons of ponderosa pine woodlands with Manzanita or mixed grasses dominant in the understory (map classes 7 and 9), and pinyon – juniper woodlands with mixed shrub understories (map class 16).




Example of photo signature for map class W-PPMS (#8).

## Map Class 9
## Ponderosa Pine / Mixed Herbaceous Woodland Complex (W-PPMH)




Photo credits: NPS

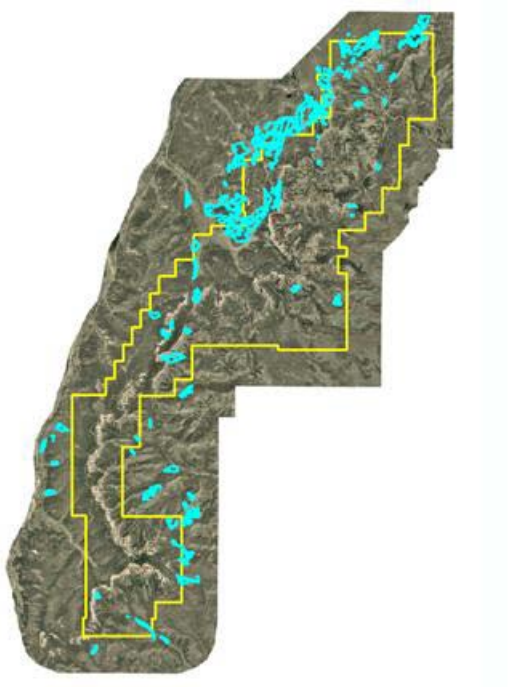
### Associations
*Pinus ponderosa / Elymus elymoides – (Elymus* spp.*)* Woodland [Park Special]
*Pinus ponderosa / Hesperostipa comata* Colorado Plateau Woodland [Park Special]
*Pinus ponderosa / Leymus salinus* Woodland
*Pinus ponderosa /* Seeded Grasses Semi-natural Woodland [Park Special]
*Pinus ponderosa /* Sparse Understory Woodland

### Common species
- *Pinus ponderosa*
- *Stipa hymenoides*
- *Elymus elymoides*
- *Poa fendleriana*
- *Stipa lettermanii*
- *Koeleria macrantha*
- *Juniperus scopulorum*
- *Hesperostipa comata*
- *Leymus salinus*
- *Carex rossii*
- *Elymus hispidus*
-

## W-PPMH Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 368 total polygons<br>190 total polygons in BRCA<br>178 total polygons in the environs |
| Total project area: | 1,340 hectares / 3,311 acres (5.6 %)<br>669 hectares / 1654 acres in BRCA<br>670 hectares / 1,657 acres in the environs |
| Average Polygon Size: | 3.6 hectares / 9 acres |
| Producer's accuracy: | 85% ± 11% |
| User's accuracy: | 83% ± 11% |

## Distribution in Mapping Area

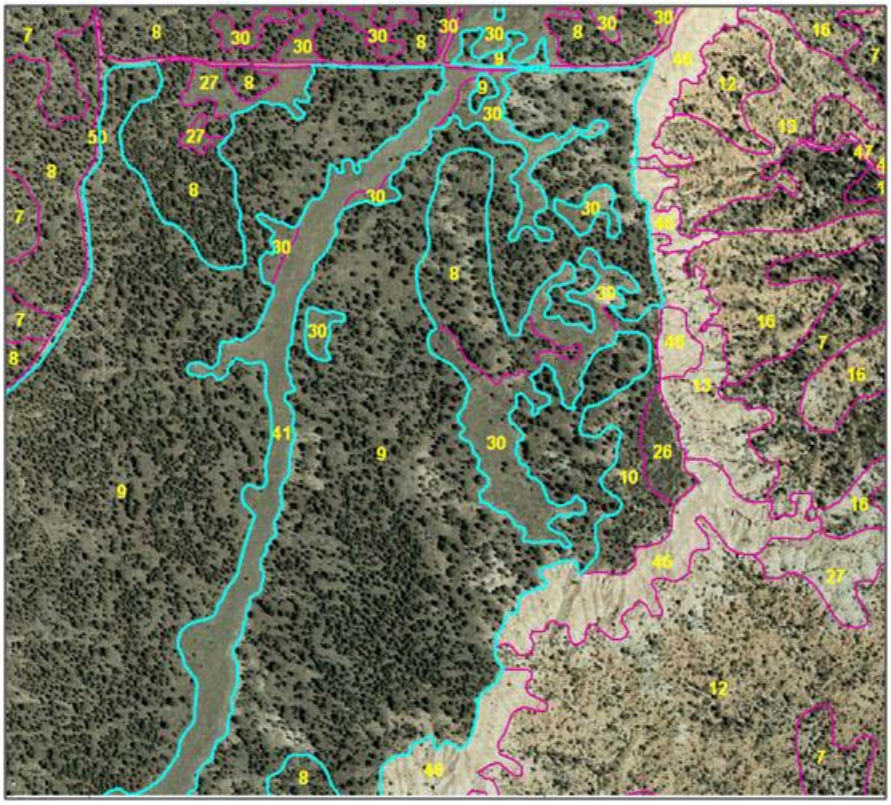


## Distribution/Ecology/Composition

Stands occur primarily on flats above the rim, along drainages below the rim and on low ridges and hills. Ponderosa pine is dominant and typically provides low to moderate cover. Trees that may occasionally occur in these stands include white fir, pinyon pine, and Utah juniper. The herbaceous vegetation can be sparse to moderately dense with Salina wildrye, squirreltail, needle-and-thread, Fendler bluegrass and/or the exotic pasture grass intermediate wheatgrass dominant in the understory along with Indian ricegrass, Ross sedge, letterman's ricegrass, and prairie Junegrass. Although total forb cover is generally low, forb diversity is moderately to extremely high in most stands of this type.

## Interpretation

This fairly common map class appears as medium to large irregular, linear polygons on flats, along drainages, or on low ridges and hills concentrated in the northwest to north-central portion of the Park at the edge of the Paunsaugunt Plateau. The grassy understory color is light gray to medium gray green and smooth-textured 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. Because these stands are common along the edges of meadows or grassy openings, common neighbors include polygons of black sagebrush shrublands (map class 30), viscid rabbitbrush shrublands (map class 32), dry meadows grasslands (map class 40), and disturbed grasslands (map class 41), along with woodlands of ponderosa pine – Douglas fir / manzanita (map class 7) and white fir / manzanita (map class 3).



Example of photo signature for map class W-PPMH (#9).

## Map Class 10
## Ponderosa Pine / Gambel Oak Woodland (W-PPGO)





Photo credits: NPS

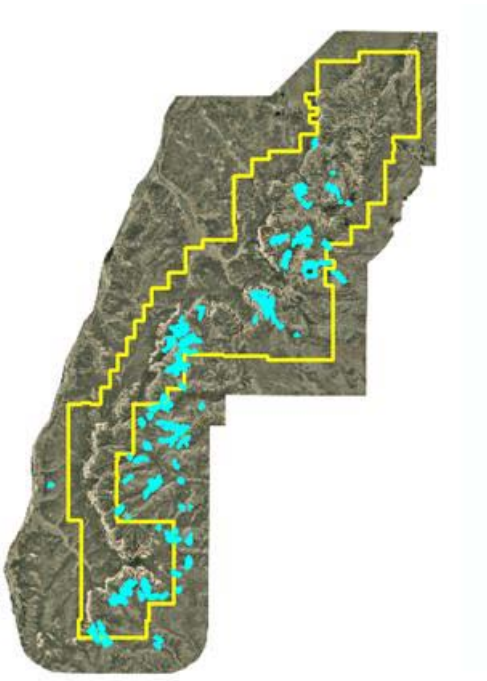
### Associations
*Pinus ponderosa / Quercus gambelii* Woodland

### Common species
- *Pinus ponderosa*
- *Quercus gambelii*
- *Arctostaphylos patula*
- *Juniperus scopulorum*
- *Cercocarpus montanus*

### W-PPGO Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 122 total polygons<br>68 total polygons in BRCA<br>54 total polygons in the environs |
| Total project area: | 410 hectares / 1,013 acres (1.7 %)<br>271 hectares / 671 acres in BRCA<br>138 hectares / 342 acres in the environs |
| Average Polygon Size: | 3.4 hectares / 8.3 acres |
| Producer's accuracy: | 71% ± 17% |
| User's accuracy: | 85% ± 16% |

### Distribution in Mapping Area

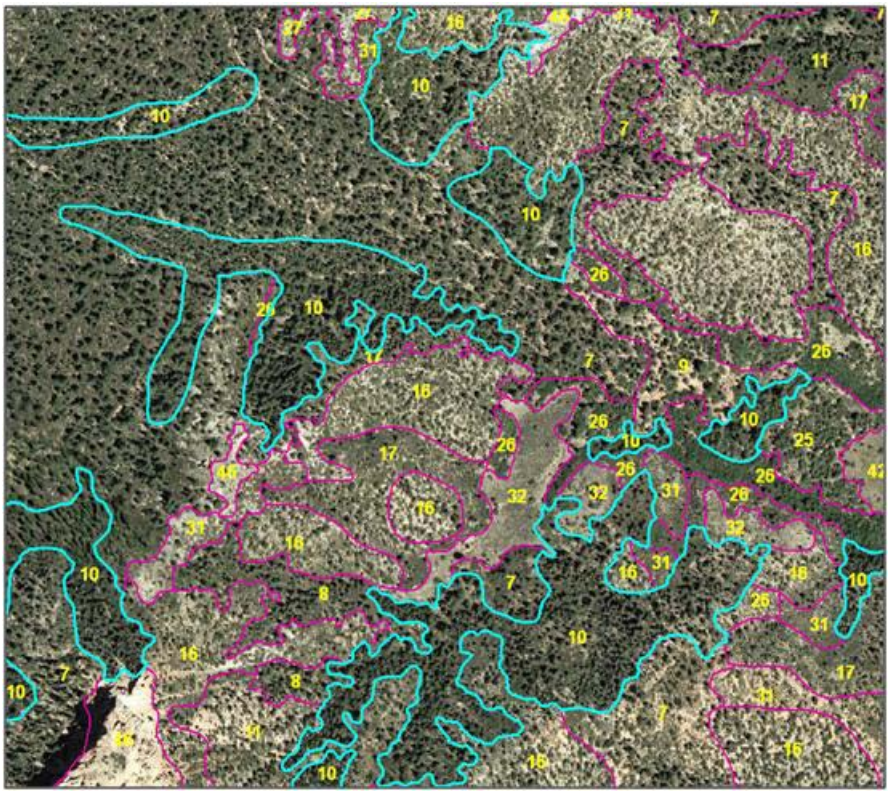


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderately steep, north to southeast-facing slopes and along drainages. Ponderosa pine is dominant and typically provides moderate cover. Trees that may occasionally occur in these stands include Douglas-fir, pinyon pine, and Utah juniper. The tall shrub Gambel oak is dominant in the understory. Additional shrub cover may include serviceberry, mountain mahogany, species of rabbitbrush, greenleaf manzanita, and bitterbrush. The stands are mesic to moderately xeric.

## Interpretation

This uncommon map class appears as medium to large irregular polygons on gentle to moderately steep slopes in the north-central to southeastern portion of the Park below the Pink Cliffs "breaks" beginning at Fairyland Canyon. The color is a continuous moderately dark gray green representing thickets of Gambel oak. The tall tree crowns provide a rough and pebbled texture and shadows produce black spots. Common neighbors include polygons of other ponderosa pine woodlands (map classes 7, 8 and 9), pinyon – juniper woodlands with mixed shrub or oak understories (map classes 16 and 17), and Gambel oak shrublands (map class 26).



Example of photo signature for map class W-PPGO (#10).

## Map Class 11
## Ponderosa Pine / Pinyon Pine - Juniper spp. / Gambel Oak Woodland (W-PPJO)





Photo credits: NPS

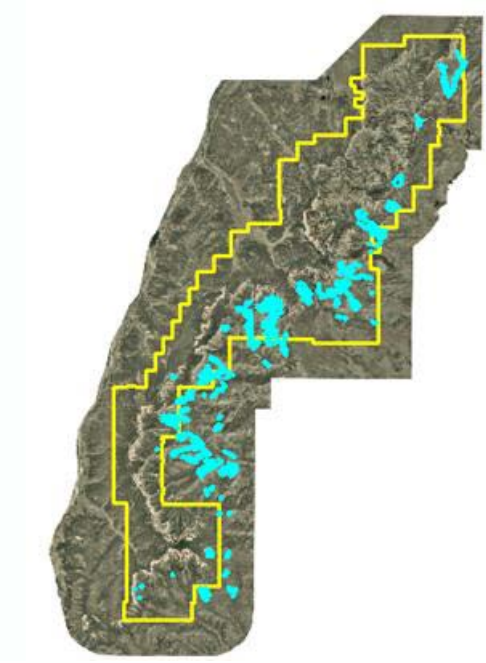
### Associations
*Pinus ponderosa / Quercus gambelii* Woodland
*Pinus edulis - Juniperus* spp. */ Quercus gambelii* Woodland

### Common species
- *Pinus ponderosa*
- *Juniperus osteosperma*
- *Quercus gambelii*
- *Arctostaphylos patula*
- *Pinus edulis*
- *Juniperus scopulorum*
- *Cercocarpus montanus*

### W-PPJO Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 136 total polygons<br>85 total polygons in BRCA<br>51 total polygons in the environs |
| Total project area: | 523 hectares / 1,293 acres (2.2 %)<br>323 hectares / 798 acres in BRCA<br>201 hectares / 496 acres in the environs |
| Average Polygon Size: | 3.8 hectares / 9.5 acres |
| Producer's accuracy: | 76% ± 15% |
| User's accuracy: | 69% ± 15% |

### Distribution in Mapping Area

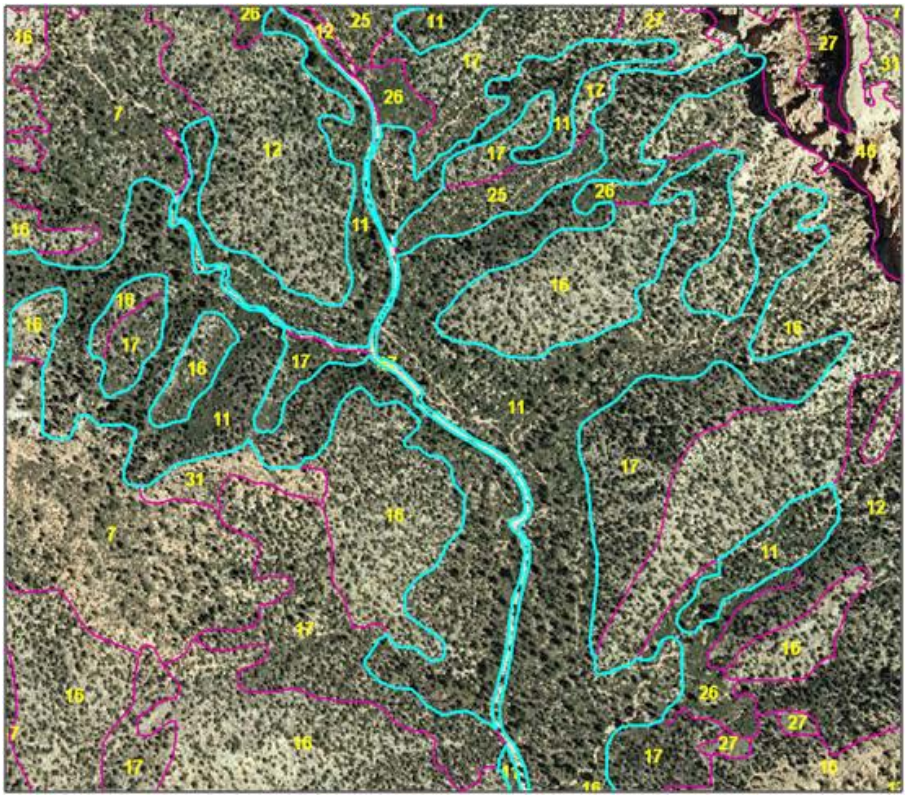


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderately steep northeast- to southwest-facing low slopes and along drainages. Ponderosa pine has generally low cover and is emergent from the dominant pinyon pine, Rocky Mountain juniper, and/or Utah juniper canopy. Douglas-fir may occur on more mesic exposures. The tall shrub Gambel oak is dominant in the understory. The stands are mesic to moderately xeric.

## Interpretation

This uncommon map class appears as medium to large irregular, sinuous polygons following drainages and on gentle to moderately steep slopes along the eastern Park boundary on the margins of Tropic Valley, Sheep Creek Flat, and Squaw Bench. The color is a continuous moderately dark gray green representing thickets of Gambel oak. The moderately tall pinyon-juniper tree crowns provide a rough and pebbled texture and the emergent crowns of ponderosa pines throw shadows that produce black spots. Common neighbors include polygons of other pinyon-juniper woodlands with or without emergent ponderosa pine (map classes 12, 14, 16 and 17), the closely related map class 10, and shrublands of Gambel oak (map class 26).



Example of photo signature for map class W-PPJO (#11).

## Map Class 12
## Ponderosa Pine / Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex (W-PPJS)





Photo credits: NPS

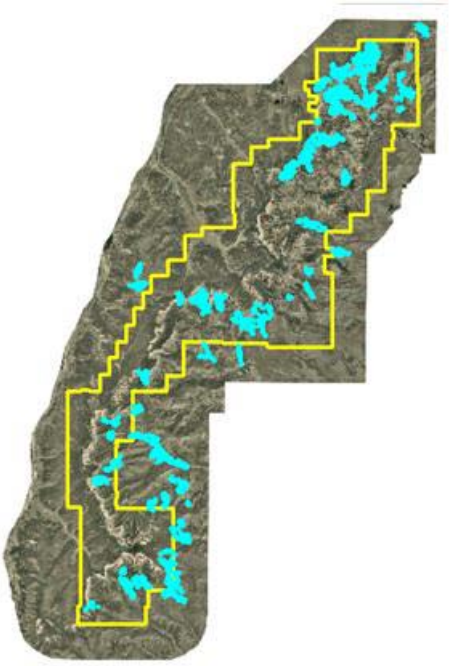
### Associations
*Pinus ponderosa / Arctostaphylos patula* Woodland
*Pinus edulis - Juniperus osteosperma / Arctostaphylos patula* Woodland
*Pinus ponderosa / Purshia tridentata* Woodland
*Pinus edulis – Juniperus osteosperma / Purshia tridentata* Woodland
*Pinus edulis - Juniperus spp. / Cercocarpus montanus* – Mixed Shrubs Woodland
*Pinus edulis – Juniperus osteosperma / Cercocarpus ledifolius* Woodland
*Pinus edulis – Juniperus osteosperma / Shepherdia rotundifolia* Woodland

### Common species
- *Pinus ponderosa*
- *Juniperus osteosperma*
- *Cercocarpus montanus*
- *Purshia tridentata*
- *Shepherdia rotundifolia*
- *Pinus edulis*
- *Juniperus scopulorum*
- *Arctostaphylos patula*
- *Cercocarpus ledifolius*
- *Quercus gambelii*

## W-PPJS Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 142 total polygons<br>96 total polygons in BRCA<br>46 total polygons in the environs |
| Total project area: | 820 hectares / 2,027 acres (3.5 %)<br>598 hectares / 1478 acres in BRCA<br>222 hectares / 549 acres in the environs |
| Average Polygon Size: | 5.8 hectares / 14.3 acres |
| Producer's accuracy: | 88% ± 8% |
| User's accuracy: | 75% ± 9% |

## Distribution in Mapping Area

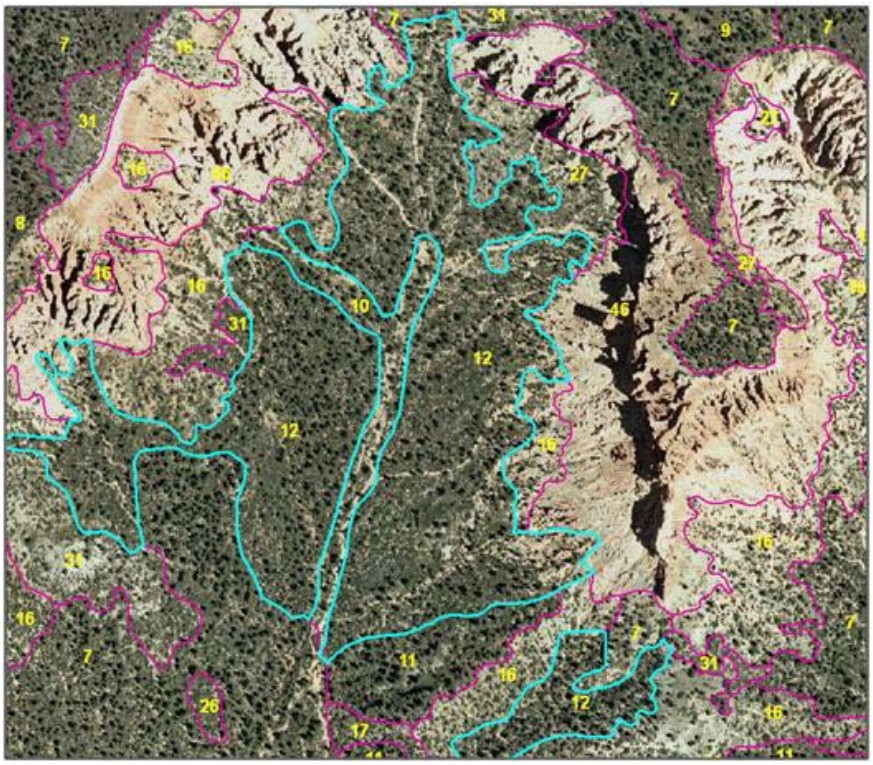


## Distribution/Ecology/Composition

Stands occur primarily on gentle to steep east to southwest-facing slopes and ridges and along drainages. Ponderosa pine is emergent from the dominant pinyon pine, Rocky Mountain juniper, and/or Utah juniper. Douglas-fir may occur on more mesic exposures. The shrub cover may range from low to high and include mountain mahogany, curl-leaf mountain mahogany, bitterbrush, species of rabbitbrush, greenleaf manzanita, roundleaf buffaloberry, western snowberry, currant, and species of sagebrush. The stands range from moderately mesic to xeric.

## Interpretation

This uncommon map class appears as medium to very large irregular polygons along drainages and on moderately steep to steep slopes throughout Tropic Canyon in the north part of the Park and scattered along the eastern side of the Park south to Yovimpa Point. They occur along the upper margins of the Pink Cliff "breaks" and on some lower exposures of the Claron Formation. The color is medium gray green for the shrub cover where it is dense with white to grayish-pink inclusions where rock and bare ground are exposed. The moderately tall pinyon-juniper tree crowns provide a rough and pebbled texture and emergent crowns of ponderosa pines throw shadows that produce black spots. Common neighbors include polygons of bristlecone pine woodlands (map class 13), pinyon – juniper / mixed shrub woodlands (map class 16), 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-PPJS (#12).

## Map Class 13
## Bristlecone Pine Woodland (W-PILO)





Photo credits: NPS

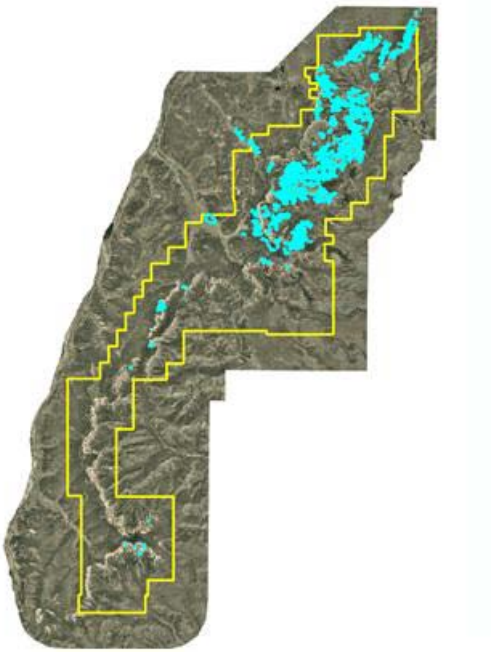
### Associations
*Pinus longaeva* Woodland
*Pinus ponderosa* Sparse Woodland (rare)

### Common species
- *Pinus ponderosa*
- *Pinus flexilis*
- *Arctostaphylos patula*
- *Pinus longaeva*
- *Pinus edulis*

### W-PILO Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 198 total polygons<br>186 total polygons in BRCA<br>12 total polygons in the environs |
| Total project area: | 757 hectares / 1,870 acres (3.2 %)<br>746 hectares / 1844 acres in BRCA<br>11 hectares / 26 acres in the environs |
| Average Polygon Size: | 3.8 hectares / 9.4 acres |
| Producer's accuracy: | 84% ± 11% |
| User's accuracy: | 84% ± 11% |

### Distribution in Mapping Area

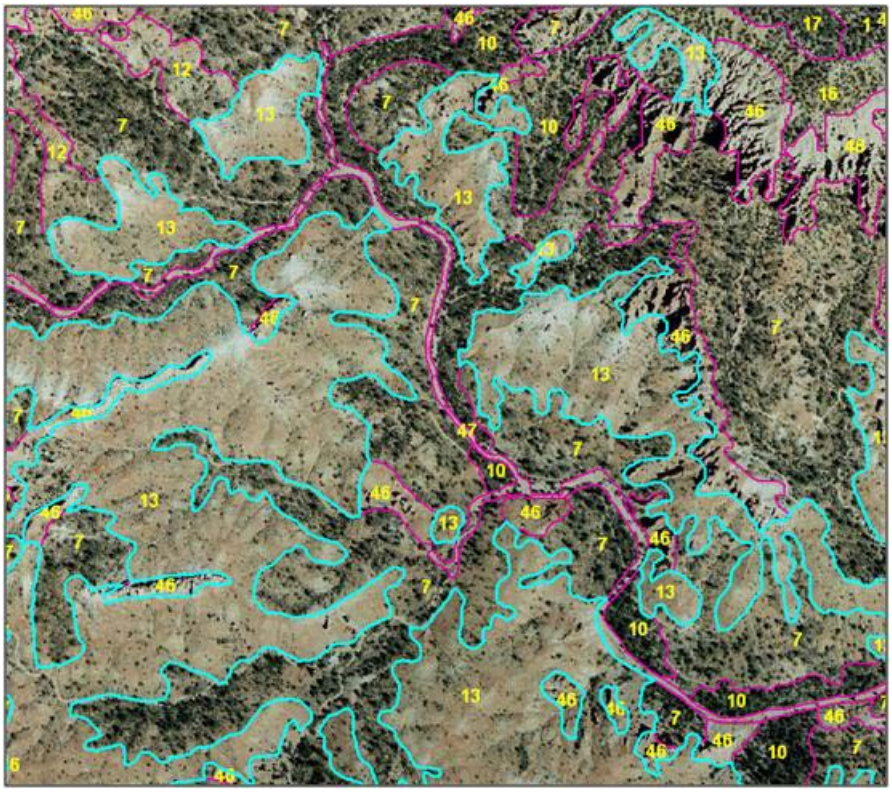


## Distribution/Ecology/Composition

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

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 (#13).

## Map Class 14
## Pinyon Pine - Juniper spp. / Saline Wildrye Woodland (W-PJSW)





Photo credits: NPS

Associations

*Pinus edulis – Juniperus osteosperma / Atriplex* spp. Woodland
*Pinus edulis – Juniperus* spp. */ Leymus salinus* Woodland
*Pinus edulis – Juniperus osteosperma / Pleuraphis jamesii* Woodland

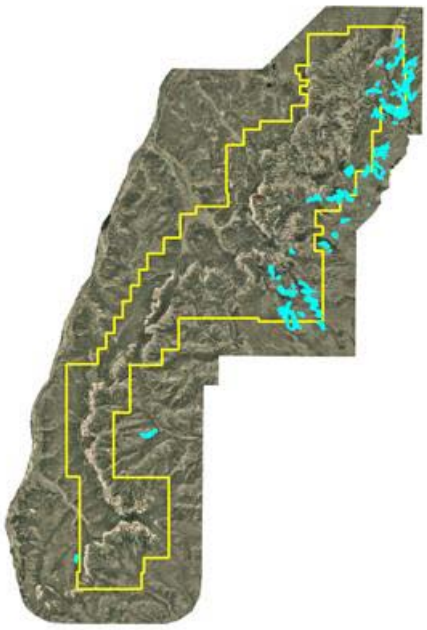
Common species

- *Pinus edulis*
- *Juniperus scopulorum*
- *Eriogonum corymbosum*
- *Pleuraphis jamesii*
- *Juniperus osteosperma*
- *Leymus salinus*
- *Atriplex canescens*

### W-PJSW Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 74 total polygons<br>40 total polygons in BRCA<br>34 total polygons in the environs |
| Total project area: | 243 hectares / 600 acres (1 %)<br>113 hectares / 278 acres in BRCA<br>130 hectares / 321 acres in the environs |
| Average Polygon Size: | 3.3 hectares / 8.1 acres |
| Producer's accuracy: | 63% ± 24% |
| User's accuracy: | 83% ± 18% |

### Distribution in Mapping Area

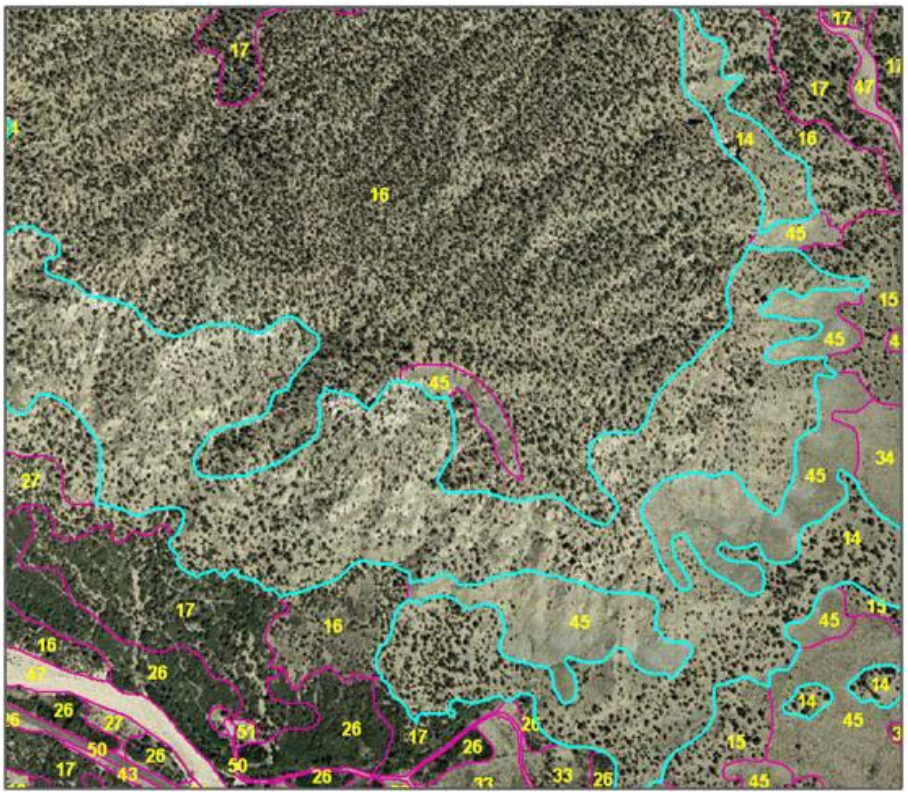


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderately steep northeast to southwest-facing slopes and low ridges and hills. The dominant trees are pinyon pine, Rocky Mountain juniper, and Utah juniper. The dominant understory grass is Salina wildrye and other common grasses include galleta grass, Fendler bluegrass along with squirreltail and needle-and-thread. The stands are xeric.

## Interpretation

This rare map class appears as small to medium regular polygons on gentle to moderately steep slopes concentrated in the northeast and central-eastern portions of the Park at the upper edge of the Tropic Valley to Yellow Creek. The signature is a smooth light gray to medium gray green representing the grass cover, with white to gray inclusions where rock and bare ground are exposed. The low tree crowns provide a rough and pebbled texture and shadows produce black spots. Common neighbors are pinyon-juniper woodlands with mixed shrub or Gambel oak understories (map classes 16 and 17) and mixed desert shrublands (map class 45).




Example of photo signature for map class W-PJSW (#14).

## Map Class 15
## Pinyon Pine - Juniper spp. / Sagebrush spp. Woodland Complex (W-PJSA)





Photo credits: NPS

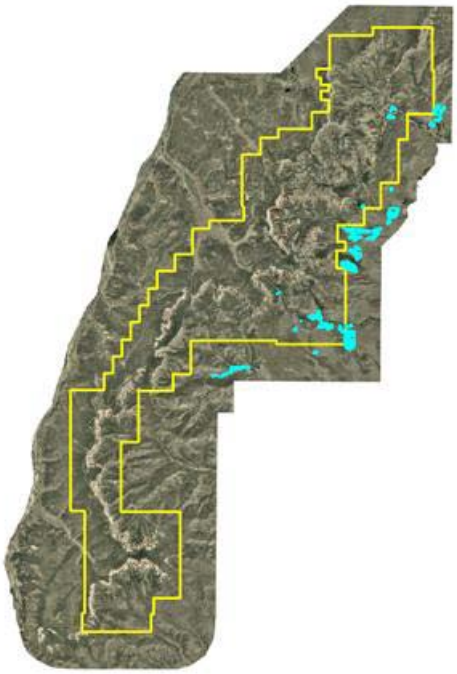
### Associations
*Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland
*Pinus edulis - Juniperus* spp. */ Artemisia tridentata (*ssp. *wyomingensis,* ssp. *vaseyana)* Woodland

### Common species
- *Pinus edulis*
- *Juniperus scopulorum*
- *Artemisia tridentata* ssp. *wyomingensis*
- *Artemisia nova*
- *Juniperus osteosperma*
- *Artemisia tridentata* ssp. *tridentata*
- *Artemisia tridentata* ssp. *vaseyana*

### W-PJSA Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 81 total polygons<br>20 total polygons in BRCA<br>61 total polygons in the environs |
| Total project area: | 134 hectares / 331 acres (0.6 %)<br>30 hectares / 75 acres in BRCA<br>104 hectares / 256 acres in the environs |
| Average Polygon Size: | 1.7 hectares / 4.1 acres |
| Producer's accuracy: | 67% ± 40% |
| User's accuracy: | 80% ± 39% |

### Distribution in Mapping Area

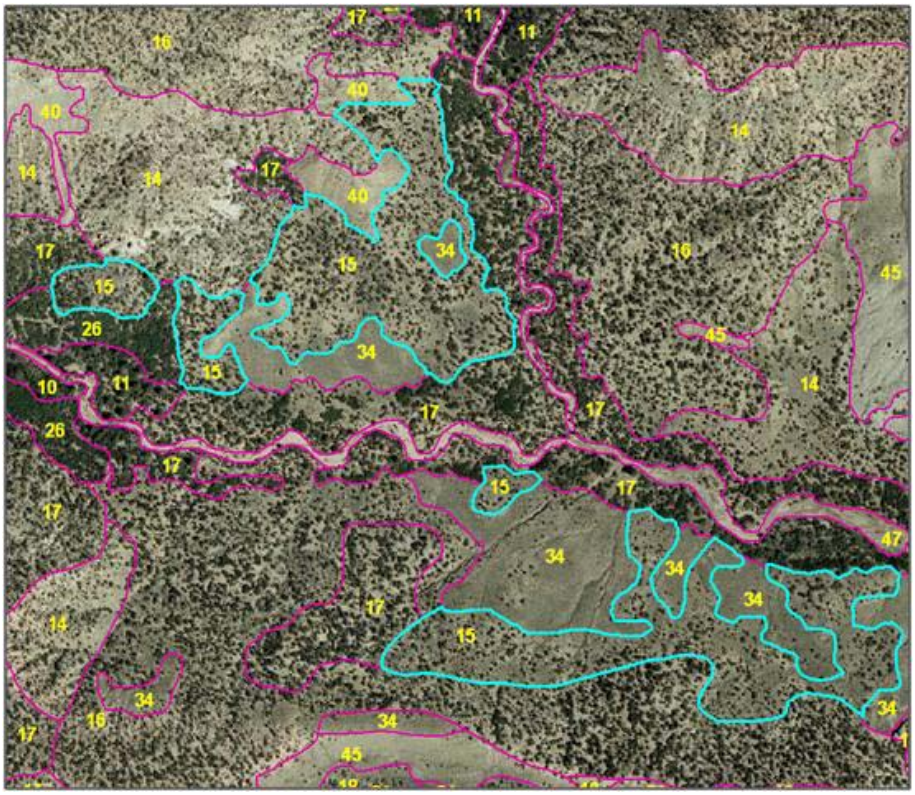


## Distribution/Ecology/Composition

Stands occur on deep soils within the Park near Jolley Hollow and Yellow Creek. Stands occur primarily on flats and rolling hills with deep soils. The dominant short-stature trees are pinyon pine, Rocky Mountain juniper, and/or Utah juniper. The shrub cover may range from low to moderate and is typified by subspecies of big sagebrush or black sagebrush, in addition to fourwing saltbush, winterfat, rabbitbrush species, and snakeweed. Due to recent drought conditions, many sagebrush shrubs that provided the photo signature are now dead. The stands are xeric.

## Interpretation

This very rare map class appears as medium to large regular polygons on flats and low slopes on the extreme eastern edge of the Park and on the upper margins of the Tropic Valley outside the Park boundary. The signature is a smooth to lightly speckled, light gray green for the shrub cover where it is dense and white to gray where rock and bare ground are exposed. The low tree crowns provide a rough and pebbled texture and shadows produce very minor black spots. Common neighbors include polygons of the other pinyon – juniper woodlands (map classes 14, 16 and 17), mixed desert shrublands (map class 45), dry meadow grasslands (map class 40), and big sagebrush shrublands (map class 34).




Example of photo signature for map class W-PJSA (#15).

## Map Class 16
## Pinyon Pine - Juniper spp. / Mixed Mountain Shrub Woodland Complex (W-PJMS)




Photo credits: NPS

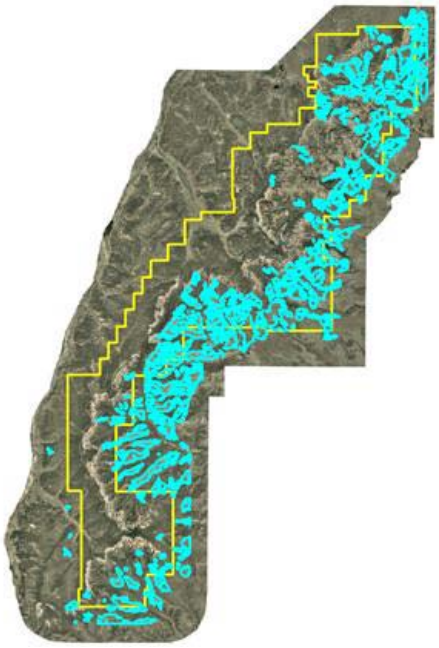
### Associations
*Pinus edulis - Juniperus osteosperma / Arctostaphylos patula* Woodland
*Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia* Woodland
*Pinus edulis - Juniperus spp. / Cercocarpus montanus* –Mixed Shrubs Woodland
*Pinus edulis - Juniperus osteosperma / Purshia stansburiana* Woodland
*Pinus edulis – Juniperus osteosperma / Purshia tridentata* Woodland
*Pinus edulis - Juniperus osteosperma / Cecocarpus ledifolius* Woodland

### Common species
- *Pinus edulis*
- *Juniperus scopulorum*
- *Shepherdia rotundifolia*
- *Cercocarpus montanus*
- *Quercus gambelii*
- *Elymus elymoides*
- *Juniperus osteosperma*
- *Arctostaphylos patula*
- *Purshia tridentata*
- *Cercocarpus ledifolius*
- *Amelanchier utahensis*

## W-PJMS Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 365 total polygons<br>195 total polygons in BRCA<br>170 total polygons in the environs |
| Total project area: | 3,815 hectares / 9,428 acres (16.1 %)<br>2305 hectares / 5695 acres in BRCA<br>1,511 hectares / 3,733 acres in the environs |
| Average Polygon Size: | 10.5 hectares / 25.8 acres |
| Producer's accuracy: | 93% ± 5% |
| User's accuracy: | 91% ± 5% |

## Distribution in Mapping Area

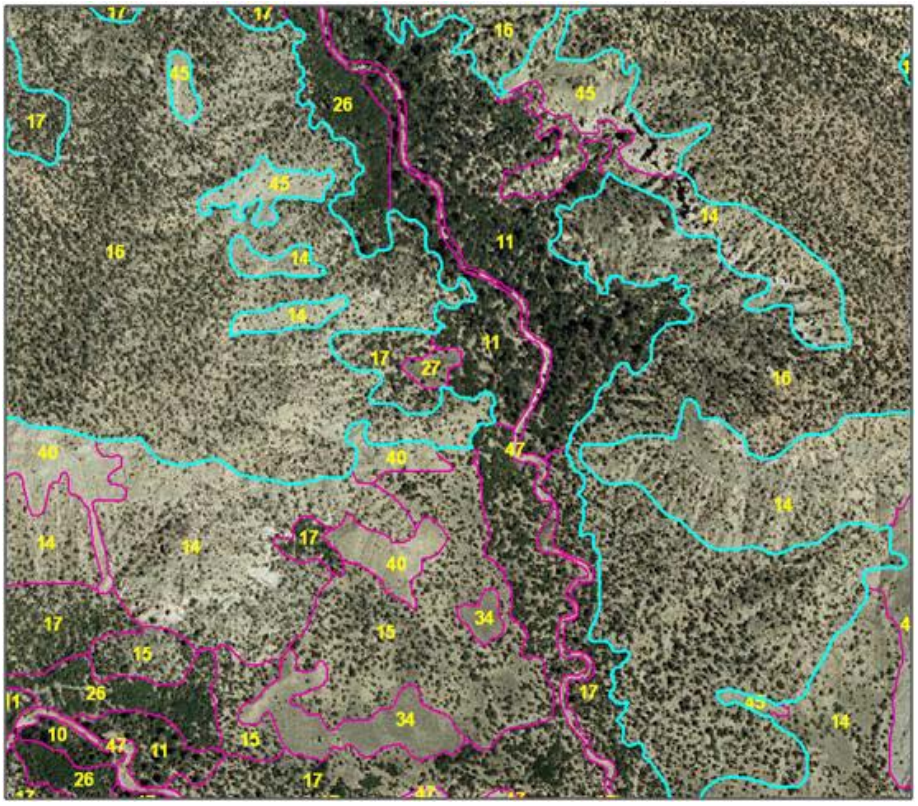


## Distribution/Ecology/Composition

Stands occur primarily on gentle to steep northeast to southwest-facing slopes and ridges and along drainages. The dominant trees include pinyon pine, Rocky Mountain juniper, and/or Utah juniper. The shrub cover may range from low to high and include curl-leaf mountain mahogany, mountain mahogany, bitterbrush, species of rabbitbrush, greenleaf manzanita, roundleaf buffaloberry, Stansbury cliffrose, and species of sagebrush. The stands range from moderately mesic to xeric.

## Interpretation

This abundant map class appears as medium to large irregular polygons on moderately steep to very steep slopes distributed throughout the Park below exposures of the Claron Formation and along its eastern boundary. Due to slope steepness the photo signature may be blurred in the orthorectification process. Polygons occur along the upper margin of the Pink Cliffs, on some lower exposures of the Claron Formation, and on the upper Straight Cliffs slopes of Tropic Valley, Sheep Creek, and Squaw Bench. The signature is a speckled, medium gray green for the shrub cover where it is dense with white to gray inclusions where rock and bare ground are exposed. The small stature tree crowns provide a rough and pebbled texture and shadows produce black spots. A variety of other map classes border this type but the most common neighbor is pinyon – juniper / Gambel oak woodlands (map class 17).



Example of photo signature for map class W-PJMS (#16).

## Map Class 17
## Pinyon Pine - Juniper spp. / Gambel Oak Woodland (W-PJGO)





Photo credits: NPS

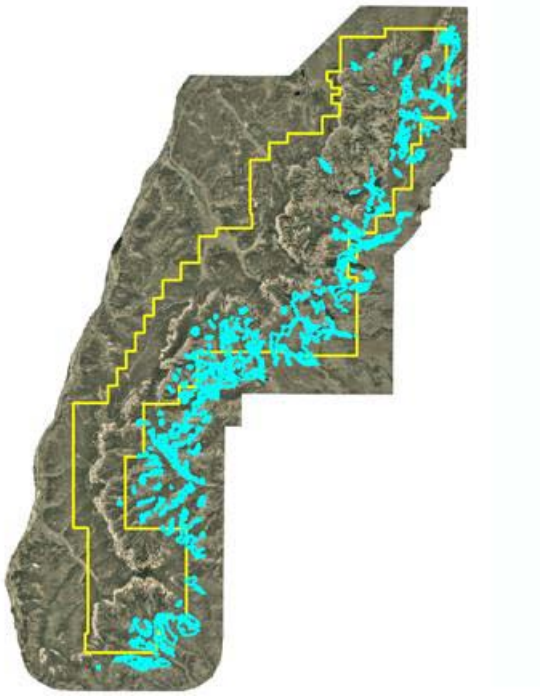
### Associations
*Pinus edulis - Juniperus* spp. */ Quercus gambelii* Woodland

### Common species
- *Pinus edulis*
- *Juniperus scopulorum*
- *Cercocarpus montanus*
- *Juniperus osteosperma*
- *Quercus gambelii*
- *Purshia tridentata*

### W-PJGO Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 324 total polygons<br>167 total polygons in BRCA<br>157 total polygons in the environs |
| Total project area: | 1,357 hectares / 3,352 acres (5.7 %)<br>547 hectares / 1352 acres in BRCA<br>809 hectares / 2,000 acres in the environs |
| Average Polygon Size: | 4.2 hectares / 10.3 acres |
| Producer's accuracy: | 67% ± 20% |
| User's accuracy: | 100% |

### Distribution in Mapping Area

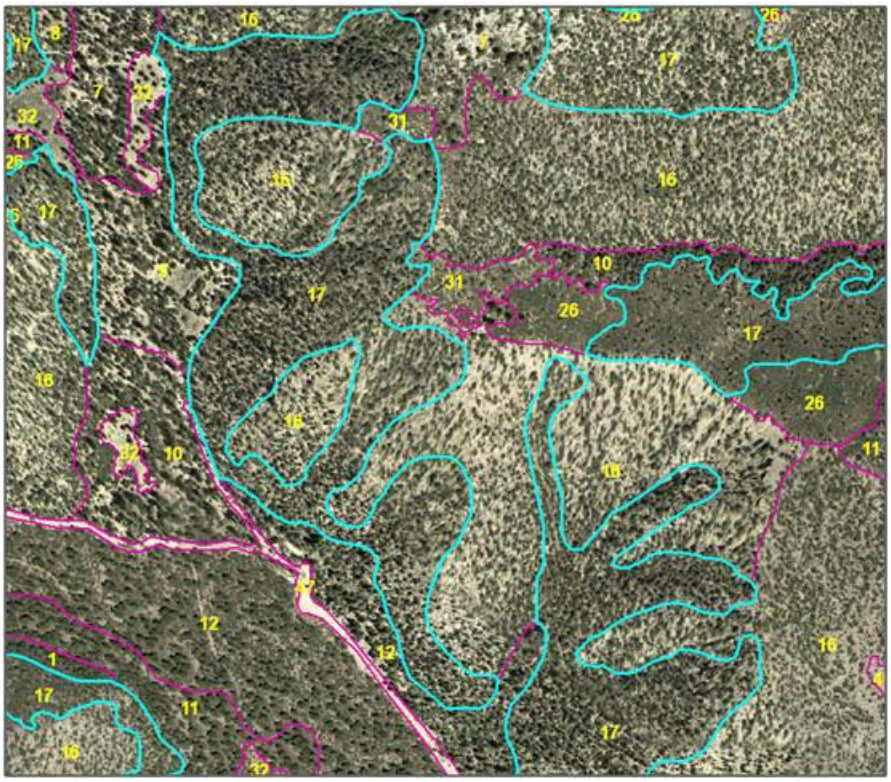


## Distribution/Ecology/Composition

Stands occur primarily on gentle to moderately steep low slopes at all aspects in sheltered spots and along drainages. The dominant small trees are pinyon pine, Rocky Mountain juniper, and/or Utah juniper. The tall shrub Gambel oak is dominant in the understory or as small to moderately large patches between trees. The stands are mesic to moderately xeric.

## Interpretation

This common map class appears as small to medium regular polygons on gentle to moderately steep slopes along the eastern Park boundary on the lower margins of the Pink Cliffs and upper margins of Tropic Valley, Sheep Creek Flat, and Squaw Bench, mostly occurring on the Straight Cliffs formation. The color is a continuous moderately dark green representing thickets of Gambel oak with white to gray inclusions where rock and bare ground are exposed. The tree crowns provide a rough and pebbled texture and shadows produce black spots and the Gambel oak clones provide a circular pattern in the canopy openings. The most common neighbor is polygons of pinyon – juniper /mixed shrub woodlands (map class 16).




Example of photo signature for map class W-PJGO (#17).

## Map Class 18
## Pinyon Pine - Juniper spp. / Sparse Understory Woodland (W-PJSP)





Photo credits: NPS

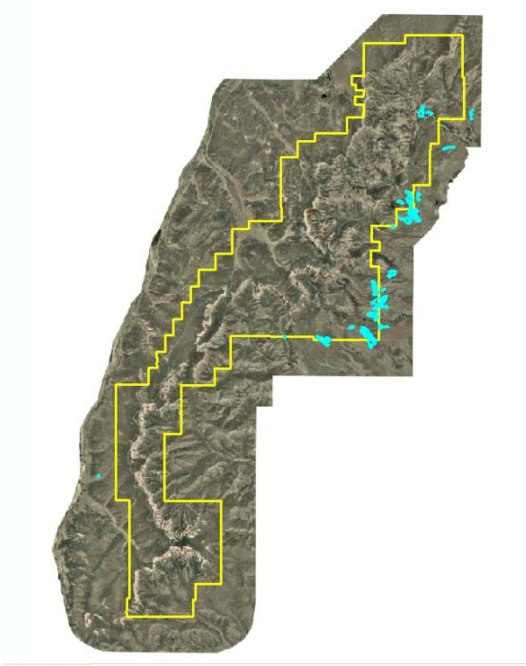
### Associations
*Pinus edulis – Juniperus osteosperma /* Sparse Understory Woodland

### Common species
- *Pinus edulis*
- *Juniperus scopulorum*
- *Juniperus osteosperma*

### W-PJSP Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 63 total polygons<br>27 total polygons in BRCA<br>36 total polygons in the environs |
| Total project area: | 116 hectares / 286 acres (0.5 %)<br>61 hectares / 151 acres in BRCA<br>55 hectares / 135 acres in the environs |
| Average Polygon Size: | 1.8 hectares / 4.5 acres |
| Producer's accuracy: | 85% ± 21% |
| User's accuracy: | 73% ± 22% |

### Distribution in Mapping Area

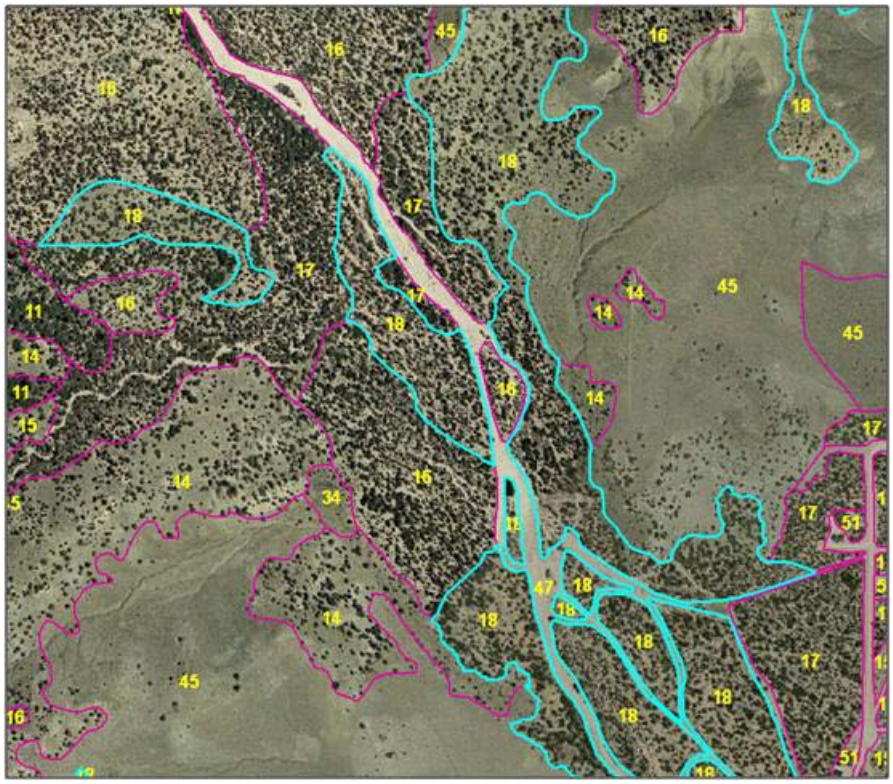


### Distribution/Ecology/Composition
Stands occur primarily on gentle to moderately steep east to south-facing slopes, low ridges, and hills. Pinyon pine, Rocky Mountain juniper, and/or Utah juniper are dominant and provide low to high cover.

Understory cover is sparse within these xeric stands due to shallow soils, high tree cover/canopy shading, or a gravelly surface that inhibits seed germination or rooting, among other possible causes.

## Interpretation

This very rare map class appears as small, regular polygons on gentle to moderately steep slopes and hills concentrated in the central-eastern portion of the Park at the edge of Tropic Valley and Sheep Creek Flat. The signature is a smooth light gray color representing the substrate (gravel, litter, or bare ground) exposed between tree canopies. The tall tree crowns provide a rough and pebbled texture and shadows produce black spots. Common neighbors include polygons of pinyon – juniper woodlands with mixed shrub or Gambel oak understories (map classes 16 and 17), mixed desert shrublands (map class 45), and siltbush shrublands (map class 48).




Example of photo signature for map class W-PJSP (#18).

# Map Class 23
# Aspen Forest Complex (F-ASPE)





Photo credits: NPS

## Associations

*Populus tremuloides / Acer grandidentatum* Forest
*Populus tremuloides / Juniperus communis* Forest
*Populus tremuloides / Symphoricarpos oreophilus* Forest
*Populus tremuloides – Pseudotsuga menziesii / Juniperus communis* Forest

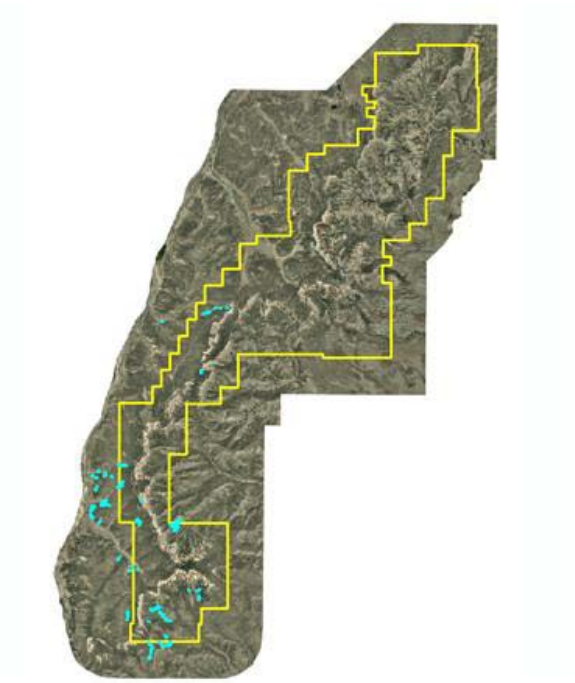
## Common species

- *Populus tremuloides*
- *Abies concolor*
- *Arctostaphylos patula*
- *Symphoricarpos oreophilus*
- *Pseudotsuga menziesii*
- *Picea pungens*
- *Juniperus communis*

## F-ASPE Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 66 total polygons<br>36 total polygons in BRCA<br>30 total polygons in the environs |
| Total project area: | 39 hectares / 96 acres (0.2 %)<br>18 hectares / 44 acres in BRCA<br>21 hectares / 52 acres in the environs |
| Average Polygon Size: | 0.6 hectares / 1.5 acres |
| Producer's accuracy: | 70% ± 29% |
| User's accuracy: | 100% |

## Distribution in Mapping Area

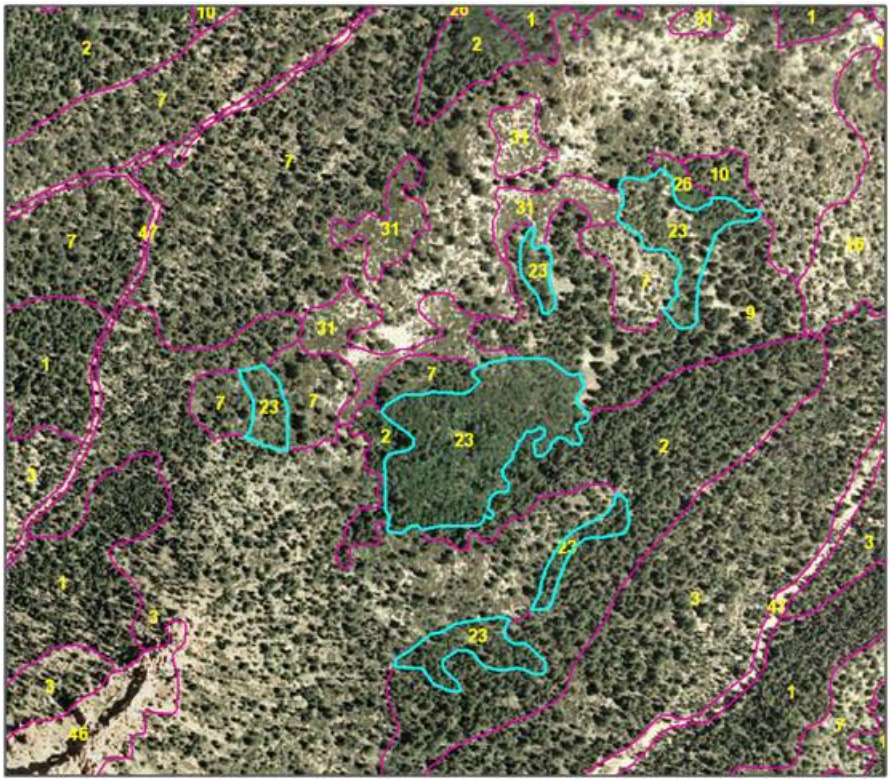


## Distribution/Ecology/Composition

Stands occur primarily on mesic or sheltered slopes and in drainages above the rims of the main canyon and their major tributaries. Quaking aspen is generally dominant, but Douglas-fir, blue spruce, white fir, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands are mesic and short shrubs including common juniper, western snowberry, mountain lover, bigtooth maple, and Oregon-grape dominate the understory in many stands. Herbaceous vegetation often includes Ross sedge, squirreltail, Kentucky bluegrass, geranium species, bracken fern, meadow rue, yarrow, American vetch, and columbine species.

## Interpretation

This rare map class appears as very small, irregular polygons on gentle to moderately steep slopes and flats in the southern portion of the Park, mostly from Whiteman Bench to Rainbow Point. The color is moderately gray-green to bright green, with nearly continuous tree crowns providing a rough but flattened texture. Common neighbors include most of the forest and woodland types dominated by white fir, Douglas fir, or ponderosa pine.




Example of photo signature for map class F-ASPE (#23).

## Map Class 25
## Curl-leaf Mountain-mahogany Woodland Alliance (W-CLMM)

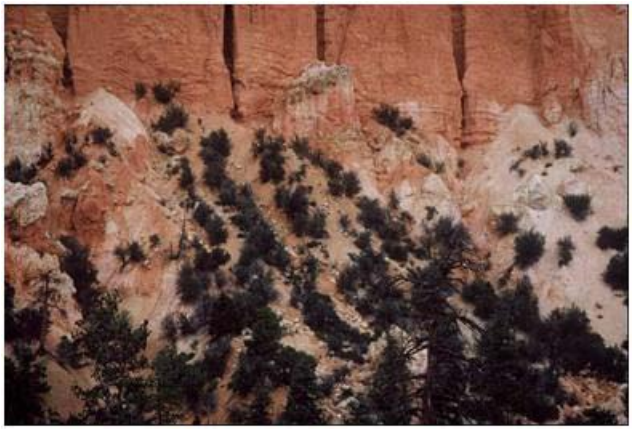




Photo credits: NPS

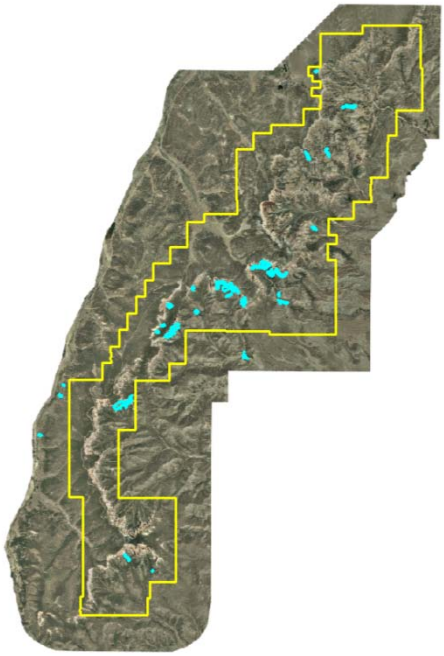
### Associations
*Cercocarpus ledifolius / Arctostaphylos patula* Woodland
*Cercocarpus ledifolius / Artemisia tridentata* Woodland
*Cercocarpus ledifolius / Quercus gambelii* Woodland
*Cercocarpus ledifolius* Woodland Alliance

### Common species
- *Cercocarpus ledifolius*
- *Artemisia tridentata*
- *Purshia tridentata*
- *Leymus salinus*
- *Arctostaphylos patula*
- *Quercus gambelii*
- *Elymus spicatus*

### W-CLMM Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 42 total polygons |
| | 36 total polygons in BRCA |
| | 6 total polygons in the environs |
| Total project area: | 110 hectares / 272 acres (0.5 %) |
| | 105 hectares / 260 acres in BRCA |
| | 5 hectares / 11 acres in the environs |
| Average Polygon Size: | 2.6 hectares / 6.5 acres |
| Producer's accuracy: | 77% ± 23% |
| User's accuracy: | 100% |

### Distribution in Mapping Area

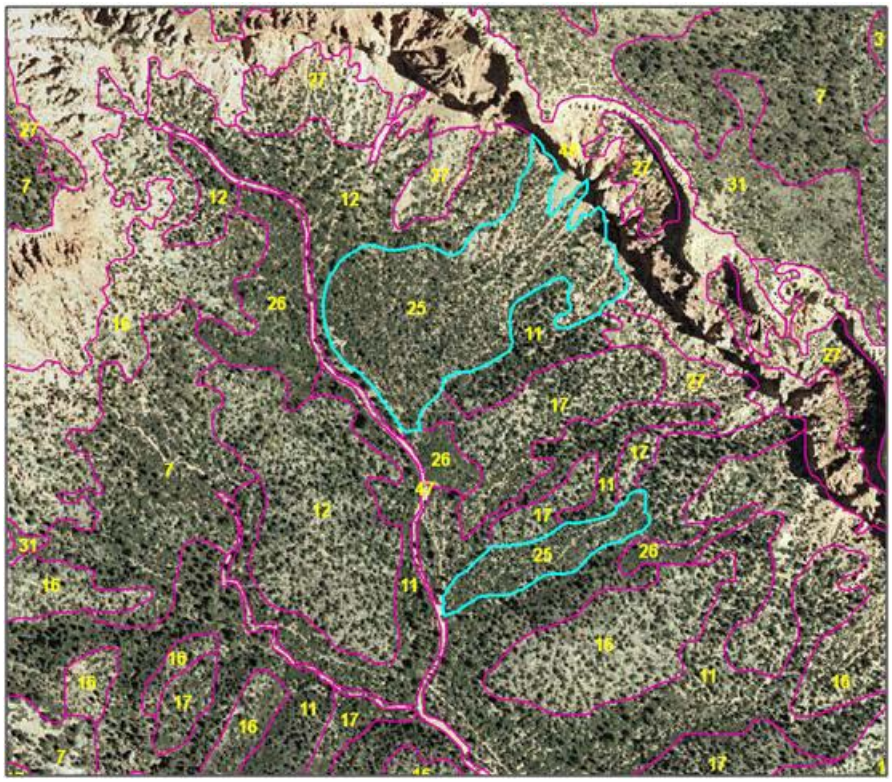


## Distribution/Ecology/Composition

Stands dominated by curl-leaf mountain mahogany trees on steep to very steep slopes of Pink Claron or along drainages. Associated shrubs may include Gambel oak, mountain mahogany, serviceberry, chokecherry, greenleaf manzanita, and bitterbrush shrubs. Associated trees include scattered Rocky Mountain juniper, white fir, and Douglas-fir. The stands are mesic to xeric depending on slope exposure.

## Interpretation

This extremely rare map class occurs in small polygons occurring on steep talus slopes at the base of the Pink Cliffs, on Boat Mesa top, and along drainages that are scattered throughout central portions of the Park. It is most common in the area of Paria View to Swamp Canyon. 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. A variety of map classes occur adjacent to curl-leaf mountain mahogany woodlands, but the most common include bristlecone pine woodlands (map class 13), ponderosa pine – Douglas fir / manzanita woodlands (map class 7), pinyon – juniper woodlands with mixed shrub or oak understories (map classes 16 and 17), and steep, barren exposures of the Claron formation (map class 46).



Example of photo signature for map class W-CLMM (#25).

## Upland Shrublands

Map Class 26
Gambel Oak Shrubland Complex (S-QUER)






Photo credits: NPS

### Associations

*Quercus gambelii* Shrubland
*Quercus gambelii* / Sparse Understory Shrubland
*Quercus gambelii - Cercocarpus montanus / (Carex geyeri)* Shrubland
*Quercus gambelii / Symphoricarpos oreophilus* Shrubland

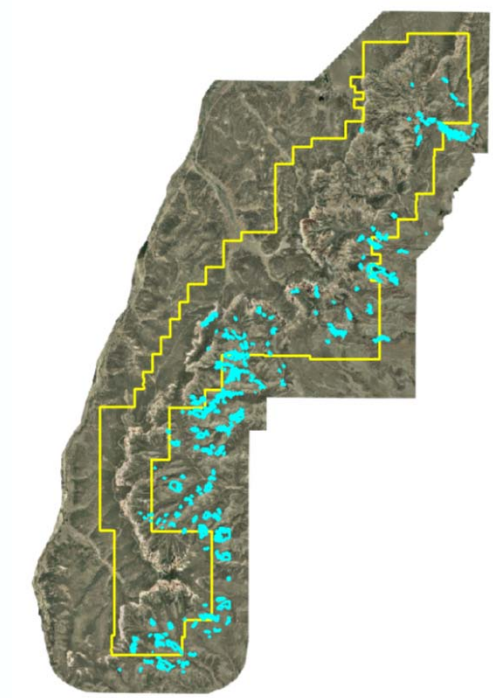
### Common species

- *Quercus gambelii*
- *Amelanchier utahensis*
- *Clematis ligusticifolia*
- *Solidago velutina*
- *Cercocarpus montanus*
- *Symphoricarpos oreophilus*
- *Smilacina stellata*

## S-QUER Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 292 total polygons<br>120 total polygons in BRCA<br>172 total polygons in the environs |
| Total project area: | 421 hectares / 1,040 acres (1.8 %)<br>133 hectares / 330 acres in BRCA<br>287 hectares / 710 acres in the environs |
| Average Polygon Size: | 1.4 hectares / 3.6 acres |
| Producer's accuracy: | 85% ± 13% |
| User's accuracy: | 92% ± 11% |

## Distribution in Mapping Area

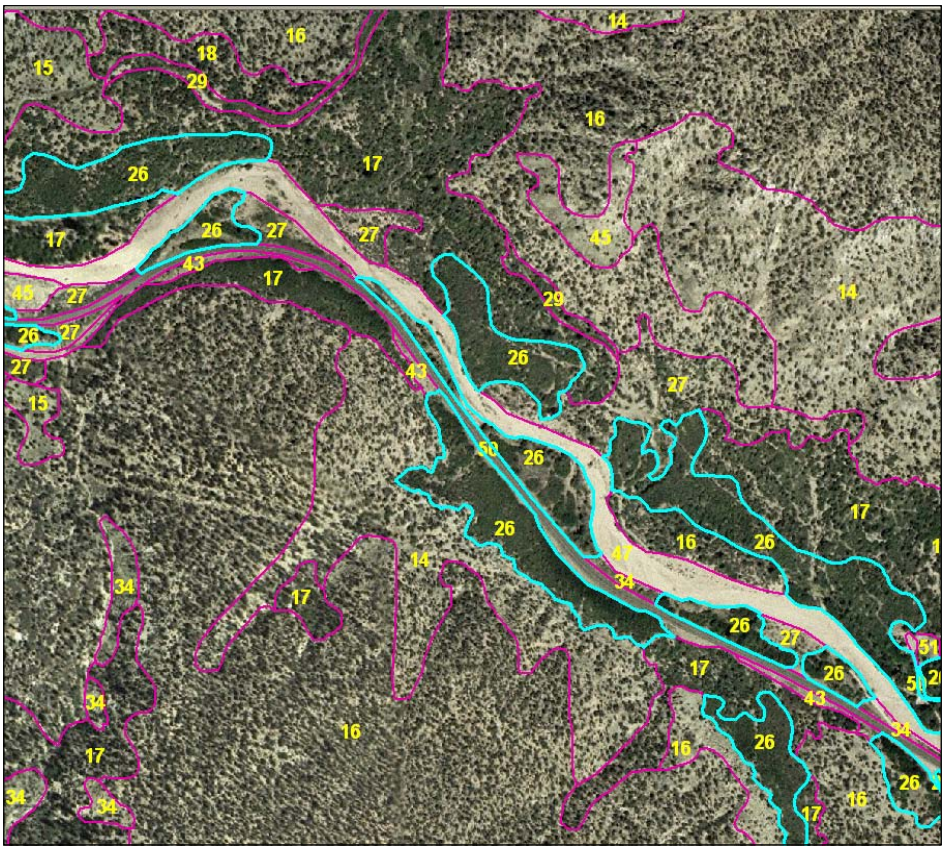


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes to flats that have deep soils. Gambel oak is the dominant tall shrub, sometimes with mixtures of mountain mahogany, Utah serviceberry, chokecherry, and the vine virgin's bower. Herbaceous vegetation provides low cover and in many stands includes false Solomon's seal and goldenrod. Associated trees may include white fir, Douglas-fir, ponderosa pine, pinyon pine, and Utah juniper providing sparse to low cover. The stands are mesic.

## Interpretation

This uncommon map class appears as small to medium regular polygons on flats and gentle slopes, often following washes, confined largely to the eastern boundary of the Park on the upper edge of Tropic Valley and Sheep Creek Flat. The color is a homogenous medium-green and the pattern reflects the circular, clonal growth of Gambel oak, with occasional scattered tree crowns providing dark green to black dots of several sizes. Common neighbors include polygons of ponderosa pine – Douglas fir / manzanita woodlands (map class 7), ponderosa pine / Gambel oak woodlands (map class 10), pinyon – juniper woodlands with mixed shrub or Gambel oak understories (map classes 16 and 17), and barren wash channels (map class 47).




Example of photo signature for map class S-QUER (#26).

## Map Class 27
## Mixed Mountain Shrubland Complex (S-MXMS)




Photo credits: NPS

### Associations

*Amelanchier (utahensis, alnifolia) – Cercocarpus montanus* Shrubland
*Cercocarpus montanus* Desert Wash Shrubland [Park Special]
*Prunus virginiana – (Prunus americana)* Shrubland
*Purshia tridentata* Desert Wash Shrubland [Park Special]
*Artemisia nova – Purshia tridentata / Poa fendleriana* Shrubland
*Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation
*Purshia tridentata / Leymus salinus* Shrubland [Park Special]
*Symphoricarpos oreophilus* Shrubland

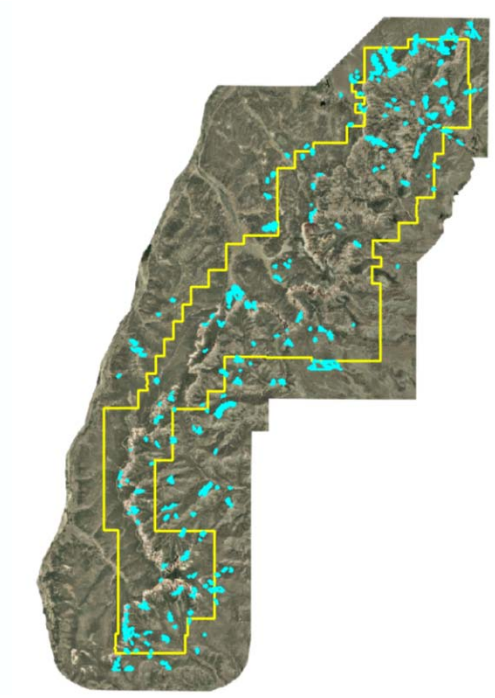
### Common species

- *Purshia tridentata*
- *Amelanchier utahensis*
- *Shepherdia argentea*
- *Artemisia nova*
- *Leymus salinus*
- *Cercocarpus montanus*
- *Prunus virginiana*
- *Symphoricarpos oreophilus*
- *Hesperostipa comata*

## S-MXMS Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 301 total polygons |
| | 190 total polygons in BRCA |
| | 111 total polygons in the environs |
| Total project area: | 363 hectares / 898 acres (1.5 %) |
| | 202 hectares / 499 acres in BRCA |
| | 161 hectares / 399 acres in the environs |
| Average Polygon Size: | 1.2 hectares / 3 acres |
| Producer's accuracy: | 63% ± 24% |
| User's accuracy: | 91% ± 19% |

## Distribution in Mapping Area

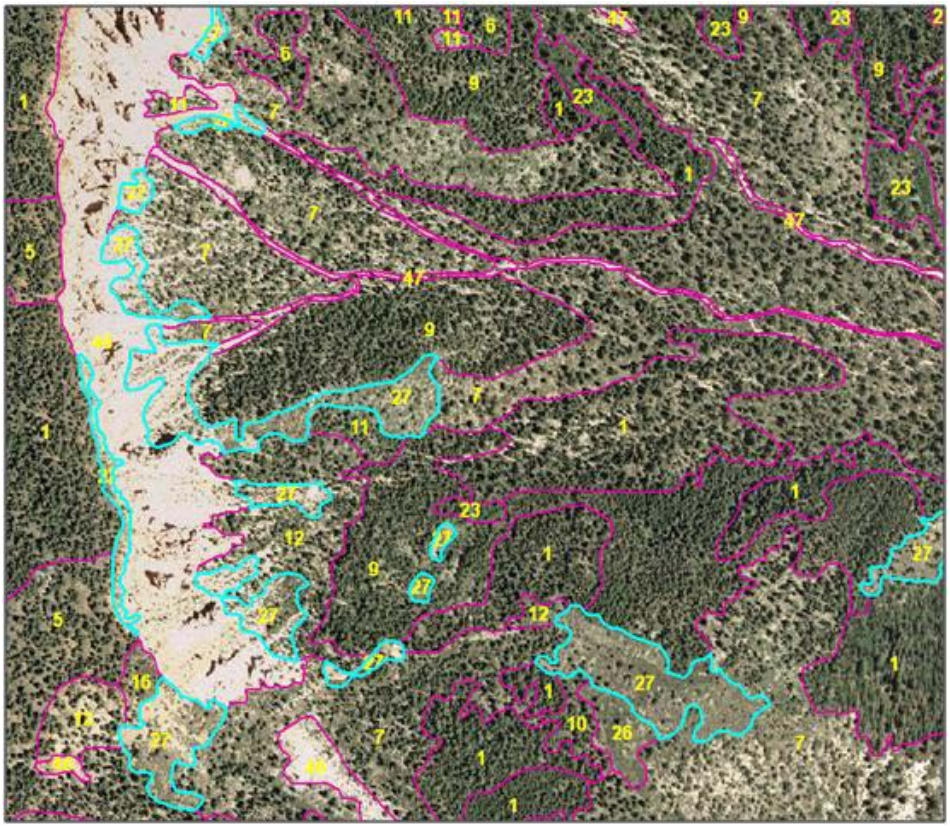


## Distribution/Ecology/Composition

Stands occur primarily on moderate slopes and flats that have deep soils. A combination of shrubs including mountain mahogany, serviceberry, chokecherry, mountain snowberry, bitterbrush, and greenleaf manzanita are generally dominant. Associated herbaceous vegetation includes Fendler bluegrass, needle-and-thread grass, Salina wildrye, Junegrass, and squirreltail with scattered white fir, Douglas-fir, ponderosa pine, pinyon pine, and Utah juniper trees. The stands are mesic to xeric.

## Interpretation

This common map class appears as small to medium irregular polygons on gentle to steep slopes, ridges, and flats and occurs throughout the Park. The color is medium-gray to gray-green, with a patchy or speckly pattern and occasionally with scattered tree crowns providing black dots of several sizes. A variety of map classes occur adjacent to mixed mountain shrublands, but the most common include ponderosa pine – Douglas fir / manzanita woodlands (map class 7), pinyon – juniper woodlands with mixed shrub understories, with or without emergent ponderosa pine (map classes 16 and 12), white fir / mixed shrub forests (map class 3) and Gambel oak shrublands (map class 26).



Example of photo signature for map class S-MXMS (#27).

## Map Class 30
## Black Sagebrush Shrubland Complex (S-ARNO)





Photo credits: NPS

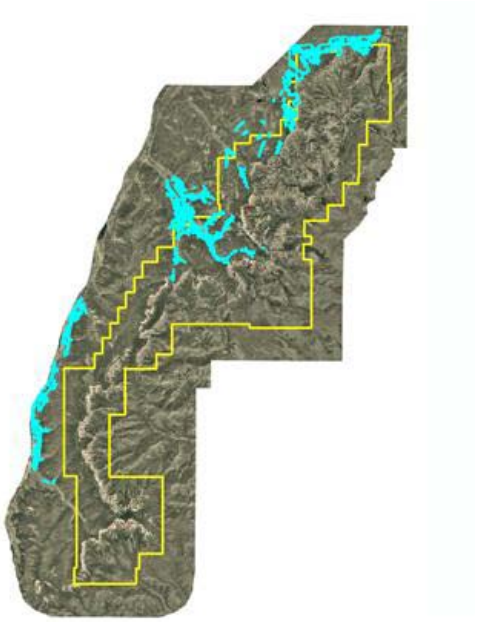
### Associations
*Artemisia nova* Shrubland
*Artemisia nova / Elymus elymoides* Shrubland
*Artemisia nova / Hesperostipa comata* Shrubland
*Artemisia nova / Leymus salinus* Shrub Herbaceous Vegetation
*Artemisia nova / Poa fendleriana* Shrubland

### Common species
- *Artemisia nova*
- *Purshia tridentata*
- *Hesperostipa comata*
- *Poa fendleriana*
- *Chrysothamnus viscidiflorus*
- *Elymus lanceolatus*
- *Koeleria macrantha*
- *Leymus salinus*

### S-ARNO Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 239 total polygons<br>72 total polygons in BRCA<br>167 total polygons in the environs |
| Total project area: | 739 hectares / 1,827 acres (3.1 %)<br>288 hectares / 711 acres in BRCA<br>452 hectares / 1,116 acres in the environs |
| Average Polygon Size: | 3.1 hectares / 7.6 acres |
| Producer's accuracy: | 97% ± 6% |
| User's accuracy: | 88% ± 10% |

### Distribution in Mapping Area

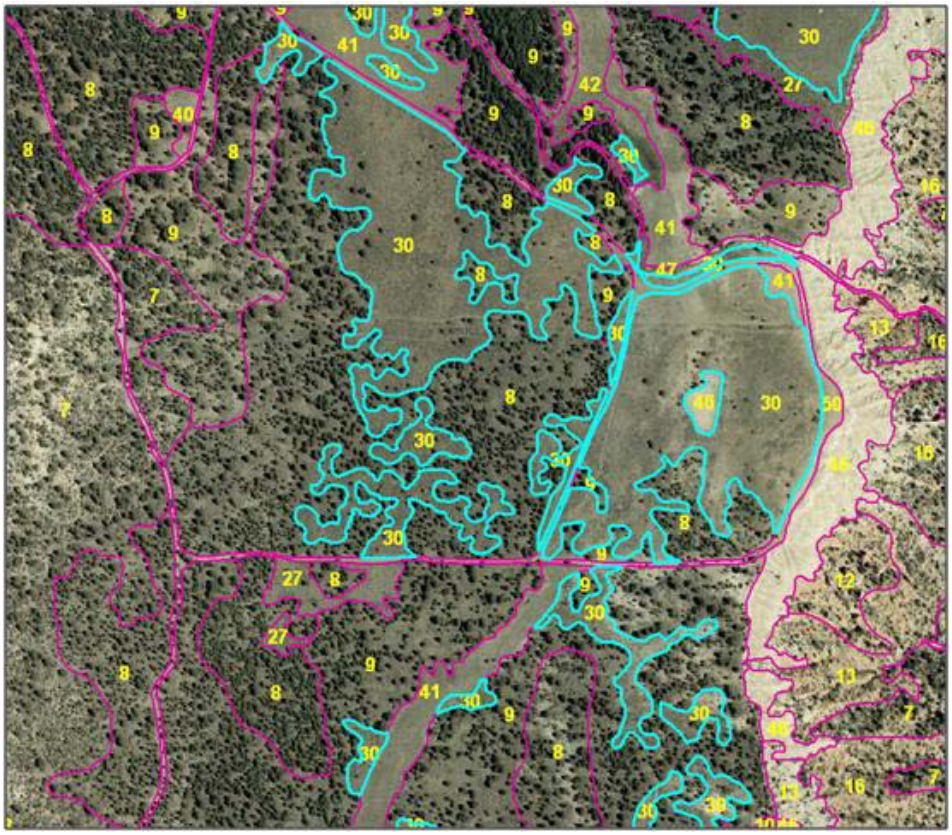


## Distribution/Ecology/Composition

Black sagebrush and viscid rabbitbrush are the dominant short shrubs. Associated herbaceous vegetation includes needle-and-thread grass, Salina wildrye, thickspike wheatgrass, and Fendler bluegrass. The stands are xeric to mesic.

## Interpretation

This uncommon map class appears as medium to large irregular polygons on gentle slopes and flats occurring along the western Park boundary on the Paunsaugunt Plateau to the Pink Cliffs rim, and outside the Park along the East Fork of the Sevier River and the north Park boundary. The color is light gray to medium-gray and the texture is smooth with smooth dark gray dots representing clumps of shrubs generally visible. Stands occur primarily on gentle slopes that have gravelly to cobbly soils. Common neighbors include polygons of ponderosa pine woodlands with mixed shrub or mixed grass understories (map classes 8 and 9), mixed mountain shrublands (map class 27), viscid rabbitbrush shrublands (map class 32), disturbed grasslands (map class 41), and wet meadows (map class 42).



Example of photo signature for map class S-ARNO (#30).

# Map Class 31
# Manzanita Shrubland Complex (S-MANZ)





Photo credits: NPS

## Associations

*Arctostaphylos patula* Shrubland
*Arctostaphylos patula – Quercus gambelii – (Amelanchier utahensis)* Shrubland

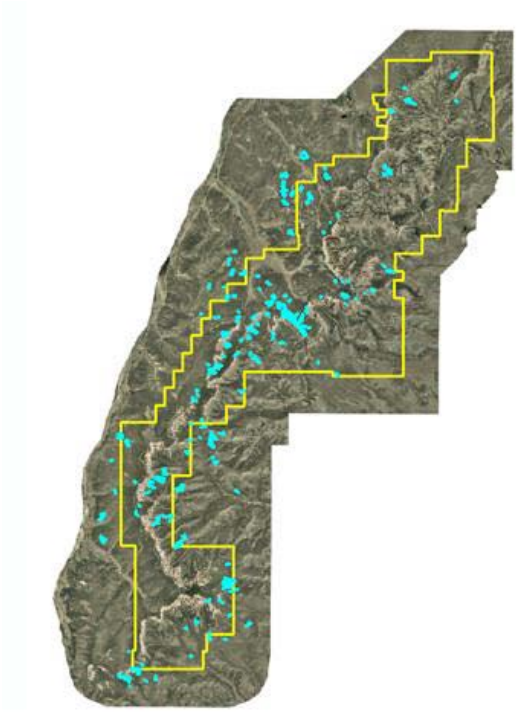
## Common species

- *Arctostaphylos patula*
- *Purshia tridentata*
- *Amelanchier utahensis*
- *Cercocarpus montanus*
- *Quercus gambelii*

## S-MANZ Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 212 total polygons<br>137 total polygons in BRCA<br>75 total polygons in the environs |
| Total project area: | 191 hectares / 471 acres (0.8 %)<br>127 hectares / 315 acres in BRCA<br>63 hectares / 156 acres in the environs |
| Average Polygon Size: | 0.9 hectares / 2.2 acres |
| Producer's accuracy: | 74% ± 16% |
| User's accuracy: | 80% ± 15% |

## Distribution in Mapping Area

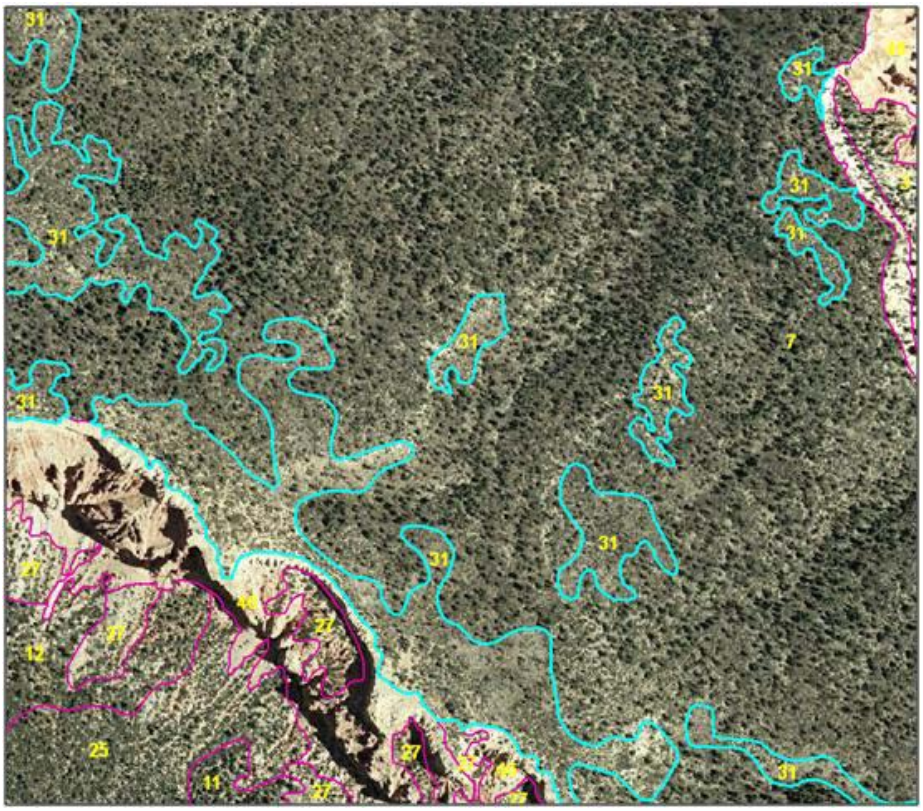


## Distribution/Ecology/Composition

Stands occur primarily on moderate to steep slopes that have gravelly soils. Greenleaf manzanita is always dominant however bitterbrush, Gambel oak, serviceberry, and species of sagebrush are often present in stands. Scattered white fir or ponderosa pine may occur along with sparse cover of squirreltail and Fendler bluegrass. The stands are xeric.

## Interpretation

This uncommon map class appears as small to large irregular polygons on steep slopes, ridges, and flats within the Pink Cliffs areas from the central to southern portions of the Park and on the Paunsaugunt Plateau where fire has removed overstory tree cover. The color is medium-gray to gray-green and the pattern is of circular clones with scattered tree crowns providing black dots of several sizes. 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 7), white fir (map class 3), or pinyon – juniper (map class 16).




Example of photo signature for map class S-MANZ (#31).

## Map Class 32
## Viscid Rabbitbrush Shrubland Complex (S-CHVI)





Photo credits: NPS

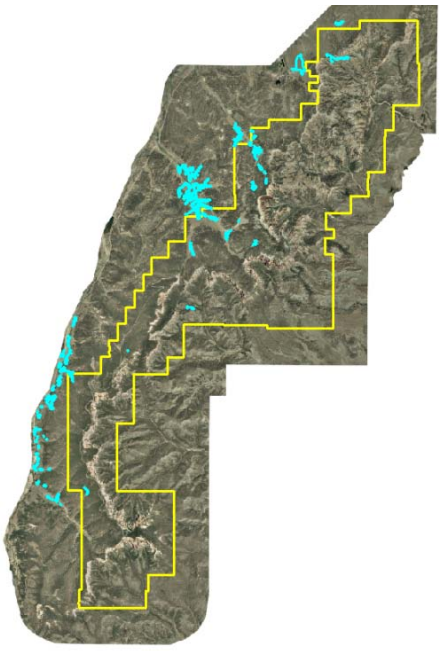
### Associations
*Chrysothamnus viscidiflorus – Ericameria parryi* Shrub Herbaceous Vegetation [Provisional]
*Chrysothamnus viscidiflorus / Hesperostipa comata* Shrubland
*Chrysothamnus viscidiflorus /* Mixed Grasses Shrubland
*Tetradymia canescens* Shrubland (rare)

### Common species
- *Chrysothamnus viscidiflorus*
- *Hesperostipa comata*
- *Poa pratensis*
- *Ericameria parryi*
- *Elymus lanceolatus*
- *Poa secunda*
- *Elymus elymoides*
- *Tetradymia canescens*

### S-CHVI Map Class Statistics

| | |
|---|---|
| Type: | Alliance |
| Frequency: | 128 total polygons<br>35 total polygons in BRCA<br>93 total polygons in the environs |
| Total project area: | 174 hectares / 431 acres (0.7 %)<br>37 hectares / 92 acres in BRCA<br>137 hectares / 339 acres in the environs |
| Average Polygon Size: | 1.4 hectares / 3.4 acres |
| Producer's accuracy: | 74% ± 20% |
| User's accuracy: | 78% ± 19% |

### Distribution in Mapping Area

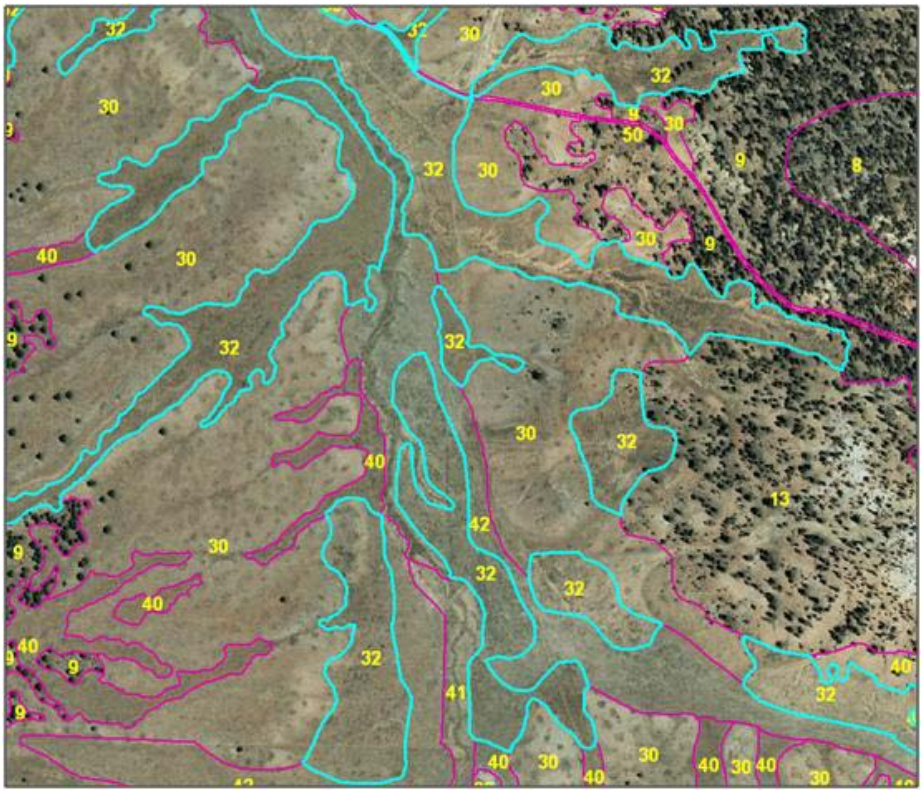


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes to flats that have deep soils. Yellow or viscid rabbitbrush occurs on plateau edges in more exposed sites, sometimes co-dominated by Parry's rabbitbrush. One example of this type was dominated by spineless horsebrush. Disturbed sites may have a fourwing saltbush component. Most examples of this type resemble a shrub herbaceous community, with grass cover equal to or greater than total shrub cover. Dominant grass species include needle-and thread grass, Kentucky bluegrass, Sandberg bluegrass, squirreltail, and thickspike wheatgrass. The stands are predominantly mesic.

## Interpretation

This uncommon map class appears as small to medium irregular polygons on gentle slopes and flats above the canyon rims. It largely occurs on the edge of the Paunsaugunt Plateau, along the East Fork of the Sevier River, and along the edge of Sheep Creek Flat. The color is medium-gray to gray-green, with scattered white to light gray patches. Common neighbors include black sagebrush shrublands (map class 30), native grasslands (map class 40), disturbed grasslands (map class 41), and wet meadows (map class 42).




Example of photo signature for map class S-CHVI (#32).

# Map Class 33
# Bottomland Shrubland Complex (S-BOTT)






Photo credits: NPS

## Associations

*Atriplex canescens – Artemisia tridentata* Shrubland
*Ericameria nauseosa / Achnatherum lettermanii* Shrubland [Park Special]
*Ericameria nauseosa* Shrubland

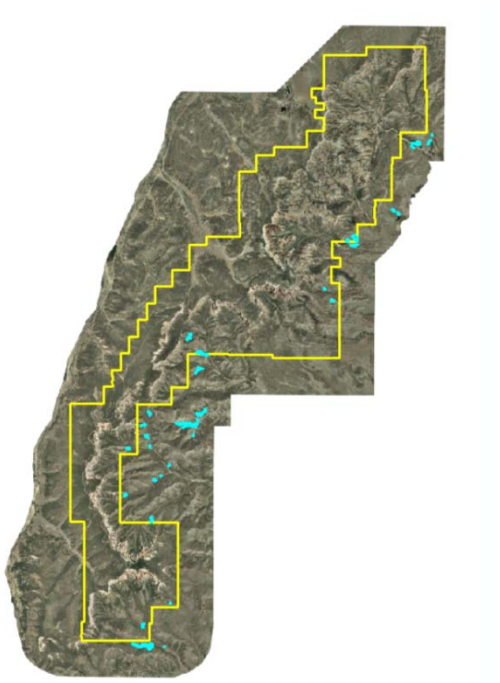
## Common species

- *Ericameria nauseosa*
- *Artemisia tridentata*
- *Atriplex canescens*
- *Achnatherum lettermanii*

## S-BOTT Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 47 total polygons |
| | 11 total polygons in BRCA |
| | 36 total polygons in the environs |
| Total project area: | 52 hectares / 128 acres (0.2 %) |
| | 13 hectares / 32 acres in BRCA |
| | 39 hectares / 96 acres in the environs |
| Average Polygon Size: | 1.1 hectares / 2.7 acres |
| Producer's accuracy: | 89% ± 23% |
| User's accuracy: | 89% ± 23% |

## Distribution in Mapping Area

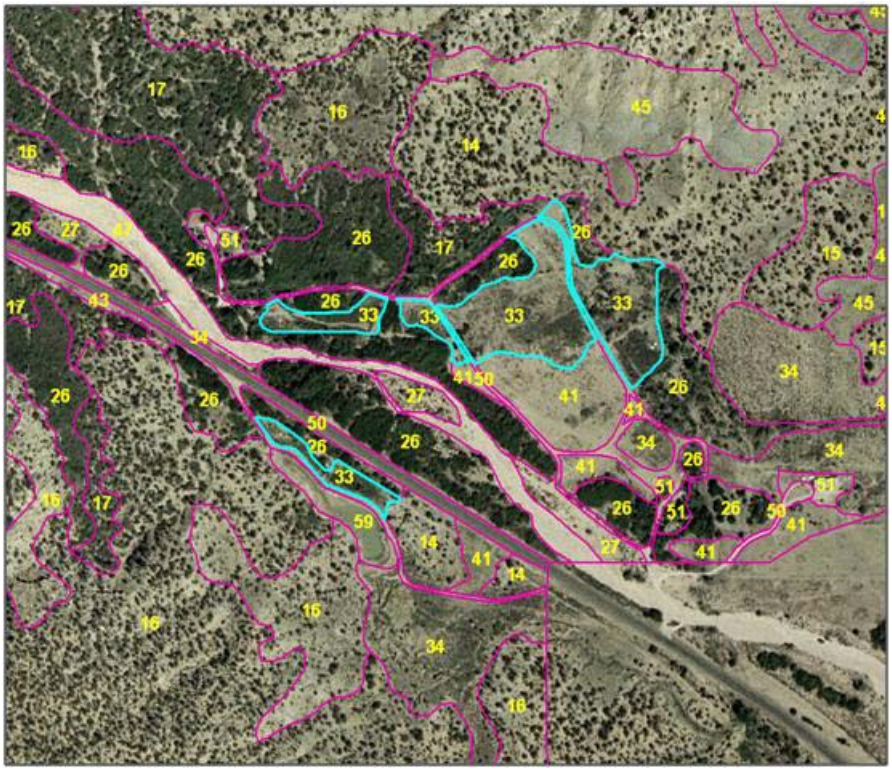


## Distribution/Ecology/Composition

Stands occur primarily on alkaline soils of the drainage bottoms, terraces, and gentle toeslopes. Rubber rabbitbrush, big sagebrush and four-wing saltbush shrubs are generally dominant and western wheatgrass and cheatgrass may occur in the understory. The stands are mesic to xeric.

## Interpretation

This very rare map class appears as small regular polygons on terraces and on flats east of the Park boundary in the Tropic Valley. The color is medium-gray to dark gray-green and textured like sandpaper with the small dots of shrubs generally visible. There are no communities consistently adjacent to this map class.




Example of photo signature for map class S-BOTT (#33).

## Map Class 34
## Big Sagebrush Shrubland Complex (S-ARTR)





Photo credits: NPS

### Associations

*Artemisia tridentata* ssp. *tridentata / Agropyron cristatum* Semi-natural Shrubland
*Artemisia tridentata* ssp. *vaseyana / Pascopyrum smithii* Shrubland
*Artemisia tridentata* ssp. *wyomingensis / Elymus lanceolatus* Shrubland [Park Special]
*Artemisia tridentata* ssp. *wyomingensis / Leymus salinus* Shrubland
*Atriplex canescens – Artemisia tridentata* Shrubland
*Atriplex canescens / Psathyrostachys juncea* Seeded Shrubland [Park Special]

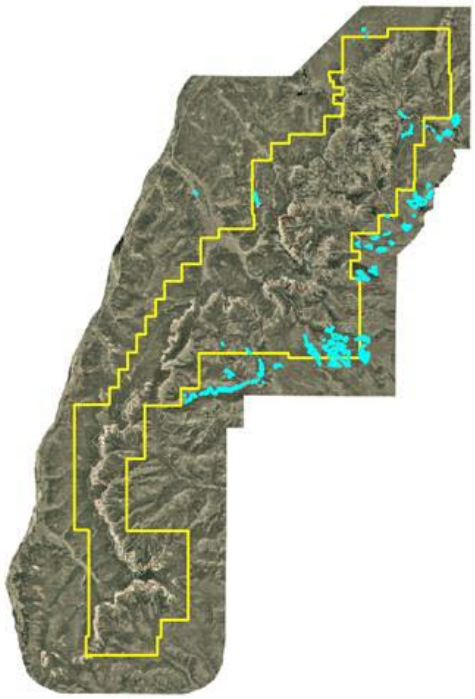
### Common species

- *Artemisia tridentata* ssp. *tridentata*
- *Artemisia tridentata* ssp. *wyomingensis*
- *Krascheninnikovia lanata*
- *Agropyron cristatum*
- *Elymus lanceolatus*
- *Poa pratensis*
- *Artemisia tridentata* ssp. *vaseyana*
- *Atriplex canescens*
- *Tetradymia canescens*
- *Pascopyrum smithii*
- *Leymus salinus*

## S-ARTR Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 108 total polygons |
| | 26 total polygons in BRCA |
| | 82 total polygons in the environs |
| Total project area: | 201 hectares / 496 acres (0.8 %) |
| | 76 hectares / 187 acres in BRCA |
| | 125 hectares / 309 acres in the environs |
| Average Polygon Size: | 1.9 hectares / 4.6 acres |
| Producer's accuracy: | 95% ± 11% |
| User's accuracy: | 100% |

## Distribution in Mapping Area

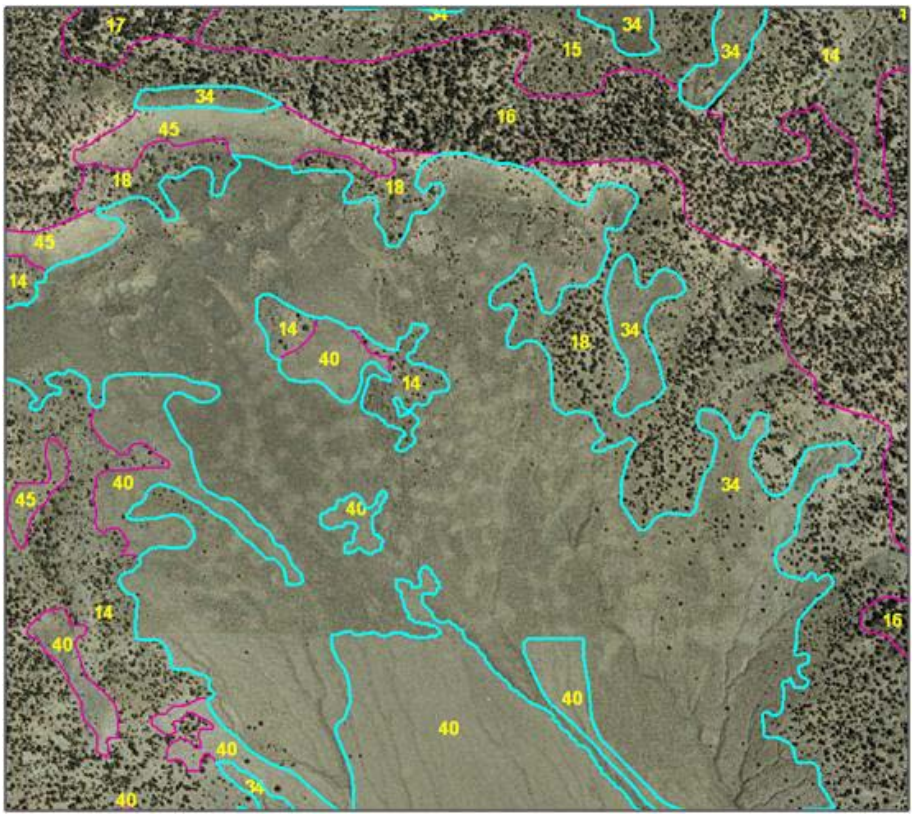


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes to flats that have deep soils. Big sagebrush subspecies are generally dominant; however some stands may be dominated by saltbush. Most big sagebrush shrubs have been killed by recent drought. Associated shrubs include fourwing horsebrush and rabbitbrush with scattered white fir, ponderosa pine, pinyon pine, and Utah juniper trees present in some stands. The understory is dominated by the grass species western wheatgrass, thickspike wheatgrass, Salina wildrye, Russian wildrye, or crested wheatgrass. The stands are xeric.

## Interpretation

This rare map class appears as medium to large regular polygons on gentle slopes, flats and occasionally ridgetops or hilltops confined to the eastern boundary of the Park on the upper edge of Tropic Valley and Sheep Creek Flat. The color is medium-gray to gray-green and textured like sandpaper with the small dots of shrubs generally visible; sometimes scattered tree crowns are present, providing black dots of several sizes. Common neighbors include polygons of pinyon – juniper woodlands with various undestories (map classes 14, 15, 16 and 17), native grasslands (map class 40), and mixed desert shrublands (map class 45).




Example of photo signature for map class S-ARTR (#34).

## Map Class 37
## Pygmy Sagebrush Dwarf-shrubland (S-ARPY)





Photo credits: NPS

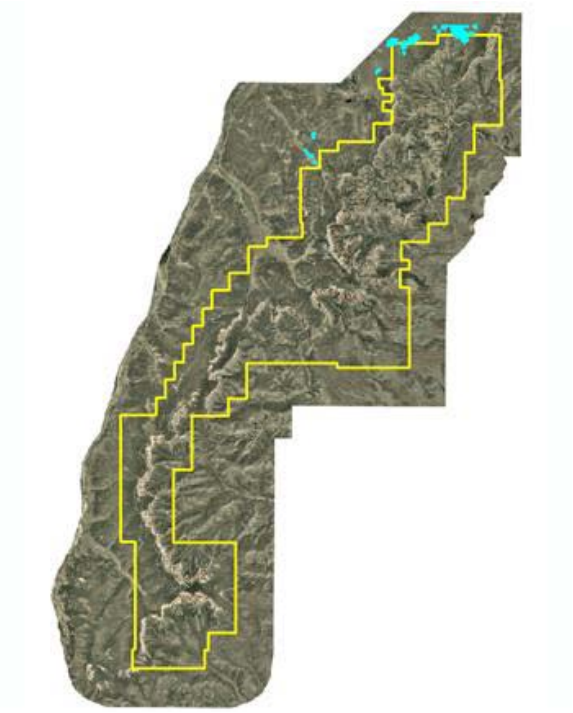
### Associations
*Artemisia pygmaea* Dwarf-shrubland [Park Special]

### Common species
- *Artemisia pygmaea*
- *Phlox hoodii*
- *Petradoria pumila*
- *Poa fendleriana*

### S-ARPY Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 53 total polygons |
| | 12 total polygons in BRCA |
| | 41 total polygons in the environs |
| Total project area: | 35 hectares / 86 acres (0.1 %) |
| | 6 hectares / 16 acres in BRCA |
| | 28 hectares / 70 acres in the environs |
| Average Polygon Size: | 0.7 hectares / 1.6 acres |
| Producer's accuracy: | 60% ± 46% |
| User's accuracy: | 100% |

### Distribution in Mapping Area

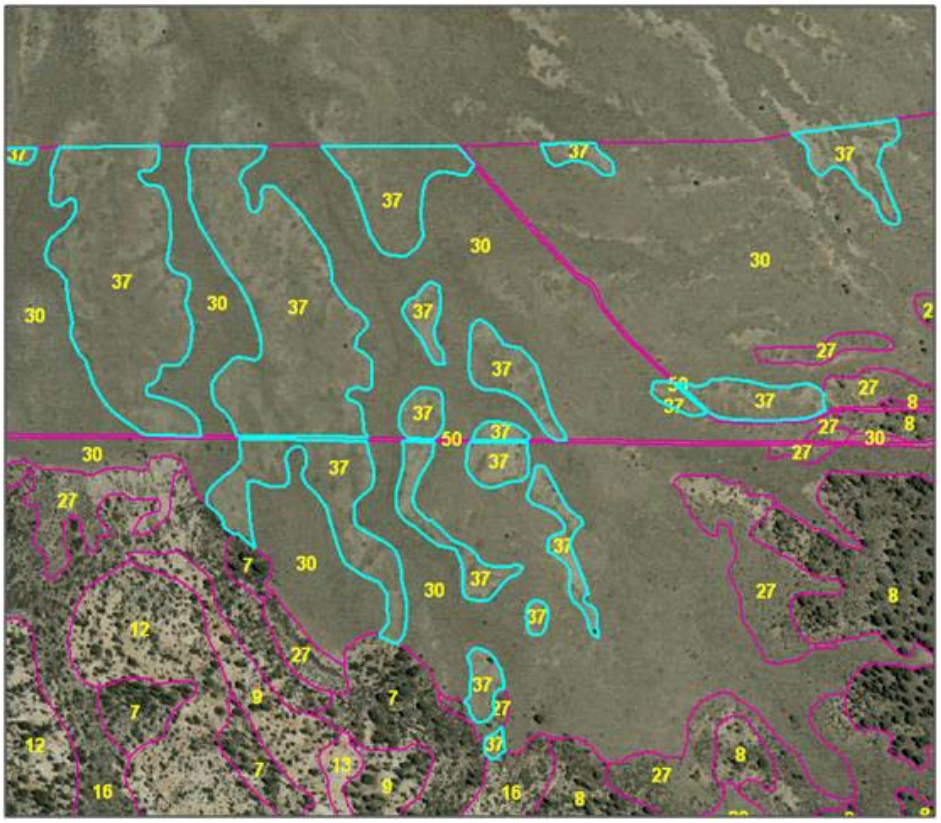


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes and shallow depressions and drainages adjacent to canyon rims or smaller erosional features. Low sagebrush, snakeweed, species of yucca, winterfat, and Fendler bluegrass are dominant. The stands are xeric and alkaline.

## Interpretation

This very rare map class appears as small rectangular to irregular polygons on gentle slopes and flats restricted to the northern portion of the Park on the rim of Little Henderson Canyon and in Dave's Hollow. The color is white to light gray with widely scattered black dots representing small Utah juniper trees. Neighboring communities are mostly black sagebrush low shrublands (map class 30).




Example of photo signature for map class S-ARPY (#37).

## Upland Herbaceous Communities

Map Class 40
Dry Meadow Mixed Herbaceous Vegetation Mosaic (H-HERB)





Photo credits: NPS

### Associations

*Achnatherum lettermanii* Herbaceous Vegetation
*Elymus elymoides* Herbaceous Vegetation [Park Special]
*Elymus lanceolatus* Herbaceous Vegetation [Park Special]
*Leymus salinus* Herbaceous Vegetation [Park Special]
*Hesperostipa comata* Great Basin Herbaceous Vegetation
*Heterotheca villosa* / Mixed Grass Shrub Herbaceous Vegetation [Park Special]
*Pascopyrum smithii* Herbaceous Vegetation
*Poa fendleriana* Herbaceous Vegetation
*Poa secunda* Herbaceous Vegetation

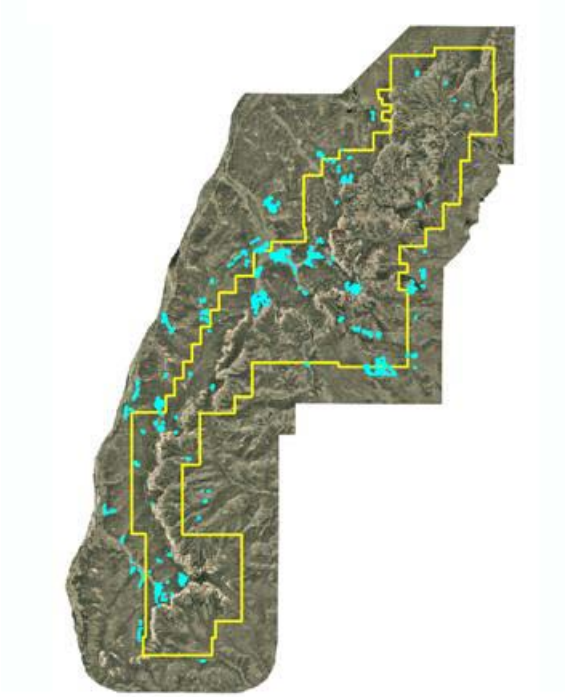
### Common species

- *Achnatherum lettermanii*
- *Leymus salinus*
- *Pascopyrum smithii*
- *Poa secunda*
- *Koeleria macrantha*
- *Purshia tridentata*
- *Elymus lanceolatus*
- *Elymus elymoides*
- *Hesperostipa comata*
- *Poa fendleriana*
- *Carex rossii*
- *Chrysothamnus viscidiflorus*
- *Gutierrezia sarothrae*
- *Heterotheca villosa*

## H-HERB Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 196 total polygons<br>93 total polygons in BRCA<br>103 total polygons in the environs |
| Total project area: | 169 hectares / 417 acres (0.7 %)<br>84 hectares / 207 acres in BRCA<br>85 hectares / 210 acres in the environs |
| Average Polygon Size: | 0.9 hectares / 2.1 acres |
| Producer's accuracy: | 67% ± 18% |
| User's accuracy: | 80% ± 17% |

## Distribution in Mapping Area

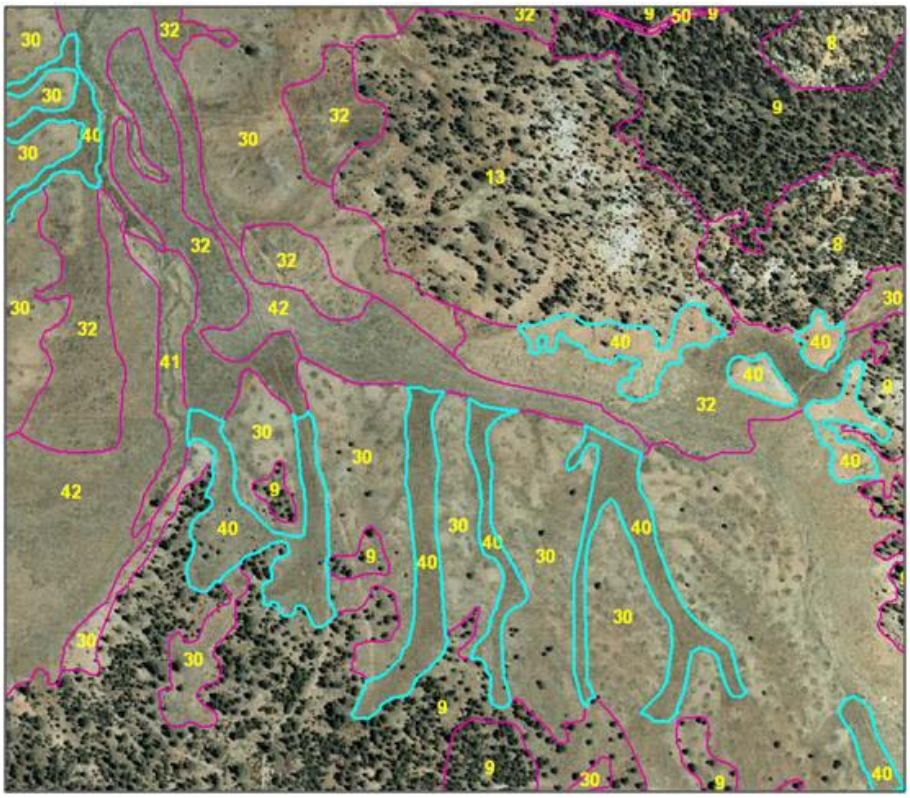


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes and flats within wooded sites above the canyon rims. Species of grasses including Salina wildrye, Letterman needlegrass, needle-and-thread, prairie Junegrass, curly bluegrass, Fendler bluegrass, Kentucky bluegrass, Arizona fescue, squirreltail, Ross sedge, thickspike wheatgrass, blue grama, western wheatgrass, and cheatgrass are common to dominant and yarrow, pussytoes, copper mallow, dandelion, fleabane species, cinquefoil species, and hairy false goldenaster are common forbs. Shrubs are present in low cover including viscid rabbitbrush, winterfat, and fringed sagewort. The stands are xeric and alkaline.

## Interpretation

This uncommon map class appears as small to large irregular polygons on gentle slopes and flats scattered from Tropic Canyon south throughout the Park except in the central canyons. The color is light gray to dark greenish-gray and smooth or mottled in texture, with scattered shrub or tree crowns occasionally providing black spots. Because grassy openings/meadows occur in a variety of habitats across the Park, a number of map classes occur adjacent to this map class.



Example of photo signature for map class H-HERB (#40).

## Map Class 41
## Perennial Disturbed Grassland Complex (C-DIST)





Photo credits: NPS

### Associations

*Agropyron cristatum – (Pascopyrum smithii, Hesperostipa comata)* Semi-natural Herbaceous Vegetation
*Bromus inermis – (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation
*Carex vallicola* Herbaceous Vegetation
*Poa pratensis – (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation
*Tetradymia canescens / Poa pratensis* Shrubland [Park Special]

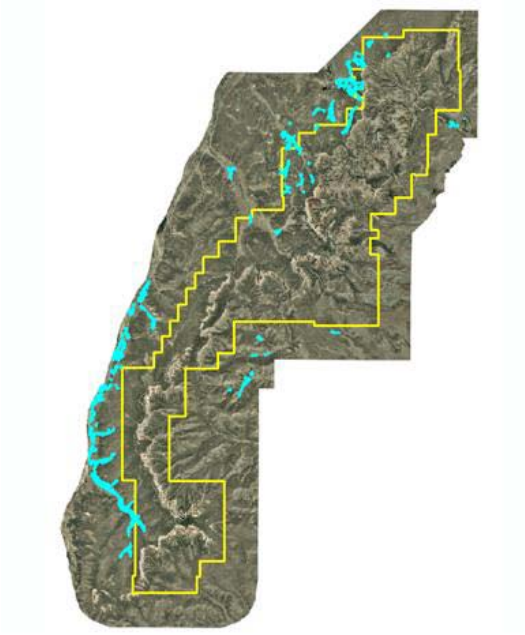
### Common species

- *Pascopyrum smithii*
- *Bromus inermis*
- *Poa pratensis*
- *Tetradymia canescens*
- *Agropyron cristatum*
- *Hesperostipa comata*
- *Carex vallicola*

### C-DIST Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 229 total polygons<br>40 total polygons in BRCA<br>189 total polygons in the environs |
| Total project area: | 280 hectares / 692 acres (1.2 %)<br>39 hectares / 96 acres in BRCA<br>241 hectares / 596 acres in the environs |
| Average Polygon Size: | 1.2 hectares / 3 acres |
| Producer's accuracy: | 80% ± 20% |
| User's accuracy: | 86% ± 19% |

### Distribution in Mapping Area

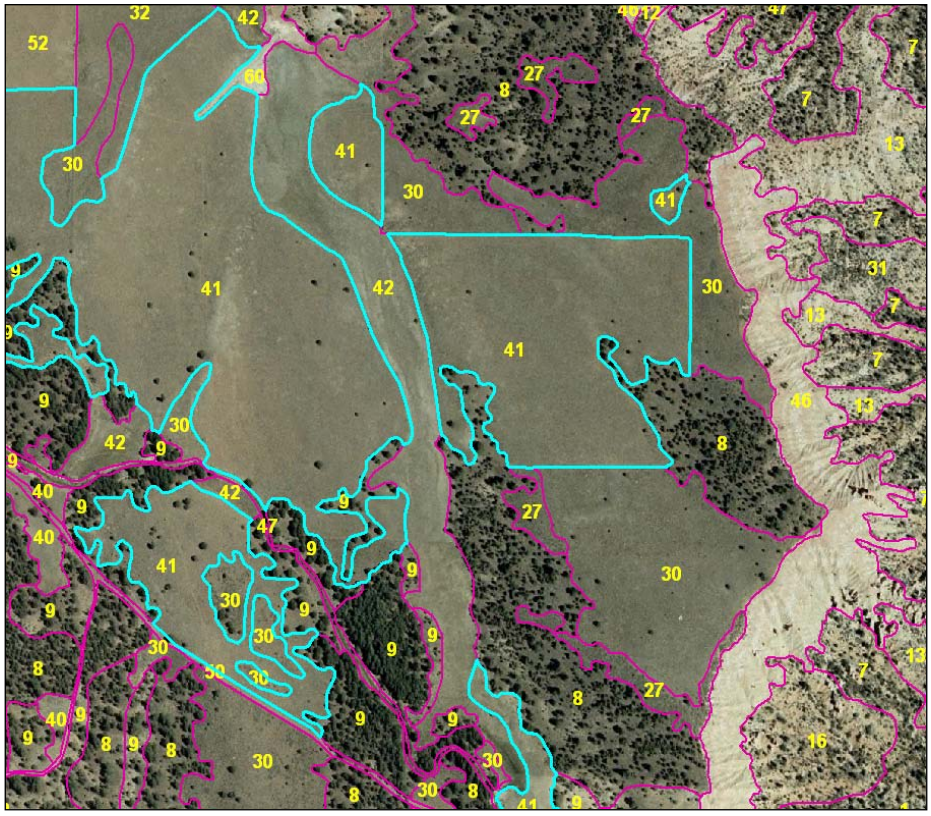


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes and flats planted to non-native pasture grasses for livestock forage. Smooth brome, crested wheatgrass, western wheatgrass, and Kentucky bluegrass are the dominant forage grasses. Spineless horsebrush shrubs are present to dominant in some stands. Forbs include copper mallow, yellow sweetclover, and dandelion. The stands are xeric to mesic.

## Interpretation

This uncommon map class appears as small to large rectangular or regular polygons on gentle slopes and flats in the western portion of the Park including along Tropic Ditch and the East Fork of the Sevier River. Most examples of this map class occur outside the western Park boundary. The color is light to medium gray, smooth-textured, and with circular patterns where clones of smooth brome are obvious. Common neighbors include polygons of black sagebrush low shrublands (map class 30) and wet meadows (map class 42).




Example of photo signature for map class C-DIST (#41).

## Map Class 43
## Roadside Restored Herbaceous Vegetation (H-ROAD)






Photo credits: NPS

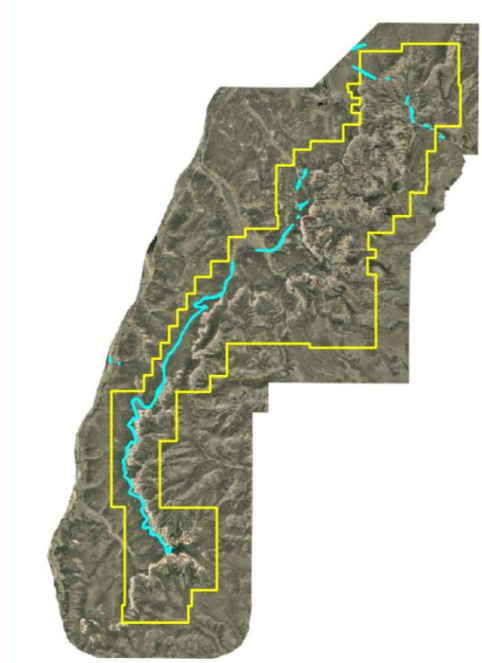
### Associations
*Elymus trachycaulus* Herbaceous Vegetation [Park Special]
*Ceanothus martini / Elymus trachycaulus* Seeded Road Cut Shrub Herbaceous Vegetation [Park Special]

### Common species
- *Elymus trachycaulus*
- *Ceanothus martinii*

### H-ROAD Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 64 total polygons<br>56 total polygons in BRCA<br>8 total polygons in the environs |
| Total project area: | 46 hectares / 114 acres (0.2 %)<br>44 hectares / 108 acres in BRCA<br>2 hectares / 6 acres in the environs |
| Average Polygon Size: | 0.7 hectares / 1.8 acres |
| Producer's accuracy: | N/A |
| User's accuracy: | N/A |

### Distribution in Mapping Area

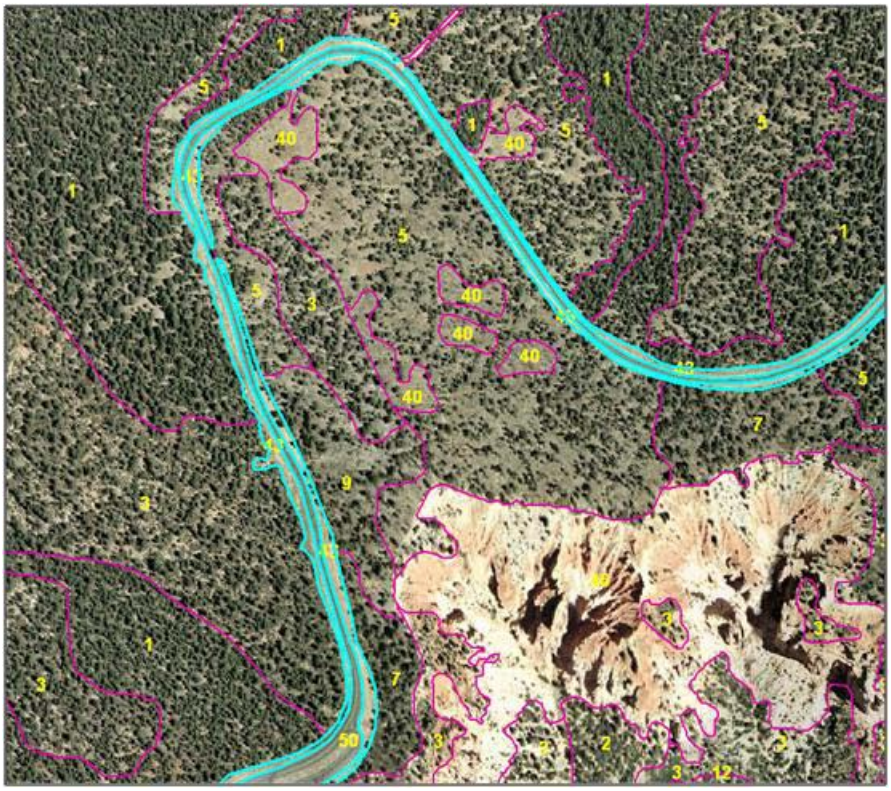


## Distribution/Ecology/Composition

Stands occur primarily on moderately steep-sloped fill material along roadsides. Slender wheatgrass is the sole dominant within stands containing some smooth brome and weedy forbs. Other stands may be dominated or co-dominated by Utah mountain lilac. The stands are xeric to mesic.

## Interpretation

This uncommon map class appears as a narrow band on the fill slopes of paved Park roads (SH 12 and SH 63) where it was introduced (seeded) for erosion control. The color is dark gray to greenish and the texture is smooth. Any polygons neighboring the roadways can be found as neighbors to this map class.



Example of photo signature for map class H-ROAD (#43).

## Sparse Vegetation & Talus Slope Communities

Map Class 45
Mixed Desert Shrubland Complex (S-MXDE)




Photo credits: NPS

### Associations

*Atriplex canescens / Elymus (elymoides, salinus)* Shrubland [Park Special]
*Atriplex confertifolia* Great Basin Shrubland
*Eriogonum corymbosum* Badlands Sparse Vegetation
*Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland
*Gutierrezia sarothrae* Wooded Dwarf-shrubland Alliance
*Tetradymia canescens* Badlands Sparse Vegetation [Park Special]

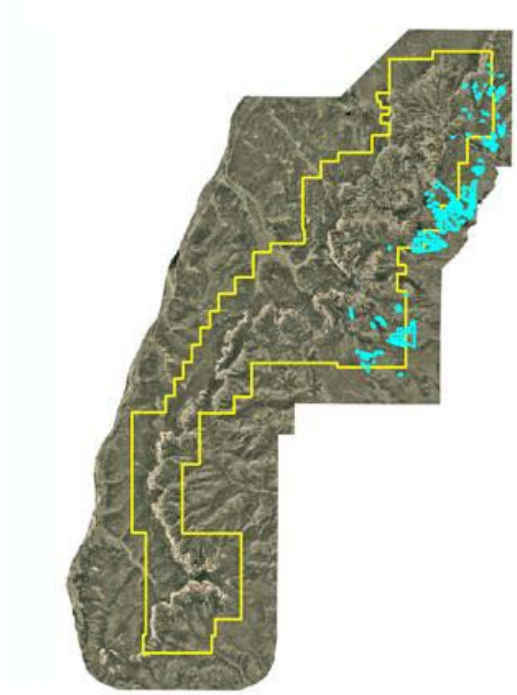
### Common species

- *Eriogonum corymbosum*
- *Gutierrezia sarothrae*
- *Atriplex canescens*
- *Leymus salinus*
- *Atriplex confertifolia*
- *Achnatherum hymenoides*
- *Tetradymia canescens*
- *Elymus elymoides*

## S-MXDE Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 141 total polygons<br>79 total polygons in BRCA<br>62 total polygons in the environs |
| Total project area: | 345 hectares / 853 acres (1.5 %)<br>101 hectares / 249 acres in BRCA<br>245 hectares / 605 acres in the environs |
| Average Polygon Size: | 2.4 hectares / 6.1 acres |
| Producer's accuracy: | 92% ± 11% |
| User's accuracy: | 89% ± 12% |

## Distribution in Mapping Area

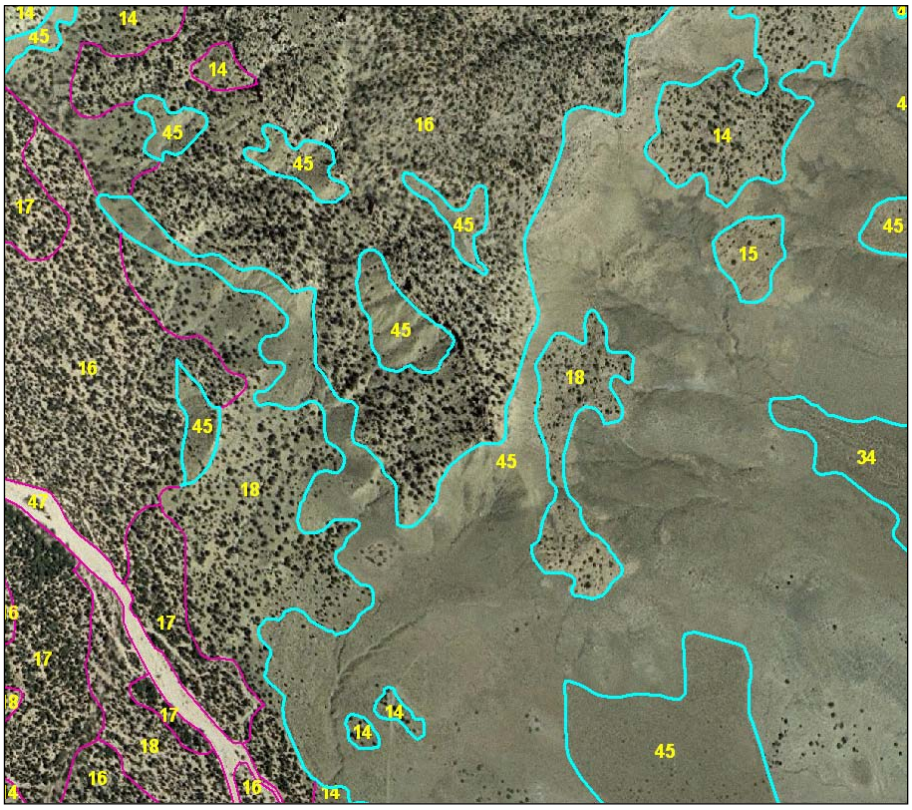


## Distribution/Ecology/Composition

Stands occur primarily on gentle to steep east to southeast-facing slopes at and above the rim of the main canyon and its major tributaries. Crispleaf buckwheat, shadscale, saltbush, and spineless horsebrush shrubs are generally dominant, but black sagebrush, snakeweed, winterfat, ponderosa pine and Utah juniper may be present in the shrub or canopy layers. The stands are xeric and herbaceous vegetation including fleabane, Salina wildrye, Indian ricegrass, and squirreltail may occur in the understory in many stands. Stands occur on badlands and shale slopes of the Tropic Shale formation.

## Interpretation

This uncommon map class appears as medium to large irregular polygons on gentle to steep slopes and flats in the northeastern to eastern portions of the Park, along the boundary, from the upper margins of Tropic Valley to the edge of Sheep Creek Flat. The color is white to medium-gray, with scattered tree crowns rarely providing a rough and pebbled texture producing black spots. Common neighbors include all examples of pinyon – juniper woodlands with a variety of understories (map classes 14-18) and big sagebrush shrublands (map class 34).




Example of photo signature for map class S-MXDE (#45).

## Map Class 48
## Siltbush Shrubland (S-ZUCK)





Photo credits: NPS

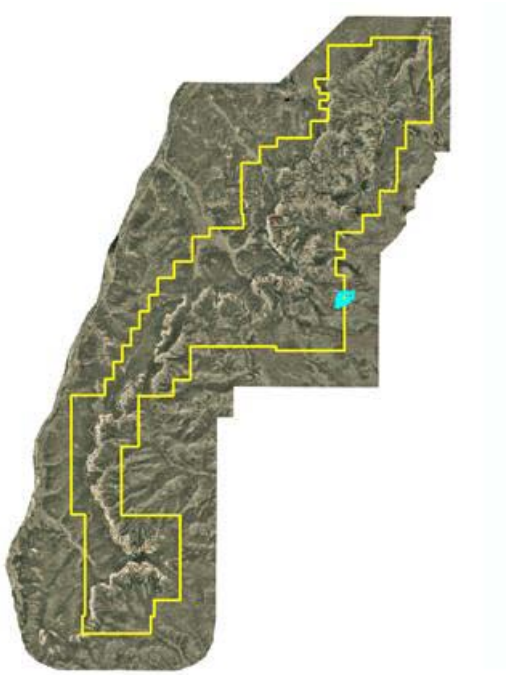
### Associations
*Zuckia brandegeei* Sparse Vegetation

### Common species
- *Zuckia brandegeei*
- *Leymus salinus*
- *Atriplex canescens*
- *Salsola tragus*

### S-ZUCK Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 7 total polygons<br>4 total polygons in BRCA<br>3 total polygons in the environs |
| Total project area: | 81 hectares / 201 acres (0.3 %)<br>34 hectares / 84 acres in BRCA<br>47 hectares / 116 acres in the environs |
| Average Polygon Size: | 11.6 hectares / 28.6 acres |
| Producer's accuracy: | 100% |
| User's accuracy: | 100% |

### Distribution in Mapping Area

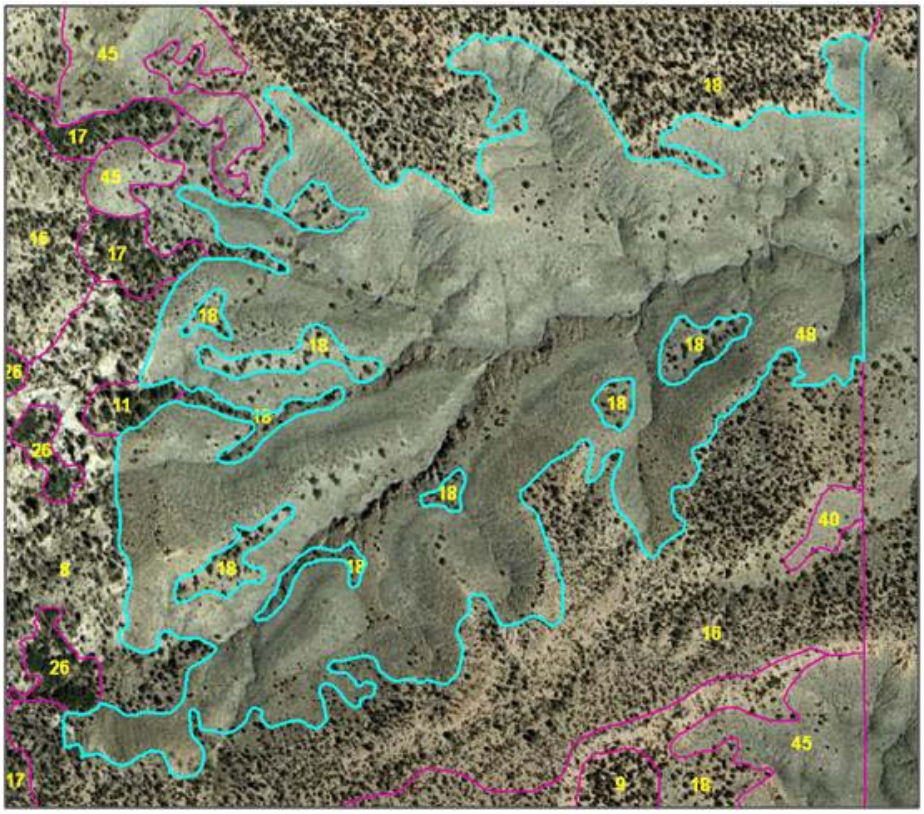


## Distribution/Ecology/Composition

Stands occur primarily on steep to very steep west-to-south-facing shale slopes and badlands of the Tropic Shale formation that are highly eroded and gullied. Siltbush is generally dominant, but Salina wildrye, ponderosa pine, and limber pine may be scattered in sparse cover within the polygons. The stands are xeric and the short shrub shadscale may be co-dominant in some stands.

## Interpretation

This rare map class appears as one large regular polygon covering steep badland slopes and ridges along the eastern Park boundary near Death Hollow. The color is white to medium-gray, with scattered tree crowns providing black dots of several sizes. Neighboring polygons are pinyon – juniper woodlands with mixed shrub (map class 16) or sparse understories (map class 18).




Example of photo signature for map class S-ZUCK (#48).

## Riparian / Wetland Woodlands and Shrublands

Map Class 24
Narrowleaf Cottonwood Woodland Complex (W-COTT)






Photo credits: NPS

### Associations

*Picea pungens / Betula occidentalis* Woodland
*Populus angustifolia - Juniperus scopulorum* Woodland
*Populus angustifolia / Betula occidentalis* Woodland
*Populus angustifolia / Cornus sericea* Woodland
*Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus)* Woodland

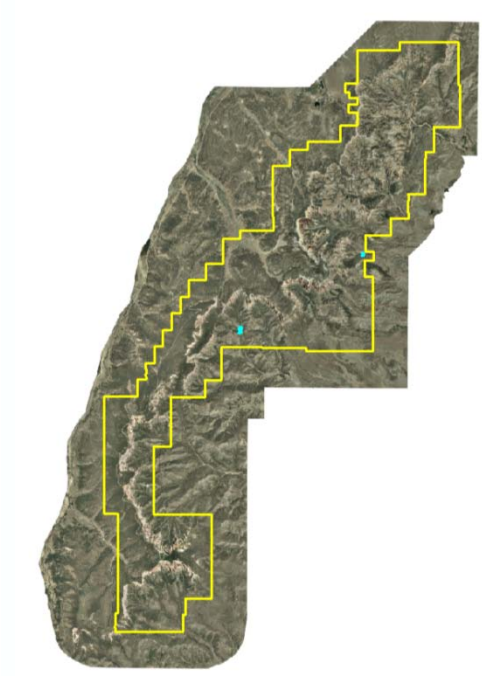
### Common species

- *Populus angustifolia*
- *Juniperus scopulorum*
- *Betula occidentalis*
- *Symphoricarpos oreophilus*
- *Picea pungens*
- *Cornus sericea*
- *Acer glabrum*

## W-COTT Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 2 total polygons |
| | 2 total polygons in BRCA |
| | total polygons in the environs |
| Total project area: | 4 hectares / 9 acres (0 %) |
| | 4 hectares / 9 acres in BRCA |
| | hectares / 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

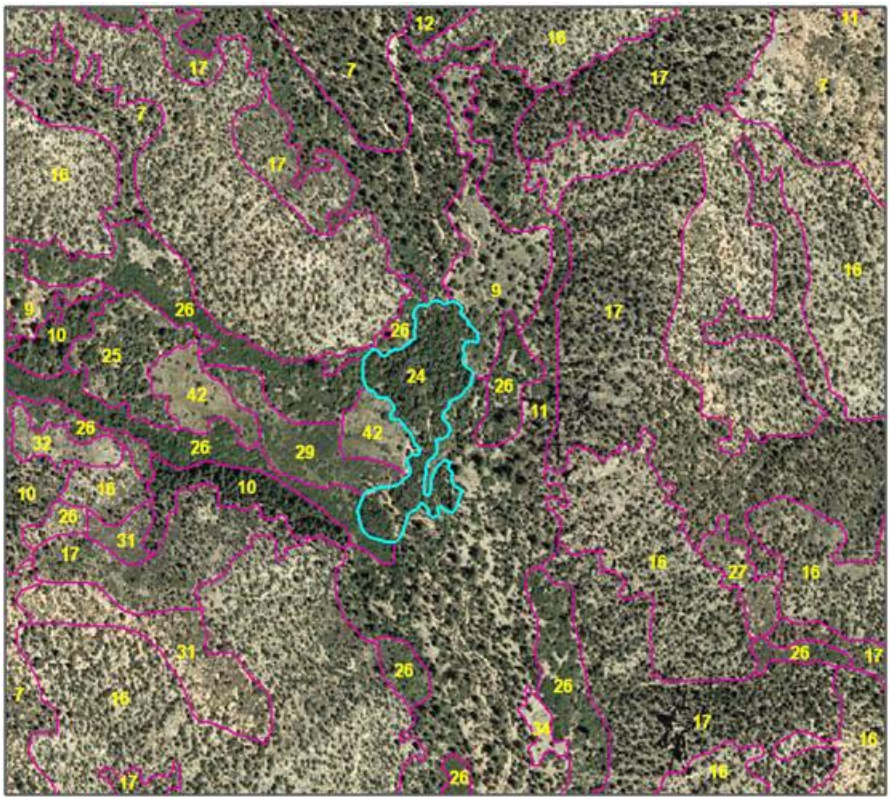


## Distribution/Ecology/Composition

Stands have become established on benches with gentle slopes and in the drainage bottom where near-to-surface groundwater occurs. Narrowleaf cottonwood is generally dominant, but quaking aspen, white fir, Douglas-fir, blue spruce, and Rocky Mountain juniper may be present in the canopy or understory layers. The stands are mesic and also support the tall shrubs water birch and Rocky Mountain maple.

## Interpretation

This very rare map unit occurs as two small rectangular polygons in drainage bottoms in Sheep Creek and a tributary to Bryce Creek. The color is moderately dark gray-green, with round tree crowns providing a closed-canopied rough and pebbled texture. A variety of polygons occur adjacent to these two polygons.



Example of photo signature for map class W-COTT (#24).

# Map Class 28
# Water Birch Shrubland (S-BIRC)





Photo credits: NPS

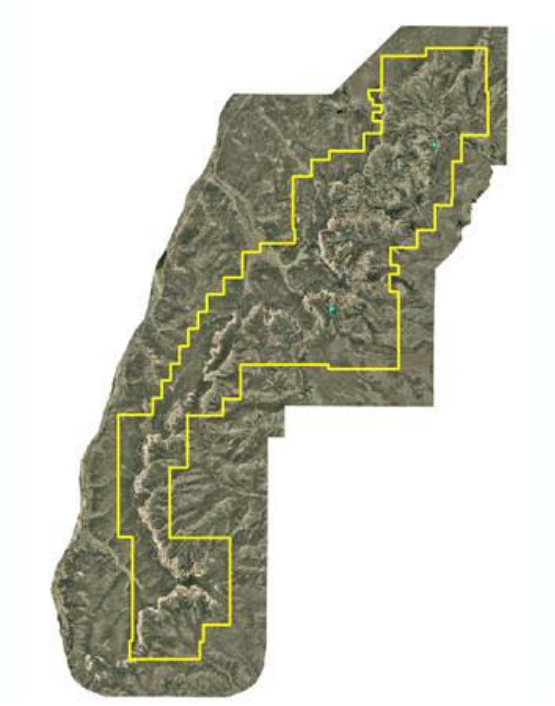
## Associations
*Betula occidentalis* Shrubland

## Common species
- *Betula occidentalis*
- *Rosa woodsii*
- *Cornus sericea*
- *Prunus virginiana*

## S-BIRC Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 2 total polygons |
| | 2 total polygons in BRCA |
| | total polygons in the environs |
| Total project area: | 1 hectares / 2 acres (0 %) |
| | 1 hectares / 2 acres in BRCA |
| | hectares / 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

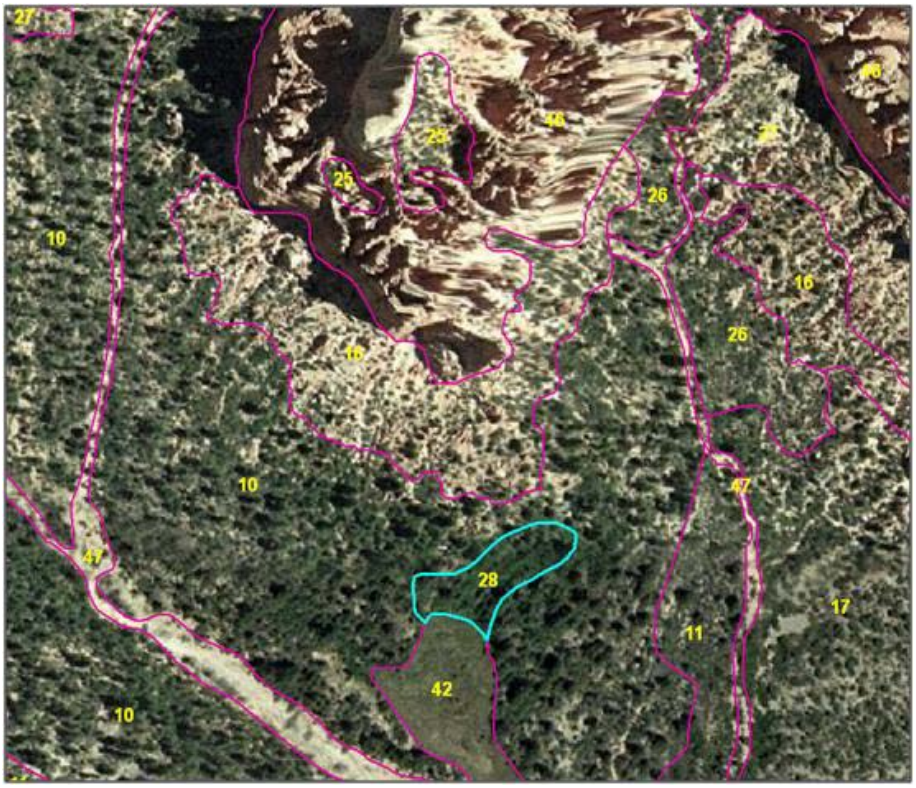


## Distribution/Ecology/Composition

Stands occur primarily in and immediately adjacent to perennial creeks in the canyon bottoms. Water birch, species of willow, serviceberry, and Gambel oak tall shrubs are dominant. The stands are mesic to inundated.

## Interpretation

This map class is very rare and appears as two small rectangular to linear polygons, and occurs along mesic drainages in the northern and central portions of the Park near Mossy Cave and Paria View. The color is bright green with widely scattered black dots representing blue spruce trees. A variety of polygons occur adjacent to these two polygons.




Example of photo signature for map class S-BIRC (#28).

## Map Class 29
## Willow spp. Temporarily Flooded Shrubland Complex (S-WILL)





Photo credits: NPS

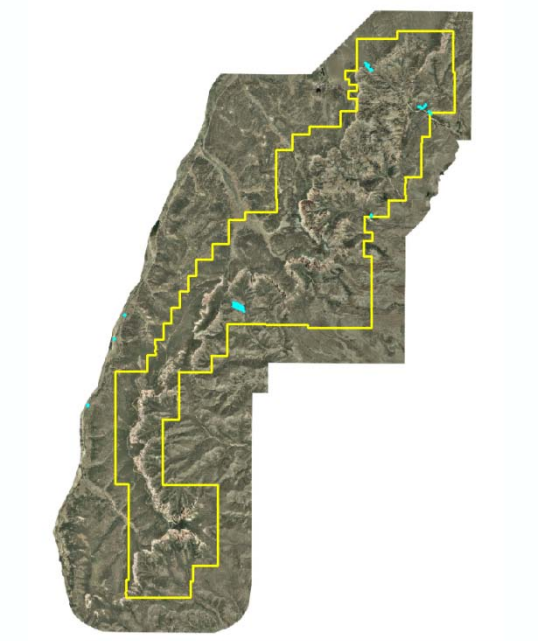
### Associations
*Cornus sericea* Rocky Mountain Shrubland
*Salix eriocephala /* Mesic Graminoids Shrubland
*Salix exigua* Temporarily Flooded Shrubland
*Shepherdia argentea* Shrubland

### Common species
- *Salix eriocephala*
- *Rosa woodsii*
- *Shepherdia argentea*
- *Equisetum arvense*
- *Salix exigua*
- *Rhus aromatica ssp. trilobata*
- *Cornus sericea*
- *Juncus balticus*

### S-WILL Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 13 total polygons |
| | 8 total polygons in BRCA |
| | 5 total polygons in the environs |
| Total project area: | 10 hectares / 25 acres (0 %) |
| | 9 hectares / 22 acres in BRCA |
| | 1 hectares / 2 acres in the environs |
| Average Polygon Size: | 0.8 hectares / 1.9 acres |
| Producer's accuracy: | 88% ± 26% |
| User's accuracy: | 88% ± 26% |

### Distribution in Mapping Area

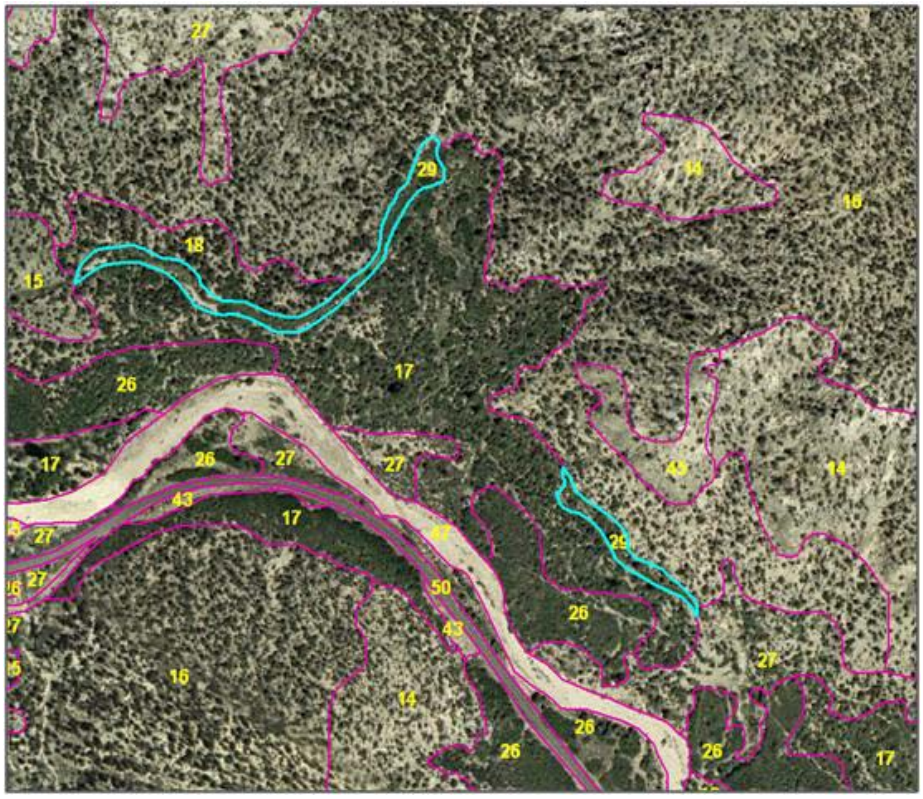


## Distribution/Ecology/Composition

Stands occur primarily on drainage terraces in saturated soils. Species of willow, water birch, serviceberry, and shrubby cinquefoil are the dominant tall shrubs with species of sedge, rush, and spike-rush common in the understory. The stands are mesic to inundated.

## Interpretation

This rare map class appears as small linear polygons on flats along drainages in the northern portion of the Park in Tropic Canyon, in Swamp Canyon, and along the East Fork of the Sevier River. The color is dark gray green to green with widely scattered black dots representing blue spruce trees. A variety of polygons occur adjacent to polygons of this map class.




Example of photo signature for map class S-WILL (#29).

## Map Class 35
## Shrubby-cinquefoil Shrubland (S-CINQ)



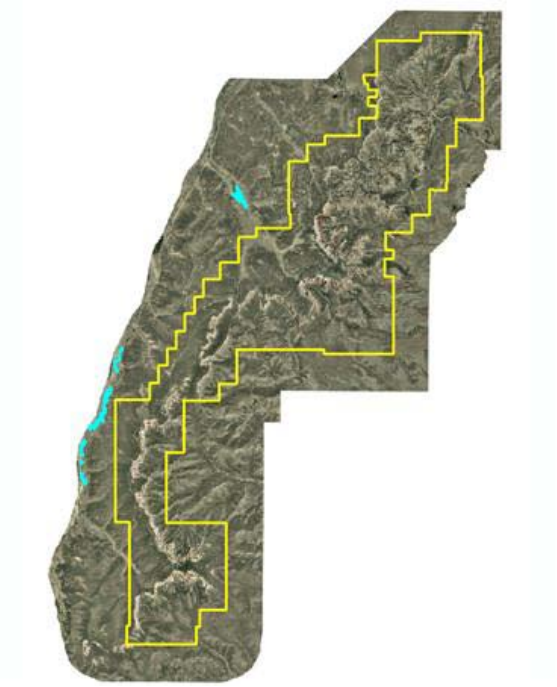
### Associations
*Dasiphora fruticosa* ssp. *floribunda* Shrubland

### Common species
- *Dasiphora fruticosa ssp. floribunda*
- *Juncus balticus*
- *Poa pratensis*

### S-CINQ Map Class Statistics

| | |
|---|---|
| Type: | Association |
| Frequency: | 41 total polygons |
| | total polygons in BRCA |
| | 41 total polygons in the environs |
| Total project area: | 37 hectares / 93 acres (0.2 %) |
| | 0 hectares / 0 acres in BRCA |
| | 37 hectares / 93 acres in the environs |
| Average Polygon Size: | 0.9 hectares / 2.3 acres |
| Producer's accuracy: | N/A |
| User's accuracy: | N/A |

### Distribution in Mapping Area

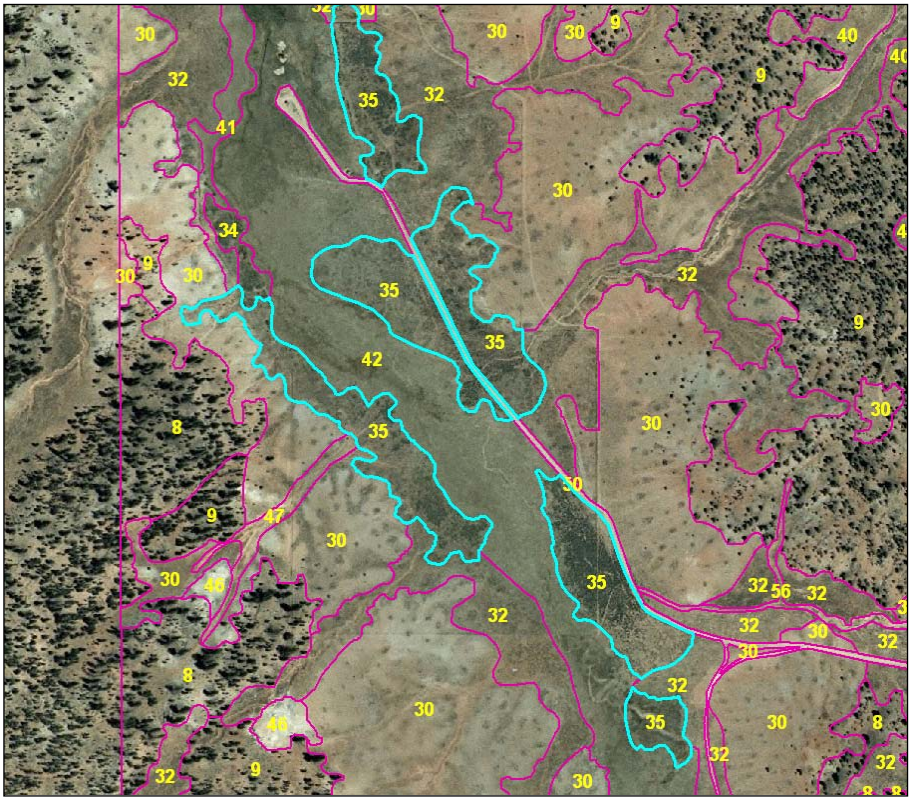


## Distribution/Ecology/Composition

Stands occur primarily along meandering drainages on the first terrace where saturated to inundated soils occur. Shrubby cinquefoil is the dominant shrub and Kentucky bluegrass and Baltic rush are common herbaceous species in these mesic stands.

## Interpretation

This rare map class appears as linear bands and irregular polygons on gentle slopes, flats, and drainages west of the Park boundary on the East Fork of the Sevier River. No examples of this type occur inside the Park. The color is dark gray to medium green with a rough, clumpy texture. Wet meadows (map class 42) and shrublands of black sagebrush (map class 30) and viscid rabbitbrush (map class 32) occur adjacent to polygons of shrubby-cinquefoil.




Example of photo signature for map class S-CINQ (#35).

## Riparian / Wetland Herbaceous Communities

Map Class 42
Sedge and Rush Wet Meadow Herbaceous Vegetation Mosaic (H-MEAD)





Photo credits: NPS

Associations

*Carex praegracilis* Herbaceous Vegetation
*Carex utriculata* Herbaceous Vegetation
*Eleocharis quinqueflora* Herbaceous Vegetation
*Juncus balticus* Herbaceous Vegetation
*Mimulus guttatus – (Mimulus* spp.) Herbaceous Vegetation
*Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Vegetation

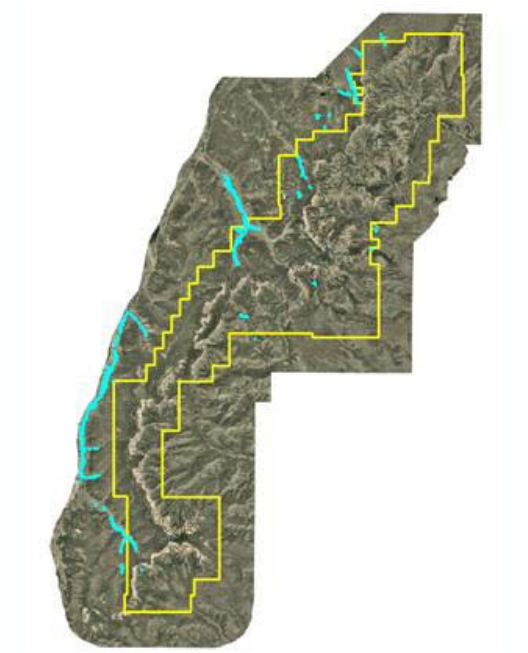
Common species

- *Carex praegracilis*
- *Carex utriculata*
- *Eleocharis quinqueflora*
- *Juncus balticus*
- *Mimulus guttatus*
- *Leymus salinus*
- *Poa pratensis*
- *Deschampsia caespitosa*

## H-MEAD Map Class Statistics

| | |
|---|---|
| Type: | Complex |
| Frequency: | 77 total polygons |
| | 22 total polygons in BRCA |
| | 55 total polygons in the environs |
| Total project area: | 136 hectares / 336 acres (0.6 %) |
| | 42 hectares / 105 acres in BRCA |
| | 94 hectares / 232 acres in the environs |
| Average Polygon Size: | 1.8 hectares / 4.4 acres |
| Producer's accuracy: | 86% ± 29% |
| User's accuracy: | 86% ± 29% |

## Distribution in Mapping Area

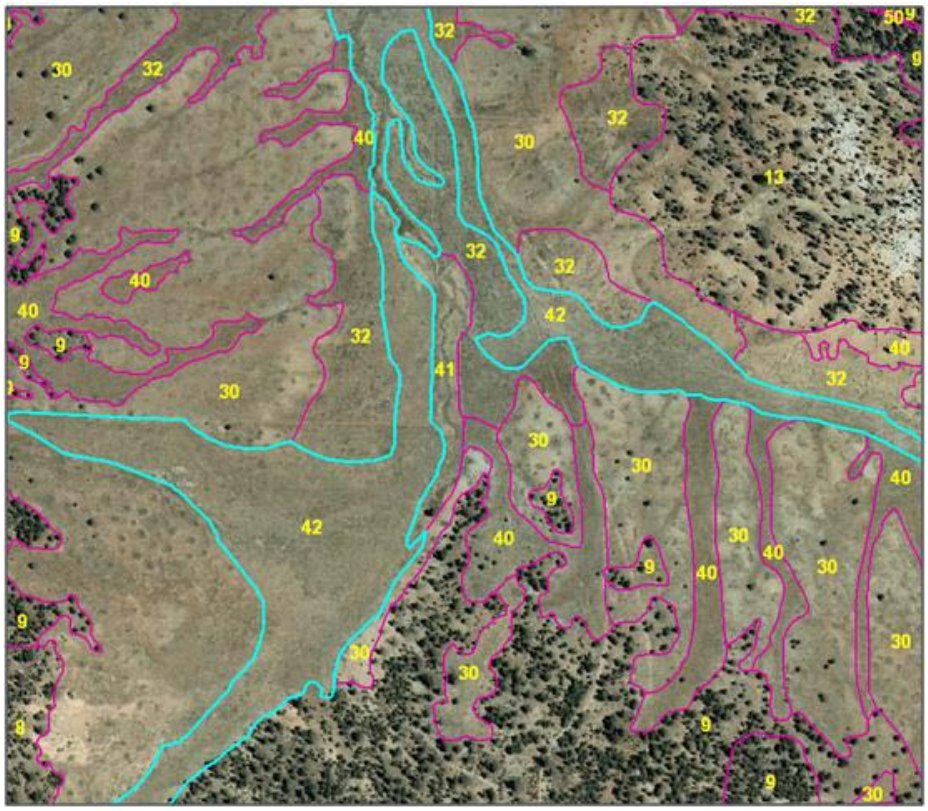


## Distribution/Ecology/Composition

Stands occur primarily on gentle slopes adjacent to meandering drainages, where the water table is near-to-surface and some flowing water may be present. Species of sedges, rushes, spike-rushes, and grasses including tufted hairgrass and Kentucky bluegrass are dominant. Mesic forbs are common including common large monkeyflower, meadow rue, black-eyed Susan, and yarrow. The stands are mesic to saturated or inundated.

## Interpretation

This rare map class appears as small to large irregular but typically linear polygons on gentle slopes and flats outside the western Park boundary along Tropic Ditch and the East Fork of the Sevier River. The color is light gray to dark greenish-gray, with scattered shrub crowns or small patches occasionally providing a rough and pebbled texture producing dark green to black spots. Shrublands of black sagebrush (map class 30), shrubby-cinquefoil (map class 35), and viscid rabbitbrush (map class 32), along with disturbed grasslands (map class 41) occur adjacent to polygons of sedge and rush wet meadows.



Example of photo signature for map class H-MEAD (#42).

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NPS 129/107133, March 2011

**National Park Service**
**U.S. Department of the Interior**

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